**Themis**

A Spot Market-based Automatic Resource Scaling Framework

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### Problem
- Scientific applications are becoming more complex and dynamic.
- To support these applications resource management mechanisms are required to be simple and flexible.
- Current mechanisms used by cloud providers meet these requirements as they allow users to provision virtualized resources instantly. However they DON'T:
  - provide support for building dynamic applications and meeting user SLOs
  - lead to an efficient resource usage.

### Our Goals
- Provide generic support to applications to scale automatically their resource demand on cloud systems
- Enforce fair resource utilization among users
- Maximize the infrastructure utilization of cloud providers

### Themis

Themis is a decentralized resource control system for virtualized infrastructures based on:
- a **virtual economy** and a **proportional share** (PS)-based spot market to allocate virtualized resources (VMs), providing fairness to users and leading to a maximum resource utilization
- autonomous controllers to scale the application resource demand to meet user SLOs

### Autonomous Application Controllers

Application-specific information (performance objectives, application deployment, budget and virtual machine configuration) in an XML format

Manages the virtual machine provisioning and application deployment

2 generic policies to adapt the bid and the number of virtual machines, based on the TCP congestion avoidance algorithm

### Resource Allocation through a Spot Market

- Users bid for VMs while the physical resource share allocated to each VM is proportional to the cloud resource price.
- The proportional-share market ensures a maximum resource utilization as it is work-conserving and allocates resources in a fine-grained manner.
- A load balancing algorithm ensures that the virtual machines get the best shares for which the users are willing to pay, while keeping a low number of virtual machine migrations.

### Running an Elastic Application with Themis

We have set up a Condor pool and used a Themis controller to provision VMs according to the fluctuations in the number of jobs and the resource price.

- The controller adjusts the number of VMs according to the number of running and waiting jobs.
- The controller can buy a maximum number of VMs according to the infrastructure capacity. In this case the Condor pool uses the entire infrastructure.
- When the price increases the controller provisions less VMs.

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