WEB MINING

WITH jMap® TECHNOLGOY

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Abstract

Web Mining With jMap Technology

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This report presents a software development process of using Breadth-First-Search algorithm to discover pages in a web site, retrieve and analyze information from such sites. The information is transformed to *joined maps* for content and structure mining. The software "Website jMap Builder" is the first step towards web mining using jMap technology. It was developed using PERL and Visual Basic. Functional and design specifications of the system are given in Chapter 4 and a user manual is provided in Chapter 5.

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1. Introduction

1.1 Background

The widespread development of internet has made the web sites the largest mass media next to the television. This growing trend will make the web the number one media in the near future. With the explosive growth of information sources available on the World Wide Web, it has become increasingly necessary for users to utilize automated tools in finding the desired information resources, and to track and analyze their usage patterns. These factors give rise to the necessity of creating server-side and client-side intelligent systems that can effectively mine for knowledge[1-3].

Web Mining is the extraction of interesting and potentially useful patterns and implicit information from artifacts or activity related to the World-wide Web. There are roughly three knowledge discovery domains that pertain to web mining: Web Content Mining, Web Structure Mining, and Web Usage Mining. Web content mining is the process of extracting knowledge from the content of documents or their descriptions. Web document text mining, resource discovery based on concepts indexing or agent-based technology may also fall in this category. Web structure mining is the process of inferring knowledge from the World-Wide Web organization and links between references and referents in the Web. Finally, web usage mining, also known as Web Log Mining, is the process of extracting interesting patterns from web access logs.

Web Content Mining

Web content mining is an automatic process that goes beyond keyword extraction. Since the content of a text document presents no machine-readable semantic, some approaches have suggested to restructure the document content in a representation that could be exploited by machines. The usual approach to exploit known structure in documents is to use wrappers to map documents to some data model. Techniques using lexicons for content interpretation are yet to come. There are two groups of web content mining strategies: Those that directly mine the content of documents and those that improve on the content search of other tools like search engines.

Web Structure Mining

World-Wide Web can reveal more information than just the information contained in documents. For example, links pointing to a document indicate the popularity of the document, while links coming out of a document indicate the richness or perhaps the variety of topics covered in the document. This can be compared to bibliographical citations. When a paper is cited often, it ought to be important. Some software already uses these methods to take advantage of this information conveyed by the links to find pertinent web pages. By means of counters, higher levels cumulate the number of artifacts subsumed by the concepts they hold. Counters of hyperlinks, in and out documents, retrace the structure of the web artifacts summarized.

Web Usage Mining

Web servers record and accumulate data about user interactions whenever requests for resources are received. Analyzing the web access logs of different web sites can help understand the user behaviour and the web structure, thereby improving the design of this colossal collection of resources. There are two main tendencies in Web Usage Mining driven by the applications of the discoveries: General Access Pattern Tracking and Customized Usage Tracking. The general access pattern tracking analyzes the web logs to understand access patterns and trends. These analyses can shed light on better structure and grouping of resource providers. Many web analysis tools have been designed to make use of web logs. Applying data mining techniques on access logs unveils interesting access patterns that can be used to restructure sites in a more efficient grouping, pinpoint effective advertising locations, and target specific users for specific selling ads. Customized usage tracking analyzes individual trends. Its purpose is to customize web sites to users. The information displayed, the depth of the site structure and the format of the resources can all be dynamically customized for each user over time, based on their access patterns. While it is encouraging and exciting to see the various potential applications of web log file analysis, it is important to know that the success of such applications depends on what and how much valid and reliable knowledge one can discover from the large raw log data. Although current web servers store limited information about the accesses, but the trend to have more logs is growing. Some scripts custom-tailored for some sites may store additional information.

Web mining is interdisciplinary in nature, cutting across such fields as information retrieval, information representation, natural language (information) processing, machine learning, database, and visualization. The web mining technology will yield benefits to at least the following fields:

- Web classification and context based search engine[4, 15].

- Web site construction and site performance tuning.
- Site effective browsing and navigation.
- User analysis for better marketing strategies

There are three challenging steps for web mining technologies. The first is to harvest information from immense web-like resources. The second step is to reorganize this tremendous amount of information in proper notations for processing. The last step is to analyze this information to produce useful results.

Currently, the majority of internet resources are open source web sites, which are made of more than 80% of HTML pages, a small portion of information is embedded in special scripts and multimedia files such as flash, sound and metadata, etc. The importance of analysis of HTML pages is obvious. The HTTP protocol is an open protocol; this make possible to make use of it to explore the web sites. There is tremendous amount of library resources have been developed to retrieve and analyze information from the Internet. One of the most abundant library resources available is for the open source language PERL. These open source libraries made much easier for developers to write tools automatically retrieving the web pages and analyzing them.

There are many representations and methodologies for information systems such as graphical notations for the information system representation and UML notation for Object oriented systems design [5]. However it is a challenge to develop a notation with good processability and simple and easy to use.

The *joined maps* viewed as *context maps* in this report is one of the ways to satisfy the above requirements. The *joined maps*, or *jMaps*, is a notation and a method for representing systems architecture, structures, processes and reusable templates. This technology was first introduced by W.M. Jaworski [6-12]. The technology was initially developed as a means of recovering and refining knowledge from legacy system. With *jMaps* or *Context Maps* technology, which uses the popular concept of a spreadsheet to represent the recovered information, thus make its represented contents easily processable. The *jMaps* notation allows efficient and complete representations of a web site contents and modeling of generic schemata for web-based information systems. It is one of the ideal technologies will render benefits for web mining process. This research is a continuing part of the researches to automate the web mining process by using jMap technology under Dr. Jaworski's supervision.

1.2 Objective of Study

The main objective of this project is to automate information recovery from a website and analyze each page using the predefined jMap template and convert the discovered information to jMap notation for web content and structure mining. The subsequent mining of recovered knowledge in jMaps is beyond the scope of current research.

The main thrust of this software was based on BFS algorithm and jMap notation technology and implemented in PERL/VBA, where the PERL program accesses web pages and anaylze contents and the VBA program is used to format the analysis results to Microsoft Excel spreadsheets. The result jMap was formatted in Microsoft Excel by

Excel Macros and ready to be processed by using jMap Context analysis programs. The main program and GUI run on UNIX, Linux and Windows systems. However, it formats the results to jMaps only on computers equipped with *MS Excel.*

1.3 Project Scope

The "Web site jMap builder" project started in the fall of 2000, under the supervision of Prof. Jaworski. The initial scope of this project is the following:

1) To understand jMap web site model and study the possibility of automating jMapping a web sites by a software program.
2) To identify suitable template for web site content and structure recovery.
3) To find suitable algorithms to map a web site and analyze pages to generate jMaps.
4) To transform recovered Web site Information to jMap and format the jMap results to Microsoft Excel for easy processing.
5) To provide basic GUI for user to specify websites. maximium depth. and maximum number of retrieved URLs.
6) To enable crossing site mapping.
7) To provide basic documentation for requirements. design and implementation. user manual.
8) To summarize project and make suggestions for future research.

2. Web Site Organization and Representation

2.1 Graph Notation

2.1.1 Representing Web as Graph

The graph notation is one of the fundamental mathematical notation and the most intuitive notation to represent a web site content and its organizing structure. We can represent a page using a vertex, and their relationship using directed edges.

One of the advantages of graph model for web site contents is its simplicity. Each HTML page can be viewed as a vertex in the graph, and all the contents can be viewed as the properties of this vertex. The hyperlinks serve as the relationship between different web pages. The script links can be viewed as the conditional relationship between pages. Table 1 Properties of A Web Page lists some of the properties of web pages and their notation in a graph.

Table 1 Properties of A Web Page

Property	Name	Graph Representation
Statistical	Number of bookmark.	vertex property
	Size of the page	vertex property
	Number of hyperlinks out to other pages from this site	vertex property
	Number of hyperlinks linked to this page from this site	vertex property

	number of hyperlink tokens	vertex property
Dynamic	Retrieval Time	vertex property
	Server Return code for this page	vertex property
Context	Meta Text: Key words	vertex property
	Title	vertex property
	HTML texts	vertex property
	Images	vertex property
	hyperlink token text/image	vertex property
	Forms, Frames and Other Advanced Elements	vertex property
	Multimedia Contents such as sound, flash media	vertex property
Relationship	bookmark	self-directed edge
	hyperlinks/image maps	directed edges
	Scripts: ASP. CGI. JAVAScript. Applet. VBA. and other technologies	directed edges with conditions

2.1.2 Web Organization Models

As far as World Wide Web is concerned. you can hardly escape references to hypertext and hypermedia. In the epoch of computer press. there is a lot of fuzzy thinking about how web-based information can somehow "link everything to everything." The implication is that with the web you can probably dispense with one of the most challenging aspects of presenting information -- how to put it into logical order and create an interesting and understandable resource for the user. Nothing could be further from the truth. If a web site has no comprehensive narrative or clear sense of organization, the readers will probably know it soon enough, and most of them will leave in pursuit of better organized material. Because of this reason, the concept of web site organization is rapidly evolving, and novel design concepts are sprouting in every corner of the cyberspace. However, from a graphical point of view, the center of the web design models falls into four categories: sequential model, grid model, hierarchy model and web model.

2.1.2.1 Sequence Model

The simplest way to organize information is in a sequence, where you present a linear narrative. Information that naturally flows as a narrative, time line, or in logical order is ideal for sequential treatment. Sequential ordering may be chronological, a logical series of topics progressing from the general to the specific, or even alphabetically sequenced, as in indexes, encyclopedias, and glossaries. However, simple sequential organization usually only works for smaller sites (or structured lists like indexes), as long narrative sequences often become more complex, and thus require more structure to remain understandable.

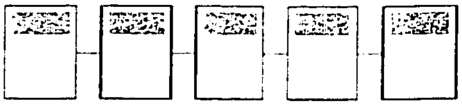


Figure 1 Sequential Organization of Web Pages

More complex Web sites may still be organized as a sequence, but each page in the main sequence may have one or more pages of digressions, parenthetic information, or links to information in other Web sites.

2.1.2.2 Grid Model

Many procedural manuals, lists of university courses, or medical case descriptions are best organized as a grid. Grids are a good way to correlate variables, such as a time line versus historical information in a number of standard categories such as "events," "technology," "culture," etc. To be successful, the individual units in a grid must share a *highly* uniform structure of topics and subtopics. The topics often have no particular hierarchy of importance. For example, "tuberculosis" is not more or less important a diagnosis than "pneumonia", but ideally both case descriptions would share a uniform structure of subtopics. Thus, the user could follow the grid "down," reading about tuberculosis, or cut "across" the grid perhaps by comparing the "diagnostic imaging" sections of both pneumonia and tuberculosis. Unfortunately, grids can be difficult to understand unless the user recognizes the interrelationships between categories of information, and so are probably best for experienced audiences who already have a basic understanding of the topic and its organization. Graphic overview maps normally accompany in grid-like Web sites.

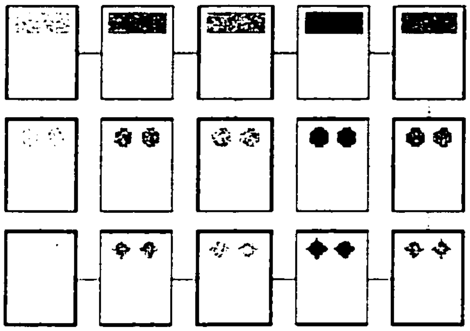


Figure 2 Grid Organization of Web Pages

2.1.2.3 Hierarchy Model

Information hierarchies are one of the best ways to organize complex bodies of information. Hierarchical organization schemes are particularly well-suited to Web sites, because Web sites should always be organized as off-shoots of a single home page. Most users are familiar with hierarchical diagrams, and find the metaphor easy to understand as a navigational aid. A hierarchical organization also imposes a useful discipline on web site content design, as hierarchies only work well with highly organized material. Since hierarchical diagrams are so familiar in corporate and institutional life, users find it easy to build mental models of the site:

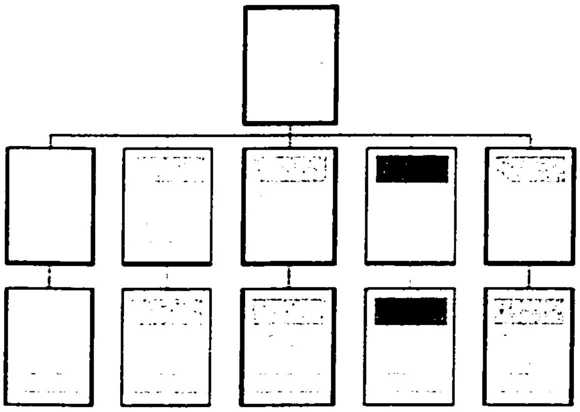


Figure 3 Hierarchy Organization of Web Pages

2.1.2.4 Web Model

Web-like organizational structures pose few restrictions on the pattern of information use. The goal is often to mimic associative thought and free flow of ideas, where users follow their interests in a heuristic, idiosyncratic pattern unique to each person who visits the site. This organizational pattern develops in Web sites with very dense links both to other information within the site, and information on other World Wide Web sites. The goal is to fully exploit the Web's power of linkage and association, but web-like organization structures can just as easily propagate confusion and fuzzy thinking about the interrelationships of web site information chunks. Ironically, organizational webs are often the most impractical structure for Web sites, because they are so hard for the user to understand and predict. Webs work best for small sites dominated by the number of links, aimed at highly educated or experienced users looking for enriching user's knowledge rather than for a basic understanding of new topic.

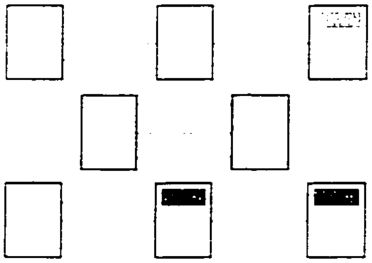


Figure 4 Web-like Organization of Web Pages

2.1.2.5 Summary

Most complex web sites share aspects of all four types of information structures except in sites that rigorously enforce a single model. The ultimate goal of a web site design is to give the users a clear, consistent and navigatable structure and content. The chart below summarizes the four basic organization patterns against the "linearity" of your narrative, and the complexity of your content.

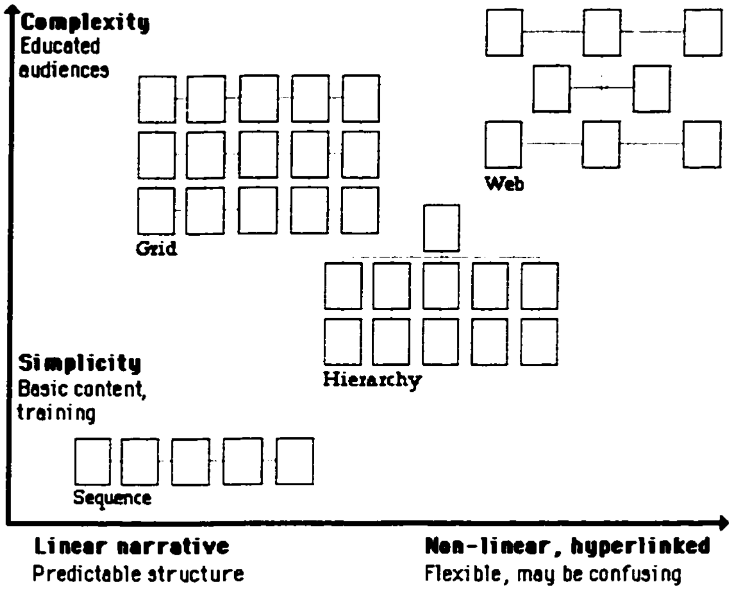


Figure 5 Comparison Chart of Web Organization Complexity

2.2 UML Notation

2.2.1 UML Web Extension

UML is a visual notation designed for object-oriented design concept[5] and a notation with system design in mind. It is widely used for communicating system design ideas and implementation details. In order to accommodate Web design concept, OMG and

Rational has introduced a new set of extensions to the UML notation[21-23], which defines a set of stereotypes, tagged values and constraints that are suitable for modeling web applications. The stereotypes and constraints are applied to certain components that are particular to web applications and allows us to represent them in the same model, and on the same diagrams that describe the rest of the system.

2.2.1.1 Stereotypes Classes

UML stereotyped classes are used to represent web components both on server side and client side. Table 2 describes the extensions.

Table 2 Extended Stereotyped Classes Introduced to UML Web Design

Class Name	Description
Server Page	A server page represents a web page that has scripts that are executed by the server
Client Page	An instance of a client page is an HTML formatted web page. Client pages are rendered by client browsers. and may contain scripts that are interpreted by the browser.
Form	A class stereotyped as a «form» is a collection of input fields that are part of a client page. A form class maps directly to the HTML form tag. Its attributes represent the HTML form's input fields.
Frame Set	A frame set is a container of multiple web pages. The rectangular viewing area is divided up into smaller rectangular frames. A frame set stereotyped class maps directly to a frameset web page. and the HTML frame tag.
Target	A target is a named compartment in a browser window where web pages can be rendered in. Typically a target is one frame in a window defined by a frameset. however a target could be a completely new browser instance or window. «Targeted link» associations specify targets as the place where a new web page is to be rendered.
JavaScript	On a JavaScript enabled browser it is possible to simulate user defined objects with JavaScript functions. «JavaScript» instances exist only in the context of client pages.

2.2.1.2 Stereotypes Associations

Stereotyped associations were introduced to describe the relationship between web classes. Currently Rational introduced 9 different types of associations to UML notation as in Table 3 Stereotyped Associations Introduced to UML Web Design.

Table 3 Stereotyped Associations Introduced to UML Web Design

Association Name	Description
Link	A link is a pointer from a client page to another «Page». In a class diagram a link is an association between a «client page» and either another «client page» or a «server page». A Link association maps directly to the HTML anchor tag. A list of parameter names that should be passed along with the request for the linked page.
Targeted Link	Similar to a «link» association, a «targeted link» is a link where the associated page is rendered in another target. This association maps directly to the HTML anchor tag, with the target specified by the tag's target attribute.
Frame Content	A frame content association is an aggregation association that is expressing a frame's containment of another page or target. A frame content association can also point to another frameset, indicating nested frames.
Submit	A «submit» association is always between a «form» and a «server page». Forms submit their field values to the server through «server pages» for processing. The web server processes the «server page», which accepts and uses the information in the submitted form. This relationship indicates which page (or pages) can process the form, and which forms a «server page» has some knowledge about. A list of parameter names that should be passed along with the request for the linked page.
Builds	The «builds» relationship is a special relationship that bridges the gap between client and server pages. Server pages only exist on the server. They are used to build client pages. The «builds» association identifies which server page is responsible for the creation of a client page. This is a directional relationship, since the client page contains no knowledge of how it came into existence. A server page can build multiple client pages, but a client page can only be built by one server page.
Redirect	A «redirect» relationship is a unidirectional association with another web page. It can be directed both from and to client and server pages.

Object	An association between a client page and an object that is embedded in it. The object is typically a Java Applet or ActiveX control. This association maps in part to the HTML <object> tag.
IIOP	IIOP (Internet Inter-Orb Protocol) is special type of relationship between objects on the client and objects on the server. It represents a communication mechanism other than HTTP for client server communications. Typically this relationship is between Java Beans on the client and Enterprise Java Beans on the server.
RMI	RMI (Remote Method Invocation) is a mechanism for Java Applets and Beans to send messages to other Java Beans on different machines. Typically this relationship is between Java Beans or Applets on the client and Enterprise Java Beans on the server.

2.2.1.3 Stereotypes Attributes

Four special attributes were introduced to UML notation to describe properties of web pages.

Table 4 Stereotyped Attributes Introduced to UML for Web Design

Attribute Name	Description
Input Element	An Input Element is an attribute of a «Form» object. It maps directly to the <input> tag in an HTML form. It is used to input of a single word or line of text. The tagged values associated with this stereotyped attribute correspond to the <input> tag's attributes.
Select Element	An input control used in forms. The select control allows the user to select one or more items from a list. Most browsers render this control as a combo or list box.
Text Area Element	An input control used in forms, that allows multiple line input.
Page	A page component is a web page. It can be requested by name by a browser. A Page component may or may not contain client or server scripts. Typically Page components are text files accessible by the web server, but they can also be compiled modules that are loaded and invoked by the web server. Ultimately when accessed by the web server (as either a file or executable) a page produces an HTML formatted document that is send in response to a browser's request.

2.2.2 Web Design Modelling with UML

UML is widely used for system design. UML web extension allows web design in a way that specifies the underline implementation technology and programming design. It does not point any way of web content structure and logical cohesions. Figure 6 is an example of UML web architecture design that shows an example of using UML for web site design. In this example, UML and UML web extension were used to describe architecture design of a web site.

From this example, we can see UML is useful for system design and implementation, but, it is not convenient and effective for representing web site contents and its structure, and nor does it render any easy processability to the model. It is not a proper notation to represent a web site for knowledge recovery and mining

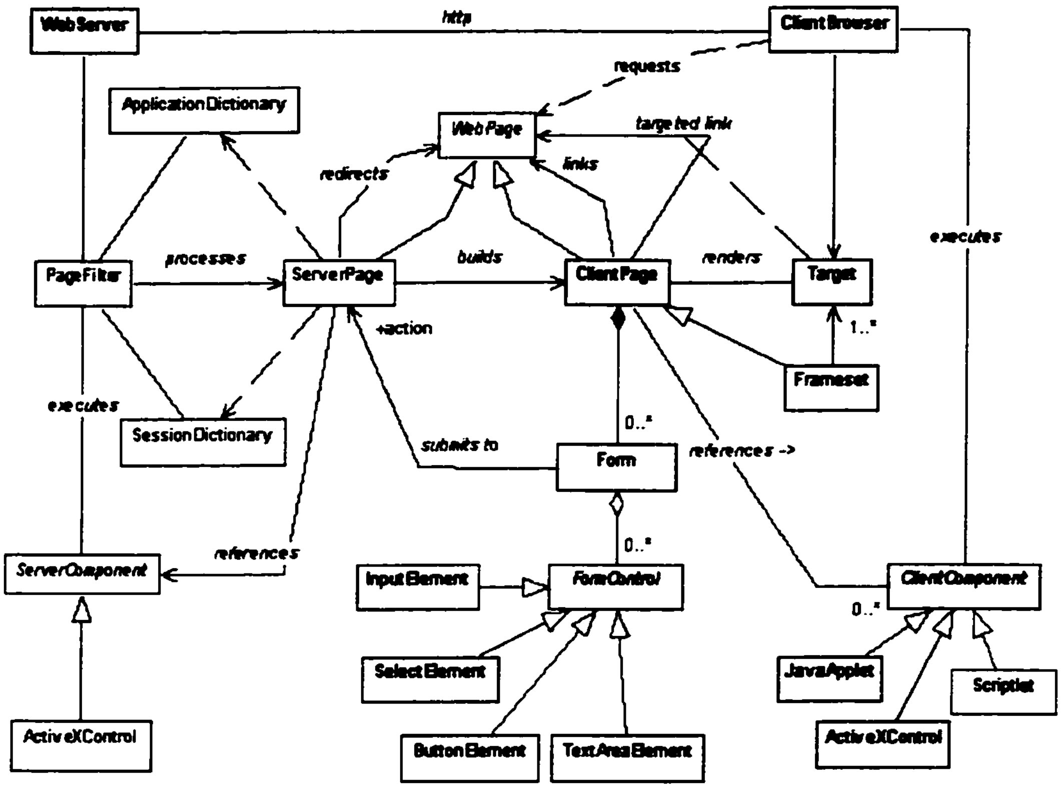


Figure 6 Example of UML Web Architecture Design

2.3 Context Map Notation

2.3.1 Context Maps

Context maps were developed by Dr. Jaworski at the University of Concordia[6-13]. This technology has a history of names. During the late 1970s and early 1980s, based on conceptual graphs introduced by J.F.Sowa, it was named as *ABL*, or *Array Based Language* [11]. In the late 1980s, it was renamed as *ABL/W4*. *W4* represents as what, when, where and why. In the early 1990s, Prof. Jaworski, by considering existing notations and methodologies, named this technology as *jMap Notation*. In the late 1990s until now, *jMaps* are presented as *Context Maps* [12].

Context maps uses style sheets to control knowledge-based information access and navigation and creates virtual information maps for the information system[9, 12]. An information set is a collection of information classes which contains information instances in a information system[12]. In a sense, *Context maps* describe what an information set is about, by formally declaring topics, and by linking the relevant parts of the information set to the appropriate topics.

Context tuple is a generic association of set members cast in roles. In the extended spreadsheet a column of roles and its related set members define context tuple. From the graphical view, context tuple, in fact, is represented by a compound edge and the connected compound nodes. A directed edge object consists of tail object, middle object and head object. Context can be defined by an aggregation of context tuples. While context tuples represents action-able system behaviors, processes, tasks, procedures or programs. The aggregated context tuples will form a *context map*.

2.3.2 Joined Maps (jMaps)

The *joined maps* or *jMaps* is a notation and method for representing systems architecture, structures, processes and reusable templates[12]. This technology was first introduced by Dr. W.M. Jaworski [10]. The technology was initially developed as a means of recovering and refining knowledge from legacy systems. By using the popular concept of spreadsheet structure, it is feasible to describe and process conceptual information. The *jMaps* notation allows efficient recovery and modeling of generic schemata for processes, objects and views of information systems.

jMaps represents the knowledge in a spreadsheet format with the relationships represented by vertical *tuples/columns*. Connecting the words jointed and map produced the term "*jMap*". The *jMaps* represent the relationship between different information nodes and provide functionality of arrays, graphs, relational tables, etc. The 'j' stands for *jointed*, because a *jMap* can be a collection of different information connected together in a strong logical way. By that we mean that you can manipulate the logical query to get the specific information that you seek from the map.

2.3.3 **jMap** ***Syntax and Process***

The syntax of *jMaps* is based on the Relationship Oriented paradigm, or on relating sets and set members. In *jMaps* the relationships are represented by (vertical) tuples/columns. The *kTuple* (knowledge tuple) construct is the fundamental structure defined by the concepts and instances related by roles.

The relating mechanism is implemented by allocating roles to sets in schema and their instance to set members/instances in map. Compared to diagrams, maps are very compact, offering a rich context within limited space of a computer screen. Maps are created or edited within an organized electronic page – spreadsheet which assures efficient manipulation of relationships (columns) and heavy reuse of components (row).

Figure 7 Diagrams Defined by Map Patterns demonstrates associations of descriptor strings to arcs and nodes. The character "f" ("t") associate the strings to the "tail" ("head') of an arc. The character "m" signifies that the string is attached to the "body" of arc or node. Clustering of arcs - and connected nodes - into graphs is shown by tagging columns with character "&". Graphs are connected if they share at least one node. As is illustrated by graph (A) and (B), reordering of columns and/or rows is an information-preservation operation, i.e. the shape of the graph might change but not the meaning. Descriptors of arcs and nodes are set members. Sets are identified by {<set name>} and are defined by enumeration. The schema-level view of a map is obtained first by hiding set instances and then by hiding redundant columns (Figure 7). The schema provides information about *joined maps* (*jMaps*) structure and size.

A	A	A	3	1	{Graph}
&	&	&	3		{A}
M	M	M	3	3	{Arc}
m			1		string4
	m		1		string5
		m	1		string6
F	F	F	3	3	{Node}
	t	f	2		string1
t	f	t	3		string2
f		t	2		string3

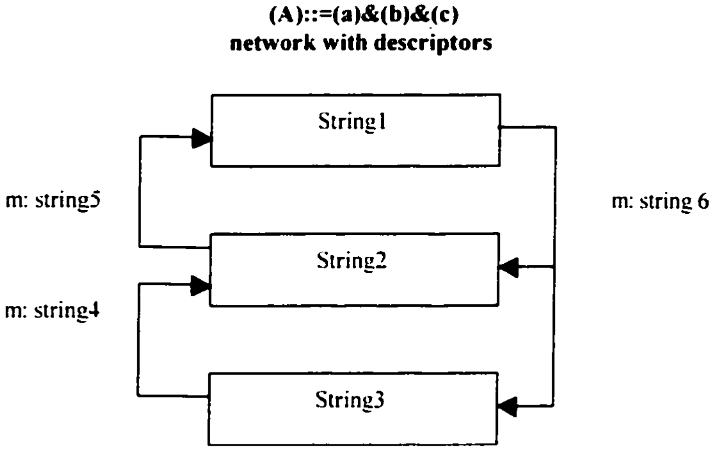
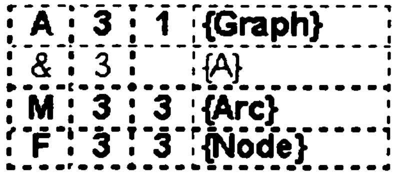


Figure 7 Diagrams Defined by Map Patterns

For the diagrams on the right side, we have the map as shown on the left side of figure. The map contains three sets namely **{Graph}, {Arc}, and {Node}**. There are three roles namely **'A', 'M'** and **'F'** and four instance roles namely '&', 'm', 'f' and 't'. Role 'A' was allocated to **{Graph}** to allow clustering of columns (i.e. relationships of instances) with instance role '&'. Role **'M'** was allocated to **{Arc}** to allow allocating of instance role 'm' to the instances 'string4', 'string5' and 'string6'. Role 'F' was allocated to **{Node}** to allow allocating the instance roles 'f' and 't' to the members/instance of these sets.



A	**3**	**1**	**{Graph}**
&	3		{A}
M	**3**	**3**	**{Arc}**
F	**3**	**3**	**{Node}**

Figure 8 Schema view of Map

Large *jMaps* models can be viewed clearer by using group function in Excel to hide the irrelevant columns and rows.

In general, abstract concepts appear on the right of the map in bold and between curly brackets. They can be thought of as a heading of a table column or a row. The instances would then be the actual contents listed in the table. Each column is to be read vertically using the syntax that was described above. For every "variable" you come across when reading down a column, you must read across towards the right of the map, to see which concept or instance the variable is referring to. Beside each instance, and under the total number of instances, represents the number of times the instance is referred to.

2.3.4 jMap Notation

jMap notation can addresses many topics such as following[9, 10, 12]:

- Information system architecture

- Recovery and reuse of system patterns
- Evolving information systems
- Software evaluation and renewal
- Systems workstations
- Automation of system design
- Modeling of web sites and knowledge hubs

JMap notation syntax was listed and explained as follows :

- **Generic jMap concepts could be one of the following:**

  A - Template Aggregation
  T – Template
  Y – Dominant
  Z – Descriptive
  K – Identifier
  O – Identity
  H – Hierarchy
  I - Generalization - "parent" or "heir"
  P - Aggregation - "whole" or "part"
  U - Uses or used
  D - Dependence
  S - Sequence - position in a sequence
  F - Flow "from" or "to"
  L - Flow "from". "to" and "loop"
  X - Unique Qualifier
  M - Association
  G - Guard or Goal
  E - Event

V - Value

? - User defined

- **Instances in jMap can be mapped to concept by using following symbols:**

1 ... * - identifier or value

o - column marker

h - tree root

1 ... * - branch

f - from:

t - to:

b - both

m - many or middle:

d - destination:

s - source:

l - loop

a - assertion

e - exception

x - unique row marker

v - related

c - composite

t - true

f - false

o - otherwise

t - implied true

f – implied false

e – enabled

d - disabled

? - user defined

u - update

2.3.5 Representing Models in jMap Notation

jMap notation is a formal notation, which can represent various systems and processes, and is equivalent to any other notations. Its distinctive feature from other notations is its P2S properties (Processable, Plugable and Searchable) in additional to its excellent visual presentation. JMap notation is also a complete notation and is equivalent to other notations in all aspects. The following subsections describe examples of jMap models which directly converted from other notation models: Entity-Relationship model and UML model.

2.3.5.1 Representing Entity Relationship Model

As an example, we represent a Customer-Orders ER model in jMap notation. In this Customer-Orders Entity-Relation model, we describe the following relational schema:

Entity: Customer { Customer Number, Name, Telephone No, Credit Limit, Balance}
Order { Order Number, Item, Quantity}

Relationship: customers places orders {Customer No, Order No, Date }

To construct a jMap for this ER relationship, the following has to be performed:

1) Identify component types i.e. identification of sets by name.
2) Enumerate sets and identify connector types
3) Create connectivity columns/map by 'connecting' components with characters "f" and "t".
4) Use "M" to identify association. Enhance connectivity columns by using characters "m" to represent association between the attributes

5) Use characters "v" to stress uniqueness/identity of an entity.

6) Use characters "F" to identify columnwise for the sets with members connected by "f" or "t".

7) To Create schema view by first hiding set members and then hiding redundant columns.

This simple ER relationship was presented in Figure 9 Customer and Orders *Model* Represented by *jMap.* In this figure, we can see the attributes of the entities are represented in the right most column as concepts, their relationship were mapped in the left columns (0-7). Column 8 is the counter of the relations relevant to this concept, column 9 is the total number of instances of the concepts. They (column 8, 9) are equivalent to summary fields in ER relationship. Obviously, the information in the above ER model was completely represented by this jMap.

A	A	A	A	A	A	A	A	8	4	**{View}**
v	v	v	v	v	v	v	v	8		ADM
A	A	A	A	A	A	A	A	8	2	**{Entity}**
v	v	v	v					4		Customers
				v	v	v	v	4		Orders
F	F	F	F	F	F	F	F	8	4	**{Customer number}**
f							t	2		456
	f			t				2		567
		f						1		678
			f		t	t		3		789
F	F	F	F					4	4	**{Name}**
t								1		Avis
	t							1		Boeing
		t						1		CA
			t					1		Dell
F	F	F	F					4	4	**{Telephone no}**
t								1		020 7123 4567
	f							1		020 8345 6789
		t						1		0123 45678
			t					1		0134 56789
F	F	F	F					4	4	**{Credit limit}**
t								1		£10,000
	f							1		£2,500
		t						1		£50,000
			t					1		£21,000
F	F	F	F					4	4	**{O/S balance}**
t								1		£4,567
	f							1		£1,098
		t						1		£14,567
			t					1		£6,789
				F	F	F	F	4	4	**{Order number}**
				f				1		11234
					f			1		11235
						f		1		11236
							f	1		11237
				F	F	F	F	4	4	**{Date}**
				t				1		03/02/99
					t			1		15/03/99
						t		1		21/04/99
							t	1		05/07/99
				F	F	F	F	4	4	**{Item}**
				t				1		ABC345
					t			1		GGI765
						t		1		KLM012
							t	1		GHJ999
				F	F	F	F	4	4	**{Quantity}**
				t				1		150
					t			1		25
						t		1		1000
							t	1		50
M	M	M	M	M	M	M	M	8	1	**{Association}**
m	m	m	m	m	m	m	m	8		has / is

Figure 9 Customer and Orders *Model* Represented by *jMap*

2.3.5.2 Representing UML Models in jMap Notation

The following jMap diagram Figure 10 A Web Design jMap Model Converted from *Figure* 6 UML model shows a complete jMap notation model directly converted from Figure 6. We define the following jMap schema to represent the contents from the diagram:

Table 5 A jMap Schema for Representing Web Designs

Symbol	**Concept**	**UML Equivalency**
A	{Content}	Description of the jmap content
X	{Edge Type}	Aggregations Relationships (Generalization and composition)
E	{Edge Component}	Association relationships(dependency, associations)
F	{Node Name} {Node Color}	Class Entity
E	{Multiplicity}	Relattionship multiplicity
A	{Content Source}	The source of this information for tracebility
A	{Author}	The authors creating this jMap for reference

Figure 10 is constructed by using above jMap schema. As seen from this jMap, the visual graphic mosaic from UML diagram was converted to text-based fields and relationship maps on a Excel spreadsheet. All the information residing in the UML diagram for the web design diagram in Figure 6 was represented completely on the jMap. It is easy for human to understand a graphic notation such as UML, however, the graphic notations are not easily processable and plugable. Clearly, this jMap representation renders the model of capability to be plugable in other analysis applications, whole or parts.

■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	28	1	{Context}	
v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	28		UML diagram	
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	28	2	{Edge Type}	
							x						x	x					x					x			x	6		generalization/inheritance	
																						x	x					2		part-of	
E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	28	13	{Edge Component}	
m																												1		http	
				m																								1		processes	
			m																						m			2		executes	
								m																				1		references	
									m																			1		redirects	
										m																		1		requests	
											m																	1		links	
												m																1		targeted link	
																m												1		builds	
																	m											1		renders	
																					t							1		+action	
																					■							1		submits to	
																										m		1		references	
F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	28	22	{Node Name}	[Node Color]
v	v																											2		WebServer	yellow
									t	t	t	t	t	t	v													7		WebPage	blank
v										■								■							v			4		ClientBrowser	yellow
		v																										1		ApplicationDisctionary	yellow
	v	v	v	■		v																						5		PageFilter	yellow
				t	■			■	■				■			■					t							7		ServerPage	yellow
					t	v																						2		SessionDictionary	yellow
			v				t	t																				3		ServerComponent	yellow
							■																					1		ActiveXControl	yellow
											■	■		■		t	v		t			t				■		8		ClientPage	green
															v		v	t		t								4		Target	green
																			■	■								2		Frameset	green
																					■	■	t					3		Form	green
																							■	t				2		FormControl	green
																								■				1		InputElement	green
																								■				1		SelectElement	green
																								■				1		ButtonElement	green
																								■				1		TextAreaElement	green
																									v	t	t	3		ClientComponent	green
																											■	1		JavaApplet	green
																											■	1		ActiveXControl	green
																											■	1		Scriptlet	green
E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	28	2	{Multiplicity}	
																				t								1		1 .. *	
																						■	■			t		3		0 .. *	
■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	28	1	{Content Source}	
v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	28		Figure 6 Example of UML Web Architecture Design	
■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	28	1	{Author}	
v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	28		Syntax and Patterns © by W.M. Jaworski, 1988-2002	

Figure 10 A Web Design *jMap* Model Converted from Figure 6 UML model

2.4 The Analysis of jMap Web Model

As exampled in previous sessions, jMap notation is unique in its excellent processabilty and convenience. It is one of the best notations for representing the retrieved information model as from web sites. Web mining can be easily done on these processable models. Currently, there are number of separate projects ongoing to process jMap model known as "Context+" projects.

3. Web Mining With jMaps

3.1 Website Structure Graph Model to jMap Model Mapping

UML model is used for web site forward engineering. It is designed as a visual notation for communicating design ideas, however its processability is quite complicated and limited. The web hierarchy model is an intuitive and well-understood model for web forward and reverse engineering and implemented by most websites in reality. jMap notation is suitable for representing the reverse-engineered website information. Its excellent processabilty and easy of use and variety of data analysis tools make it the best fit for web mining notation. jMap technology is a well-structured web site container, which can represent a web site contents, structure information.

In this report, the research and software development project deals with two aspects of web mining: information retrieval and jMap conversion, which covers both web site content mining and web site structure mining. However, the content and structure analysis part is not in current project scope. For more information, jMap processing utilities such as "Context+" can be referenced.

3.2 Website Structure Recovering using BFS

3.2.1 Breadth-First-Search Algorithm (BFS)

Breadth-First Search(BFS) is one of the simplest algorithms for searching a graph and the archetype for many important graph algorithms such as Prim's minimum-spanning-tree algorithm and Dijkstra's single-source shortest-paths algorithm[16].

Given a graph G = (V, E) and a distinguished source vertex s, BFS systematically explores the edges of G to discover every vertex that is reachable from s. It computes the distance (smallest number of edges) from s to each reachable vertex. It also produces a BFS tree with root s that contains all reachable vertices. For any vertex v reachable from s, the path in BFS tree from s to v corresponds to s shortest-path from s to v in G, that is, a path containing the smallest number of edges. This algorithm works on both directed and undirected graphs.

BFS is named because it expands the frontier between discovered and undiscovered vertices uniformly across the breadth of the frontier. Namely, BFS algorithm discovers all vertices at distance k form s before discovering any vertices at distance k+1.

Breadth-First-Search results in a BFS tree. Its root is the source vertex s. It starts at scanning s's adjacency list to explore new vertices connected to s and saves the discovered vertices in the queue. Whenever a white vertex v is discovered in the course of scanning the adjacency list of an already discovered vertex u. the vertex v and the edge (u.v) are added to the tree. u is called the predecessor or parent of v in the BFS tree. Since a vertex is discovered at most once, it has at most one parent.

As BFS tree only preserves a small portion of website structure information in the tree because one vertex is only discovered at most once, it is used mainly as the exploration algorithm for the "Website jMap Builder" program to discover pages in the site. It saves the discovered new page hyperlinks in the queue for the program to retrieve and analyze information from the pages. The relationship between the retrieved pages were analyzed using various string sorting and searching algorithms. Since sorting and searching algorithms are trivial program tasks, they will be ignored in detail from this report.

Algorithm

BFS algorithm can be presented as in the following peseudo code:

```
BFS(G, s)
For each vertex $u \in V[G] - \{s\}$
        do color[u] $\leftarrow$ WHITE
        d[u] $\leftarrow \infty$
        $\pi$ [u] $\leftarrow$ NIL
        Q $\leftarrow \Phi$
        Enqueue(Q, s)
While Q != $\Phi$
        Do u $\leftarrow$ Dequeue(Q)
                For each $v \in$ Adj[u]
                        Do if color[u] $\leftarrow$ GRAY
                        D[v] $\leftarrow$ d[u] +1
                        $\pi$ [u] $\leftarrow$ u
                        Enqueue(Q, v)
                Color[u] $\leftarrow$ BLACK
```

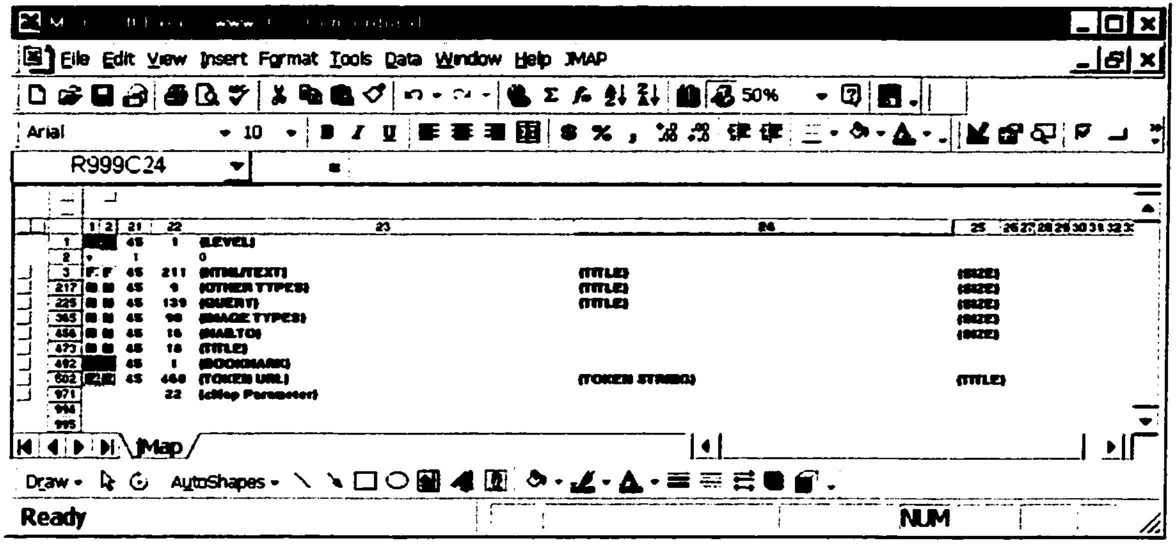
Analysis

The total run time for a BFS-based algorithm is O(V+E), i.e., the running time is proportional to the total number of nodes and total number of vertices in the graph. When BFS algorithm is used to retrieve information from a web site, since the number of pages in a web site is unknown and the time spent on the retrieving pages is much more than the analysis on the local machine, therefore the total running time is linear, O(V), i.e., it is only related to the number of pages retrieved. The actual speed is totally depends on the speed of internet connections and the number of pages will be analysed.

3.2.2 Generic Website jMap Schema

jMap technology is flexible and complete for representation of a web site's contents and structure information. This project only uses a simple set of web page's attributes in the jMap schema. The information retrieval from a web page is currently limited to of the following concepts in the schema as described below. This schema could be easily extended with minor change of the design of the program.

- { HTML/TEXT }
- { QUERY }
- { FTP }
- { MAILTO }
- { IMAGE }
- { TITLE }
- { Size }
- { TOKEN }
- { LEVEL }
- {BOOKMARK}
- {LINKOUT}



	1 2	21	22	23	24	25
1		45	1	{LEVEL}		
2		1	0			
3	F F	45	211	{HTML/TEXT}	{TITLE}	{SIZE}
217		45	9	{OTHER TYPES}	{TITLE}	{SIZE}
225		45	139	{QUERY}	{TITLE}	{SIZE}
365		45	90	{IMAGE TYPES}		{SIZE}
456		45	16	{MAILTO}		{SIZE}
473		45	18	{TITLE}		
492		45	1	{BOOKMARK}		
602		45	468	{TOKEN URL}	{TOKEN STRING}	{TITLE}
971			22	{jMap Parameter}		
994						
995						

Figure 11 Generic *jMaps* Template for Website Model

3.2.3 Mapping Website Attributes and BFS tree attributes to jMap Concepts

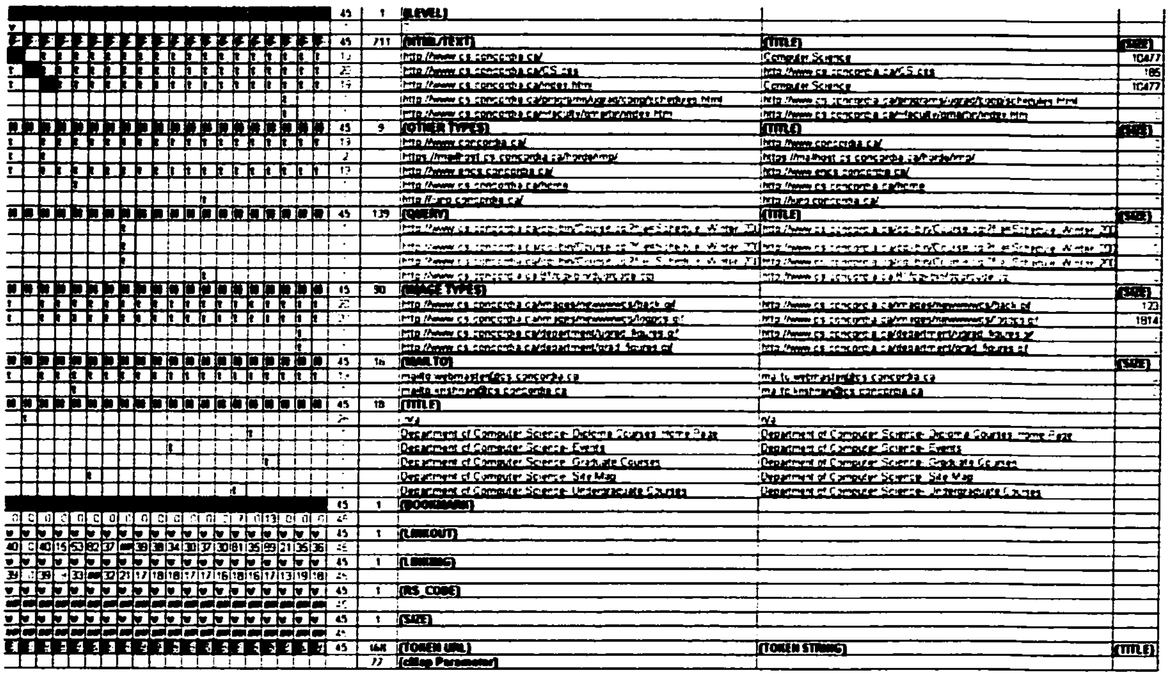
BFS algorithm forms the basis of the software design. However, it is only used as an exploration method, the methods used for retrieving and analysing web page attributes are mostly independent from BFS algorithm. Various techniques and program libraries were employed to extract and analyse attributes from each HTML page. The mapping between web site attributes and jMap attributes are computation intensive. The relationship between HTML pages was the result of analysis by means of sorting and searching keys. It was reflected on jMap relationship mapping fields as identified by "t" and "f" symbols. This relationship is considered to be complete and honest to the original web organizations as identified in generic jMap templates.

Table 6 Website Attribute Mapping To jMap Concepts

	jMap Schema attribute	***HTML Page Attribute***	***Web Graph Attribute***	***BFS Attributes***
1	{ LEVEL }		explored BFS tree depth	Level on the tree
2	{HTML/TEXT}	HTML/TEXT hyperlinks	directed edge from this page as Source vertex with label "hyperlink"	Children of this page
3	{ MAILTO }	embedded email hyperlinks	discarded edge	
4	{ FTP }	ftp hyperlinks	directed edge from this page as source vertex with label "ftp"	
5	{ QUERY }	GET and POST query links	directed edge from this page as source vertex with lable "query"	
6	{ TITLE }	Title of this page	contents of the vertex	
7	{ SIZE }	Sice of this page	contents of the vertex	
8	{ TOKEN }	Context Text of the hyperlinks		
9	{BOOKMARK}	Total hyperlink to this pages	self-directed edge	
10	{ LINKOUT }	Total hyperlink to other pages	children	Children
11	Hyperlink Relationships	hyperlinks to predecessor can be mapped as back edges. to sibling page as cross edges. to self as self-directed edges. to child page as forward edges. All edges in jMap starts from source vertex with "f" and ends with target vertex with "to". multiple edges are marked with its cardinality such as "3t".		

3.2.4 A Website Model Recovered with jMaps

Since a web site jMap model is quite large - in Figure 12 A Tailored Version of Web Site Model for www.cs.concordia.ca. - we show only a small fraction of instances for each concept in the jMap. This figure shows a formatted jMap in Excel spreadsheet. The color scheme was added with jMap processing utilities. For a complete view of this jMap model, an Excel spreadsheet is attached with this report in Appendix B.



45	1	{LEVEL}		
45	711	{HTML/TEXT}	{TITLE}	{SIZE}
13		http://www.cs.concordia.ca/	Computer Science	10477
22		http://www.cs.concordia.ca/CS.css	http://www.cs.concordia.ca/CS.css	185
19		http://www.cs.concordia.ca/index.html	Computer Science	10477
·		http://www.cs.concordia.ca/programs/ugrad/coop/schedules.html	http://www.cs.concordia.ca/programs/ugrad/coop/schedules.html	-
·		http://www.cs.concordia.ca/faculty/[illegible]/index.htm	http://www.cs.concordia.ca/faculty/[illegible]/index.htm	-
45	9	{OTHER TYPES}	{TITLE}	{SIZE}
13		http://www.concordia.ca/	http://www.concordia.ca/	-
2		https://mailhost.cs.concordia.ca/horde/imp/	https://mailhost.cs.concordia.ca/horde/imp/	-
13		http://www.encs.concordia.ca/	http://www.encs.concordia.ca/	-
·		http://www.cs.concordia.ca/home	http://www.cs.concordia.ca/home	-
·		http://juno.concordia.ca/	http://juno.concordia.ca/	-
45	139	{QUERY}	{TITLE}	{SIZE}
·		http://www.cs.concordia.ca/[illegible] Winter 20[illegible]	http://www.cs.concordia.ca/[illegible] Winter 20[illegible]	-
·		http://www.cs.concordia.ca/[illegible] Winter 20[illegible]	http://www.cs.concordia.ca/[illegible] Winter 20[illegible]	-
·		http://www.cs.concordia.ca/[illegible] Winter 20[illegible]	http://www.cs.concordia.ca/[illegible] Winter 20[illegible]	-
·		http://www.cs.concordia.ca/[illegible]	http://www.cs.concordia.ca/[illegible]	-
45	90	{IMAGE TYPES}		{SIZE}
22		http://www.cs.concordia.ca/images/[illegible]/back.gif	http://www.cs.concordia.ca/images/[illegible]/back.gif	123
2[illegible]		http://www.cs.concordia.ca/images/[illegible]/logo[illegible].gif	http://www.cs.concordia.ca/images/[illegible]/logo[illegible].gif	1814
·		http://www.cs.concordia.ca/department/grad_figures.gif	http://www.cs.concordia.ca/department/grad_figures.gif	-
·		http://www.cs.concordia.ca/department/grad_figures.gif	http://www.cs.concordia.ca/department/grad_figures.gif	-
45	16	{MAILTO}		{SIZE}
[illegible]		mailto:webmaster@cs.concordia.ca	mailto:webmaster@cs.concordia.ca	-
·		mailto:[illegible]@cs.concordia.ca	mailto:[illegible]@cs.concordia.ca	-
45	18	{TITLE}		
2[illegible]		n/a	n/a	
·		Department of Computer Science- Diploma Courses Home Page	Department of Computer Science- Diploma Courses Home Page	
·		Department of Computer Science- Events	Department of Computer Science- Events	
·		Department of Computer Science- Graduate Courses	Department of Computer Science- Graduate Courses	
·		Department of Computer Science- Site Map	Department of Computer Science- Site Map	
·		Department of Computer Science- Undergraduate Courses	Department of Computer Science- Undergraduate Courses	
45	1	{BOOKMARK}		
45	1	{LINKOUT}		
45	1	{LINKING}		
45	1	{RS_CODE}		
45	1	{SIZE}		
45	[illegible]	{TOKEN URL}	{TOKEN STRING}	{TITLE}
	77	{cMap Parameter}		

Figure 12 A Tailored Version of Web Site Model for www.cs.concordia.ca

3.3 Development Tools

The development tool used is listed as follows:

- PERL, with libraries: PERL/TK8.00. LWP. HTML, MIME. MAIL modules.

  PERL is an open source language. There are plenty of libraries available for download free of charge and license restrictions. PERL is also famous for its text processing, system and network administration capabilities.

- Platform: Windows/UNIX (Solaris)/Linux

  Website jMap Builder software is designed to run on any platform. which a PERL portal is available for it.

- Microsoft Excel

  Excel is a spreadsheet that allows users to organize data, do complicated calculations, make decisions, draw graph from data, develop professional-looking reports, convert Excel files for use on the database, access the database, etc. Visual Basic Application(VBA) for Excel provides us with the means to accomplish a wide range of the programing tasks. With *VBA*, we can create full-fledged custom applications in *Microsoft Excel.*

3.4 Website jMap Builder Design Constraints

This software is mainly constrained by the power of the computer and the speed of Internet connection. This software is also limited by the following third party software:

- **Microsoft Excel**

  Which currently limit the maximum number of 256 column and 65535 rows.

- **PERL**

  Perl is a open source software. It has aboundant modules available for download free of charge. This software makes use of the following PERL modules:

  - PERL/Tk for GUI.
  - LWP for accessing to WWW including HTTP, FTP protocols.
  - HTML for extracting links, parsing and analyzing HTML page for page properties.

  However, all the links not in HTML scope such as in java script, flash, image maps are not processable by current libraries.

4. Software Specifications

4.1 Architecture

This software was designed for all platforms with a PERL portal. The back-end program and front-end user interface were developed in PERL and can run on various platforms. Because of the nature of jMap application, the final jMaps have to transform to a PC environment and formatted in Excel spreadsheet.

The main thrust for jMap processing is designed for three front end user interfaces as in Figure 13 Web jMap Builder Architecture:

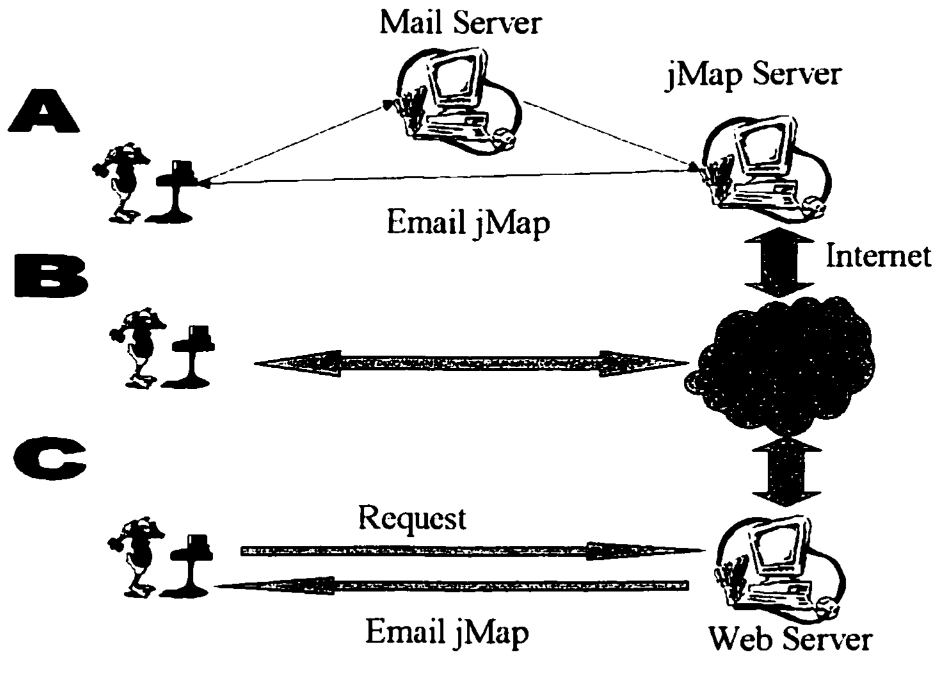


Figure 13 Web jMap Builder Architecture

A: Email Request Server; B: Local Terminal GUI; C: Web CGI Interface

Configuration A is a service based configuration and designed for heavy load jMapping of big web sites, which need huge amount of CPU power and memory. Ideally, the jMap Website Builder server should be an UNIX server. The user can place a request by sending a formatted email to the mail server. The jMap server will poll the mail server regularly and process the user requests and send results back to the user via email. This is the most powerful way of using this software.

Configuration B is designed for individual user to run this application from his personal computer with fast internet connections. It is most convenient way of using this software.

The Web CGI interface is currently not implemented in current project.

4.2 Functionalities

One of the main features of this project is to develop an automatic tool to explore the given websites and harvest the information from the websites and export it to Excel spreadsheet for processing by jMap Macros and VBA utilities. The main system's functions as seen by the user can be summarized as:

1) To provide user interfaces to specify parameters for web site jMapping.
2) To explore the websites and export the result.
3) To format the results to a proper jMap notation in Microsoft Excel spreadsheet.
4) Cross platform capability and scalability.

4.3 Software Design

4.3.1 Architecture Design

This software targets cross-platform application and scalability. The architecture design for interprocess communications was limited to only plain text files. Although Figure 13 Web jMap Builder Architecture shows three user interfaces in the architecture, currently only two user interfaces were implemented so far as shown in Figure 14 Software Architecture Design Diagram.

The first design is to use an Excel spreadsheet GUI interface and VBA macros to expore and process jMaps in a local environment. The GUI helps to gather user requirements and invokes the main thrust program to process web site jmaps. The user can open and format the jMap results though Excel GUI.

The second design aims to use a more powerful server computer which can process much larger sites and is capable of cross-site jointed mapping. A user has to send a formatted email to a designated email address to request the Website jMap Building service. The server will process the requests and email the results back to the user in the attachments.

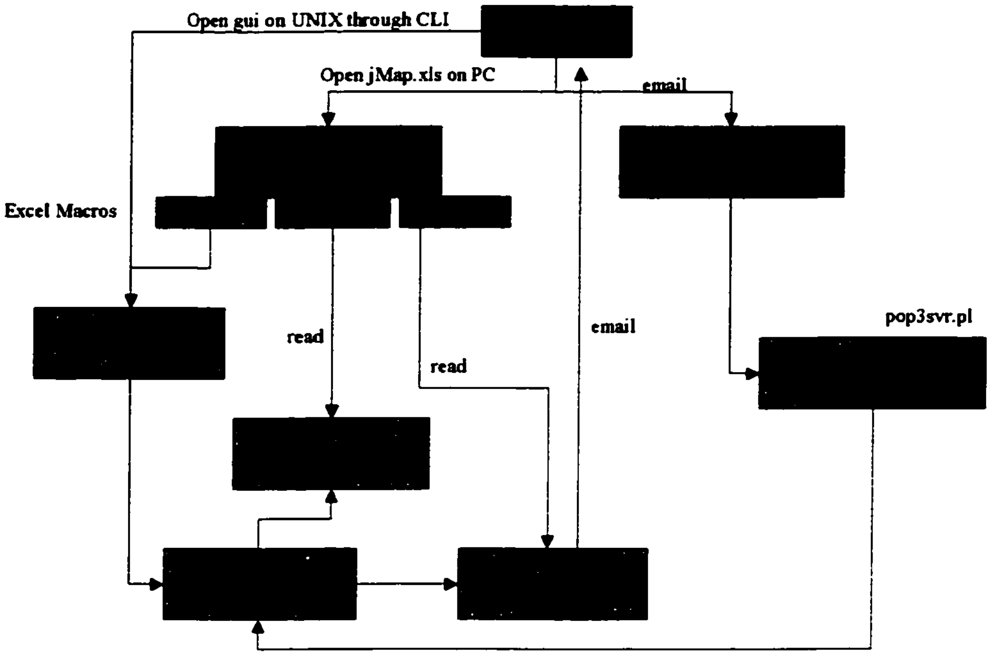


Figure 14 Software Architecture Design Diagram

4.3.2 Detailed Design

4.3.2.1 Main Thrust Program

The main thrust program (file: webjmapm.pl) implements the BFS algorithms to expore the internal pages in the given web site and uses JFILE and JMAP classes to retrieve and process information from the discovered pages. The design details are described as below in Figure 15 Website jMap Builder Library Classes. These two perl classes are object-oriented PERL packages and used by the main thrust program. They can be installed in PERL lib directories as well as the main program working directory.

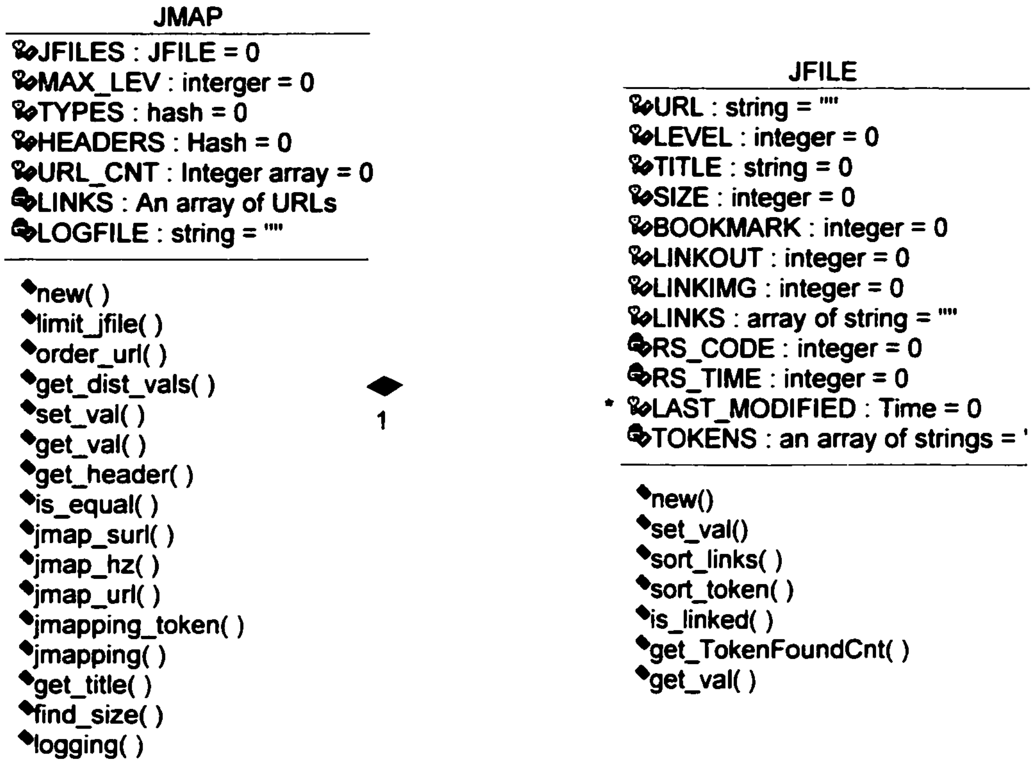


Figure 15 Website jMap Builder Library Classes

JMAP

This class is used for process jMaps.

Protected Properties:

JFILES : JFILE = 0

An array of JFILES.

MAX_LEV : integer = 0

The maximum level of the BFS tree to be build.

TYPES : hash = 0

A hash of different file types.

HEADERS : Hash = 0

A hash of headers.

URL_CNT : Integer array = 0

An array of counters for different type of URLs.

LINKS : An array of URLs

URLs explored.

LOGFILE : string = ""

Log file name and path.

Public Methods:

new () : &JMAP

Constructor.

limit_jfile () : void

In case of too many jfiles. we eliminate the outside links or links without properties

order_url () : void

Sort and put LINKS in a specified order.

get_dist_vals () :

process all distinct values from jfile objects return a list with distinct values:

set_val () :

Mutator.

get_val () :

Accessor.

get_header () :

Map a concept to proper header for jMap.

is_equal () :

Compare two values.

jmap_surl () :

Map different type of URL separately to jMap.

jmap_hz () :

Joined mapping the JFILEs horizontally.

jmap_url () :

joined mapping all URLs.

jmapping_token () :

Joined mapping tokens.

jmapping () :

Joined map all concepts to jMap.

get_title () :

Obtain a title for this token or page.

find_size () :

Return the size of a page.

logging () :

Log messages to a file for display.

JFILE

This class is used for storing properties of a HTML page.

Protected Properties:

URL : string = ""

The URL of this web page.

LEVEL : integer = 0

The BFS search tree level. i.e., the depth of the BFS tree.

TITLE : string = 0

The title of a web page.

SIZE : integer = 0

The size of a page which only the text in HTML format was counted. The linked files were not included.

BOOKMARK : integer = 0

The number of bookmarks in this HTML page.

LINKOUT : integer = 0

The number of links to other pages in this page.

LINKIMG : integer = 0

The number of images in this page.

LINKS : array of string = ""

All the hyperlinks found in this page.

LAST_MODIFIED : Time = 0

The last modified timestamp of this page.

RS_CODE : integer = 0

HTTP request return code.

RS_TIME : integer = 0

The number of seconds of this HTTP request.

TOKENS : an array of strings = ""

All the context tokens found in this page.

Public Methods:

new() () : &JFILE

Constructor of a JFILE.

set_val() (: argtype = default) :

Mutator to set class attributes.

sort_links () :

Sort LINKS in alphabetical order.

sort_token () :

Sort TOKEN in alphabetical order.

is_linked () :

Test if a link contained in this page's hyperlinks.

get_TokenFoundCnt () :

Get the count of token found in this page.

get_val () :

Accessor to obtain class attribute value.

4.3.2.2 Mail Order Server

The mail order server (pop3svr.pl) is based on POP3 protocol. It acts as a POP3 client polling a mail server regularly and parse messages to save in commands.txt file. If there are request. it calls the main thrust program to process the request. The main thrust program (webmapm.pl) will process the request and send the result back to the user via email.

4.3.2.3 Main Excel Macros

There are three Excel Macros were created to attach to the buttons on Excel GUI.

sub initEnv():

This macro initializes some global variables.

sub RunPerl():

This macro is used to invoke PERL/TK GUI for the main thrust program and attached to "Run Website JMAP GUI" button in WebjMap sheet of file jMap.xls.

Sub OpenJmapReopt

This macro is used to open and format JmapReport.txt file.

Sub openJmap

This macro is used to open and format jmap.xxx.txt temporary jMap files produced by the main thrust program.

5. Software User Manual

5.1 System Requirements

Before running this program, you need check if your system meets following requirements:

Hardware Requirements:

- CPU: Intel Pentium 200 or faster /Sun Workstation/HP Workstation
- Monitor – SVGA (800x600) or better
- RAM – at least 256 MB
- Pointing device: Mouse.
- Hard Disk Space: at least 50 MB free space for PERL/TK/Website JMAP installation.

Software:

- Microsoft Excel 97 or Excel 2000
- PERL 5.005 or later with Required libraries as in Section 5.2.2 PERL Libraries

Platform:

The program was tested to run on the following platforms:

- Windows 95/98/Me/2000/NT4
- RedHat Linux

- UNIX (Sun Solaris)

5.2 Software Installation

5.2.1 PERL 5.005

Perl 5.005 or later can be download free from the following sites:

- For Win32 based platform, http://www.activeperl.com
- For Solaris/Linux based platform: http://www.cpan.com

The installation procedure was described in those websites and accompanying with the software.

5.2.2 PERL Libraries

Perl library modules can be downloaded from previously mentioned websites free of charge and can be installed according to the installation procedure as specified in the readme file accompanying with the software.

- PERL/TK 8.00 or later (For GUI, optional for Server)
- LWP (mandatory)
- HTML (mandatory)
- Mail: Mail::Sendmail (mandatory for Server, optional for GUI application)

5.2.3 Microsoft Excel

- Microsoft Excel 97 or 2000

5.2.4 Website jMap Builder Software

5.2.4.1 MAP Home Directory

To install "Website jMap Builder", the first step is to create a directory to host the directory structure and files of jMap Builder. This directory is called JMAP_HOME. It is recommended that the name of this directory should contain the version number, so , multiple versions can co-exist in one system. For example, D:\JMAP5.

5.2.4.2 Directory Structure and Files

Web Site jMap Builder software has the following directory structure and files:

Table 7 Web Site jMap Builder Directory Structure and Files

Directory	**Files**	**Functions**
$JMAP_HOME/bin	gui	UNIX shell script to start GUI in UNIX shells.
	gui.bat	DOS shell script to start GUI in DOS shell.
	gui.pl	PERL/TK GUI program.
	jmap	UNIX shell script to start GUI in UNIX shells.
	jmap.bat	DOS shell script to start GUI in DOS shell.
	JMAP.pm	User PERL class library for jMap processing.
	JFILE.pm	User PERL class library for page information storage
	jMap.xls	Excel template and Macros for jMap formatting.
	pop3svr.pl	POP3 mail request server program.
	webjmap4.pl	Generic version of webjmap building program.
	webjmapc.pl	Web jMap building program for CGI application.
	webjmapg.pl	Web jMap building program for GUI application.
	webjmapm.pl	Web jMap building program for mail server application.

$JMAP_HOME/conf	command.txt	An interface file between GUI-WebjMapx program or pop3svr.pl and webjmapx.pl
	session.txt	A persistent storage of session number. The number is incremental.
	jMap.conf	Website jMap Builder configuration file.
	stop.txt	An user control interface file between GUI-WebjMapx program or pop3svr.pl and webjmapx.pl
$JMAP_HOME/doc	documentation files	documentations of this software
$JMAP_HOME/jmaps	jmap.xxxx.txt	Result jMap in text format. xxxx represent the session number.
	jmap.cxxxx.txt	cross-sites joint mapping text result.
	JmapReport.txt	a summary report for last sessions.
$JMAP_HOME/lib		Perl libraries
$JMAP_HOME/lib/activeperl	*	for WIN32 portals. From ActivePerl.
$JMAP_HOME/lib/CPAN	*	For UNIX/LINUX (also good for WIN32) from CPAN.
$JMAP_HOME/log/	pop3svr.log	pop3 server log file.
$JMAP_HOME/tmp/	jmap.log	temporary log file acting interfaces between GUI and webjmapx.pl program.
	temp.html	temporary web page used for parsing.

* some libraries may be not distributed with this software.

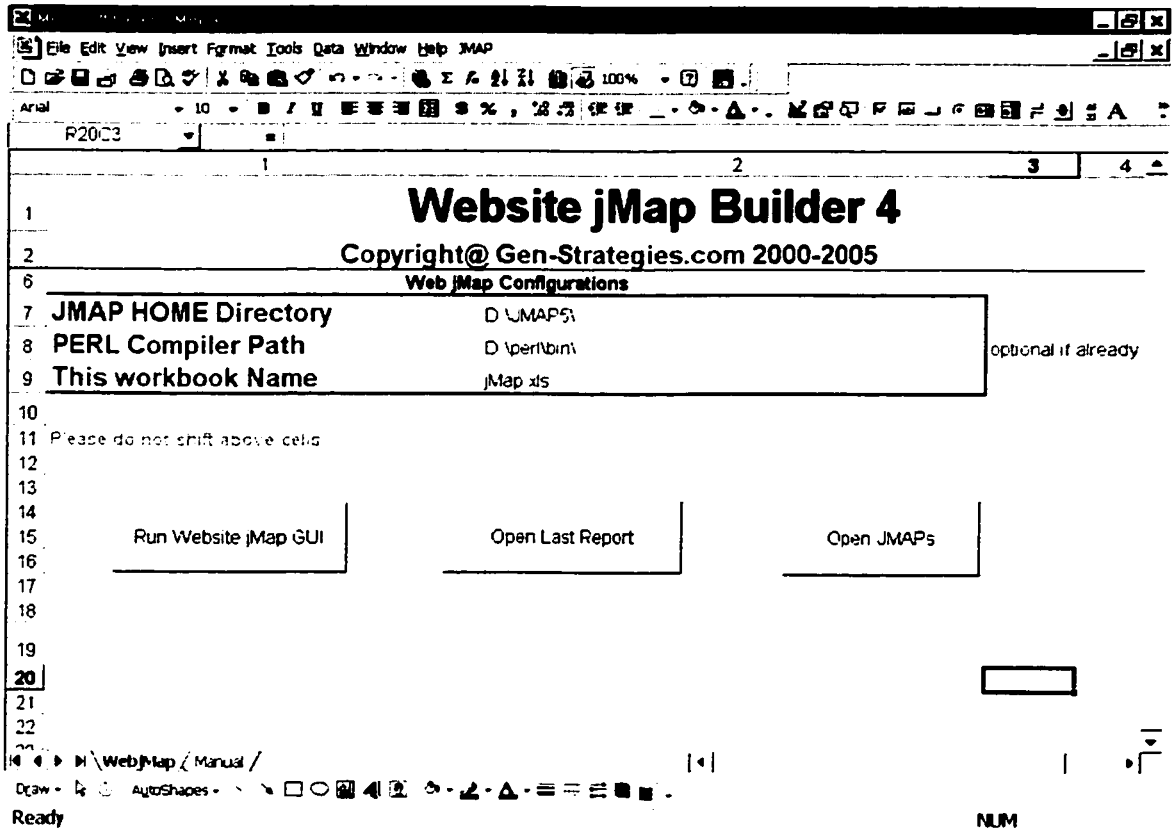
5.3 Local Terminal Application

5.3.1 Run Local Terminal Application on a PC

Local terminal application(LTA) is the most convenient way to map a web site to its jMap notation. The following steps are recommanded to use Website JMap Builder on a PC from Excel spreadsheet interface.

1: Open Microsoft Excel, open **jMap.xls** in $JMAP_HOME/bin directory, click " **Enable Macros** " button to open the file when Excel prompts the dialogue. The open Sheet should look like Figure 16 MS Excel Macros Interface. If you select

Disable Macros button, then you will be unable to run the Macros in the program.



Website jMap Builder 4

Copyright@ Gen-Strategies.com 2000-2005

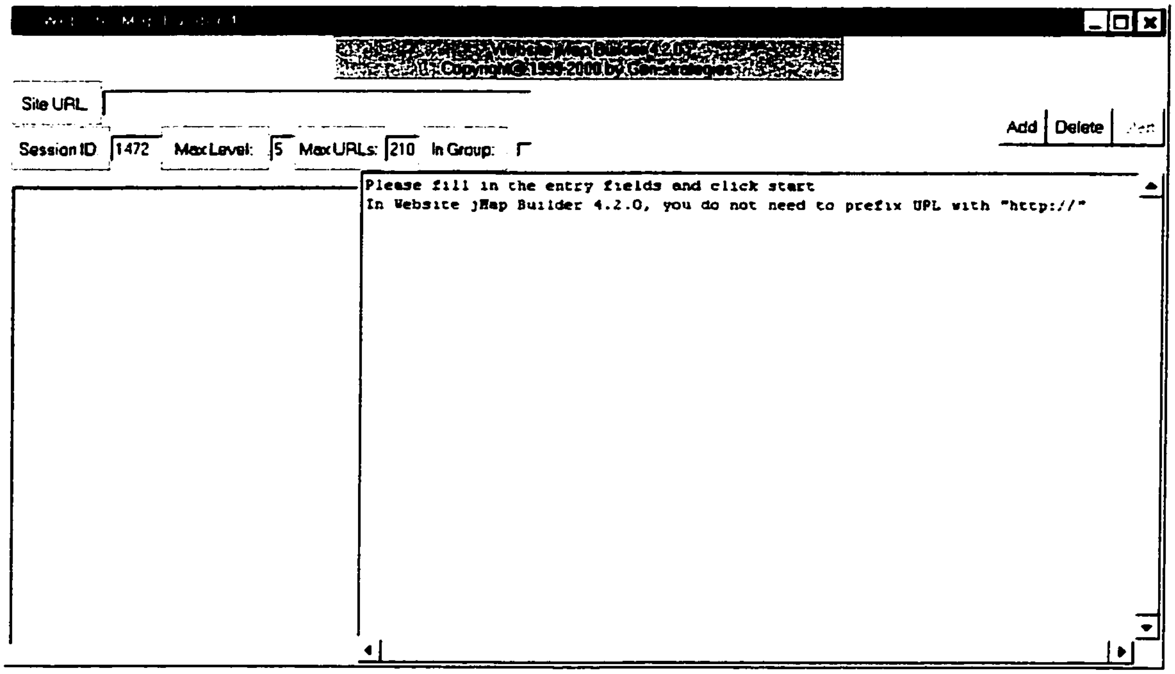
Web jMap Configurations

JMAP HOME Directory	D:\JMAPS\	
PERL Compiler Path	D:\perl\bin\	optional if already
This workbook Name	jMap.xls	

Please do not shift above cells

Figure 16 MS Excel Macros Interface Worksheet

2: Enter configuration information in the Cells B7:B9 or (R7C2 : R9C2). It is mandatory to enter $JMAP_HOME directory path (post-fixed with "\") to B7. TO start Website jMap Builder GUI. click "Run Website jMap GUI" button. A GUI looks like Figure 17 "Website jMap Builder" GUI should appear. If not. check the $JMAP_HOME is correct or not.


Website jMap Builder 4.2.0
Copyright@1999-2000 by Gen-strategies
Site URL
Add
Delete

Session ID 1472 Max Level: 5 Max URLs: 210 In Group: ☐

```
Please fill in the entry fields and click start
In Website jMap Builder 4.2.0, you do not need to prefix UPL with "http://"
```

Figure 17 "Website jMap Builder" GUI

3: Enter root URL of the websites. maximum level of the site to be explored. maximum number of URL to be retrieved. check the option to indicate this root to be in the cross-site mapping or not. click "Add" to add this root to the batch request. In case of error. click the entries in the list box. click "delete" to remove them.

4: Click "Start" button to process the request. now the GUI text area will display the processing information. The program can be stopped by clicking "Stop" button. After all processing is accomplished. the text area should have displayed the information and the "Stop" button should become "View Report" button. Click the "View Report" button. a summary report will be displayed on the text area.

5.3.2 Run Local Terminal Application on UNIX/Linux

To run "Website jMap Builder" On UNIX or Linux system, the Microsoft Excel GUI is not available on these systems. Instead of starting from Excel, goto $JMAP_HOME/bin directory, type "gui" or "jmap" at the command line. Then, follow the steps in Section 5.3.1 Run Local Terminal Application on a PC (step 3 and 4).

5.4 POP3 jMap Builder Server for Processing Mail Requests

5.4.1 Single Process Configuration

The following instructions are given for setting-up a POP3 server to process requests and email back jMaps to the users.

1: Open an email account on a mail server which supports POP3 protocol. Note down the server name, account name, and password.

2: Use a text edit to open $JMAP_HOME/conf/jMap.conf, and set your configurations. The following shows an example configuration. The "OS" is the operating system on which pop3svr.pl runs, not your POP3 mail server's OS. "Outgoing SMTP Server" is your default mail server to send emails which support SMTP. "Reply Email address" is your email address. "Request Subject" is a filter the pop3svr.pl program will look for requests. It is useful especially when this mail account is not just used for jMap requesting service.

```
#jMap.conf
#jMAP configurations, it must have spaces before and after "=" sign
#OS: UNIX or WIN32
OS = WIN32
```

```
#email host configuration.

Outgoing SMTP Server =  smpt.server.ip.or.name

Reply Email address = your.name@domain.ca



#JMAP POP3 Configuration

POP3 Server = mail.domain.com

POP3 User = xxxxx

POP3 Password = xxxxxx
Request Subject = Website jMap Building Request
```

3: Run pop3svr.pl from $JMAP_HOME/bin. Up to now, the server is up and running and ready to serve the requests.

5.4.2 Multiple Process Configuration

Multiple POP3 Servers can be run on different platform and different architecture. It is recommended to run multiple processes on a single server or different servers to suffice the service reliability and increase throughput.

1: To run multiple pop3svr.pl process on a single server environment, it is highly recommended to duplicate the $JMAP_HOME directory structure and run different processes from their own home directories to completely segregate the server processes. Currently, there is no synchronization mechanisms build-in the server process to control the accesses to the shared resources. It is likely to clash when running multiple processes from the same location. A recommended structure looks like this:

```
$JMAP_HOME/process1/
                    /bin
                    /conf
                    /jmaps
                    /tmp
$JMAP_HOME/process2/
                    /bin
                    /conf
                    /jmaps
                    /tmp
$JMAP_HOME/process3/
                    /bin
                    /conf
                    /jmaps
                    /tmp
$JMAP_HOME/lib/
$JMAP_HOME/docs/
```

2: To run multiple pop3svr.pl process on multiple server environment, it is also highly recommended to to run multiple processes on each server and all processes should be completely segregated as stated in previous configuration (1).

5.4.3 Process Configuration

The jMap Builder Mailer and Server does not work without specifying configurations in the $JMAP_HOME/conf/jMap.conf file. The file looks like the follows.

```
#jMAP configurations, it must have spaces before and after "=" sign
#OS: UNIX or WIN32
OS = WIN32
#email host configuration
Outgoing SMTP Server = smtp.xxx.ca
Reply Email address = your.email@address.ca

#JMAP POP3 Configuration
POP3 Server = xxx.ddd.200.20
POP3 User = pupeng
POP3 Password = xxxxxx
Request Subject = Website jMap
Polling Interval = 10 minutes
```

Outgoing SMTP server: the server you normally send out MIME type emails in your local LAN or dialup networks.

Reply Email address: The email address you want the user to know.

Pop3 Server: The server on which you have the email account setup for service. If DNS is not available on the network, an IP address is needed.

Pop3 User: your account name on the POP3 Server used for request service.

POP3 password: password to access this POP3 mail account.

Request Subject: a filter for the server program to select proper mail for parsing for request. This is useful for separating the request from your personal mails.

Polling Interval: the time interval between this server checks the POP3 emails. Depends on the traffic of the request and the number of processes. Reducing the interval allows the server to process more requests.

5.4.4 Sending Email to Request Website jMap Building Service

To request a service from the server. a user has to send an email to the designated address with the following:

1: With the configured key words in the subject line.

2: Commands in the text body using format:

http://your.domain.com <spaces or tab> max_level <spaces or tab> max_url <spaces or tab> jmap_style <spaces or tab> in_group

max_level: the maximum depth of BFS tree you want to explore this site.

Max_url: the maximum number of urls you want to retrieve and analysis.

jmap_style : 0 for no token string analysis, 1 for jMaps including Token analysis.

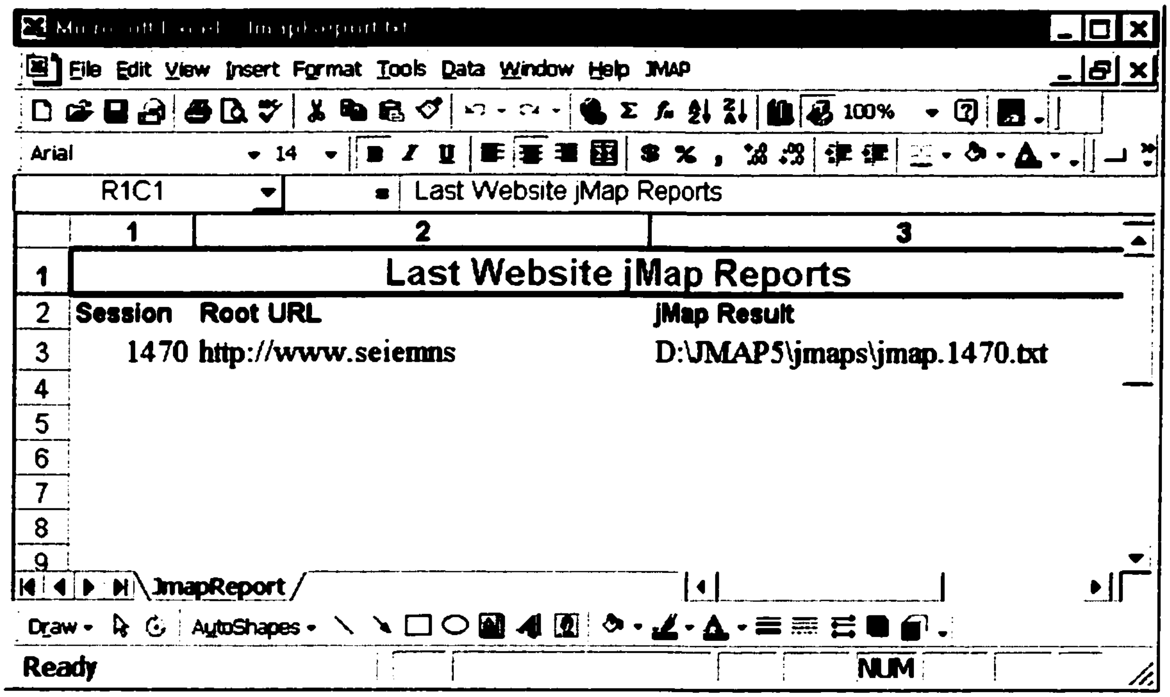
In_group: 0 for individual website analysis, 1 for cross-site jMapping.

3: Multiple command lines were allowed in the mail.

5.5 Load Web Site jMap Building Report

If the processing of website jMap was done on a UNIX/Linux server, the temporary jMap files and the JmapReport.txt should be transfer to a PC based system and the files should be saved in $JMAP_HOME/jmaps/ directory.

To load the JmapReport, simply click the "Open Last Report" button. The report should be shown in a separate sheet looking like Figure 18 Open Web Site jMap Building Report.



R1C1 | Last Website jMap Reports

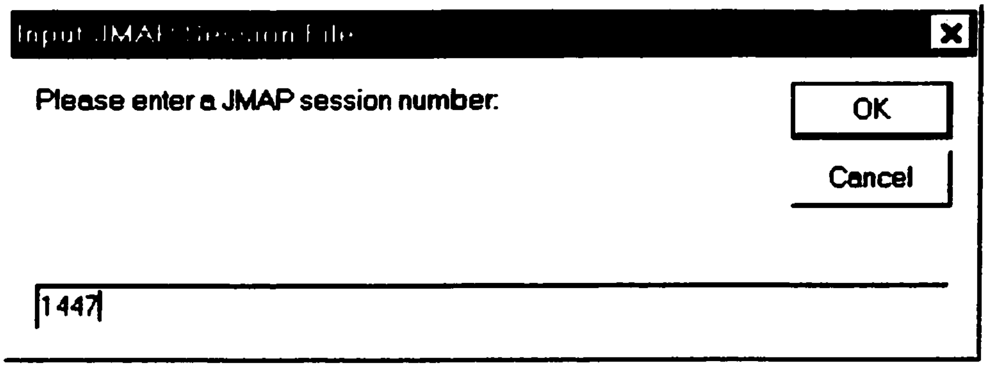
	1	2	3
1	Last Website jMap Reports		
2	Session	Root URL	jMap Result
3	1470	http://www.seiemns	D:\JMAP5\jmaps\jmap.1470.txt
4			
5			
6			
7			
8			
9			

Figure 18 Open Web Site jMap Building Report

5.6 Formatting Text jMap to Excel Spreadsheet

1: To format a text based jMap temporary file to Excel spreadsheet, all jMap files have to be moved to a PC and the jmap files in $JMAP_HOME/jmaps/ have to copied to $JMAP_HOME/jmaps/ in a PC installation.

2 Then, click the "Open jMAPs" button, input JMAP session File dialogue will be prompted: Figure 19 Enter Session Number to Open jMap.

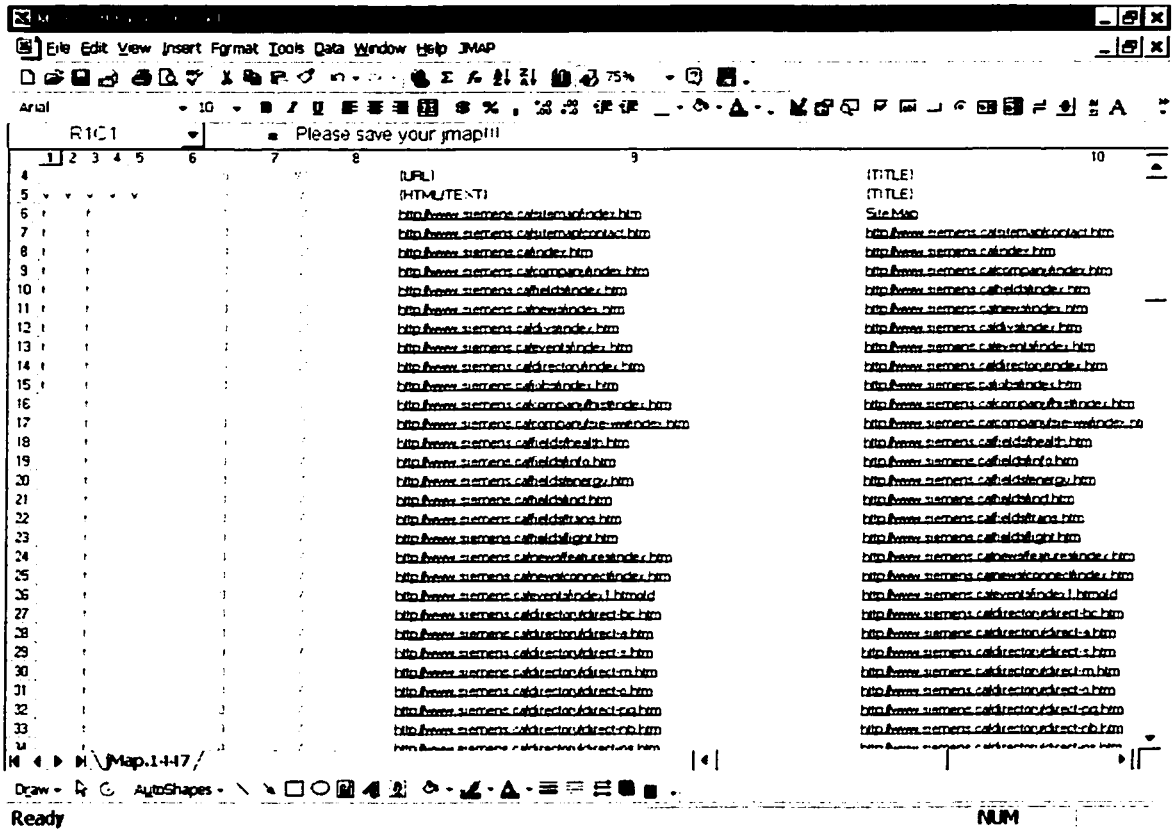


Please enter a JMAP session number:

1447

Figure 19 Enter Session Number to Open jMap

3 Enter the jMap session number. If it is a cross-site join mapping file, enter c+session number. Click "OK" button to load the jMap file and format it. The formatted result looks like Figure 20 Formatting jMap Results.



Please save your jmap!!!

	9	10
4	{URL}	{TITLE}
5	{HTML/TEXT}	{TITLE}
6	http://www.siemens.ca/sitemap/index.htm	Site Map
7	http://www.siemens.ca/sitemap/contact.htm	http://www.siemens.ca/sitemap/contact.htm
8	http://www.siemens.ca/index.htm	http://www.siemens.ca/index.htm
9	http://www.siemens.ca/company/index.htm	http://www.siemens.ca/company/index.htm
10	http://www.siemens.ca/fields/index.htm	http://www.siemens.ca/fields/index.htm
11	http://www.siemens.ca/news/index.htm	http://www.siemens.ca/news/index.htm
12	http://www.siemens.ca/divs/index.htm	http://www.siemens.ca/divs/index.htm
13	http://www.siemens.ca/events/index.htm	http://www.siemens.ca/events/index.htm
14	http://www.siemens.ca/directory/index.htm	http://www.siemens.ca/directory/index.htm
15	http://www.siemens.ca/jobs/index.htm	http://www.siemens.ca/jobs/index.htm
16	http://www.siemens.ca/company/history/index.htm	http://www.siemens.ca/company/history/index.htm
17	http://www.siemens.ca/company/[illegible]/index.htm	http://www.siemens.ca/company/[illegible]/index.ht
18	http://www.siemens.ca/fields/health.htm	http://www.siemens.ca/fields/health.htm
19	http://www.siemens.ca/fields/info.htm	http://www.siemens.ca/fields/info.htm
20	http://www.siemens.ca/fields/energy.htm	http://www.siemens.ca/fields/energy.htm
21	http://www.siemens.ca/fields/ind.htm	http://www.siemens.ca/fields/ind.htm
22	http://www.siemens.ca/fields/trans.htm	http://www.siemens.ca/fields/trans.htm
23	http://www.siemens.ca/fields/light.htm	http://www.siemens.ca/fields/light.htm
24	http://www.siemens.ca/news/features/index.htm	http://www.siemens.ca/news/features/index.htm
25	http://www.siemens.ca/news/connect/index.htm	http://www.siemens.ca/news/connect/index.htm
26	http://www.siemens.ca/events/index1.htmold	http://www.siemens.ca/events/index1.htmold
27	http://www.siemens.ca/directory/direct-bc.htm	http://www.siemens.ca/directory/direct-bc.htm
28	http://www.siemens.ca/directory/direct-a.htm	http://www.siemens.ca/directory/direct-a.htm
29	http://www.siemens.ca/directory/direct-s.htm	http://www.siemens.ca/directory/direct-s.htm
30	http://www.siemens.ca/directory/direct-m.htm	http://www.siemens.ca/directory/direct-m.htm
31	http://www.siemens.ca/directory/direct-o.htm	http://www.siemens.ca/directory/direct-o.htm
32	http://www.siemens.ca/directory/direct-pq.htm	http://www.siemens.ca/directory/direct-pq.htm
33	http://www.siemens.ca/directory/direct-nb.htm	http://www.siemens.ca/directory/direct-nb.htm

Figure 20 Formatting jMap Results

5.7 Web Mining Process with Context+ Utilities

The formatted jMaps can be easily processed by Excel Macros developed previously as "Context+". The use of these programs is beyond the scope of this report.

6. Conclusion And Future Work

6.1 Summary and Conclusions

In brief, we summarize the following as the work carried out in this project:

1) A BFS based main thrust program was developed to automatically retrieve and analyze a web site's contents and structure information.
2) Web page organization in a website was viewed as a hierarchy graph, and BFS algorithm was used for discovering pages in the site.
3) A website jMap generic template was developed and implemented in the software.
4) jMap representation of a website contents are achieved by the developed software and shown to be well suited for web mining. *jMaps* syntax is simple and robust. All discovered contents by the program was transformed to modular, possible jMap notation. And the main jMap result can be readily formatted to processable jMaps. jMap notation accommodated all retrieved information.
5) A GUI for local terminal application was developed and tested.
6) A POP3 server for mail request service for website jMap building was developed.
7) The formatted jMaps can be processed by any standard *jMap* utilities such as "Context+".

We conclude that jmaps provide a viable alternative to the design and analysis of web-based information.

6.2 Future Works

This project can be extended in the following ways:

1) A web CGI GUI for the main thrust program.
2) Some algorithms for sorting and searching can be improved to boost performance.
3) To evaluate and improve the usability of GUI is yet another work needs to be done.
4) To increase the current program's capability to process pages containing FRAMESET, .JavaScripts and ASP scripts.

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Appendix A: Source Code

The program was coded in *VBA* and PERL, the project consists of three parts:

- Excel Macros
- Main thrust PERL program.
- Server Program to process POP3 mail request.

A-1 Excel Macros

A-1.1 Global Variable

```
' Global variable declaration
Dim JmapHomeDir As String 'JMAP HOME
Dim JmapManualSheetName As String '
Dim JmapFileDir As String 'JMAP Txt file DIR
Dim JmapBinDir As String    'JMAP binary DIR
Dim JmapTxtDir As String    'JMAP temporary txt file dir
```

A-1.2 Sub initEnv()

```
Option Explicit
Sub InitEnv()
Sheets("WebjMap").Select
JmapHomeDir = Range("B7").Value

If (JmapHomeDir = "") Then
JmapHomeDir = "d:\jmap5\bin\"  'default
End If

JmapFileDir = JmapHomeDir + "conf\"
JmapBinDir = JmapHomeDir + "bin\"
JmapTxtDir = JmapHomeDir + "jmaps\"
End Sub
```

A-1.3 Sub RunPerl()

```
Sub RunPerl()
Dim GuiBatchFile As String
Workbooks("jMap.xls").Activate
InitEnv
ChDir (JmapBinDir)
GuiBatchFile = JmapBinDir + "gui.bat"
ActiveSheet.Select
```

```
Dim dummy As Double
dummy = Shell(GuiBatchFile, vbHide)
End Sub
```

A-1.4 Sub OpenJmapReport()

```
Sub OpenJmapReport()
'
' OpenJmapReport Macro
' Macro recorded 2/11/2002 by Philip Peng
'
    InitEnv
    Workbooks.OpenText Filename:=JmapTxtDir + "JmapReport.txt", Origin:= _
        xlWindows, StartRow:=1, DataType:=xlDelimited, TextQualifier:= _
        xlDoubleQuote, ConsecutiveDelimiter:=False, Tab:=True, Semicolon:=False, _
        Comma:=False, Space:=False, Other:=False, FieldInfo:=Array(Array(1, 1), _
        Array(2, 1), Array(3, 1))
          Rows("1:1").Select
    Selection.Insert Shift:=xlDown
    Columns("A:A").ColumnWidth = 8
    Columns("B:B").Select
    Selection.ColumnWidth = 30.89
    Columns("C:C").Select
    Selection.ColumnWidth = 35.44
    Rows("1:1").Select
    Selection.Insert Shift:=xlDown
    Range("B1").Select
    ActiveCell.FormulaR1C1 = "Last Website jMap Reports"
    Range("A1:C1").Select
    With Selection
        .HorizontalAlignment = xlCenter
        .VerticalAlignment = xlBottom
        .WrapText = False
        .Orientation = 0
        .AddIndent = False
        .ShrinkToFit = False
        .MergeCells = False
    End With
    Selection.Merge
    With Selection.Font
        .Name = "Arial"
        .Size = 14
        .Strikethrough = False
        .Superscript = False
        .Subscript = False
        .OutlineFont = False
        .Shadow = False
        .Underline = xlUnderlineStyleNone
        .ColorIndex = xlAutomatic
    End With
    Selection.Font.Bold = True
    Selection.Font.ColorIndex = 41
    Range("A2").Select
    ActiveCell.FormulaR1C1 = "Session"
    Range("B2").Select
    ActiveCell.FormulaR1C1 = "Root URL"
    Range("C2").Select
    ActiveCell.FormulaR1C1 = "jMap Result"
    Range("A2:C2").Select
    Selection.Font.ColorIndex = 51
    Selection.Font.Bold = True
    Selection.Font.ColorIndex = 0
    Range("A3:C3").Select
    With Selection.Font
        .Name = "Arial"
        .Size = 12
        .Strikethrough = False
        .Superscript = False
        .Subscript = False
        .OutlineFont = False
        .Shadow = False
        .Underline = xlUnderlineStyleNone
        .ColorIndex = xlAutomatic
    End With
    With Selection.Font
        .Name = "Times New Roman"
        .Size = 12
        .Strikethrough = False
        .Superscript = False
        .Subscript = False
        .OutlineFont = False
        .Shadow = False
        .Underline = xlUnderlineStyleNone
        .ColorIndex = xlAutomatic
    End With
    Range("A1").Select
End Sub
```

A-1.5 Sub OpenJmap()

```
Sub OpenJmap()
'
' OpenJmap1 Macro
' Macro recorded 11/27/99 by Richard Peng
'   ChDir "C:\WINDOWS\TEMP"
    Dim JmapFile As String
    Dim JmapSession As String
    Dim WorkBookName As String
    Dim Prompt, Title As String
    Dim JmapSheetName As String
    Dim Message, boxTitle, Default As String

    InitEnv 'get configurations from the webjMap page

    Message = "Please enter a JMAP session number:"    ' Set prompt.
    boxTitle = "Input JMAP Session File"    ' Set title.
    Default = "1000"    ' Set default.
' Display message, title, and default value.
```

```
   JmapSession = InputBox(Message, boxTitle, Default)

' Use Helpfile and context. The Help button is added automatically.
'  MyValue = InputBox(Message, Title, , , , "DEMO.HLP", 10)

' Display dialog box at position 100, 100.
' MyValue = InputBox(Message, Title, Default, 100, 100)

   JmapFile = "jmap." + JmapSession + ".txt"
   JmapSheetName = "jmap." + JmapSession

   Application.ScreenUpdating = False
   'setup R1C1 reference style
   With Application
      .ReferenceStyle = xlA1
      'xlR1C1
      .UserName = "Philip Peng"
      .StandardFont = "Arial"
      .StandardFontSize = "10"
      .DefaultFilePath = JmapTxtDir
      .EnableSound = False
      .RollZoom = False
   End With

   WorkBookName = Range("B9") '"jMap.xls"
   If WorkBookName = "" Then
   WorkBookName = "jMap.xls"
   End If



'the following code will open the tempory file and move it to a new sheet
   Workbooks.OpenText Filename:=(JmapTxtDir + JmapFile), Origin:= _
      xlWindows, StartRow:=1, DataType:=xlDelimited, TextQualifier:= _
      xlDoubleQuote, ConsecutiveDelimiter:=False, Tab:=True, Semicolon:=False, _
      Comma:=False, Space:=False, Other:=False, FieldInfo:=Array(Array(1, 1))

   Windows(JmapFile).Activate
   Sheets(JmapSheetName).Select
   Application.StatusBar = True

' copy loaded data and copy and paste to sheet2, rename to jMap
   Cells.Select
   Selection.Copy

' starting format jMap
'  Format_jMap
'  move jmap.tmp to c458.xls
   Windows(JmapFile).Activate
   Sheets(JmapSheetName).Select
   Sheets(JmapSheetName).Move After:=Workbooks(WorkBookName).Sheets(1)
   Sheets(JmapSheetName).Select
   Sheets(JmapSheetName).Name = "jMap"
   Cells.Select
   Selection.ColumnWidth = 2
   ActiveWindow.Zoom = 75
```

```
    With ActiveSheet.Outline
        .AutomaticStyles = False
        .SummaryRow = xlAbove
        .SummaryColumn = xlLeft
    End With
    Range("A1").Select

' hyperLink Macro
' Macro recorded 03/23/2000 by Philip Peng
'

Dim numJfile As Integer
Dim numLevel As Integer
Dim numURL As Integer
Dim numHtml As Integer
Dim numOther As Integer
Dim numQuery As Integer
Dim numImage As Integer
Dim numMailto As Integer
Dim numFTP As Integer
Dim numTitle As Integer
Dim numSize As Integer
Dim numLinkOut As Integer
Dim numLinkImg As Integer
Dim numToken As Integer
Dim numSkipRow As Integer

Dim link As String
Dim i As Integer
Dim StartRow As Integer
Dim StartCol As Integer
Dim StopRow As Integer


    Worksheets("jMap").Activate

    numJfile = Range("B1").Value
    numLevel = Range("D1").Value
    numURL = Range("F1").Value
    numHtml = Range("H1").Value
    numOther = Range("J1").Value
    numQuery = Range("L1").Value
    numImage = Range("N1").Value
    numMailto = Range("P1").Value
    numFTP = Range("R1").Value
    numTitle = Range("T1").Value
    numToken = Range("V1").Value

    numSize = 2
    numLinkOut = 2
    numLinkImg = 2
    numSkipRow = 10

    StartRow = 3 + numLevel
```

```
  StopRow = StartRow + numURL + numTitle + numToken + numSkipRow + 6 'numHtml asked to
hyperlink all
  StartCol = numJfile + 3
  Application.StatusBar = "Formatting JMAP ....."

  'format url column width and fonts
  Range("A1").Offset(1, StartCol).Select
  Selection.ColumnWidth = 60

  'format title column width
  Range("A1").Offset(1, StartCol + 1).Select
  Selection.ColumnWidth = 60


  'distingsh values column
  Range("A1").Offset(1, StartCol - 1).Select
  Selection.ColumnWidth = 10
  ActiveCell.EntireColumn.Select

  Application.CutCopyMode = False
  With Selection.Font
      .Name = "Arial"
      .FontStyle = "Bold"
      .Size = 10
      .Strikethrough = False
      .Superscript = False
      .Subscript = False
      .OutlineFont = False
      .Shadow = False
      .Underline = xlUnderlineStyleNone
      .ColorIndex = 40
  End With
  With Selection.Interior
      .ColorIndex = 35
      .Pattern = xlSolid
      .PatternColorIndex = xlAutomatic
  End With


  'link in column
  Range("A1").Offset(1, StartCol - 2).Select
  Selection.ColumnWidth = 10

  ActiveCell.EntireColumn.Select

  Application.CutCopyMode = False
  With Selection.Font
      .Name = "Arial"
      .FontStyle = "Bold Italic"
      .Size = 10
      .Strikethrough = False
      .Superscript = False
      .Subscript = False
      .OutlineFont = False
      .Shadow = False
      .Underline = xlUnderlineStyleNone
      .ColorIndex = 46
   End With
   With Selection.Interior
      .ColorIndex = 35
      .Pattern = xlSolid
      .PatternColorIndex = xlAutomatic
   End With


   'objects number column

   Range("A1").Offset(1, StartCol - 3).Select
   Selection.ColumnWidth = 10

   ActiveCell.EntireColumn.Select

   Application.CutCopyMode = False
   With Selection.Font
      .Name = "Arial"
      .FontStyle = "Bold"
      .Size = 10
      .Strikethrough = False
      .Superscript = False
      .Subscript = False
      .OutlineFont = False
      .Shadow = False
      .Underline = xlUnderlineStyleNone
      .ColorIndex = 46
   End With
   With Selection.Interior
      .ColorIndex = 35
      .Pattern = xlSolid
      .PatternColorIndex = xlAutomatic
   End With

   'make clear to read by dim skip points
   Dim HTML_Header_SKIP_ROW As Integer
   Dim OTHER_Header_SKIP_ROW As Integer
   Dim QUERY_Header_SKIP_ROW As Integer
   Dim IMAGE_Header_SKIP_ROW As Integer
   Dim MAILTO_Header_SKIP_ROW As Integer
   Dim TITLE_Header_SKIP_ROW As Integer
   Dim FTP_Header_SKIP_ROW As Integer
   Dim TOKEN_Header_SKIP_ROW As Integer

   'calculate the skip point or range
   HTML_Header_SKIP_ROW = StartRow + numHtml
   OTHER_Header_SKIP_ROW = StartRow + numHtml + numOther + 1
   QUERY_Header_SKIP_ROW = StartRow + numHtml + numOther + numQuery + 2
   IMAGE_Header_SKIP_ROW = StartRow + numHtml + numOther + numQuery + numImage + 3
   MAILTO_Header_SKIP_ROW = StartRow + numHtml + numOther + numQuery + numImage +
numMailto + 4
   TITLE_Header_SKIP_ROW = StartRow + numHtml + numOther + numQuery + numImage +
numMailto + numFTP + 5
   FTP_Header_SKIP_ROW = StartRow + numHtml + numOther + numQuery + numImage + numMailto
+ numFTP + numTitle + 6
```

```
  TOKEN_Header_SKIP_ROW = StartRow + numHtml + numOther + numQuery + numImage +
numMailto + numFTP + numTitle + numSkipRow + 6


  'hyperlinking for url and title
  Application.StatusBar = "Setup hypelinks for HTML Pages"
  For i = StartRow To StopRow Step 1
    If i = StartRow + numHtml _
    Or i = StartRow + numHtml + numOther + 1 _
    Or i = StartRow + numHtml + numOther + numQuery + 2 _
    Or i = StartRow + numHtml + numOther + numQuery + numImage + 3 _
    Or i = StartRow + numHtml + numOther + numQuery + numImage + numMailto + 4 _
    Or i = StartRow + numHtml + numOther + numQuery + numImage + numMailto + numFTP + 5 _
    Or i = StartRow + numHtml + numOther + numQuery + numImage + numMailto + numFTP +
numTitle + 6 _
    Or (i > StartRow + numHtml + numOther + numQuery + numImage + numMailto + numFTP +
numTitle + 6 _
      And i <= StartRow + numHtml + numOther + numQuery + numImage + numMailto + numFTP +
numTitle + numSkipRow + 6) _
    Then
      Application.StatusBar = "Skipping the header lines ...."

  Else

    Range("A1").Offset(i, StartCol).Select
    link = ActiveCell.Value
    ActiveSheet.Hyperlinks.Add Anchor:=Selection, Address:=link
   'title link
    Range("A1").Offset(i, StartCol + 1).Select
   ' If ActiveCell.Value = "" Then
   '  Else
    ActiveSheet.Hyperlinks.Add Anchor:=Selection, Address:=link
   ' End If
  'token tilte hyper link
    If (i > TOKEN_Header_SKIP_ROW) Then
      Range("A1").Offset(i, StartCol + 2).Select
      If ActiveCell.Value = "" Then
      Else
      ActiveSheet.Hyperlinks.Add Anchor:=Selection, Address:=link
      End If
    End If
  End If
  Next i

 ' Selection.Delete Shift:=xlUp
  Application.StatusBar = False
  Application.ScreenUpdating = True
  Range("A1").Select
  'setup R1C1 reference style

  With Application
    .ReferenceStyle = xlR1C1
    'xlR1C1
    .UserName = "Philip Peng"
    .StandardFont = "Arial"
    .StandardFontSize = "10"
```

```
        .DefaultFilePath = JmapTxtDir
        .EnableSound = False
        .RollZoom = False
    End With

    Cells.Select
    'Workbooks.Add
    Windows("jMap.xls").Activate
    Sheets("jMap").Move
'    Sheets("JmapReport").Select
    Sheets("jMap").Name = "jMap." + JmapSession
    Range("A1").Select
    ActiveCell.FormulaR1C1 = "Please save your jmap!!!"
    Range("A1").Select
    'Windows("jMap.XLS").Close
End Sub
```

A-2 JMAP Main Thrust Source Code

A-2.1 JFILE.pm

```
#@# JFILE.pm
package JFILE;

$debug = 0;

sub new {
# input url
  my      $r_self        = $_[0];
  my      $url           = $_[1];
  my      $level         = $_[2];
  my      $title         = $_[3];
  my      $size          = $_[4];
  my      $links_in      = $_[5];    # of internal bookmarks
  my      $links_out     = $_[6];
  my      $links_img     = $_[7];
  my      $response_code = $_[8];       # broken or suspended, timeout
  my      $lks           = $_[9];       # array reference
  my      $tokens        = $_[10];      #array reference
  my      $response_time;      #can compute the transfer rate
  my      $content_type;
  my      $last_modified=0;

          $r_self = {
                    "URL"           => $url,
                    "LEVEL"         => $level,
                    "TITLE"         => $title,
                    "SIZE"          => $size,
                    "BOOKMARK"      => $links_in,
                    "LINKOUT"       => $links_out,
                    "LINKIMG"       => $links_img,
                    "LINKS"         => $lks,
                    "RS_CODE"       => $response_code,
                    "RS_TIME"       => $response_time,
                    "LAST_MODIFIED" => $last_modified,
                    "TOKENS"        => $tokens
                    };

  bless ( $r_self, "JFILE");
  return $r_self;

}

sub set_val {
# input set type, value
    my ($obj, $attr, $vals) = @_;

    $obj -> {$attr} = $vals;
#    if ($attr eq "LINKS")
#    {
#      $obj -> {$attr} = $vals;
#      }
#    else
#    {
#         $obj -> {$attr} = $vals;
#      }
}

#sort the links for better bin_search()
sub sort_links
{

#  my $debug =1;
  my $obj = shift();
  my @temp = sort @{$obj->get_val("LINKS")};
  $obj -> set_val("LINKS", \@temp);
  if ($debug) {

      print "This is the sorted JFILE links \n\n";
      print join("\n", @temp);
#     <STDIN>;
      }
}

sub sort_token
{
  my $obj = shift();
  my @result = ();
  my @temp = sort @{$obj->get_val("TOKENS")};

  my $tkn = pop(@temp);
  my $counter =1;
  my $processed =0;
  my $num_tks = scalar(@temp);
  while (defined($next_tkn = pop(@temp)) && $processed < $num_tks)
  {
    if ($next_tkn eq $tkn)
    {
      $counter++;
      $processed++;
    }
    else
    {
     $tkn = $counter."\t\tl\t".$tkn."\n";
     push(@result, $tkn);
     $tkn = $next_tkn;
     $counter = 1;
    }
  }
  $obj -> set_val("TOKENS", \@result);
#  print STDERR join("\n", @result);
}

#sub is_linked {
# my ($obj, $lk_url) = @_;
# my    $miss1 = $lk_url."/";
# my @lks = split(/ /, $obj->get_val('LINKS'));
# foreach $lk (@lks)
# {
#        my $miss2 = $lk."/";
#        if ($lk eq $lk_url)
##        || ($lk eq $miss1) || ($lk_url eq $miss2))
#        {
#           return 1;
#        }
# }
# return 0;
#}


sub is_linked {
#binary search an index from an array of string
#input: a string, a sorted array
#return $index or -1 for not found
#my $debug=1;
my $obj = shift();  #JFILE object
my $str = shift();  #a URL
my @sortedArray = @{$obj->get_val("LINKS")};

if ($debug) {print "bin search ......\n";}
my $top = scalar(@sortedArray)-1;  #top index
my $btm = 0;  #bottom index
my $mid = undef; #mid index
if ($debug) {print "my top = $top; \n";}
#<STDIN>;
while($top >= $btm) {
      $mid = int(($top + $btm)/2);
#     if ($debug) {
#           print "****BIN_SEARCH:\n\tmidIndex = $mid \t
mid=$sortedArray[$mid]\n";
#           print"\ttopIndex=$top \t top=$sortedArray[$top]\n";
#           print "\tbtmIndex=$btm \t btm=$FmEventIDList[$btm]\n";
#           <STDIN>;
#     }
      if (($sortedArray[$mid] eq $str)||
          ($sortedArray[$top] eq $str) ||
          ($sortedArray[$btm] eq $str)
          )
      {
            if ($debug) {
                  print "****BIN_SEARCH:found link!!!\n";
#                 <STDIN>;
            }
            return 1;
      }

      if ($sortedArray[$mid] le $str) {
            $btm = $mid+1;
      }else {
            $top = $mid-1;
      }
    } #end while
      return 0; # No match found

}

sub get_TokenFoundCnt{
my $debug =0;
  my ($obj, $tk_str) = @_;
  my @tokens = @{$obj->get_val("TOKENS")};
  my $found =0;
  my $num_tokens = scalar(@tokens);
  for ($i=0; $i< $num_tokens; $i++)
    {
      if ( $tokens[$i] eq $tk_str)
      {
        $found++;
      }
    }
if ($debug) { print STDERR "\nFound $found tokens\n";}
  return $found;  # return the number of token found in this page
}

sub get_val {
#input type
    my ($obj, $attr) = @_;
    return $obj -> {$attr};
}

1;
```

A-2.2 JMAP.pm

```
#@# JMAP.pm
require 'JFILE.pm';
require 5.004;
package JMAP;

=head1 COPYRIGHT

 COPYRIGHT(R)  Philip PENG, 1999-2004, peng_philip@hotmail.com
 version 3.1.2
```

```
=cut

$VERSION = "3.1.2";

=head1 VERSION HISTROY

=over 4

=item
1.0.2    abstract method to fit all jmapping

=item
1.0.1    working version but too much repeation of code

=item
1.0.0    start constructing, building common method

=back


=cut

=head1  CLASS DESCRIPTION

###############################################################
THIS MODULE provides basic functions for jmap processing

   Attributes

       %TYPES{`$type'} = $extensions
       @URL_Queue

       @Concept_Views
       @obj_files : save the object in an array, index is $seq
       %Header_Symbols{$concept} = $symbols

       @levels, contains # of url in the level

   Methods

       new()        constructor
       print_report()
       sequence_jfile
       get_dist_vals($attr, $datatype)
           jmap_header($concept, $symbol)
           jmap_level()
           jmap_url
           jmap_title
           jmap_size
           jmap_rs_code
           jmap_lk_cnt  :  links in, links out, img links
             jmap_dir_tree();

##################################################################

=cut
```

```
use JFILE;

#global constant declaration
my $debug = 0;


sub new {
# initialize the JMAP defaults
    my    $r_jmap        = $_[0] ;
    my    $r_jfiles      = $_[1] ;
    my    $max_level     = $_[2] ;
    my    $r_types       = $_[3] ;
    my    $r_headers     = $_[4] ;
    my    $r_links       = $_[5];    # sorted links set by order_url()
    my    $log           = $_[6];    # log file name ; added for
monitoring activities
    my    $cnt_title = 0;
#     my $num_jfs = scalar(@{$r_jfiles});
#     if (!defined($num_jfs)) { $num_jfs =0;};
#                 "NUM_JFILE"     =>  $num_jfs
    if ($log eq "")
      {
      $log = "jmap.log";
      }
    my @URL_CNT ; # remember counters for each type of URL
    # 0 -- HTML, 1 -- OTHER,  2-- QUERY,  3-- IMG , 4 -- MAILTO, 5 --
FTP

     $r_jmap = {
            "JFILES"       =>  $r_jfiles,
            "MAX_LEV"      =>  $max_level,
            "TYPES"        =>  $r_types,
            "HEADERS"      =>  $r_headers,
            "URL_CNT"      =>  \@URL_CNT,
                "TITLE_CNT"    =>  $cnt_title,
            "LINKS"        =>  $r_links,
            "LOGFILE"      =>  $log
            };

    bless ($r_jmap, 'JMAP');
    return $r_jmap;
}

sub limit_jfile {
# in case of too many jfiles, we eliminate the outside links or links
# without properties
    my $jmp = shift();
    my @jfiles = @{$jmp->get_val('JFILES')};
    my $rs_code;
    my @result=();

    foreach $jf (@jfiles)
    {
       $rs_code = $jf->get_val('RS_CODE');

       if (!defined($rs_code))
       {
         next;
       }
       else
       {
         push(@result, $jf);
       }
    }
    $jmp ->set_val("JFILES", \@result);

}

sub order_url {
# adjust jfile in certain order such as html, cgi, jpg, jepg, gif, ftp,
mail, other

  my ($jmp, @urls) = @_;

  my %type = %{$jmp -> get_val('TYPES')};    # get types from jmp object
  my $url = "";
  my @mailto=();
  my @imgs=();
  my @query=();
  my @htmls=();
  my @others=();
  my @ftps = ();
  my @result =();
  my $debug = 0;

  if ($debug)
  {
     print "\nOrdering urls: jfiles ", scalar(@jfiles);
     print "\nTypes: ", join("!", %type);
  }

# classify url

  foreach $url (@urls)
  {

    if ( $url =~ m!$type{'MAILTO'}!i )
    {
       push(@mailto, $url);
       if ($debug) { print "---->This is a mail link.\n";}
    }
    elsif ( $url =~ m!$type{'FTP'}!i)
    {
       push(@ftps, $url);
       if ($debug) { print "---->This is a ftp link.\n";}
    }
    elsif ( $url =~ m!$type{'IMG'}!i)
    {
       push(@imgs, $url);
       if ($debug) { print "---->This is a image link.\n";}
    }
#    elsif ($url =~ m!$type{'QUERY'}!)  # fuck, I don't know why it does
not work
```

```
    elsif( $url =~ m![\?\&\%\+]|\.asp|\.as|\.cgi|\.exe|\.pl|\/cgi-
bin\/|\.dll! )
    {
      push(@query, $url);
      if ($debug) { print "---->This is a query link.\n";}
    }
    elsif ($url =~ m!$type{'HTML'}!i)
    {
      push(@htmls, $url);
      if ($debug) { print "---->This is a html link.\n";}
    }
    else
    {
      push(@others, $url);
      if ($debug) { print "---->This is a other type link.\n";}
    }

#    if ($debug)  {  <STDIN>; }

  } # end foreach

#make new url list and remember the counters
    my @COUNTER;
    push(@result, @htmls);
    $COUNTER[0] = scalar(@htmls);

    push(@result, @others);
    $COUNTER[1] = scalar(@others);

    push(@result, @query);
    $COUNTER[2] = scalar(@query);

    push(@result, @imgs);
    $COUNTER[3] = scalar(@imgs);

    push(@result, @mailto);
    $COUNTER[4] = scalar(@mailto);

    push(@result, @ftps);
    $COUNTER[5] = scalar(@ftps);

#    my  %cnt = %{$jmp -> get_val('URL_CNT')};
#     $cnt{'HTML'}    = scalar(@htmls);
#     $cnt{'QUERY'}   = scalar(@query);
#     $cnt{'MAILTO'}  = scalar(@mailto);
#     $cnt{'OTHER'}   = scalar(@others);
#     $cnt{'FTP'}     = scalar(@ftps);
#        $cnt{'IMG'}     = scalar(@imgs);
#     $jmp -> set_val('URL_CNT', \%cnt);  # reset the values

 # added for processing categorized urls sub sections
        $jmp -> set_val("URL_CNT", \@COUNTER);
        $jmp -> set_val("LINKS", \@result);
         return (@result);

}       # end sub
```

```
sub get_dist_vals {
# process all distinct values from jfile objects
# return a list with distinct values;
#datatype must be "numeric" or "string", this is optional
my $debug =0;
    my ($obj, $view, $datatype) = @_;
    my $temp = "";
    my $temp1="";
    my $temp2="";
    my @flist =();
    my @result =();


  if ($debug)
  { print STDERR "\n--->get_dist_val is processing distinct $view
values.\n";}

  if (($view eq "URL") || ($view eq "TITLE")|| ($view eq "TOKENS"))
  {
      $datatype = "string";
  }
  else
  {
      $datatype = "numeric";
  }


   my @jfs = @{$obj-> get_val('JFILES')};

   my $num_jfs = scalar(@jfs);

    foreach $obf (@jfs)      # get values
    {
       $temp = $obf -> get_val($view);

       if (defined($temp))
       {
       #here is modified to accommodate token processing
       if ($view eq "TOKENS")
         {
           push(@result, @{$temp}); #token is an array reference
         }
       else  # single values
         {
           push(@result, $temp);   # push file's properties into arrays
         }
       }
    }

    if ($debug) {
        print STDERR "----> just looped all values.....\n";
#        <STDIN>;
        print STDERR "---> start sorting the $view value.....\n";
        }

# sorting arrays and eliminate duplicates
```

```
    if ($datatype eq "numeric" )
    {
      @result = sort {$a<=>$b}(@result);
      if ($debug) { print STDERR "\n-----> finished sorting $view
numbers ...\n";}
    }
    elsif ($datatype eq 'string')                           # default to
alphabetic order
    {
      @result = sort (@result);    # there will be problems for urls
here ?
      if ($debug) { print STDERR "\n======>>>>>finished sorting $view
strings ...\n";}
    }

      $templ = shift(@result);

# there is an infinite loop here!!!!!!
        my $processed =0;
my $max_limit = scalar(@result);
        while (defined($templ)
             && $processed < $max_limit) #$num_jfs)    # process
distinct list
      {
            $processed++;
            $temp2 = shift(@result);
            if ($debug)
            {
                print STDERR "--->start making unique value  ===\n";
                print STDERR "====> templ: $templ;  temp2:  $temp2; \n";
            }
          if (!($obj -> is_equal($datatype, $templ, $temp2)))
          {
            push(@flist, $templ);
            $templ = $temp2;
          }
      }  # end while for both datatype


    if ($view eq "URL")
    {
      @flist = $obj -> order_url(@flist);
    }
    if ($debug)
    {
        print STDERR "\n==== finished processing dist vals.\n";
        print  STDERR "\nList is: ", join("|", @flist);
#        <STDIN>;
    }
    if (($view eq "URL") || ($view eq "TITLE"))
  {
      $obj -> set_val("TITLE_CNT",  scalar(@flist));
  }
    return @flist;
}
```

```
sub set_val {
    my ($jmp, $attr, $val) = @_;
    $jmp -> {$attr} = $val;
}


sub get_val {
    my ($obj, $concept) = @_;
    return ($obj->{$concept});
}

sub jmap_header {
# type:  concept view type, level: main veiw (0) or subtype, (1)
# num_dist: number of distinct values in the list
# return a row of string symbols

  my ($jmp, $concept, $num_hits_t, $num_dist, $num_hits_f ) = @_;

  if ($debug)
  {
  print "\nJmap header:  obtained. $concept, $num_hits, $num_dist, \n";
  }
  my $num_jf = scalar(@{$jmp -> get_val ('JFILES')});
  if ($concept eq "0") { $symb_concept = "HTML";}
  if ($concept eq "1") { $symb_concept = "OTHER";}
  if ($concept eq "2") { $symb_concept = "QUERY";}
  if ($concept eq "3") { $symb_concept = "IMG";}
  if ($concept eq "4") { $symb_concept = "MAILTO";}
  if ($concept eq "5") { $symb_concept = "FTP";}

  my $symb = ${$jmp -> get_val ('HEADERS')}{$symb_concept};
  my $header ="";

  for ($i=0; $i < $num_jf; $i++)
  {
   $header = $header."$symb\t";
  }
  if ($concept eq "URL")
  {
     $header .=
"$num_hits_f\t$num_hits_t\t$num_dist\t\{".$concept."\}\t\{TITLE\}\n";
  }
  elsif ($concept eq "0") # HTML
  {
     $header .=
"$num_hits_f\t$num_hits_t\t$num_dist\t\{HTML\/TEXT\}\t\{TITLE\}\t\{SIZE\
}\n";
  }
  elsif ($concept eq "1") # OTHER
  {
     $header .= "$num_hits_f\t$num_hits_t\t$num_dist\t\{OTHER
TYPES\}\t\{TITLE\}\t\{SIZE\}\n";
  }
  elsif ($concept eq "2") # QUERY
  {
     $header .=
"$num_hits_f\t$num_hits_t\t$num_dist\t\{QUERY\}\t\{TITLE\}\t\{SIZE\}\n";
```

```
  }
  elsif ($concept eq "3") # IMAGE
  {
     $header .= "$num_hits_f\t$num_hits_t\t$num_dist\t\{IMAGE
TYPES\}\t\t\{SIZE\}\n";
  }
  elsif ($concept eq "4") # MAILTO
  {
     $header .=
"$num_hits_f\t$num_hits_t\t$num_dist\t\{MAILTO\}\t\t\{SIZE\}\n";
  }
  elsif ($concept eq "5") # FTP
  {
     $header .=
"$num_hits_f\t$num_hits_t\t$num_dist\t\{FTP\}\t\t\{SIZE\}\n";
  }
  elsif ($concept eq "TOKENS")
  {
     $header .= "$num_hits_f\t$num_hits_t\t$num_dist\t\{TOKEN
URL\}\t\{TOKEN STRING\}\t\{TITLE\}\n";
  }
  else
  {
     $header .= "$num_hits_t\t\t$num_dist\t\{".$concept."\}\n";
  }
  return $header;
}


sub is_equal {
      my ($obj, $datatype, $val1, $val2) = @_;
      if ($datatype eq 'string')
      {
          return ($val1 eq $val2);
        }
      elsif ($datatype eq "numeric")
      {
            return ($val1 == $val2);
      }
      elsif ($datatype eq "url")
        {
#        print "Finding equal for url, $val1, $val2 \n";
         if ( ($val1 eq $val2 )¦¦("$val1" eq "$val2"."/")¦¦("$val1"."/"
eq $val2))
           {
#            print "return is 1\n";
             return 1;
           }
        }
      return 0;
}
sub jmap_surl {
#this function will map the url separately for
#   0 HTML/TXT;
#   1 UNKNOWN TYPES
#   2 QUERY;
#   3 GIF/JPEG;
#   4 MAILTO;
#   5 FTP;

# input: distinct sorted @URLS
# precondition:  the URL must be sorted first using order_url()
  my ($obj, $lks) = @_;
  my @cnt_url = @{$obj -> get_val("CNT_URL")};
  my $total_types = scalar(@cnt_url);

print STDERR "SURL: total types are $total_types\n";

  my $tmp_jmap_str = $obj->jmapping("URL", $lks );
  my @splited_maps = split(/\n/, $tmp_jmap_str);
  my $jmap_str = pop(@splited_maps); # the URL header

#add header for each subtype
  for ($i=0; $i<$total_types; $i++)
    {
      $jmap_str .= "\n".$obj->jmap_header("$i");
      for ($j = 0; $j < $cnt_url[$i]; $j++)
        {
        $jmap_str .= "\n".(pop(@splited_maps));
        }
    }

   $jmap_str .="\n" ; # last line break
   return $jmap_str;

}

sub jmapping_hz {  # mapping the digit lists in horizonal way
my ($obj, $concept) = @_;
my @jfiles = @{$obj->get_val("JFILES")};
my $num_jfile = scalar(@jfiles);
my $num_hits =0;
my $jmap_str ="";
my $val =0;
my $sum_val =0;
  $obj -> logging("\n=====>Start jmapping $concept ...", "new");
  $obj -> logging("\n=====>There are total $num_jfile to be mapped,
please wait ...\n", "append");
for ($i=0; $i<$num_jfile; $i++)
  {
    $obj -> logging(">$i", "append");
    $val = $jfiles[$i]->get_val($concept);
    if (defined($val)&&  $val != 0)
      {
        $num_hits++;
        $sum_val += $val;
      }
    $jmap_str .= $val."\t";
  }
   if ($num_hits >=1){ $avg= $sum_val/$num_jfile};
   $jmap_str .=$num_hits."\t".$avg."\n";
my $header = $obj-> jmap_header($concept, $num_jfile, $num_hits);
   $jmap_str = $header.$jmap_str;
  return $jmap_str;
```

```
}

sub jmap_url  {
        my $jmp = shift();
        my @list_url = @_;
        my @jfiles = @{$jmp -> get_val("JFILES")};

#        my @list_url = @{$jmp -> get_dist_vals("URL")};
      my $num_url = scalar(@list_val);
      my $num_jfile = scalar (@jfiles);
      my $jmap_str ="";
      my $header = "";
        my $total_hits_f = 0;
        my $total_hits_t = 0;

      if ($debug)
        {
         print "\nJMAP_URL: ==========\n";
         print "JFILES: $num_jfile;   Vals:  $num_val \n";
#        <STDIN>;
      }

        my $url_cnt=0, $f_cnt=0, $t_cnt=0;
        my $jfs_cnt =0;
      my $curr_val, $f_url;

      for ($url_cnt = 0; $url_cnt < $num_val; $url_cnt++)
      {
         $curr_url = $list_val[$url_cnt];
           $f_cnt = 0;
           $t_cnt = 0;
           for ($jf_cnt =0; $jf_cnt < $num_jfile; $jf_cnt++)
         {
                $f_url = $jfiles[$jf_cnt] -> get_val("URL");

            if ($debug)
            {
               print "Get Links : ";
                   print @{$jfiles[$jf_cnt] -> get_val("LINKS")};
#           <STDIN>;
            }

                $linked = $jfiles[$jf_cnt] -> is_linked($curr_url);

            if ($f_url eq $curr_url)
            {
              $jmap_str .= "f\t";
                       $f_cnt++;
                  if ($debug) {print "\nTHis is a from page.";}
            }
            elsif ( $linked ==1)
            {
                  $jmap_str .= "t\t";
                       $t_cnt++;
#                 if ($debug)
#                 {
#                    print "\nV V V V V I found linked.";
#                     <STDIN>;
#                  }
            }
            else
            {
                  $jmap_str .= "\t";
                  if ($debug)
                  {
                        print "\n xxxxxx nothing.";
                  }
                 }
          } # inner for

            $jmap_str .= "$f_cnt\t$t_cnt\t\t$curr_elem\n";
            $total_hits_f += $f_cnt;
            $total_hits_t += $t_cnt;

      }  # outer for

        $header = $jmp -> jmap_header("URL", $total_hits_f, $num_url);
      $jmap_str = $header.$jmap_str;
      return $jmap_str;
}

sub jmapping_token {
  my $obj = shift();
  my @jfiles = @{$obj-> get_val("JFILES")};
  my $debug =0;
  if ($debug){
  print STDERR "\n**************MAPPING TOKENS ************************\n";
  }

  $obj -> logging("\n=====>start mapping tokens ...\n");
  my $total_jfile = scalar(@jfiles);

  my @tk_list = $obj -> get_dist_vals("TOKENS");
  my $jmap_str = "";

  my $prefix = "";
  my $i=0;
  my $num_found =0;
  my  $total_tks =0;  # each row
  my $grand_total_tks = 0;  # grand total
  my  $total_dist_tks = scalar(@tk_list);
 if ($debug) { print STDERR "\n------------------Jfiles:
$total_jfile\n";
             print STDERR "\n***total distinct tokens:
$total_dist_tks\n";
           }
 $obj -> logging("\n=====>There are $total_dist_tks distinct token to be
jmapped, please wait ...\n", "append");
for ($cnt_token =0; $cnt_token < $total_dist_tks; $cnt_token++)
{
  if ($debug) { print STDERR "\n---Token line $cnt_token:
$tk_list[$cnt_token]\n";}
#   $obj -> logging(">", "append");
  $obj -> logging(">$cnt_token", "append");
```

```
   $total_tks =0; # reset for each row
   $prefix = "";  # reset prefix for each url-token pair
   $num_found =0;
   for ($i=0; $i<$total_jfile ; $i++) # inner for loop for one token line
     {
#      $obj -> logging(">", "append");
      $num_found = $jfiles[$i]->get_TokenFoundCnt($tk_list[$cnt_token]);
       if ($debug) { print STDERR "\n---Found # of Token:  $num_found\n";
}
           $total_tks += $num_found;
             $grand_total_tks += $num_found;
        if ($num_found == 0)
          {
            $prefix .= "\t";
           if ($debug) { print STDERR "\n---Print a tab on the
prefix.\nprefix: $prefix\n";}
          }
          elsif ($num_found == 1)
         {
           $prefix .= "t\t";
           if ($debug) { print STDERR "\n---Print a t on the
prefix.\nprefix: $prefix\n";}
         }
          else
          {
           $prefix .= "$num_found"."t\t";
           if ($debug) {
             print STDERR "\n---Print a $num_found t on the
prefix.\nprefix: $prefix\n";
           }
          } #end else

    }  #  finish inner for for one token line
    # end of one line, get the title
    my $title = $obj->get_title($tk_list[$cnt_token]);
#<STDIN>;
     $jmap_str .=
$prefix."1\t\t".$total_tks."\t".$tk_list[$cnt_token]."\t$title\n";

     if ($debug) { print STDERR "\nThis token line:\n",

$prefix."1\t\t".$total_tks."\t".$tk_list[$cnt_token]."\n";
#                <STDIN>;
               }
}
  my @COUNTER = @{$obj -> get_val("URL_CNT")};
     $COUNTER[6]= $total_dist_tks;
     $obj -> set_val("URL_CNT", \@COUNTER);
  my $jmap_header = $obj -> jmap_header("TOKENS",
                               $grand_total_tks,
                               $total_dist_tks,
                               $total_jfile );
  $jmap_str  = $jmap_header.$jmap_str;
  return $jmap_str;
}

sub jmapping {
```

```
# my $debug =1;
   my ($obj, $view, $listval) = @_;
#    my $log = $obj->get_val("LOGFILE"); #for logging progress
#    if (!open(LOG, ">$log") )
#      {
#        print STDERR "The log file cannot be opened\n";
#      }

  $obj->logging("\n===>processing jmap attribute $view ....\n",
"append");
  my @list_sval = ();  # distinct value list
  my $num_val   = 0;   # total value
  my $num_related = 0;  # related jfile numbers

  if ($debug) { print "--> try to get distict values ...\n";}

  if ($view eq "URL")
  {
        @list_val = @{$listval};
        @list_val = $obj -> order_url(@list_val);
  }
  else
  {
        @list_val = $obj -> get_dist_vals($view);  # attribute list for
jmapping
  }

  if (($debug) && ($view eq "URL"))
  {      print "-->jmap get list: ", join(" ", @list_val);
#        <STDIN>;
  }

  my @jfiles  = @{$obj -> get_val("JFILES")};
  my $jff = $obj -> get_val("JFILES");

  my $num_jfile = scalar(@jfiles);
  my $jmap_str = "";
  my $val ;
  my $datatype ="";
  my $curr_elem;
  my $t_cnt =0;      # related item counter
  my $f_cnt =0;
  my $total_hits_t =0;    # count t hits
  my $total_hits_f =0;  # only count the f hits

  if (($view eq "URL") || ($view eq "TITLE"))
  {
      $datatype = "string";
  }
  else
  {
      $datatype = "numeric";
  }

  if ($debug) { print "\nJmap datatype:  $datatype, \n"; }
  $num_val = scalar(@list_val);


  if ($debug)
  {
      print "\nList val $num_val: ", join("|", @list_val), "\n";
#        <STDIN>;
  }

  my $i, $j, $title, $size;

  for ($i = 0; $i < $num_val ; $i++)
  {
        $f_cnt =0;                      # reset for every row
        $t_cnt =0;
        $curr_elem = $list_val[$i];
        $title = "";
      $curr_elem_match = $curr_elem;  # eliminate () when matching
      $size = $obj->find_size($curr_elem);  # get the size for this page

        $curr_elem_match =~ s/\(/\\(/;     # delimit (
        $curr_elem_match =~ s/\)/\\)/;      #           )
        $curr_elem_match =~ s/\{/\\{/;      #           {
        $curr_elem_match =~ s/\}/\\}/;      #           }
        $curr_elem_match =~ s!\?!\\?!;      #           ?
        $curr_elem_match =~ s!\&!\\&!;      #           &
        $curr_elem_match =~ s!\%!\\%!;      #           %
        $curr_elem_match =~ s!\+!\\+!;      #           +
        $curr_elem_match =~ s!\-!\\-!;      #           -
        $curr_elem_match =~ s!\#!\\#!;      #           #
      $curr_elem_match =~ s!\*!\\*!;      #           *
      $curr_elem_match =~ s!\*\*!\\*\\*!;         #           **
      $curr_elem_match =~ s!\*\*\*!\\*\\*\\*!;    #           ***
      $curr_elem_match =~ s!\=!\\=!;              #           =
        $curr_elem_match =~ s!\~!\\~!;

        if ($debug) { print "\n ********list val: $curr_elem, \n";}
        for ($j = 0; $j < $num_jfile; $j++)
      {
            $obj_jf = $jff->[$j];
            $val  = $obj_jf -> get_val($view);

            if ($view eq "URL")   #  URL part is special since it is a
start of relation
                {
                    if ($debug)
                {print "\n\n\tTring to find linked url.";
                print "$j---selecting jfile val: $val, ";
                print "My linked pages are : ", join("\n",@{$obj_jf-
>get_val("LINKS")});
                print $obj_jf->get_val("LINKS");
#               <STDIN>;

                }

#                    my @links = @{$obj_jf ->get_val("LINKS")};
```

```
                     if ($val eq $curr_elem)
                     {
                   $jmap_str .= "f\t";
                         $title = $obj_jf->get_val("TITLE"); # keep title
                         $f_cnt++;
                   if ($debug) {print "\nTHis is a from page.";}
                 }
#                      elsif ( $links =~ m!$curr_elem_match!)
#                      elsif ( $obj->is_linked($curr_elem, $links))
#                       elsif (($links =~ m!$curr_elem_match!)||
                        elsif  ( $obj_jf->is_linked($curr_elem))
                 {
                   $jmap_str .= "t\t";
                         $t_cnt++;
#                         if ($debug) {
#                              print "\nV V V V V I found linked.";
#                             <STDIN>;
#                        }
                 }
                 else
                 {
                   $jmap_str .= "\t";
                   if ($debug) { print "\n xxxxxx nothing.";

                   }
                 }
            }
            elsif ($obj->is_equal($datatype, $val, $curr_elem))
            {
                $jmap_str .= "t\t";          # mark relation
                    $t_cnt++;
            }
            else
            {
                $jmap_str .= "\t";           # escape
            }


        }  # end for, inner loop
     #writing postfix to jmap
        if ($view eq "URL")
        {
        if ($title eq " n/a")
          {
            $title = "";
          }
          $jmap_str .= "$f_cnt\t$t_cnt\t\t$curr_elem\t$title\t$size\n";
        }
        else
        {
          $jmap_str .= "$t_cnt\t\t\t$curr_elem\n";
        }
        $total_hits_f += $f_cnt;
        $total_hits_t += $t_cnt;

  }  # end for
```

```
        my $header = $obj -> jmap_header($view, $total_hits_t, $num_val,
$total_hits_f);
      $jmap_str = $header.$jmap_str;
      return $jmap_str;
}

#sub is_linked {
#  my ($obj, $curr_lk, $links) = @_;
#  my @lks = split(/ /, $links);
#  foreach $lk (@lks)
#  {
#   if ($lk eq $curr_lk)
#   {
#        return 1;
#   }
#  }
#  return 0;
#}

sub get_title {
# input a url, return a title or html file not obtained
my ($obj, $tkurl)= @_;
my @Jfiles = @{$obj->get_val("JFILES")};
my $num_jfiles = scalar(@Jfiles);
my @tkurl_split = split(/\t/, $tkurl);
my $linkurl = $tkurl_split[0];
# print "The number of jfile is $num_jfiles, get title for $linkurl\n";
my $title = " !this link was not processed.";

   for ($i=0; $i<$num_jfiles; $i++)
     {
       if ($obj->is_equal("url", $linkurl, $Jfiles[$i]->get_val("URL")))
       {
#        print "Found a title for this URL\n";
         $title = $Jfiles[$i]->get_val("TITLE");
           last;
       }
     }
return $title;
}

sub find_size {
# input a url, return the size of this page
my ($obj, $lkurl)= @_;
my @Jfiles = @{$obj->get_val("JFILES")};
my $num_jfiles = scalar(@Jfiles);

# print "The number of jfile is $num_jfiles, get title for $linkurl\n";
#<STDIN>;
my $size = 0;

   for ($i=0; $i<$num_jfiles; $i++)
     {
       if ($obj->is_equal("url", $lkurl, $Jfiles[$i]->get_val("URL")))
       {
#        print "Found a title for this URL\n";
         $size = $Jfiles[$i]->get_val("SIZE");
#        <STDIN>;
           last;
       }
     }
return $size;
}

sub logging {  #logging message to the window
 my ($obj, $msg, $opt) = @_;
   my $log = $obj->get_val("LOGFILE"); #for logging progress

#print STDERR "my log file is $log ]]]]]]]\n";

   if ($opt eq "" || $opt eq "new")
    {
      open(Log, ">$log")||die "Cannot open log file\n";
    }
   else
   {
      open(Log, ">>$log");
   }
    print Log "$msg";
    close(Log);
}
1;
```

A-2.3 webjmapm.pm

```
#!/site/bin/perl
# PERL WIN32, JMAP BUILDER Main program for CGI
BEGIN { require 'JFILE.pm';
        require 'JMAP.pm';
      }

=head1 WEBSITE JMAP BUILDER 4

=head1 COPYRIGHT
################################################################

 COPYRIGHT:  Philip PENG, 1999-2005
 JMAP is the trademark of Gen-Strategies, WMJ, 1995-2000


=head1 VERSION 4.1.0

VERSION HISTORY:
        2.0.3   infinite loop unsolved when only 1 url ,
                URL seems give 3-4 url with level 0
                order_url does not work in jmap.pm
        2.0.2   problems with jmap modules resolved, datatype
        2.0.1   dramatic abstraction was done, code is compressed
        2.0.0   draft version, no much abstraction for methods
        3.0.0   draft version, add token extraction and jmapping
        3.0.1   add vetical # attribute representation for link out,
                link img, bookmarks
        3.0.2   split URL columns to separate ones
        3.1.0   add methods to do horizonal layout of number properties
        3.1.1   add interface function to get stop message
        4.0.0   Web cgi version
        4.1.0   Revised Directory Structure and changed algorithms
        4.1.1   Both GUI and webjmap4.pl can run on UNIX solaris and
WIN32
        4.2.0   Add sendMail function to automate sending jMap
################################################################

=cut

#main program starts
########################################################################
#
#        jMap Configuration                                 #
########################################################################
#
   my $OS = "WIN32";  # WIN32 or UNIX
   my $version = "Website jMap Builder 4.1.1";

#Email configuration to automate sending jMap to user
   my $smtp_svr = "ticsmtp2.innovation.siemens.ca";
   my $sender = "Philip.Peng\@tic.siemens.ca";
   my $receiver ="Philip.Peng\@tic.siemens.ca";

#main program starts
########################################################################
#
#          global  Variable Declaration
#
########################################################################
#
   my $JMAP_HOME = &getJmapHome();
      print "JMAP home is $JMAP_HOME\n";
    my $debug = 1;
    my $config_file = "$JMAP_HOME/conf/jMap.conf";
    my $start_time = time();
    my $finish_time =0;
    my $used_time =0;
    my $log = "$JMAP_HOME/tmp/jmap.log";
    my $root="";
    my $max_level = 210;
    my $curr_level =0;
    my $max_url = 500;
    my $jmap_style=1;
    my $email_opt = 1;

    my  @URL_Q = ();
    my  @LEVEL = ();
    my  @TITLES =();   #hold unique value of title
    my  @SIZES = ();
    my  @RS_CODES =();
    my  @LINKS = ();    # an array to ensure every url we request will
be unique
    my  @LINKSIN=();
    my  @LINKSOUT=();
    my  @LINKSIMG =();
    my  @JFILES =();
    my  @HS_PARAM = ();
    my  $filename = "$JMAP_HOME/jmaps/jmap.txt";
    my $stop = 0;    # user optional to stop after a while
    my $cmdfile = "$JMAP_HOME/conf/stop.txt"; # gui can pass control to
this program
    my  $jmap;
    my %TYPE;
    my %HEADER;
    my $num_url_processed =0;   # urls processed in each level
    my $total=0;   # total urls were processed
    my $curr_level =0;
    my $size = 0;
    my $title = "";
    my $links_int = 0;   # bookmarks with #
    my $links_out = 0;   #mailto also countered
    my $links_img = 0;
    my @TURLS=();
    my $htmlfile = "$JMAP_HOME/tmp/temp.html";

  my $commandfile = "$JMAP_HOME/conf/commands.txt";
  my @Parameters;
  my @CMDS =();
  my $num_cmds = 0;
  my $SID = 0;    # session ID
  my $num_sites = 0;  # number of joint map sites
  my $report_file = "$JMAP_HOME/jmaps/JmapReport.txt";

#########################################################################
#
#          Grand JMAP Variable Initialization
#
#########################################################################
#
 my $grand_level =0;
 my @GRAND_JFILES = ();
 my @GRAND_LINKS = ();


#########################################################################
#

# processing view types
      %TYPES = ( "HTML"      =>
"\.html|\.htm|\.txt|\.text|http\S+\/\$",
                   "IMG"       =>  "\.jpg|\.jpeg|\.gif",
                   "QUERY"     =>  "[\?\&\+]|\.asp|\.as|\.cgi|\/cgi-
bin\/|\.exe|\.dll|\.pl",
                   "FTP"       =>  "ftp:\/\/",
                   "MAILTO"    =>  "mailto:",
                   "OTHER"     =>  "(\S+)",
                   "SKIP"      =>  "\.doc|\.ps|\.pdf|\.ppt|\.xls"
                   );  # current supported types

# view header symbols
     %HEADER = (
        "URL"      => "L",
         "LEVEL"    => "A",
         "level"    => 'v',
         "ADDRESS"  => "M",
         "HTML"     => "v",
         "OTHER"    => "v",
         "IMG"      => "v",
         "QUERY"    => "v",
         "MAILTO"     => "v",
         "FTP"      => "v",
         "SIZE"     => "N",
         "LINKS"    => 'N',
         "BOOKMARK" => "v",
         "LINKOUT"  => "v",
         "LINKIMG"  => "v",
         "TITLE"    => "N",
         "RS_CODE"  => 'N',
         "TOKENS"    => "T"
         );

##########################################################################
#
#             Variable Declaration
#
##########################################################################
#



##########################################################################
#
#           Main function starts here
#
##########################################################################
#
   &set_stop(0);  #overwrite the previous stop file
   &read_config(); #read in configuration from jMap.conf
   &read_cmds($commandfile);  # read in process request
   print STDERR "\nNumber of commands is $num_cmds\n";
   open(REPORT, ">$report_file");
#  print REPORT "Session ID\tURL\t\tJMAP Filename\n";
for(my $cmd_counter=0; $cmd_counter<$num_cmds ; $cmd_counter++)
{
    my @cmds = split(/\t/, $CMDS[$cmd_counter]);
    $SID = $cmds[0];           # session ID
    $Parameters[0] = $cmds[1]; # URL
    $Parameters[1] = $cmds[2]; # max_level
    $Parameters[2] = $cmds[3]; # max_url
    $Parameters[3] = $cmds[4]; # jmap_style
    $Parameters[4] = $cmds[5]; # Associate sites jointed maps indicator
    $Parameters[5] = $cmds[6]; # email notification option
#    print STDERR "SID = $SID, URL =  $cmds[1]; \n";
#  &set_session_filenames($SID);  #$1= sid
      $filename = "$JMAP_HOME/jmaps/jmap."."$SID".".txt";
      if ($debug) {     print STDERR "Jmap file name is $filename\n";}
      if ($OS eq "WIN32"){
      print REPORT "$SID\t$cmds[1]\t", &get_dos_filename($filename),
"\n";
```

```
      }else {
      print REPORT "$SID\t$cmds[1]\t", $filename, "\n";
      }
print STDERR
"\n*****************************************************\n";
      print STDERR "\n\n>>>Start process website $cmd_counter: $cmds[1]
..\n\n";
      &process_url(@Parameters); # retrieve URL, token and save them to
JFILES
    if ($Parameters[4] == 1 )
    {
      $num_sites++;
      print STDERR "Saving Paremeters for cross mapping\n";
#     <STDIN>;
      &save_current_params(); # save current parameters for joint site
processing
      }
      if ($Parameters[5] == 1 )
    {
      $email_opt =1;
      }
#    print STDERR "JMAP file name is $filename\n";

      print STDERR "\n\n>>>Start process JMAP for site  $cmds[1] ..\n";
      &process_jmap();  #process jmap using current global variables
}

  if ($num_sites >= 1 )
  {
    $filename = "$JMAP_HOME/jmaps/jmap."."c$SID".".txt";
    print STDERR
"\n\n*************************************************\n";
    print STDERR "\nStart cross-mapping between the websites ...\n";
    &show_time("\nStart cross-mapping between the websites ...\n");
    $curr_level = $grand_level;
    @JFILES = @GRAND_JFILES;
    @LINKS = @GRAND_LINKS;
#    print STDERR "Total Jfile = ", scalar(@GRAND_JFILES), "\n";
#    print STDERR "Total Links = ", scalar(@GRAND_LINKS), "\n";
    &process_jmap();
    print REPORT "$SID\tcross mapping $num_sites sites\t",
&get_dos_filename($filename), "\n";
  }
  close(REPORT);

#print last message before close
       open(LOG, ">$log")|| die "Cannot open log file to write\n";;
       print LOG "\n\nJMAP 4.1.0 has finished jmapping $num_sites
websites.\n";
       print LOG "Total used time is $used_time seconds. \n";
       print LOG "Avarage used processing time per url is $used_time /
$total second.\n";
       print LOG "Thank you using JMAP to JMAPing website.\n";
       print LOG "Please click View report to see the report.\n";
       close(LOG);
       unlink($htmlfile);
       print STDERR "\nJMAP completed mapping the websites ...\n\n";
       &set_stop(0);
       0;

#main program ends


#########################################################################
#
#          Subroutine implementation starts here
#
#########################################################################
#
sub getJmapHome{
      use Cwd;
      chdir("..");
      my $home = getcwd();
      chdir("bin");
      return $home;
}

sub read_config {
#read in jMap.conf configuration parameters
open (CONF, "<$config_file") ||
      print STDERR  "Reading configuration file $config_file file
failed.\n";

# $OS = "WIN32";  # WIN32 or UNIX
# $version = "Website jMap Builder 4.1.1";
   while (<CONF>) {
      chomp();
      if ( /OS\s+=\s+UNIX$/) { $OS = "UNIX";}
      elsif ( /OS\s+=\s+WIN32$/) { $OS = "WIN32";}
      elsif (/Outgoing SMTP Server\s+=\s+(.*)$/)
        { $smtp_svr = $1 }
      elsif (/Reply Email address\s+=\s+(.*)$/)
        { $sender = $1;}

}
close(CONF);
print STDERR "OS: $OS\n";
print STDERR "SMTP SERVER: $smtp_svr\n";
print STDERR "Reply Email: $sender\n";
#Email configuration to automate sending jMap to user
}

sub read_cmds {
# read customer commands
  my $cmd_file = shift();
  open(CMD, "<$cmd_file");
  while (<CMD>)
    {
       chomp();  # get ride of new line characters
     if ($_ =~ /\d+\t\S+/)
      {
        $CMDS[$num_cmds++] = $_;
     } elsif (/mailto:\s+(.*)$/) {
```

```
                  $receiver = $1;  #email receiver
                  print STDERR "Email to: $receiver\n";
      }
    }
  close(CMD);
  print join("\n", @CMDS);
}

sub set_session_filenames {
# set up temp file name, output file name
  my $sid = shift();
  $filename = "jmap"."$sid".".txt";
# print STDERR "New file name is $filename\n";
}

sub save_current_params {
#save current session for future joint mapping

  if ($curr_level > $grand_level)
    {
      $grand_level = $curr_level;
    }
  push(@GRAND_LINKS, @LINKS);
  print "TOtal saved LINKS = ", scalar(@LINKS), " Grand ",
scalar(GRAND_LINKS), "\n";
  push(@GRAND_JFILES, @JFILES);
}

sub process_url {
 my ($rt, $mx_level, $mx_url, $jmap_sty) = @_;
#
 $root = $rt;
 $max_level = $mx_level;
 $max_url = $mx_url;
 $jmap_style = $jmap_sty;
# $email_opt = $email_chk;

print STDERR "$root,  $max_level, $max_url, $jmap_style, $email_opt \n";
use LWP::UserAgent;
use LWP::Simple;
use HTML::Parser;
use HTML::HeadParser;
use HTML::LinkExtor;
use URI::URL;
use JFILE;
use JMAP;


#    my $start_time = time();
#    my $finish_time =0;
#    my $used_time =0;
#    my $jmap_style =0;
#    my $log = "$JMAP_HOME/tmp/jmap.log";
#    my $root = $args[0]; # user input url as root of the server
#    my $max_level = $args[1];  # user input for the maxium level

    my $excel_limit = 230;  # maxium 230 columns
    if (!(defined($max_level)))
      {
        $max_level = 10;
        if ($debug) {print "Default level to 4.\n";}
      }

    if (!(defined($max_url)))
      {
        $max_url = $excel_limit;     # this is the max column for Excel
97
        if ($debug) {print "Default number of file to $max_url.\n";}
      }

#    print STDERR "Default jmap style is  $jmap_style.\n";
    if (!(defined($jmap_style)))
      {
        $jmap_style = 1;      # this is the max column for Excel 97
        if ($debug) {print STDERR "Default jmap style is
$jmap_style.\n";}
      }

    open(LOG, ">$log")||die ("cannot open log file\n");
    print LOG "Start processing web site urls....\n";
    close(LOG);

# Reset global variables for this current session
      @URL_Q = ();
      @LEVEL = ();
      @TITLES =();   #hold unique value of title
      @SIZES = ();
      @RS_CODES =();
      @LINKS = ();    # an array to ensure every url we request will be
unique
      @LINKSIN=();
      @LINKSOUT=();
      @LINKSIMG =();
      @JFILES =();
      $jmap;

     $num_url_processed =0;   # urls processed in each level
     $total=0;   # total urls were processed
     $curr_level =0;
     $size = 0;
     $title = "";
     $links_int = 0;   # bookmarks with #
     $links_out = 0;   #mailto also countered
     $links_img = 0;
     @TURLS=();
     $htmlfile = "$JMAP_HOME/tmp/temp.html";


$url = $root;

# tailor $root for filter string
    if ($root =~
/^(http\:\/\/\S+\/)\S+($TYPE{'HTML'}|$TYPE{'QUERY'})$/i)
      {
        $root = $1;
      }
    elsif ($root =~ /^(http:\/\/\S+[^\/]$)/)
      {
        $root = $1."\/";
      }

        print STDERR "The root is selected as $root.\n";

        push(@LINKS, $root);
        push(@URL_Q, $root);
#change root to a closest domain name
        $root = get_domain_name($root);

        print STDERR "The domain filter is  $root\n";
        $LEVEL[0]=1;

        $ua = new LWP::UserAgent;
# header parser for HTML
        $h = HTTP::Headers->new();

# ($curr_level <= $max_level) &&

 while ($total < $max_url)
{
     &check_stop();       # check stop flag
     if ($stop) {
      &show_time("Website jMap Builder is stopping.", 1);
      last;
      }
    $myurl=shift(@URL_Q);
    if (!defined($myurl))
    {
        if ($debug) { print "\nAll links have been processed.\n";}
        last;
    }  # if no more links, out of loop

# session initialization
    undef $response_code;
    undef $protocol;
    $size      = 0;
    $links_out = 0;
    $links_int = 0;
    $links_img = 0;
    $title     = "";
    undef $rs_time;
    $total++;
    push(@TURLS, $myurl);

     my $Msg ="\nProcessing URL Number: $total \nPage url : $myurl
....\n";
     $Msg .= "\n=====>Starting extracting links from page.\n";
     print STDERR "\n Now processing ".$total."th url : $myurl ....\n";
     &show_time($Msg, 1);

    @new_links =();    # hold all A type links
    $num_url_processed++;
    if ($num_url_processed > $LEVEL[$curr_level])
    {
      $curr_level++;
      $num_url_processed = 1 ;  # reset for current level
      if ($curr_level > $max_level) { last;}
    }

    if ($debug)
    {
        print "\n>>>>>Current level is $curr_level and ",
                $num_url_processed, " is been processing.\n";
    }

# extract new links from only HTML, QUERY type links

# Make the parser.Unfortunately, we don't know the base yet (it might be
diffent from $url)
        $p = HTML::LinkExtor->new(\&cb_save_links);

# header parser for HTML
        $hp = HTML::HeadParser->new($h);

# Request document and parse it as it arrives
        $req = HTTP::Request->new(GET => $myurl);
        $response = $ua->request($req, \&cb_request);

        $response_code = $response->code();
        $title = $hp->header('Title');
        if (!defined($title))
        {
          $title = " n/a";
        }
        undef $hp;
        undef $h;
        undef $p;

       if ($response -> is_success)
        {
# Expand all image URLs to absolute ones
          my $base = $response->base;
          @new_links = map { $_ = url($_, $base)->abs;} @new_links;
          ($links_out, $links_int, $links_img) = &links_out($myurl,
@new_links);
          &enqueue(@new_links);       #push links to @URL_Q, maintain
@LINKS
        } # end of if success response

# -----------------------------------------------------------------------
----
# save JFILE
# -----------------------------------------------------------------------
----

#    $lk_str = join(" ", @new_links);
   print "Starting map tokens in this page....\n";
   my @Jf_tokens = &map_token($myurl);
   $jfile = new JFILE( $myurl,
                        $curr_level,
                        $title,
                        $size,
                        $links_int,
                        $links_out,
                        $links_img,
                        $response_code,
#                        $lk_str,
                  \@new_links,
                        \@Jf_tokens
                       );
    if (scalar(@new_links) >= 1) {
    $jfile->sort_links();  #sorting links for binary search
    }
     push(@JFILES, $jfile); # first file obj

} # end of outer most while
} # end process_url

sub process_jmap {
# global @JFILES, $curr_level, %TYPES, %HEADER

# make JMAP object to process jmap

#     if ($debug) { print "\nTotal Jfiles ", scalar(@JFILES), "\n";}
      open(LOG, ">$log");
      print LOG "\n\nStart jmapping this website, please be
patient...\n";
      close(LOG);
      my @full_url =();
              $jmap = JMAP->new(\@JFILES,
                          $curr_level,
                          \%TYPES,
                          \%HEADER
                          );
      @full_url = $jmap -> order_url(@LINKS);
      $jmap->set_val("LOGFILE", $log);
#process first line parameters
      @HS_PARAM  = @{$jmap->get_val('URL_CNT')};
     my $html_cnt  = $HS_PARAM[0];
     my $other_cnt = $HS_PARAM[1];
     my $query_cnt = $HS_PARAM[2];
     my $imgs_cnt  = $HS_PARAM[3];
     my $mailto_cnt= $HS_PARAM[4];
     my $ftp_cnt   = $HS_PARAM[5];
     my $token_cnt = $HS_PARAM[6];

    my $jmap_str  = "";
       $jmap_str .=   $jmap -> jmapping("LEVEL");
       $jmap_url  =   $jmap -> jmapping("URL", \@full_url);    # @LINKS
can be used
       $jmap_str .=   &split_url($jmap_url);
       $jmap_str .=   $jmap -> jmapping("TITLE");
       if ($jmap_style == 0)
       {
       $jmap_str .=   $jmap -> jmapping("BOOKMARK");
       $jmap_str .=   $jmap -> jmapping("LINKOUT");
       $jmap_str .=   $jmap -> jmapping("LINKIMG");
       $jmap_str .=   $jmap -> jmapping("RS_CODE");
       $jmap_str .=   $jmap -> jmapping('SIZE');
       }
      else
       {
       $jmap_str .=   $jmap -> jmapping_hz("BOOKMARK");
       $jmap_str .=   $jmap -> jmapping_hz("LINKOUT");
       $jmap_str .=   $jmap -> jmapping_hz("LINKIMG");
       $jmap_str .=   $jmap -> jmapping_hz("RS_CODE");
       $jmap_str .=   $jmap -> jmapping_hz('SIZE');
       $jmap_str .=   $jmap -> jmapping_token();
       }


     if (!open(JMP, ">$filename"))
      {

&show_time("\n\n!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!\n===>!!!\tThe tempory jmap file has been lock by an other
application,\n===>!!!\tplease close that application.\n===>!!!\tCurrent
jmap was saved in jmap.new, please rename it \n===>!!!\tto jmap.tmp in
JMAP3 directory to recover current
result.\n!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!", 1);
        open(JMP, ">$filename"."new")||die("\nCannot open alternative
jmap file.\n");
       }
#process first line parameters: tokens
     @HS_PARAM  = @{$jmap->get_val('URL_CNT')};
     $token_cnt = $HS_PARAM[6];
     print JMP "jfiles\t",   scalar(@JFILES),
              "\tlevel\t",  $curr_level+1,
              "\tURLs\t",   scalar(@LINKS),
              "\thtml\t",   $html_cnt,
              "\tother\t",  $other_cnt,
              "\tquery\t",  $query_cnt,
              "\timages\t", $imgs_cnt,
              "\tMailto\t", $mailto_cnt,
              "\tftp\t",    $ftp_cnt,
              "\ttitles\t", $jmap->get_val("TITLE_CNT"),
              "\ttokens\t", $token_cnt,
              "\n";

     print JMP $jmap_str;
     close(JMP);

     if ($email_opt == 1) {
          &send_email($filename); #does not need a dos name
     }
     $finish_time = time();
     $used_time = $finish_time - $start_time;

#       open(LOG, ">$log") || die "Cannot open log file to log\n";
#       print LOG "\n\nJMAP 4.0.0 has finished jmapping this
website.\n";
#       print LOG "There are total $total linkes been processed\n";
#       print LOG "Total used time is $used_time seconds. \n";
#       print LOG "Avarage used processing time per url is ",
$used_time/$total, " second.\n";
#       print LOG "Thank you using JMAP to JMAPing website.\n";
#       print LOG "Please click View report to see the report.\n";
#       close(LOG);
#       unlink($htmlfile);
}  # end of process_jmap


sub jmap_sites {
# jmap cross all processed sites
}


########################################################################
#
#           Get options from user
#
########################################################################
#
sub check_stop {
# read user message to stop the program
  open(STOP, "<$cmdfile") || return;
  my $cmd = <STOP>; # currently only one line
  close(STOP);

  if ($cmd =~ /STOP\=1/)
    {
      $stop =1;
      unlink($cmdfile);
      my $msg = "\n\n=====>Now, JMAP 4.0 is trying to stop after the
last request....\n";
      &show_time($msg, 0);
    }
  else
  {
      $stop = 0;
  }

  return;
}

sub set_stop {
      #input 0 or 1
      my $stp = shift();
      open(STOP, ">$cmdfile") || return;
      print STOP "STOP=$stp\n"; # currently only one line
      close(STOP);
}

sub cb_request {
  my ($str, $res, $prot) = @_;
        $p->parse($_[0]);
        $hp->parse($_[0]);
        $size += scalar(split(//, $_[0]));
}
```

```
sub cb_save_links {
# push found links to two different categories
        my($tag, %attr) = @_;
        push(@new_links, values %attr);
        return;
}

sub links_out {
  my ($curr_url, @lks) = @_;
  my $int_counter = 0;   # internal bookmark
  my $ext_counter = 0;  # it also includes itself
  my $img_counter = 0;
  my @pieces = ();
  my @lk_url="";

  foreach $lk (@lks)
  {
    if ($lk =~ /\#\S/i)
    {
      @pieces = split(/\#/, $lk);
      $lk_url = shift(@pieces);
      if ($lk_url eq $curr_url)
      {
        $int_counter++;
      }
      else
      {
        $ext_counter++;
      }
    }
    elsif ($lk =~ m!$TYPES{'IMG'}$!i)
    {
      $img_counter++;
    }
    else  # if ($lk =~ m!$TYPES{'HTML'}|$TYPES{'QUERY'}!i)
    {
      $ext_counter++;
    }
  }
   return   ($ext_counter, $int_counter, $img_counter);
 }


sub is_duplicate {
# input a element and an array, return true if found in the current list
else false
  my ($c_url, @MYLIST) = @_;
  my $miss1=$c_url."/";       # some missing /
  my $miss2;
  foreach $l_url (@MYLIST)
  {
    $miss2 = $l_url."/";
    if ( $l_url eq $c_url || $miss2 eq $c_url || $miss1 eq $l_url )
    {
       return 1;
    }
  }
      return 0;
}

sub enqueue {
# input extracted html links
# filter out internal bookmarks, mailto, ftp, etc links
# make sure the value is unique in the @LINKS
        my @new_lks = @_;
        my @LK=();  #select links
        my @LK_OUT=();  # non-selected links
        my @lks_new = ();
  foreach $lk (@new_lks)
  {
        if ($lk =~ /^(\S+).\#.\S+$/)
        {
           $lk = $1;        # strip internal bookmarks
        }

        push(@lks_new, $lk);  # rearrange choped links

        if (!(&is_duplicate($lk, @LINKS)))
        {
           push(@LINKS, $lk);

 # ftp links are dangerous big sometimes, get ride of ftp mailto, some
unknown types
           if  ($lk =~ /$root/)      # separate current site from others
           {
                push(@LK, $lk);
           }  # inner if
           else      # get outside links to make a jfile
           {
                push(@LK_OUT, $lk);
           }

        }   # end outer if
  }

  @new_lks = @lks_new;    # replace the links with new stuff

  push(@URL_Q, @LK);
# increase # of url in queue for next level
  $LEVEL[$curr_level+1] += scalar(@LK);

}

sub map_token
  {
    use LWP::UserAgent;
    use HTML::LinkExtor;
    use URI::URL;
    use HTML::TokeParser;

# input URL as the first argument
    my $jfurl = shift();
    my $html;
    my $MSG = "\n=====>Start extracting tokens from page: $jfurl...\n";
    &show_time($MSG, 0);
    my @Tokens=();

       print STDERR "Get token for : $jfurl \n";
       $html= get($jfurl);
#       $htmlfile= "temp.html";  #already defined in main
    open(HTMLFH, ">$htmlfile");
    print HTMLFH "$html\n";
    close(HTMLFH);

    $ua = new LWP::UserAgent;
    my $links = $ua->request(HTTP::Request->new(GET => $jfurl));
    # Expand all image URLs to absolute ones
    my $base = $links->base;

    $p = HTML::TokeParser->new($htmlfile) || die "Cannot open html
page\n";
    while (my $token = $p->get_tag("a"))
      {
        my $turl = $token->[1]{"href"};
        $turl = url($turl, $base)->abs;
        my $text = $p->get_trimmed_text("/a");
        my $tokn = $turl."\t$text";
      push(@Tokens, $tokn);
      }



    $MSG = "\n=====>Finished token extraction from this page.\nNext page
...\n";
    &show_time($MSG, 0);
    return @Tokens;
}

sub find_symbol
  {
    my $urlin = shift();
    for ($i=0; $i< scalar(@full_url); $i++)
      {
      if ($urlin == $full_url[$i])
        {
          return "s".$i;
        }
      }
  }

sub show_time{
  my $msg = shift();
  my $is_new = shift(); # 1 for new message, otherwise append only
          $finish_time = time();
          $used_time = $finish_time - $start_time;
        if ($is_new == 1)
        {
          open(LOG, ">$log");
          print LOG "Processing session\t", $SID;
```

```
           print LOG "\nStarting elapsed time: ", $used_time, "
seconds.";
           print LOG $msg;
         }
         else
         {
           open(LOG, ">$log");
           print LOG "\n=====>Current elapsed time:", $used_time, "
seconds.\n";
           print LOG $msg;

         }
           close(LOG);
}

sub split_url {
#this function will map the url separately for
#   0 HTML/TXT;
#   1 UNKNOWN TYPES
#   2 QUERY;
#   3 GIF/JPEG;
#   4 MAILTO;
#   5 FTP;

# input: $url_map, and $lks
# precondition:  the URL must be sorted first using order_url()
  my $url_map  = shift();

  my $total_types = scalar(@HS_PARAM);


  my @splited_maps = split(/\n/, $url_map);

  my $tmp_jmap_str = shift(@splited_maps)."\n"; # the URL header


#add header for each subtype
  for ($i=0; $i< $total_types; $i++)
   {
     $tmp_jmap_str .= $jmap->jmap_header($i, 0
,$HS_PARAM[$i],scalar(@JFILES));
     for ($j = 0; $j < $HS_PARAM[$i]; $j++)
       {
       $tmp_jmap_str .= shift(@splited_maps)."\n";
       }
   }


   return $tmp_jmap_str;

}

sub  get_domain_name {
      my $dn = shift();
      #print "this is the input root ", $sn, "\n";
      my $lastIndex = rindex($dn, "/");
      #print "The reverse index for last / is ",  $lastIndex, "\n";
      if ($lastIndex > 11){
      $dn = substr($dn, 0, $lastIndex);
      }
      #print "this is the output root ", $dn, "\n";
      return $dn;
}

sub get_dos_filename {
      my $filenm = shift();
      my @dos_filenms = split(/\//, $filenm);
      return  join("\\", @dos_filenms);
}

sub send_email {
#send email to customer
use MIME::QuotedPrint;
use MIME::Base64;
use Mail::Sendmail 0.75; # doesn't work with v. 0.74!
if ($receiver eq "") {
      return;
    }
print STDERR "\n\nSending jMap to the user.....\n";

my $jmapfile = shift(); # This is the perl executable

my $hostname = `hostname`;
my $subject = "jMap for session $SID, $root";
my $Thankyou = "$version mailer:\n";
   $Thankyou .= "\njMap Session: $SID\n";
   $Thankyou .= "jMap Root URL: $root\n";
   $Thankyou .= "jMap file attached: $jmapfile\n\n";
   $Thankyou .= "\nThank you for using $version.\n";
   $Thankyou .= "\nPlease see attachments for the jMap.\n\n";
   $Thankyou .= "\nFrom you jMap host \@$hostname\n";

&show_time("Sending email to $receiver .....of \n$jmapfile\n", 1);
my %mail = (
        SMTP => $smtp_svr,
        from => $sender,
        to => $receiver,
        subject => $subject,
        );


$boundary = "====" . time() . "====";
$mail{'content-type'} = "multipart/mixed; boundary=\"$boundary\"";

$message = encode_qp( "$Thankyou" );



open (F, $jmapfile) or die "Cannot read $jmapfile: $!";
binmode F; undef $/;
$mail{body} = encode_base64(<F>);
close F;

$boundary = '--'.$boundary;
```

```
$mail{body} = <<END_OF_BODY;
$boundary
Content-Type: text/plain; charset="iso-8859-1"
Content-Transfer-Encoding: quoted-printable

$message
$boundary
Content-Type: application/octet-stream; name="$jmapfile"
Content-Transfer-Encoding: base64
Content-Disposition: attachment; filename="$jmapfile"

$mail{body}
$boundary--
END_OF_BODY

sendmail(%mail) || print "Error: $Mail::Sendmail::error\n";


}

1;
```

A-3 Web JMAP Builder Mail Server

A-3.1 pop3svr.pl

```
#!/usr/bin/perl

#===================================================
# How to obtain jmap email Request  with Net::POP3
# Copyright 2000, Philip Peng, W. M. Jawarski,
# Email: WMJ@gen-strategies.com
# Created 02/2/02
#===================================================
# This script is designed to check pop3 jmap request
# email and call webjmap to process request and send
# jmap result back to user.
# Require module:  Net::POP3,
# Windows : IMAP
#===============================

use strict;

print "Content-type: text/plain", "\n\n";

use Net::POP3;

# This debug flag will print debugging code to your browser, depending
on its value
# Set this to 1 to send debug code to your browser.  Set it to 0 to turn
it off.
my $DEBUG = 0;

if($DEBUG)
{
   $| = 1;
   open(STDERR, ">&STDOUT");
}

# Set this variable to your POP3 server name
my $ServerName = "mail.mondenet.com";
# Initiate the mail transaction
my $UserName = "ppeng";
my $Password = "bmcy4ax7";
my @Q_CMDS = (); #a queue for all incoming commands
my $RequestKey = "Website jMap Building Request";

my $jmap_Path = &getJmapHome();
my $session_file = "$jmap_Path/conf/"."session.txt";
my $config_file = "$jmap_Path/conf/jMap.conf";
my $command_file = "$jmap_Path/conf/commands.txt";
my $stop_file = "$jmap_Path/conf/stop.txt";
my $pop3svr_logfile = "$jmap_Path/log/pop3svr.log";
my $log_msg ="Website jMap Building Mail Server log.\n\n";
my $webjmap_exe = "webjmapm.pl";

if (!( -e $pop3svr_logfile)) {
      if (open(POPLOG, ">$pop3svr_logfile")){
            print POPLOG $log_msg;
      }#end if
} #end if


my $interval = 3; #every 15 minutes to check email
my $SID =0;


#read in above configuration file path and vars to update
read_config();
set_stop("0");  #set stop flag to 0

while (1) {
#flush command Queue
      sleep($interval);
      print  get_timestamp(), ": POP3 server is awake now....\n";
      write_log("POP3 server is awake now....");
      @Q_CMDS = ();

      if (check_stop()) { # jMap is busy
            print "jMap Pop3 Server is stopping now ...\n";
            write_log("jMap Pop3 Server is stopping now ...");
            exit(0);
      }

# Create a new POP3 object
      write_log("Try to connect to server.");
      my $pop3 = Net::POP3->new($ServerName, Debug => $DEBUG);

# If you can't connect, don't proceed with the rest of the script
#     die "Couldn't log on to server.\n"  unless $pop3;
      if (!defined($pop3)) {
            print "---> Couldn't log on to server.\n" ;
            write_log("Couldn't log on to server.") ;
            next;
        }

      my $Num_Messages = $pop3->login($UserName, $Password);
      print "---> Login to POP3 server is sucessful. Total $Num_Messages
mails.\n";
      write_log("Login to POP3 server is sucessful. Total $Num_Messages
mails.");
# Get the list of messages
      my $Messages;
      my $msg_id;
      $SID = &get_sid();
      my $init_sid = $SID;
      $Messages = $pop3->list();

# Parse each message header for "From" and "Subject" fields
      foreach $msg_id (keys(%$Messages))
      {
            my $MsgContent = $pop3->top($msg_id, 20);
#    print join("\n", @{$MsgContent});
#    <STDIN>;
            if (extract_cmds(@$MsgContent)) {
                  $pop3->delete($msg_id);
            } else {
                  $SID = $init_sid; #roll back sid
            }
      } #end foreach

# Close the connection
      $pop3->quit();
      if ($SID > $init_sid) {
            &save_sid($SID);
      }

      my $num_cmd = scalar(@Q_CMDS);
      my $processed_cmds=0;
      if ($num_cmd >0) {  # process all the commands from Queue
            while (write_command()|| $processed_cmds < $num_cmd)
            {
              system("perl $webjmap_exe");
              $processed_cmds++;
              write_log("Webjmapm.pl was called, the $processed_cmds
request was processed.");
            }
      } #end if
} #end while

print "Server exits, no more service is available.";
write_log("Server exits, no more service is available.\n\n");
exit(0);

1;

# This subroutine parses the "From" and "Subject" fields of a message
header
sub extract_cmds
```

```
{
 # Assign parameter to a local variable
 my (@lines) = @_;

 # Declare local variables
 my ($from, $line, $subject, $return_addr);
 my @CMDS =(); #my local array to store commands
# my $cmd = "";
 # Check each line in the header
 foreach $line (@lines)
 {
   if($line =~ m/^From: (.*)/)
   {
      # We found the "From" field, so let's get what we need
      $from = $1;
      if ($from =~ /\<(.*)\>/)
      {
#           print "Email: $1\n";
            $from = $1;
            push(@CMDS, "mailto:\t$from");
#           $cmd = "mailto:\t$from\n";
      }
#      $from =~ s/"|<.*>//g;
#      $from = substr($from, 0, 39);
  }
  elsif( $line =~ m/^Subject: (.*)/)
  {
      # We found the "Subject" field, so let's get what we need
      $subject = $1;
#      $subject = substr($subject, 0, 29);
   }
  elsif ( $line =~ m/(http:\/\/)(.*)\s+(\d+)\s+(\d+)\s+(\d+)\s+(\d+)/) {
      $SID++;
      push(@CMDS, "$SID\t$1"."$2\t"."$3\t"."$4\t"."$5\t"."$6");
#     $cmd .= "$SID\t$1"."$2\t"."$3\t"."$4\t"."$5\t"."$6\n";
   }
   # If we have parsed the "From" and "Subject" field, then we don't
need
   # to keep on going.  Let's quit the loop here.
#   last if( defined($subject) && defined($from));
  } #end foreach

  # Print the result
  printf "\n\nFrom: %-40s \nSubject: %s\n", $from, $subject;

  if ( $subject =~ /$RequestKey/i ) {
      #print commands
      my $cm = join("\n", @CMDS);
      print "Yes, this is a Request. \n$cm \n";
      push(@Q_CMDS, $cm );
      return 1;
  }
  return 0;
}# end: PrintList()

sub getJmapHome{
      use Cwd;
      chdir("..");
      my $home = getcwd();
      chdir("bin");
      return $home;
}

sub get_sid {
#$sessionfile = "session.txt";
   open(SESS, "<$session_file")||  die("Cannot open session file for
validation.\n");
   my $sess_id=0;
   while (<SESS>){
        chomp();
        if (/^(\d+)/)
        {
            $sess_id = $1;
             last;
         } # end else
       }  #end while
   close(SESS);
   return $sess_id;
}

sub save_sid {
      my $sid3 = shift(@_);
      $sid3 += 1;
      open(SESS1, ">$session_file")||die("unable to open session.txt to
overwrite\n");
      print "\nTHis is the new sid: ", $sid3;
      print SESS1 "$sid3\n";
      close(SESS1);
}

sub write_command {
   my $mresult = 0;
   open(CMD, ">$command_file") || return 0;  #failed, so give up
   my $cmdss = shift(@Q_CMDS);
   print "****Writing commands to $command_file\n$cmdss\n";
   if (defined($cmdss)) {
      print "Writing commands to $command_file\n$cmdss\n";
      print CMD $cmdss;
      $mresult = 1;
   }else {
      print "No more commands to $command_file\n$cmdss\n";
      $mresult = 0;
   }
   close(CMD);
   write_log("This is the request:\n$mresult");
   return $mresult;
}

sub set_stop {
      #input 0 or 1
      my $stp = shift();
      open(STOP, ">$stop_file") || return;
      print STOP "STOP=$stp\n"; # currently only one line
      close(STOP);
```

```
}

sub check_stop {
# read user message to stop the program
  open(STOP, "<$stop_file") || return;
  my $cmd = <STOP>; # currently only one line
  close(STOP);

  if ($cmd =~ /STOP\=1/) { return 1; }
  else { return 0;}
}

sub read_config {
#read in jMap.conf configuration parameters
open (CONF, "<$config_file") ||
      print STDERR  "Reading configuration file $config_file file
failed.\n";

# $OS = "WIN32";  # WIN32 or UNIX
# $version = "Website jMap Builder 4.1.1";
   while (<CONF>) {
      chomp();
      if ( /POP3 Server =\s+(.*)/) { $ServerName = $1;}
      elsif ( /POP3 User\s+=\s+WIN32$/) { $UserName = $1;}
      elsif (/POP3 Password\s+=\s+(.*)$/){ $Password = $1 }
      elsif (/Request Subject\s+=\s+(.*)$/){ $RequestKey = $1;}
      }
close(CONF);
print STDERR "ServerName: $ServerName\n";
print STDERR "User: $UserName\n";
print STDERR "Password: $Password\n";
#Email configuration to automate sending jMap to user
}

sub write_log {
#write log file:  timestamp: $msg\n
      my $msg = shift();
      open(POPLOG, ">>$pop3svr_logfile") || return;
      print POPLOG get_timestamp(), ": $msg\n";
      close (POPLOG);

}

sub get_timestamp{
#return a time stamp with format: 2002-2-28 15:22:23
#   my ($sec,$min,$hour,$mday,$mon,$year,$wday,$yday,$isdst) =
localtime(time);
#  return "$year\-$mon\-$mday $hour:$min:$sec";
      my $ts = localtime();
#     Sat Feb  9 21:06:56 2002
      if ($ts =~ /(\w+)\s+(\w+)\s+(\d+)\s+(\d+)\:(\d+)\:(\d+)\s+(\d+)/ )
      {
            $ts = "$7\-$2\-$3 $4\:$5\:$6";
      }
      return $ts;
}
```

A-4 PERL/TK GUI

A-4.1 gui.pl

```
#Revision History
#  Version    Date      Changes
#  3.0        21-08-00  Add stop, wait, style function to allow use stop
#                       at any time
#  3.1        5-09-00   Add token number in the processing param line
#  4.0        5-03-01   allow multiple mapping
use Tk;

my $root = "";
my $level=5;
my $max_url =210;
my $join_chk=0;
my $email_chk =0;  #email notification of the jMap is turned off in GUI
my $num_root =0;
my $sidx =0;
my $version =  "Website jMap Builder 4.2.0";

# messages
my $readme = "Please fill in the entry fields and click start\nIn
$version, you do not need to prefix URL with \"http://\"\n";
my $msg_warning = "Microsoft Excel cannot handle more than 234
columns\nPlease choose a maxium number of url not more than its limit.";
my $msg_waiting ="Starting retrieving information from site, please
click view log and wait.\n";
my $msg =$readme;
my $command = "";

# file names
my $jmap_Path = &getJmapHome();
my $jmap_tmp_file = "$jmap_Path/jmaps/"."jmap.txt";
my $report = "$jmap_Path/jmaps/"."JmapReport.txt";
my $log ="$jmap_Path/tmp/"."jmap.log";
my $stop_file = "$jmap_Path/conf/"."Stop.txt";
my $command_file = "$jmap_Path/conf/"."commands.txt";
my $session_file = "$jmap_Path/conf/"."session.txt";
my $jmap_exe = "$jmap_Path/bin/"."webjmapg.pl";
my $jmap_style =1;
my $receiver = "Philip.Peng\@tic.siemens.ca";

if (-e "$jmap_tmp_file") { unlink ("$jmap_tmp_file");}
#if (!(-e "$log"))
#   {
        open(LOG, ">$log");
        print LOG "$readme\n";
        close(LOG);
#   }


$mwin = MainWindow->new();
```

```
$mwin->title($version);
$menu = $mwin->Menu();
$menu->add('command', -label=>'File');
$lbl_text1 = $mwin->Label(-text => "$version\nCopyright@ 1999-2000 by
Gen-strategies",
                          -background => 'orange',
                          -foreground => 'blue',
                          -anchor => 'n',
                          -relief => 'groove',
                          -width => 60,
                          -height => 2
                         );
$lbl_text1->pack();

#divide GUI to four frames
$fm_top = $mwin ->Frame()->pack(-side => 'top', -fill=>'both');
$fm_left = $mwin ->Frame()->pack(-side => 'left', -fill=>'both');
$fm_right = $mwin ->Frame()->pack(-side => 'right', -fill=>'both');
$fm_btm = $mwin ->Frame()->pack(-side => 'bottom', -fill=>'both');

#two frames in top frame
$fm_top_left = $fm_top->Frame()->pack(-side => 'left', -fill=>'both');
$fm_top_right = $fm_top->Frame()->pack(-side => 'right', -fill=>'both');

#TOP_LEFT TOP & BTM FRAMES
$fm_top_left_top = $fm_top_left->Frame()->
            pack(-side => 'top', -fill=>'both');
$fm_top_left_btm = $fm_top_left->Frame()->
            pack(-side => 'bottom', -fill=>'both');

#URL
$lbl_root = $fm_top_left_top ->Label(text => 'Site URL: ',
                        relief => 'groove',
                        width => 10,
                        height => 2
                        )->pack(-side => 'left');

$etr_root = $fm_top_left_top -> Entry( -textvariable => \$root,
                            -width=>50,
                            -background => 'white')
                  ->pack(-side => 'left');

#Session ID
$lbl_session = $fm_top_left_btm ->Label(text => 'Session ID: ',
                        relief => 'groove',
                        width => 11,
                        height => 2
                        )->pack(-side => 'left');

$sidx = &get_sid();
$etr_session = $fm_top_left_btm -> Entry( -textvariable => \$sidx,
                            -width=>5,
                            -state=>'disabled',
                            -background => 'white')
                  ->pack(-side => 'left');
$lbl_level = $fm_top_left_btm ->Label(-text => 'Max Level: ',
                         -relief => 'groove',
                          -width => 12,
                          -height => 2
                          )
                 ->pack(-side => 'left');


$etr_level = $fm_top_left_btm  -> Entry( -textvariable => \$level,
                             -width=>2,

                             -background => 'white')
                  ->pack(-side => 'left');

$lbl_mx_url  = $fm_top_left_btm ->Label(text => 'Max URLs: ',
                        relief => 'groove',
                        width => 10,
                        height => 2
                        )->pack(-side => 'left');

$etr_mx_url = $fm_top_left_btm -> Entry( -textvariable => \$max_url,
                             -width=>3,
                             -background => 'white')
                  ->pack(-side => 'left');

$lbl_isJoin = $fm_top_left_btm ->Label(text => 'In Group:',
                        relief => 'groove',
                        width => 10,
                        height => 2
                        )->pack(-side => 'left');
$chk_isJoin =  $fm_top_left_btm -> Checkbutton(-variable => \$join_chk)
            ->pack(-side => 'left');

#TOP FRAME RIGHT BUTTONS
$addButton= $fm_top_right ->Button(text => 'Add',
                       command => \&add_root)
                        -> pack(-side=> 'left');

$delButton= $fm_top_right ->Button(text => 'Delete',
                       command => \&del_root)
                        -> pack(-side=> 'left');

$button= $fm_top_right ->Button(text => 'Start',
                  -state => 'disabled',
                       command => \&change_label)
                        -> pack(-side=> 'left');

# $fml = $mwin ->Frame()->pack(-side => 'right');
  $lstBox = $fm_left->Listbox(      -height=>20,
                        -selectmode => 'multiple',
                        -width =>40)
                        ->pack(-side=>'left');

$txt_t = $fm_right ->Scrolled("Text", -scrollbars => 'se');

$txt_t->pack(-expand=>1);
$txt_t -> insert('end', $readme);
$rpt_id = $txt_t -> repeat(500, \&refresh_txt);
```

```
MainLoop();

sub refresh_txt {
          $txt_t -> delete('1.0', 'end');
          if ($button->cget('text') eq "Stop" ||
            $button->cget('text') eq "View Report"||
            $button->cget('text') eq "Wait"
           )
          {
           $msg = "";
           open(LOG, "$log") || return;
           while (<LOG>)
            {
              $msg .= $_;
              if (($msg =~ /click View report/)
                  && (   $button->cget('text') eq 'Stop'
                    ||$button->cget('text') eq 'View Report'
                    ||$button->cget('text') eq 'Wait'
                  )
             )
              {
                $button -> configure( -text => 'View Report');
              }
              elsif (($msg =~ /Please start again/)
                  && ($button->cget('text') eq 'View Report'
                || $button->cget('text') eq 'Stop')
                )
              {
                $button -> configure( -text => 'Start');
              }
            }
           close(LOG);
          }
          $txt_t -> insert('end', $msg);
#          $txt_t -> yviewScroll(2, "units");
           $txt_t -> Subwidget("yscrollbar")
                 -> configure(-background => 'blue');
#           $txt_t -> yviewMoveto(1);
}

sub change_label {
my $textin = "Hello, this is jmap";
my $cmds = "";

   if ($button->cget('text') eq "Start")
   {
      $addButton->configure(-state=>'disabled');
      $delButton->configure(-state=>'disabled');
      &save_sid($sidx);
        if ($max_url > 250)
        {
          $txt_t -> delete('1.0', 'end');
          $msg = $msg_warning;
          $txt_t -> insert('end', $msg);
          $button -> bell();
        }
        else
```

```
    {
     my @allCmds = $lstBox->get(0, end);
     open(CMD, ">$command_file");
     for ($j=0; $j<scalar(@allCmds); $j++)
     {
      print CMD "mailto:\t$receiver\n";
      print CMD "$allCmds[$j]\n";
     }
     close(CMD);
     $txt_t -> delete('1.0', 'end');
     $msg = $msg_waiting;
     $txt_t -> insert('end', $msg);
     $button->configure(text => 'Stop');
     open(LOG, ">$log");
     print LOG "Start processing urls.\n";
     print LOG "The following url will be explored:\n";
     print LOG $cmds;
     close(LOG);
     open(FH, "perl $jmap_exe |");
    }
  }

#=headl

  elsif ($button ->cget('text') eq "Stop")
  {
    $txt_t -> delete('1.0', 'end');
    my $msg = "STOP=1";
    open(STOP, ">$stop_file")||return;
   print STOP $msg;
   close(STOP);
    $txt_t -> insert('end', "\n\n===>now stoping ....\n");
   open(LOG, ">$log")||return;
   print LOG "\n=====> Now $version is trying to stop the engine,
please wait for......\n\tone more page being processed.\n\n";
   close(LOG);
    $button->configure(text => 'Wait');
  }

#=cut


  elsif ($button ->cget('text') eq "View Report")
  {
    $txt_t -> delete('1.0', 'end');
    $msg ="";
    open(RP, "$report");
    foreach (<RP>) {
     $msg .= $_;
    }
    close(RP);
    $txt_t -> insert('end', $msg);
    $rpt_id -> cancel();
    $button->configure(text => 'Exit');
  }
  elsif ($button->cget('text') eq "Exit")
  {
        exit;
    }

}

sub get_sid {
#$sessionfile = "session.txt";
      open(SESS, "<$session_file")||  die("Cannot open session file for
validation.\n");
   my $sess_id=0;
   while (<SESS>){
        chomp();
        if ($_ =~ /^(\d+)/) {   # $mysid is a local variable
             $sess_id = $1;
              break;
         } # end else
       }  #end while
      close(SESS);
#     print join("\n", @sess_id);
      return $sess_id;
}

sub save_sid {
      my $sid3 = shift(@_);
      $sid3 += 1;
      open(SESS1, ">$session_file")||die("unable to open session.txt to
overwrite\n");
      print "\nTHis is the new sid: ", $sid3;
      print SESS1 "$sid3\n";
      close(SESS1);
}

sub add_root {
      if ($root eq "") { return;}
      $button->configure(-state=>'active');
      $lstBox->activate($num_root++);
      $lstBox-> insert($num_root,
"$sidx\thttp://$root\t$level\t$max_url\t$jmap_style\t$join_chk\t$email_c
hk");
      $lstBox -> selectionAnchor($num_root);
      $lstBox -> see ($num_root);
      $sidx++;
      $root ="";
      $level=5;
      $max_url =210;
      $join_chk=0;

}

sub del_root {
      my @selectedItems = $lstBox->curselection();
      for ($i=0; $i<scalar(@selectedItems); $i++)
      {
            $lstBox->delete(active); #$selectedItems[$i]
      }
      $lstBox->selectionAnchor(0);
      $lstBox ->see(active);
      my @allCmds = $lstBox->get(0, end);
      if (scalar(@allCmds) == 0)
      {
            $button->configure(-state=>'disabled');
      }
}

sub getJmapHome{
      use Cwd;
      chdir("..");
      my $home = getcwd();
      chdir("bin");
      return $home;
}
```

A-5 Shell Batch Files

A-5.1 DOS gui.bat

```
perl gui.pl
```

A-5.2 DOS jmap.bat

```
perl gui.pl
```

A-5.3 UNIX gui

```
#!/usr/bin/sh
perl gui.pl
```

A-5.4 UNIX jmap

```
#!/usr/bin/sh
perl gui.pl
```

Appendix B: An Example of Web Site jMap Model

The following section shows a hard copy of the recovered jMap web site model by this program from www.cs.concordia.ca. The total 45 URLs have been retrieved and analysed to build this web site jMap model as an example.

45	1	(LEVEL)		
1		0		
45	211	(HTML/TEXT)	(TITLE)	(SIZE)
19		http://www.cs.concordia.ca/	Computer Science	10477
20		http://www.cs.concordia.ca/CS.css	http://www.cs.concordia.ca/CS.css	185
19		http://www.cs.concordia.ca/index.html	Computer Science	10477
19		http://www.cs.concordia.ca/search/search.html	Search	6584
19		http://www.cs.concordia.ca/people/contacts.html	Department of Computer Science- Contacts	11809
3		http://www.cs.concordia.ca/sitemap.html	Department of Computer Science- Site Map	14421
8		http://www.cs.concordia.ca/prospective_students.html	Concordia University - Department of Computer Science - Prospective Students	7379
8		http://www.cs.concordia.ca/current_students.shtml	Concordia University - Department of Computer Science - Current Students	34704
11		http://www.cs.concordia.ca/department/announcements/announcements.html	Department of Computer Science- Announcements	6969
8		http://www.cs.concordia.ca/department/admissions/admissions.html	Department of Computer Science - Admissions	6869
11		http://www.cs.concordia.ca/events/events.html	Department of Computer Science- Events	8118
7		http://www.cs.concordia.ca/department/location.html	Department of Computer Science - Location	6963
12		http://www.cs.concordia.ca/department/facilities/facequ.html	Department of Computer Science - Facilities and Equipment	7867
8		http://www.cs.concordia.ca/department/hiring.html	Department of Computer Science- Career Opportunities	14603
6		http://www.cs.concordia.ca/programs/ugrad/courses.html	Department of Computer Science- Undergraduate Courses	10830
5		http://www.cs.concordia.ca/programs/grad/diploma/courses.html	Department of Computer Science- Diploma Courses' Home Page	8250
6		http://www.cs.concordia.ca/programs/grad/courses.html	Department of Computer Science- Graduate Courses	13792
4		http://www.cs.concordia.ca/programs/ugrad/coop/employers.html	Department of Computer Science - Co-op Information for Potential Employers	9930
11		http://www.cs.concordia.ca/department/about.html	About the Department of Computer Science at Concordia	8106
11		http://www.cs.concordia.ca/people/people.html	Department of Computer Science - People	8118
12		http://www.cs.concordia.ca/research/research.html	http://www.cs.concordia.ca/research/research.html	0
8		http://www.cs.concordia.ca/help/help.html	http://www.cs.concordia.ca/help/help.html	0
10		http://www.cs.concordia.ca/department/disclaimer.html	http://www.cs.concordia.ca/department/disclaimer.html	0
2		http://www.weather.ca/cities/can/Montreal_QC.htm	http://www.weather.ca/cities/can/Montreal_QC.htm	0
4		http://www.cs.concordia.ca/people/staff.htm	http://www.cs.concordia.ca/people/staff.htm	0
2		http://www.cs.concordia.ca/events/conferences/conferences.html	http://www.cs.concordia.ca/events/conferences/conferences.html	0
2		http://www.cs.concordia.ca/events/seminars/seminars.shtml	http://www.cs.concordia.ca/events/seminars/seminars.shtml	0
2		http://www.cs.concordia.ca/events/defences/defences.shtml	http://www.cs.concordia.ca/events/defences/defences.shtml	0
4		http://www.cs.concordia.ca/programs/ugrad/soen/soen.html	http://www.cs.concordia.ca/programs/ugrad/soen/soen.html	0
4		http://www.cs.concordia.ca/programs/ugrad/cs/cs.html	http://www.cs.concordia.ca/programs/ugrad/cs/cs.html	0
1		http://www.cs.concordia.ca/programs/ugrad/cs/curriculum.htm	http://www.cs.concordia.ca/programs/ugrad/cs/curriculum.htm	0
3		http://www.cs.concordia.ca/programs/ugrad/cs/digital.html	http://www.cs.concordia.ca/programs/ugrad/cs/digital.html	0
4		http://www.cs.concordia.ca/programs/ugrad/coop/coop.html	http://www.cs.concordia.ca/programs/ugrad/coop/coop.html	0
4		http://www.cs.concordia.ca/programs/ugrad/honours/honours.html	http://www.cs.concordia.ca/programs/ugrad/honours/honours.html	0
6		http://www.cs.concordia.ca/programs/grad/diploma/diploma.html	http://www.cs.concordia.ca/programs/grad/diploma/diploma.html	0
5		http://www.cs.concordia.ca/programs/grad/masters/master.html	http://www.cs.concordia.ca/programs/grad/masters/master.html	0
6		http://www.cs.concordia.ca/programs/grad/PhD/phd.html	http://www.cs.concordia.ca/programs/grad/PhD/phd.html	0
2		http://www.cs.concordia.ca/department/facilities/hours.html	http://www.cs.concordia.ca/department/facilities/hours.html	0
2		http://www.cs.concordia.ca/department/facilities/courses.html	http://www.cs.concordia.ca/department/facilities/courses.html	0
1		http://www.cs.concordia.ca/department/facilities/ugrad_labs.html	http://www.cs.concordia.ca/department/facilities/ugrad_labs.html	0
2		http://www.cs.concordia.ca/department/facilities/grad_labs.html	http://www.cs.concordia.ca/department/facilities/grad_labs.html	0
2		http://www.cs.concordia.ca/department/facilities/lab_policies.html	http://www.cs.concordia.ca/department/facilities/lab_policies.html	0
2		http://www.cs.concordia.ca/department/facilities/lars_policy.html	http://www.cs.concordia.ca/department/facilities/lars_policy.html	0
1		http://www.cs.concordia.ca/department/facilities/accounts.html	http://www.cs.concordia.ca/department/facilities/accounts.html	0
1		http://www.cs.concordia.ca/department/facilities/login.html	http://www.cs.concordia.ca/department/facilities/login.html	0
2		http://www.cs.concordia.ca/department/facilities/researchlabs.html	http://www.cs.concordia.ca/department/facilities/researchlabs.html	0
1		http://www.cs.concordia.ca/programs/ugrad/coop/current.html	http://www.cs.concordia.ca/programs/ugrad/coop/current.html	0
4		http://www.cs.concordia.ca/department/mission.html	http://www.cs.concordia.ca/department/mission.html	0
6		http://www.cs.concordia.ca/department/floors/floors.html	http://www.cs.concordia.ca/department/floors/floors.html	0
3		http://www.cs.concordia.ca/people/faculty.html	http://www.cs.concordia.ca/people/faculty.html	0
4		http://www.cs.concordia.ca/people/staff.html	http://www.cs.concordia.ca/people/staff.html	0
3		http://www.cs.concordia.ca/people/graduates.html	http://www.cs.concordia.ca/people/graduates.html	0
1		http://www.cs.concordia.ca/people/gradrooms.html	http://www.cs.concordia.ca/people/gradrooms.html	0
2		http://www.cs.concordia.ca/people/associations.html	http://www.cs.concordia.ca/people/associations.html	0
2		http://www.cs.concordia.ca/people/phonedir.html	http://www.cs.concordia.ca/people/phonedir.html	0
1		http://www.cs.concordia.ca/research/researchareas.html	http://www.cs.concordia.ca/research/researchareas.html	0
1		http://www.cs.concordia.ca/research/collaboration.html	http://www.cs.concordia.ca/research/collaboration.html	0
1		http://www.cs.concordia.ca/research/relationships.html	http://www.cs.concordia.ca/research/relationships.html	0
1		http://www.cs.concordia.ca/research/rescenters.html	http://www.cs.concordia.ca/research/rescenters.html	0
1		http://www.cs.concordia.ca/help/tutorials/tutorials.html	http://www.cs.concordia.ca/help/tutorials/tutorials.html	0
1		http://www.cs.concordia.ca/help/faq/faq.html	http://www.cs.concordia.ca/help/faq/faq.html	0
1		http://www.cs.concordia.ca/help/problems.html	http://www.cs.concordia.ca/help/problems.html	0
1		http://www.cs.concordia.ca/help/helpdesk.html	http://www.cs.concordia.ca/help/helpdesk.html	0
1		http://www.cs.concordia.ca/help/monitor.html	http://www.cs.concordia.ca/help/monitor.html	0
2		http://www.cs.concordia.ca/department/policies/policies.html	http://www.cs.concordia.ca/department/policies/policies.html	0
1		http://www.cs.concordia.ca/lab_assignments_winter_2002.html	http://www.cs.concordia.ca/lab_assignments_winter_2002.html	0
1		http://www.cs.concordia.ca/department/announcements/service_desk.html	http://www.cs.concordia.ca/department/announcements/service_desk.html	0
1		http://www.cs.concordia.ca/department/announcements/assignmentelectronically.html	http://www.cs.concordia.ca/department/announcements/assignmentelectronically.html	0
1		http://www.cs.concordia.ca/department/announcements/uploadfile.html	http://www.cs.concordia.ca/department/announcements/uploadfile.html	0
1		http://www.cs.concordia.ca/department/announcements/sharefile.html	http://www.cs.concordia.ca/department/announcements/sharefile.html	0
1		http://www.cs.concordia.ca/department/announcements/map.html	http://www.cs.concordia.ca/department/announcements/map.html	0
1		http://www.cs.concordia.ca/department/announcements/diploma.html	http://www.cs.concordia.ca/department/announcements/diploma.html	0
1		http://www.cs.concordia.ca/department/announcements/ugrad.html	http://www.cs.concordia.ca/department/announcements/ugrad.html	0
1		http://www.cs.concordia.ca/department/announcements/soen.html	http://www.cs.concordia.ca/department/announcements/soen.html	0
1		http://www.cs.concordia.ca/department/announcements/undergraduate.html	http://www.cs.concordia.ca/department/announcements/undergraduate.html	0
1		http://www.cs.concordia.ca/department/announcements/graduate.html	http://www.cs.concordia.ca/department/announcements/graduate.html	0
1		http://www.cs.concordia.ca/department/announcements/newugrad.html	http://www.cs.concordia.ca/department/announcements/newugrad.html	0
1		http://www.cs.concordia.ca/department/admissions/ugrad.htm	http://www.cs.concordia.ca/department/admissions/ugrad.htm	0
1		http://www.cs.concordia.ca/programs/ugrad/coop/admission.html	http://www.cs.concordia.ca/programs/ugrad/coop/admission.html	0
1		http://www.cs.concordia.ca/department/admissions/grad.htm	http://www.cs.concordia.ca/department/admissions/grad.htm	0
1		http://www.cs.concordia.ca/events/other.html	http://www.cs.concordia.ca/events/other.html	0
				0

											1									1		http://www.concordia.ca/about/tour/sgw1.shtml	http://www.concordia.ca/about/tour/sgw1.shtml		0
												1								1		http://www.cs.concordia.ca:81/help/problems.html	http://www.cs.concordia.ca:81/help/problems.html		0
												1								1		http://www.cs.concordia.ca/department/facilities/teachlabs.html	http://www.cs.concordia.ca/department/facilities/teachlabs.html		0
												1								1		http://www.cs.concordia.ca/department/facilities/printers.html	http://www.cs.concordia.ca/department/facilities/printers.html		0
1		1		1	1					1	1		1					1	1	9		http://www.cs.concordia.ca/department/hiring.htm	http://www.cs.concordia.ca/department/hiring.htm		0
1		1			1		1							1						5		http://www.cs.concordia.ca/programs/ugrad/courses.htm	http://www.cs.concordia.ca/programs/ugrad/courses.htm		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/cs/comp201.shtml	http://www.cs.concordia.ca/programs/ugrad/cs/comp201.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/cs/comp212.shtml	http://www.cs.concordia.ca/programs/ugrad/cs/comp212.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/cs/comp218.shtml	http://www.cs.concordia.ca/programs/ugrad/cs/comp218.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/cs/comp248.shtml	http://www.cs.concordia.ca/programs/ugrad/cs/comp248.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/cs/comp249.shtml	http://www.cs.concordia.ca/programs/ugrad/cs/comp249.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/cs/comp348.shtml	http://www.cs.concordia.ca/programs/ugrad/cs/comp348.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/cs/comp352.shtml	http://www.cs.concordia.ca/programs/ugrad/cs/comp352.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/cs/comp238.shtml	http://www.cs.concordia.ca/programs/ugrad/cs/comp238.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/cs/comp239.shtml	http://www.cs.concordia.ca/programs/ugrad/cs/comp239.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/cs/comp335.shtml	http://www.cs.concordia.ca/programs/ugrad/cs/comp335.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/cs/comp361.shtml	http://www.cs.concordia.ca/programs/ugrad/cs/comp361.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/cs/comp367.shtml	http://www.cs.concordia.ca/programs/ugrad/cs/comp367.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/cs/comp465.shtml	http://www.cs.concordia.ca/programs/ugrad/cs/comp465.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/cs/comp228.shtml	http://www.cs.concordia.ca/programs/ugrad/cs/comp228.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/cs/comp229.shtml	http://www.cs.concordia.ca/programs/ugrad/cs/comp229.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/cs/comp346.shtml	http://www.cs.concordia.ca/programs/ugrad/cs/comp346.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/cs/comp326.shtml	http://www.cs.concordia.ca/programs/ugrad/cs/comp326.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/cs/comp442.shtml	http://www.cs.concordia.ca/programs/ugrad/cs/comp442.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/cs/comp444.shtml	http://www.cs.concordia.ca/programs/ugrad/cs/comp444.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/cs/comp445.shtml	http://www.cs.concordia.ca/programs/ugrad/cs/comp445.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/soen/soen422.shtml	http://www.cs.concordia.ca/programs/ugrad/soen/soen422.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/soen/soen423.shtml	http://www.cs.concordia.ca/programs/ugrad/soen/soen423.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/cs/comp353.shtml	http://www.cs.concordia.ca/programs/ugrad/cs/comp353.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/cs/comp451.shtml	http://www.cs.concordia.ca/programs/ugrad/cs/comp451.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/cs/comp457.shtml	http://www.cs.concordia.ca/programs/ugrad/cs/comp457.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/cs/comp458.shtml	http://www.cs.concordia.ca/programs/ugrad/cs/comp458.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/cs/comp472.shtml	http://www.cs.concordia.ca/programs/ugrad/cs/comp472.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/cs/comp474.shtml	http://www.cs.concordia.ca/programs/ugrad/cs/comp474.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/cs/comp473.shtml	http://www.cs.concordia.ca/programs/ugrad/cs/comp473.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/soen/soen282.shtml	http://www.cs.concordia.ca/programs/ugrad/soen/soen282.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/soen/soen321.shtml	http://www.cs.concordia.ca/programs/ugrad/soen/soen321.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/cs/comp354.shtml	http://www.cs.concordia.ca/programs/ugrad/cs/comp354.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/cs/comp454.shtml	http://www.cs.concordia.ca/programs/ugrad/cs/comp454.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/soen/soen337.shtml	http://www.cs.concordia.ca/programs/ugrad/soen/soen337.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/soen/soen341.shtml	http://www.cs.concordia.ca/programs/ugrad/soen/soen341.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/soen/soen342.shtml	http://www.cs.concordia.ca/programs/ugrad/soen/soen342.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/soen/soen343.shtml	http://www.cs.concordia.ca/programs/ugrad/soen/soen343.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/soen/soen344.shtml	http://www.cs.concordia.ca/programs/ugrad/soen/soen344.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/soen/soen345.shtml	http://www.cs.concordia.ca/programs/ugrad/soen/soen345.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/soen/soen383.shtml	http://www.cs.concordia.ca/programs/ugrad/soen/soen383.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/soen/soen402.shtml	http://www.cs.concordia.ca/programs/ugrad/soen/soen402.shtml		0
														1						1		http://www.cs.concordia.ca/programs/ugrad/soen/soen431.shtml	http://www.cs.concordia.ca/programs/ugrad/soen/soen431.shtml		0
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							1													1		http://www.cs.concordia.ca/cgi-bin/Course.cgi?file=Schedule_Winter_2002&course=comp+34	http://www.cs.concordia.ca/cgi-bin/Course.cgi?file=Schedule_Winter_2002&course=comp+346		0
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1		http://www.cs.concordia.ca/cgi-bin/Course.cgi?file=Schedule_Winter_2002&course=comp+784	http://www.cs.concordia.ca/cgi-bin/Course.cgi?file=Schedule_Winter_2002&course=comp+784		0
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1		http://www.cs.concordia.ca/cgi-bin/Course.cgi?file=Schedule_Winter_2002&course=soen+282	http://www.cs.concordia.ca/cgi-bin/Course.cgi?file=Schedule_Winter_2002&course=soen+282		0
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2		Computer Science	Computer Science	
1		Concordia University - Department of Computer Science - Current Students	Concordia University - Department of Computer Science - Current Students	
1		Concordia University - Department of Computer Science - Prospective Students	Concordia University - Department of Computer Science - Prospective Students	
1		Department of Computer Science - Admissions	Department of Computer Science - Admissions	
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1		Department of Computer Science - People	Department of Computer Science - People	
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1		Department of Computer Science- Contacts	Department of Computer Science- Contacts	
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1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	19		http://www.cs.concordia.ca/department/announcements/uploadfile.html	Uploading files	This link was not processed
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					1							1								2		http://www.cs.concordia.ca/department/facilities/accounts.html	Computer Accounts	This link was not processed
					1															1		http://www.cs.concordia.ca/department/facilities/acc_policy.html	Access Policies	This link was not processed
												1								1		http://www.cs.concordia.ca/department/facilities/courses.html	Courses Supported in the Teaching Labs This Term	This link was not processed
1		1				21	21	21			21			21	21	21		21		10		http://www.cs.concordia.ca/department/facilities/courses.html	Courses Supported this Term	This link was not processed
					1															1		http://www.cs.concordia.ca/department/facilities/faceqpu.html	Facilities & Equipment	Department of Computer Science - Facilities and Equipment
					1															1		http://www.cs.concordia.ca/department/facilities/faceqpu.html	Facilities and Equipment	Department of Computer Science - Facilities and Equipment
												1								1		http://www.cs.concordia.ca/department/facilities/grad_labs.html	Graduate Laboratories	This link was not processed
					1							1								2		http://www.cs.concordia.ca/department/facilities/grad_labs.html	Graduate Labs	This link was not processed
					1							1								2		http://www.cs.concordia.ca/department/facilities/hours.html	Lab Hours	This link was not processed
					1															1		http://www.cs.concordia.ca/department/facilities/lab_policies.html	Lab Policies	This link was not processed
												1								1		http://www.cs.concordia.ca/department/facilities/login.html	Login Information	This link was not processed
					1															1		http://www.cs.concordia.ca/department/facilities/printers.html	Where the printers are located?	This link was not processed
																						http://www.cs.concordia.ca/department/facilities/researchlabs.html	Research Laboratories	This link was not processed

												1								1		http://www.cs.concordia.ca/department/facilities/researchlabs.html	Research Labs	This link was not processed
												1								1		http://www.cs.concordia.ca/department/facilities/teachlabs.html	Teaching Labs	This link was not processed
					1															1		http://www.cs.concordia.ca/department/facilities/ugrad_labs.html	Undergraduate Laboratories	This link was not processed
					1		2				2	2						2		6		http://www.cs.concordia.ca/department/floors/floors.html	Floor Plans	This link was not processed
																		1		1		http://www.cs.concordia.ca/department/grad_figures.gif	445 graduate students	This link was not processed
													2							1		http://www.cs.concordia.ca/department/hiring.html	http://www.cs.concordia.ca/department/hiring.html	Department of Computer Science- Career Opportunities
1		1		2	2					2	2							2	2	8		http://www.cs.concordia.ca/department/hiring.html	Career Opportunities	Department of Computer Science- Career Opportunities
													1							1		http://www.cs.concordia.ca/department/hiring.html#comp_fac	Tenure-Track and Instructor Positions – Computing and Communications	This link was not processed
													1							1		http://www.cs.concordia.ca/department/hiring.html#soen_fac	Tenure-Track and Instructor Positions – Software Engineering	This link was not processed
1		1			3	2							2					2		6		http://www.cs.concordia.ca/department/location.html	Location	Department of Computer Science - Location
					1						2		2					1		4		http://www.cs.concordia.ca/department/mission.html	Mission Statement	This link was not processed
																		1		1		http://www.cs.concordia.ca/department/mission.html	Mission statement	This link was not processed
							2									2				2		http://www.cs.concordia.ca/department/policies/policies.html	Policies	This link was not processed
																		1		1		http://www.cs.concordia.ca/department/ugrad_figures.gif	999 undergraduate students	This link was not processed
					1															1		http://www.cs.concordia.ca/events/conferences/conferences.html	Conferences	This link was not processed
										1										1		http://www.cs.concordia.ca/events/conferences/conferences.html	Upcoming Conferences	This link was not processed
					1															1		http://www.cs.concordia.ca/events/defences/defences.shtml	Thesis Defences	This link was not processed
										1										1		http://www.cs.concordia.ca/events/defences/defences.shtml	Upcoming Thesis Defences	This link was not processed
				2	1	2	2	2					2					2		7		http://www.cs.concordia.ca/events/events.html	Events	Department of Computer Science- Events
1		1																		2		http://www.cs.concordia.ca/events/events.html	Upcoming Events	Department of Computer Science- Events
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										1										1		http://www.cs.concordia.ca/events/other.html	Other Upcoming Events	This link was not processed
					1															1		http://www.cs.concordia.ca/events/seminars/seminars.shtml	Seminars	This link was not processed
										1										1		http://www.cs.concordia.ca/events/seminars/seminars.shtml	Upcoming Seminars	This link was not processed
					1															1		http://www.cs.concordia.ca/help/faq/faq.html	Frequently Asked Questions (FAQ)	This link was not processed
1		1																		2		http://www.cs.concordia.ca/help/help.html	Computer Support	This link was not processed
														1		1				2		http://www.cs.concordia.ca/help/help.html	Help & Tips	This link was not processed
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1		1																		2		http://www.cs.concordia.ca/help/help.html	Help Pages and Tutorials	This link was not processed
					1															1		http://www.cs.concordia.ca/help/helpdesk.html	Help Desk	This link was not processed
					1															1		http://www.cs.concordia.ca/help/monitor.html	Lab Monitor	This link was not processed
					1															1		http://www.cs.concordia.ca/help/problems.html	Report a Problem	This link was not processed
					1															1		http://www.cs.concordia.ca/help/tutorials/tutorials.html	Tutorials	This link was not processed
				1																1		http://www.cs.concordia.ca/home	Department of CS	This link was not processed
				1																1		http://www.cs.concordia.ca/cgi-bin/fac_page.cgi?Atwood	J. William Atwood	This link was not processed
				1																1		http://www.cs.concordia.ca/cgi-bin/fac_page.cgi?Bui	T. D. Bui	This link was not processed
				1																1		http://www.cs.concordia.ca/cgi-bin/fac_page.cgi?Grogono	Peter Grogono	This link was not processed
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1		1	1		1	1	1	1	1	1		1	1	1	1	1	1	1	1	17		http://www.cs.concordia.ca/index.html	Department of CS	Computer Science
1		1			1						2		1					2		6		http://www.cs.concordia.ca/index.html	Department of Computer Science	Computer Science
			2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	17		http://www.cs.concordia.ca/index.html	Home	Computer Science
			1			1	1	1	1	1		1		1	1	1	1		1	12		http://www.cs.concordia.ca/index.html	[IMG]	Computer Science
							1													1		http://www.cs.concordia.ca/lab_assignments_winter_2002.html	Lab Assignments	This link was not processed
					1														1	2		http://www.cs.concordia.ca/people/associations.html	Student Associations	This link was not processed
1		1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	2	19		http://www.cs.concordia.ca/people/contacts.html	Contacts	Department of Computer Science- Contacts
1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	19		http://www.cs.concordia.ca/people/contacts.html	Contacts |	Department of Computer Science- Contacts
																		1		1		http://www.cs.concordia.ca/people/faculty.html	30 full-time faculty members	This link was not processed
					1															1		http://www.cs.concordia.ca/people/faculty.html	Faculty	This link was not processed
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					1															1		http://www.cs.concordia.ca/people/gradrooms.html	Graduate Students' Room Numbers	This link was not processed
																2			1	2		http://www.cs.concordia.ca/people/graduates.html	Graduate Students	This link was not processed
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2		2		2	1	2	2	2		2		2	2							10		http://www.cs.concordia.ca/people/people.html	People	Department of Computer Science - People
					1														1	2		http://www.cs.concordia.ca/people/phonedir.html	Concordia Phone Directory	This link was not processed
					1														1	2		http://www.cs.concordia.ca/people/staff.html	Staff	This link was not processed
																		1		1		http://www.cs.concordia.ca/people/staff.html#lab	one laboratory coordinator	This link was not processed
																		1		1		http://www.cs.concordia.ca/people/staff.html#secretarial	6 secretaries	This link was not processed
																		1		1		http://www.cs.concordia.ca/people/staff.html#tech	11 professional and technical staff members	This link was not processed
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																1				1		http://www.cs.concordia.ca/programs/grad/PhD/comp8011.shtml	COMP 8011	This link was not processed
																1				1		http://www.cs.concordia.ca/programs/grad/PhD/encs8501.shtml	ENCS 8501	This link was not processed
																1				1		http://www.cs.concordia.ca/programs/grad/PhD/encs8611.shtml	ENCS 8611	This link was not processed
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									2											1		http://www.cs.concordia.ca/programs/grad/PhD/phd.html	Ph.D. Program	This link was not processed
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																13				1		http://www.cs.concordia.ca/programs/grad/courses.html	http://www.cs.concordia.ca/programs/grad/courses.html	Department of Computer Science- Graduate Courses
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															1:					1		http://www.cs.concordia.ca/programs/grad/diploma/comp5121.shtml	COMP 5121	This link was not processed
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																1:				1		http://www.cs.concordia.ca/programs/grad/masters/comp6281.shtml	COMP 6281	This link was not processed
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