EC2 Cloud Spot Instances for ATLAS Jobs
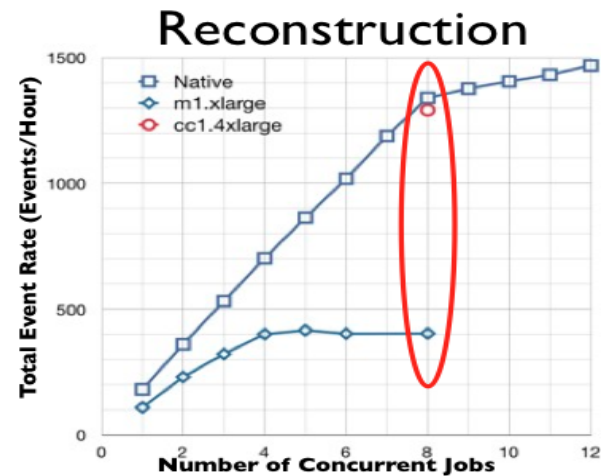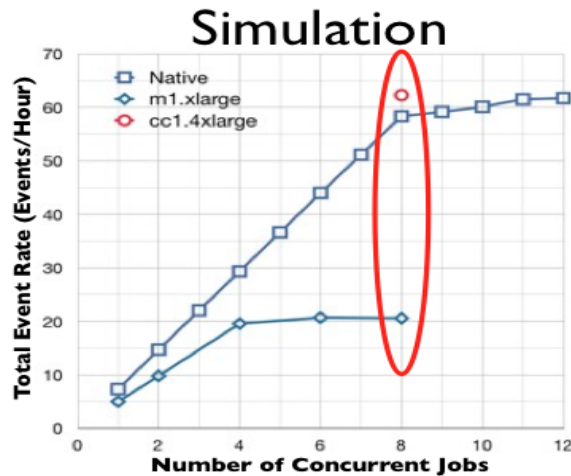
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Introduction

- Cost of ATLAS jobs on EC2 Cloud

- Amazon EC2 Spot Instances

- Reduce costs using Spots Instances

- Spot Instances for ATLAS Jobs

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Cost Estimate (Cost per 1K Evt)

Simulation

Reconstruction

Assume we run 8 concurrent jobs for all cases, the cost per 1k event is calculated.

Cost / 1K Event (USD)	EC2		Tier3 Size Center	Large Center (hundreds K cores)
	m1.xlarge	cc1.4xlarge		
Simulation	37	26	11	5
Reconstruction	1.88+Storage	1.24+Storage	0.48	0.24

EC2 cost doesn't include storage (in/out/store), which is very significant as well!!!!

Yushu Yao, *Performance of ATLAS Jobs in the EC2 Cloud*, April 4, 2011.

EC2 Spot Instances

- Gives the ability to bid for unused Amazon EC2 capacity

- The price fluctuates based on supply and demand (range below: $0.304 – $0.336)

Spot Instance Pricing History   Cancel ✕

Product: Linux/UNIX ▲▼   **Instance Type:** m1.xlarge ▲▼   **Date Range:** 1 day ▲▼

Value:	$0.3360	
Time:	Wed May 18 2011 06:43:57	

$0.3400

$0.3300

$0.3200

$0.3100

$0.3000

20:00   0:00   4:00   8:00   12:00   16:00

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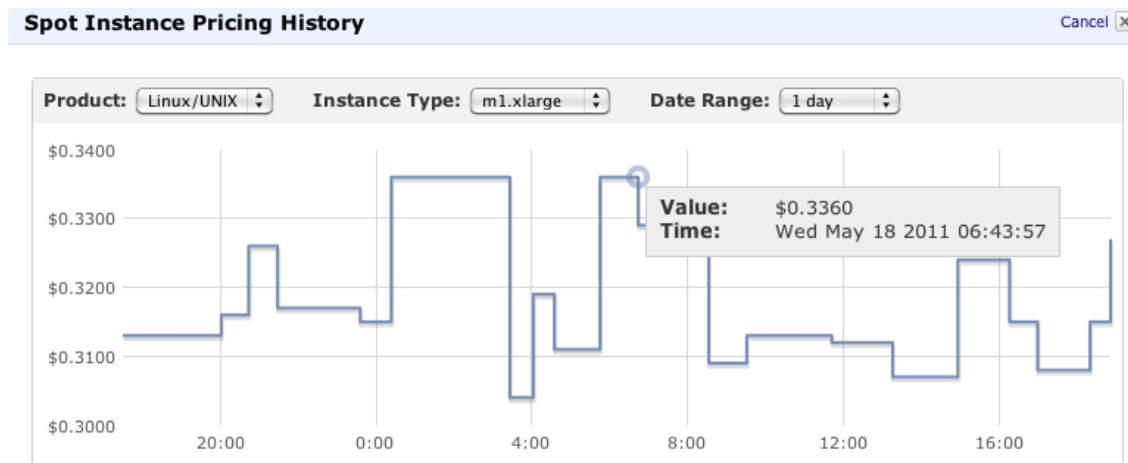
Spot vs. On-Demand Instances

	On-Demand	**Spot Instance**
Pricing	Flat Hourly Rate	Variable Hourly Rate
Start-up	Immediate	May be delayed *
Termination	Only by user	May be terminated by EC2

* if the spot price is equal to your max bid price your instance may or may not be started based on the number of requests at that price
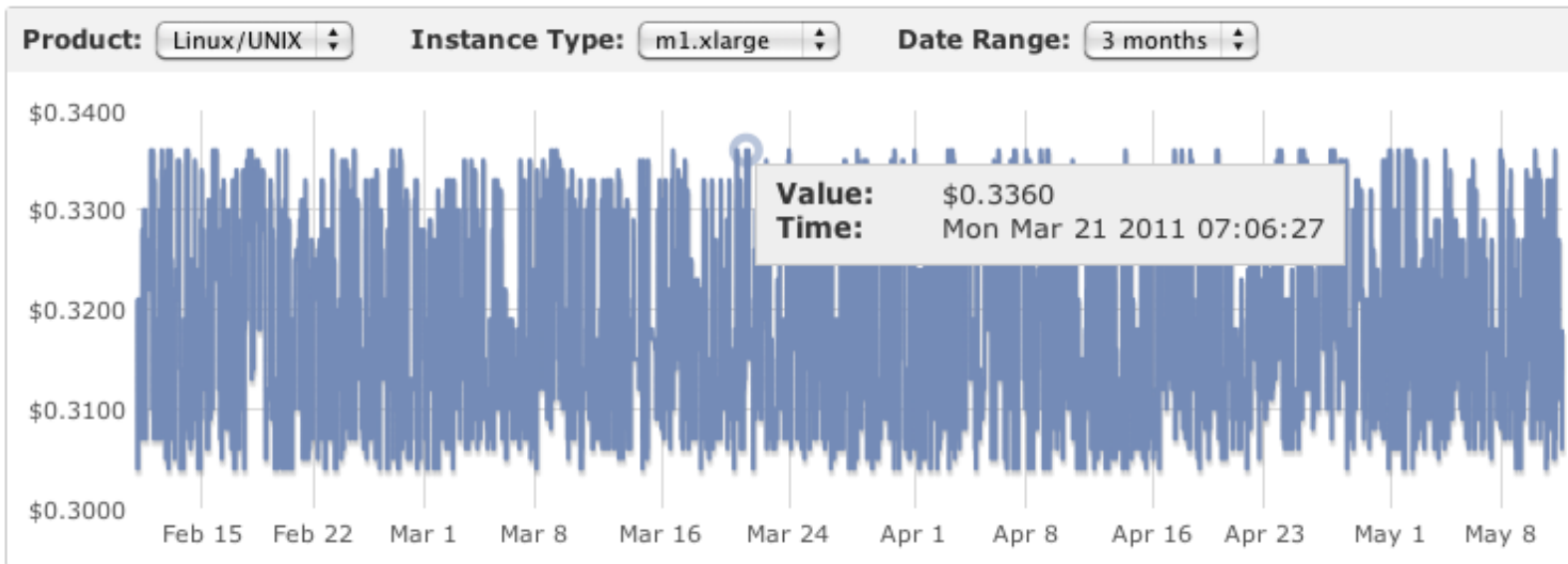
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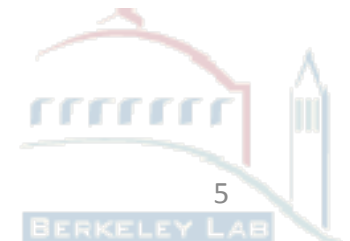
Review the price history

```
$ ec2-describe-spot-price-history -t m1.xlarge

SPOTINSTANCEPRICE        0.330000 2011-03-12T12:11:24-0800  m1.xlarge    Linux/UNIX

SPOTINSTANCEPRICE        0.306000 2011-03-12T14:59:06-0800  m1.xlarge    Linux/UNIX

SPOTINSTANCEPRICE        0.307000 2011-03-12T16:02:26-0800  m1.xlarge    Linux/UNIX
…
```


* On-Demand $0.76 per instance hour

Consider a max bid price

- You will often pay less per instance hour than your max bid price
    - everyone pays same spot price no matter what their max bid is
- Spot instances will be terminated when the spot price goes above your max bid price
    - if the spot price is equal to your max bid price your request may or may not get terminated
    - make sure workloads and applications can handle this
    - you are not charged for partial hours unless you terminate your own instance
- The durability of your request can either be one-time or persistent

Choose a request type

- Use a *one-time request* with a *high spot price* expecting that your instances get enough compute time to complete the job without interruption.

- Use **a *persistent request*** with **a *lower spot price*** combining a number of instances run over time whose aggregate time would be enough to complete the job.

Hourly Cost Per Core					
m1.xlarge On-Demand	m1.xlarge High Spot Price	cc1.4xlarge On-Demand	cc1.4xlarge High Spot Price	Tier 3 Center	Large Data Centers (Tier 1)
$0.19	$0.08325	$0.20	N/A*	~$0.08	~$0.04

Initial Questions

- *What does it mean to terminate an instance in terms of the ATLAS jobs?*

  We can either :
  - Use ATLAS bookkeeping in order to resume event processing on restart.
  - Use Amazon Simple Queue Service (SQS) for bookkeeping

  And store results with either:
  - Amazon EBS back AMIs which creates a new EBS for each instance.
    (Amazon EBS volumes are created in a particular Availability Zone and can be from 1 GB to 1 TB in size.)
  - Amazon Simple Storage Service (S3)
    (unlimited data, data transfer between EC2 and S3 is free via COPY request within an Amazon Region.)

- *What do we do with partially processed input files? Luminosity block alignment?*

- *Perhaps the simplest solution is to overbid by 10% above highest spot price.*

Conclusion

- Running ATLAS jobs using EC2 On-Demand Instances is too expensive

- Amazon EC2 Spot Instances can reduce the costs of running ATLAS jobs possibly making it competitive with the cost of Tier 3 sized centers.

- Therefore, there is much more hope that EC2 and Tier3 costs are compatible which gives us a strong reason to pursue this.

- I have run some initial tests over the last week and found that there seems to be a time difference in the delayed start-up depending on the time of day. Also, my average spot price for m1.xlarge was $0.318 per instance hour with a max bid price higher than the highest spot price of $0.336.

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Resources

- Yushu Yao, *Performance of ATLAS jobs on EC2 Cloud*
  - https://twiki.cern.ch/twiki/bin/view/AtlasPublic/AtlasPublicCloudMagellan
- Amazon Documentation:
  - http://aws.amazon.com/ec2/instance-types/
  - http://aws.amazon.com/ec2/spot-instances/
- http://cloudexchange.org/: visualizations of the spot prices by region and instance type.

Spot Instance Features

- **Durability**
  - *Persistent*: remains in consideration after each instance termination and is resubmitted with initial parameters
  - *One-time:* a request is only satisfied once

- **Cluster** (may reduce the chance that your spot request is fulfilled)
  - *Launch Groups*: ensures that cluster instances start and terminate simultaneously
  - *Availability Zones*: ensure that cluster instances are launched in the same Availability Zone

- **Pricing history** is provided by Amazon to help you determine an appropriate spot price.