Victoria University of Wellington

QOS AWARE WEB SERVICE DISTRIBUTION DESIGN

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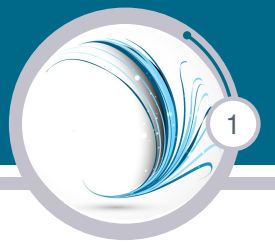
Introduction



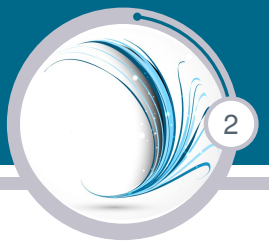
Web service providers want to find a way to maximize their profit as well as improve the quality of services.
Main goals:

- Minimize the total cost
- Maximize the quality of services

A promising approach to solve this problem is to allocate services across multiple locations. Unfortunately, it is **NP-hard** to find an optimal plan when consider multiple-factors.

- Single objective algorithms: Linear programming $\rightarrow$ Low efficiency
- Multi-objective genetic algorithm (NSGA-II) $\rightarrow$ Low scalability

Project Aims



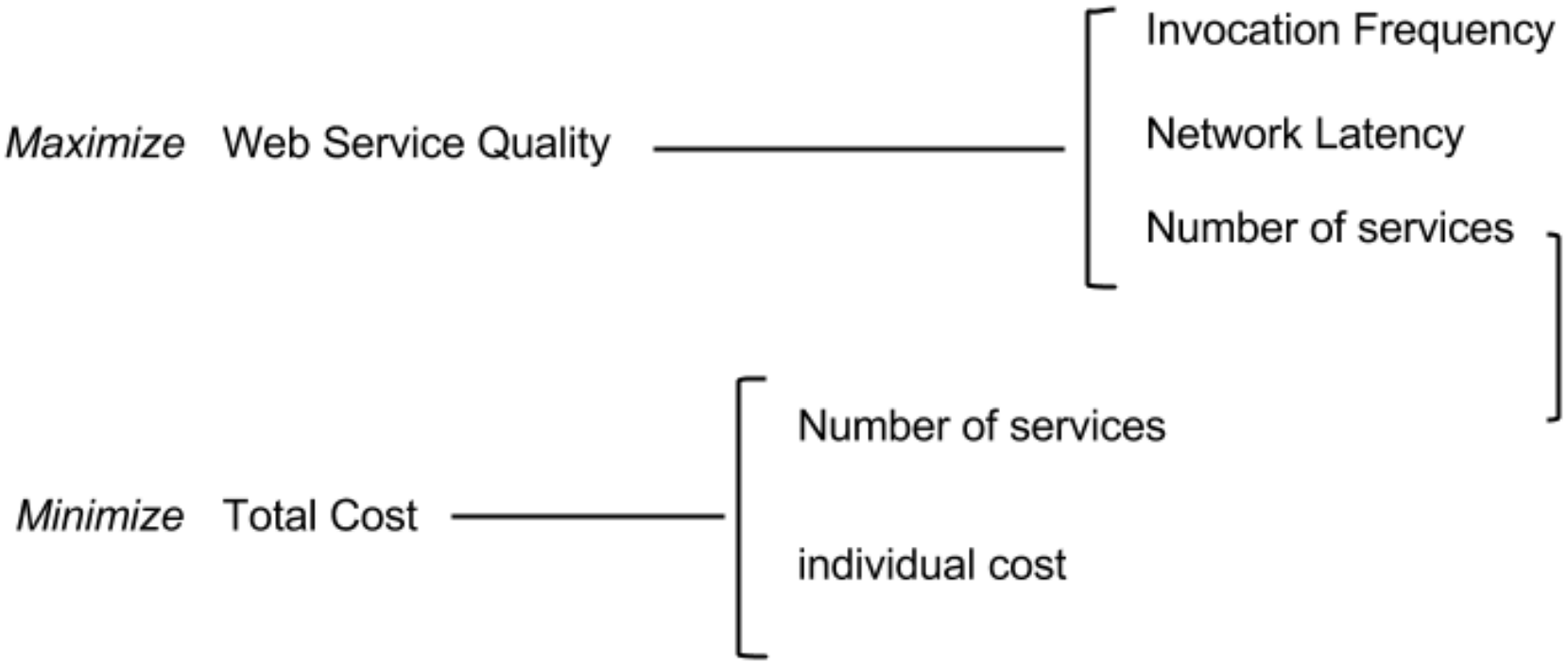
PSO has shown its promise in solving NP-hard problem.

The aim of this project is to propose a multi-objective PSO based algorithm to solve this problem.

- To model the Web service location-allocation problem
- To develop a Multi-objective PSO based approach

Work Done
Problem Modeling

Factors that affect the decision making.



Work Done
Modeling Details

Fitness functions:

Response matrix

$$R = \begin{array}{c} \\ i_1 \\ i_2 \\ i_3 \end{array} \begin{array}{c} \begin{array}{ccc} s_1 & s_2 & s_3 \end{array} \\ \begin{bmatrix} 5.776 & 6.984 & 0 \\ 0 & 2.035 & 0 \\ 1.135 & 2.3 & 0.984 \end{bmatrix} \end{array}$$

Invocation Frequency matrix

$$F = \begin{array}{c} \\ i_1 \\ i_2 \\ i_3 \end{array} \begin{array}{c} \begin{array}{ccc} s_1 & s_2 & s_3 \end{array} \\ \begin{bmatrix} 120 & 35 & 56 \\ 14 & 67 & 24 \\ 85 & 25 & 74 \end{bmatrix} \end{array}$$

Maximize Web Service Quality ⟹ *Minimize* $LatencyFitness = \sum_{i \in I} \sum_{s \in S} r_{is} \times f_{is}$

Minimize Total Cost ⟹ *Minimize* $CostFitness = \sum_{s \in S} \sum_{j \in J} c_{sj} \times a_{sj}$

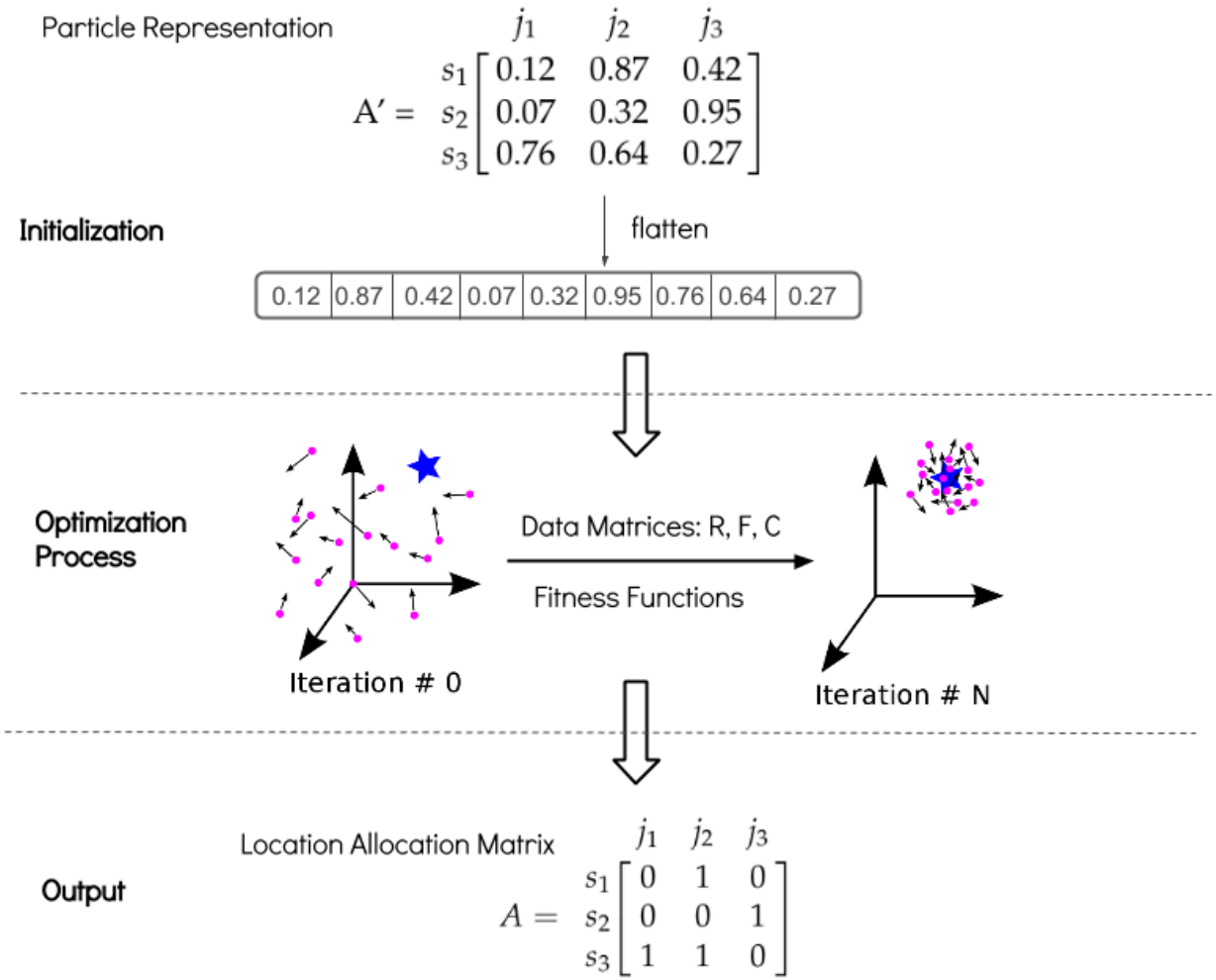
Cost Matrix

$$C = \begin{array}{c} \\ s_1 \\ s_2 \\ s_3 \end{array} \begin{array}{c} \begin{array}{ccc} j_1 & j_2 & j_3 \end{array} \\ \begin{bmatrix} 130 & 80 & 60 \\ 96 & 52 & 86 \\ 37 & 25 & 54 \end{bmatrix} \end{array}$$

Service location-allocation Matrix

$$A = \begin{array}{c} \\ s_1 \\ s_2 \\ s_3 \end{array} \begin{array}{c} \begin{array}{ccc} j_1 & j_2 & j_3 \end{array} \\ \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix} \end{array}$$

Work Done
Multi-objective PSO



Experimental Design

We designed four test cases with different complexities based on a real world dataset (WS-DREAM).

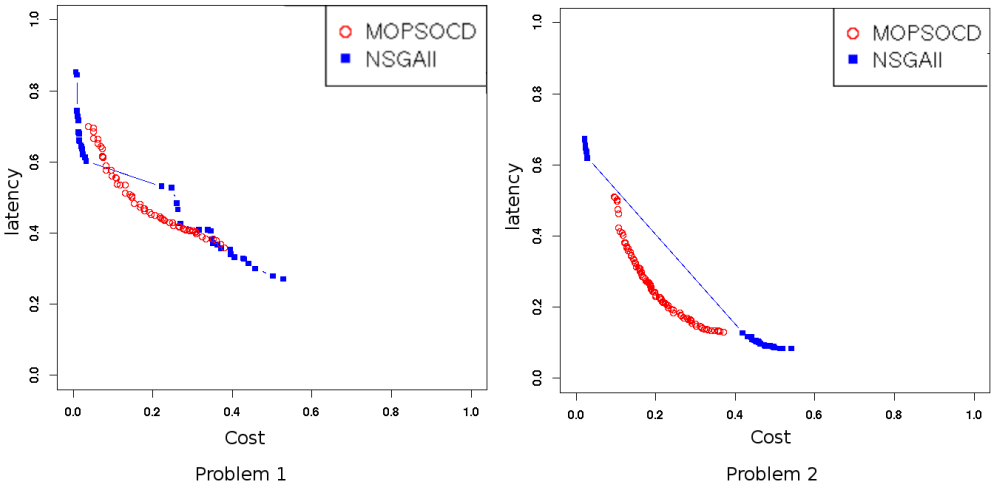
Table: Test Cases

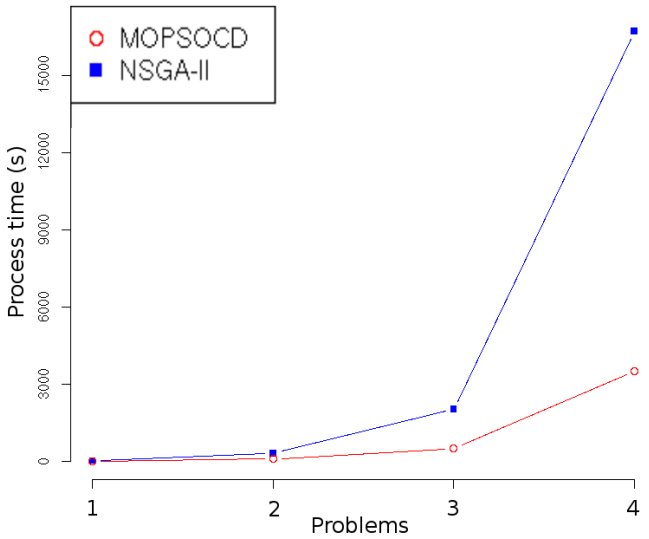
problem	number of service	number of candidate location	number of user center
1	20	5	10
2	50	15	20
3	100	25	40
4	200	40	80

Conduct experiments on two algorithms:

- Multi-objective PSO
- NSGA-II

Experimental Result





Future Plan

- Develop a single-objective PSO and compare with Multi-objective PSO
- Use hypervolume and Invert Generational Distance (IGD) to analyze the parameter settings and further improve the algorithm.