(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
19 June 2014 (19.06.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/092536 A1

(51) International Patent Classification:
G06F 9/50 (2006.01)

(21) International Application Number:
PCT/MY2013/000233

(22) International Filing Date:
6 December 2013 (06.12.2013)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
PI 2012005442 14 December 2012 (14.12.2012) MY

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

[Continued on next page]

(54) Title: A SYSTEM AND METHOD FOR DYNAMIC GENERATION OF DISTRIBUTION PLAN FOR INTENSIVE SOCIAL NETWORK ANALYSIS (SNA) TASKS

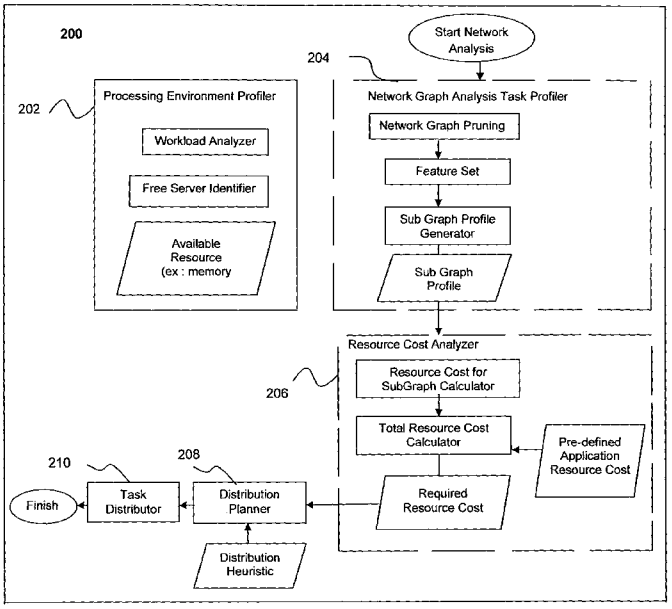


FIG. 2.0

(57) Abstract: A system (200) and method (300) for dynamic generation of distribution plan for intensive social network analysis (SNA) tasks in a distributed environment comprising at least one Processing Environment Profiler (202); at least one Network Graph Analysis Task Profiler (204); at least one Resource Cost Analyzer (206); at least one Distribution Planner (208); and at least one Task Distributer (210). The at least one Network Graph Analysis Task Profiler (204) further comprises at least one Network Graph Pruning module having means to eliminate unnecessary links and nodes from network graph to produce accurate analysis. A distribution plan for Intensive Social Network (SNA) Tasks is achieved by utilizing a pruned network which extracts the Sub Graph from network graph based on feature set extraction (non-dependent Sub Graph) and estimating the resource cost required to perform each of the given tasks which further map the said task to the appropriate server.

WO 2014/092536 A1

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

A SYSTEM AND METHOD FOR DYNAMIC GENERATION OF DISTRIBUTION PLAN FOR INTENSIVE SOCIAL NETWORK ANALYSIS (SNA) TASKS

FIELD OF INVENTION

The present invention relates to a system and method for dynamic generation of distribution plan for intensive social network analysis (SNA) tasks in a distributed environment. In particular, the present invention utilizes a pruned network which extracts the Sub Graph from network graph based on feature set extraction (non-dependent Sub Graph) and estimating the resource cost required to perform each of the given task which further maps the said task to the appropriate server.

BACKGROUND ART

Huge network graph data cause inefficiency in execution especially in distributed computing environment which generate low performance and long response time in execution of Social Network Analysis (SNA) tasks as there is no proper distribution plan. Further, imbalance load in network contributes to waste of computational resources usage.

Existing mechanism which relates to data parallelism and task parallelism are described in United States Patent No. 6,675,189 B2 (hereinafter referred to as US 189 Patent). In this system, computer system (i.e. memory utilization and Central Processing Unit (CPU)) are measured while identifying available resources to propose a task distribution plan for parallel scheduling of distribution. However, the said system as described in the US 189 Patent deals only with single server instead of resources of multiple servers. Further, application Data Color Tracker system as described in the US 189 Patent does not provide for network graph analysis task as the distribution plan focus only on Color Tracker System Task Distribution wherein task is divided into several subtasks.

Another mechanism for task allocation is described in a published paper entitled "Contextual Resource Negotiation-Based Task Allocation and Load Balancing in Complex Software Systems" by Yichuan Jiang and Jiuchuan Jiang published by IEEE Transactions on Parallel and Distributed Systems, Vol. 20, No. 5, May 2009 (hereinafter

referred to as Jiang's paper). Jiang's paper proposes task allocation plan and load balancing wherein available resources are identified and it involves resources of multiple servers. Task allocation model is based on contextual resource negotiation in the complex software system. A principle agent that has high contextual enrichment factor is provided for required resources wherein principle agent will negotiate with its contextual agent to execute the assigned task and it provide reduction of the acceptance capabilities upon receiving overlarge number of new tasks in the principle agent and contextual agent.

Another mechanism for task distribution is described in a published paper entitled "Assignment and Scheduling Communicating Periodic Tasks in Distributed Real-Time Systems" by Dar-Tzen Peng et al.; published by IEEE Transactions on Software Engineering, Vol. 23, No. 12, December 1997 (hereinafter referred to as Peng's paper). In Peng's paper, task allocation and distribution plan is provided by allocation of communicating periodic tasks to heterogeneous processing nodes (PNs) in a distributed real-time system. Resource cost is proposed using an algorithm. Tasks are based on task graph which then will be assigning to PNs utilizing a branch and bound (B&B) search algorithm, the said task graph prunes in polynomial time and does not provide a feature set extractor (i.e. temporal/spatial/user-defined extractor) as provided in the present invention.

The subject matter claimed herein is not limited to embodiments that solve any disadvantages or that operate only in environments such as those described above. Rather, this background is only provided to illustrate one exemplary technology area where some embodiments described herein may be practice.

SUMMARY OF INVENTION

The present invention relates to a system and method for dynamic generation of distribution plan for intensive social network analysis (SNA) tasks in a distributed environment. One aspect of the present invention provides a system for dynamic generation of distribution plan for intensive social network analysis (SNA) tasks. The system comprising at least one Processing Environment Profiler (202); at least one Network Graph Analysis Task Profiler (204); at least one Resource Cost Analyzer (206); at least one Distribution Planner (208); and at least one Task Distributer (210). The at least one Network Graph Analysis Task Profiler (204) further comprises at least one Network Graph Pruning module having means to eliminate unnecessary links and nodes from network graph to produce accurate analysis.

Another aspect of the invention provides for the at least one Processing Environment Profiler (202) wherein said Processing Environment Profiler (202) further having means for profiling each processing environment by calculating work load of each analysis server using workload analyzer; and identifying any free analysis server and available computational resources.

A further aspect of the invention provides for the at least one Resource Cost Analyzer (206) wherein said Resource Cost Analyzer (206) further having means for calculating resource cost for each task by calculating resource cost for each sub graph by calculating memory cost of sub graph based on summation of memory cost required to process all nodes and links in sub graph; and calculating total resource cost for each task based on sub graph resource cost plus pre-defined application resource cost.

Yet another aspect of the invention provides for the at least one Distribution Planner (208) wherein said Distribution Planner (208) further having means for generating distribution plan for each task by matching resource cost with environment profile; and identifying most appropriate server based on distribution heuristic.

In still another aspect the invention provides for the at least one Task Distributer (210) wherein said Task Distributer (210) further having means for distributing task to appropriate analysis server.

In another aspect the invention provides method (300) for dynamic generation of distribution plan for intensive social network analysis (SNA) tasks in a distributed environment. The method comprising steps of profiling each processing environment (302); profiling network graph analysis task (304); calculating resource cost for each task (306); generating distribution plan for each task (308); and distributing task to appropriate analysis server (310). The step of profiling network graph analysis task further comprises network graph pruning (400) to eliminate unnecessary links and nodes from network graph to produce accurate analysis by identifying candidate links from first candidate link (402, 404); removing candidate link (406); and identifying associated nodes by first determining existence of nodes (408). If nodes exist; the said methodology proceeds by determining if there is dependency on associated nodes (412); removing associated node if said node does not have any dependency (416); and iterating step to identify existence of nodes when there is dependency of node with associated nodes. If nodes do not exist; the said methodology proceeds by checking next candidate link to determine existence of link to arrive at a pruned network when there are no links to candidate (418); and iterating step to remove candidate link and subsequent steps if there is a link to candidate.

In a further aspect the invention provides a method wherein profiling each processing environment further comprises steps of calculating work load of each analysis server using workload analyzer; and identifying any free analysis server and available computational resources.

In yet another aspect the invention provides a method wherein profiling network graph analysis task upon arriving at a pruned network further comprises steps of extracting data from pruned network using an extractor engine for a specific task to obtain sub graph network (502, 504, 506); and analyzing sub graph network to obtain sub graph network data which includes graph density, node description ser and link description set (516, 518, 520).

In a further aspect the invention provides a method wherein calculating resource cost for each task further comprises steps of calculating resource cost for each sub graph by calculating memory cost of sub graph based on summation of memory cost required to process all nodes and links in sub graph (602); and calculating total resource cost for each task based on sub graph resource cost plus pre-defined application resource cost (604).

In still another aspect the invention provides a method wherein generating distribution plan for each task further comprises steps of matching resource cost with environment profile; and identifying most appropriate server based on distribution heuristic.

The present invention consists of features and a combination of parts hereinafter fully described and illustrated in the accompanying drawings, it being understood that various changes in the details may be made without departing from the scope of the invention or sacrificing any of the advantages of the present invention.

BRIEF DESCRIPTION OF ACCOMPANYING DRAWINGS

To further clarify various aspects of some embodiments of the present invention, a more particular description of the invention will be rendered by references to specific embodiments thereof, which are illustrated in the appended drawings. It is appreciated that these drawings depict only typical embodiments of the invention and are therefore not to be considered limiting of its scope. The invention will be described and explained with additional specificity and detail through the accompanying drawings in which:

FIG. 1.0 illustrates a general background problem of performing network graph analysis tasks in a distributed environment.

FIG. 2.0 illustrates a general system in accordance with the present invention.

FIG. 3.0 is a flowchart illustrating an embodiment of the method of the present invention.

FIG. 4.0 is a flowchart illustrating the methodology of network pruning of the present invention.

FIG. 5.0 illustrates Feature Set Extractor and Sub Graph Profile Generator in profiling network graph analysis task upon arriving at a pruned network.

FIG. 6.0 illustrates Resource Cost Analyzer and Distribution Planner.

FIG. 7.0 illustrates dynamic profiling of the processing environment.

FIG. 8.0 illustrates an example of network graph pruning.

FIG. 9.0 illustrates an example of dynamically calculating resource cost for each task.

FIG. 10.0 illustrates an example of execution of the Distribution Planner.

FIG. 11.0 illustrates an example of Task Distributer.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention provides a system and method for dynamic generation of distribution plan for intensive social network analysis (SNA) tasks in a distributed environment. In particular, the present invention utilizes a pruned network which extracts the Sub Graph from network graph based on feature set extraction (non-dependent Sub Graph) and estimating the resource cost required to perform each of the given tasks which further maps the said task to the appropriate server.

Referring to FIG. 1.0, network graph analysis tasks suffer from inefficiency of execution with no proper distribution plan due to the need of network graph data communication between computer units. Consequently, this contributes to performance issue, whereby huge network graph data takes longer response time in obtaining analysis results which would degrade the application and system performance. Although particular servers are equipped with additional computation resources, such as higher CPU (Central Processing Unit) and memory, said computational resources are not loaded with tasks that require higher computation power. On the other hand, there might be other servers that are equipped with lower resources with the most load of tasks. This is due to improper planning of tasks distribution among the available computation resources which cause the waste of resources in distributed computing environment.

Turning to FIG. 2.0, the architecture of the system (200) of an embodiment of the present invention is illustrated. The system of the present invention for dynamic generation of distribution plan for intensive social network analysis (SNA) tasks in a distributed environment comprising a Processing Environment Profiler (202); a Network Graph Analysis Task Profiler (204); a Resource Cost Analyzer (206); a Distribution Planner (208); and a Task Distributer (210).

The methodology of an embodiment of the present invention is illustrated generally in FIG. 3.0 while FIGs. 4.0, 5.0 and 6.0 respectively illustrates the process flow of the components of the system and the examples of the execution process of the components of the system of the present invention. The method (300) for dynamic generation of distribution plan for intensive social network analysis (SNA) tasks in a

distributed environment comprising steps of first profiling each processing environment (302) wherein a Processing Environment Profiler (202) profile each processing environment (700) by calculating work load of each analysis server using workload analyzer. A plurality of parameters becomes the indication, such as CPU utilization, memory usage and the execution time of unit in each dedicated servers. Free analysis server and available computational resources are identified to determine the number of free analysis server as well as the available computational resource in the servers.

Upon profiling each processing environment, a Network Graph Analysis Task Profiler (204) profiles network graph analysis task to eliminate unnecessary links and nodes from network graph to produce accurate analysis. The said Network Graph Analysis Task Profiler (204) further utilizes a Network Graph Pruning module to prune the network by first identifying candidate links from first candidate link (402, 404) and removing identified candidate link (406). Thereafter, associated nodes are identified by first determining the existence of nodes in the network (408). If nodes exist; dependency on associated nodes are determined (412) and subsequently associated nodes are removed if said node does not have any dependency (416). The said step is iterated to identify existence of nodes when there is dependency of node with associated nodes. If nodes do not exist, the next candidate link to determine the existence of the link to arrive at a pruned network when there are no links to candidate are checked (418). Thereafter, the said step is iterated to remove candidate link and subsequent steps if there is a link to candidate.

The pruned network will be forwarded to Feature Set Extractor wherein Feature Set Extractor extracts the data from the pruned network using an extractor engine particularly to the specific task to obtain sub graph network (502, 504, 506). For example, if the network graph task is a temporal-based analysis, then a Temporal Feature Extractor engine will extract the data based on temporal feature set (e.g. time range, day, month, year and etc.). Similarly, if the task is a spatial-based analysis, then a Spatial Feature Extractor engine will extract the data based on geo-spatial feature set (e.g. location, latitude, longitude and etc.). User-Defined Extractor engine is specified for any kind of task defined by the user. The task can be any network graph analysis of particular properties and the feature set will be based on that

specified properties. The result of this process will be a sub graph network which will be processed further in Sub Graph Profile Generator. The Sub Graph Profile Generator analyzes the sub graph network (516, 518, 520). A plurality of parameters that can be obtained from the sub graph network data includes the graph density, node description set (e.g. number of nodes, type of nodes) and link description set (e.g. number of links, direction of links, weighted of links, type of links). The output of this process is a sub graph profile which will be forwarded to the Resource Cost Analyzer.

The Resource Cost Analyzer calculates the resource cost for each task of the sub graph network. It takes the information of nodes and links from the sub graph profile and calculates the resource cost required to process the sub graph. For example, the memory cost required for the sub graph is calculated based on the summation of memory cost needed to process all nodes and links in the sub graph (602). The total resource cost for each task is calculated based on the sub graph resource cost plus the pre-defined application resource cost where the pre-defined application resource is pre-calculated before the present invention process starts (604). The result of Resource Cost Analyzer module is the total required cost to perform each dedicated task and said resource cost is forwarded to Distribution Planner module wherein the required resource for each task is mapped and matched to each of environment profile resulted from Processing Environment Profiler module (1000). The process uses a set of distribution heuristic to identify the most appropriate server for each task (1000). Each task distributed to the most appropriate server is identified from the Distribution Planner module.

Turning to FIGs. 7.0, 8.0, 9.0, 10 and 11, examples of each processes involved are illustrated. FIG. 7.0 illustrates the dynamic profiling of each processing environment module. For instance, in *Linux* environment, an automated back-end program can be developed to call command "*–free –t –m" to* get the memory usage (in bytes) and command "*–top"* to get the details of occupied resources for each application running in the server. FIG. 8.0 illustrates the example of Network Graph Pruning process, a sub process under Network Graph Task Profiler module while FIG. 9.0 illustrates the example of another sub process of under Network Graph Task Profiler_module, Dynamically Calculate Resource Cost for each task. This illustrative example shows

on the methodology to calculate the memory cost to perform each task. The example given is based on an assumption that the object type of the node and link is represented as a Java String Object.

FIG. 10.0 illustrates the example on execution of the Distribution Planner. As illustrated in FIG. 10.0, the resource cost for each task is matched to each environment profile in order to identify the most appropriate server to perform the task. The Distribution Heuristic can be any combination of resource indicator (e.g. CPU level, Memory Space and etc.) and is used as the main factor to determine the right server. FIG. 11.0 illustrates the network graph analysis task distributed to the appropriate server wherein each process involved is important and is a key factor to dynamically generate an appropriate distribution plan for intensive network graph analysis tasks.

The present invention dynamically generates a distribution plan for Intensive Social Network (SNA) Tasks by utilizing a pruned network which extracts the Sub Graph from network graph based on feature set extraction (non-dependent Sub Graph) and estimating the resource cost required to perform each of the given tasks which further map the said task to the appropriate server.

Unless the context requires otherwise or specifically stated to the contrary, integers, steps or elements of the invention recited herein as singular integers, steps or elements clearly encompass both singular and plural forms of the recited integers, steps or elements.

Throughout this specification, unless the context requires otherwise, the word "comprise", or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated step or element or integer or group of steps or elements or integers, but not the exclusion of any other step or element or integer or group of steps, elements or integers. Thus, in the context of this specification, the term "comprising" is used in an inclusive sense and thus should be understood as meaning "including principally, but not necessarily solely".

It will be appreciated that the foregoing description has been given by way of illustrative example of the invention and that all such modifications and variations thereto as would be apparent to persons of skill in the art are deemed to fall within the broad scope and ambit of the invention as herein set forth.

CLAIMS

1. A system (200) for dynamic generation of distribution plan for intensive social network analysis (SNA) tasks in a distributed environment, the system comprising:

at least one Processing Environment Profiler (202);

at least one Network Graph Analysis Task Profiler (204);

at least one Resource Cost Analyzer (206);

at least one Distribution Planner (208); and

at least one Task Distributer (210)

characterized in that

the at least one Network Graph Analysis Task Profiler (204) further comprises at least one Network Graph Pruning module having means to eliminate unnecessary links and nodes from network graph to produce accurate analysis by

identifying candidate links from first candidate link;

removing candidate link;

identifying associated nodes by first determining existence of nodes;

if nodes exist;

determining if there is dependency on associated nodes;

removing associated node if said node does not have any dependency;

iterating step to identify existence of nodes when there is dependency of node with associated nodes;

if nodes do not exist;

checking next candidate link to determine existence of link to arrive at a pruned network when are no links to candidate; and

iterating step to remove candidate link and subsequent steps if there is a link to candidate.

2. A system (200) according to Claim 1, wherein the at least one Processing Environment Profiler (202) further having means for profiling each processing environment by:

calculating work load of each analysis server using workload analyzer; and

identifying any free analysis server and available computational resources.

3. A system (200) according to Claim 1, wherein the at least one Resource Cost Analyzer (206) further having means for calculating resource cost for each task by:

calculating resource cost for each sub graph by calculating memory cost of sub graph based on summation of memory cost required to process all nodes and links in sub graph; and

calculating total resource cost for each task based on sub graph resource cost plus pre-defined application resource cost.

4. A system (200) according to Claim 1, wherein the at least one Distribution Planner (208) further having means for generating distribution plan for each task by:

matching resource cost with environment profile; and

identifying most appropriate server based on distribution heuristic.

5. A system (200) according to Claim 1, wherein the at least one Task Distributer (210) further having means for distributing task to appropriate analysis server.

6. A method (300) for dynamic generation of distribution plan for intensive social network analysis (SNA) tasks in a distributed environment, the method comprising steps of:

profiling each processing environment (302);

profiling network graph analysis task (304);

calculating resource cost for each task (306);

generating distribution plan for each task (308); and

distributing task to appropriate analysis server (310)

characterized in that

profiling network graph analysis task further comprises network graph pruning (400) to eliminate unnecessary links and nodes from network graph to produce accurate analysis by

identifying candidate links from first candidate link (402, 404);

removing candidate link (406);

identifying associated nodes by first determining existence of nodes (408);

if nodes exist;

determining if there is dependency on associated nodes (412);

removing associated node if said node does not have any dependency (416);

iterating step to identify existence of nodes when there is dependency of node with associated nodes;

if nodes do not exist;

checking next candidate link to determine existence of link to arrive at a pruned network when there are no links to candidate (418); and

iterating step to remove candidate link and subsequent steps if there is a link to candidate.

7. A method (700) according to Claim 3, wherein profiling each processing environment further comprises steps of:

calculating work load of each analysis server using workload analyzer; and

identifying any free analysis server and available computational resources.

8. A method (500) according to Claim 3, wherein profiling network graph analysis task upon arriving at a pruned network further comprises steps of:

extracting data from pruned network using an extractor engine for a specific task to obtain sub graph network (502, 504, 506); and

analyzing sub graph network to obtain sub graph network data which includes graph density, node description ser and link description set (516, 518, 520).

9. A method according to Claim 3, wherein calculating resource cost for each task further comprises steps of:

calculating resource cost for each sub graph by calculating memory cost of sub graph based on summation of memory cost required to process all nodes and links in sub graph (602); and

calculating total resource cost for each task based on sub graph resource cost plus pre-defined application resource cost (604).

10. A method (1000) according to Claim 3, wherein generating distribution plan for each task further comprises steps of:

matching resource cost with environment profile; and

identifying most appropriate server based on distribution heuristic.

100

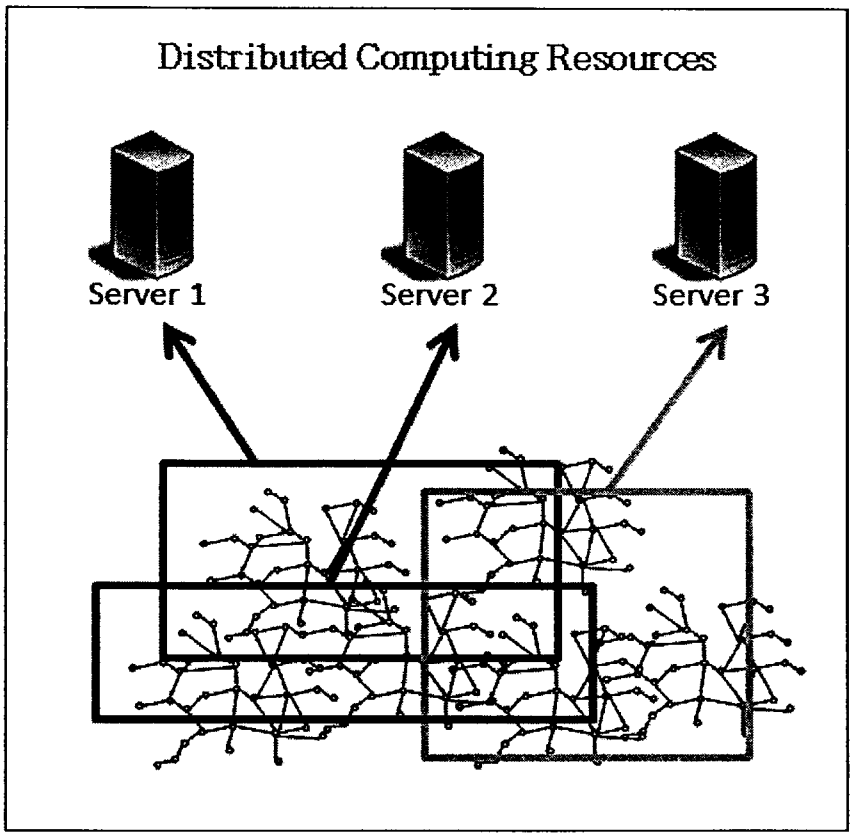

Distributed Computing Resources
Server 1
Server 2
Server 3

FIG. 1.0

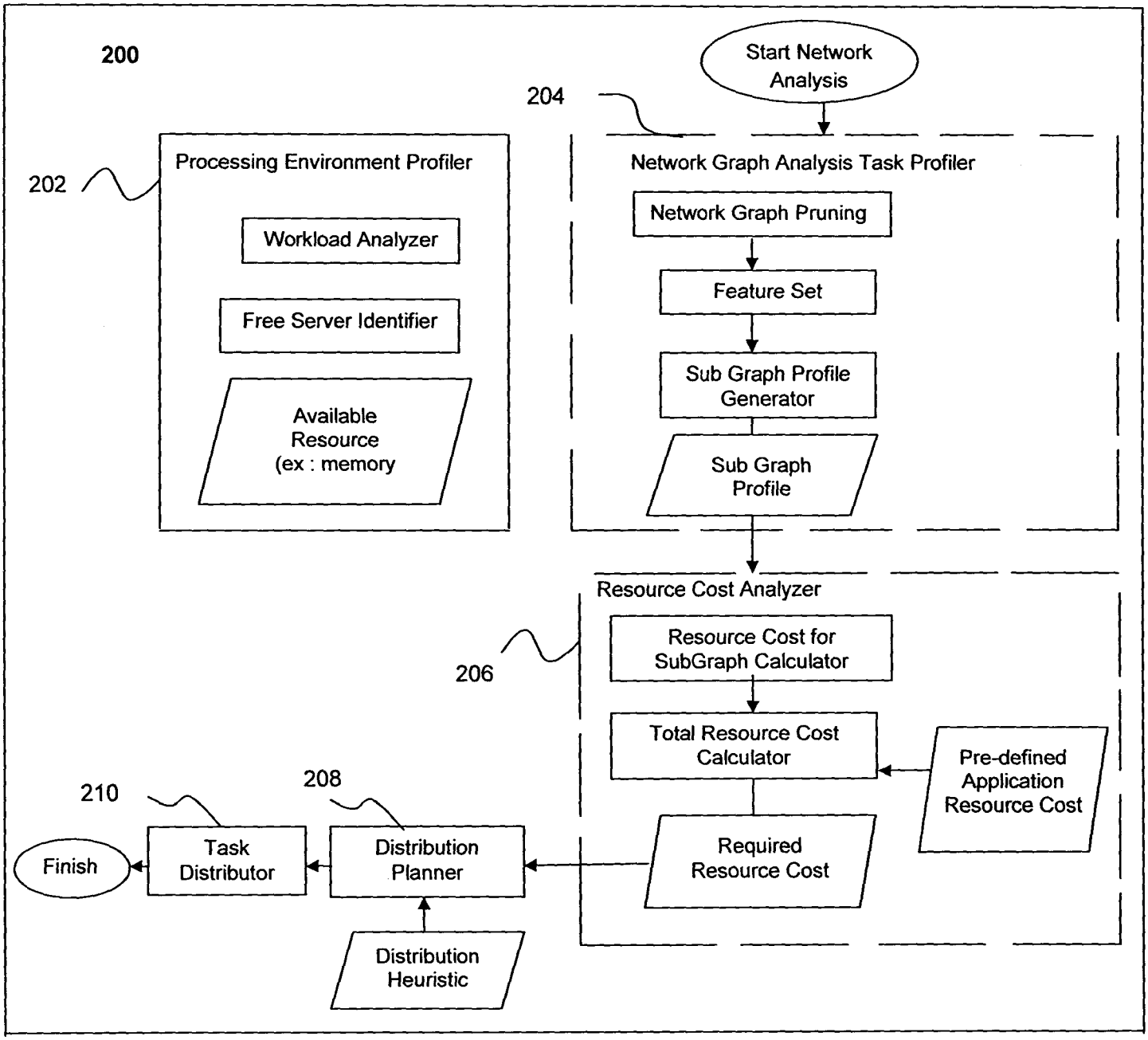

200
Start Network Analysis
204
Processing Environment Profiler
202
Workload Analyzer
Free Server Identifier
Available Resource (ex : memory
Network Graph Analysis Task Profiler
Network Graph Pruning
Feature Set
Sub Graph Profile Generator
Sub Graph Profile
Resource Cost Analyzer
206
Resource Cost for SubGraph Calculator
Total Resource Cost Calculator
Pre-defined Application Resource Cost
Required Resource Cost
210
208
Finish
Task Distributor
Distribution Planner
Distribution Heuristic

FIG. 2.0

300

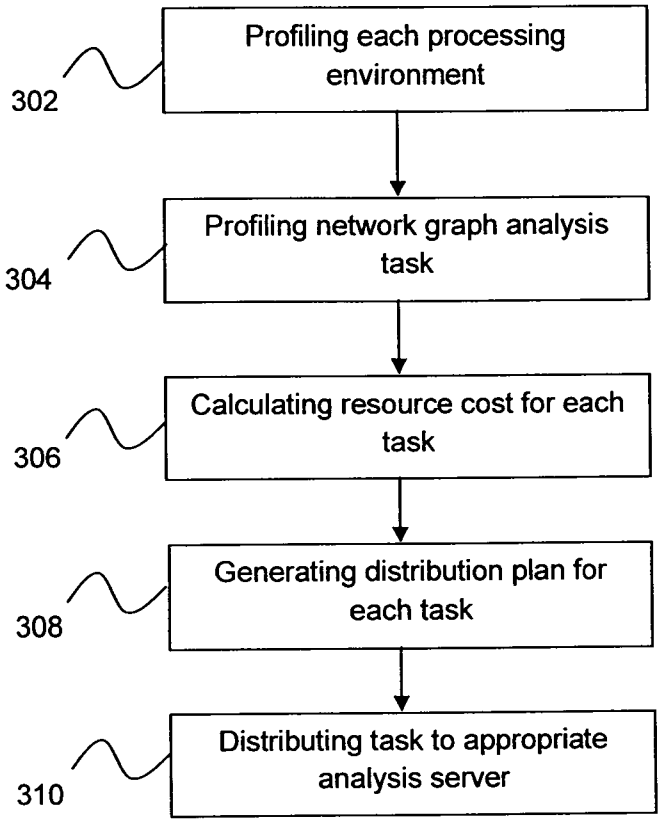

Profiling each processing environment
302
Profiling network graph analysis task
304
Calculating resource cost for each task
306
Generating distribution plan for each task
308
Distributing task to appropriate analysis server
310

FIG. 3.0

400

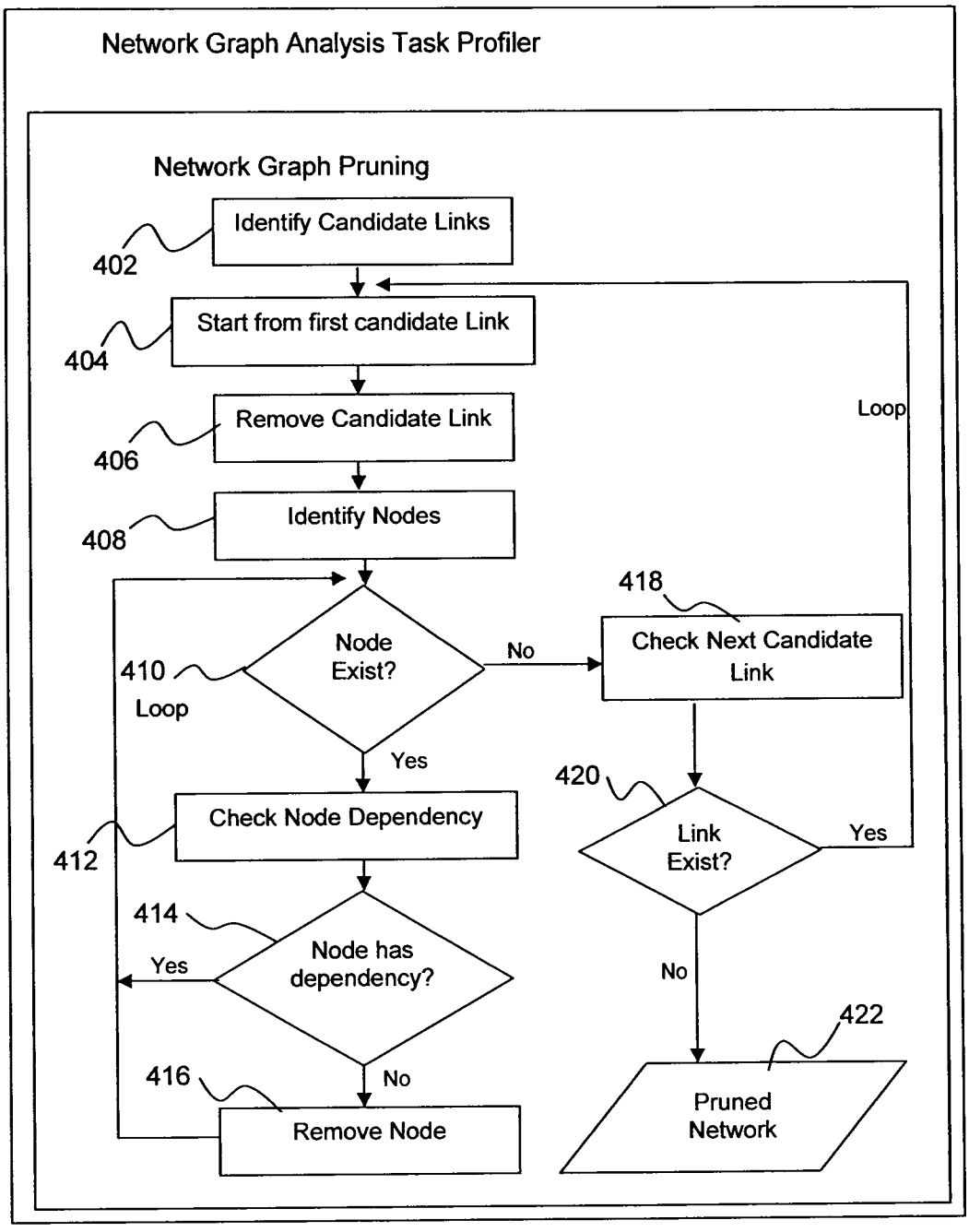

Network Graph Analysis Task Profiler
Network Graph Pruning
Identify Candidate Links
402
Start from first candidate Link
404
Remove Candidate Link
406
Identify Nodes
408
Node Exist?
410
Loop
No
Yes
Check Next Candidate Link
418
Loop
Check Node Dependency
412
Node has dependency?
414
Yes
No
Remove Node
416
Link Exist?
420
Yes
No
Pruned Network
422

FIG. 4.0

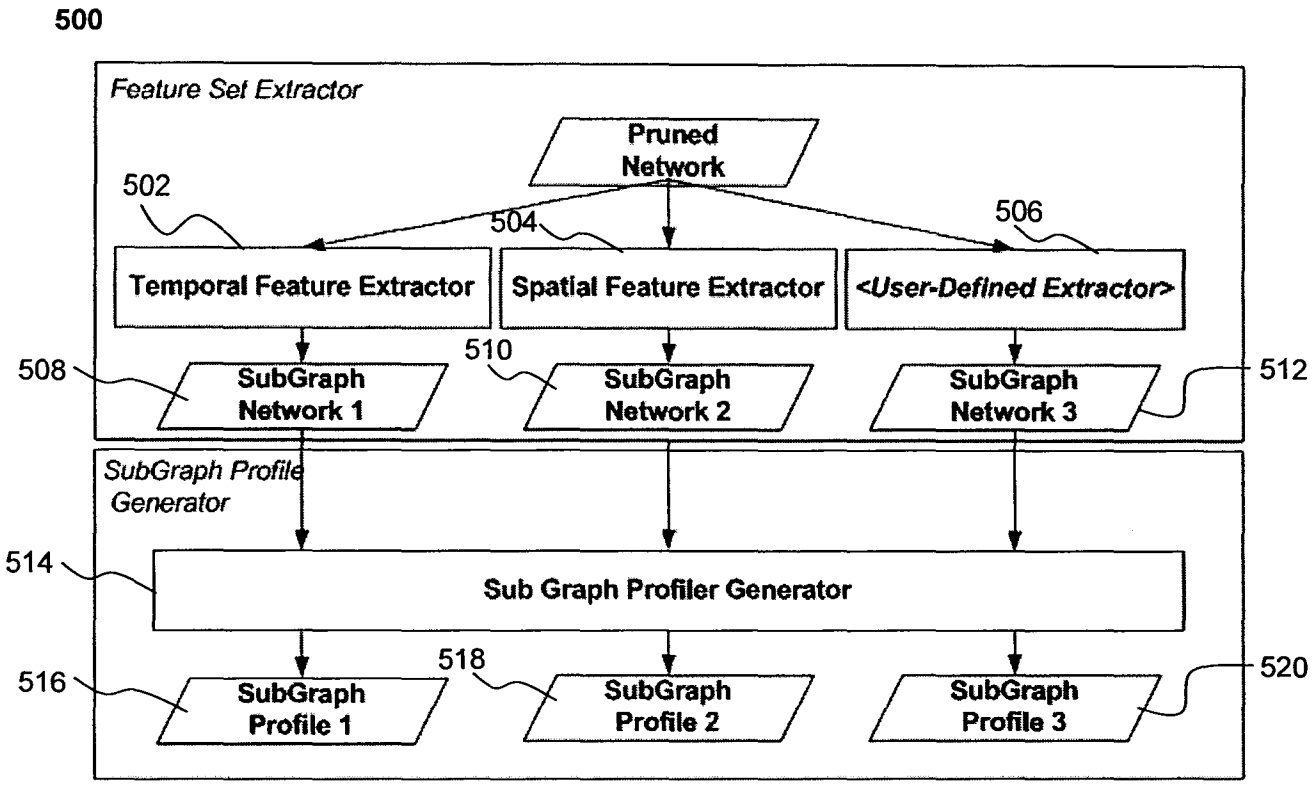

500
Feature Set Extractor
Pruned Network
502
504
506
Temporal Feature Extractor
Spatial Feature Extractor
<User-Defined Extractor>
508
510
512
SubGraph Network 1
SubGraph Network 2
SubGraph Network 3
SubGraph Profile Generator
514
Sub Graph Profiler Generator
516
518
520
SubGraph Profile 1
SubGraph Profile 2
SubGraph Profile 3

FIG. 5.0

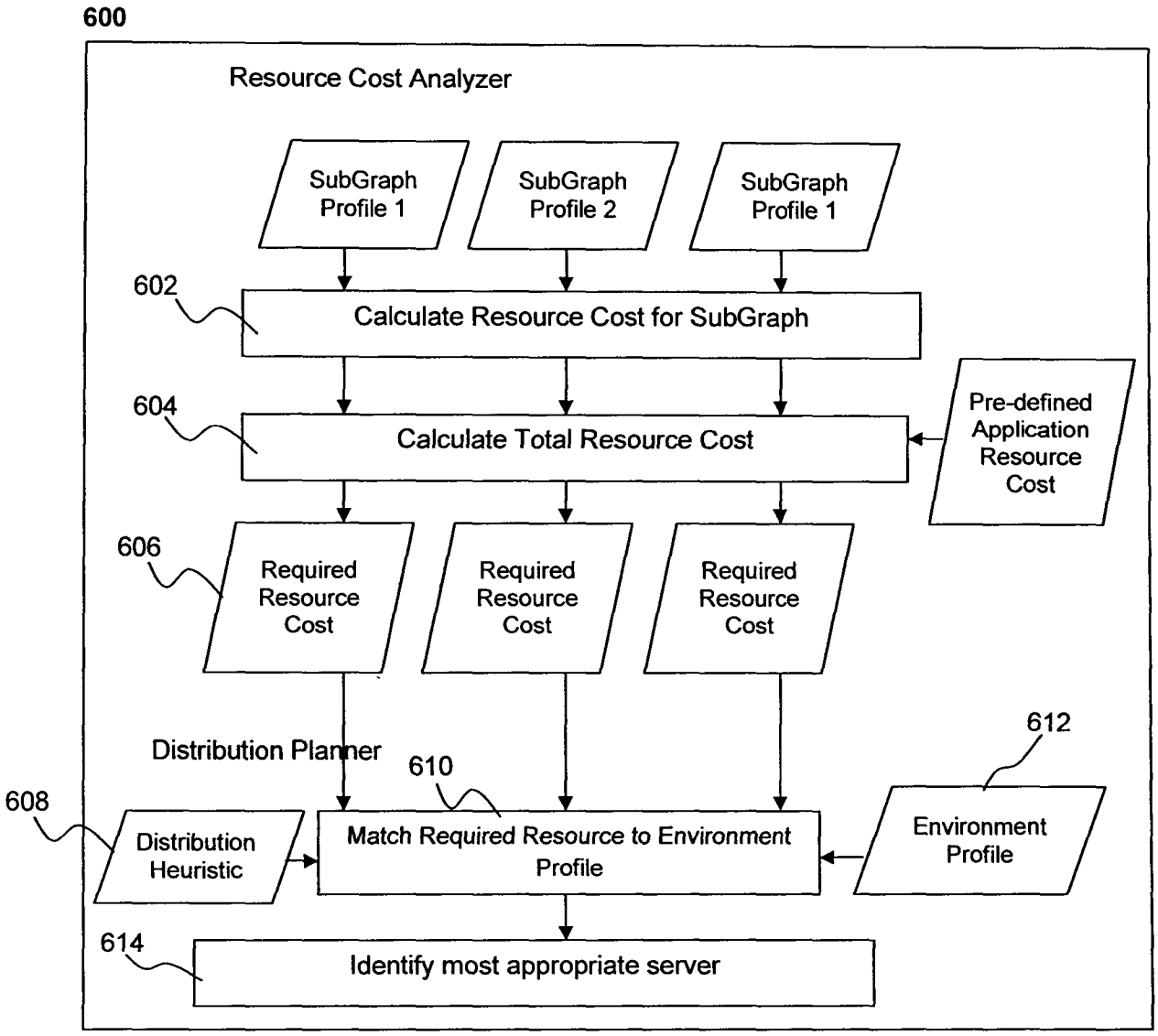

600
Resource Cost Analyzer
SubGraph Profile 1
SubGraph Profile 2
SubGraph Profile 1
602
Calculate Resource Cost for SubGraph
604
Calculate Total Resource Cost
Pre-defined Application Resource Cost
606
Required Resource Cost
Required Resource Cost
Required Resource Cost
Distribution Planner
610
612
608
Distribution Heuristic
Match Required Resource to Environment Profile
Environment Profile
614
Identify most appropriate server

FIG. 6.0

700

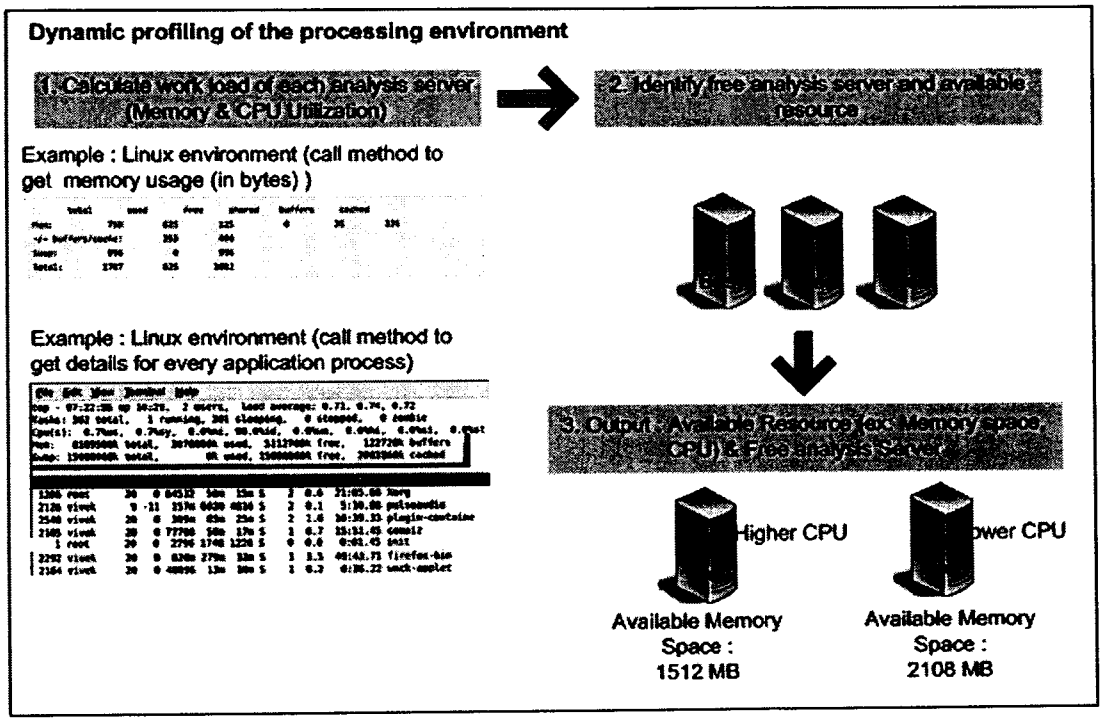


FIG. 7.0

800

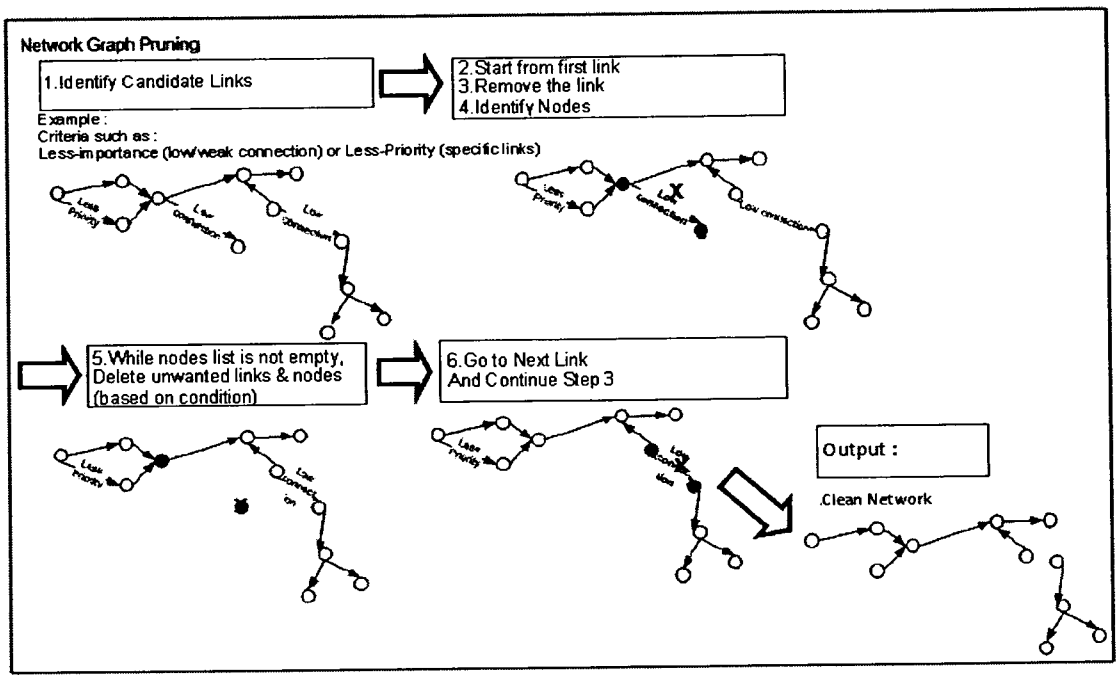


FIG. 8.0

900

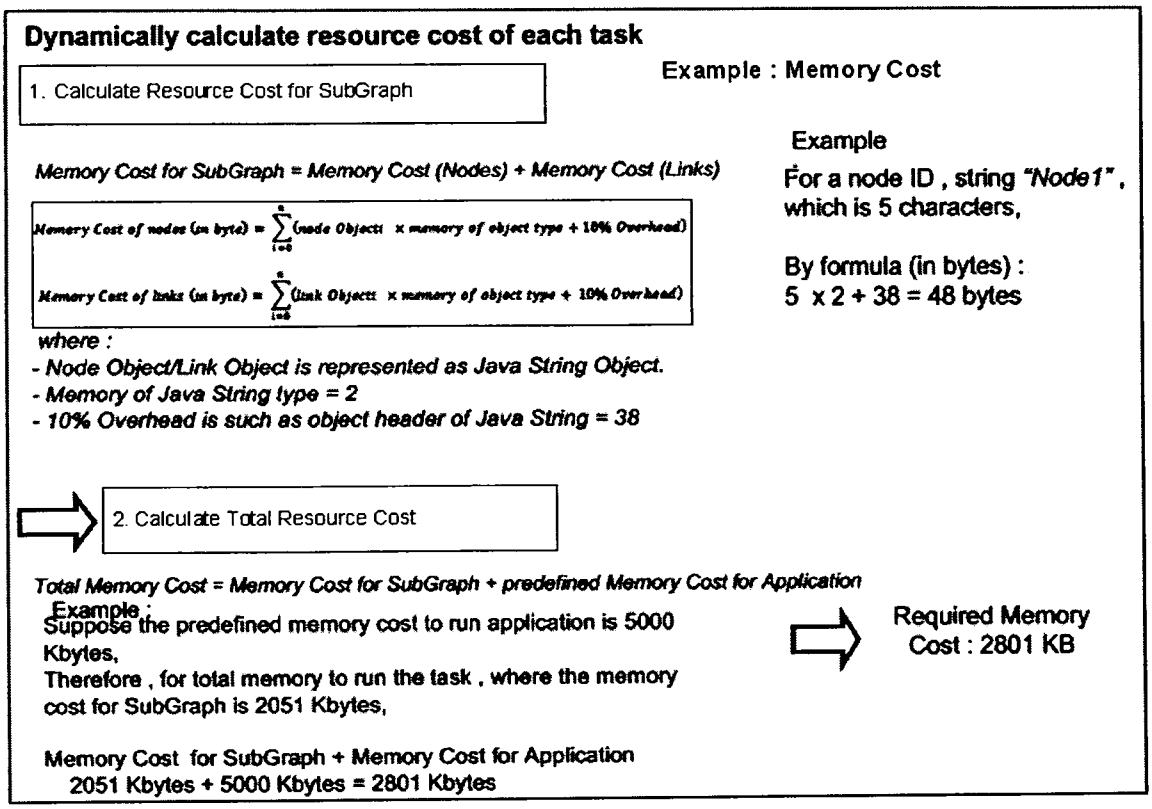


FIG. 9.0

1000

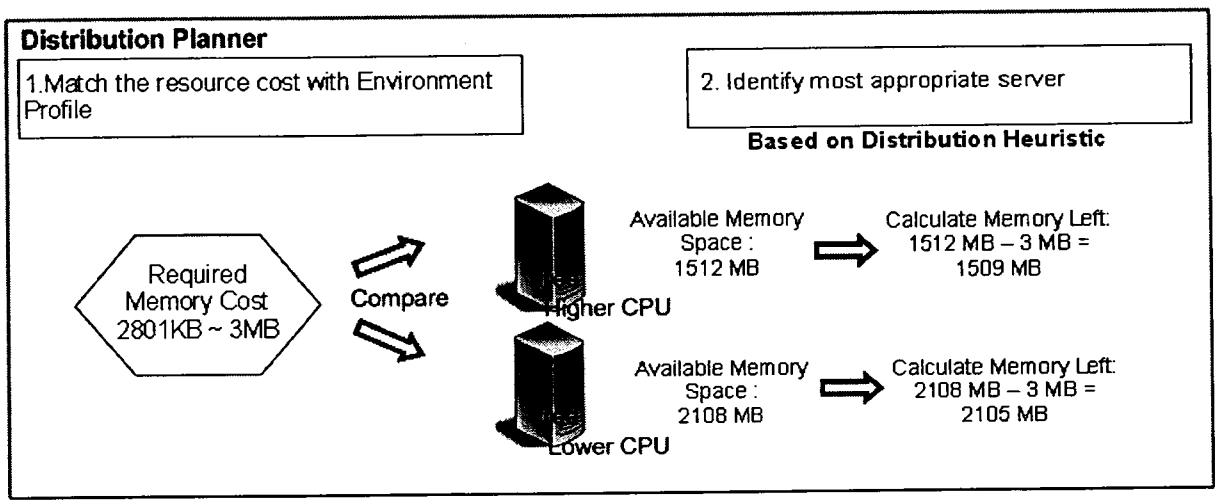


FIG. 10.0

1100

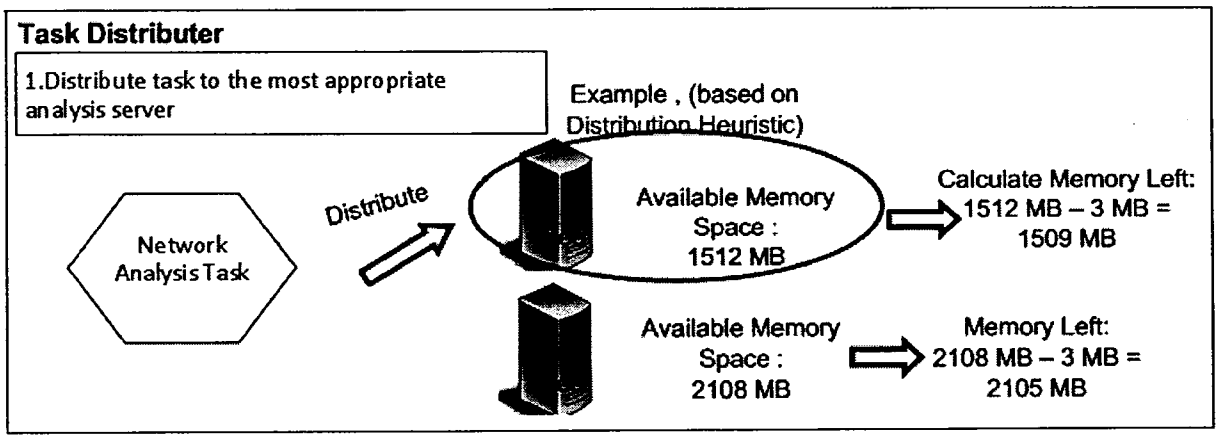

Task Distributer
1.Distribute task to the most appropriate analysis server
Example , (based on Distribution Heuristic)
Network Analysis Task
Distribute
Available Memory Space : 1512 MB
Calculate Memory Left: 1512 MB – 3 MB = 1509 MB
Available Memory Space : 2108 MB
Memory Left: 2108 MB – 3 MB = 2105 MB

FIG. 11.0

INTERNATIONAL SEARCH REPORT

International application No
PCT/MY2013/000233

A. CLASSIFICATION OF SUBJECT MATTER
INV. G06F9/50
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data, PAJ, INSPEC, COMPENDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2011/302144 A1 (HAMILTON II RICK A [US] ET AL HAMILTON RICK A [US] ET AL) 8 December 2011 (2011-12-08) abstract	1-10
A	US 2005/060287 A1 (HELLMAN ZIV Z [US] ET AL) 17 March 2005 (2005-03-17) the whole document	1-10
A	US 2009/109872 A1 (SKUBACZ MICHAL [DE] ET AL) 30 April 2009 (2009-04-30) the whole document	1-10
A	US 2012/284340 A1 (YOUNG MALCOLM P [GB]) 8 November 2012 (2012-11-08) the whole document	1-10

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 May 2014	22/05/2014

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Beltrán-Escavy, José

1

INTERNATIONAL SEARCH REPORT

International application No
PCT/MY2013/000233

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DAR-TZEN PENG ET AL.: "Assignment and Scheduling Communicating Periodic Tasks in Distributed Real-Time Systems", IEEE TRANSACTIONS ON SOFTWARE ENGINEERING, vol. 23, no. 12, December 1997 (1997-12), XP002724187, cited in the application abstract page 746, left-hand column, paragraph 3 - page 749, left-hand column, paragraph 1 page 749, left-hand column, last paragraph - page 753, left-hand column, paragraph 1 page 753, left-hand column, paragraph 3 - page 754, right-hand column, paragraph 2 figure 3	1-10
A	DING XIAO ET AL: "Community Ranking in Social Network", COMPUTER AND COMPUTATIONAL SCIENCES, 2007. IMSCCS 2007. SECOND INTERNATIONAL MULTI-SYMPOSIUMS ON, IEEE, PISCATAWAY, NJ, USA, 13 August 2007 (2007-08-13), pages 322-329, XP031338419, ISBN: 978-0-7695-3039-0 the whole document	1-10

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/MY2013/000233

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		DE 112011101293 T5	07-02-2013
		JP 2013527543 A	27-06-2013
		TW 201224988 A	16-06-2012
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US 2005060287 A1	17-03-2005	NONE	
US 2009109872 A1	30-04-2009	NONE	
US 2012284340 A1	08-11-2012	NONE	