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M.Sc I.T. SEM-2 - Cloud Computing

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Case Study on Open Source & Commercial Clouds

Eucalyptus

- Eucalyptus is a paid and open-source computer software for building Amazon Web Services (AWS)-compatible private and hybrid cloud computing environments, originally developed by the company Eucalyptus Systems.
- Eucalyptus is an acronym for **Elastic Utility Computing Architecture for Linking Your Programs to Useful Systems**.
- Eucalyptus enables pooling compute, storage, and network resources that can be dynamically scaled up or down as application workloads change.
- Mårten Mickos was the CEO of Eucalyptus.
- In September 2014, Eucalyptus was acquired by **Hewlett-Packard** and then maintained by DXC Technology.
- After DXC stopped developing the product in late 2017, AppScale Systems forked the code and started supporting Eucalyptus customers.
- Eucalyptus commands can manage either Amazon or Eucalyptus instances. Users can also move instances between a Eucalyptus private cloud and the Amazon Elastic Compute Cloud to create a hybrid cloud. Hardware virtualization isolates applications from computer hardware details.

Eucalyptus uses the terminology:

- **Images** – An image is a fixed collection of software modules, system software, application software, and configuration information that is started from a known baseline (immutable/fixed). When bundled and uploaded to the Eucalyptus cloud, this becomes a Eucalyptus machine image (EMI).
- **Instances** – When an image is put to use, it is called an instance. The configuration is executed at runtime, and the Cloud Controller decides where the image will run, and storage and networking is attached to meet resource needs.
- **IP addressing** – Eucalyptus instances can have public and private IP addresses. An IP address is assigned to an instance when the instance is created from an image. For instances that require a persistent IP address, such as a web-server, Eucalyptus supplies elastic IP addresses. These are pre-allocated by the Eucalyptus cloud and can be reassigned to a running instance.
- **Security** – TCP/IP security groups share a common set of firewall rules. This is a mechanism to firewall off an instance using IP address and port block/allow functionality. Instances are isolated at TCP/IP layer 2. If this were not present, a user could manipulate

the networking of instances and gain access to neighboring instances violating the basic cloud tenet of instance isolation and separation.

- **Networking** – There are three networking modes. In Managed Mode, Eucalyptus manages a local network of instances, including security groups and IP addresses. In System Mode, Eucalyptus assigns a MAC address and attaches the instance's network interface to the physical network through the Node Controller's bridge. System Mode does not offer elastic IP addresses, security groups, or VM isolation. In Static Mode, Eucalyptus assigns IP addresses to instances. Static Mode does not offer elastic IPs, security groups, or VM isolation.

- **Access Control** – A user of Eucalyptus is assigned an identity, and identities can be grouped together for access control.
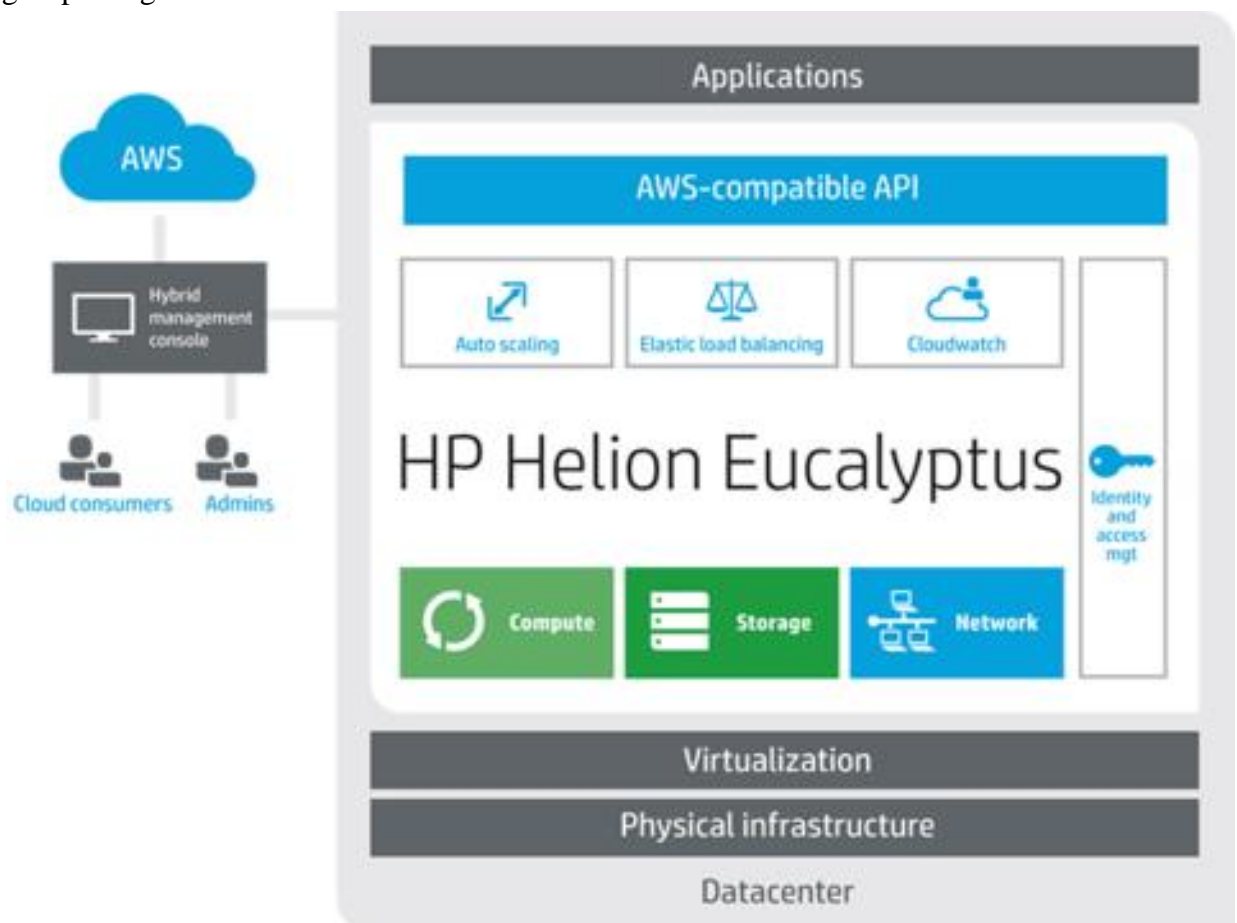
Microsoft Azure

What is Azure?
- Azure is Microsoft's cloud platform, just like Google has it's Google Cloud and Amazon has it's Amazon Web Service or AWS.000.
- Generally, it is a platform through which we can use Microsoft's resource.
- For example, to set up a huge server, we will require huge investment, effort, physical space and so on.

- In such situations, Microsoft Azure comes to our rescue. It will provide us with virtual machines, fast processing of data, analytical and monitoring tools and so on to make our work simpler.
- The pricing of Azure is also simpler and cost-effective.
- Popularly termed as "Pay As You Go", which means how much you use, pay only for that.
- Microsoft unveiled Windows Azure in early October 2008 but it went to live after February 2010.
- Later in 2014, Microsoft changed its name from **Windows Azure to Microsoft Azure**.
- Azure provided a service platform for .NET services, SQL Services, and many Live Services.
- Many people were still very skeptical about "the cloud".
- Microsoft Azure is getting bigger and better in coming days.
- More tools and more functionalities are getting added. It has two releases as of now.
- It's famous version **Microsoft Azure v1** and later **Microsoft Azure v2**.
- Microsoft Azure v1 was more like JSON script driven then the new version v2, which has interactive UI for simplification and easy learning.
- Microsoft Azure v2 is still in the preview version.

Amazon EC2

- There are times when one is limited by the capabilities of a desktop or laptop.
- Suppose a data scientist has a large dataset that they would like to do some analysis on.
- The scientist proceeds to try and load the entire dataset into memory and an error like the one below occurs.

```
> data <- read.csv(file = 'massiveFile.csv')
Error: cannot allocate vector of size 500.0 Mb
```

- The error resulted because the available RAM was exhausted.
- The operating system couldn't allocate another 500Mb of RAM.
- While there are many different solutions to this type of problem, one possible solution could be to upgrade the RAM of the computer.
- Besides having to make an investment in more RAM, there are limits to how far some computers can be upgraded. The potential solution explored in this tutorial is to use a virtual machine in the cloud (AWS) with more RAM and CPU.
- Virtual machines on AWS EC2, also called instances, have many advantages.
- A few of the advantages include being highly scalable, they are easy to start and stop and they allow for the selection of different platforms (operating systems).
- An important point thing to emphasize is that although this tutorial covers how to launch a Windows based virtual machine, there are many different types of virtual machines for many different purposes.
- With that, let's get started.
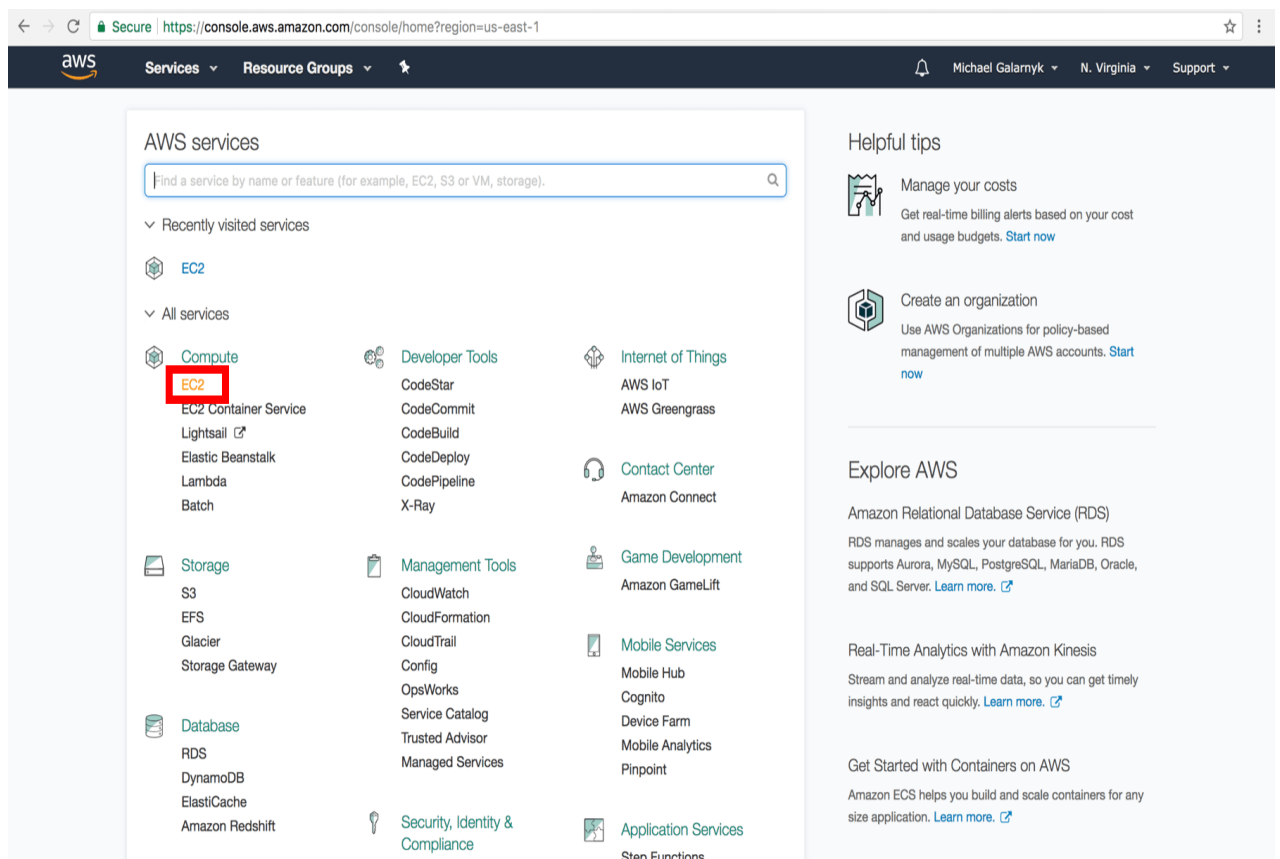
Create an AWS Account and Sign into AWS.

1. On the Amazon Web Services site click on "Sign In to the Console".
2. Sign in if you have account. If you don't, you will need to make one.
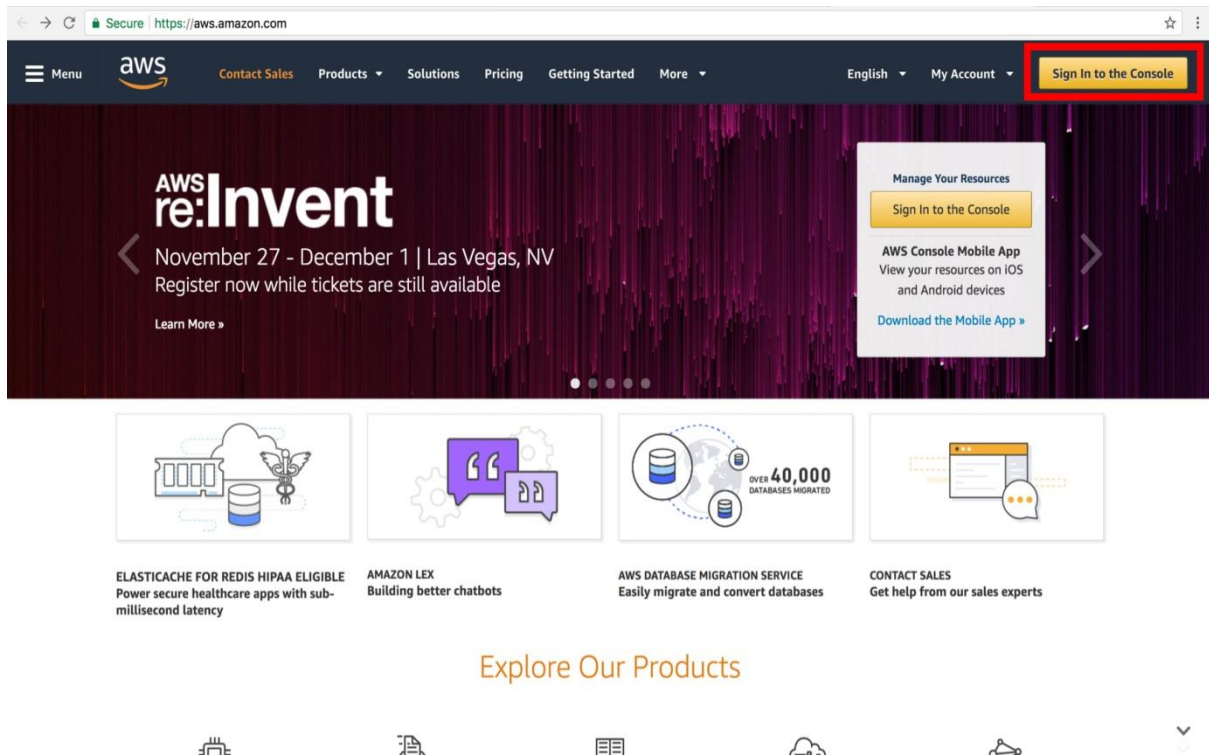
3. On the EC2 Dashboard, click on EC2.

Create an Instance

4. On the Amazon EC2 console, click on Launch Instance.
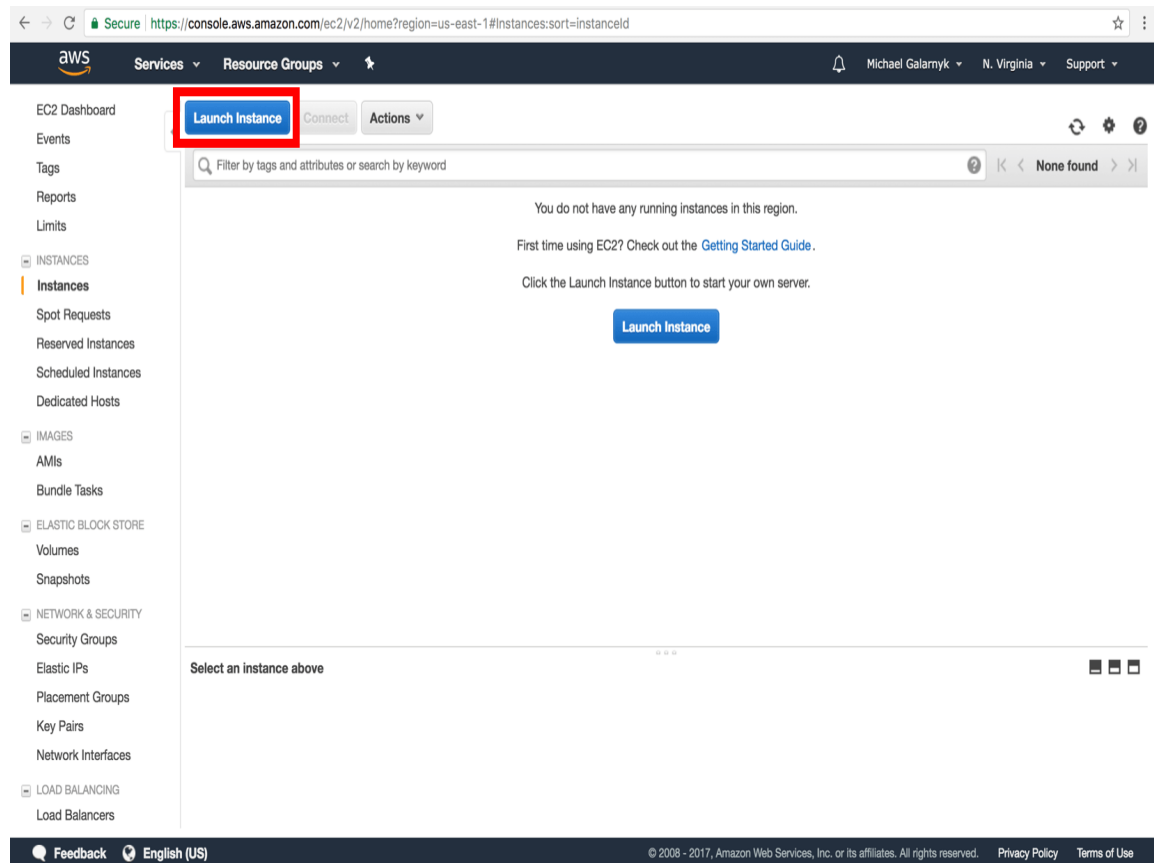
5. Click on the "Select" button in the row with Microsoft Windows Server 2016 Base. Please note that this will create a Windows based instance instead of a typical Linux based instance. This effects how you will connect to the instance.

6. Make sure t2 micro (free instance type) is selected. and click on "Review and Launch"
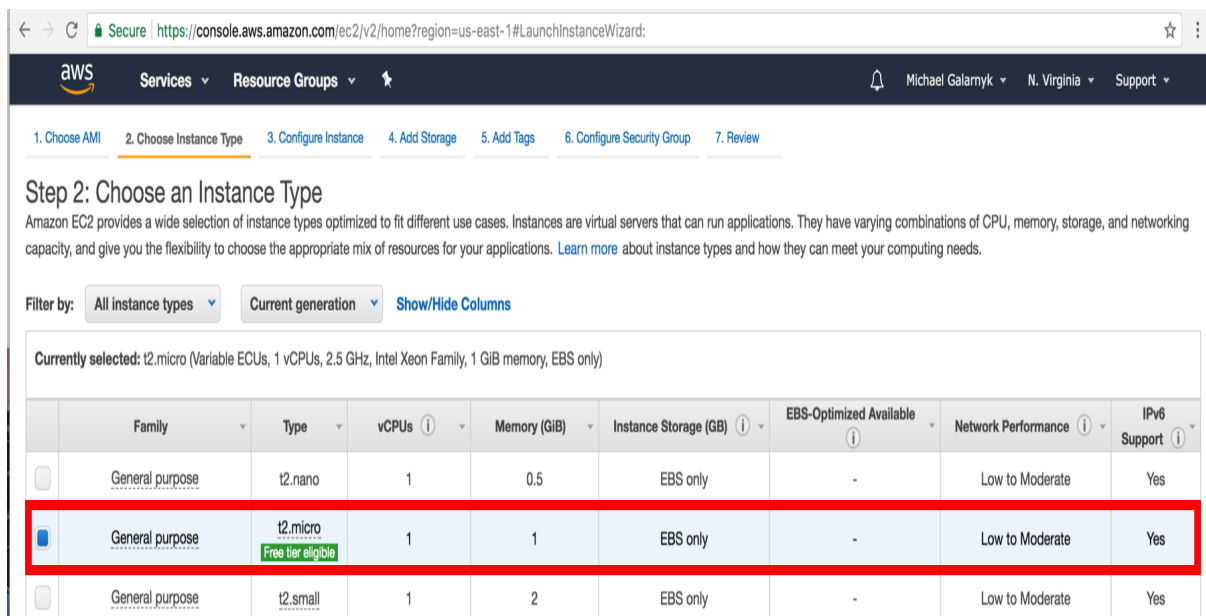
7. Click on Launch.

8. Select "Create a new key pair". In the box below ("Key pair name"), fill in a key pair name. I named my key DataCampTutorial, but you can name it whatever you like. Click on "Download Key Pair". This will download the key. Keep it somewhere safe.
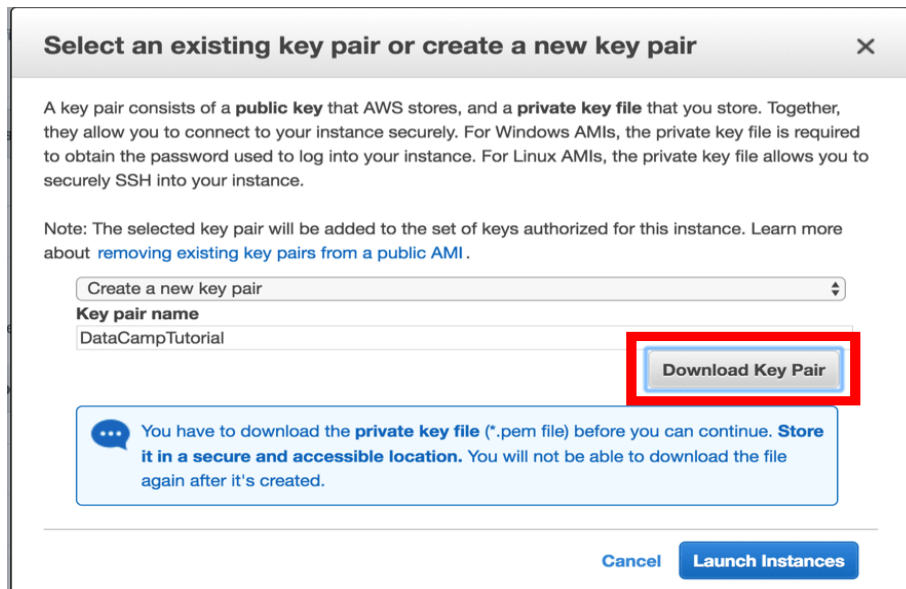
9. Next, click on "Launch Instances"

10. The instance is now launched. Go back to the Amazon EC2 console. I would recommend that you click on what is enclosed in the red rectangle as it will bring you back to the console.

11. Wait till you see that "Instance State" is running before you proceed to the next step. This can take a few minutes.

12. Click on connect.

13. Click on "Download Remote Desktop File". Save the remote desktop file (rdp) file somewhere safe.
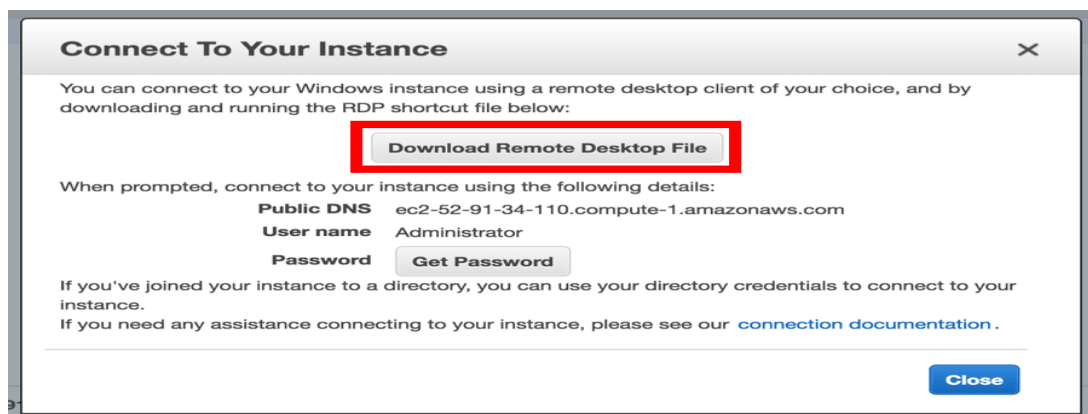
14. Click on "Get Password". Keep in mind that you have to wait at least 4 minutes after you launch an instance before trying to retrieve your password.

15. Choose the pem file you downloaded from step 7 and then click "Decrypt Password"

16. After you decrypt your password, save it somewhere safe. You will need it to log into your instance.

17. Open your rdp file. Click on continue. If your local computer is a Mac, you will need to download "Microsoft Remote Desktop" from the App Store to be able to open your rdp file.

18. Enter your password you got from step 15

Difference between AWS (Amazon Web Services), Google Cloud and Azure

	AWS	Google Cloud	Azure
Technology	EC2 (Elastic Compute Cloud)	Google Compute Engine (GCE)	VHD (Virtual Hard Disk)
Databases Supported	AWS fully supports relational and NoSQL databases and Big Data.	Technologies pioneered by Google, like Big Query, Big Table, and Hadoop, are naturally fully supported.	Azure supports both relational and NoSQL databases, and Big Data, through Windows Azure Table and HDInsight.
Pricing	Per hour – rounded up	Per minute – rounded up (minimum 10 minutes)	Per minute – rounded up commitments (pre-paid or monthly)
Models	On demand, reserved, spot	On demand – sustained use	On demand – short term commitments (pre-paid or monthly)
Difficulties	Many enterprises find it difficult to understand the company's cost structure	Fewer features and services.	Less "enterprise-ready"
Storage Services	• Simple Storage Service (S3) • Elastic Block Storage (EBS) • Elastic Block Storage (EBS)	• Blob Storage • Queue Storage • File Storage • Disk Storage • Data Lake Store	• Cloud Storage • Persistent Disk • Transfer Appliance
Machine Learning	• Sage Maker • Lex • Polly • And many more	• Machine Learning • Azure Bot Service • Cognitive Service	• Cloud Speech API • Cloud Video Intelligence • Cloud Machine Learning Engine • And many more.

Case study on Eucalyptus

- **Rafter is an educational software company** that operates BookRenter.com, which was the first online textbook rental service.
- The company's Rails-based platform requires considerable cloud resources for application development and testing. , it needed a way to lower its own spending on public cloud infrastructure and meet developer requirements for additional testing and development.
- By building a Eucalyptus cloud, Rafter realized immediate advantages over its previously Amazon Web Services (AWS)-only infrastructure.
- This provided better automation and image management than virtualization tools such as VMware or hosted services such as Rackspace and much more economically feasible than Amazon Reserved Instances.
- Overall, Eucalyptus gave them variable AWS costs and benefit from a more predictable and affordable configuration.
- Organizations can use or reuse AWS-compatible scripts to manage their own on-premise IaaS environments.
- The AWS API is implemented on top of Eucalyptus, so tools in the cloud ecosystem that can communicate with AWS can use the same API with Eucalyptus.
- If your company started with an entirely AWS environment, then you can go on using the same tools, scripts and images with Eucalyptus. Or, if Eucalyptus is the first part of your cloud journey, then our deep AWS API compatibility sets you up to efficiently scale and automate hybrid cloud infrastructure as operations grow."
- Eucalyptus is compatible with the following AWS features:
    - Amazon Elastic Compute Cloud (EC2)
    - Amazon Elastic Block Storage (EBS)
    - Amazon Machine Image (AMI)
    - Amazon Simple Storage Service (S3)
    - Amazon Identity and Access Management (IAM)
    - Auto Scaling
    - Elastic Load Balancing
    - Amazon CloudWatch
- Datacenter IT and DevOps teams are responsible for managing the company's Eucalyptus implementation.
- Eucalyptus featured the AWS compatibility, flexibility and advanced features necessary to improve Rafter's development and test environment.
- Eucalyptus works with popular AWS tools for making it easy to migrate applications from the public cloud without rewriting or duplicating code.

Benefits of Eucalyptus

- Empowered software engineers to easily provision their own instances, reducing the IT department's burden
- Easily integrated with existing EC2-based code and dev/test infrastructure, due to Eucalyptus' AWS API compatibility
- Allowed for easy capacity expansion as the private cloud demand continues to grow
- Multiplied engineering productivity by using the latest hardware available, at a fraction of the cost to similar public cloud options
- Greatly reduced costs, while still making it easy to leverage hybrid capabilities and scale to the public cloud when needed
- The private and hybrid solution lowered costs .
- Allowed Rafter to use much more powerful hardware by using private cloud rather than public.
- Rafter could retain AWS's considerable capacity and elasticity for specific workloads.
- Eucalyptus doubled Rafter's cloud capacity, increased engineering productivity and generated substantial cost savings.
- It has twice as many instances on Eucalyptus as it did under the original AWS setup, with minimal monthly operating expenses. At the same time, Rafter's integration of Eucalyptus increased its flexibility with cloud vendors, preventing it from being too dependent on any single service.
- On the cost side, Rafter has been able to better control the expenses of Amazon Reserved Instances, on-demand instances and EBS storage/snapshots.
- Eucalyptus has replaced the high variable costs of AWS with much lower fixed costs.

Case study on Microsoft Azure

- Globally recognized for its ground-breaking approach towards delivering business value, increasing speed digital innovation and enabling business platforms to be future-ready enterprises, Wipro Ltd. is one of the most successful IT companies in India and around the world.
- It is a trusted IT partner of choice for global businesses looking to 'differentiate at the front' and 'standardize at the core' through technology interventions.

Wipro Before Cloud

- Wipro began the transformation of its internal application background a couple of years back and has been progressing forcefully to provide a great digital experience to its employees, simplified workflows and systems, enhanced automation and innovation.

- Its focus has been to develop applications and services, which would give employees a great user experience, open up new revenue generation streams, enhance productivity and make IT more responsive and cost effective.
- To build a strong digital core, it was important that the organization transformed its legacy enterprise applications into fully renovated, mobile enabled and analytics driven ones.
- In order to do so and cope up with the expectation of rapid app development and deployment, it was very important that the organization upgraded its infrastructure and moved from on premises to cloud.
- Apart from elasticity in infrastructure, cloud adoption would also mean increased efficiencies related to data center footprint, network planning and utilization, hardware refreshes, standardized business processes, which would bring significant cost benefits on a large scale.
- Additionally, since Wipro has been a pioneer in cloud adoption, it would also help in opening new streams of revenue for the organization.
- **Wipro was therefore looking out for a cost-effective, elastic and enterprise friendly IT infrastructure solution.**

Introduction of Microsoft Azure

- Post detailed evaluation of different vendors, Wipro chose Microsoft Azure as it Cloud partner because of agility, stability, cost effectiveness and the deep integration it offered with Office Suite of apps.
- To start off with it was important for the company to have a higher availability with infrastructure, scale up and down as per demand and this aspect was fundamental for the Wipro.
- Real value of cloud comes with the ease of management, insights and the micro services
- We are happy we chose the Azure platform from Microsoft. They have worked with us in shaping up our platform roadmap," says Senior Vice President of Wipro Limited.

How Microsoft Azure Benefited Wipro

- Migrating to Microsoft Azure has given Wipro elasticity on its infrastructure, as well as increased efficiencies related to data center.
- To reduce cost of infrastructure and take advantage of the platform, the application was developed and deployed in MS Azure PaaS.
- All the modules in the system were written in a new architecture, Web and API layers.
- The front end was developed using modern JQuery libraries to make the application fast.
- Entire application was developed and deployed in just 6 weeks. It was estimated that the overall cost of this application was reduced by more than 60%

Other benefits are:

Scalability:

- Many enterprise applications at Wipro have a cyclical usage period, requiring scalability, concurrency and high performance for short period of time.

- High availability is a must during that period and demands high scalability of resources.

- Wipro can now easily scale up and down based on demand and pay for what is being consumed.

Cost-effectiveness:

- With Azure, The infrastructure costs on the cloud platform were calculated based on usage, it gave the organization the ability to pay for what's being used and not be bound to pay for unused services and resources.

Time-to-market of new applications:

- Earlier, due to the unavailability of the latest hardware or very time-intensive cycles, the time-to-market of the applications was much high.

- With Microsoft Azure, all these issues were solved. Microsoft acted as an end-to-end 'cloud partner' capable of providing an entire scope of services on the cloud.

Conclusion

- The Azure platform has helped us build modern applications, which offer simplicity and great user experience with extensive leverage of open source technology. And thanks to the great set of micro services, which could be consumed with ease, the apps could be developed at a very short time span. --- **General Manager and Head of Applications, Information Systems**

Introduction to AWS

Amazon Web Services (AWS) is a collection of remote computing services, also called web services, that make up a cloud computing platform by Amazon.com. The most central and well-known of these services are Amazon EC2 and Amazon S3. The service is advertised as providing a large computing capacity (potentially many servers) much faster and cheaper than building a physical server farm.

Benefits:-

1. **Easy to use:-** AWS is designed to allow application providers, ISVs, and vendors to quickly and securely host your applications – whether an existing application or a new SaaS-based application. You can use the AWS Management Console or well-documented web services APIs to access AWS's application hosting platform.

2. **Flexible:-** AWS enables you to select the operating system, programming language, web application platform, database, and other services you need. With AWS, you receive a virtual environment that lets you load the software and

services your application requires. This eases the migration process for existing applications while preserving options for building new solutions.

3. **Cost effective:-** You pay only for the compute power, storage, and other resources you use, with no long-term contracts or up-front commitments. For more information on comparing the costs of other hosting alternatives with AWS, see the AWS Economics Center.

4. **Reliable:-** With AWS, you take advantage of a scalable, reliable, and secure global computing infrastructure, the virtual backbone of Amazon.com's multi-billion dollar online business that has been honed for over a decade.

5. **Scalable and High Performance:-** Using AWS tools, Auto Scaling, and Elastic Load Balancing, your application can scale up or down based on demand. Backed by Amazon's massive infrastructure, you have access to compute and storage resources when you need them.

6. **Secure:-** AWS utilizes an end-to-end approach to secure and harden our infrastructure, including physical, operational, and software measures. For more information, see the AWS Security Center.

Application Solutions:- AWS offers a reliable and flexible cloud infrastructure platform that enables customers to run any type of business application, from small departmental solutions to mission-critical applications in a secure and robust environment.

AMAZON EC2 CASE STUDY

- Amazon Elastic Compute Cloud (EC2) is a central part of Amazon.com's cloud computing platform, Amazon Web Services (AWS).
- EC2 allows users to rent virtual computers on which to run their own computer applications.
- EC2 allows scalable deployment of applications by providing a Web service through which a user can boot an Amazon Machine Image to create a virtual machine, which Amazon calls an "instance", containing any software desired.
- A user can create, launch, and terminate server instances as needed, paying by the hour for active servers, hence the term "elastic".
- EC2 provides users with control over the geographical location of instances that allows for latency optimization and high levels of redundancy.

Case study
- HDM:- The company first launched in 1999 as "Hungama.com", a promotional marketing portal.

- In 2000 the company acquired Indiafm and in the following years began to work marketing campaigns for companies such as Coca-Cola and Nike.
- In 2007 Hungama launched their gaming portal and in 2009, the company re-launched their website and company name, changing it to Hungama Digital Media Entertainment.
- In 2012 Hungama Digital Media Entertainment launched Artist aloud!, a digital platform for artists and music fans.

Challenges:-

- Before migrating to AWS, the company ran its servers in local data centers. This solution soon became expensive, time-consuming, and inefficient.
- Hungama wanted to turn projects around quickly but old equipment caused delays in implementation and service launches.
- In 2008, Hungama migrated to AWS to take advantage of the cost effectiveness, flexibility, and fast time-to-market offered by the cloud.
- "Our migration to AWS in 2008 reduced IT costs considerably," Hungama.
- The cost savings allowed Hungama to focus its engineering resources on getting products and services to market more quickly.
- The company began to grow rapidly, but as more internal teams started using AWS, its monthly costs also grew.
- Hungama's infrastructure team engaged AWS Support to help them find ways to optimize costs.

Solution by AWS:-

- As a content provider and aggregator, Hungama requires enormous amounts of storage. The company uses Amazon Simple Storage Service (Amazon S3) to host more than 60 TB of content.
- For server and storage management, Hungama uses Amazon Elastic Compute Cloud (Amazon EC2) and Amazon Relational Database Service (Amazon RDS) with Amazon S3. The flexibility of the AWS solution enables the Bollywood moviemaker to develop applications on multiple platforms and programming models including Java, PHP, .NET, Oracle, MySQL, and SQL technologies.
- As an AWS Support, Enterprise-level tier customer, Hungama has access to AWS Trusted Advisor, which customers can use to audit their AWS usage against known best practices.
- AWS Trusted Advisor identifies opportunities to save money, improve system performance, and security.
- Hungama used AWS Trusted Advisor to run Cost Optimizing checks, which audited Amazon EC2 instances and Amazon Elastic Block Store (Amazon EBS) volumes in Hungama's environment.