e to Reinforcement Learning & its

/BLOG/CATEGORY/MACHINE-LEARNING/) PYTHON

THON-2/)

Introduction

One of the most fundamental question for scientists across the globe has been – "How to learn a new skill?". The desire to understand the answer is obvious – if we can understand this, we can enable human species to do things we might not have thought before. Alternately, we can train machines to do more "human" tasks and create true artificial intelligence.

While we don't have a complete answer to the above question yet, there are a few things which are clear. Irrespective of the skill, we first learn by interacting with the environment. Whether we are learning to drive a car or whether it an infant learning to walk, the learning is based on the interaction with the environment. Learning from interaction is the foundational underlying concept for all theories

earning – a goal-oriented learning based on interaction with
said to be the hope of true artificial intelligence. And it is
t Reinforcement Learning possesses is immense.

ly, producing wide variety of learning algorithms for different applications. Hence it is important to be familiar with the techniques of reinforcement learning. If you are not familiar with reinforcement learning, I will suggest you to go through my previous article (https://datahack.analyticsvidhya.com/contest/lord-of-the-machines/?utm_source=blog_side_bottom).

/2016/12/getting-ready-for-ai-based-gaming-agents-
-learning-platforms/) on introduction to reinforcement
ns.

erlying fundamentals, proceed with this article. By the end of
erstanding of Reinforcement Learning and its practical

P.S. *For implementation, we assume that you have basic knowledge of Python. If you don't know Python, you should first go through this tutorial (https://www.analyticsvidhya.com/blog/2016/01/complete-tutorial-learn-data-science-python-scratch-2/)*

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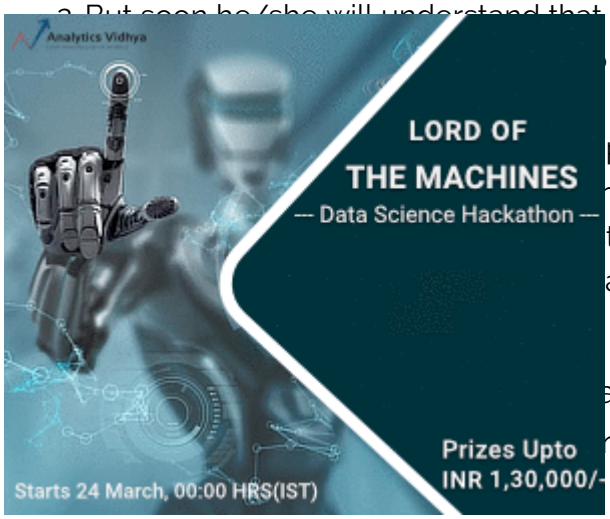
...ent Learning Problem

...to do and how to map situations to actions. The end result is ... The learner is not told which action to take, but instead must ...mum reward. Let's understand this with a simple example

Consider an example of a child learning to walk.

Here are the steps a child will take while learning to walk:

1. The first thing the child will observe is to **notice** how you are walking. You use two legs, taking a step at a time in order to walk. Grasping this concept, the child tries to replicate you.
2. But soon he/she will understand that before walking, the child has to stand up! This is a challenge that now the child **attempts to get up,** staggering and slipping but



pe up with. Standing up was easy, but to **remain still** is another nd support, the child manages to stay standing.

tart walking. But it's easy to say than actually do it. There are so alancing the body weight, deciding which foot to put next and

ally is a bit challenging to get up and start walking, but you not fazed by the task. But now you can get the gist of how

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Let's formalize the above example, the "problem statement" of the example is **to walk**, where **the** e **environment (which is the surface on which it walks)** by tries to go from one **state (viz each step he/she takes)** to **ay chocolate)** when he/she accomplishes a **submodule of** will not receive any chocolate **(a.k.a negative reward)** when ified description of a reinforcement learning problem.

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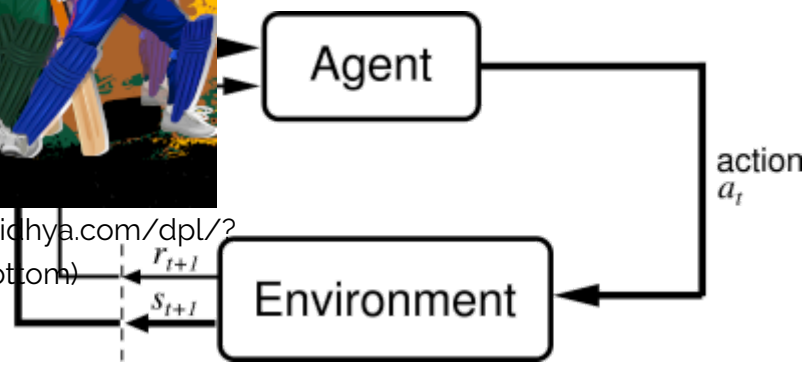
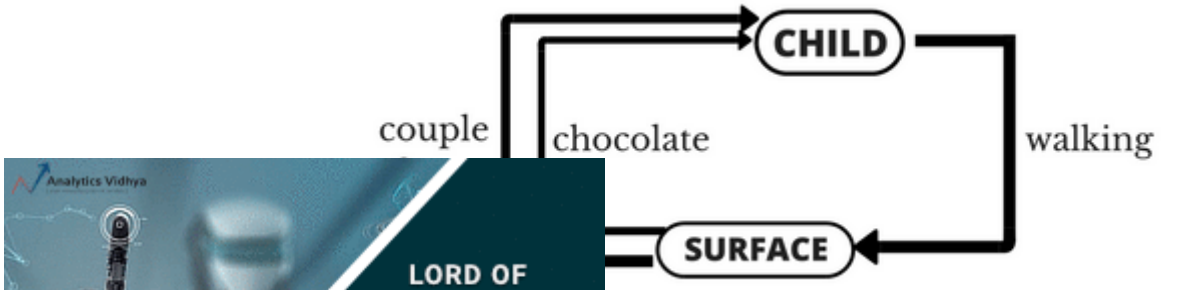


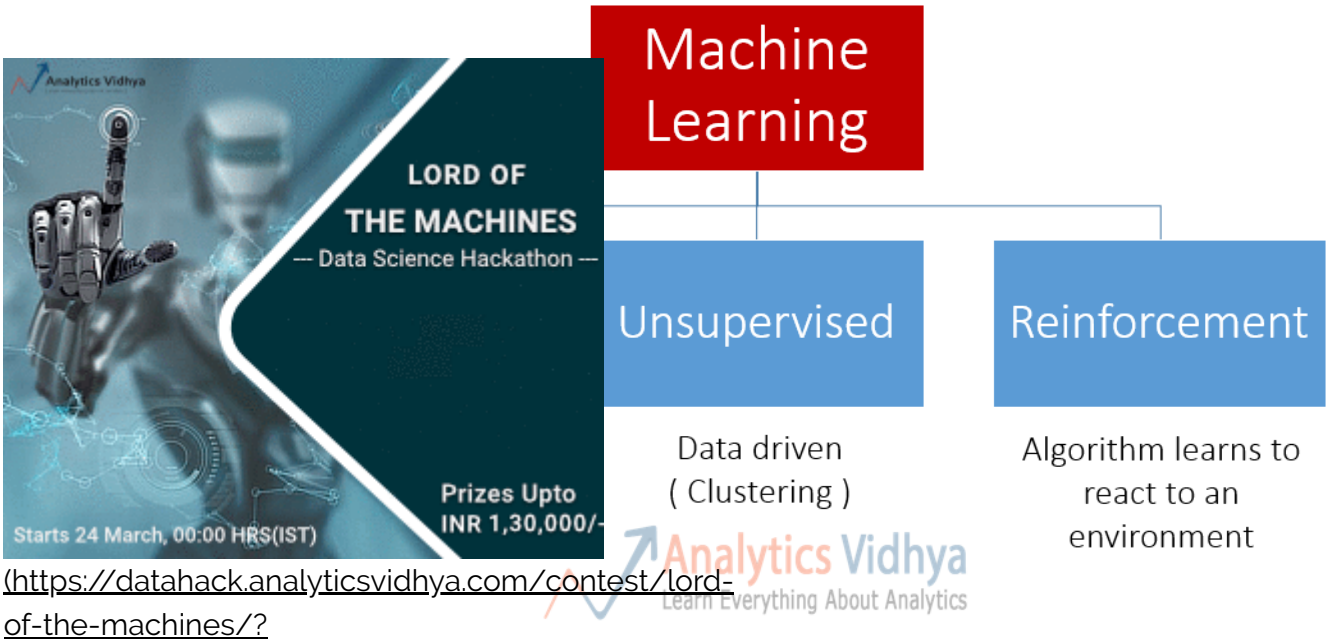


forcement Learning.

t learning

2. Comparison with other machine learning methodologies

Reinforcement Learning belongs to a bigger class of machine learning algorithm. Below is the description of types of machine learning methodologies.



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others:

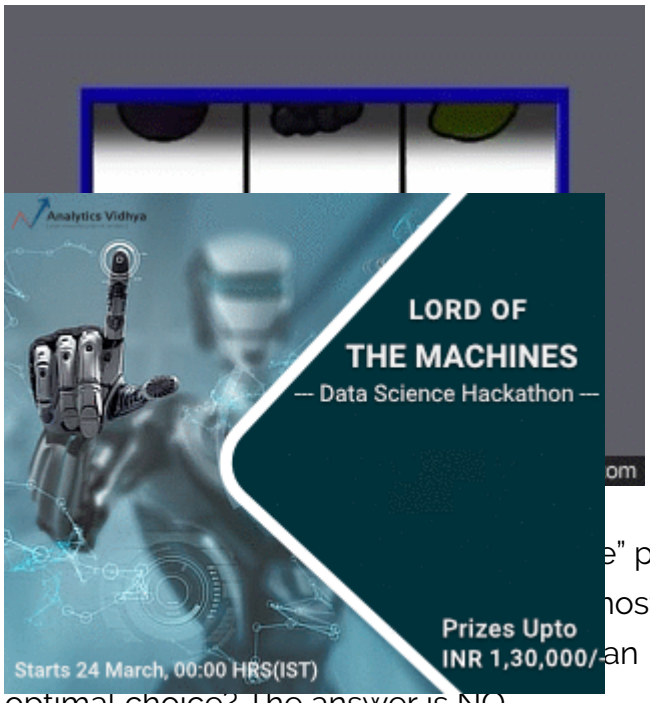
ng: In supervised learning, there's an external "supervisor", which nd who shares it with the agent to complete the task. But there e so many combinations of subtasks that the agent can perform ting a "supervisor" is almost impractical. For example, in a chess f moves that can be played. So creating a knowledge base that these problems, it is more feasible to learn from one's own rom them. This is the main difference that can be said of reinforcement learning and supervised learning. In both supervised and reinforcement learning, there is a mapping between input and output. But in reinforcement learning, there is a reward function which acts as a feedback to the agent as opposed to supervised learning.

- **Unsupervised vs Reinforcement Leanring**: In reinforcement learning, there's a mapping from input to output which is not present in unsupervised learning. In unsupervised learning, the main task is to find the underlying patterns rather than the mapping. For example, if the task is to suggest a news article to a user, an unsupervised learning algorithm will look at similar articles which the person has previously read and suggest anyone from them. Whereas a reinforcement learning algorithm will get constant feedback from the user by suggesting few news articles and then build a "knowledge graph" of which articles will the person like.

There is also a fourth type of machine learning methodology called **semi-supervised** learning, which is essentially a combination of supervised and unsupervised learning. It differs from reinforcement learning as similar to supervised and semi-supervised learning has direct mapping whereas reinforcement does not.

inforcement Learning Problems

ment learning problem, let's go through a classic example of ti-Armed Bandit Problem. First, we would understand the exploitation and then go on to define the framework to solve



Suppose you have many slot machines (https://en.wikipedia.org/wiki/Slot_machine) with random payouts. A slot machine would look something like this.

Now you want to do is get the maximum bonus from the slot machines as fast as possible. What would you do?

One naive approach might be to select only one slot machine and keep pulling the lever all day long. e" payouts. With this approach, you might hit the jackpot (with ost of the time you may just be sitting in front of the slot an be defined as a **pure exploitation** approach. Is this the optimal choice? The answer is NO.

d pull a lever of each & every slot machine and pray to God ckpot. This is another naive approach which would keep you u sub-optimal payouts. Formally this approach is a **pure**

l, and we have to find a proper balance between them to get **ration vs exploitation dilemma** of reinforcement learning.

for reinforcement learning problem and then list down the m.

Markov Decision Process:

The mathematical framework for defining a solution in reinforcement learning scenario is called **Markov Decision Process**. This can be designed as:

- Set of states, S
- Set of actions, A
- Reward function, R
- Policy, π
- Value, V

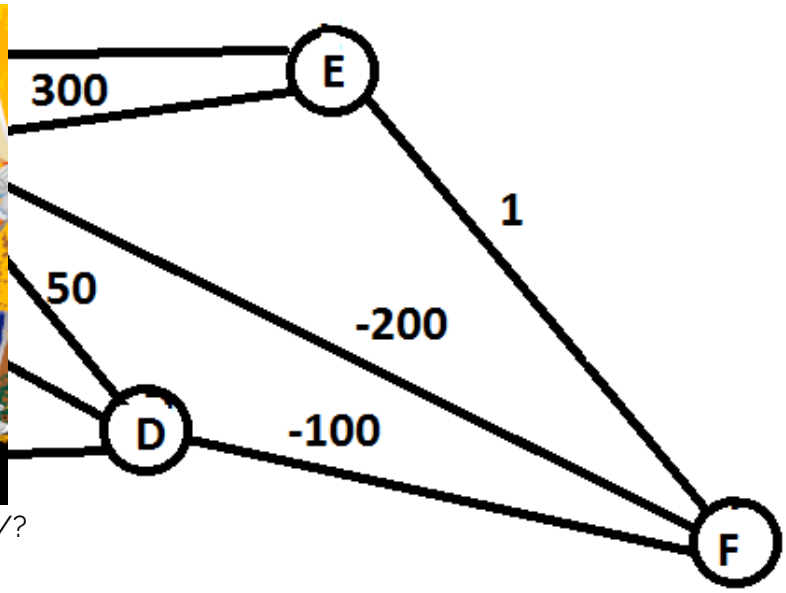
We have to take an action (A) to transition from our start state to our end state (*S*). In return getting rewards (R) for each action we take. Our actions can lead to a positive reward or negative reward.

The set of actions we took define our policy (π) and the rewards we get in return defines our value (V).

by choosing the correct policy. So we have to maximize

$$E(r_t \mid \pi, s_t)$$

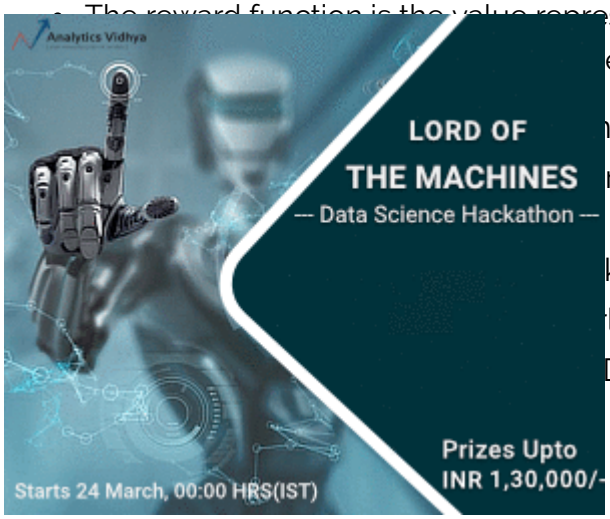
e to make it clear.



This is a representation of a traveling salesman problem. The task is to go from place A to place F, with as low cost as possible. The numbers at each edge between two places represent the cost taken to traverse the distance. The negative cost are actually some earnings on the way. We define Value is the total cumulative reward when you do a policy.

Here,

- The set of states are the nodes, viz {A, B, C, D, E, F}
- The action to take is to go from one place to other, viz {A -> B, C -> D, etc}
- The reward function is the value represented by edge, i.e. cost
- e task, viz {A -> C -> F}



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nly visible path is your next destination and anything beyond rvable space).

ke the best possible next step, which is going from {A -> D} ly now you are at place D and want to go to place F, you can D -> F} has the lowest cost and hence we take that path.

F} and our Value is -120.

Congratulations! You have just implemented a reinforcement learning algorithm. This algorithm is known as **epsilon greedy**, which is literally a greedy approach to solving the problem. Now if you (the ce F again, you would always choose the same policy.

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policy belong to i.e. (pure exploration vs pure exploitation)?

optimal policy. We would have to "explore" a little bit to find we took here is policy based learning, and our task is to find e policies. There are different ways to solve this problem, I'll

- **Policy based,** where our focus is to find optimal policy
- **Value based,** where our focus is to find optimal value, i.e. cumulative reward
- **Action based,** where our focus is on what optimal actions to take at each step

I would try to cover in-depth reinforcement learning algorithms in future articles. Till then, you can refer to this paper on a survey of reinforcement learning algorithms. (https://www.jair.org/media/301/live-301-1562-jair.pdf)

4. An implementation of Reinforcement Learning

We will be using Deep Q-learning algorithm. Q-learning is a policy based learning algorithm with the function approximator as a neural network. This algorithm was used by Google to beat humans at

ed on one of the action selection policies (eg. epsilon greedy)
rd **'r'** as well as the new state **'s'**.
he observed reward and the maximum reward possible for the
rding to the formula and parameters described above.
eat the process until a terminal state is reached.

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e summarized as follows:

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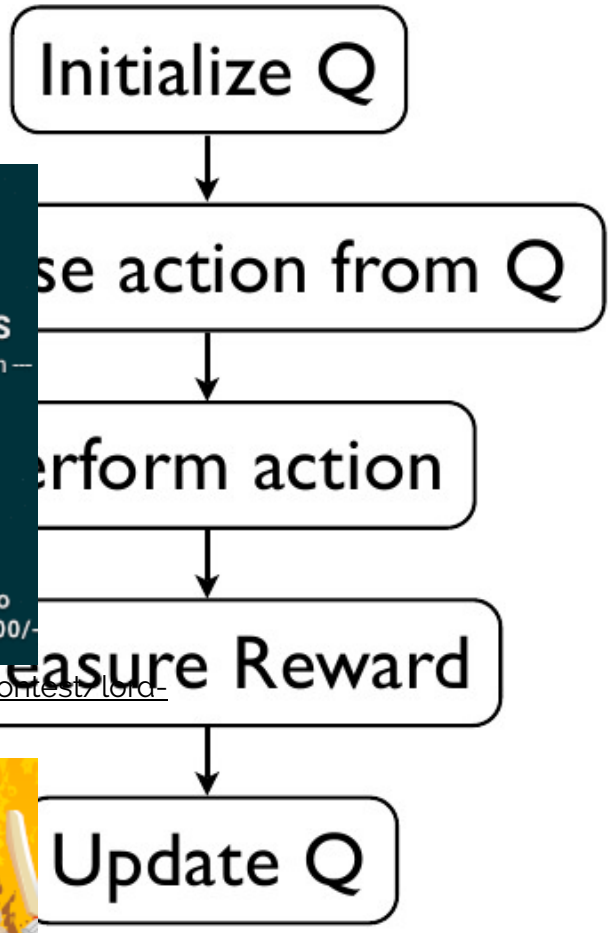

s then go on to coding up a solution

ld pick a stick and try to balance it on one hand. Me and my
ere whoever balances it for more time would get a “reward”,

Here’s a short video description of a real cart-pole system

Cart-Pole Swing-up

(https://datahack.analyticsvidhya.com/contest/lord-of-the-machines/?

l a few things,

nds:

```
pert/keras-rl.git
```

```
python setup.py install
```

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Step 2: Install dependencies for CartPole environment

Assuming you have pip installed, you need to install the following libraries

```
pip install h5py
pip install gym
```

Step 3: lets get started!

First we have to import modules that are necessary


```
on, Flatten
from rl.policy import EpsGreedyQPolicy
from rl.memory import SequentialMemory
```


```
mber of actions available in the Cartpole problem
nb_actions = env.action_space.n
```

Next, we build a very simple single hidden layer neural network model.

```
model = Sequential()
model.add(Flatten(input_shape=(1,) + env.observation_space.shape))
model.add(Dense(16))
```

(https://datahack.analyticsvidhya.com/contest/lord-of-the-machines/?

```
memory = SequentialMemory(limit=50000, window_length=1)
dqn = DQNAgent(model=model, nb_actions=nb_actions, memory=memory, nb_steps_warmup=10,
])
We visualize the training here for show, but this slows dow
ue, verbose=2)
```

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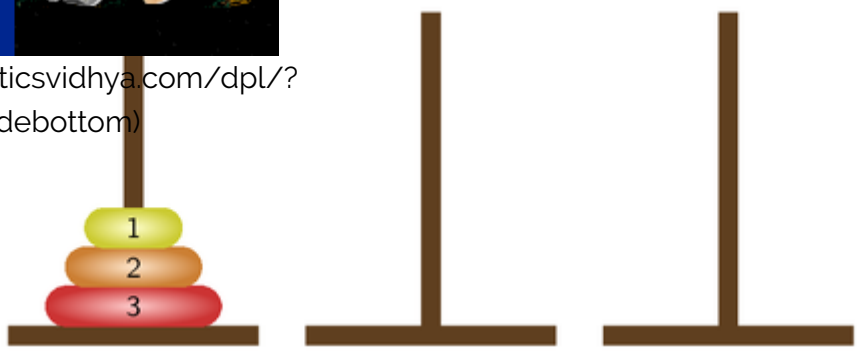
```
dqn.test(env, nb_episodes=5, visualize=True)
```

This will be the output of our model:

ntation of Re-inforcement learning, let us start moving
the complexity little bit every time.



For those, who don't know the game – it was invented in 1883 and consists of 3 rods along with a number of sequentially-sized disks (3 in the figure above) starting at the leftmost rod. The objective is to move all the disks from the leftmost rod to the rightmost rod **with the least number of moves**. (You

can read more on wikipedia (https://en.wikipedia.org/wiki/Tower_of_Hanoi))

If we have to map this problem, let us start with states:

rod (in order 1, 2 and 3 from top to bottom)
d (in order 1, 2 and 3 from top to bottom)

ks in a d	(23) disks in a rod	(12) disks in a rod
(123)** 321	(13)2*	(23)1*	(12)3*
(123)* 312	(13)*2	(23)*1	(12)*3
		1(23)*	3(12)*
		*(23)1	*(12)3
		1*(23)	3*(12)
		*1(23)	*3(12)

eftmost rod (top to bottom) 3 in middle rod and * denotes an

Numerical Reward:

Since we want to solve the problem in least number of steps, we can attach a reward of -1 to each step.

Policy:

Now, without going in any technical details, we can map possible transitions between above states. For example (123)** -> (23)1* with reward -1. It can also go to (23)*1

If you can now see a parallel, each of these 27 states mentioned above can represent a graph similar we can find the most optimal solutions by experimenting

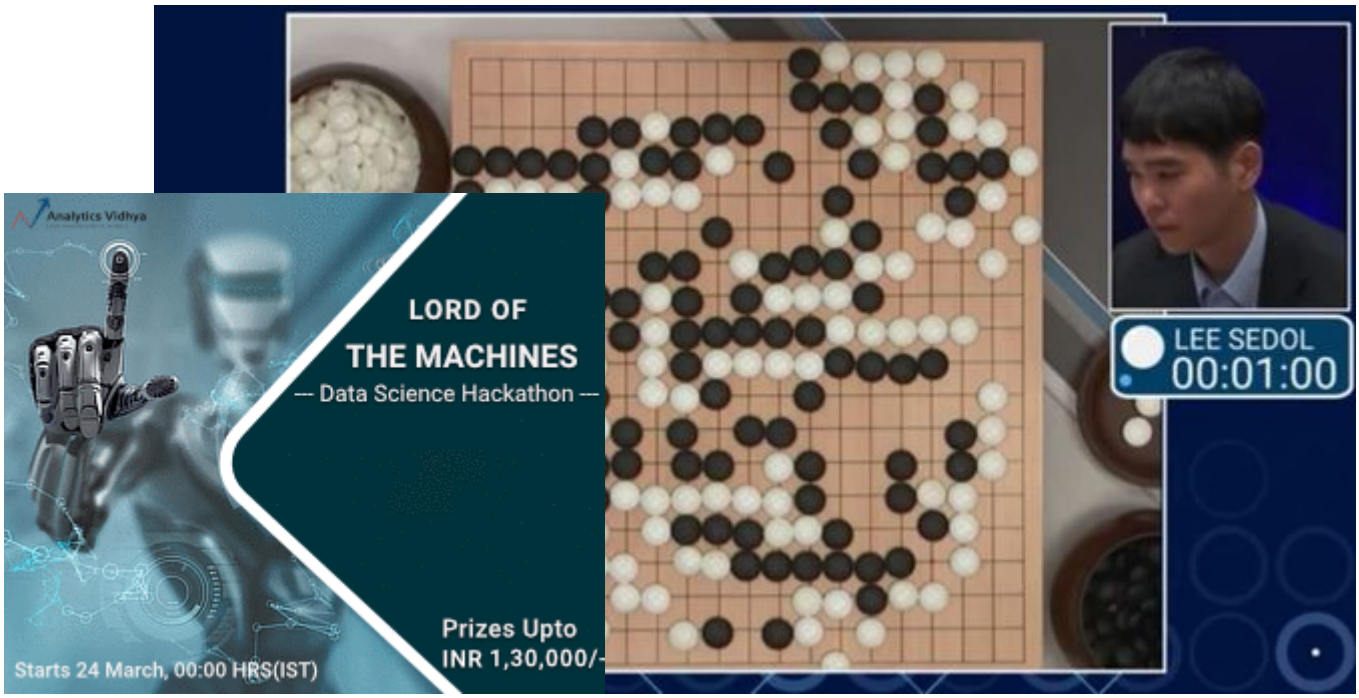
uld want you to do this by yourself. Follow the same line of good.

e end state. Next, define all possible states and their transitions along with reward and policy. Finally, you should be able to create a solution for solving a Rubix cube using the same approach.

ncements in Reinforcement Learning

of this Rubix Cube is many folds higher than the Towers of possible number of options have increased in number. Now, a game of Chess and then in Go! Google DeepMind recently created a deep reinforcement learning algorithm which defeated Lee Sedol!

With the recent success in Deep Learning, now the focus is slowly shifting to applying deep learning to solve reinforcement learning problems. The news recently has been flooded with the defeat of Lee Sedol by a deep reinforcement learning algorithm developed by Google DeepMind. Similar breakthroughs are being seen in video games, where the algorithms developed are achieving human-level accuracy and beyond. Research is still at par, with both industrial and academic masterminds working together to accomplish the goal of building better self-learning robots



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Source: https://www.tomshardware.com/news/alphago-defeats-sedol-second-time,31377.html)

applied are as follows:

tion

and with the current craze of deep learning applied to reinforcement learning, there certainly are breakthroughs incoming!

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Here is one of the recent news:

7. Additional Resources

I hope now you have in-depth understanding of how reinforcement learning works. Here are some additional resources to help you explore more about reinforcement learning

- Videos on Reinforcement Learning (https://www.analyticsvidhya.com/blog/2016/12/21-deep-learning-videos-tutorials-courses-on-youtube-from-2016/)
- Book on Introduction to Reinforcement Learning (http://people.inf.elte.hu/lorincz/Files/RL_2006/SuttonBook.pdf)
- Awesome Reinforcement Learning Github repo (https://github.com/aikorea/awesome-rl)

- Course on Reinforcement Learning by David Silver (https://www.youtube.com/playlist?list=PLV_1KI9mrSpGFoaxoL9BCZeen_s987Yxb)

u have any doubts or questions, feel free to post them
ment Learning before then share your experience
ovide you an overview of reinforcement learning with its
e found it useful.

a.com/blog), compete, hack
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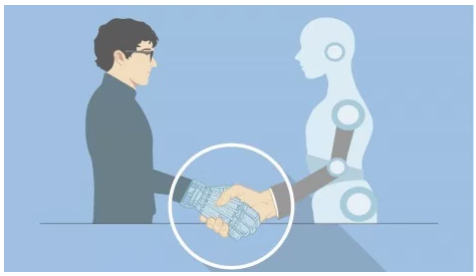

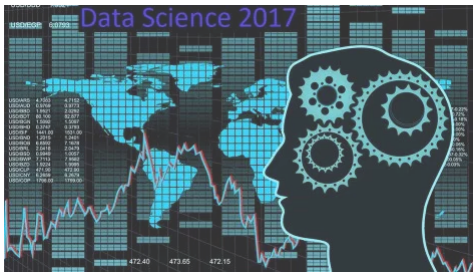

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Author

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d a Deep learning rookie. A recent Comp. Sc. undergrad, he ills to push the boundaries of AI research.

/faizankshaikh) (http://github.com/faizankshaikh)

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This is article is quiet old now and you might not get a prompt response from the author. We would request you to post this comment on Analytics Vidhya **Discussion portal** (https://discuss.analyticsvidhya.com/) to get your queries resolved.

28 COMMENTS

David Jung says: (HTTPS://WWW.ANALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/?REPLYTOCOM=121258#RESPOND)

JANUARY 19, 2017 AT 8:30 AM (HTTPS://WWW.ANALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/#COMMENT-121258)

Thanks for posting the article. Very interesting and clear though my first trying for atari(https://github.com/matthiasplappert/keras-rl.git/example/dqn_atari.py

pert/keras-rl.git/example/dqn_atari.py)) training has ended up nce I'm using GT730 GDDR5 1G RAM and I'm rather noob in this mal situation that I can't fit my model(atari example) with my

2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/?REPLYTOCOM=121264#RESPOND)

ANALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-

x.

To be frank, I think 1GB of VRAM is somewhat low to do "not-so-simple" tasks and especially deep with problem in the past when I had a 2GB NVidia card before possible, you can try increasing memory or use the available

you to try a few things

ared here (https://github.com/matthiasplappert/keras-rl-atari/breakout (https://github.com/matthiasplappert/keras-rl-atari/breakout)). This would save you to time for training and ot sure if this would fit the memory limit

in **process_state_batch** function change *astype('float32')* to tion in the code, this would decrease memory use by 4X. Beware

that I haven't done this, so cannot comment will it work or not.

If this still doesn't work, try asking the issue on their official gitter channel (https://gitter.im/keras-rl/Lobby (https://gitter.im/keras-rl/Lobby))

Hope this helps!

David Jung says: (HTTPS://WWW.ANALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/?REPLYTOCOM=121265#RESPOND)

JANUARY 19, 2017 AT 9:04 AM (HTTPS://WWW.ANALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/#COMMENT-121265)

Thank you Faizan!

Ashwini says: (HTTPS://WWW.ANALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/?REPLYTOCOM=137467#RESPOND)
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d reinforcement learning

g.com) says: ION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/?REPLYTOCOM=121266#RESPOND)
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ave a site, which is useful in support of my know-how. thanks
arkable articles. Cheers for sharing your website page.Excellent

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2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/?REPLYTOCOM=121272#RESPOND)
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Faizan Shaikh says: TICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/?REPLYTOCOM=121273#RESPOND)
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Thanks Sandeep

Vaibhav says: (HTTPS://WWW.ANALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/?REPLYTOCOM=121296#RESPOND)
JANUARY 20, 2017 AT 2:31 AM (HTTPS://WWW.ANALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/#COMMENT-121296)

Brilliant Article Faizan , There are 10 tutorials of Reinforcement Learning which is taught by David Silver.
David is one of the founding fathers of Reinforcement Learning.
Here is the link, Its really amazing & worth watching,

?v=2pWv7GOvuf0 (https://www.youtube.com/watch?

/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/?REPLYTOCOM=121311#RESPOND)
ANALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-

our suggestion. Added!
(https://datahack.analyticsvidhya.com/contest/lord-of-the-machines/?

2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/?REPLYTOCOM=127203#RESPOND)
ALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-

s context … an overkill

. .. Thanks

2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/?REPLYTOCOM=129122#RESPOND)
YTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-

(https://datahack.analyticsvidhya.com/dpl/?utm_source=AVblog_sidebottom)
Thanks harry

Ashok Lathwal says:
(HTTP://WWW.ANALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/?REPLYTOCOM=127556#RESPOND)
APRIL 24, 2017 AT 9:01 PM (HTTPS://WWW.ANALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/#COMMENT-127556)

Thanku for this great article 🙂

Faizan Shaikh says: (HTTPS://WWW.ANALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/?REPLYTOCOM=129123#RESPOND)
MAY 24, 2017 AT 9:08 AM (HTTPS://WWW.ANALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/#COMMENT-129123)

Thanks Ashok

2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/?REPLYTOCOM=133502#RESPOND)
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is fantastic. I get so amazed after reading this article. Thank You

2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/?REPLYTOCOM=134621#RESPOND)
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http://datahack.analyticsvidhya.com/contest/lord-of-the-machines/?

You are welcome Saksham!

2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/?REPLYTOCOM=133636#RESPOND)
ALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-

e terminal. when I ran the "git clone
pert/keras-rl.git (https://github.com/matthiasplappert/keras-
s not recognized…". I think that I did something wrong. I am a
be I didn't do something that i should.

(https://datahack.analyticsvidhya.com/dpl/?utm_source=AVblog_sidebottom)

gurgosk says: (HTTPS://WWW.ANALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/?REPLYTOCOM=133638#RESPOND)
AUGUST 4, 2017 AT 2:59 AM (HTTPS://WWW.ANALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/#COMMENT-133638)

however this is a very good article and I understood a lot

Faizan Shaikh says: (HTTPS://WWW.ANALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/?REPLYTOCOM=134624#RESPOND)
AUGUST 18, 2017 AT 3:55 PM (HTTPS://WWW.ANALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/#COMMENT-134624)

Hi,

You would have to install git to clone this project. Here is the link for installation steps https://git-scm.com/downloads (https://git-scm.com/downloads)

2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/?REPLYTOCOM=133944#RESPOND)
ALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-

xplains basics!

(https://datahack.analyticsvidhya.com/contest/lord-of-the-machines/?

NALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/?REPLYTOCOM=134619#RESPOND)
NALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-

2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/?REPLYTOCOM=142221#RESPOND)
.ANALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-

xample with markov dcision process in matlab

(https://datahack.analyticsvidhya.com/dpl/?utm_source=AVblog-sidebottom)

Faizan Shaikh says: TICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/?REPLYTOCOM=144016#RESPOND)
NOVEMBER 16, 2017 AT 6:04 PM (HTTPS://WWW.ANALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/#COMMENT-144016)

Hi – you can easily search for this on the web

Alex says: HTTPS://WWW.ANALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/?REPLYTOCOM=144283#RESPOND)
NOVEMBER 21, 2017 AT 7:57 PM (HTTPS://WWW.ANALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/#COMMENT-144283)

Hi! Can I use your article as a source for our group report and show the examples and explanations in this article to my classmates? This is a really great article, it was easy to understand and has helped me understand beginner concepts in so I thought I could use your explanations to introduce my classmates to RL. If it is not okay, I can understand.

2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/?REPLYTOCOM=146616#RESPOND)
ANALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-

s a resource. It would be great if you could mention the

) Says:

NTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/?REPLYTOCOM=144321#RESPOND)
W.ANALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-
IMPLEMENTATION/#COMMENT-144321)

(https://datahack.analyticsvidhya.com/contest/lord-of-the-machines/?

Great article. Can reinforcement learning be applied on financial transnational data to learn
redict future cash flow. I see unsupervised learning has been
ut yet reinforcement learning is not researched on transactional
e same would benefit?

2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/?REPLYTOCOM=146617#RESPOND)
ANALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-

n – there definitely may be research going on in this field too. For
s of reinforcement learning in stock market prediction etc

(https://datahack.analyticsvidhya.com/dpl/?utm_source=AVblog_sidebottom)

Benny Says:

HTTPS://WWW.ANALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/?REPLYTOCOM=146586#RESPOND)
DECEMBER 7, 2017 AT 10:51 AM (HTTPS://WWW.ANALYTICSVIDHYA.COM/BLOG/2017/01/INTRODUCTION-TO-REINFORCEMENT-LEARNING-IMPLEMENTATION/#COMMENT-146586)

Thanks for a great article. You explain it in a clear way that helps me move forward on the ideas.

LEAVE A REPLY

Your email address will not be published.

Comment

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om/blog/2018/03/essentials-of-deep-learning-visualizing-

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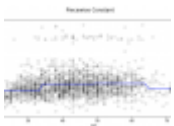
FAIZAN SHAIKH , MARCH 22, 2018



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Introduction to Regression Splines (with Python codes) (https://www.analyticsvidhya.com/blog/2018/03/introduction-regression-splines-python-codes/)
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