Hands-on Cloud Computing Services

Lezione 1

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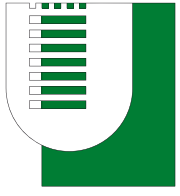

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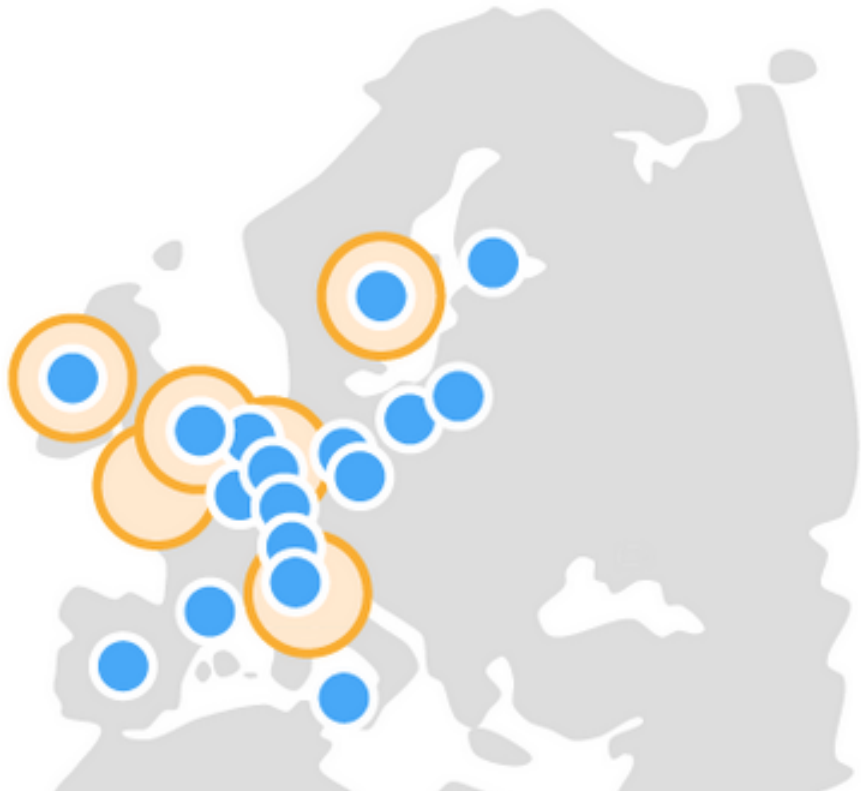
Overview

Hands-on Cloud Computing Services

- Cloud Computing services in action
  - Amazon Web Services
- Tools for cloud automation
  - Ansible
  - Terraform
  - …
- Examples

Amazon Web Services (AWS)

- Most popular public cloud provider
- 200+ different services
- 25 **regions**
  - in Italy: Milano (since 2020)
- 2+ **availability zones** in each region
- 225 Edge locations across 47 countries
  - In Italy: Milano, Roma, Palermo
- Numbers keep growing…



Services

- **Computation** (EC2, Lambda, …)
- **Storage** (S3, …)
- **Machine Learning** (Rekognition, Lex, …)
- **Networking and Content Delivery** (CloudFront, Route 53, …)
- **Security** (Cognito, …)
- …

How to Interact with AWS?

- Web Console
- AWS CLI
- SDK for various languages (e.g., `Boto3`)
- (Infrastructure-as-Code tools)

Note: regardless of the chosen approach, you need to explictly select the AWS Region you want to use. Services activated in one region cannot be managed within a different one.

IAM users

- AWS Identity and Access Management (IAM)
- When you register to AWS, you get a root account
- IAM allows you to create and manage users within your account
- It's a good practice to use an IAM user (with full permissions) rather than the root account (if compromised, an IAM user can be deleted without losing the whole account)[1]

[1] https://docs.aws.amazon.com/IAM/latest/UserGuide/id_users_create.html

Amazon EC2

- Resizable compute capacity in the cloud
- Virtual machines = Instances
- Many different instance types
  - Different amount of vCPUs, memory
  - Different storage
  - Different processors (ARM vs x86 CPUs, GPUs, …)
  - **Different price!**
- On-demand / spot / reserved instances
- Starting from less than 0.01 $/hour

Example

- Let's create an EC2 instance
- **AMI**: we can use Amazon Linux
- **Instance type**: pick something cheap (e.g., `t3.micro/nano`)
- **Security group**: create a new SG
  - Allow SSH and HTTP inbound traffic
- Shutdown behavior: `Terminate`
- Create (if necessary) a new **key pair**
  - Store the private key in a safe place!
  - Public key automatically installed on the instance

Connecting to the new instance

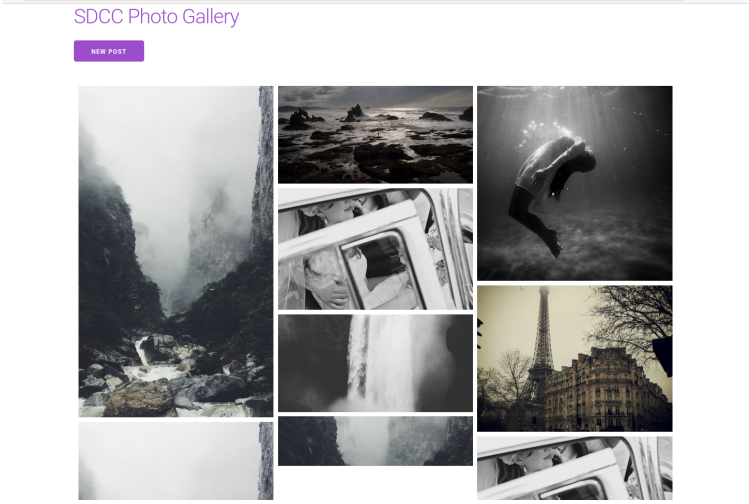
```
$ ssh -i <file.pem> ec2-user@<Public IP/Public DNS>
```

Monitor your Costs!

- The **Billing Dashboard** provides useful information to analyze paid and expected costs
- It is recommended to set an alarm so as to be notified whenever the expected monthly costs exceed a certain value: `https://docs.aws.amazon.com/AmazonCloudWatch/latest/monitoring/monitor_estimated_charges_with_cloudwatch.html`
- ...and avoid things like this: `https://www.reddit.com/r/aws/comments/g1ve18/i_am_charged_60k_on_aws_without_using_anything/`
- **Note**: estimated cost to reproduce steps from this lecture (EC2 + ELB) using services for a whole day: 1 EUR

Example Application: Photogallery

- Web application, written in Python using Flask
- Just a toy: no security, no robustness, …
- We'll use and extend it during the lectures
- You may develop your own customized version



Roadmap:

Photogallery version 1: static set of images; upload not supported

…

Photogallery version N: image upload and tagging; image search; automatic resizing and tagging based on object recognition; …

Deploying Photogallery on EC2

Running Photogallery

```
$ export FLASK_APP=galleryApp.py
$ flask run -h 0.0.0.0 -p <numero di porta>
$ # Note: \-- requires root privileges for port 80
```

or, using the script `run.sh`:

```
$ bash run.sh
```

- Create a new EC2 instance to deploy the app
- Connect via SSH to the instance:

  ```
  $ ssh -i <file.pem> ec2-user@<Public IP/Public DNS>
  ```

Deploying Photogallery on EC2 (contd.)

- Install the required software:

```
$ sudo yum install python3
$ sudo pip3 install flask
```

- Copy the app files from your PC using `scp`:

```
$ scp -i <chiaveprivata.pem> -r <cartellalocale> \
  ec2-user@<istanza ec2>:/home/ec2-user/
```

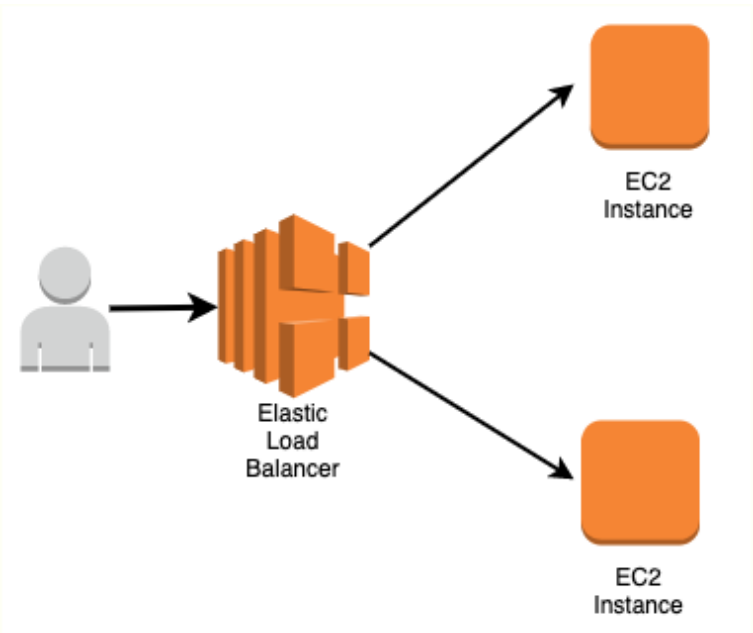
- Start the application:

```
$ cd photogallery/
$ bash run.sh
```

- Open `http://EC2-PUBLIC-IP/` in a browser
- Test: what if we “close” port 80 in the security group?

Replicating App Instances

- Current configuration is neither scalable or fault-tolerant
- Let's run multiple replicas of the web server
- We need a **load balancer**



Preliminary Tasks

- We run the app as a systemd **service**, automatically started at boot

/etc/systemd/system/photogallery.service

```
[Unit]
Description=Simple systemd service for Photogallery.

[Service]
Type=simple
WorkingDirectory=/home/ec2-user/photogallery
ExecStart=/bin/bash /home/ec2-user/photogallery/run.sh

[Install]
WantedBy=multi-user.target
```

Preliminary Tasks (contd.)

Starting and enabling the service

```
$ sudo systemctl daemon-reload
$ sudo systemctl start photogallery.service
$ sudo systemctl enable photogallery.service
```

Register an AMI

We also create an **AMI** using a snapshot of the running instance. We will be able to re-use the AMI to create new instances where the application is already installed and configured to start.

Preliminary Tasks (contd.)

Note: each AMI is associated with a snapshot of the root ELB volume attached to the instance. Keeping this snapshot has a (small) cost: `https://aws.amazon.com/premiumsupport/knowledge-center/ebs-snapshot-billing/`

Run Commands at Launch: cloud-init and User Data

- Creating a custom AMI allowed us to create new EC2 instances without manually configuring the application every time
- An alternative (and smarter) approach exists
- Cloud providers allow you to run commands when instances are launched:
  `https://docs.aws.amazon.com/AWSEC2/latest/UserGuide/user-data.html`
- In AWS, you can use the User Data option to specify:
  - a Bash script
  - cloud-init directives (`https://cloudinit.readthedocs.io/en/latest/`)

Next Step

We will configure Elastic Load Balancer in the next lecture