

Développement logiciel pour le Cloud (TLC)

1. Cloud computing

Guillaume Pierre

Université de Rennes 1

Fall 2012

<http://www.globule.org/~gpierre/>



Table of Contents

- 1 A bit of history
- 2 Cloud computing
- 3 Pros and cons

Table of Contents

- 1 A bit of history
- 2 Cloud computing
- 3 Pros and cons

Personal Computers



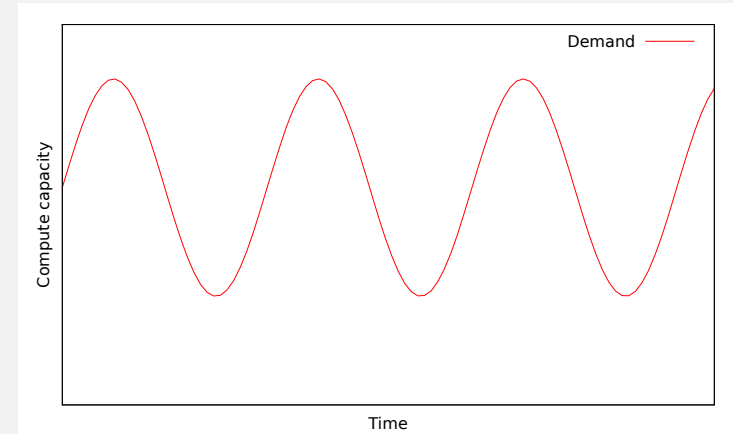
- 😊 Absolute control over the machine
- 😞 Compute capacity is limited – not suitable for large enterprise applications

Cluster computers

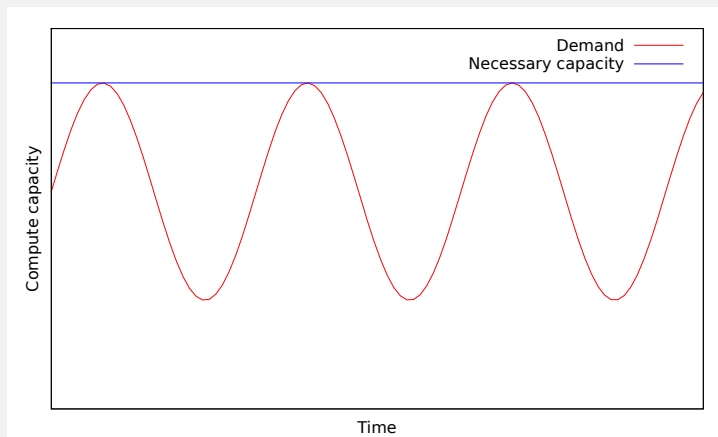


- 😊 Better performance
- 😞 Compute capacity is **still** limited
- 😞 We cannot **vary** capacity on demand

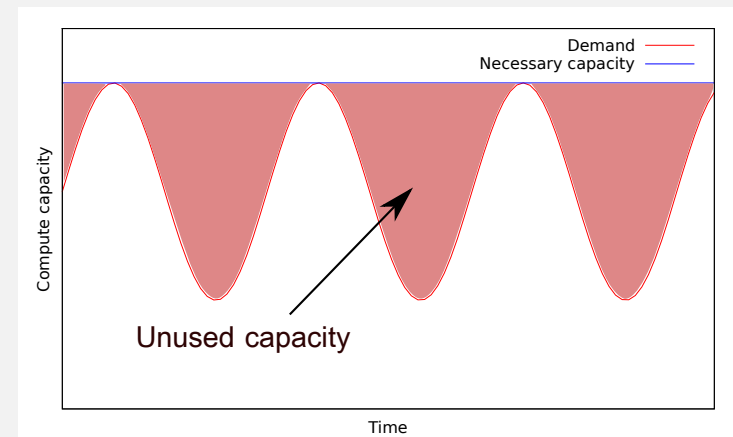
The varying capacity problem



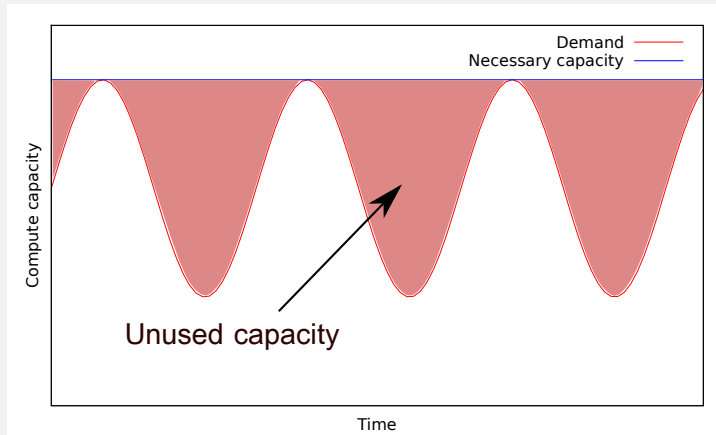
The varying capacity problem



The varying capacity problem



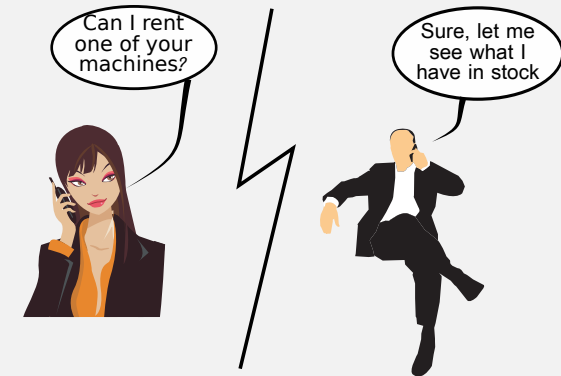
The varying capacity problem



What if demand increases beyond the capacity?



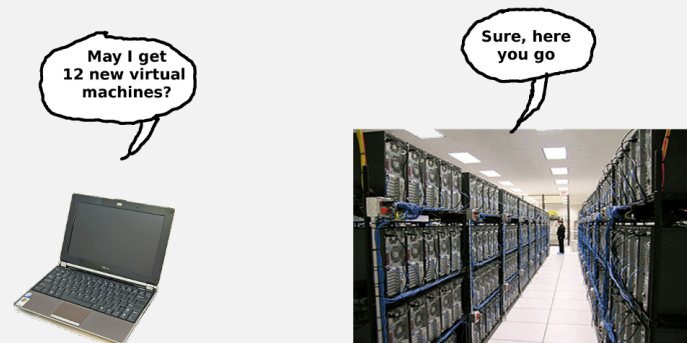
Data centers



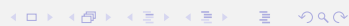
- 😊 Resources on demand
- 😊 Pay only for what you use
- 😞 This is a **manual process**...
- 😞 **Slow!**



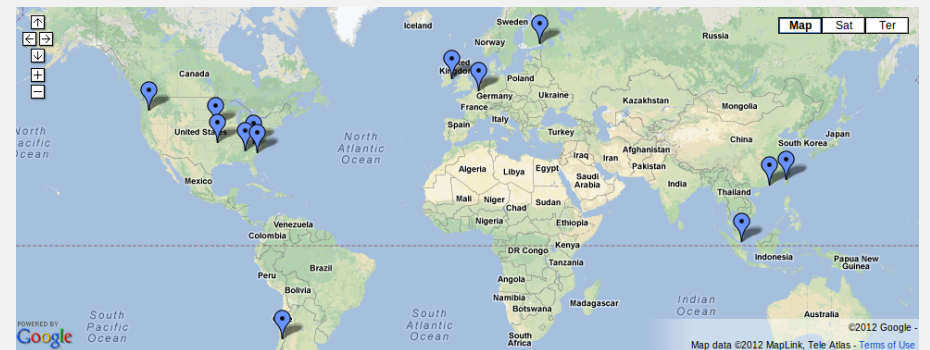
Cloud computing



- 😊 Resources on demand
- 😊 Pay only for what you use
- 😊 Fully automated

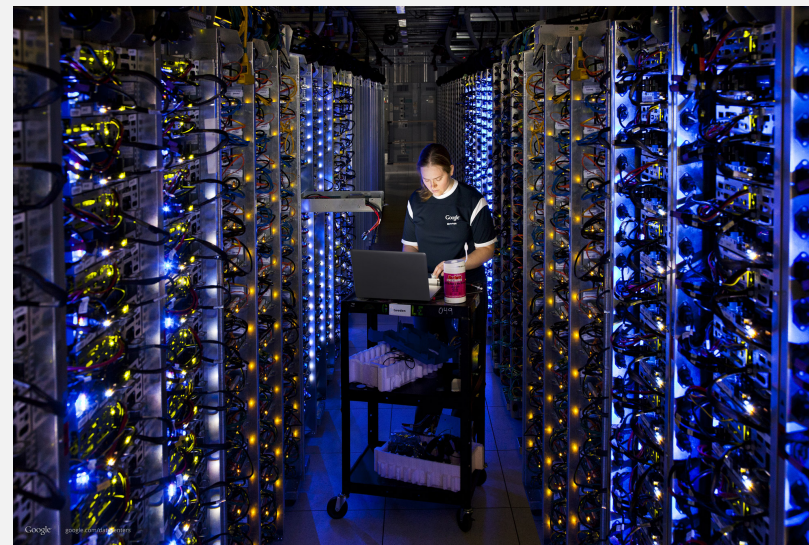
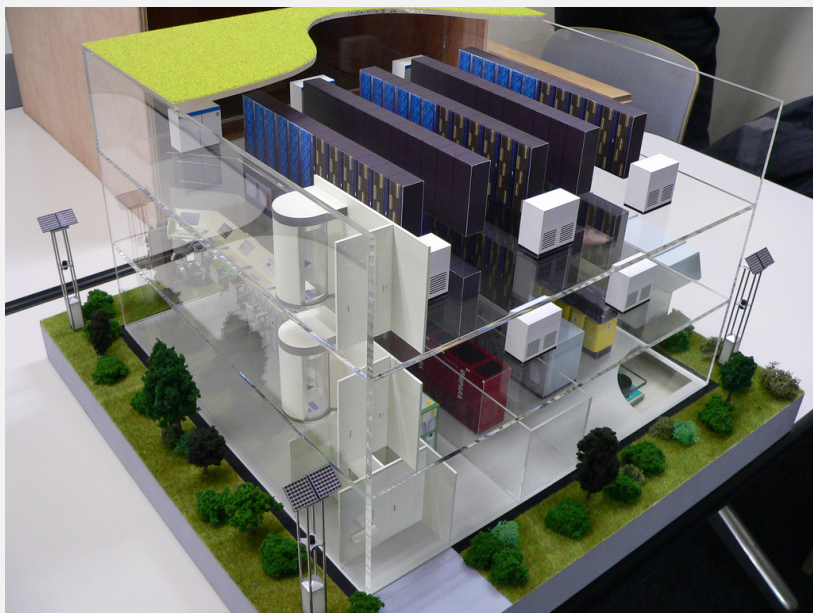


Real data centers



Google data centers (2012)





The first modern cloud was created by Amazon

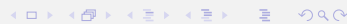
- What is the relationship between a **retail company** and a **new IT paradigm**?
 - ▶ Lots of compute power
 - ▶ Many different services
 - ▶ Varying workloads (day/night, week/weekend, christmas season)
- Amazon first built its cloud infrastructure for its internal use
 - ▶ An internal IT provider (“we have compute capacity for sale”)
 - ▶ All other departments are customers of the IT service (“I need 10 new machines right now”)
- Can we sell the same service to external customers?
 - ▶ ... and make profit from our unused capacity

Table of Contents

- 1 A bit of history
- 2 Cloud computing
- 3 Pros and cons

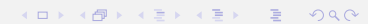
What defines Cloud computing exactly?

- 1 Computing is considered as a **service** customers use, not as something they own
 - ▶ This is called utility computing
- 2 Cloud providers offer a collection of compute/storage/network services **via the Internet**
 - ▶ Customers cannot get physical access to the devices
 - ▶ The actual location of devices is (almost) irrelevant
- 3 The cloud **hides the complexity** and details of the physical infrastructure from its users
 - ▶ Users only see a simple API + a graphical interface
- 4 Services are available **on demand**
 - ▶ Always available, anywhere, anytime
- 5 **Pay-per-use**
 - ▶ Pay only for the resources you actually use. You can release resources any time and stop paying immediately.

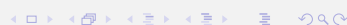
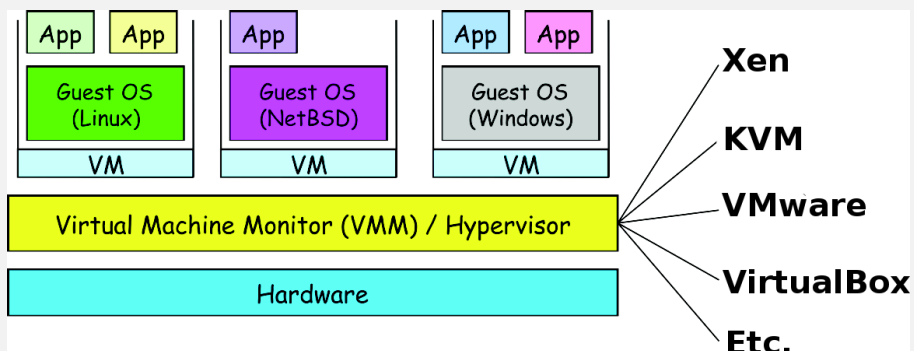


The cloud creates new types of business relationships

- Traditional software companies have two main roles
 - ▶ Software provider
 - ▶ End user
- Cloud computing introduces new relationships
 - ▶ Cloud IaaS provider
 - ▶ Cloud platform provider
 - ▶ Cloud customer (or cloud tenant)
 - ▶ End user

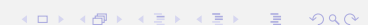


Cloud computing relies on virtualization technologies

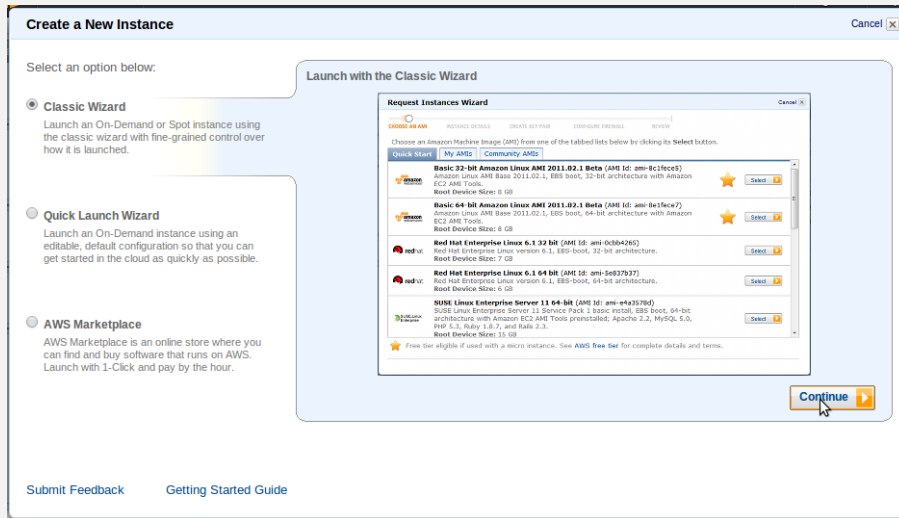


Example: create a new machine at Amazon EC2

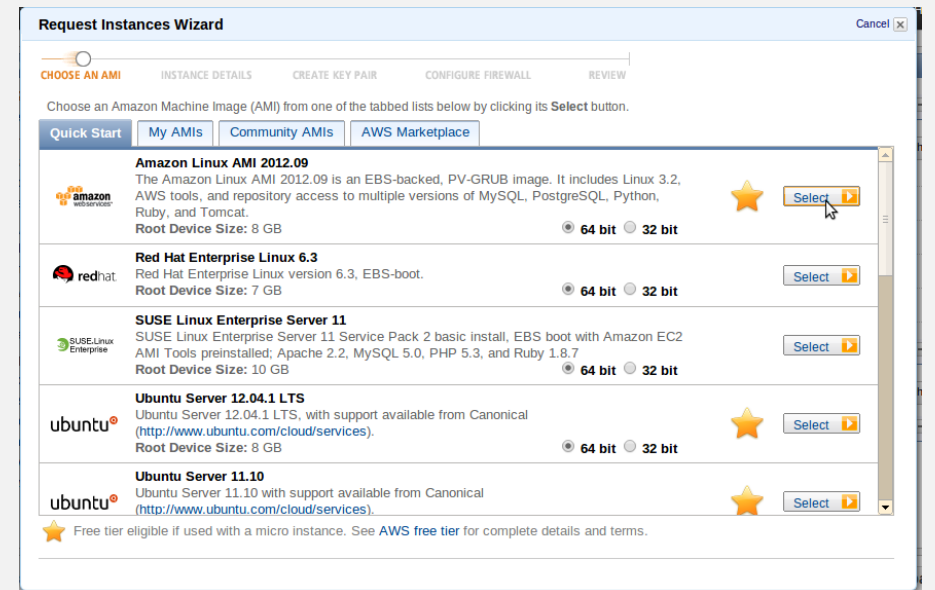
The screenshot shows the Amazon EC2 Console Dashboard. The 'Getting Started' section is highlighted, showing a 'Launch Instance' button. The 'My Resources' section shows 2 Running Instances, 4 EBS Volumes, 1 Key Pair, and 2 Security Groups. The 'Service Health' section shows Amazon EC2 (US West - Oregon) is operating normally.



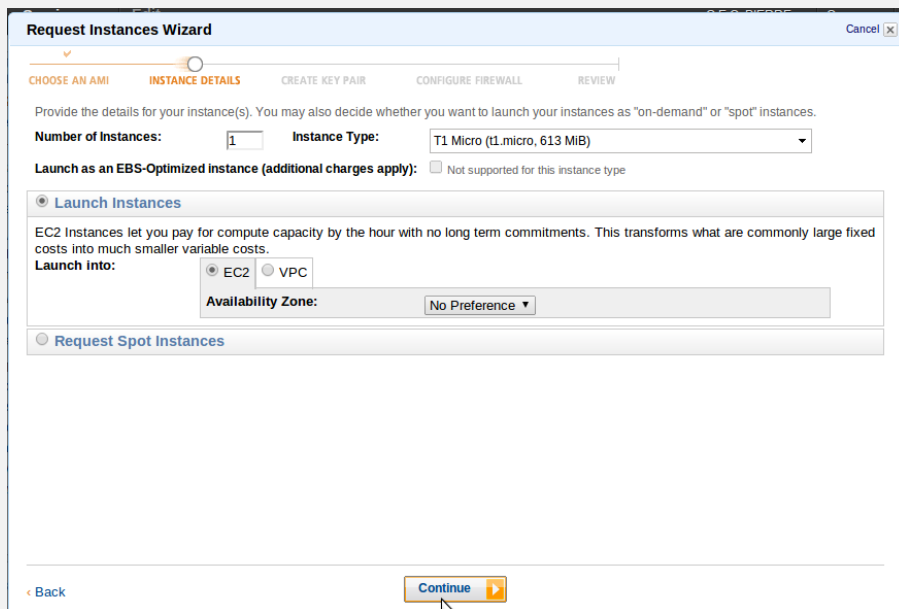
Example: create a new machine at Amazon EC2



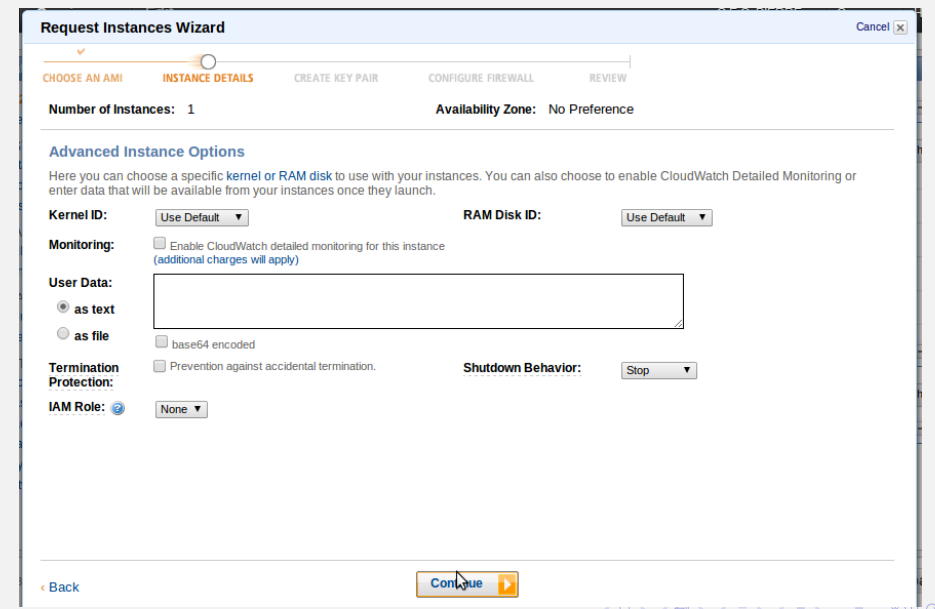
Example: create a new machine at Amazon EC2



Example: create a new machine at Amazon EC2



Example: create a new machine at Amazon EC2



Example: create a new machine at Amazon EC2

Request Instances Wizard [Cancel]

CHOOSE AN AMI | **INSTANCE DETAILS** | CREATE KEY PAIR | CONFIGURE FIREWALL | REVIEW

Number of Instances: 1
Availability Zone: No Preference

Storage Device Configuration
Your instance will be launched with the following storage device settings. Edit these settings to add EBS volumes, instance store volumes, or edit the settings of the root volume.

Type	Device	Snapshot ID	Size	Volume Type	IOPS	Delete on Termination
Root	/dev/sda1	snap-921bb2b4	8GiB	standard		true

[Edit]

[Back] [Continue]

Example: create a new machine at Amazon EC2

Request Instances Wizard [Cancel]

CHOOSE AN AMI | **INSTANCE DETAILS** | CREATE KEY PAIR | CONFIGURE FIREWALL | REVIEW

Add tags to your instance to simplify the administration of your EC2 infrastructure. A form of metadata, tags consist of a case-sensitive key/value pair, are stored in the cloud and are private to your account. You can create user-friendly names that help you organize, search, and browse your resources. For example, you could define a tag with key = Name and value = Webserver. You can add up to 10 unique keys to each instance along with an optional value for each key. For more information, go to [Using Tags](#) in the *EC2 User Guide*.

Key (127 characters maximum)	Value (255 characters maximum)	Remove
Name	My new VM	✖
		✖

Add another Tag. (Maximum of 10)

[Back] [Continue]

Example: create a new machine at Amazon EC2

Request Instances Wizard [Cancel]

CHOOSE AN AMI | INSTANCE DETAILS | **CREATE KEY PAIR** | CONFIGURE FIREWALL | REVIEW

Public/private key pairs allow you to securely connect to your instance after it launches. For Windows Server Instances, a Key Pair is required to set and deliver a secure encrypted password. For Linux Server Instances, a key pair will allow you to SSH into your instance. To create a key pair, enter a name and click **Create & Download your Key Pair**. You will then be prompted to save the private key to your computer. Note, you only need to generate a key pair once - not each time you want to deploy an Amazon EC2 instance.

Choose from your existing Key Pairs

Your existing Key Pairs*: contrail-oregon

Create a new Key Pair

Proceed without a Key Pair

[Back] [Continue]

Example: create a new machine at Amazon EC2

Request Instances Wizard [Cancel]

CHOOSE AN AMI | INSTANCE DETAILS | CREATE KEY PAIR | **CONFIGURE FIREWALL** | REVIEW

Security groups determine whether a network port is open or blocked on your instances. You may use an existing security group, or we can help you create a new security group to allow access to your instances using the suggested ports below. Add additional ports now or update your security group anytime using the Security Groups page.

Choose one or more of your existing Security Groups

sg-0046d830 - conpaas-online
sg-b0ce5b80 - default

(Selected groups: sg-0046d830)

Create a new Security Group

[Back] [Continue]

Example: create a new machine at Amazon EC2

Request Instances Wizard

CHOOSE AN AMI INSTANCE DETAILS CREATE KEY PAIR CONFIGURE FIREWALL REVIEW

Please review the information below, then click Launch.

AMI: Amazon Linux AMI ID ami-2a31bf1a (x86_64)
Name: Amazon Linux AMI 2012.09
Description: The Amazon Linux AMI 2012.09 is an EBS-backed, PV-GRUB image. It includes Linux 3.2, AWS tools, and repository access to multiple versions of MySQL, PostgreSQL, Python, Ruby, and Tomcat. [Edit AMI](#)

Number of Instances: 1
Availability Zone: No Preference
Instance Type: T1 Micro (t1.micro)
Instance Class: On Demand [Edit Instance Details](#)
EBS-Optimized: No

Monitoring: Disabled **Termination Protection:** Disabled
Tenancy: Default
Kernel ID: Use Default **Shutdown Behavior:** Stop
RAM Disk ID: Use Default

Network Interfaces:
Secondary IP Addresses:
User Data:
IAM Role: [Edit Advanced Details](#)

Key Pair Name: contrail-oregon [Edit Key Pair](#)

[Back](#) [Launch](#)

Example: create a new machine at Amazon EC2

Launch Instance Wizard

✓ **Your Instances are now launching.**
 Instance ID(s): i-9df3f0ae

Note: Your instances may take a few minutes to launch, depending on the software you are running.
 Note: Usage hours on your new instances will start immediately and continue to accrue until you stop or terminate your instances.

You can perform the following tasks while your instances are launching:

- ▶ [Create Status Check Alarms](#)
 You can use status check alarms to be notified if these instances fail status checks (additional charges may apply).
- ▶ [Create EBS Volumes](#) (Additional charges may apply.)
- ▶ [View your instances on the Instances page](#)

[Close](#)

Availability Zone Status Details
 Current Status Availability
 ✓ us-west-2a

Documentation
 All EC2 Resources
 CloudFormation on AWS Marketplace

© 2008 - 2012, Amazon Web Services, Inc. or its affiliates. All rights reserved. [Privacy Policy](#) [Terms of Use](#) [Feedback](#)

Example: create a new machine at Amazon EC2

Amazon EC2 Console Dashboard

Getting Started

To start using Amazon EC2 you will want to launch a virtual server, known as an Amazon EC2 instance.

[Launch Instance](#)

Note: Your instances will launch in the US West (Oregon) region.

Service Health

Service Status
 Current Status: Amazon EC2 (US West - Oregon) Service is operating normally
[View complete service health details](#)

Availability Zone Status
 Current Status: us-west-2a Availability: ✓

My Resources

You are using the following Amazon EC2 resources in the US West (Oregon) region:

- 2 Running Instances
- 0 Elastic IPs
- 4 EBS Volumes
- 2 Running Instances
- 2 Snapshots
- 1 Key Pair
- 0 Load Balancers
- 0 Placement Groups
- 2 Security Groups

Events

US West (Oregon): No events [Refresh](#)

Related Links

- ▶ [Getting Started Guide](#)
- ▶ [Documentation](#)
- ▶ [All EC2 Resources](#)
- ▶ [CloudFormation on AWS Marketplace](#)

© 2008 - 2012, Amazon Web Services, Inc. or its affiliates. All rights reserved. [Privacy Policy](#) [Terms of Use](#) [Feedback](#)

<https://console.aws.amazon.com/ec2/home?region=us-west-2#5=Instances>

Example: create a new machine at Amazon EC2

My Instances

[Launch Instance](#) Instance Actions [Show/Hide](#) [Refresh](#) [Help](#)

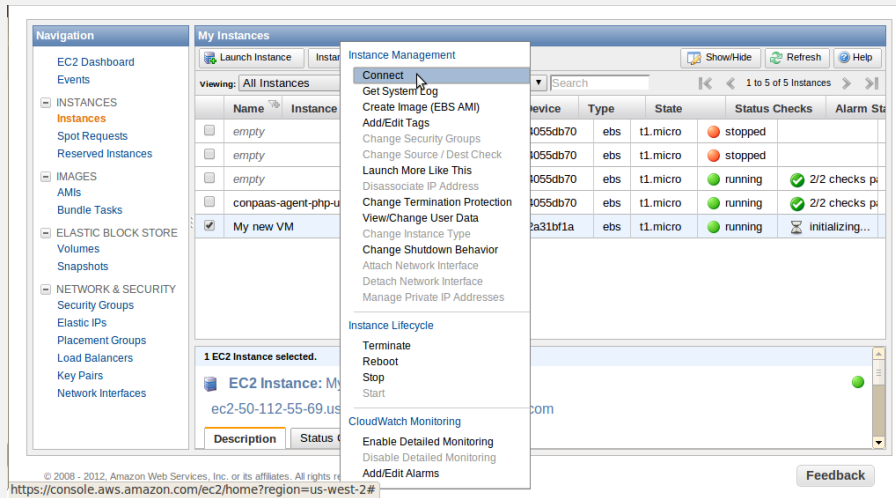
Viewing: All Instances All Instance Types Search 1 to 5 of 5 Instances

Name	Instance	AMI ID	Root Device	Type	State	Status Checks	Alarm St
empty	i-657e5e56	ami-4055db70	ebs	t1.micro	stopped		
empty	i-eb775fd8	ami-4055db70	ebs	t1.micro	stopped		
empty	i-01685e32	ami-4055db70	ebs	t1.micro	running	2/2 checks p	
compaas-agent-php-u43-s342	i-a93c3f9a	ami-4055db70	ebs	t1.micro	running	2/2 checks p	
My new VM	i-9df3f0ae	ami-2a31bf1a	ebs	t1.micro	running	initializing...	

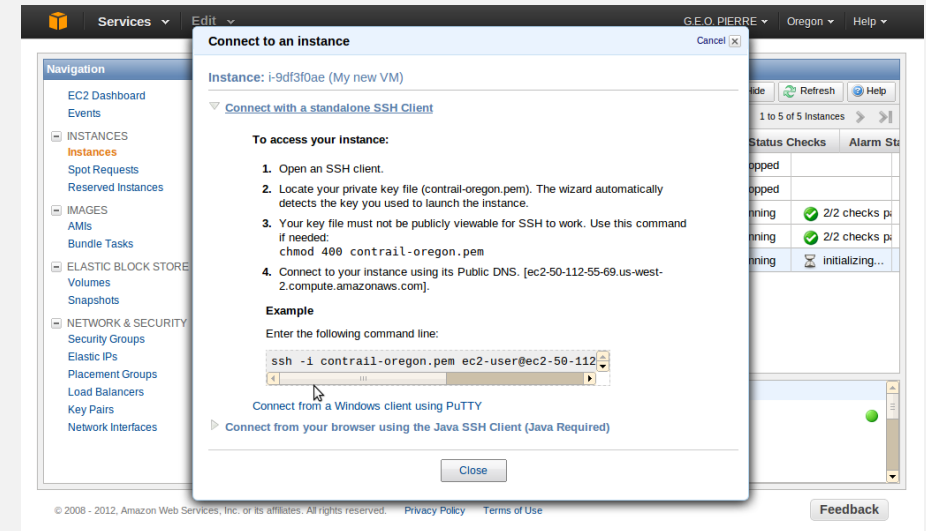
No EC2 Instances selected.
 Select an instance above

© 2008 - 2012, Amazon Web Services, Inc. or its affiliates. All rights reserved. [Privacy Policy](#) [Terms of Use](#) [Feedback](#)

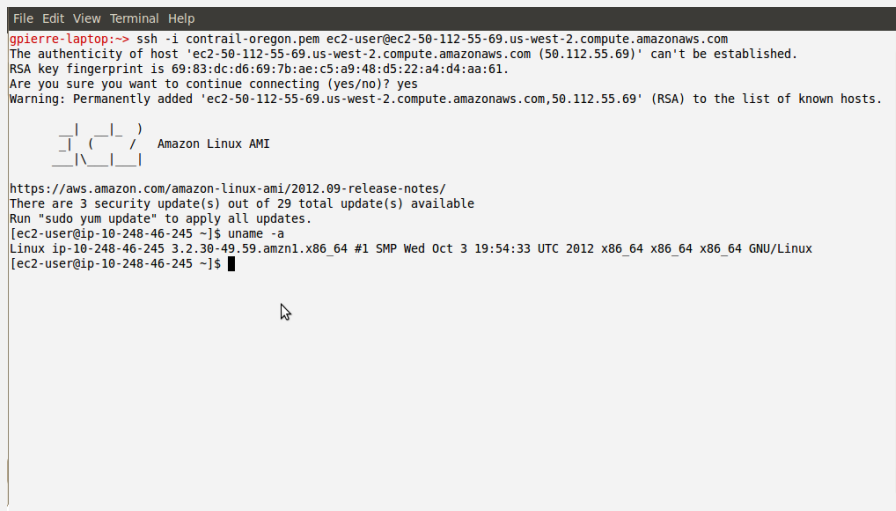
Example: create a new machine at Amazon EC2



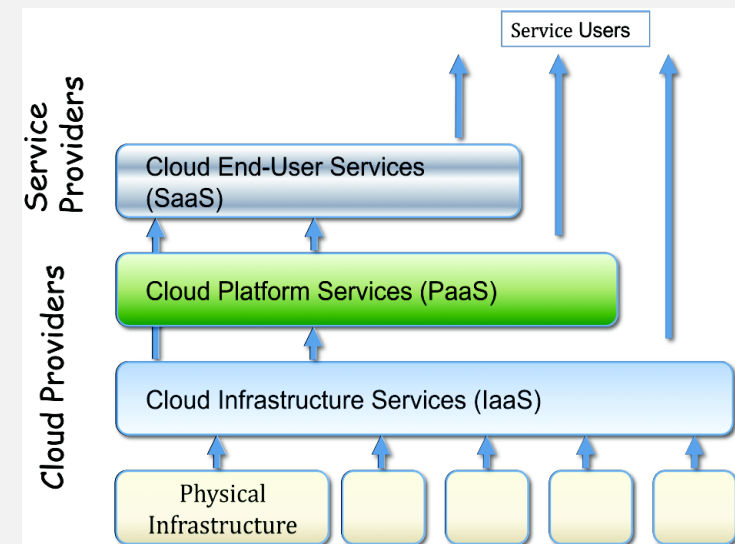
Example: create a new machine at Amazon EC2



Example: create a new machine at Amazon EC2

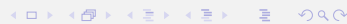


Cloud service layers



The main Cloud service layers

- **Infrastructure-as-a-Service** (IaaS) offers basic computing services
 - ▶ Computing: “Create a new machine for me”
 - ▶ Data storage: “Store/retrieve this data for me”
 - ▶ Communication
- **Platform-as-a-Service** (PaaS) offers high-level services for developers
 - ▶ Databases: “I need a SQL database”
 - ▶ Runtime environments: “Here is my Web application, run it for me”
 - ▶ Development tools: “Give me a git repository”
- **Software-as-a-Service** (SaaS) offers high-level services for end users
 - ▶ Mail: Gmail
 - ▶ Office applications: Google docs
 - ▶ Enterprise applications: human resource applications, finance. . .
 - ▶ Payment services: Paypal
 - ▶ Data management: Dropbox, iCloud
 - ▶ Music on demand: iTunes, Spotify



Services offered by a mature cloud provider

- **Compute:** Elastic Compute Cloud (EC2), Elastic MapReduce, Auto-scaling, Elastic load balancing.
- **Content delivery:** CloudFront.
- **Database:** Relational database service (RDS), DynamoDB, SimpleDB, ElastiCache.
- **Deployment&Management:** Identity and access management, CloudWatch, Elastic Beanstalk, CloudFormation.
- **Application services:** CloudSearch, Simple workflow service, Simple queue service, Simple notification service, Simple email service.
- **Software:** Marketplace.
- **Networking:** Route53, Virtual private cloud, Direct Connect.
- **Payment and billing:** Flexible payment service, DevPay.
- **Storage:** Simple storage service (S3), Glacier, Elastic Block Store (EBS), import/export, Storage gateway.
- **Workforce:** Mechanical Turk.

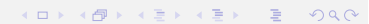


Table of Contents

- 1 A bit of history
- 2 Cloud computing
- 3 **Pros and cons**



Benefits of cloud computing

- **Cost**
 - ▶ Pay-as-you-go may reduce costs compared to overprovisioning
 - ▶ Capital expenditures → Operation expenditure
 - ▶ Less financial risk for the cloud customers
 - ▶ Economies of scale
- **Flexibility**
 - ▶ Cloud applications may request the resources they need whenever they need them
 - ▶ Dynamic resource provisioning
- **Performance**
 - ▶ “Infinite” pool of available resources
 - ▶ Some services allow you to reserve certain levels of performance
- **Security**
 - ▶ Good cloud providers have dedicated security teams



Drawbacks of cloud computing

- **Cost:** resources can be very expensive
 - ▶ Example: data storage in Amazon S3 costs \$0.125/GB/month
 - ▶ Storing 2 TB for 3 years costs \$9216 vs. \$300 if you buy your own RAID
- **Flexibility**
 - ▶ Each cloud has its own API
 - ▶ Customer lock-in
- **Performance**
 - ▶ Some devices have poor performance for demanding applications (networks)
 - ▶ Worse: performance is often unpredictable
- **Security**
 - ▶ Can the cloud tenant trust the cloud provider?
 - ▶ Legal concerns (patriot act in the US)