Basics of Cloud Computing – Lecture 7

More AWS and Research at Mobile & Cloud Lab

Satish Srirama
Outline

• More Amazon Web Services
• Cloud based Research @ Mobile & Cloud Lab
Cloud Providers and Services – we already discussed

• Amazon Web Services
  – Amazon EC2
  – Amazon S3
  – Amazon EBS
  – Amazon Elastic Load Balancing
  – Amazon Auto Scale
  – Amazon CloudWatch

• Eucalyptus
• OpenStack
• SciCloud
• Management providers
  – ElasticFox
  – RightScale
• PaaS
  – Google AppEngine
  – Windows Azure
MORE AWS
AWS we discuss

• AWS Management Console
• AWS Identity and Access Management
• AWS Elastic Beanstalk
• AWS CloudFormation
• Amazon Simple Workflow Service
• Amazon Elastic MapReduce
AWS Management Console

• Hope some of you have started using Amazon accounts
• You can manage your complete Amazon account with management console (Similar to Hybridfox)
  – AMI Management
  – Instance Management
  – Security Group Management
  – Elastic IP Management
  – Elastic Block Store
  – Key Pair management etc.
• Have different panes for different services
AWS Management Console - screenshot

https://console.aws.amazon.com/
AWS Identity and Access Management (IAM)

• How can an enterprise or group of people use a single credit card?
• Manage IAM users
  – Create new users and manage them
  – Create groups
• Manage permissions
  – Creating policies
• Manage credentials
  – Create and assign temporary security credentials
IAM policy

• Example policy giving access to complete EC2

```json
{
  "Statement": [
    {
      "Action": "ec2:*",
      "Effect": "Allow",
      "Resource": "*"
    },
    {
      "Effect": "Allow",
      "Action": "elasticloadbalancing:*",
      "Resource": "*"
    },
    {
      "Effect": "Allow",
      "Action": "cloudwatch:*",
      "Resource": "*"
    },
    {
      "Effect": "Allow",
      "Action": "autoscaling:*",
      "Resource": "*"
    }
  ]
}
```

http://aws.amazon.com/iam/
AWS Elastic Beanstalk

• Enables to easily deploy and manage applications in the AWS cloud
  – Simply upload a bundle of the applications built using .NET, PHP and Java technologies

• Automatically handles the deployment details of capacity provisioning, load balancing, auto-scaling, and application health monitoring

• Something similar to PaaS

• One retains full control over the AWS resources powering the application
  – You can access the underlying resources at any time
AWS Elastic Beanstalk

- AWS EB is built using familiar software stacks such as the Apache HTTP Server for PHP, IIS 7.5 for .NET, and Apache Tomcat for Java
- There is no additional charge for Elastic Beanstalk
  - Only the underlying AWS resources (e.g. Amazon EC2, Amazon S3) are charged
- Leverages AWS services such as Amazon EC2, S3, SNS, ELB, and Auto Scaling to deliver the same highly reliable, scalable, and cost-effective infrastructure

http://aws.amazon.com/elasticbeanstalk

25/03/2014  Satish Srirama
AWS CloudFormation

• Provides an easy way to create and manage a collection of related AWS resources, provisioning and updating them in an orderly and predictable fashion

• It is based on templates model
  – Templates describe the AWS resources, the associated dependencies, and runtime parameters to run an app.
  – The templates describe stacks, which are set of software and hardware resources.
  – Something similar to CloudML and RightScale server templates

• Hides several details
  – How the AWS services need to be provisioned
  – Subtleties of how to make those dependencies work.
AWS CloudFormation

• Amazon provides several pre-built templates to start common apps as:
  – WordPress (blog)
  – LAMP stack
  – Gollum (wiki used by GitHub)
  – ...

• There is no additional charge for AWS CloudFormation. You pay for AWS resources (e.g. EC2 instances, Elastic Load Balancers, etc.)

http://aws.amazon.com/cloudformation/
Amazon Simple Workflow Service

- A workflow service for building scalable, resilient applications
- Reliably coordinates all of the processing steps within applications
  - such as business processes, sophisticated data analytics applications, or managing cloud infrastructure services
- Manages task execution dependencies, scheduling, and concurrency
- Provides simple API calls from code written in any language
- Capable to run on EC2 instances, or any of the customer’s machines located anywhere in the world
Amazon Simple Workflow Service

- Maintains application state
- Tracks workflow executions and logs their progress
- Holds and dispatches tasks
- Controls which tasks each of the application hosts will be assigned to execute

http://aws.amazon.com/swf/
Amazon Elastic MapReduce

• Web interface and command-line tools for running Hadoop jobs on EC2
• Data stored in Amazon S3
• Monitors job and shuts machines after use
• Running a job
  – Upload job jar & input data to S3
  – Create the cluster
  – Create a Job Flow as steps
  – Wait for the completion and examine the results

http://aws.amazon.com/elasticmapreduce/
Other interesting AWS

• Amazon Relational Database Service
  – Provides access to the capabilities of familiar database engines
  – MySQL, Oracle or Microsoft SQL Server

• NoSQL databases
  – Simple DB
  – DynamoDB
Scientific Computing on the Cloud

• Public clouds provide very convenient access to computing resources
  – On-demand and in real-time
  – As long as you can afford them

• High performance computing (HPC) on cloud
  – Virtualization and communication latencies are major hindrances [Srirama et al, SPJ 2011; Batrashev et al, HPCS 2011]
    • Things have improved significantly over the years
  – Research at scale
Adapting Computing Problems to Cloud

• Reducing the algorithms to cloud computing frameworks like MapReduce [Srirama et al, FGCS 2012]
• Designed a classification on how the algorithms can be adapted to MR
  – Algorithm $\rightarrow$ single MapReduce job
    • Monte Carlo, RSA breaking
  – Algorithm $\rightarrow$ $n$ MapReduce jobs
    • CLARA (Clustering), Matrix Multiplication
  – Each iteration in algorithm $\rightarrow$ single MapReduce job
    • PAM (Clustering)
  – Each iteration in algorithm $\rightarrow$ $n$ MapReduce jobs
    • Conjugate Gradient
• Applicable especially for Hadoop MapReduce
Issues with Hadoop MapReduce

• It is designed and suitable for:
  – Data processing tasks
  – Embarrassingly parallel tasks

• Has serious issues with iterative algorithms
  – Long „start up“ and „clean up“ times ~17 seconds
  – No way to keep important data in memory between MapReduce job executions
  – At each iteration, all data is read again from HDFS and written back there at the end
  – Results in a significant overhead in every iteration
Alternative Approaches

• Restructuring algorithms into non-iterative versions
  – CLARA instead of PAM [Jakovits & Srirama, Nordicloud 2013]

• Alternative MapReduce implementations that are designed to handle iterative algorithms
  – E.g. Twister [Jakovits et al, ParCo 2011], HaLoop, Spark

• Alternative distributed computing models
  – Bulk Synchronous Parallel model [Valiant, 1990] [Jakovits et al, HPCS 2013]
  – Building a fault-tolerant BSP framework (NEWT) [Kromonov et al, UCC 2013]
Remodeling Enterprise Applications for the Cloud

• Remodeling workflow based applications for the cloud
  – To reduce communication latencies among the components
  – Intuition: Reduce inter-node communication and to increase the intra-node communication

• LP based mathematical models to find ideal deployment configuration [Paniagua et al, iiWAS 2011]
  – Based on the loads and regions
The Seven Mass Media

First Mass Media Channel - *Print* from the 1500s
Second Mass Media Channel - *Recordings* from 1900
Third Mass Media Channel - *Cinema* from 1910s
Fourth Mass Media Channel - *Radio* from 1920s
Fifth Mass Media Channel - *TV* from 1950s
Sixth Mass Media Channel - *Internet* from 1990s
Seventh Mass Media Channel - *Mobile* from 2000s

Report: Mobile cloud to grow beyond $11 billion in 2018

Written by CopperEgg // July 12, 2012 // No Comment // Cloud Performance

The proliferation of smartphones, tablets and other mobile devices is contributing to change in the private sector, as businesses continue to leverage these gadgets in an attempt to enhance efficiency and potentially gain a competitive advantage. According to a new report by Global Industry Analysts, the evolution of mobility is also changing the cloud computing landscape, pushing the mobile cloud market to generate more than $11 billion in revenue by 2018.

Verizon's Stratton: The Future Of IT Is Mobile And Cloud

25/03/2014
Satish Srirama
Mobile Applications

• One can do interesting things on mobiles directly
  – Today’s mobiles are far more capable
  – Location-based services (LBSs), mobile social networking, mobile commerce, context-aware services etc.

• It is also possible to make the mobile a service provider
  – Mobile web service provisioning [Srirama et al, ICIW 2006; Srirama and Paniagua, MS 2013]
  – Challenges in security, scalability, discovery and middleware are studied [Srirama, PhD 2008]
  – Mobile Social Network in Proximity [Chang et al, ICSOC 2012; PMC 2013]
Mobile Cloud Applications

• Bring the cloud infrastructure to the proximity of the mobile user
• Mobile has significant advantage by going cloud-aware
  – Increased data storage capacity
  – Availability of unlimited processing power
  – PC-like functionality for mobile applications
  – Extended battery life
Mobile Cloud Binding Models

Task Delegation

[Flores & Srirama, JSS 2013]

Satish Srirama
Mobile Cloud Middleware

[Srirama and Paniagua, MS 2013]

[Warren et al, IEEE PC 2014]

[Flores et al, MoMM 2011; Flores and Srirama, JSS 2013]
CroudSTag – Scenario

• CroudSTag takes the pictures/videos from the cloud and tries to recognize people
  – Pictures/Videos are actually taken by the phone
  – Processes the videos
  – Recognizes people using facial recognition technologies
• Reports the user a list of people recognized in the pictures
• The user decides whether to add them or not to the social group
• The people selected by the user receive a message in facebook inviting them to join the social group
CroudSTag [Srirama et al, PCS 2011; SOCA 2012]

- Cloud services used
  - Media storage on Amazon S3
  - Processing videos on Elastic MapReduce
  - face.com to recognize people on facebook
  - Starting social group on facebook
Code Offloading

• Studied extensively by community [MAUI, Cloudlets etc.]

• Is Mobile Cloud taking full advantage of Cloud Computing?
  – Parallelization and elasticity are not exploited

• Offloading from a different perspective
  – “Offloading is a global learning process rather than just a local decision process” [Flores and Srirama, MCS 2013]

• How it can learn?
  – Analysis of code offloading traces which are generated by the massive amount of devices that connect to cloud

“EMCO: Evidence-based mobile code offloading”
Evidence-based Mobile Code Offloading

[Flores and Srirama, MCS 2013]

25/03/2014 Satish Srirama
Process-intensive Tasks on Cloud

• Media processing
  – CloudSTag demonstrates image and video processing

• Sensor data analysis
  – Human activity recognition [Srirama et al, NGMAST 2011]
  – Context aware gaming
  – MapReduce based sensor data analysis [Paniagua et al, MobiWIS 2012]
Data Analytics on the Cloud

- Cloud scale data storage solutions
- Cloud scale data analytics
  - Pig & Hive
- NoSQL
- Implementing graph algorithms on graph databases

Large-scale Data Processing on the Cloud - MTAT.08.036 (Fall 2014)
email: srirama@ut.ee

WE ALWAYS WELCOME NEW IDEAS!
This week in lab

• Advanced Google AppEngine
  – You will try accessing DB
Next Week

• Summarize what we have learnt
• How to prepare for the examination
References

- Check Amazon videos and webinars at http://aws.amazon.com/resources/webinars/
References - continued