

AbadIA Using Reinforcement Learning to play and solve the abbey of crime

Juantomás García - Chief Envisioning Officer - Singular

Good Morning ING

Who I am

Juantomás García (0-)

- Chief Envisioning Officer @ Sngular
- GDEx2 (Google Developer Expert) for cloud and Machine Learning
- #AbadIA Cheer Leader

Others

- Co-Author of the first Spanish free software book “La Pastilla Roja”
- Former President of Hispalinux (Spanish Linux User Group)
- Organizer of the Machine Learning Spain and GDG Cloud Madrid.

What we will see

How #AbadIA started

“

My buddy Sebas told me:

Is it possible to create an AI that can learn to play
and solve the game?

It's a really crazy idea with an insane cult 8-bit
game, but I like it

”



The Game: The Abbey of the Crime

THE GAME

Do you know the game?

First 8-bit RPG in pseudo 3D (2.5D)

It was at 1987 and this game is a kind of legend in the video games world.

Based in Umberto Eco book “In the name of the rose”

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it can be done.



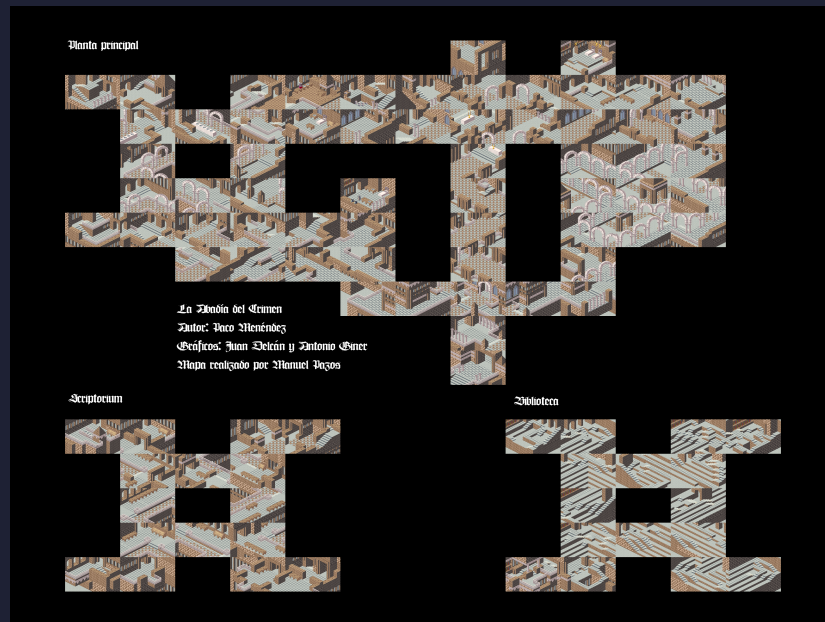
THE GAME

Do you know the game?

Size of the program: **87 Kb**

That include:

- Code
- Graphics
- Music
- Maps



THE GAME

Do you know the game?

The size of this avatar is: 87Kb



ABOUT THE GAME



Was programmed by **Paco Menéndez**
Graphics was designed by **Juan Delcán**



It was programmed using Z80
assembler for Amstrad CPC and
Sinclair Spectrum



The Plan



The plan:
Make an **AI**
that can learn
to play and
solve the game

What we had

The original executable

Original Code

Manuel Abadía disassembled the original Amstrad CPC game rom.

He documented all the code, marked the graphics, sounds, etc.

GitHub page: <https://bit.ly/2I9TMZk> 

```
8666 3E61: 3A 3A 30 ld a,($303A) ; a = altura de guillermo
8667 3E64: CD 73 24 call $2473 ; b = altura base de la pl
8668 3E67: 68 ld l,b
8669 3E68: FD 7E 04 ld a,(iy+$04) ; a = altura del personaje
8670 3E6B: CD 73 24 call $2473 ; b = altura base de la pl
8671 3E6E: 78 ld a,b
8672 3E6F: BD cp l
8673 3E70: C0 ret nz ; si los personaje
8674 3E71: FD 7E 01 ld a,(iy+$01) ; obtiene la orientación d
8675 3E74: 87 add a,a ; cada entrada ocu
8676 3E75: 87 add a,a
8677 3E76: 21 9F 3D ld hl,$3D9F ; indexa en la tabla valor
8678 3E79: CD 2D 16 call $162D ; hl = hl + a
8679 3E7C: 3A 38 30 ld a,($3038) ; obtiene la posición x de
8680 3E7F: 86 add a,(hl) ; le suma una constante se

hub.com/luzbel/vigasocosdl-la-abadia-... Search
```



```
[0x3c99] -> 0x21 (0xa1) -> contador del tiempo de respuesta de guillermo a l
[0x3f0e] -> 0x22 (0xa2) -> modifica la frase que muestra la rutina 0x3f0b
[0x3c96] -> 0x23 (0xa3) -> indica si están listos para empezar la 0x3c96/la cor
[0x2def] -> 0x24 (0xa4) -> objetos que tiene guillermo
[0x3c94] -> 0x25 (0xa5) -> indica que berengario le ha dicho al abad que gui
[0x2e04] -> 0x26 (0xa6) -> objetos que tiene el abad
[0x3c92] -> 0x27 (0xa7) -> personaje al que sigue la cámara si se está sin p
[0x2e0b] -> 0x28 (0xa8) -> objetos de berengario
[0x0840] -> 0x29 (0xa9) -> ??? no usado ???
[0x3c95] -> 0x2a (0xaa) -> indica el momento del día de las últimas acciones
[0x3ca1] -> 0x2b (0xab) -> indica que jorge o bernardo gui están activos par
```

Current Version

GAME EVOLUTION

VigasocoSDL

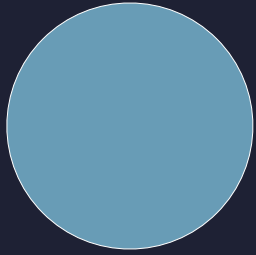
Manuel Abadía make a port to C++ of the game using his special video games framework: Vigasoco

Sebastian Blanes fork the project to use SDL. VigasocoSDL was born. Now the abbey can be played in chrome, PS3, CC, linux, MacOS, Windows, etc.



How difficult is the Challenge

HOW DIFFICULT IS THE CHALLENGE?



Number of
atoms in our
universe?

HOW DIFFICULT IS THE CHALLENGE?



10^{80}

Number of
atoms in our
universe
(Hawking said
there are more
than one
universe!!)

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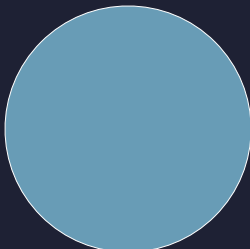
it can be done.

HOW DIFFICULT IS THE CHALLENGE?



10^{80}

Number of
atoms in our
universe
(Hawking said
there are more
than one
universe!!)



Number of
chess legal
moves?

s|ngular

it can be done.

HOW DIFFICULT IS THE CHALLENGE?



10^{80}

Number of
atoms in our
universe
(Hawking said
there are more
than one
universe!!)



10^{120}

Number of
chess legal
moves

s|ngular

it can be done.

HOW DIFFICULT IS THE CHALLENGE?



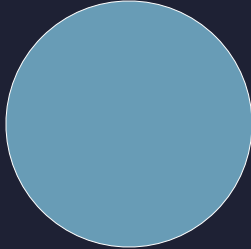
10^{80}

Number of
atoms in our
universe
(Hawking said
there are more
than one
universe!!)



10^{120}

Number of
chess legal
moves



Number of GO
legal moves?

s|ngular

it can be done.

HOW DIFFICULT IS THE CHALLENGE?

10^{80}

Number of
atoms in our
universe
(Hawking said
there are more
than one
universe!!)

10^{120}

Number of
chess legal
moves

10^{761}

Number of GO
legal moves

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it can be done.

HOW DIFFICULT IS THE CHALLENGE?



10^{80}

Number of
atoms in our
universe
(Hawking said
there are more
than one
universe!!)



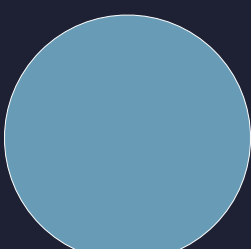
10^{120}

Number of
chess legal
moves



10^{761}

Number of GO
legal moves



AbadiA moves
needs to solve
the game?

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it can be done.

HOW DIFFICULT IS THE CHALLENGE?

10^{80}

Number of
atoms in our
universe
(Hawking said
there are more
than one
universe!!)

10^{120}

Number of
chess legal
moves

10^{761}

Number of GO
legal moves

10^{10k}

AbadIA legal
moves where N
is the depth of
the game you
wish to check.
For N= 10000 is
 10^{10000}

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it can be done.

**The AI & Human Players only know if
the game is solved after 10.000 actions.**

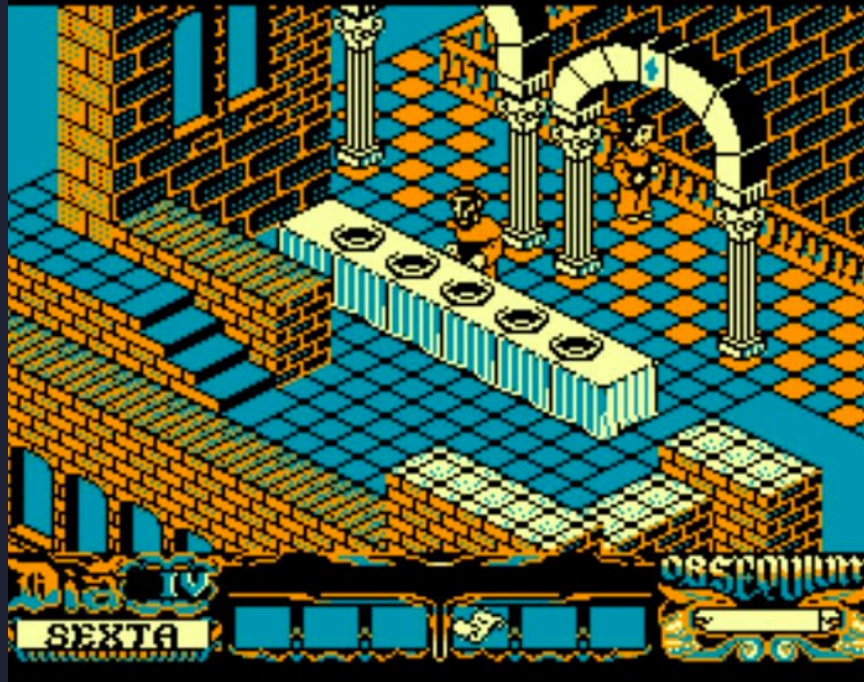
HOW DIFFICULT IS THE CHALLENGE?



HOW DIFFICULT IS THE CHALLENGE?



HOW DIFFICULT IS THE CHALLENGE?



HOW DIFFICULT IS THE CHALLENGE?



First Steps

Interacting with the game

AI TOOLS

You will need lots of tools
before starting to create
the AI

1

How to interact with the
game.

2

How you get and save the
game information.

3

How to play millions of
games.

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it can be done.

HOW TO INTERACT



You will need send actions, get game info, reset it, etc.

How to interact with the game??

it can be done.

HOW TO INTERACT



It can be done.

First version with too Beers



HOW TO INTERACT



You may use a fake keyboard driver, a unix pipe, a socket, but

do you know what is the really cool way to do this:

it can be done.

HOW TO INTERACT



An embedded web
server inside the
game !!!!

it can be done.

HOW TO INTERACT WITH THE GAME

Now we have a REST based API.
Two way communication.



We send actions

- Moves
- Resets
- Save/Load states



We got information

- State dumps
- Actions
- Checkpoints

AS EASY AS

```
curl -X POST http://localhost:4477/abadIA/game/current/actions/RIGHT
```

or

```
curl -X GET http://localhost:4477/abadIA/game/current -H 'accept: application/json'
```

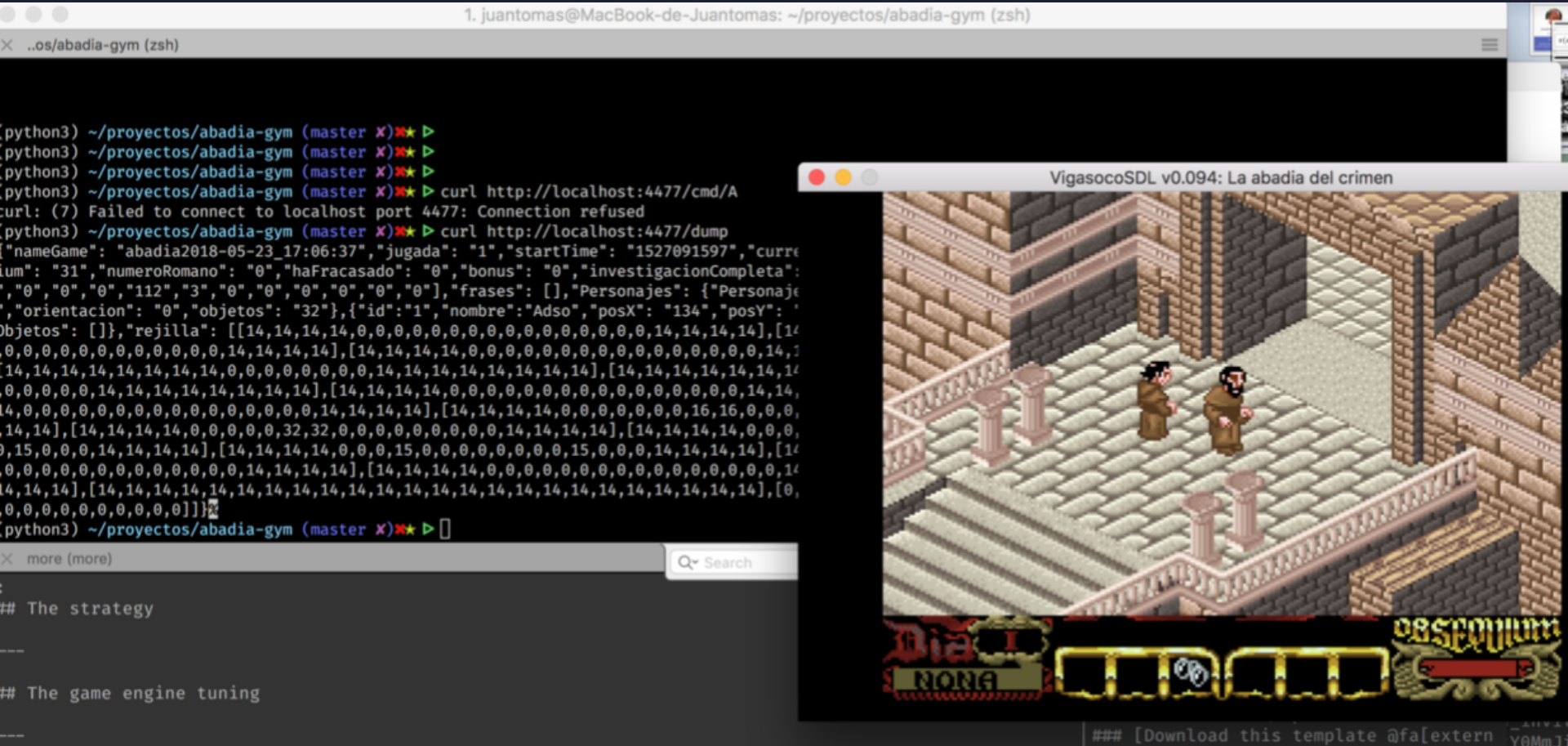
or

Use python **request** library

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it can be done.

Demo game engine + web server + curl



Gathering Information

HOW TO SCALE IT

At the beginning a laptop was enough.
But very soon you need more CPU/
GPU.

Then product like Google Cloud is
your best ally.

We had created a few Dockers, so
now we can execute lots of instances
of the game in parallel.

note: If we use Google Cloud services
like GKE, we can launch hundred of
games in parallel.

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it can be done.



GATHERING INFORMATION

We recollect a lot of information

- Game Info (timestamps, rewards, bonus, obsequium)
- Games moves (state, action, reward, new_state)
- Checkpoints (to restore the game at an interesting time)
- ML Models (for recovering good models or just make a benchmark)

```
(python3) ~/proyectos/abadia-gym (master ✖)*★▶ curl http://localhost:4477/dump  
{"nameGame": "abadia2018-05-23_17:06:37","jugada": "1","startTime": "1527091597","currentGame": "1527091626","  
ium": "31","numeroRomano": "0","haFracasado": "0","bonus": "0","investigacionCompleta": "0","porcentaje": "0",  
,"0","0","0","112","3","0","0","0","0","0","0"],frases": [],Personajes": {"Personaje": [{"id":"0","nombre":  
,"orientacion": "0","objetos": "32"}, {"id":"1","nombre":"Adso","posX": "134","posY": "169","altura": "0","ori  
Objetos": []},rejilla": [[14,14,14,14,0,0,0,0,0,0,0,0,0,0,0,0,0,0,14,14,14,14],[14,14,14,14,0,0,0,0,0,0,0,  
,0,0,0,0,0,0,0,0,0,0,0,0,14,14,14,14],[14,14,14,14,0,0,0,0,0,0,0,0,0,0,0,0,0,0,14,14,14,14],[14,14,14,14,1  
[14,14,14,14,14,14,14,14,0,0,0,0,0,0,0,0,14,14,14,14,14,14,14], [14,14,14,14,14,14,14,14,0,0,0,0,0,0,0,0,14,  
,0,0,0,0,0,14,14,14,14,14,14,14], [14,14,14,14,0,0,0,0,0,0,0,0,0,0,0,0,0,0,14,14,14,14], [14,14,14,14,0,0  
14,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,14,14,14,14], [14,14,14,14,0,0,0,0,0,0,0,0,0,16,16,0,0,0,0,0,0,14,14,14,14], [1  
,14,14], [14,14,14,14,0,0,0,0,0,0,32,32,0,0,0,0,0,0,0,0,0,14,14,14,14], [14,14,14,14,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
```

GATHERING INFORMATION

It takes a lot of time to get all the parts working all together.

Building tools, testing every piece, every option.

Sometimes I feel like I was Mario Bros.



Playground for the game

PLAYGROUND FOR PLAYING

One the most frequently used tool is OpenAI Gym



So we design an AbadIA gym



The gym is a standard place to train and interact with Reinforcement Learning agents.



In our project the gym is framework to wrap the game engine.



SO WE HAVE

A game
server with
REST API

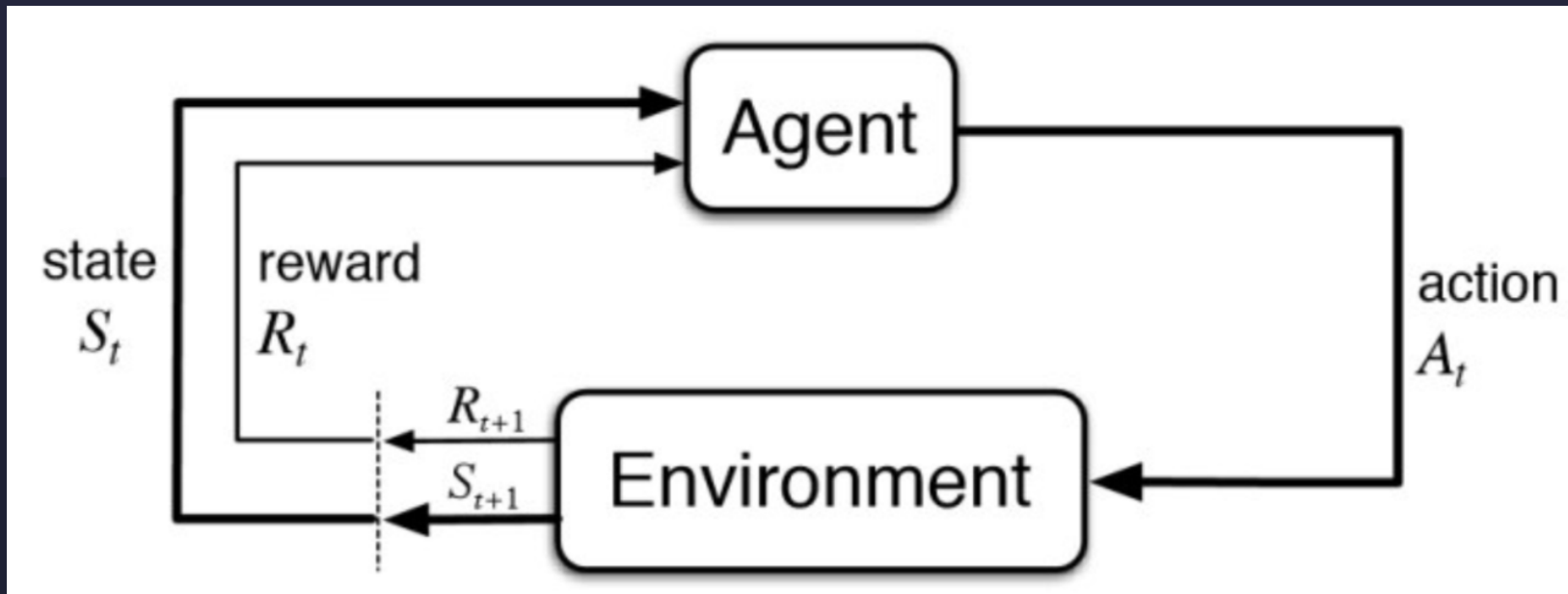
An openAI
Gym

Enough
hardware
resources

An small intro to Reinforcement Learning

CREATE A RL AGENT

A RL agent is a program that interacts with an environment, in our case a OpenAI gym for AbadIA, and learn from observations and rewards.



And that looks like:



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it can be done.

Demo Time + Video

```
./loopagentv4.sh (python3)
episode(0:78) A(1)XYOP 142,172,1,23 → 142,172 r:-0.1 tr:-7.8
episode(0:79) A(2)XYOP 142,172,1,23 → 142,172 r:-0.1 tr:-7.9
episode(0:80) A(1)XYOP 142,172,1,23 → 142,172 r:-0.1 tr:-8.0
guillermo 142,172 Adso 142,169
-----+-----+
.....#      #.....|###      ###| e e e e
.....#      #.....|###      ###| e e e e
.....###     ###     |###      ###| e e e e
.....#      #.....|###      ###| e e e e
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.....#      #.....|#####      #####| e e e e e e e e
.....#      A.....|#####      #####| e e e e e e e e
.....#      #.....|###      ###| e e e e
.....# ##     ##     |###      ###| e e e e
.....# ##     ##G   |###      ###| e e e e
.....# ##     ##     |###      ###| e e e e
.....# ##     ##     |###      PP ###| e e e e
.....# ##     ##     |###      PP ###| e e e e
.....#####.....|###      ###| e e e e
.....|#####      #      #PP ###| e e e e f
.....|#####      #      #PP ###| e e e e f
.....|#####      #      #      ###| e e e e f
.....|#####      ###      ###| e e e e
.....|#####      ###      ###| e e e e
-----+-----+
episode(0:81) A(1)XYOP 142,172,1,23 → 142,172 r:-0.1 tr:-8.1
episode(0:82) A(1)XYOP 142,172,1,23 → 142,171 r:-0.1 tr:-8.2
episode(0:83) A(3)XYOP 142,171,1,23 → 142,171 r:-0.1 tr:-8.3
episode(0:84) A(2)XYOP 142,171,1,23 → 142,171 r:-0.1 tr:-8.4
episode(0:85) A(6)XYOP 142,171,1,23 → 142,171 r:-0.1 tr:-8.5
```



AbadIA RL Strategies

REINFORCEMENT LEARNING STRATEGIES

Random

Q*tables

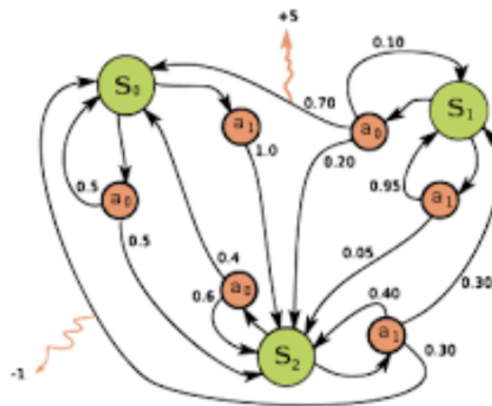
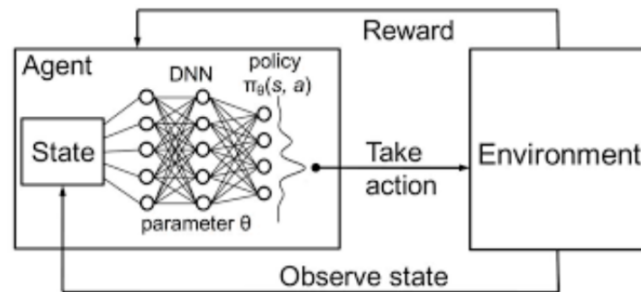
Q*Learning

DQN

CNN

A3C

MiniGames



Simple Neural Network Model

```
def create_model(self):
    self.env.logging.info("Creating a new model v4")
    model = Sequential()
    state_shape = self.env.observation_space.shape
    model.add(Dense(24, input_dim=state_shape[0], activation="relu"))
    model.add(Dense(48, activation="relu"))
    model.add(Dense(24, activation="relu"))
    model.add(Dense(self.env.action_space.n))
    model.compile(loss="mean_squared_error",
                  optimizer=Adam(lr=self.learning_rate))
    return model

def load_model(self, name):
    self.env.logging.info("Loading a model from: ({}).format(name))
    return load_model(name)
```

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it can be done.

AbadIA

Architecture Parts

Game Engine & Agent Containers

First we create the first 2 containers for:

- AbadIA Game Engine
- AbadIA Agent



K8S small cluster

Cluster Features:

- Preemptible
- n1-standard-1 (7€ month)

preemptible (5 nodes, version 1.10.11-gke.1)



Name	preemptible	
Current size	5	
Node version	1.10.11-gke.1	Upgrade available
Node image	Container-Optimized OS (cos)	Change
Machine type	n1-standard-1 (1 vCPU, 3.75 GB memory)	
Total cores	5 vCPUs	
Total memory	18.75 GB	
Automatic node upgrades	Disabled	
Automatic node repair	Enabled	
Autoscaling	On	
Minimum size	0	
Maximum size	10	
GKE Metadata Server	Disabled	
Preemptible nodes	Enabled	
Boot disk type	Standard persistent disk	

Gathering Information

Game info pipeline

GCS BigQuery Import



Cloud Storage



Cloud
Functions

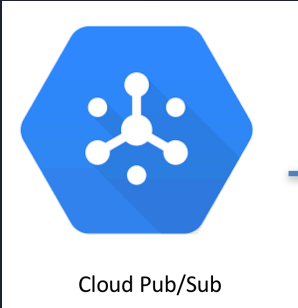


BigQuery

AutoGaming

Games Checkpoints

Game Generator



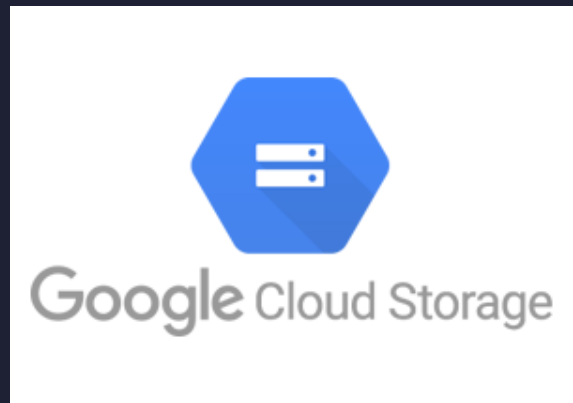
Cloud Pub/Sub

[illegible]



Storage of the info:

- Game Information
- Actions - States - Rewards
- Snapshots
- Models





How to Integrate the all the information:

- Serverless
- Easy
- Fast





Advanced and Massive Analytics:

- Game Information
- Actions - States - Rewards
- Snapshots
- Even some ML (LRs)



Google
BigQuery

Notebooks



How to manipulate and visualize
with Datalabs or Colab:

- Notebooks
- Managed
- Integrated with Google Drive / Bigquery

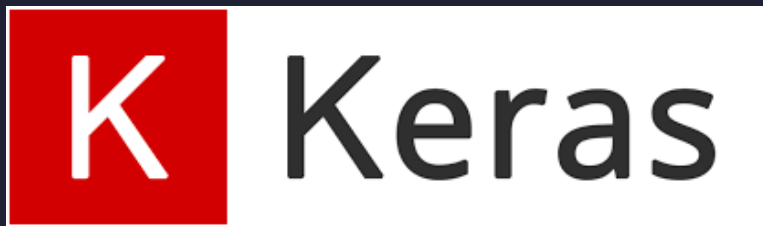


AI Frameworks



How to training and serve
models at scale:

- Tensorflow / Keras
- ML Engine
- AutoML



Orchestrating



How to execute
hundreds of instances:

- Kubernetes
- Google Containers



**Show me the code
(how to collaborate)**

HOW TO COLLABORATE

GitHub
LaAbadlAdelCrimen

abadia-gym

A simple stochastic OpenAI environment for training RL agents

Python 1 Updated 2 days ago

abadIA-frontends

Some frontend to interact with the game engine and/or visualize information from.

HTML MIT Updated 5 days ago

LaAbadlAdelCrimen.github.io

gh-pages y wiki globales de la organización y el proyecto abadIA

Updated 24 days ago

VigasocoSDL

Forked from luzbel/VigasocoSDL

Versión headless y personalizada de VigasocoSDL para interactuar con la IA que intentará resolver el juego.

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it can be done.

<https://github.com/LaAbadlAdelCrimen>



**Join US, we'll share
the glory with you**

Slack AbadIA

JOIN US!!!!

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it can be done.

AbadIA

Juantomas

Ir a...

Todos los hilos

Canales

aleatorio

bootstrap

general

tomasfalsas

Mensajes directos

slackbot

Juantomas (tú)

Adrián Vázquez

agraboso

albarji

Asier Aranda

#tomasfalsas

Hoy


@Juantomas

 se lo pasaba pipa con el antiguo /reset y seguía dándole una y otra vez

VigasocoSDL

 11:18

ha subido y comentado esta imagen: [image.png](#)



@Juantomas

 abusando del bug del /reset para emular al camarote de los hermanos Marx

Questions?

twitter: @juantomas

juantomas.garcia@sngular.com

We're Hiring, Sngular People

Selfie Time: If you like the talk just smile while I take the selfie ;-)

This talk have a free questions lifetime warranty: If you have any questions or concerns about this talk, feel free to contact me anytime.

Thank You!!