



UbiHPC Club 4.0: Introducción al desarrollo de software para vehículos aéreos no tripulados (UAVs) inteligentes -- Sección 2

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Agenda

- Tutorial Git/GitHub (pendiente sesión 1)
- Tutorial de ArduPilot SITL (Software In The Loop)
- Charla: “Aplicaciones con UAVs” (Dr. Pablo Royo - Universitat Politècnica de Catalunya)
- Tutorial de DroneKit
- Tutorial de Amazon Web Services
- Preguntas

Agenda del curso

Sección 1 (4 horas) ✓

- Revisión de aplicaciones actuales con UAVs y aplicaciones futuras inmediatas
- Emprendimiento
- Tutorial de Python general
- Tutorial de Git y GitHub

Sección 2 (4 horas)

- Tutorial de ArduPilot SITL (Software In The Loop)
- Tutorial de DroneKit
- Tutorial de Amazon Web Services



Charla aplicaciones con UAVs y oportunidades en Universitat Politècnica de Catalunya

3

Sección 3 (4 horas)

- Tutorial de cluster de UAVs simulado
- Programación de aplicación software para múltiples UAV



Charla integración de UAVs en espacio aéreo y oportunidades en Cranfield university

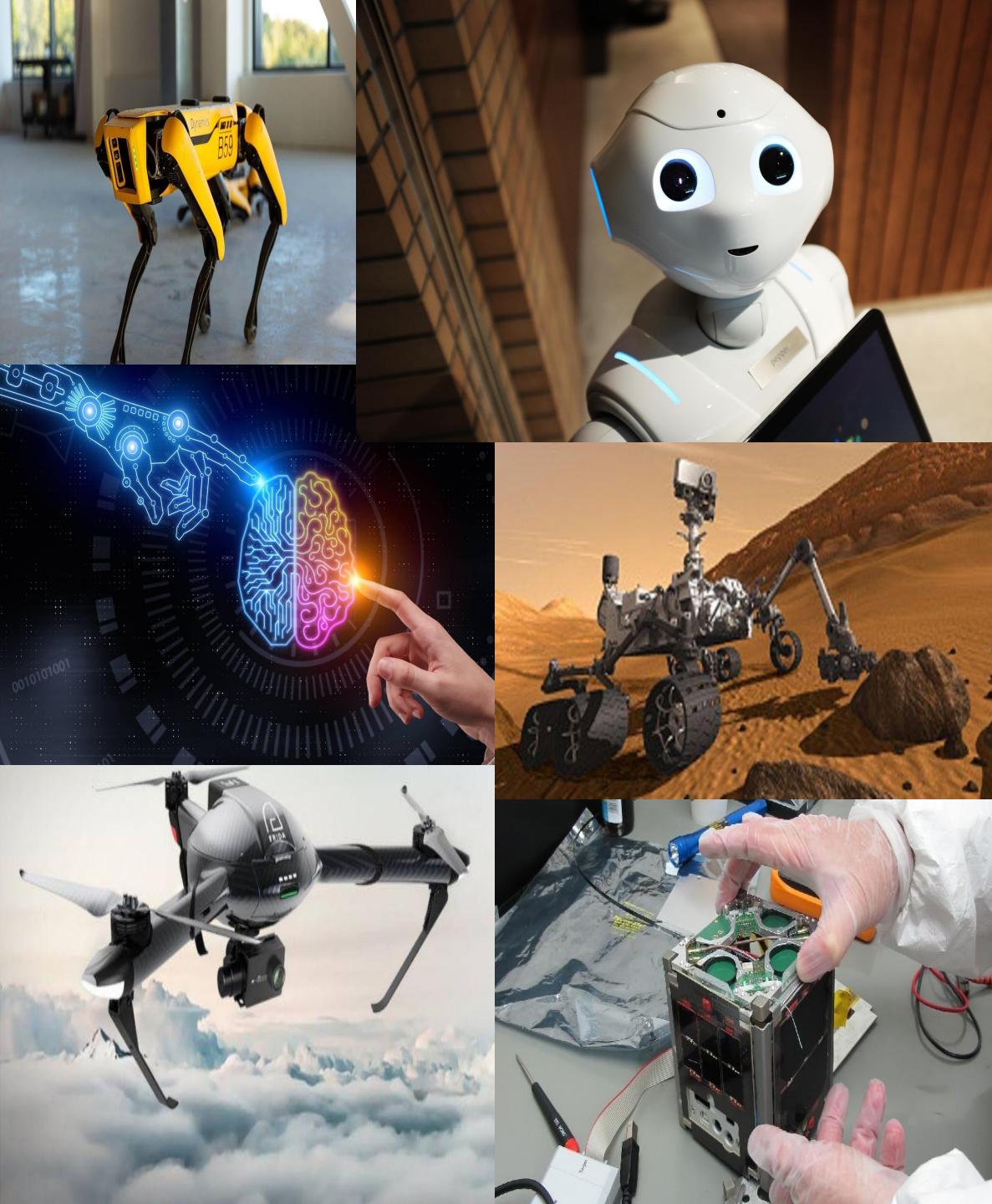
Sesión 4 (3 horas)

- Introducción a Deep Learning y Visión por computador con OpenCV.



Charla SubT, Landing on an asteroid using computer vision y oportunidades en NASA Jet Propulsion Laboratory

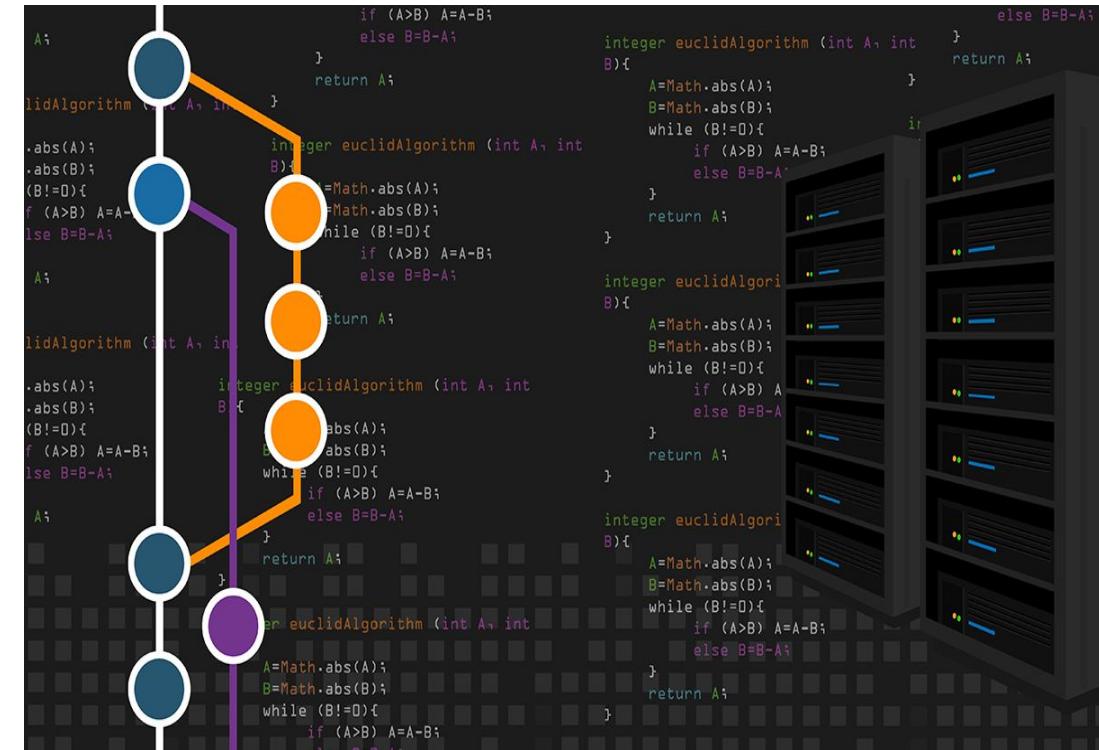
Git / GitHub



Git

Sistema de control de versiones

- Branches
- Distribuido (historia completa, commits locales, escalabilidad)
- Pull requests (Pedir a otro desarrollador que haga un “merge” de un branch) -- trazabilidad
- Comunidad
- Faster release cycle



<https://github.com/leonardocfor>

Repo: teaching
Folder: curso_intro_smart_uavs

Git

Create a new repository

A repository contains all project files, including the revision history. Already have a project repository elsewhere?

[Import a repository.](#)

Owner * Repository name *



/

intro_to_smart_uavs

Great repository names are short and memorable. Need inspiration? How about [fluffy-waffle](#)?

Description (optional)



Public

Anyone on the internet can see this repository. You choose who can commit.



Private

You choose who can see and commit to this repository.

Initialize this repository with:

Skip this step if you're importing an existing repository.

Add a README file

This is where you can write a long description for your project. [Learn more.](#)

Add .gitignore

Choose which files not to track from a list of templates. [Learn more.](#)

Choose a license

A license tells others what they can and can't do with your code. [Learn more.](#)

[Create repository](#)

Quick setup — if you've done this kind of thing before

or [HTTPS](#) [SSH](#) https://github.com/leonardocfor/intro_to_smart_UAVs.git

Get started by [creating a new file](#) or [uploading an existing file](#). We recommend every repository include a [README](#), [LICENSE](#), and [.gitignore](#).

...or create a new repository on the command line

```
echo "# intro_to_smart_UAVs" >> README.md
git init
git add README.md
git commit -m "first commit"
git branch -M master
git remote add origin https://github.com/leonardocfor/intro_to_smart_UAVs.git
git push -u origin master
```

...or push an existing repository from the command line

```
git remote add origin https://github.com/leonardocfor/intro_to_smart_UAVs.git
git branch -M master
git push -u origin master
```

...or import code from another repository

You can initialize this repository with code from a Subversion, Mercurial, or TFS project.

[Import code](#)

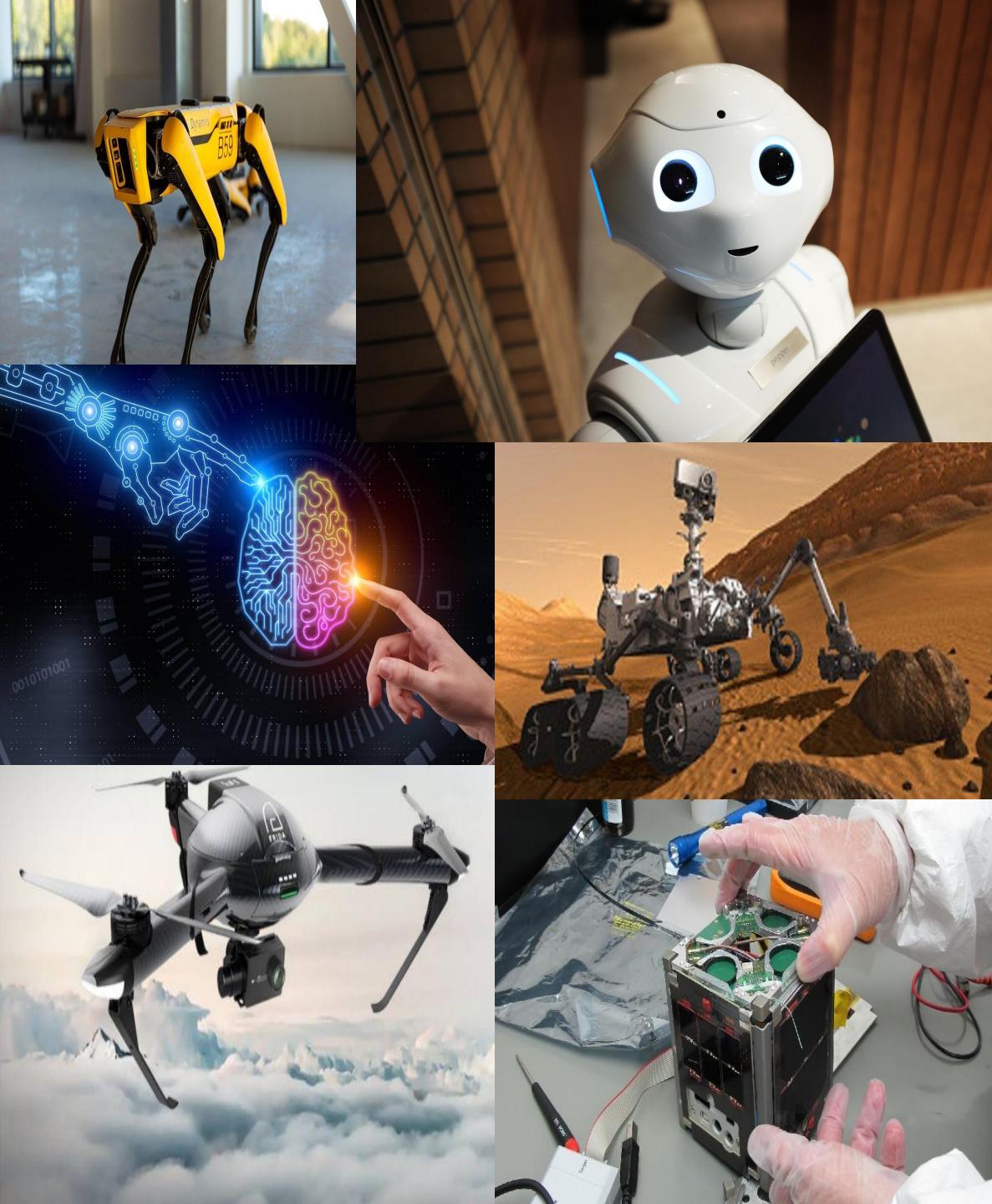
Git

Practica

```
$ sudo apt-get install git // # apt-get install git  
$ cd  
$ cd intro_to_smart_uavs  
$ git init  
$ git add __init__.py session1/__init__.py session2/__init__.py session3/__init__.py session4/__init__.py  
$ git commit -m "Adds course folder structure"  
$ git branch -M master  
$ git remote add origin https://github.com/<your_user>intro_to_smart_UAVs.git  
$ git push -u origin master
```

Ejercicio

Hacer un commit con los archivos drones.py mydrone.py



Tutorial de ArduPilot SITL

Aplicaciones con drones



Agricultura de precisión



Búsqueda y Rescate



Monitoreo/vigilancia



Construcción



Petróleo & Gas



Inmobiliaria



Policía, bomberos y
guardia costera



Drone sports & e-sports

Costos de un drone



20.000 USD (en Colombia)



35.000 USD (en Colombia)



20.000 USD (en Colombia)



35.000 USD (en Colombia)

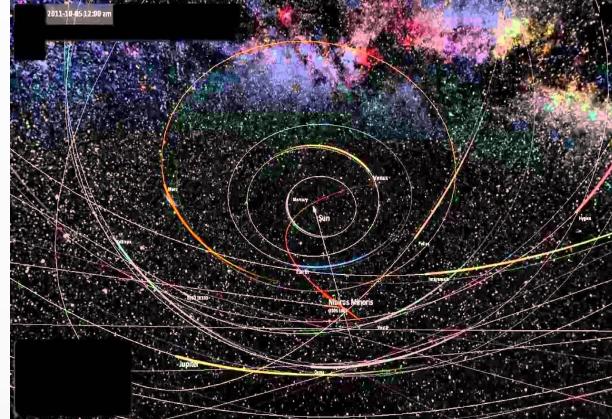
Lo que podría pasar



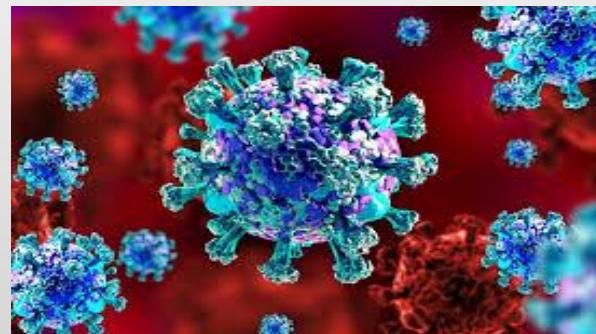
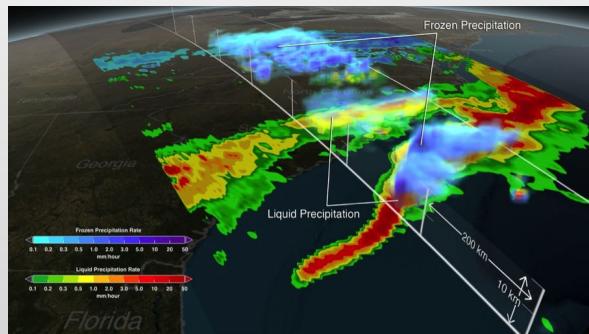
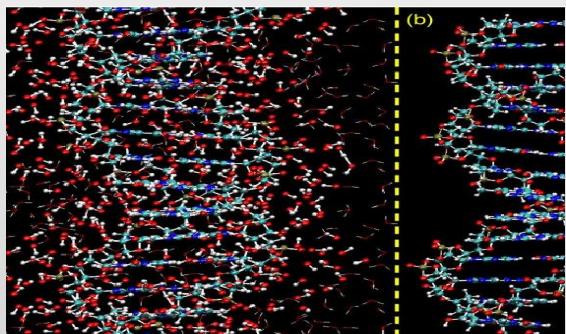
11



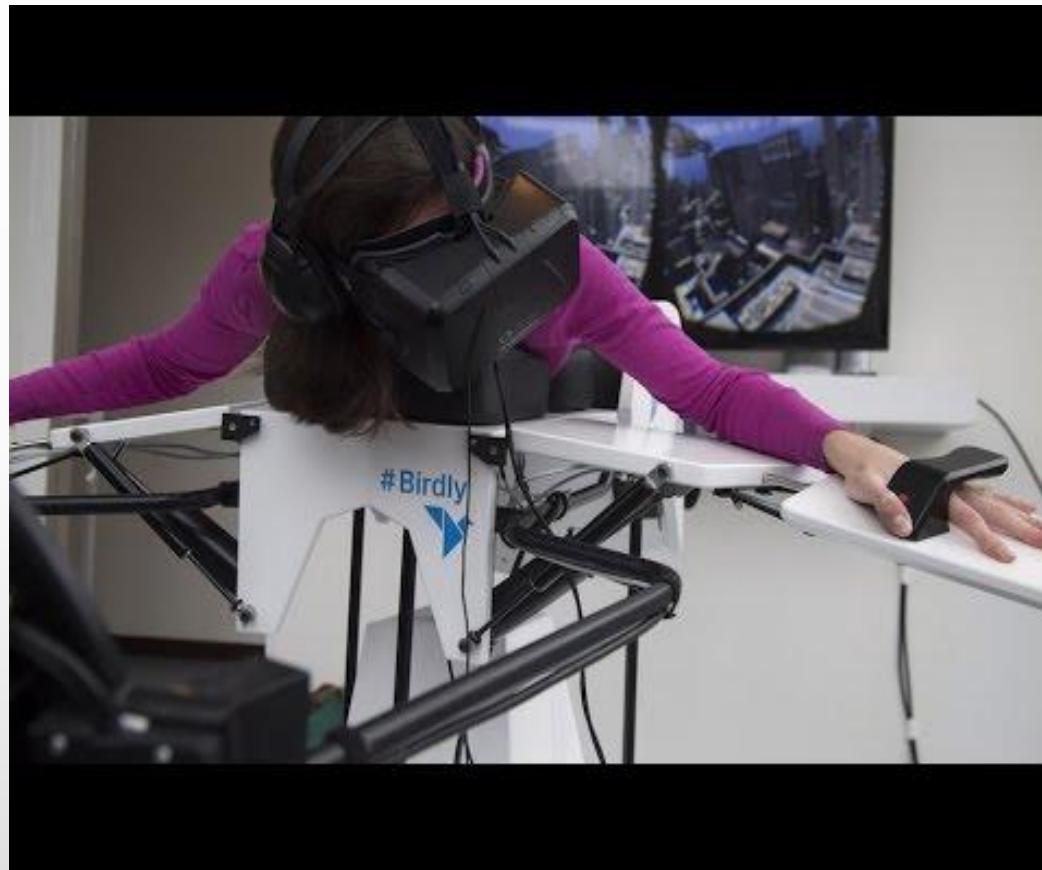
Simular primero



SIMULACIÓN



Simular primero - VR



A screenshot of a Udemy course page titled "VR Development Fundamentals With Oculus Quest And Unity". The page shows a preview video of a person wearing a VR headset. Text in the video says "Let's admit it. Oculus Quest was a hit." Below the video, there's a section titled "What you'll learn" with a list of topics including "Virtual Reality Development Fundamentals", "Side-Loading to Oculus Quest", and "Oculus Controllers and Hand Tracking". On the right side, there's a summary of the course: "99 \$129.99 91% off", "10-Day Money-Back Guarantee", and a "Buy now" button. The course has a 4.4 rating and 245 reviews.

<https://www.udemy.com/course/oculus-quest-development-with-unity/>

11.99 USD

Simulación VS Realidad



VS



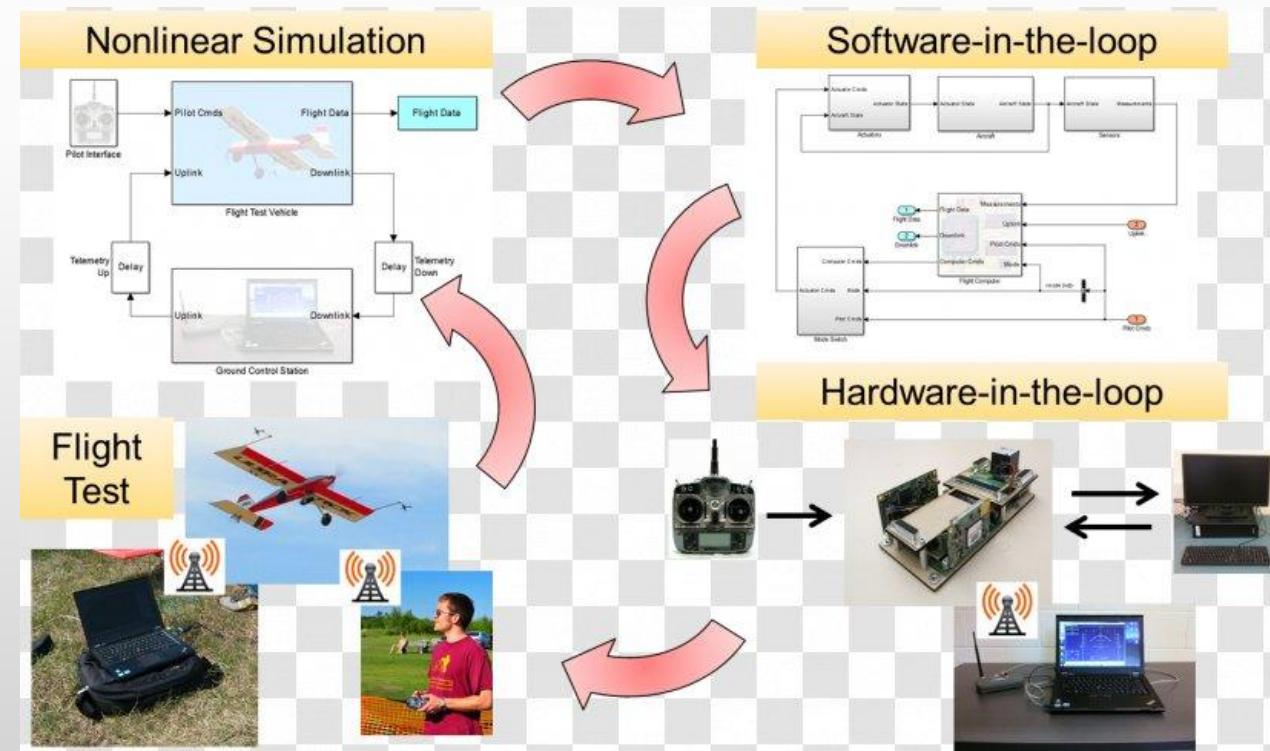
14

¿Qué limitantes existen en la simulación de un UAV?

Software in The Loop (SITL)

SITL/SIL: Software In The Loop

HITL/HIL: Hardware In The Loop



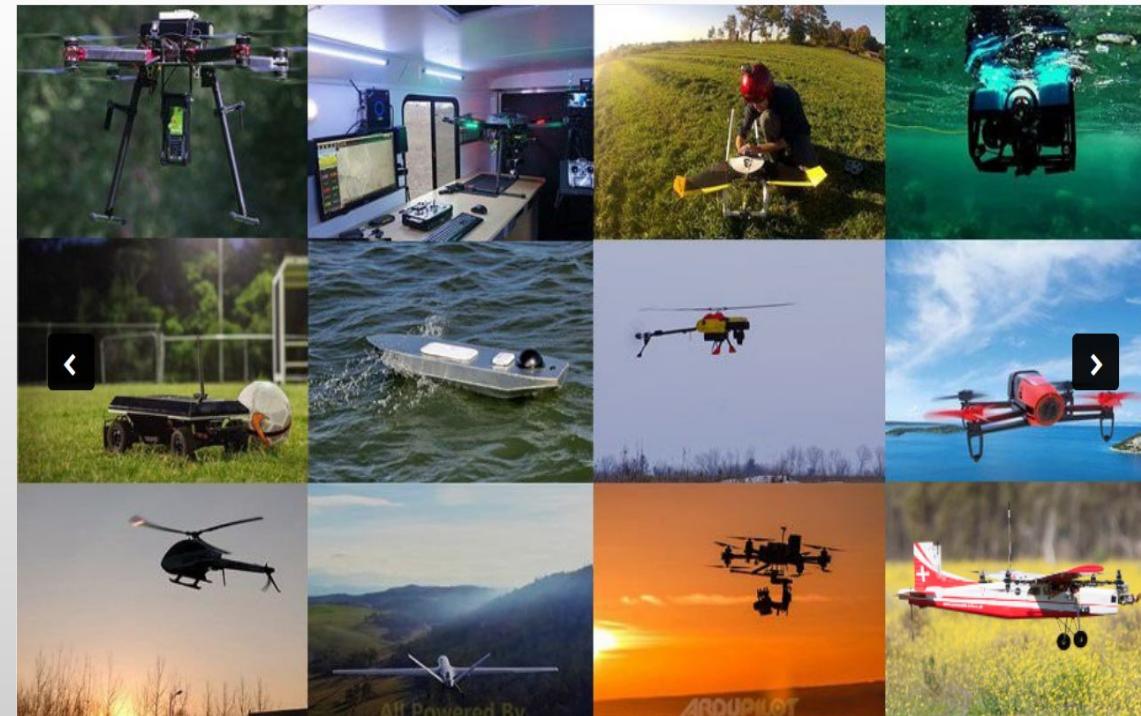
ArduPilot



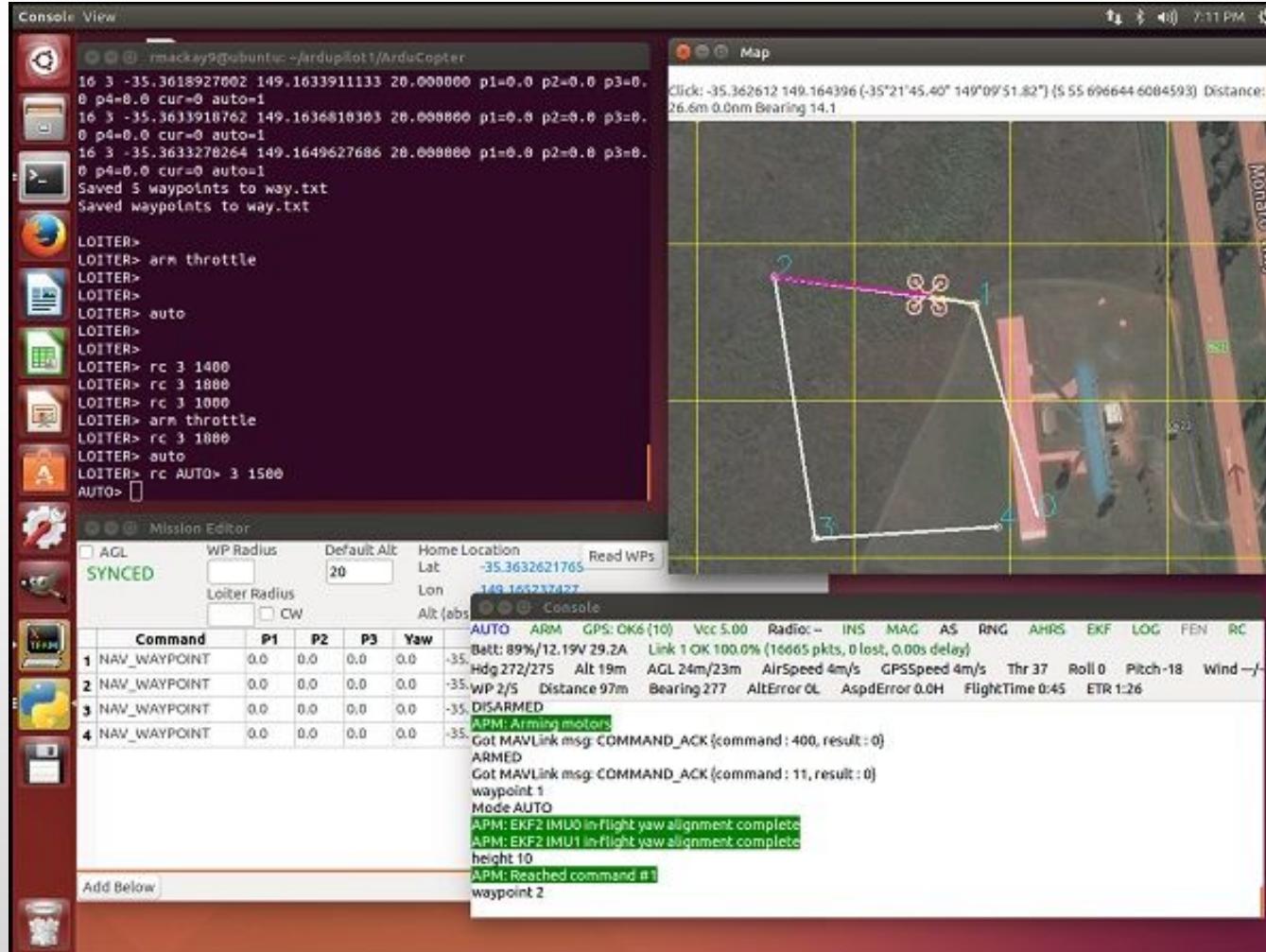
Pixhawk 2 Cube



- Open source
- Instalado en más de 1 millón de vehículos en el mundo
- NASA, Intel y Insitu/Boeing, incontables universidades en el mundo

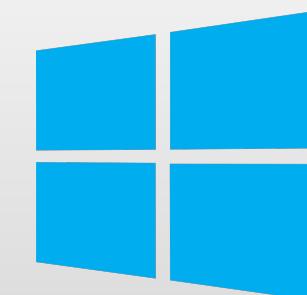


ArduPilot SITL

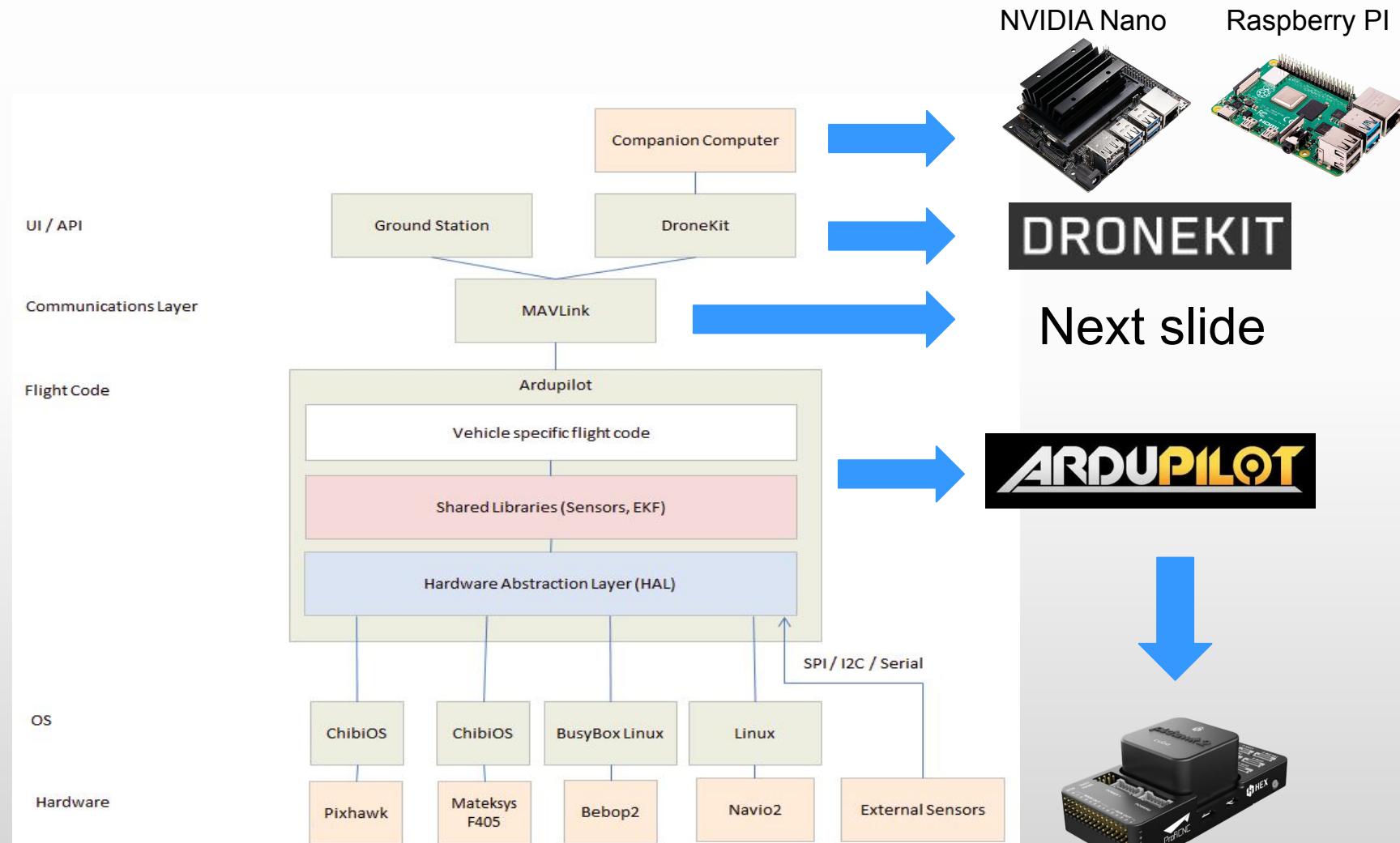


- multi-rotor aircraft
- fixed wing aircraft
- ground vehicles
- underwater vehicles
- camera gimbals
- antenna trackers
- a wide variety of optional sensors, such as Lidars and optical flow sensors

17



Arquitectura software ArduPilot



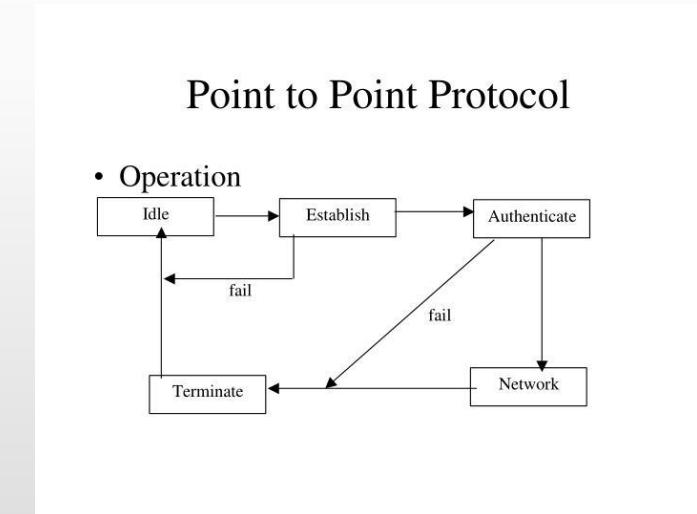
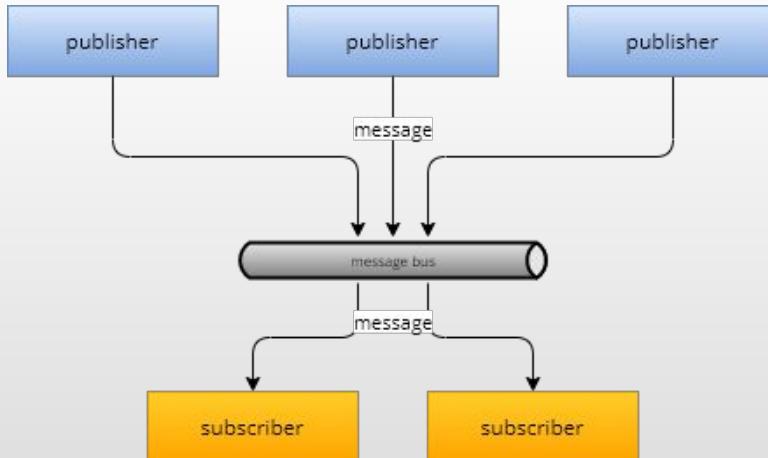
Next slide

18

MAVLink



MAVLink is a very lightweight, header-only message library for communication between drones and/or ground control stations. It consists primarily of message-set specifications for different systems ("dialects") defined in XML files, and Python tools that convert these into appropriate source code for [supported languages](#). There are additional Python scripts providing examples and utilities for working with MAVLink data.



Retransmisión



Tutorial de ArduPilot SITL

\$ sim_vehicle.py --help

¿Qué parámetro usar para cambiar la ubicación por defecto?

\$ sim_vehicle.py -v ArduCopter --map --console -L <location> nano /home/<user>/ardupilot/Tools/autotest/locations.txt

¿Qué parámetro usar para asignar a una ubicación específica?

\$ sim_vehicle.py -v ArduCopter --map --console -l <latitude>,<longitude>,<absolute-altitude>,<heading>

STABILIZE> mode Leer los modos y analizarlos <https://ardupilot.org/copter/docs/flight-modes.html#flight-modes>

STABILIZE> mode guided Dar enter dos veces

GUIDED> GUIDED> arm throttle Armar (en el caso de UAVs se desarmen muy rápido)

GUIDED> takeoff <int> Despegar

GUIDED> mode land

GUIDED> Ctrl+c

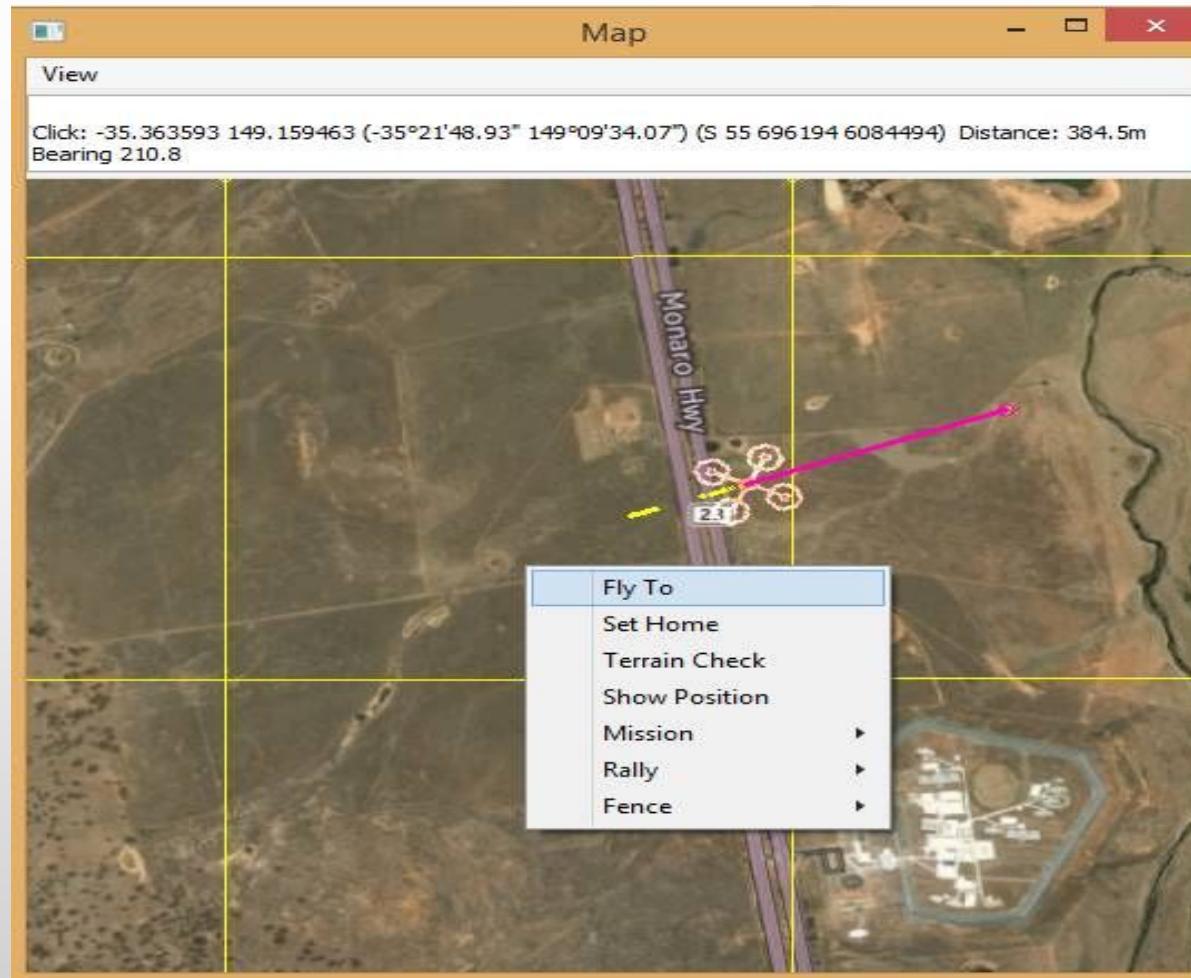
Usar terminator

20

Console														
MAVProxy	Vehicle	Link	Mission	Rally	Fence	Parameter								
GUIDED	ARM	GPS: OK6 (10)	Vcc 5.00	Radio: -	INS	MAG	AS	RNG	AHRS	EKF	LOG	FEN		
Batt: 0%/12.19V 22.4A		Link 1 OK 100.0% (89962 pkts, 0 lost, 0.00s delay)												
Hdg 129/326	Alt 40m	AGL 40m/40m	AirSpeed 0m/s	GPSSpeed 0m/s	Thr 40	Roll 0	Pitch 0	Wind --						
WP 0	Distance 0m	Bearing 264	AltError 0m(H)	AspdError 0m/s(H)	FlightTime 10:36	ETR 0:00	Param							

Tutorial de ArduPilot SITL

```
$ sim_vehicle.py -v ArduCopter --map --console
```



Play with it

Tutorial de ArduPilot SITL

```
$ sim_vehicle.py -v ArduCopter --map --console
```

```
STABILIZE> mode guided
```

```
GUIDED> arm throttle
```

```
GUIDED> takeoff <int>
```

```
GUIDED> wp load ardupilot/Tools/autotest/<escoger_mission.txt> Load mission
```

Abrir el archivo de la misión en otra ventana de terminator → nano ardupilot/Tools/autotest/<escoger_mission.txt>

```
GUIDED> mode ???      Qué modo se necesita para empezar la misión?
```

```
???> mode ??      Qué modo se necesita para retornar a casa?
```

```
???> Ctrl+C
```



Tutorial de DroneKit²³

Tutorial de DroneKit

Previous 

```
pip3 install dronekit geographiclib pymavlink
```

24

Next 

Tutorial de DroneKit

↑ Previous

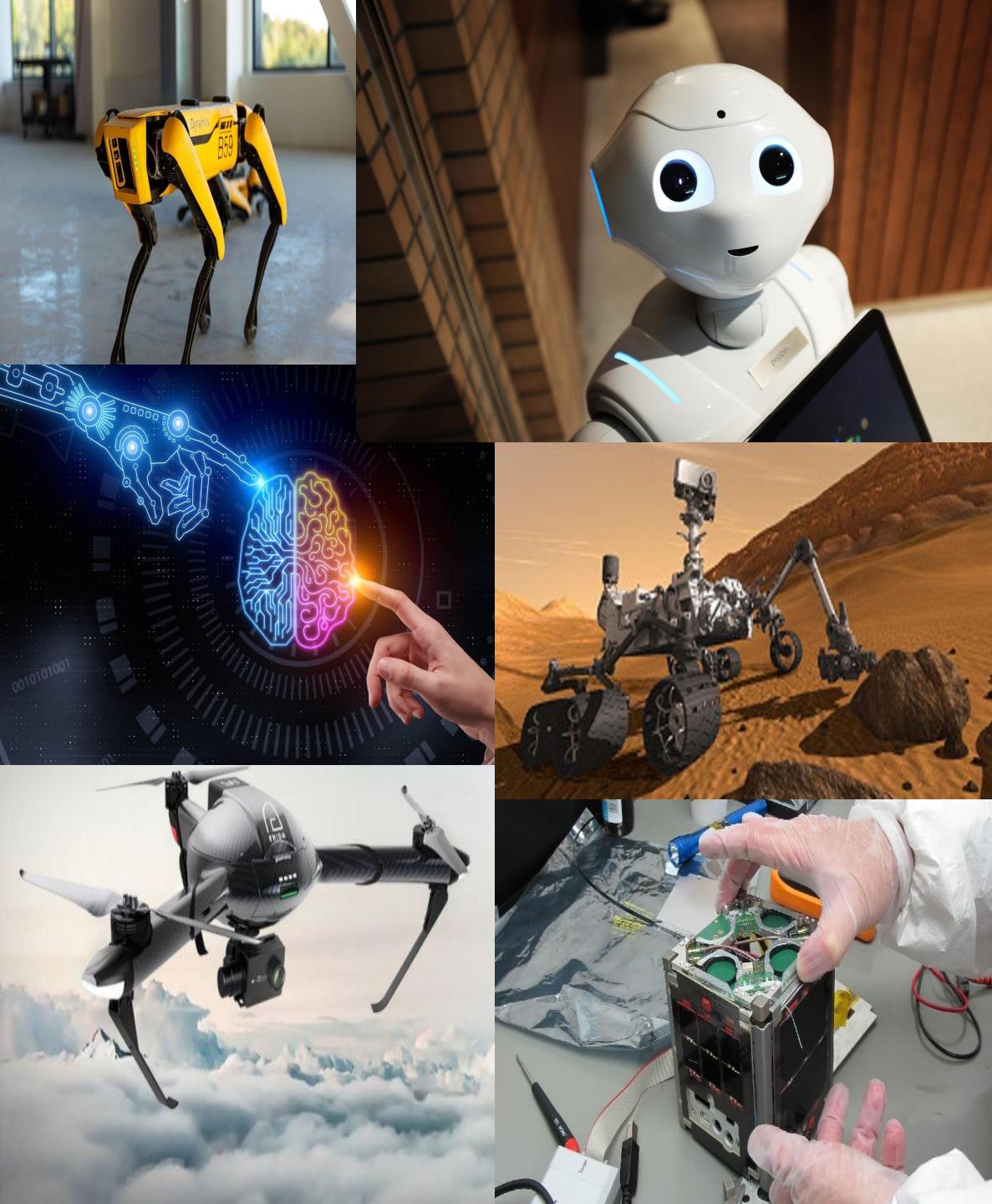
Abrir terminator y partir la ventana en dos

Ventana 1: sim_vehicle.py -v ArduCopter --map --console --out 127.0.0.1:14550 --out 127.0.0.1:14551 -l 2.148971,-73.944397,0,270
Ventana 2: python3

<https://github.com/leonardocfor/teaching/blob/master/DroneKit/basic.md>

25

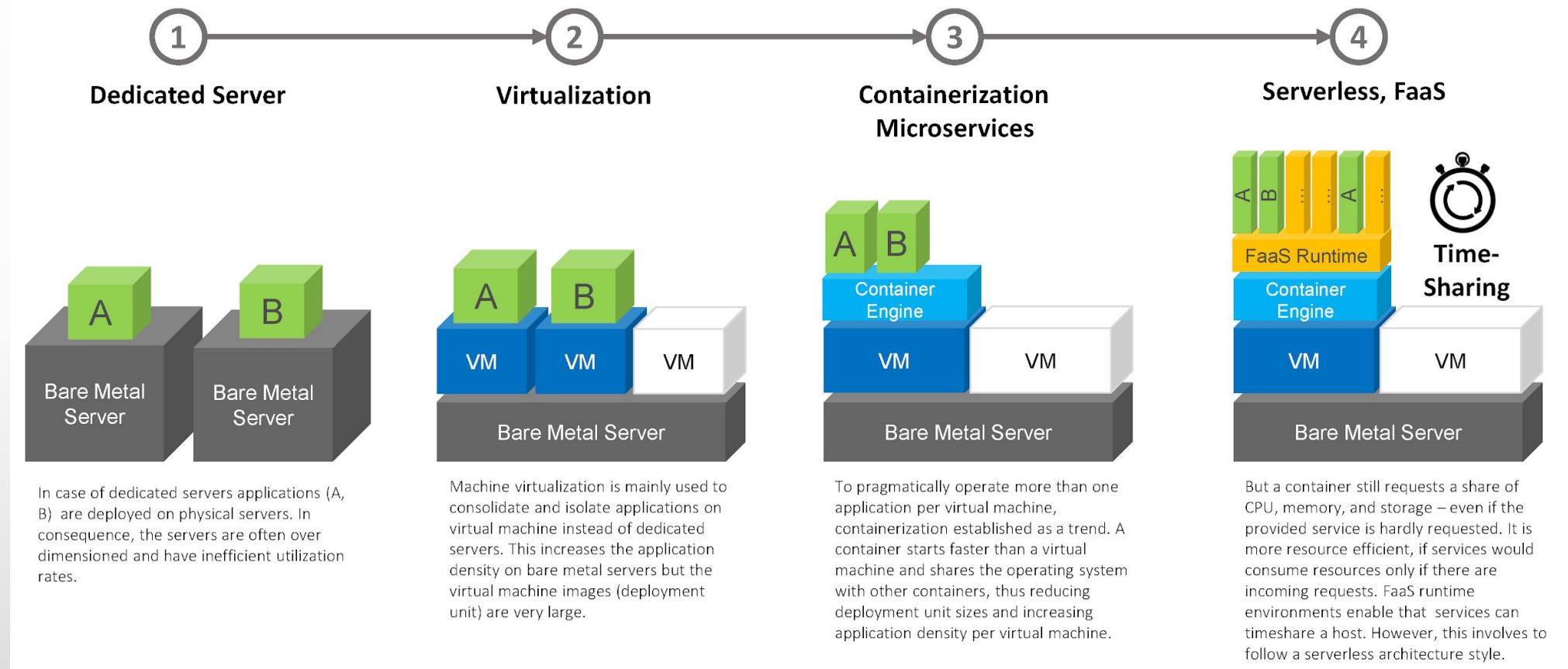
Next ↓



Tutorial de AWS

26

Tutorial de AWS



Tutorial de AWS



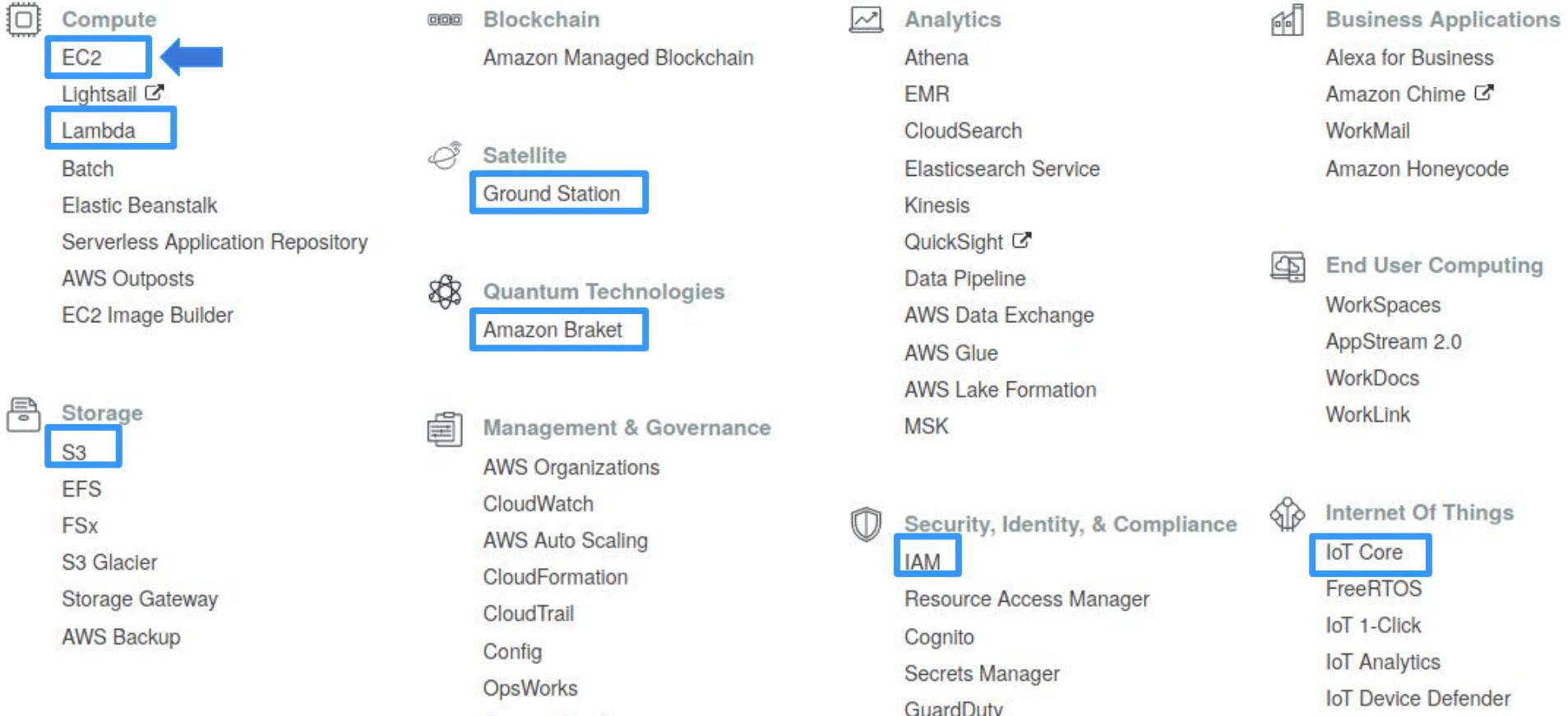
Amazon Web Services

- Costos (servidores, administración, personal)
- Escalabilidad
- Seguridad
- Resiliencia
- Multitud de servicios

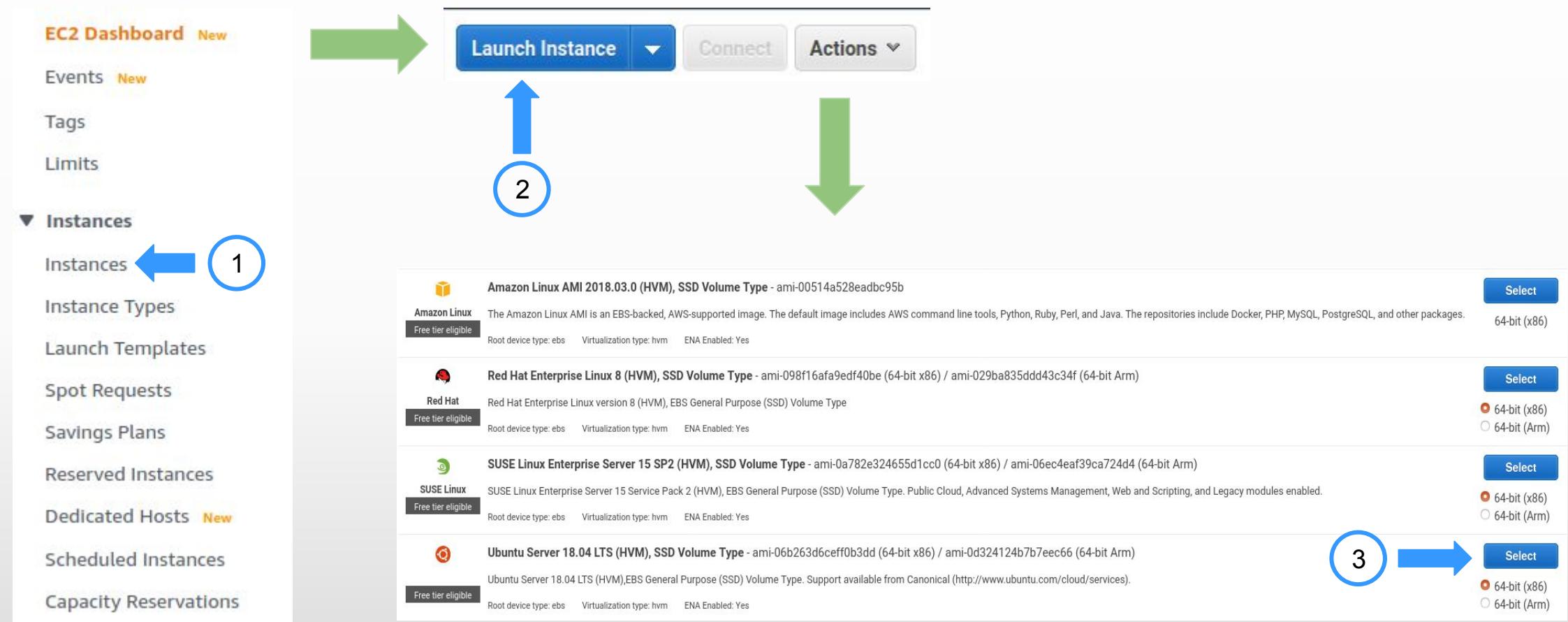
Tutorial de AWS



Tutorial de AWS



Tutorial de AWS



Tutorial de AWS

	VCPU	ECU	Memory (GiB)	Instance Storage (GB)	Linux/UNIX Usage
General Purpose - Current Generation					
a1.medium	1	N/A	2 GiB	EBS Only	\$0.0255 per Hour
a1.large	2	N/A	4 GiB	EBS Only	\$0.051 per Hour
a1.xlarge	4	N/A	8 GiB	EBS Only	\$0.102 per Hour
a1.2xlarge	8	N/A	16 GiB	EBS Only	\$0.204 per Hour
a1.4xlarge	16	N/A	32 GiB	EBS Only	\$0.408 per Hour
a1.metal	16	N/A	32 GiB	EBS Only	\$0.408 per Hour
t4g.nano	2	N/A	0.5 GiB	EBS Only	\$0.0042 per Hour
t4g.micro	2	N/A	1 GiB	EBS Only	\$0.0084 per Hour
t4g.small	2	N/A	2 GiB	EBS Only	\$0.0168 per Hour
t4g.medium	2	N/A	4 GiB	EBS Only	\$0.0336 per Hour
t4g.large	2	N/A	8 GiB	EBS Only	\$0.0672 per Hour
t4g.xlarge	4	N/A	16 GiB	EBS Only	\$0.1344 per Hour
t4g.2xlarge	8	N/A	32 GiB	EBS Only	\$0.2688 per Hour
t3.nano	2	Variable	0.5 GiB	EBS Only	\$0.0052 per Hour
t3.micro	2	Variable	1 GiB	EBS Only	\$0.0104 per Hour
t3.small	2	Variable	2 GiB	EBS Only	\$0.0208 per Hour
t3.medium	2	Variable	4 GiB	EBS Only	\$0.0416 per Hour

GPU Instances - Current Generation					
p3.2xlarge	8	31	61 GiB	EBS Only	\$3.06 per Hour
p3.8xlarge	32	97	244 GiB	EBS Only	\$12.24 per Hour
p3.16xlarge	64	201	488 GiB	EBS Only	\$24.48 per Hour
p2.xlarge	4	16	61 GiB	EBS Only	\$0.90 per Hour
p2.8xlarge	32	97	488 GiB	EBS Only	\$7.20 per Hour
p2.16xlarge	64	201	732 GiB	EBS Only	\$14.40 per Hour
g4dn.xlarge	4	N/A	16 GiB	125 GB NVMe SSD	\$0.526 per Hour
g4dn.2xlarge	8	N/A	32 GiB	225 GB NVMe SSD	\$0.752 per Hour
g4dn.4xlarge	16	N/A	64 GiB	225 GB NVMe SSD	\$1.204 per Hour
g4dn.8xlarge	32	N/A	128 GiB	900 GB NVMe SSD	\$2.176 per Hour
g4dn.12xlarge	48	N/A	192 GiB	900 GB NVMe SSD	\$3.912 per Hour
g4dn.16xlarge	64	N/A	256 GiB	900 GB NVMe SSD	\$4.352 per Hour
g3.4xlarge	16	58	122 GiB	EBS Only	\$1.14 per Hour
g3.8xlarge	32	97	244 GiB	EBS Only	\$2.28 per Hour
g3.16xlarge	64	201	488 GiB	EBS Only	\$4.56 per Hour
g3s.xlarge	4	13	30.5 GiB	EBS Only	\$0.75 per Hour

Tutorial de AWS

Step 2: Choose an Instance Type

Amazon EC2 provides a wide selection of instance types optimized to fit different use cases. Instances are virtual servers that can run applications. They have varying combinations of CPU, memory, storage, and networking capacity, and give you the flexibility to choose the appropriate mix of resources for your applications. [Learn more about instance types and how they can meet your computing needs.](#)

Filter by: All instance types ▾ Current generation ▾ Show/Hide Columns

Currently selected: t2.micro (Variable ECUs, 1 vCPUs, 2.5 GHz, Intel Xeon Family, 1 GiB memory, EBS only)

	Family	Type	vCPUs ⓘ	Memory (GiB) ⓘ	Instance Storage (GB) ⓘ	EBS-Optimized Available ⓘ	Network Performance ⓘ	IPv6 Support ⓘ
<input type="checkbox"/>	General purpose	t2.nano	1	0.5	EBS only	-	Low to Moderate	Yes
<input checked="" type="checkbox"/>	General purpose	t2.micro Free tier eligible	1	1	EBS only	-	Low to Moderate	Yes
<input type="checkbox"/>	General purpose	t2.small	1	2	EBS only	-	Low to Moderate	Yes
<input type="checkbox"/>	General purpose	t2.medium	2	4	EBS only	-	Low to Moderate	Yes
<input type="checkbox"/>	General purpose	t2.large	2	8	EBS only	-	Low to Moderate	Yes
<input type="checkbox"/>	General purpose	t2.xlarge	4	16	EBS only	-	Moderate	Yes
<input type="checkbox"/>	General purpose	t2.2xlarge	8	32	EBS only	-	Moderate	Yes
<input type="checkbox"/>	General purpose	t3a.nano	2	0.5	EBS only	Yes	Up to 5 Gigabit	Yes
<input type="checkbox"/>	General purpose	t3a.micro	2	1	EBS only	Yes	Up to 5 Gigabit	Yes
<input type="checkbox"/>	General purpose	t3a.small	2	2	EBS only	Yes	Up to 5 Gigabit	Yes
<input type="checkbox"/>	General purpose	t3a.medium	2	4	EBS only	Yes	Up to 5 Gigabit	Yes
<input type="checkbox"/>	General purpose	t3a.large	2	8	EBS only	Yes	Up to 5 Gigabit	Yes

Cancel Previous Review and Launch Next: Configure Instance Details

Tutorial de AWS

Step 3: Configure Instance Details

Configure the instance to suit your requirements. You can launch multiple instances from the same AMI, request Spot instances to take advantage of the lower pricing, assign an access management role to the instance, and more.

Number of instances	<input type="text" value="1"/>	Launch into Auto Scaling Group
Purchasing option	<input type="checkbox"/> Request Spot instances	
Network	<input type="text"/>	Create new VPC
Subnet	<input type="text" value="No preference (default subnet in any Availability Zone)"/>	Create new subnet
Auto-assign Public IP	<input type="text" value="Use subnet setting (Enable)"/>	
Placement group	<input type="checkbox"/> Add instance to placement group	
Capacity Reservation	<input type="text" value="Open"/>	
Domain join directory	<input type="text" value="No directory"/>	Create new directory
IAM role	<input type="text" value="None"/>	Create new IAM role
Shutdown behavior	<input type="text" value="Stop"/>	
Stop - Hibernate behavior	<input type="checkbox"/> Enable hibernation as an additional stop behavior	
Enable termination protection	<input type="checkbox"/> Protect against accidental termination	
Monitoring	<input type="checkbox"/> Enable CloudWatch detailed monitoring <small>Additional charges apply.</small>	
Tenancy	<input type="text" value="Shared - Run a shared hardware instance"/> <small>Additional charges will apply for dedicated tenancy.</small>	
Elastic Inference	<input type="checkbox"/> Add an Elastic Inference accelerator <small>Additional charges apply.</small>	
Cancel Previous Review and Launch Next: Add Storage		

34

Tutorial de AWS

1. Choose AMI 2. Choose Instance Type 3. Configure Instance 4. Add Storage 5. Add Tags 6. Configure Security Group 7. Review

Step 4: Add Storage

Your instance will be launched with the following storage device settings. You can attach additional EBS volumes and instance store volumes to your instance, or edit the settings of the root volume. You can also attach additional EBS volumes after launching an instance, but not instance store volumes. [Learn more](#) about storage options in Amazon EC2.

Volume Type	Device	Snapshot	Size (GiB)	Volume Type	IOPS	Throughput (MB/s)	Delete on Termination	Encryption
Root	/dev/sda1		8	General Purpose SSD (gp2)	100 / 3000	N/A	<input checked="" type="checkbox"/>	Not Encrypted

Add New Volume

Free tier eligible customers can get up to 30 GB of EBS General Purpose (SSD) or Magnetic storage. [Learn more](#) about free usage tier eligibility and usage restrictions.

35

Cancel Previous Review and Launch Next: Add Tags

Tutorial de AWS

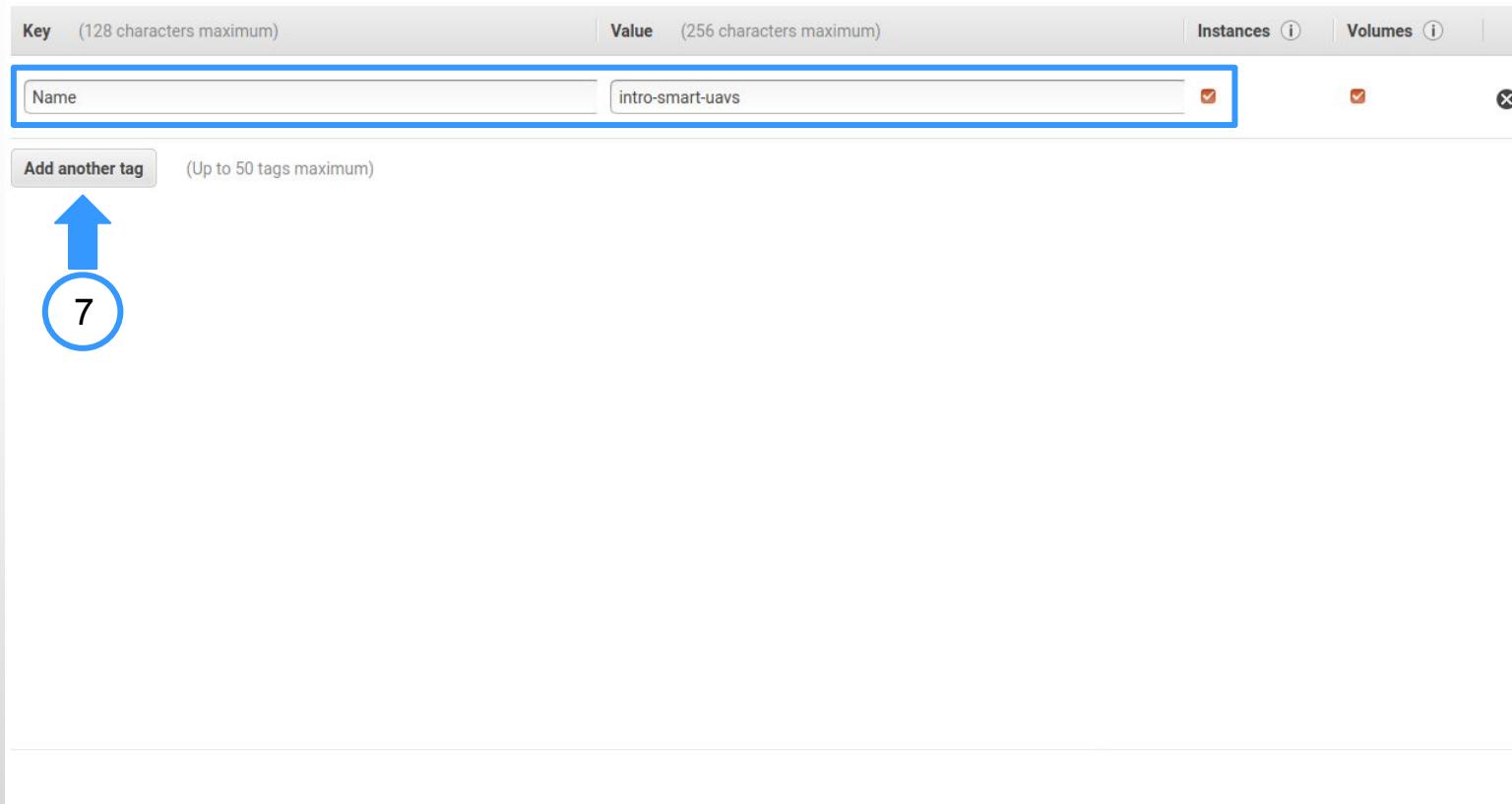
1. Choose AMI 2. Choose Instance Type 3. Configure Instance 4. Add Storage 5. Add Tags 6. Configure Security Group 7. Review

Step 5: Add Tags

A tag consists of a case-sensitive key-value pair. For example, you could define a tag with key = Name and value = Webserver.

A copy of a tag can be applied to volumes, instances or both.

Tags will be applied to all instances and volumes. [Learn more](#) about tagging your Amazon EC2 resources.



Key (128 characters maximum) Value (256 characters maximum) Instances ⓘ Volumes ⓘ

Name	intro-smart-uavs	<input checked="" type="checkbox"/>	<input type="checkbox"/>	X
------	------------------	-------------------------------------	--------------------------	---

Add another tag (Up to 50 tags maximum)

Cancel Previous Review and Launch Next: Configure Security Group

36

Tutorial de AWS

1. Choose AMI 2. Choose Instance Type 3. Configure Instance 4. Add Storage 5. Add Tags 6. Configure Security Group 7. Review

Step 6: Configure Security Group

A security group is a set of firewall rules that control the traffic for your instance. On this page, you can add rules to allow specific traffic to reach your instance. For example, if you want to set up a web server and allow Internet traffic to reach your instance, add rules that allow unrestricted access to the HTTP and HTTPS ports. You can create a new security group or select from an existing one below. [Learn more](#) about Amazon EC2 security groups.

Assign a security group: Create a new security group

Select an existing security group

Security group name:

Description:

Type	Protocol	Port Range	Source	Description
SSH	TCP	22	Custom 0.0.0.0/0	e.g. SSH for Admin Desktop

Add Rule

Warning
Rules with source of 0.0.0.0/0 allow all IP addresses to access your instance. We recommend setting security group rules to allow access from known IP addresses only.

37

Cancel Previous Review and Launch

9

Tutorial de AWS

1. Choose AMI 2. Choose Instance Type 3. Configure Instance 4. Add Storage 5. Add Tags 6. Configure Security Group 7. Review

Step 7: Review Instance Launch

Please review your instance launch details. You can go back to edit changes for each section. Click **Launch** to assign a key pair to your instance and complete the launch process.

AMI Details

Edit AMI

 Ubuntu Server 18.04 LTS (HVM), SSD Volume Type - ami-06b263d6ceff0b3dd

Free tier eligible Ubuntu Server 18.04 LTS (HVM),EBS General Purpose (SSD) Volume Type. Support available from Canonical (<http://www.ubuntu.com/cloud/services>).
Root Device Type: ebs Virtualization type: hvm

Instance Type

Edit instance type

Instance Type	ECUs	vCPUs	Memory (GiB)	Instance Storage (GB)	EBS-Optimized Available	Network Performance
t2.micro	Variable	1	1	EBS only	-	Low to Moderate

Security Groups

Edit security groups

Security group name

Description

Type 	Protocol 	Port Range 	Source 	Description 
SSH	TCP	22	0.0.0.0/0	

Instance Details

Edit instance details

Storage

Edit storage

Cancel **Previous** **Launch**

10

Tutorial de AWS

Select an existing key pair or create a new key pair X

A key pair consists of a **public key** that AWS stores, and a **private key file** that you store. Together, they allow you to connect to your instance securely. For Windows AMIs, the private key file is required to obtain the password used to log into your instance. For Linux AMIs, the private key file allows you to securely SSH into your instance.

Note: The selected key pair will be added to the set of keys authorized for this instance. Learn more about [removing existing key pairs from a public AMI](#).

Create a new key pair ▼

Key pair name

Download Key Pair

You have to download the **private key file** (*.pem file) before you can continue. **Store it in a secure and accessible location**. You will not be able to download the file again after it's created.

Cancel **Launch Instances**

11

12

13

Tutorial de AWS

The screenshot shows the AWS EC2 Dashboard. On the left, under the 'Instances' section, there is a blue circle around the number '14' next to the 'Instances' link. A large green arrow points from the top center towards the instance list. Another green arrow points downwards from the top center towards the 'Connect to your instance' dialog box. The dialog box contains instructions for connecting to an instance named 'intro-smart-u...'. It lists four steps: 1. Open an SSH client (using PuTTY), 2. Locate the private key file ('intro-smart-uavs.pem'), 3. Ensure the key is not publicly viewable (use 'chmod 400 intro-smart-uavs.pem'), and 4. Connect using Public DNS ('your_public_DNS'). It also includes an example command: `ssh -i "intro-smart-uavs.pem" ubuntu @your_public_DNS`. At the bottom, it says: 'Please note that in most cases the username above will be correct, however please ensure that you read your AMI usage instructions to ensure that the AMI owner has not changed the default AMI username.' A 'Close' button is at the bottom right of the dialog.

EC2 Dashboard [New](#)

Events [New](#)

Tags

Limits

Instances

Instances [14](#)

Instance Types

Launch Templates

Spot Requests

Savings Plans

Reserved Instances

Dedicated Hosts [New](#)

Scheduled Instances

Capacity Reservations

intro-smart-u... t2.micro us-east-1e running

Connect to your instance

Connection method A standalone SSH client [i](#)
 Session Manager [i](#)
 EC2 Instance Connect (browser-based SSH connection) [i](#)

To access your instance:

1. Open an SSH client. (find out how to [connect using PuTTY](#))
2. Locate your private key file (`intro-smart-uavs.pem`). The wizard automatically detects the key you used to launch the instance.
3. Your key must not be publicly viewable for SSH to work. Use this command if needed:
`chmod 400 intro-smart-uavs.pem`
4. Connect to your instance using its Public DNS:
`your_public_DNS`

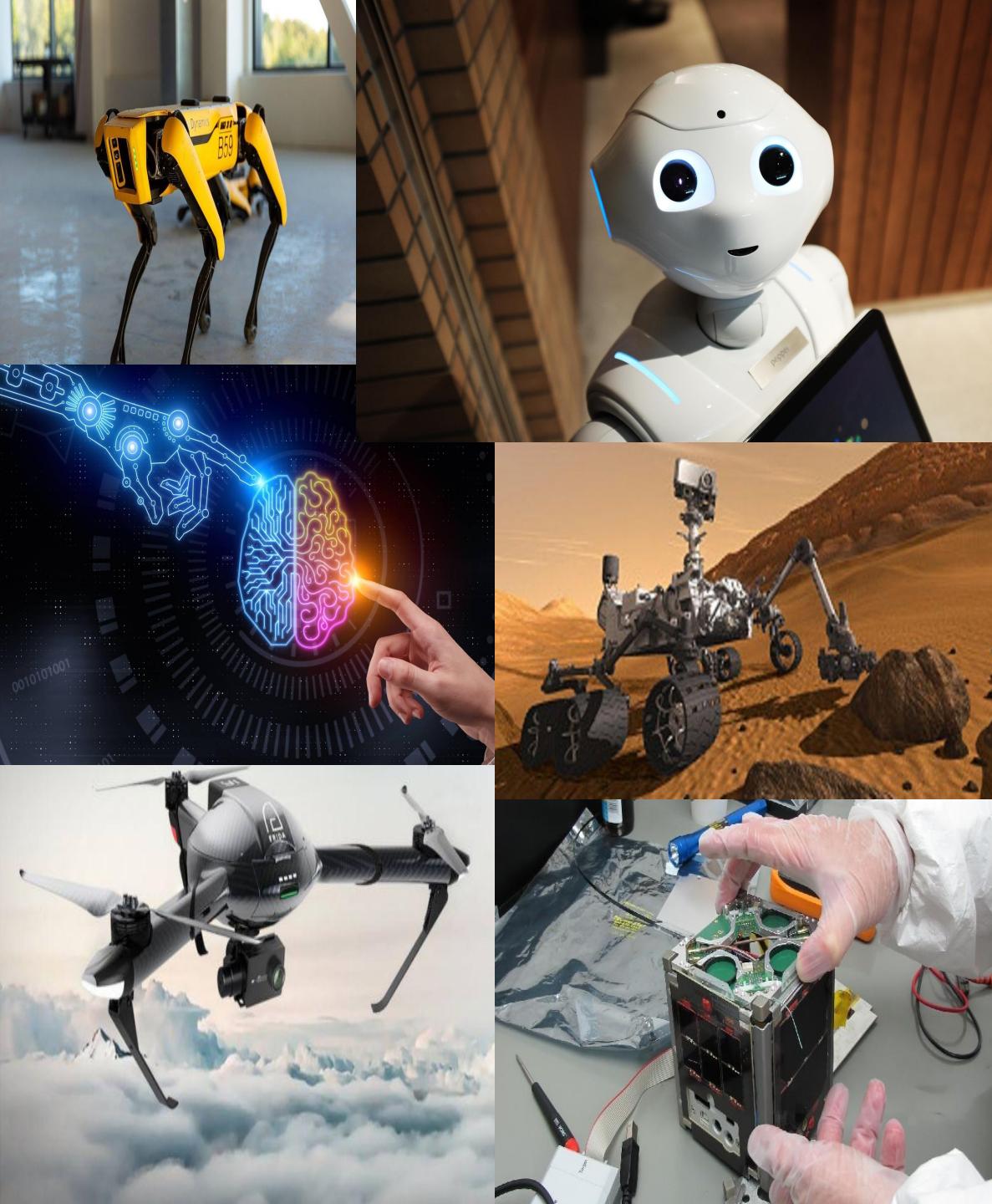
Example:

```
ssh -i "intro-smart-uavs.pem" ubuntu @your_public_DNS
```

Please note that in most cases the username above will be correct, however please ensure that you read your AMI usage instructions to ensure that the AMI owner has not changed the default AMI username.

If you need any assistance connecting to your instance, please see our [connection documentation](#).

[Close](#)



Para la siguiente sección

Para la siguiente sección

<https://github.com/leonardocfor/HPRC-Cluster-deployment>

42

Gracias

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