University of BRISTOL

DEPARTMENT OF COMPUTER SCIENCE

Pricing the Cloud

An Investigation into Financial Brokerage for Cloud Computing

Project Outline

Cloud Computing is the latest paradigm backed as the realisation of the long sought dream of supplying compute resource as a utility. In just a few short years, the popularity of cloud platforms has exploded, providing consumers with the ability to rapidly scale their services on-demand.

In 2012, Rogers and Cliff published a paper[1] proposing that a third party broker could be introduced into the current market structure. This is achieved by offering the users options, a special sort of financial instrument. The model has several advantages:

1) It benefits the provider, giving them a better idea of upcoming demand and therefore enabling cost streamlining.
2) It benefits the user, as purchasing options is a cheaper alternative than the on-demand instances direct from the provider.
3) The broker is able to sustain a profit from offering the service.

In this project, that research is extended further. This is achieved by implementing the model in CReST, a data centre simulation platform. The performance of the model is analysed in a multitude of situations, using both Rogers' strategies and further original scenarios. Finally, a method is proposed to allow the fully autonomous operation of the agent to remain profitable in any market scenario with no *a priori* knowledge of the domain.

[1] Owen Rogers and Dave Cliff. A financial brokerage model for cloud computing. Journal of Cloud Computing: Advances, Systems and Applications, 1, 2012.

Preliminary Results

Stage 1: Replication

- The first stage involved implementing the model in CReST and using the same parameters and prices as Rogers to verify.
- Results found:
  1) The broker is profitable when using reserved instances.
  2) That considering past demand is beneficial to the broker.
  3) T-Tests revealed that the profitability changes found when altering the threshold are statistically significant.

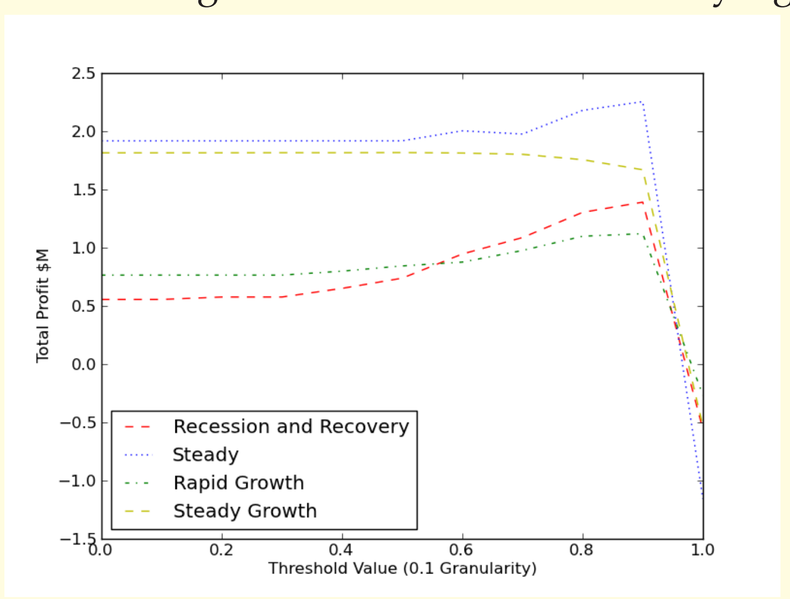

Figure: Overall Broker Profits using Different Threshold Values.

Stage 2: Parameter Space Exploration

- Tested the affect of changing parameters, including instance prices, cost factor and adding variance to demand.
- Trends emerged that even small changes to simulations resulted in a different threshold becoming the most profitable.

Stage 3: Extension of the Model

- In response to a changing optimal threshold, an auomated method is proposed based on the Widrow-Hoff ML algorithm.
- Results find that the technique outperforms using even the optimal static threshold in both steady and erratically changing markets, but only performs averagely in growth markets where a 'more risky' approach of purchasing more reserved instances is more profitable.

Business Plan Strategy

One of the themes of the project is judging whether the model is feasible for a real world venture. The simulations suggest that if the broker selects a suitable threshold value, the model should yield a significant profit.

- The market is currently unoccupied; providing a platform for a disruptive venture to enter and establish itself quickly.
- The company would offer the brokerage services covered within the project. I.e. allow users to submit requirements and deliver instances when required.
- IP for the company would cover the automated thresholding strategy, a uniquely developed feature in this work.
- Only limited staff will be required, to deal with clients and set up the required application services.
- £100,000 in startup costs required to fund investment into building services and purchasing reserved instances.

Progress and Status

Completed

- Replicate and verify results of Rogers' experiments.
- Discover whether brokerage is a profitable venture.
- Perform a sensitivity analysis of extrinsic parameters.
- Extend the Broker model through automated thresholding.

Partial Completion

- Thoroughly test static and adaptive thresholding methods under different market scenarios, including Market Shocks.

Issues

- Auto thresholding performance issues in Growth Markets. Tends to favour less risk currently; could potentially add a modifier if a growth market is detected.

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