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Performance Evaluation of Bender's Decomposition Algorithm

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Abstract

In cloud computing, provisioning an optimal resource to consumer gets more and more crucial. Cloud computing consumers are able to use the set of computing resources by net. Cloud providers will receive some amount for these computational resources depending on usage of cloud resource. The provisional resource plans are reservation and also on demand. The computing resources will be provided based on cloud resource provisioning concept. In this concept resource charge is high due to the hard to find optimization of resource price in uncertainty. The resource optimization price is depends on indefiniteness of resource provisioning charge. The indefiniteness of resource provisioning charge consists of: on demand price, reservation price, expending price. This results in difficulty to accomplish resource provisioning optimization price in computing cloud. The Integer Stochastic Programming is applied for the problem to achieve resource providing optimum cost. The Two Stage Integer Stochastic Programming with recourse is applied to find a solution for the complexity problem optimization in uncertainty. The stochastic programming is extended as Deterministic Equivalent Formulation to solve the probability distribution of entire scenarios to decrease the on demand price. The Decomposition Bender's is applied to divide the resource optimization problem into many sub problems to decrease the on demand cost and reservation cost. Scenario Tree Generation is considered in order to represent scenarios. Scenario Reduction Techniques are applied to reduce problem by reducing number of scenarios. This will decrease reservation price and expending price.

Keywords: Computing Cloud, Resource Provisioning Optimization, Integer Stochastic Programming, Formulation Deterministic Equivalent, Decomposition Bender's, Scenario Tree Generation, Scenario Tree Reduction.

1. Introduction

In cloud computing, resource provisioning is a vital topic of how resources are provided and allocated. Cloud consumer be capable of access these resources with no worrying on any maintenance or management of real resources. Cloud resource provisioning concept offers computing resources consists of: processing power, storage, software, and network bandwidth. The resources are optimized in inadequately defined deciding environments or in cases where scenarios are definite or useless. Effective resource optimization requires a certain rigor, consistency and agreement on processes. The main goal of resource optimization is to decrease the resource provisioning charge in cloud computing. In spot market, the price of the resource is irregular all the time depending on the resource provide and demand levels. For example, Amazon enforces an auction method to decide order pricing in its spot market. In particular, the following feature of the cost optimization problem draws importance of optimizing resource cost and how to optimally supply cloud resources to achieve service requirements. The problem lies in the indefiniteness of computational resource cost. The stochastic programming is an absolute solution of optimal resource price under indefiniteness. This programming must optimize on demand cost, Reservation cost, Expending cost in the direction to attain optimal resource provisioning in cloud computing environments. The Deterministic Equivalent Formulation (DEF) algorithm is useful to solve linear mathematical optimization programming script errors. The on demand cost is decrease with this DEF algorithm. The Benders Decomposition algorithm is useful to partition the optimization problems which they are divided to multiple sub problems. It is used to decrease the on demand cost and reservation cost of the resource provisioning Level. Scenario Tree Generation is implemented in order to represent set of scenarios we have considered in our problem. Scenario Reduction Techniques can reduce number of scenarios for problem to obtain optimal resource provisioning cost. It is used to decrease the reservation cost and expending cost.

2. Related Work

They proposed an optimal model for the problem and give a solution by implementing stochastic integer programming method [2]. The proposed work regards a stochastic programming problem with simple integer recourse in which the value of the recourse variable is controlled to a multiple of a nonnegative integer. The algorithm of a dynamic slope scaling method for solving this problem is implemented by using a property of the probable recourse function [4]. The proposed system is to implement a

Deterministic Resource Rental Planning (DRRP) model, by a mixed integer linear program, to produce optimal rental decisions for given fixed cost parameters. The proposed Stochastic Resource Rental Planning (SRRP) model clearly considers the cost uncertainty in rental deciding [1].In this system, Quantitative modeling and optimization move toward are proposed for supporting such decisions in cloud computing services. The proposed learning curve models useful to capture the providers' price decreasing with economy of scale [3]. In this system a latest approach is proposed to optimization of tasks processing time and cost at the same time. The proposed gravitational attraction search algorithm has been implemented to solve Grid Resource Allocation problem [5]. The system is a machine driven providing for database replicas to application allocation in dynamic content web server cluster. The proposed K-Nearest Neighbor algorithm is used for light weight monitoring of essential system and application metrics with the aim of decide how databases should be provide to a given workload [8]. The system is to implement an optimization framework in the resource provisioning problem. The proposed method Limited Look ahead Control schema will considers the switching costs incurred in resource provisioning and clearly converts risk in the optimization problem [7]. The system is to build a large scale workflows consist millions of tasks and needs thousands of hours of aggregate computation time. The conventional approach to using these resources suffers from several overheads that produce poor performance. The proposed methods consist of advance reservations, multi-level scheduling, and infrastructure as a service (IaaS) [6]. The proposed Optimum Cloud Resource Provisioning (OCRP) algorithm takes decisions depending on the best possible solution of integer stochastic programming to lease resources of cloud providers. The working of the OCRP algorithm is assessed by numerical studies and simulation [9].

3. Proposed Scheme

The complete development of the proposed system is depicted in Fig. 1 which contains resource provisioning model, stochastic integer programming, Deterministic Equivalent Formulation, Benders Decomposition, Scenario Tree Generation, Scenario Tree Reduction.

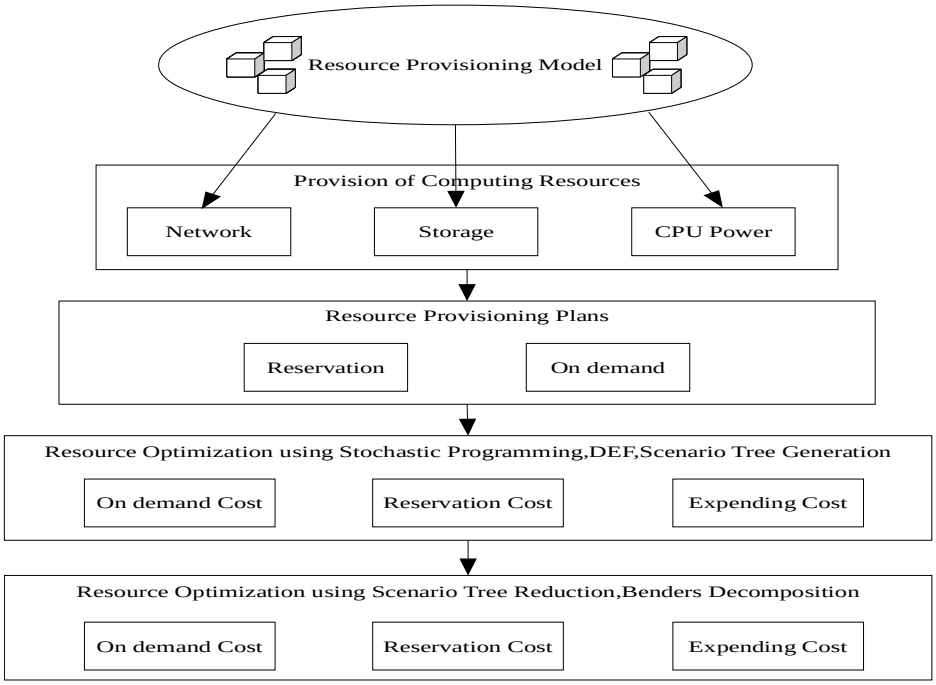

Fig. 1: Overall Process of the Proposed System model.

3.1 Resource provisioning Model in Cloud

In this proposed system the VMware Player is used to mount Windows XP operating system in order to access the open stack private cloud. The computing resources are provided by using the resource provisioning model and the provision resources are network, storage, CPU processing power**.** The quantity of resource types can be computing power in unit of CPU-hours, storage in unit of GBs/month, and network bandwidth for Internet data transfer in unit of GBs/month. In Virtual Machine repository each Virtual Machine class specifies the quantity of resources in each resource type.

3.2 Stochastic Integer Programming

Stochastic Programming is a Mathematical Programming about deciding under uncertainty. The goal of the stochastic programming model function is to minimize the cloud consumer's total resource provisioning cost. The deterministic optimization problems are developed with known parameters within certain bounds.

Minimize:

$$Z = \sum_{i \in I} \sum_{j \in J} \sum_{k \in K} C_{ijk}^{(R)} \; X_{ijk}^{(R)} + IE_{\Omega} \; [\, Q\,(X_{ijk}^{(R)}, \omega)], \qquad (1)$$

Subject to:

$$X_{ijk}^{(R)} \in IN_0 \,, \;\; \forall i \in I, \forall j \in J, \forall k \in K \,. \qquad (2)$$

The aim of Equation (1) is to minimize the resource provisioning costs include: on demand cost, reservation cost, expected cost. In this calculation the stochastic two stage integer recourse is developed for solving complexity of resource cost optimization problems in uncertainty. In this formulation, representation IE_{Ω} represents the decreased expected cost of resource provisioning. In Equation (2) the reservation cost represent to number of cloud provider, number of virtual machines, and set of provisioning stages. In two-stage stochastic programming, the deciding variables of problem optimization under indefiniteness are divided into two groups. The initial stage variables have to be determined before the realization of indefinite parameters. Consequently, once the random events have demonstrated itself, advance propose or functional policy advances can be done by choosing, at a definite cost, the values of the stage second, or recourse, indefinite values. The stage second indefinite values are represented as corrective measures or recourse beside any infeasibilities occurring due to a particular understanding of uncertainty. The stage second difficulty may also be a functional-level deciding problem subsequent a first-stage plan and the indefiniteness realization. Due to indefiniteness, the stage second cost is an indefinite variable. The aim is to choose the first-stage indefinite values in such a way that the sum of the stage first costs and the expected value of the random stage second costs is decreased.

3.3 Deterministic Equivalent Formulation

The two stage stochastic programs are represented as large stochastic linear programs. This representation is called as Deterministic Equivalent Formulation. A deterministic equivalent formulation is a mathematical program that make use to calculate the optimal first-stage decision. This formulation exists for continuous probability distributions also, when one can correspond to the second-stage cost. The probability distributions of both price and demand must be presented in deterministic equivalent formulation. In this optimization problem on demand cost is focused to be obtaining optimal solution of resource provisioning. The stochastic programming model uncertainty problems are find solution here using deterministic formulation. In this formulation number of cloud provider are focused to optimize the on demand cost of resource provisioning. The linear mathematical optimization programming script errors are decreased by using this formulation.

3.4 Benders Decomposition

The Benders decomposition algorithm is used to find solution for the stochastic programming problem which is developed in stochastic programming model. This algorithm can be used for any type of optimization problem, but it should need a certain structure part within the problem to obtain effective optimization of resource provisioning cost. The goal of this algorithm is to partition the optimization problem into various smaller problems which can be find solution autonomously and parallel. The Benders decomposition algorithm can break down integer programming problems having complicating variables into two major problems: master problem and also sub problem. The master problems are consists of the complicating variables and the sub

problems are consists of the other decision variables are calculated and then lower and upper bounds are computed by this process.

3.5 Scenario Tree Generation

A linear stochastic multistage program (LSMP) is a demonstration of linear stochastic optimization, where the aim and conditions are one dimensional. When any of the random indefinite values have made use in the LSMP are non-terminating, the problem is unlimited dimensional. In a way to possibly handle such a difficulty we typically replace it with a finite dimensional estimation. Even when all the random indefinite values have fixed support, the problem is over and over again computationally difficult and must be estimated by a problem of minor dimension. One of the principal challenges in the field of stochastic programming handles with finding effective ways to assess the significance of atoms, and to make use of that data to reduce the tree of scenario's in such a way that the solution to the smaller best possible solution difficulty is not much dissimilar than the difficulty stated with the original tree. The Generation of Scenario Tree algorithm is a finite element technique that deals with this difficulty for the class of LSMP with random variables.

3.6 Scenario Tree Reduction

Stochastic programming problems seem as mathematical models for optimization problems in stochastic uncertainty. Most computational approaches for finding solution of such models are based on estimating the inherent probability distribution by a probability compute with fixed support. Since the operational difficulty for finding solution of stochastic programs gets inferior when increasing the count of atoms (or scenarios), it is sometimes needed to decrease their number. Methods for reduction of scenarios usually need fast heuristics for finding solution of combinatorial sub problems. The Scenario Tree Reduction (STR) algorithm is a finite element technique that deals with this problem for the class LSMP with random variables.

4. Results

A Resource optimization is considered before and after stochastic programming model with scenario reduction along with Bender's Decomposition. Fig. 5 depicts the resource optimization before and after applying scenario tree reduction of stochastic Programming Model with Bender's Decomposition and results are showed. Fig 5 depicts the Cloud Providers in x axis and the computing total costs in y axis.

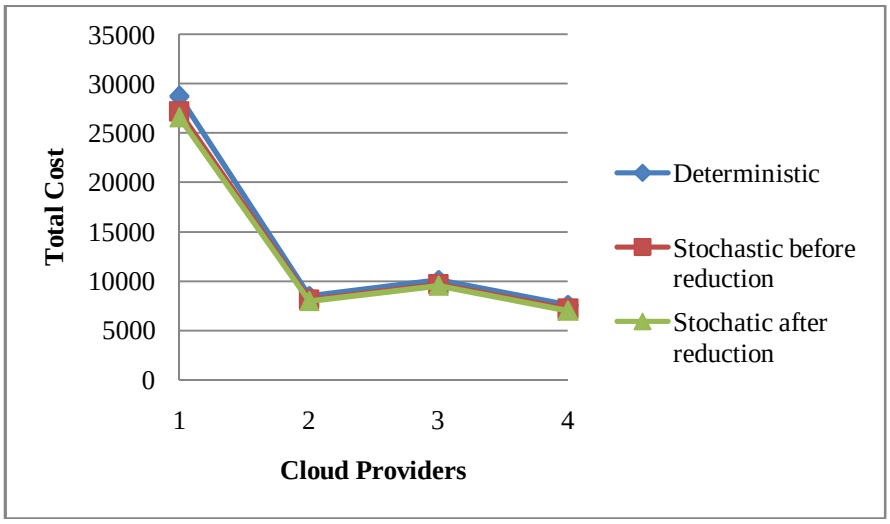

Fig. 2: Resource Optimization Before & after Scenario Reduction of Stochastic Programming with Bender's Decomposition.

5. Conclusion

The open stack private cloud environment is configured by using VMware player. The cloud resources are provisioned by using open stack resource provisioning model. The Stochastic Integer Programming is used for problem of obtaining resource providing optimum cost. The Integer Two Stage Stochastic Programming with recourse is useful to find solution for the difficulty of optimization problems in uncertainty. The stochastic programming is extended as Deterministic Equivalent Formulation (DEF) to find solution for the probability distribution of all scenarios to minimize the on demand cost. The Deterministic Equivalent Formulation (DEF) algorithm is useful for solving mathematical optimization of linear programming script errors. The Benders Decomposition is useful for partitioning the resource optimization problem into many sub problems. It is used to decrease the on demand cost and reservation cost in the resource provisioning stage. Scenario Tree Reduction (STR) is useful for decrease the difficulty scenarios in a problem resource optimization. This method is used to minimize the reservation cost and expending cost. The performance is compared and evaluated for resource optimization before and after applying scenario reduction of stochastic programming model with Bender's Decomposition. In this performance comparison, computing resource costs are optimized by after applying stochastic programming model with Bender's Decomposition of Scenario reduction.

References

[1] Miao Pan, Xinxin Liu, Xiaolin Li, Yuguang Fang, "Optimal Resource Rental Planning for Elastic Applications in Cloud Market," IEEE 26th International Conference on Parallel & Distributed Processing Symposium (IPDPS), May 2012.

[2] Qiang Li, "Applying Stochastic Integer Programming to Optimization of Resource Scheduling in Cloud Computing," Journal of Networks, Jul 2012.

[3] Amit Gera, Cathy H. Xia, "Learning Curves and Stochastic Models for Pricing and Provisioning Cloud Computing Services," Journel of Service Science, 2011.

[4] Takayuki Shiina, "Dynamic Slope Scaling Procedure for Stochastic Integer Programming Problem," International Journal of Economics and Management Sciences 6 2012.

[5] Narjes Khatoon. Naseri, Amin. Jula, "A New Approach to Optimize Time-Cost in Grid Resource Allocation," International Conference on Soft Computing and its Applications (ICSCA'2012) August 25-26, 2012.

[6] Juve and E. Deelman, "Resource Provisioning Options for Large-Scale Scientific Workflows," Proc. IEEE Fourth Int'l Conf. e-Science, 2008.

[7] Kusic and N. Kandasamy, "Risk-Aware Limited Lookahead Control for Dynamic Resource Provisioning in Enterprise Computing Systems," Proc. IEEE Int'l Conf. Autonomic Computing, 2006.

[8] J. Chen, G. Soundararajan, and C. Amza, "Autonomic Provisioning of Backend Databases in Dynamic Content Web Servers," Proc. IEEE Int'l Conf. Autonomic Computing, 2006.

[9] S. Chaisiri, B.S. Lee, and D. Niyato, "Optimization of Resource Provisioning Cost in Cloud Computing," IEEE Transactions on Services Computing, Vol.5, no. 2, 2012.