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Cloud Service Selection Techniques : State-of-the-Art and Road Ahead

Cloud computing is an emerging computing paradigm of IT world. It is an Internet-based "PAY-AS-YOU-USE" model whereby shared resources, software and information are provided to computers and devices on-demand. Cloud Service Provider (CSP) is an entity who provides cloud services to users. Selecting any cloud service for an organization is a skillful job. This is the main focus of the present research paper. In this paper, we will discuss various cloud service selection techniques. Present status and further challenges have been explored. Uncertainty in assessing the quality requirements of users, trustworthiness and reputation of CSPs are main issues which need to be addressed. ***Key Words : Cloud computing, CSP, Trustworthiness, Reputation of CSP.***

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Introduction :

Cloud service selection techniques have been divided into two broad categories :

(a) Multi Criteria Decision Making (MCDM) : In this technique, decision has been made while considering multiple criterions. Here objective is to build computational and mathematical techniques for selecting best alternative among several alternatives while taking care of specific criteria. MCDM focuses on discrete decision space problems. In these problems the set of decision alternatives has been predetermined and finite.[1]

(b) Multi Objective Decision Making (MODM) : This technique assists to locate optimal solution (maximize or minimize) of a problem while adhering to given set of constraints.[2] MODM examines decision problems in which there is continuous decision space. Mathematical programming problems with multiple objective functions are examples of this technique[1].

Difference between Cloud service and Web Service selection techniques[3]

Following table depicts differences between cloud service and web service selection techniques :

Table 1 : Comparison between Cloud and Web Services

Criteria	Cloud Services	Web Services
Payment Mode	Flexible	Fixed
Quality Parameters	More	Limited
Target Groups	Large Number	Limited
Complexity	More	Less

MCDM Techniques :

(1) AHP[4] : This technique was developed in the year 1970 by Thomas L. Saaty. Here Hierarchical technique is used to organize and analyze complex decision problems. Technique has following phases.

(a) Problem Decomposition : Given problem is decomposed into AHP hierarchy, which consists of overall goal, group of alternatives to satisfy that goal, set of criteria or parameters which coordinate goal with alternatives. In Figure 1, overall goal is decided based on five criteria; criterion 1, criterion 2, criterion 5. There are four alternatives for decision maker; Alternative 1,..., Alternative 4.

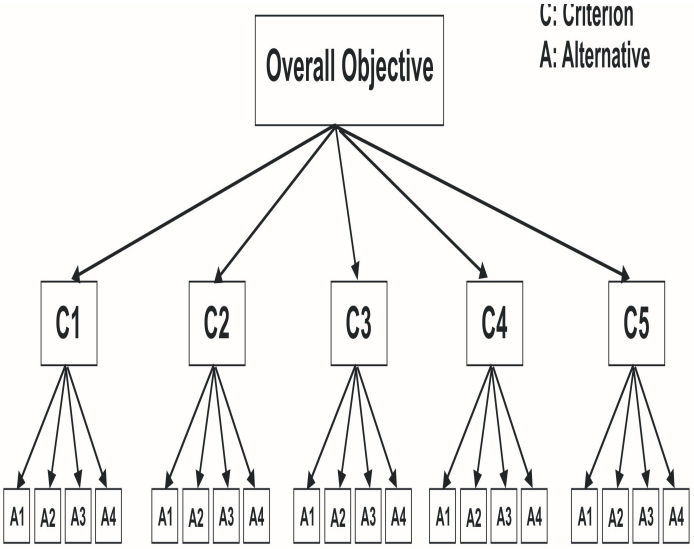

Figure 1 : Problem decomposition into criteria and alternatives

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(b) Judgment of Priorities[5] : Criteria are compared against the goal for importance and numerical weights are assigned to them. In the similar manner alternatives are pairwise compared against each criterion for importance.

(c) Synthesis Process : In this step priorities assigned are synthesized to find final priorities of alternatives to achieve the overall goal.

(2) ANP[6] : ANP technique is a generalization of AHP technique. ANP considers interdependency between items of hierarchy. In real world, there are many decisions problems that cannot be directly hierarchically structured because they have interaction and dependency issues with higher levels and lower levels items. ANP is illustrated by network rather than hierarchy. Feedback structure in ANP is not represented by top to bottom hierarchy but rather than in the form of network in which there are no levels but self referential loops that connect element with itself. In ANP network there are two types of nodes source and sink nodes. A source node is one from where path originates and it is never be a destination of any node. In contrary, a sink node is a destination node and it is not a source of any node. Network contains starting, ending, intermediating, source and sink nodes. Beside these nodes it also contains cycles and loops.

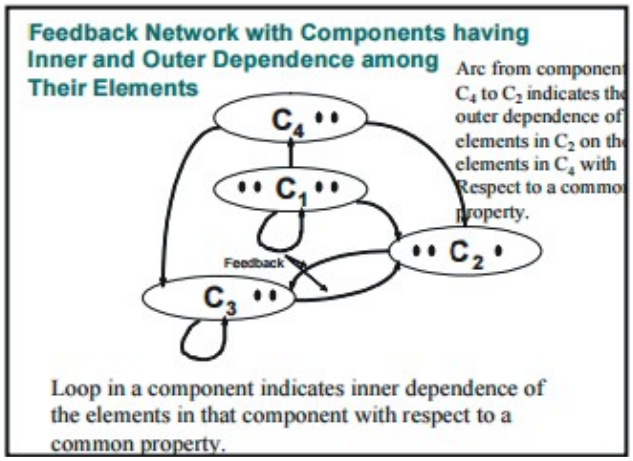

Figure 2 : ANP network with inner and outer dependencies

C1, C2, C3 and C4 are components with elements. C1 and C3 have inner dependencies represented in the form of loops. C2 has outer dependency on component C4. Figure 2 also contains feedback loops between C2 and C3 components.

Difference between AHP and ANP :

AHP represents decision problem in hierarchical structure where there are no dependencies between elements. In contrary ANP depicts a decision problem in the form of network where there are interdependencies (inner and outer) between elements.

(3) ELECTRE : This technique was developed by Bernard Roy in the year 1965[7]. Earlier it was discovered to choose best action out of given set of actions but later it was applied on three main problems: choosing, ranking and sorting. Since then several versions of ELECTRE were evolved ELECTRE I, ELECTRE II, ELECTRE III, ELECTRE IV, ELECTRE IS and ELECTRE TRI. Its main application is in the field of business, development, design and small hydropower. This technique is based on definition of outranking relations between alternatives considering two at any instant[8]. Alternative Ak outranks another alternative Ap (Ak→Ap) if it represents improved or atleast equal performance parameters as suggested by Ap with respect to majority of criteria.

(4) MODM Techniques :

(a) Dynamic Programming : Dynamic programming[9] approach divides the problem into smaller segments and makes a series of decisions. Next it tries to find optimal solutions for these smaller problems. At last, it combines optimal solutions of all the smaller segments to locate the optimal solution of entire problem. Dynamic programming is based on Bellman's Principle of Optimality which states that "An optimal policy has the property that whatever the initial state and initial decision are, the remaining decisions must constitute an optimal policy with regard to the state resulting from the first decision."

(b) Greedy Method : This method[10] always tries to locate an optimal solution at every stage of a problem. For instance, if there is a problem to optimize (maximize or minimize) a given objective function, it always makes a choice such that at each step function has optimal value. User has to be careful while making choices at every step of a problem because steps are irreversible.

(c) Integer Programming : Integer programming also finds optimal solution of a problem, but in this all the involved variables are integers. Suppose we have following linear equation[11]:

max{cx; Ax <= b and x >= 0}

Where A is mxn matrix. c is a n-dimensional row vector, b is a m-dimensional column vector and x is n-dimensional column vector of variables. If some of the variables in the above equation are integers then it is called as Mixed Integer Program (MIP) otherwise if all variables are integer then it is Integer programming approach. Further if in above equation variables are restricted to {0,1}then equation is called Binary Integer programming approach.

Conclusion and Future Directions :

Selecting a cloud for an organization involves multiple criteria, alternatives and quality constraints. Here objective is to select optimal cloud service which can satisfy organization needs. Present research paper discussed classic and advanced cloud service selection techniques. Further, we would like to emphasize that users are not sometimes certain about their requirements. Subjective requirements are difficult to mention and quantify. So this uncertainty creates complications in service selection. Also, user has to rely on third party for getting cloud services, so it is very important that service provider should be reliable and trustworthy because if it is not so, overall goal of

migrating to cloud is defeated. Information may be leaked or hacked by some unauthorized person. Reputation of provider is also one of the crucial factors in cloud selection. Selecting provider with poor reputation can also stake company's image. To conclude above discussion, here are some challenges and further directions in cloud service selection :

(i) Assessment of subjective requirements of users.

(ii) Trustworthiness of Cloud service provider.

(iii) Reputation of provider.

References :

(1) *E. Triantaphyllou, "Multi-criteria Decision Making Methods: A Comparative Study", SpringerLink, DOI 10.1007/ 978-1-4757-3157-6, ISBN: 978-1-4419-4838-0, Volume 44, pp 1-274, 2000.*

(2) *A.V. Dastjerdi and R. Buyya, "A taxonomy of QoS management and service selection methodologies for Cloud computing", Cloud computing: Methodology, Systems, and Applications, DOI: 10.1201/b11149-8, pp 109-131, October 2011.*

(3) *L. Sun H. Dong, F.K. Hussain, O.K. Hussain and E. Chang, "Cloud service selection: State-of-the-art and future research directions", Journal of Network and Computer Applications Elsevier, pp 134-150, August 2014.*

(4) *https://en.wikipedia.org/wiki/ Analytic_hierarchy_process [Accessed online on 2-6-2017]*

(5) *S.K. Garg S. Versteeg and R. Buyya, "SMICloud: A Framework for Comparing and Ranking Cloud Services", 2011 Fourth IEEE International Conference on Utility and Cloud Computing, DOI 10.1109/UCC.2011.36, ISBN: 978-0-7695-4592-9, pp 210-218, 2011.*

(6) *T.L. Saaty, "The Analytic Network Process, Iranian Journal of Operational Research, Volume 1, Number 1(5-2008).*

(7) *https://en.wikipedia.org/wiki/ELECTRE [Accessed online on 15-6-2017]*

(8) *N. Caterino I. Iervolino, G. Manfredi and E. Cosenza, "Comparative analysis of decision making methods for the seismic retrofit of rc buildings", The 14th World Conference on Earthquake Engineering, pp 1-8, October 2008.*

(9) *J.Y. Wang, "Dynamic Programming", Operation Research II, College of Management, NCTU, Spring, 2009.*

(10) *https://www.hackerearth.com/practice/algorithms/ greedy /basics-of-greedy-algorithms/tutorial [Accessed online on 30-6-2017]*

(11) *D. Mishra, "Theory of Integer Programming", April 2011.*

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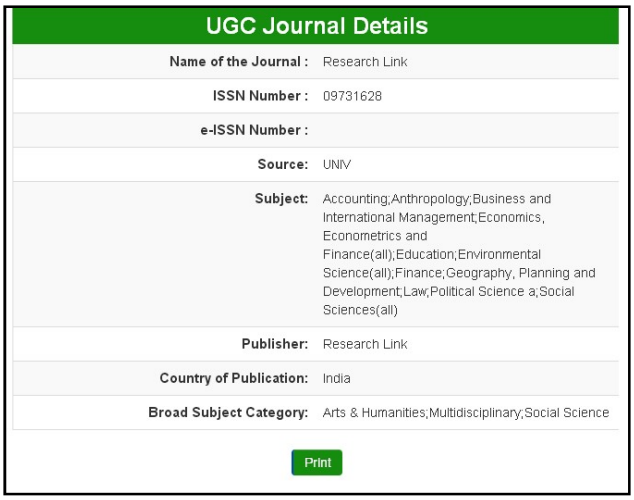

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(7) गुजराती माध्यम के शोधपत्र **हरेकृष्णा (Harekrishna), टेराफोंट वरुण (Terafont Varun), टेराफोंट आकाश (Terafont Aaksah)** में टाईप करवाकर 'पेजमेकर 6.5' में भेजे जा सकते हैं।

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