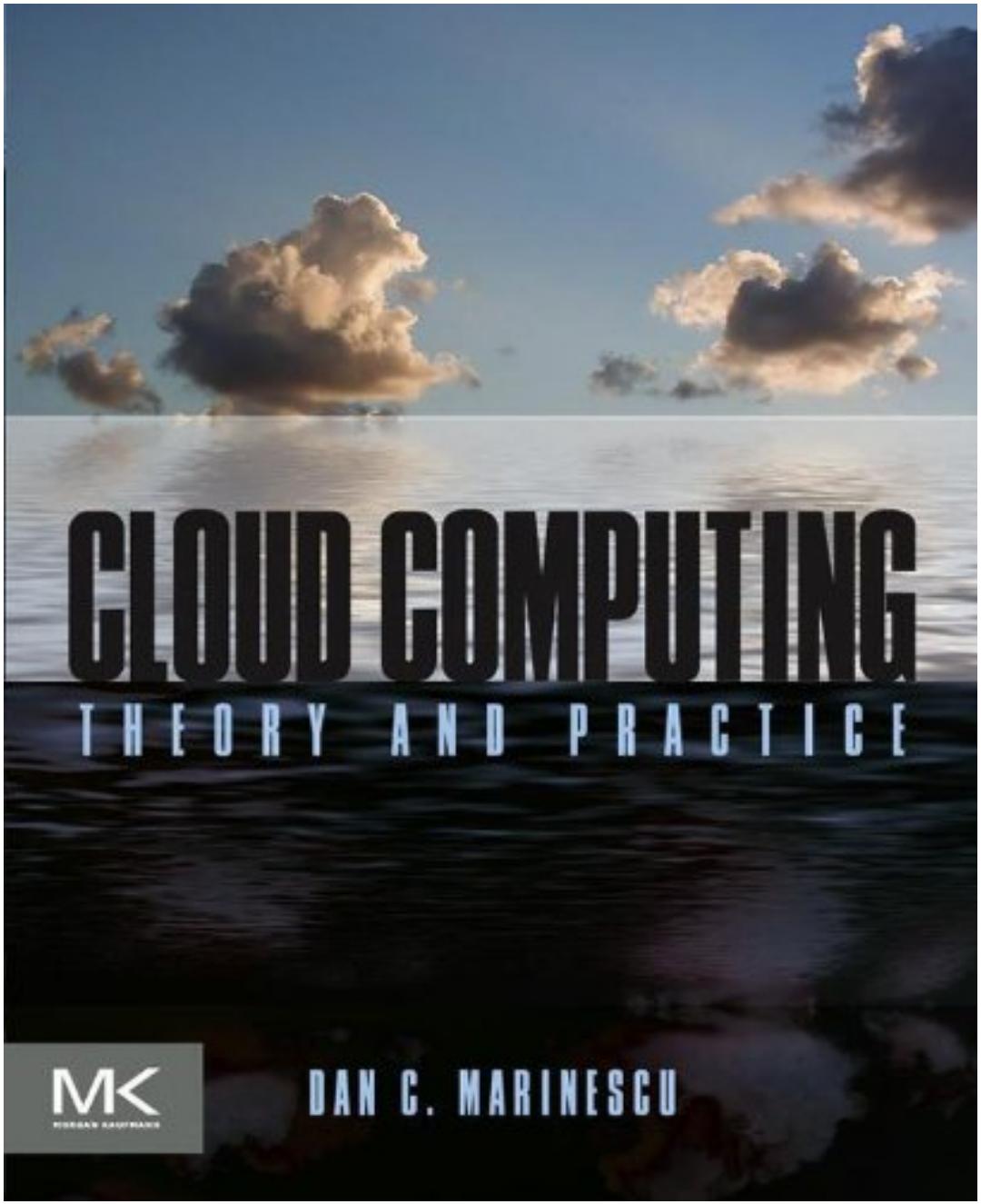
Cloud Infrastructure


CLOUD COMPUTING
THEORY AND PRACTICE
DAN C. MARINESCU

Contents

- IaaS services from Amazon.
  - Regions and availability zones for Amazon Web Services.
  - Instances – attributes and cost.
  - A repertoire of Amazon Web Services.
- SaaS and PaaS services from Google.
- SaaS and PaaS services from Microsoft.
- Open-source platforms for private clouds.
- Cloud storage diversity and vendor lock-in.
- Cloud interoperability; the Intercloud.
- Energy use and ecological impact large datacenters .
- Service and compliance level agreements.
- Responsibility sharing between user and the cloud service provider.
- User security concerns.
- User motivation.

Who is Amazon !!

American international multibillion dollar electronic commerce company with headquarters in Seattle, Washington, USA.

- started in 1995 by Jeff Bezos as an online bookstore.
- but soon diversified, selling DVDs, VHSs, CDs, video and MP3 downloads/streaming, software, video games, electronics, apparel, furniture, food, toys, and jewelry.
- The company also produces consumer electronics: Kindle e-book reader and the Kindle Fire tablet computer.
- In 2006, Amazon officially launched the Amazon Web Services (AWS) to became a major provider of cloud computing services.

Amazon Web Services (AWS)

- AWS IaaS cloud computing services launched in 2006.
- Businesses in 200 countries used AWS in 2012.
- The infrastructure consists of compute and storage servers interconnected by high-speed networks and supports a set of services.
- An application developer:
  - Installs applications on a platform of his/her choice.
  - Manages resources allocated by Amazon.

Amazon Web Services (AWS)

- The introduction by Amazon of its Elastic Compute Cloud (EC2) service in 2006 marked the true beginning of cloud computing.
- EC2 is based on virtualization technology, which allows one server to run independent, isolated operating systems (OSs) for multiple users simultaneously.
- Since then Microsoft, Google, and many others have introduced virtual machine (VM) services based on this technology

Some Major cloud infrastructure

- The cloud computing infrastructure at Amazon, Google, and Microsoft (as of mid 2012).
  - Amazon is a pioneer in Infrastructure-as-a-Service (IaaS).
  - Google's efforts are focused on Software-as-a-Service (SaaS) and Platform-as-a-Service (PaaS).
  - Microsoft is involved in PaaS.
- Private clouds are an alternative to public clouds. Open-source cloud computing platforms such as:
  - Eucalyptus,
  - OpenNebula,
  - Nimbus,
  - OpenStack

  can be used as a control infrastructure for a private cloud.

AWS regions and availability zones

- Amazon offers cloud services through a network of data centers on several continents.
- In each *region* there are several availability zones interconnected by high-speed networks.
- An *availability zone* is a data center consisting of a large number of servers.

Region	Location	Availability zones	Cost
US West	Oregon	us-west-2a/2b/2c	Low
US West	North California	us-west-1a/1b/1c	High
US East	North Virginia	us-east-1a/2a/3a/4a	Low
Europe	Ireland	eu-west-1a/1b/1c	Medium
South America	Sao Paulo, Brazil	sa-east-1a/1b	Very high
Asia Pacific	Tokyo, Japan	ap-northeast-1a/1b	High
Asia Pacific	Singapore	ap-southeast-1a/1b	Medium

- Regions do not share resources and communicate through the Internet.


US West
(Oregon)
US West
(N. California)
US East
(N. Virginia)
EU
(Ireland)
Asia Pacific
(Tokyo)
Asia Pacific
(Singapore)
South America
(San Paulo)
Low cost region
Medium cost region
High cost region
Very high cost region

AWS instances

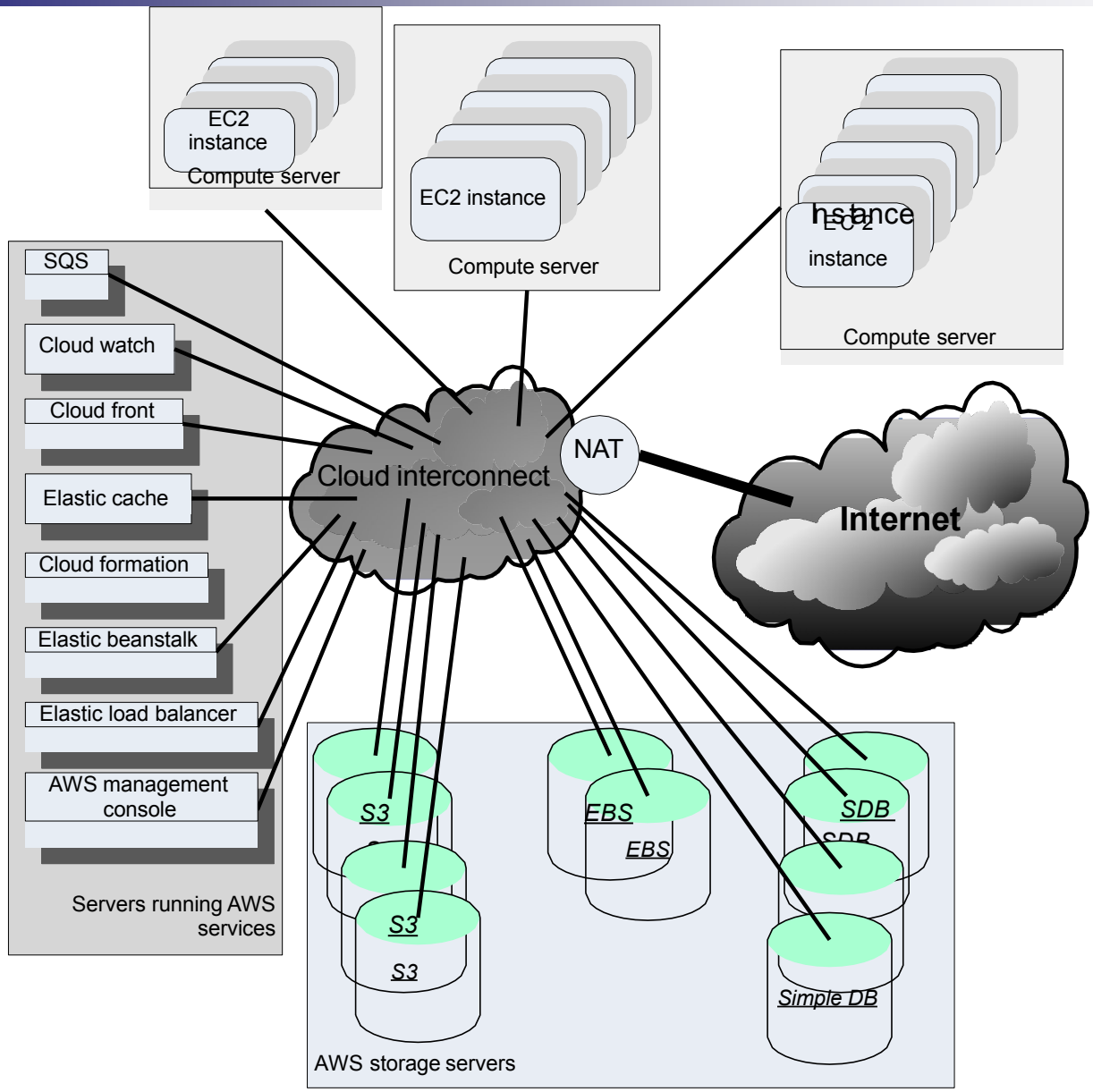
- An instance is a virtual server with a well specified set of resources including: CPU cycles, main memory, secondary storage, communication and I/O bandwidth.
- The user chooses:
  - The region and the availability zone where this virtual server should be placed.
  - An instance type from a limited menu of instance types.
- When launched, an instance is provided with a DNS name; this name maps to a
  - *private IP address:* for internal communication within the internal EC2 communication network.
  - *public IP address:* for communication outside the internal Amazon network, e.g., for communication with the user that launched the instance.

CPU cycle Usually, the time required for the execution of one simple processor operation such as an addition; this time is normally the reciprocal of the clock rate.

www.encyclopedia.com

AWS instances (cont'd)

- Network Address Translation (NAT) maps external IP addresses to internal ones.
- The public IP address is assigned for the lifetime of an instance.
- An instance can request an *elastic IP address*, rather than a public IP address. The elastic IP address is a static public IP address allocated to an instance from the available pool of the availability zone.
- An elastic IP address is not released when the instance is stopped or terminated and must be released when no longer needed. (Else ?)


EC2 instance
Compute server
EC2 instance
Compute server
EC2 instance
Compute server
SQS
Cloud watch
Cloud front
Elastic cache
Cloud formation
Elastic beanstalk
Elastic load balancer
AWS management console
Servers running AWS services
Cloud interconnect
NAT
Internet
S3
S3
S3
EBS
EBS
SDB
Simple DB
AWS storage servers

Steps to run an application

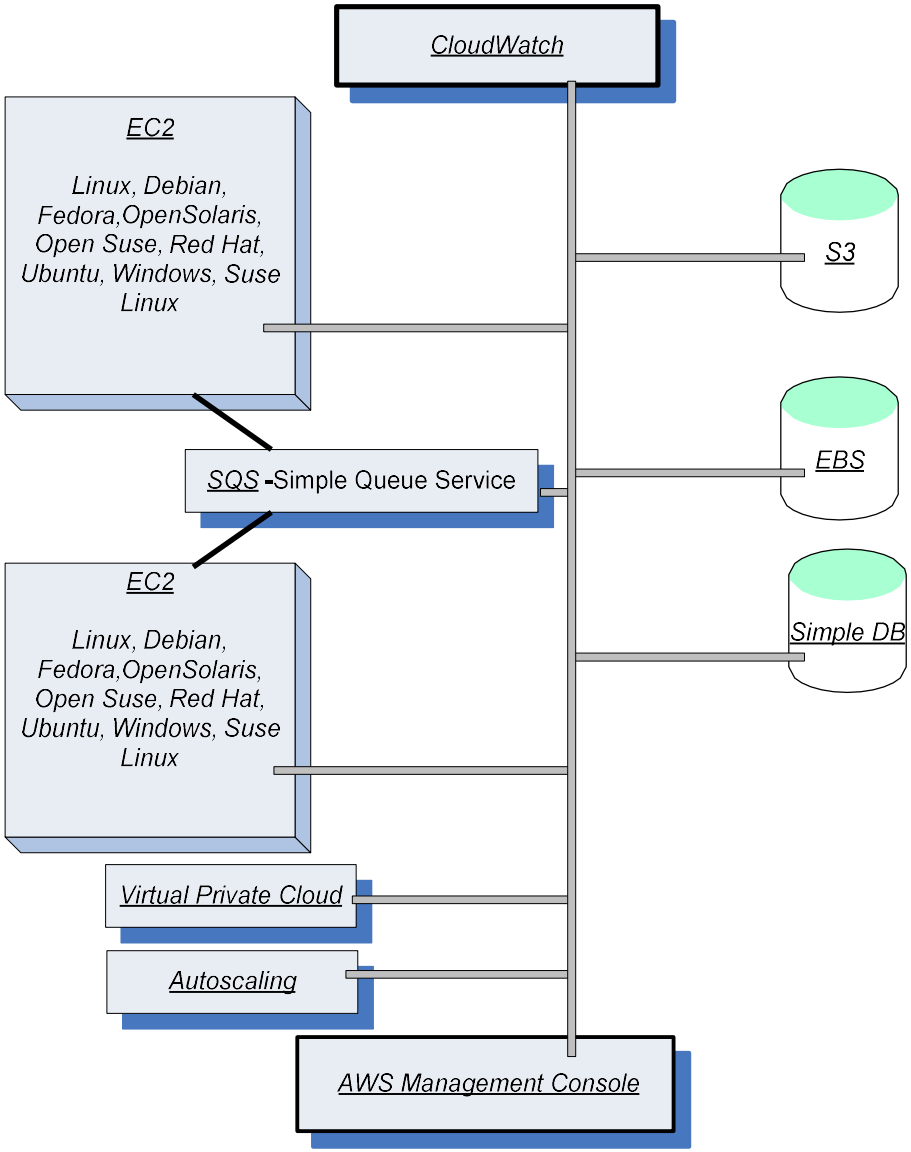
- Retrieve the user input from the front-end.
- Retrieve the disk image of a VM (Virtual Machine) from a repository.
- Locate a system and requests the VMM (Virtual Machine Monitor) running on that system to setup a VM.
- Invoke the Dynamic Host Configuration Protocol (DHCP) and the IP bridging software to set up MAC and IP addresses for the VM.

User interactions with AWS

- The AWS Management Console. The easiest way to access all services, but not all options may be available.
- AWS SDK libraries and toolkits are provided for several programming languages including Java, PHP, C#, and Objective-C.

Examples of Amazon Web Services

- *AWS Management Console* - allows users to access the services offered by AWS .
- *Elastic Cloud Computing (EC2)* - allows a user to launch a variety of operating systems.
- *Simple Queuing Service (SQS)* - allows multiple *EC2* instances to communicate with one another.
- *Simple Storage Service (S3)*, *Simple DB*, and *Elastic Bloc Storage (EBS)* - storage services.
- *Cloud Watch* - supports performance monitoring.
- *Auto Scaling* - supports elastic resource management.
- *Virtual Private Cloud* - allows direct migration of parallel applications.
- And many more….


CloudWatch
EC2
Linux, Debian, Fedora,OpenSolaris, Open Suse, Red Hat, Ubuntu, Windows, Suse Linux
S3
EBS
SQS -Simple Queue Service
EC2
Linux, Debian, Fedora,OpenSolaris, Open Suse, Red Hat, Ubuntu, Windows, Suse Linux
Simple DB
Virtual Private Cloud
Autoscaling
AWS Management Console

EC2 – Elastic Cloud Computing

- *EC2* - web service for launching instances of an application under several operating systems, such as:
  - Several Linux distributions.
  - Microsoft Windows Server 2003 and 2008.
  - OpenSolaris.
  - FreeBSD.
  - NetBSD.
- A user can
  - Load an *EC2* instance with a custom application environment.
  - Manage network's access permissions.
  - Run the image using as many or as few systems as desired.

EC2 (cont'd)

- Import virtual machine (VM) images from the user environment to an instance through *VM import*.
- *EC2* instances boot from an AMI (Amazon Machine Image) digitally signed and stored in *S3*.
- Users can access:
  - Images provided by Amazon.
  - Customize an image and store it in *S3*.
- An *EC2* instance is characterized by the resources it provides:
  - VC (Virtual Computers) – virtual systems running the instance.
  - CU (Compute Units) – measure computing power of each system.
  - Memory.
  - I/O capabilities.

Instance types

- Standard instances: micro (StdM), small (StdS), large (StdL), extra large (StdXL); small is the default.
- High memory instances: high-memory extra large (HmXL), high-memory double extra large (Hm2XL), and high-memory quadruple extra large (Hm4XL).
- High CPU instances: high-CPU extra large (HcpuXL).
- Cluster computing: cluster computing quadruple extra large (Cl4XL).

Instance types

Instance name	API name	Platform (32/64-bit)	Memory (GB)	Max EC2 compute units	I-memory (GB)	I/O (M/H)
StdM		32 and 64	0. 633	1 VC; 2 CUs		
StdS	`m1.small`	32	1.7	1 VC; 1 CU	160	M
StdL	`m1.large`	64	7.5	2 VCs; 2 × 2 CUs	85	H
StdXL	`m1.xlarge`	64	15	4 VCs; 4 × 2 CUs	1,690	H
HmXL	`m2.xlarge`	64	17.1	2 VCs; 2 × 3.25 CUs	420	M
Hm2XL	`m2.2xlarge`	64	34.2	4 VCs; 4 × 3.25 CUs	850	H
Hm4XL	`m2.4xlarge`	64	68.4	8 VCs; 8 × 3.25 CUs	1,690	H
HcpuXL	`c1.xlarge`	64	7	8 VCs; 8 × 2.5 CUs	1,690	H
Cl4XL	`cc1.4xlarge`	64	18	33.5 CUs	1,690	H

Instance cost

- A main attraction of the Amazon cloud computing is the low cost.

Instance	Linux/Unix	Windows
StdM	0.007	0.013
StdS	0.03	0.048
StdL	0.124	0.208
StdXL	0.249	0.381
HmXL	0.175	0.231
Hm2XL	0.4	0.575
Hm4XL	0.799	1.1
HcpuXL	0.246	0.516
Cl4XL	0.544	N/A

Amazon EC2 Functionality

- Select a pre-configured, templated image to get up and running immediately.
- Or create an Amazon Machine Image (AMI) containing your applications, libraries, data, and associated configuration settings.
- Configure security and network access on your Amazon EC2 instance.
- Choose which instance type(s) and operating system you want, then start, terminate, and monitor as many instances of your AMI as needed, using the web service APIs or the variety of management tools provided.
- Determine whether you want to run in multiple locations, utilize static IP endpoints, or attach persistent block storage to your instances.
- Pay only for the resources that you actually consume, like instance-hours or data transfer.

OS and Software

Amazon Machine Images (AMIs) are preconfigured with an ever-growing list of operating systems.

Operating Systems		
Red Hat Enterprise Linux	Windows Server	Oracle Enterprise Linux
SUSE Linux Enterprise	Amazon Linux AMI	Ubuntu Linux
Fedora	Gentoo Linux	Debian

Databases	Resource Management	Web Hosting
IBM DB2	StackIQ Rocks+	Apache HTTP
IBM Informix Dynamic Server	Hadoop	IIS/Asp.Net
Microsoft SQL Server Standard	Condor	IBM Lotus Web Content Management
MySQL Enterprise		IBM WebSphere Portal Server
Oracle Database 11g		

Application Development Environments	Application Servers	Video Encoding & Streaming
IBM sMash	IBM WebSphere Application Server	Wowza Media Server Pro
JBoss Enterprise Application Platform	Java Application Server	Windows Media Server
Ruby on Rails	Oracle WebLogic Server	

Security

- Amazon EC2 includes web service interfaces to configure firewall settings that control network access to and between groups of instances.

- When launching Amazon EC2 resources within Amazon Virtual Private Cloud (Amazon VPC), you can isolate your compute instances by specifying the IP range you wish to use, and connect to your existing IT infrastructure using industry-standard encrypted IPsec VPN.

- You can also choose to launch Dedicated Instances into your VPC. Dedicated Instances are Amazon EC2 Instances that run on hardware dedicated to a single customer for additional isolation.

Cost Saving Considerations

On-Demand Instances – On-Demand Instances let you pay for compute capacity by the hour with no long-term commitments. This frees you from the costs and complexities of planning, purchasing, and maintaining hardware and transforms what are commonly large fixed costs into much smaller variable costs.

Reserved Instances – Reserved Instances give you the option to make a low, one-time payment for each instance you want to reserve and in turn receive a significant discount on the hourly charge for that instance.

Spot Instances – Spot Instances allow customers to bid on unused Amazon EC2 capacity and run those instances for as long as their bid exceeds the current Spot Price.

S3 – Simple Storage System

- Service designed to store large objects; an application can handle an unlimited number of objects ranging in size from 1 byte to 5 TB.
- An object is stored in a bucket and retrieved via a unique, developer-assigned key; a bucket can be stored in a Region selected by the user.
- Supports a minimal set of functions: write, read, and delete; it does not support primitives to copy, to rename, or to move an object from one bucket to another.
- The object names are global.
- S3 maintains for each object: the name, modification time, an access control list, and up to 4 KB of user-defined metadata.

S3 (cont'd)

- Authentication mechanisms ensure that data is kept secure.
- Objects can be made public, and rights can be granted to other users.
- *S3* computes the MD5 of every object written and returns it in a field called ETag.
- System computes the MD5 of an object stored or written to compare this with the ETag; if the two values do not match, then the object was corrupted during transmission or storage.

Elastic Block Store (EBS)

- Provides persistent block level storage volumes for use with *EC2* instances; suitable for database applications, file systems, and applications using raw data devices.
- A volume appears to an application as a raw, unformatted and reliable physical disk; the range 1 GB -1 TB.
- An *EC2* instance may mount multiple volumes, but a volume cannot be shared among multiple instances.
- The volumes are grouped together in Availability Zones and are automatically replicated in each zone.
- EBS volumes are network-attached like SAN, and persist independently from the life of an instance.

Persistence: the fact of continuing in an opinion or course of action in spite of difficulty or opposition

Elastic Block Store (EBS)

EBS provides the ability to create point-in-time snapshots of volumes, which are persisted to Amazon S3.

- These snapshots can be used as the starting point for new Amazon EBS volumes, and protect data for long-term durability.
- The same snapshot can be used to instantiate as many volumes as you wish.
- These snapshots can be copied across AWS regions.

EBS and S3

- EBS can only be used with EC2 instances while S3 can be used outside EC2
- EBS appears as a mountable volume while the S3 requires software to read and write data
- EBS can accommodate a smaller amount of data than S3
- EBS can only be used by one EC2 instance at a time while S3 can be used by multiple instances
- S3 typically experiences write delays while EBS does not

Platform Services

Amazon Elastic Beanstalk

https://www.goodreads.com/book/show/18455358-jack-and-the-beanstalk

Amazon Elastic Beanstalk

AWS Elastic Beanstalk provides a solution to **quickly deploy** and manage applications in the AWS cloud.

Deploy using AWS Management Console, a Git repository, or an integrated development environment (IDE) such as Eclipse or Visual Studio to upload your application

You **simply upload your application**, and Elastic Beanstalk **automatically** handles the deployment details of capacity **provisioning**, **load balancing, auto-scaling,** and application health **monitoring**.

Elastic Beanstalk leverages AWS services such as **Amazon EC2**, **Amazon S3**, ….

To ensure easy portability of your application, Elastic Beanstalk is built using familiar software stacks such as:

- Apache HTTP Server for Node.js, PHP and Python
- Passenger for Ruby,
- IIS 7.5 for .NET
- Apache Tomcat for Java.

There is **no additional charge** for Elastic Beanstalk - you **pay only for the AWS resources** needed to store and run your applications.

SimpleDB….. NoSQL Storage

- Non-relational data store. Supports store and query functions traditionally provided only by relational databases.
- Supports high performance Web applications; users can store and query data items via Web services requests.
- Creates multiple geographically distributed copies of each data item.
- It manages automatically:
  - The infrastructure provisioning.
  - Hardware and software maintenance.
  - Replication and indexing of data items.
  - Performance tuning.

- SimpleDB would be used over S3 in the case where you want to store multiple key-value pairs associated with an item and want to retain the ability to find items based on any of the key-value pairs.

- SimpleDB is more flexible with the stored metadata. The key-value pairs are indexed, so querying can be quick.

- You can add and modify key-value pairs that are already in SimpleDB, where you'd need to delete and recreate objects in S3 to update metadata.

Storage

- **Instance –store :** disappears with the instance (transient)
- **Block storage:** SAN-like, persists across time
- **S3** is independent of an instance: for archival purposes: vault: store it now and retrieve it at a later date
- **SimpleDB:** Relational database better than MySQl or Oracle for reliability.

SQS - Simple Queue Service

- Amazon Simple Queue Service (SQS) is a fully managed message queuing service
- SQS eliminates the complexity and overhead associated with managing and operating message oriented middleware.
- Using SQS, user can send, store, and receive messages between software components at any volume, without losing messages or requiring other services to be available.
- User can get started with SQS in minutes using the AWS console, Command Line Interface or SDK of your choice, and three simple commands.

SQS - Simple Queue Service

- Hosted message queues are accessed through standard Simple Object Access Protocol (SOAP) and Query interfaces.
- Supports automated workflows - *EC2* instances can coordinate by sending and receiving SQS messages.
- Applications using SQS can run independently and asynchronously, and do not need to be developed with the same technologies.
- User can use Amazon SQS to exchange sensitive data between applications using server-side encryption (SSE) to encrypt each message body.
- A received message is “locked" during processing; if processing fails, the lock expires and the message is available again.
- Queue sharing can be restricted by IP address and time-of-day.

SQS - Simple Queue Service

- SQS offers two types of message queues.
  - Standard queues offer maximum throughput, best-effort ordering, and at-least-once delivery.
  - SQS FIFO queues are designed to guarantee that messages are processed exactly once, in the exact order that they are sent.

Amazon Simple Workflow Service (SWF)

Amazon SWF is a **task coordination** and **state management service** for cloud applications.

Using Amazon SWF, user **structures** the various **processing steps** in an application that **runs across one or more machines** as a set of "**tasks**."

Amazon SWF **manages dependencies** between the tasks, **schedules** the tasks for execution, and runs any logic that needs to be **executed in parallel**.

The service also **tracks** the tasks' **progress**.

As the **business requirements change**, Amazon SWF makes it **easy to change application logic** without having to **worry about the underlying state machinery** and **flow control**.

Amazon Virtual Private Cloud (VPC)

Amazon VPC lets you **provision** a **logically isolated section** of the Amazon Web Services (AWS) Cloud.

You have **complete control** over your virtual networking environment, including:

selection of your own **IP address range**,
creation of subnets, and
configuration of route tables and **network gateways**.

VPC allows **bridging with an onsite IT infrastructure** with an **encrypted VPN connection** with an **extra charge per VPN Connection-hour**.

There is **no additional charge** for using Amazon Virtual Private Cloud, aside from the normal Amazon EC2 usage charges.

CloudWatch

- Monitoring infrastructure used by application developers, users, and system administrators to collect and track metrics important for optimizing the performance of applications and for increasing the efficiency of resource utilization.
- Without installing any software a user can monitor either seven or eight pre-selected metrics and then view graphs and statistics for these metrics.
- When launching an Amazon Machine Image (AMI) the user can start the CloudWatch and specify the type of monitoring:
  - Basic Monitoring - free of charge; collects data at five-minute intervals for up to seven metrics.
  - Detailed Monitoring - subject to charge; collects data at one minute interval.

AWS services introduced in 2012

- *Route 53* - low-latency DNS service used to manage user's DNS public records.
- *Elastic MapReduce (EMR)* - supports processing of large amounts of data using a hosted Hadoop running on *EC2*.
- *Simple Workflow Service (SWF)* - supports workflow management; allows scheduling, management of dependencies, and coordination of multiple *EC2* instances.
- *ElastiCache* - enables web applications to retrieve data from a managed in-memory caching system rather than a much slower disk-based database.
- *DynamoDB* - scalable and low-latency fully managed NoSQL database service.

- out More……Assignment: Make ppt's about AWS latest

AWS services introduced in 2012 (cont'd)

- *CloudFront* - web service for content delivery.
- *Elastic Load Balancer* - automatically distributes the incoming requests across multiple instances of the application.
- *Elastic Beanstalk* - handles automatically deployment, capacity provisioning, load balancing, auto-scaling, and application monitoring functions.
- *CloudFormation* - allows the creation of a stack describing the infrastructure for an application.

- Find out more (Assignment 3: Ten latest Cloud Services Introduced by Amazon Recently)

SaaS services offered by Google

- *Gmail* - hosts Emails on Google servers and provides a web interface to access the Email.
- *Google docs* - a web-based software for building text documents, spreadsheets and presentations.
- *Google Calendar* - a browser-based scheduler; supports multiple user calendars, calendar sharing, event search, display of daily/ weekly/monthly views, and so on.
- *Google Groups* - allows users to host discussion forums to create messages online or via Email.
- *Picasa* - a tool to upload, share, and edit images.
- *Google Maps* - web mapping service; offers street maps, a route planner, and an urban business locator for numerous countries around the world
- *Google Drive* - an online service for data storage.

PaaS services offered by Google

- *AppEngine* - a developer platform hosted on the cloud.
  - Initially supported Python, Java was added later.
  - The database for code development can be accessed with GQL (Google Query Language) with a SQL-like syntax.
- *Google Co-op* - allows users to create customized search engines based on a set of facets/categories.
- *Google Base* - allows users to load structured data from different sources to a central repository, a very large, self-describing, semi-structured, heterogeneous database.

PaaS and SaaS services from Microsoft

- *Microsoft Azure* - an operating system; has 3 components:
  - Compute - provides a computation environment.
  - Storage - for scalable storage.
  - Fabric Controller - deploys, manages, and monitors applications.

- *SQL Azure* - a cloud-based version of the SQL Server.

- *Azure AppFabric*, formerly .NET Services - a collection of services for cloud applications.

Open-source platforms for private clouds

- *Eucalyptus* - can be regarded as an open-source counterpart of Amazon's EC2.
- *Open-Nebula* - a private cloud with users actually logging into the head node to access cloud functions. The system is centralized and its default configuration uses the NFS file system.
- *Nimbus* - a cloud solution for scientific applications based on Globus software; inherits from Globus:
  - The image storage.
  - The credentials for user authentication.
  - The requirement that a running Nimbus process can **ssh** into all compute nodes.

- Assignment 4: Write up on Eucalyptus, Openstack, Nimbus

Eucalyptus

- *Virtual Machines* - run under several VMMs including Xen, KVM, and VMware.
- *Node Controller* - runs on server nodes hosting a VM and controls the activities of the node.
- *Cluster Controller* - controls a number of servers.
- *Cloud Controller* - provides the cloud access to end-users, developers, and administrators.
- *Storage Controller* - provides persistent virtual hard drives to applications. It is the correspondent of EBS.
- *Storage Service (Walrus)* - provides persistent storage; similar to S3, it allows users to store objects in buckets.

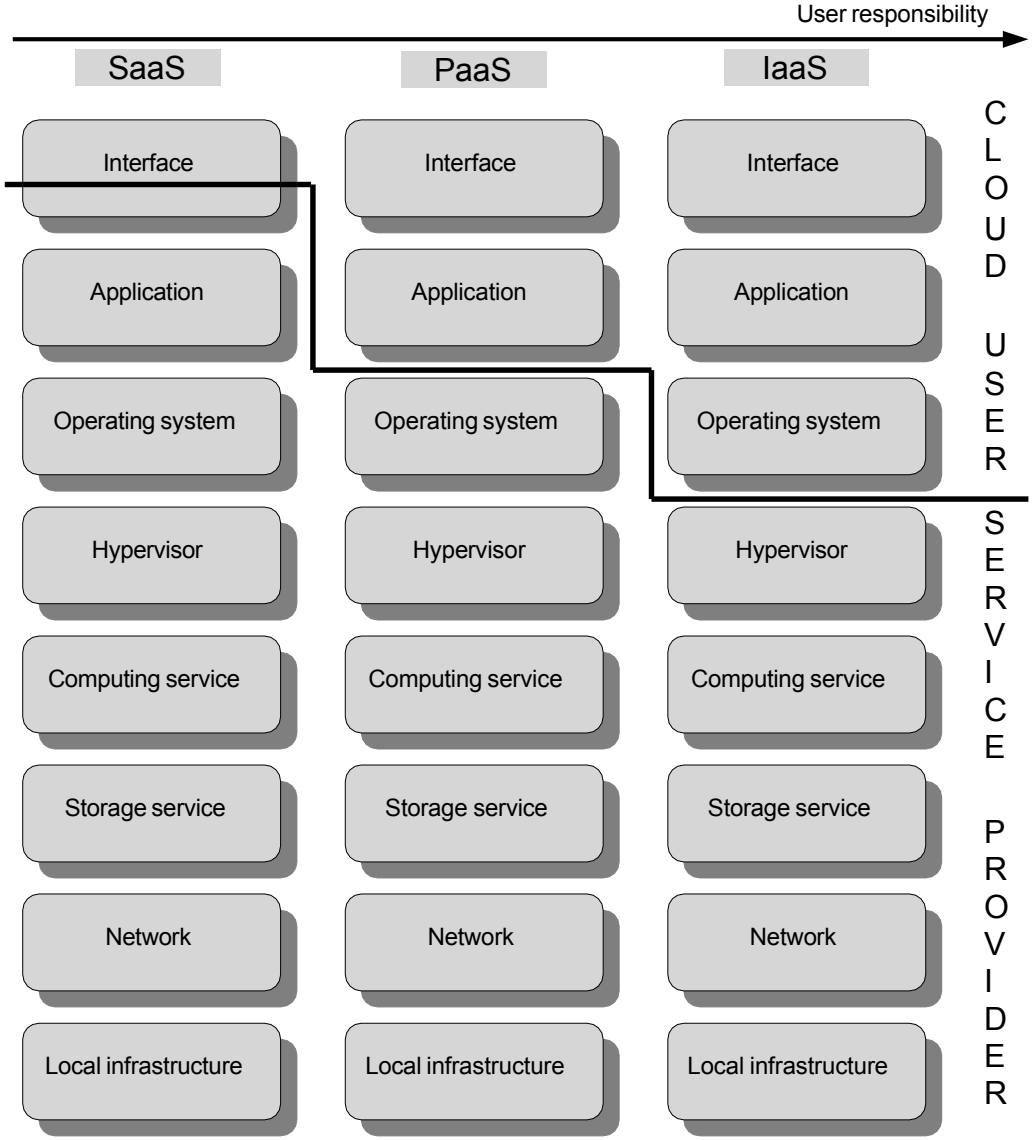
Cloud storage diversity and vendor lock-in

- Risks when a large organization relies on a single cloud service provider:
  - Cloud services may be unavailable for a short or an extended period of time.
  - Permanent data loss in case of a catastrophic system failure.
  - The provider may increase the prices for service.
- Switching to another provider could be very costly due to the large volume of data to be transferred from the old to the new provider.
- A solution is to replicate the data to multiple cloud service providers, similar to data replication in RAID

Service Level Agreement (SLA)

- SLA - a negotiated contract between the customer and CSP; can be legally binding or informal. Objectives:
  - Identify and define the customer's needs and constraints including the level of resources, security, timing, and QoS.
  - Provide a framework for understanding; a critical aspect of this framework is a clear definition of classes of service and the costs.
  - Simplify complex issues; clarify the boundaries between the responsibilities of clients and CSP in case of failures.
  - Reduce areas of conflict.
  - Encourage dialog in the event of disputes.
  - Eliminate unrealistic expectations.
- Specifies the services that the customer receives, rather than how the cloud service provider delivers the services.

Responsibility sharing between user and CSP



User security concerns

- Potential loss of control/ownership of data.
- Data integration, privacy enforcement, data encryption.
- Data remanence after de-provisioning.
- Multi tenant data isolation.
- Data location requirements within national borders.
- Hypervisor security.
- Audit data integrity protection.
- Verification of subscriber policies through provider controls.
- Certification/Accreditation requirements for a given cloud service.

Preliminaries

We will use Microsoft's Azure for Hands-on Exercises

Initializing your account

Download Azure Storage Explorer http://storageexplorer.com/

Access tutorial tarball https://SciEngCloud.github.io/tutorial.tar.gz

On mac:

gunzip tutorial.tar.gz

tar –xf tutorial.tar

on PC use something like 7-zip or other decompression and extractor.

Access to these slides and Jupyter Notebooks are also available

From the book "Cloud Computing for Science and Engineering" by Ian Foster an Dennis Gannon, to be published soon by MIT Press.

The link to the book is here

https://Cloud4SciEng.org

Python and Jupyter

Jupyter in the cloud

- Go to https://notebooks.azure.com
- Signup – it's free.
  - If you are new to Jupyter do Welcome.ipynb
  - If you are new to Python do Python.ipynb

Installing Jupyter on your laptop

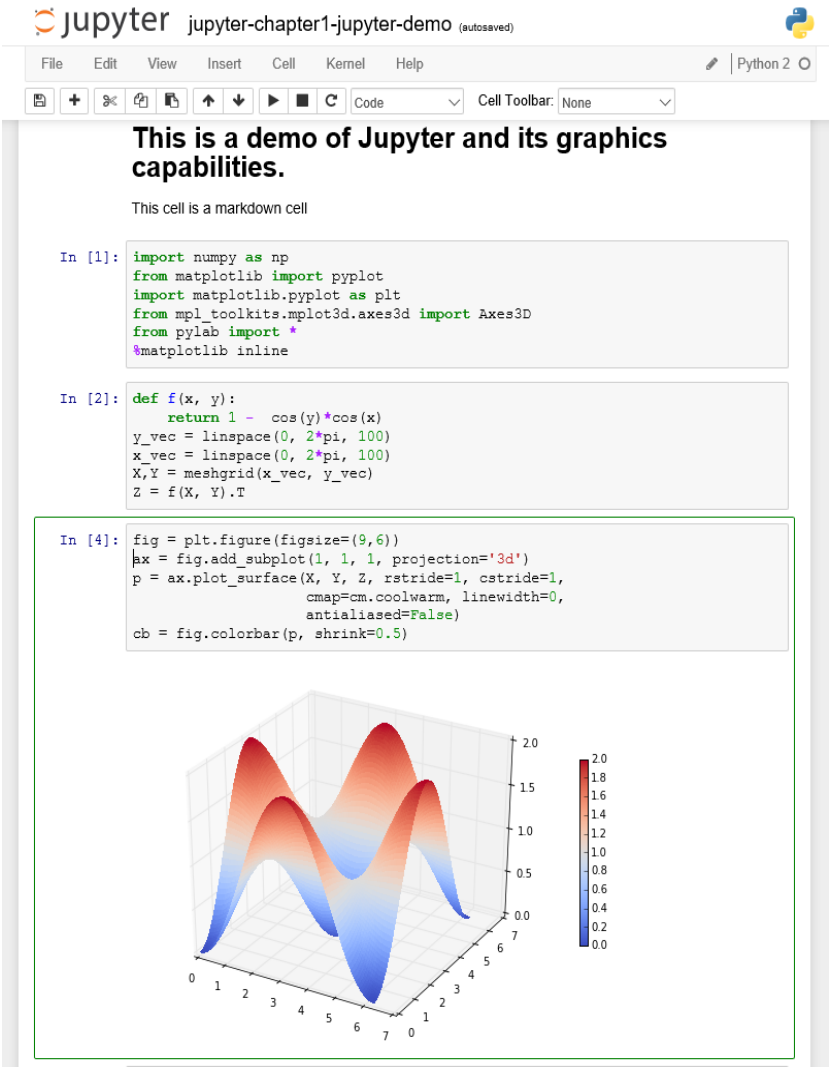
- Go to https://docs.continuum.io/anaconda/install
- Do it. Then "Jupyter notebook" at the shell

A Better solution: install Docker

- https://docs.docker.com/engine/installation/

and run Jupyter in a container

- docker run –it -p 8888:8888 dbgannon/tutorial
- Accept security exceptions and login with "tutorial"
- Open notebook jupyter.ipynb to see the one on the right



Two ways to access the cloud

Portals and SDKs

Web Portals

- Dashboard that allow you to see and manage your cloud resources.

Software Development Kits (SDKs)

- Libraries that give you the tools to manage cloud resources from a program or script.
- Based on REST web service calls

Let's look at several Cloud Web Portals

Amazon AWS Portal

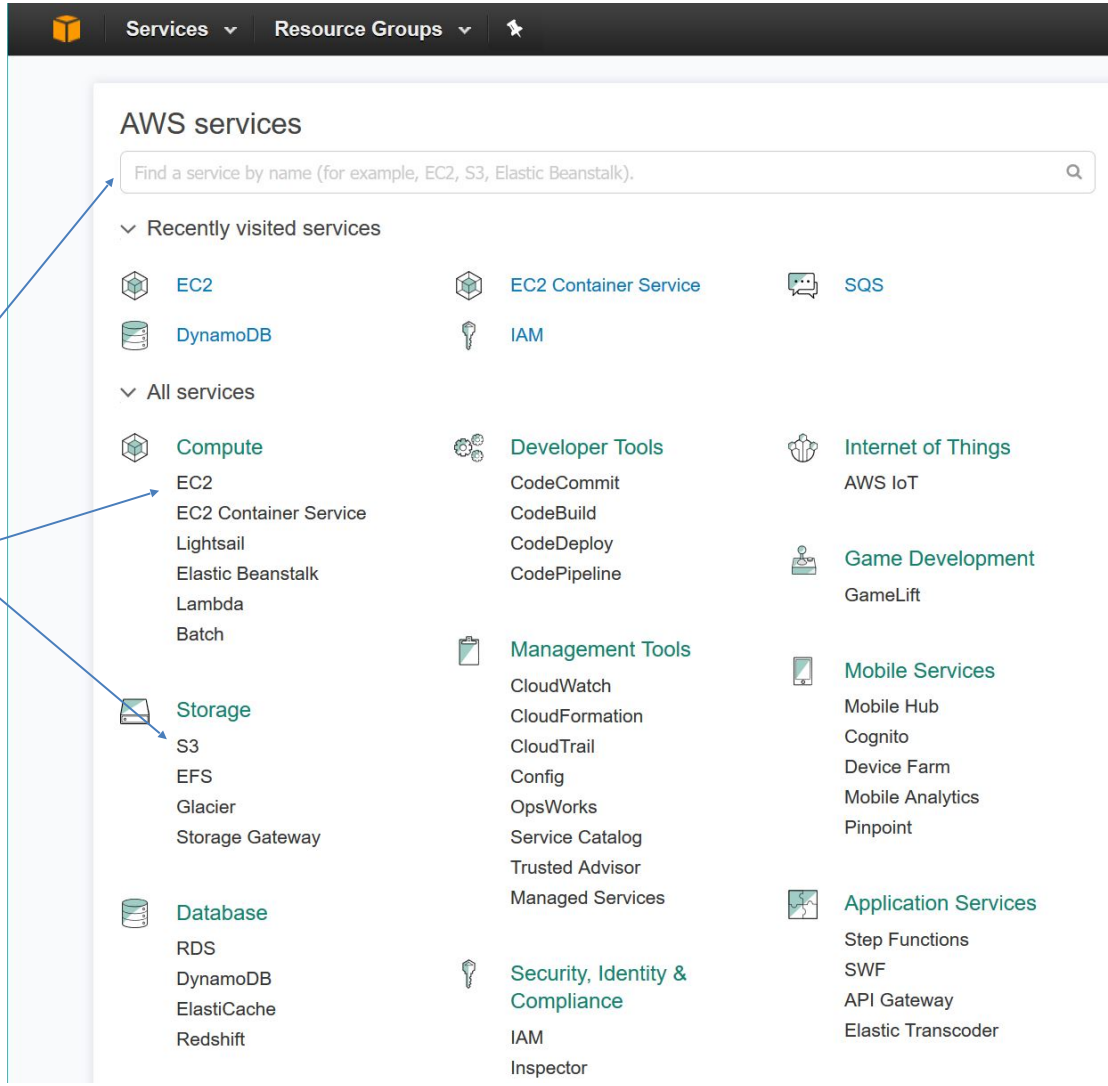
You see links to all the standard services

You also have a search bar to find others.

To create a storage account go to S3

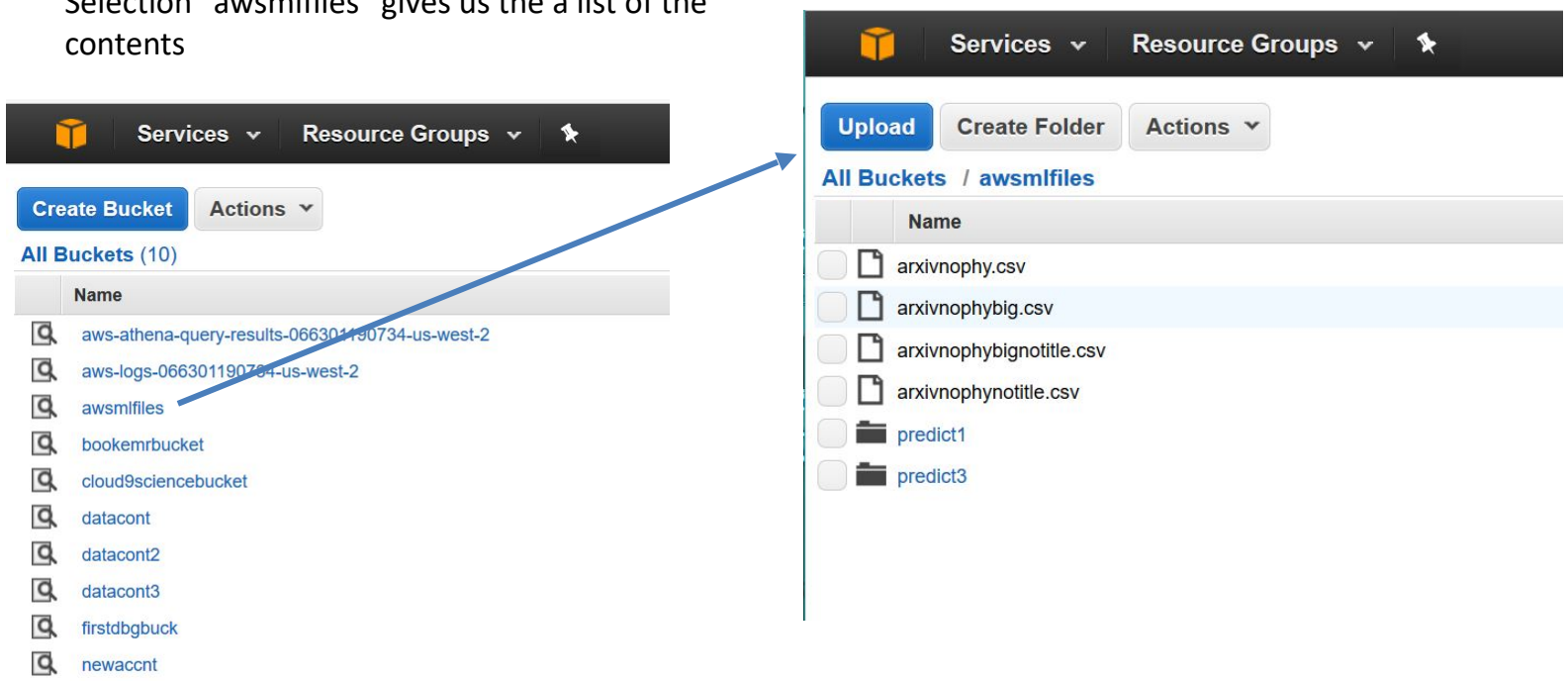
To launch a Virtual Machine go to EC2

Let's look at the S3 storage system



Selecting S3 we get the bucket list

Selection “awsmifiles” gives us the a list of the contents



Notice that it has regular objects AND folders.

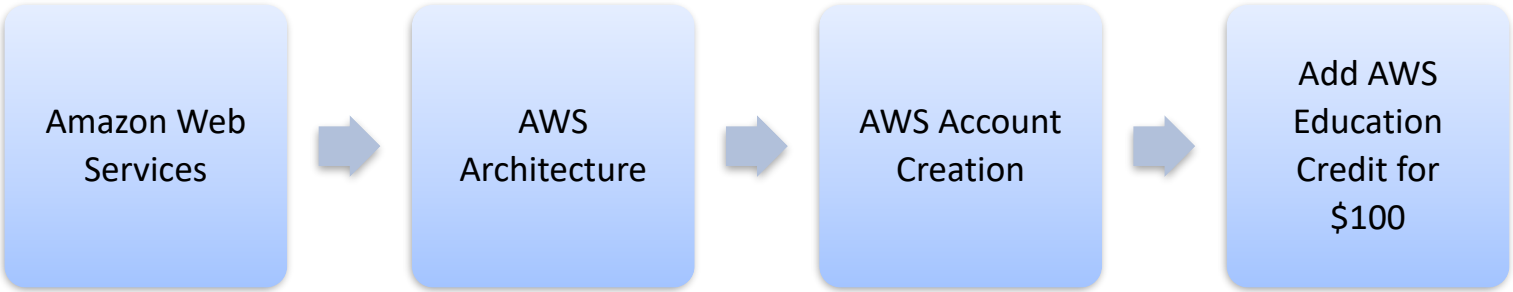
AWS: Enticing New Customers

Free Tier*

As part of AWS's Free Usage Tier, new AWS customers can get started with Amazon EC2 for free. Upon sign-up, new AWS customers receive the following EC2 services each month for one year:

- 750 hours of EC2 running Linux/Unix Micro instance usage
- 750 hours of EC2 running Microsoft Windows Server Micro instance usage
- 750 hours of Elastic Load Balancing plus 15 GB data processing
- 30 GB of Amazon Elastic Block Storage (EBS) plus 2 million IOs and 1 GB snapshot storage
- 15 GB of bandwidth out aggregated across all AWS services
- 1 GB of Regional Data Transfer

Lab Steps



Lab – AWS Account Setup, Services Overview, Resource Discovery, and Instance Setup

Purpose of the Lab

Understand definitions of various Amazon Web Services (AWS) and their use in cloud computing based web applications that are accessible over the Internet through an AWS account

Use the AWS account for the discovery, reservation and access of virtual compute/ storage infrastructure instances

Watch out for unexpected Costs

When you finish your work remember to make sure of the following to avoid unwanted costs:

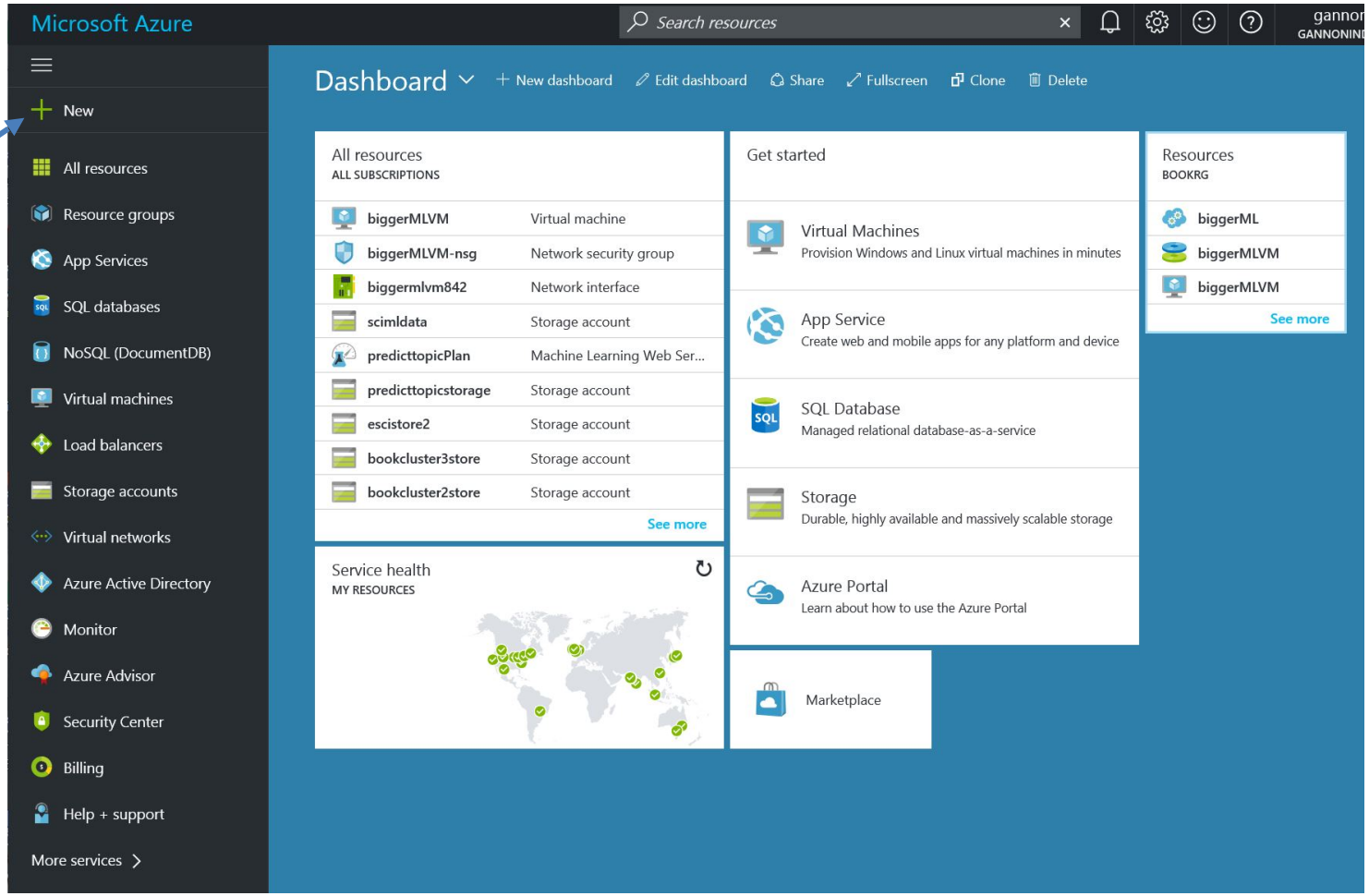
- **Delete** your **S3** objects.
- Stop or **Shut Down** your **EC2** and **RDS** instances.

The customer is responsible for the resources she's using.

AWS declines any responsibility if the customer forgets to shut down resources.

The Azure Portal

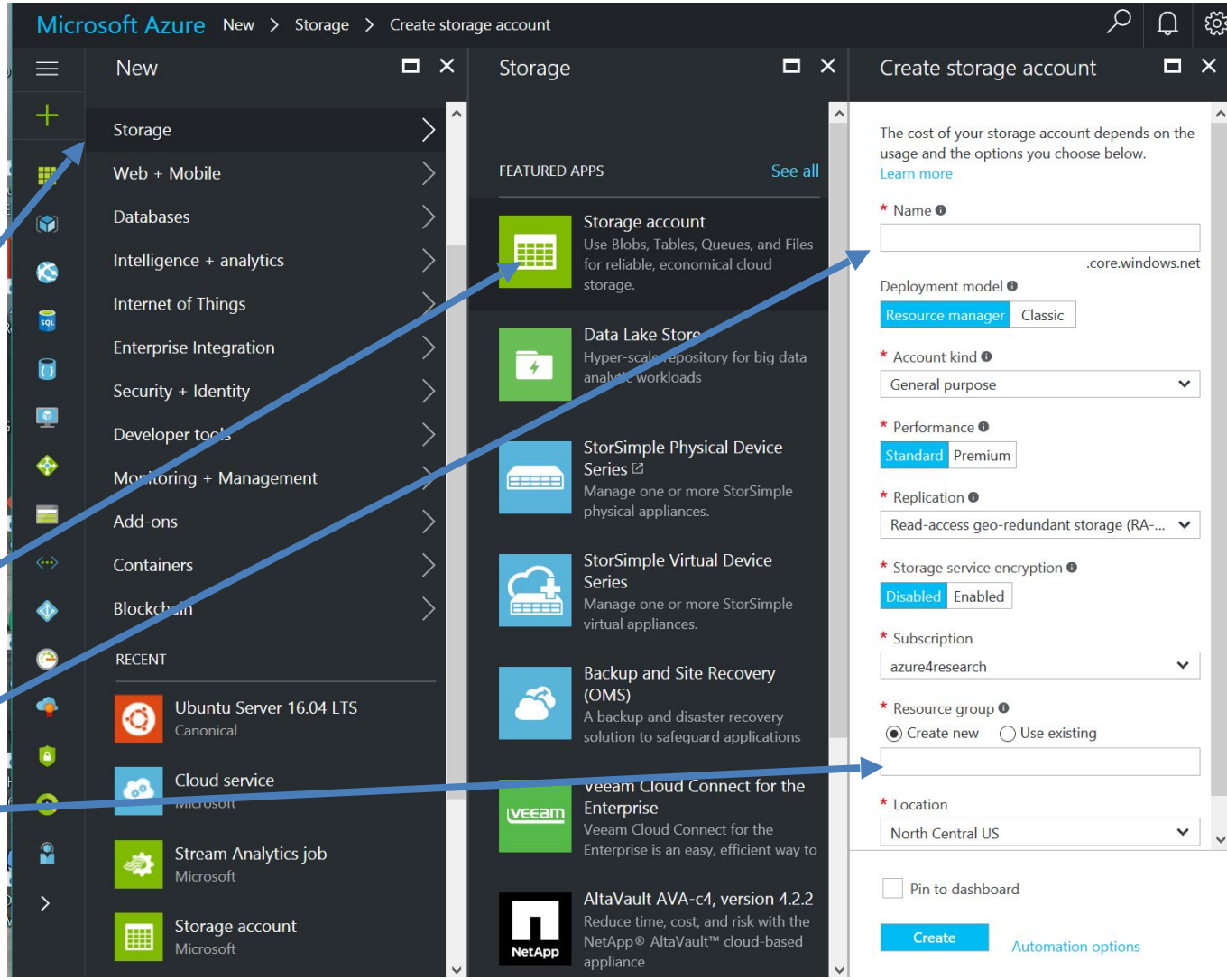
Select “+ New”



Selecting “+” gives this list of options.

Selecting “Storage” gives the secondary menu of types of storage apps.

To create a storage account select the top one.
- give it a name, research group and location.



Web Sources

- cs.queensu.ca › ~khalifa › AWS1
- https://media.amazonwebservices.com › icons › AWS_Simple_Icons_ppt
- cs.uccs.edu › aws
- silver.web.unc.edu › files › 2015/07 › AWS-Slides
- https://cse.buffalo.edu › ~bina › cse487 › fall2010 › AWSOct18
- https://d36cz9buwru1tt.cloudfront.net › AWS_Overview

Other Interesting Links

- http://docs.amazonwebservices.com/AWSEC2/latest/UserGuide/
- http://docs.amazonwebservices.com/AWSEC2/latest/CommandLineReference/
- http://docs.amazonwebservices.com/AWSEC2/latest/APIReference/

https://goodjobpal.com/3-great-ideas-for-national-thank-you-month/