

Chapter 2: Discover Your AI Toolkit

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375 commits 1 branch 0 releases 3 contributors MIT

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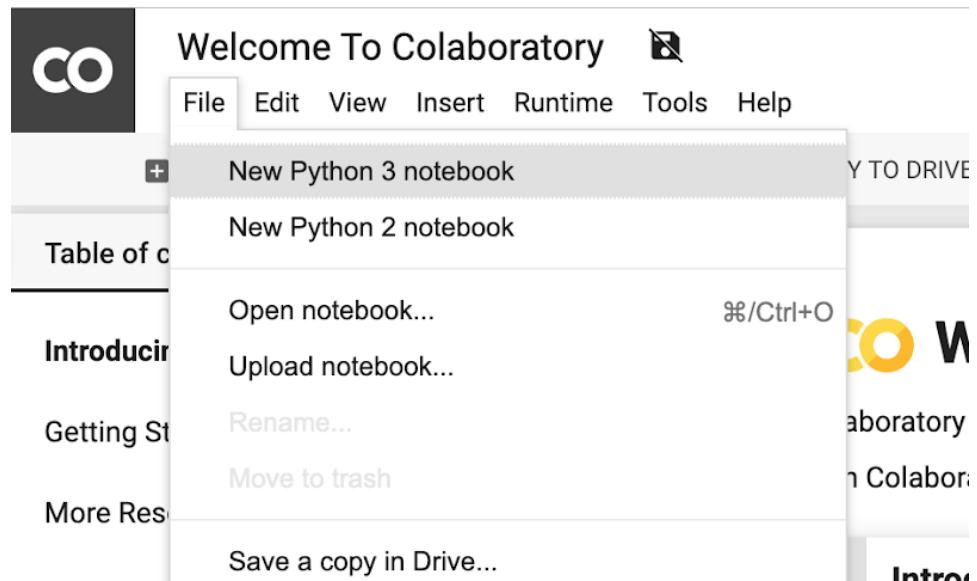
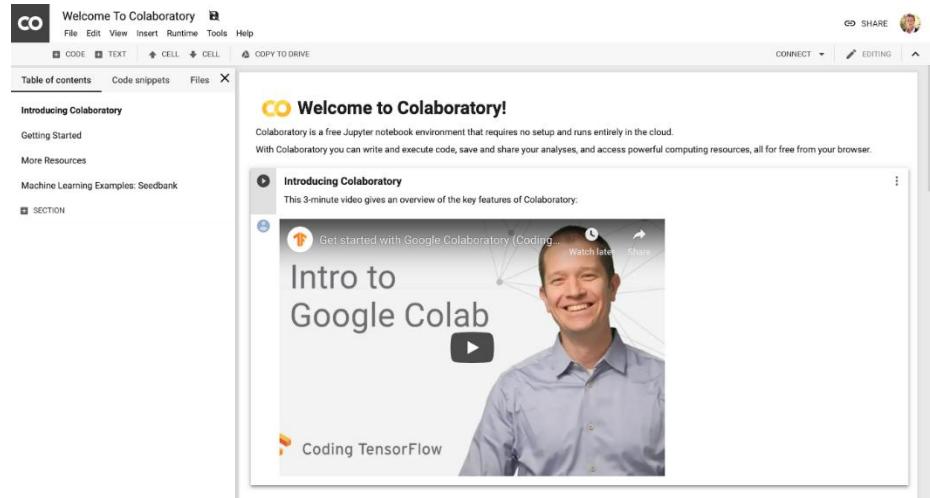
hadelin2p Update README.md Latest commit 9fa0ea6 13 minutes ago

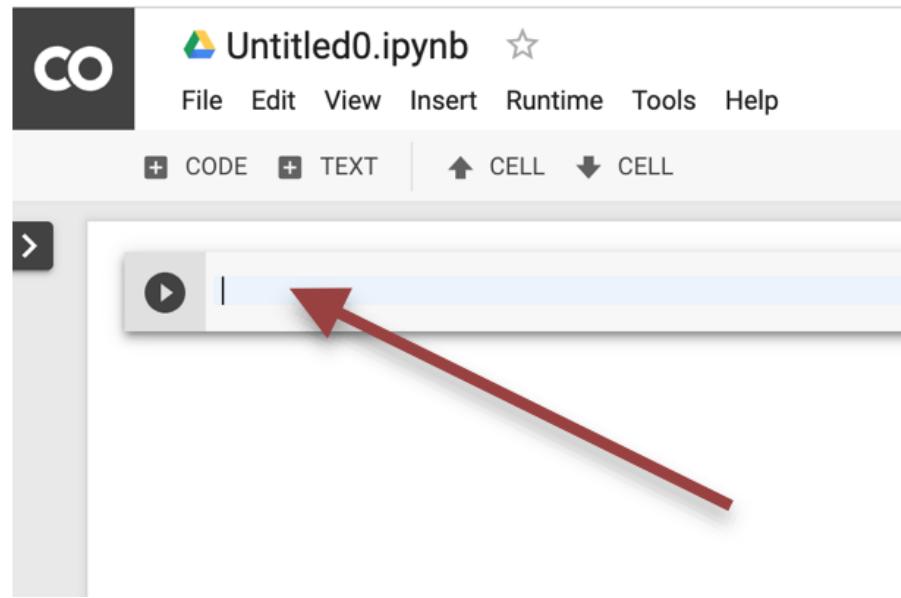
File	Commit Message	Time Ago
Chapter 03	Add files via upload	13 days ago
Chapter 04	Add files via upload	13 days ago
Chapter 05	Add files via upload	13 days ago
Chapter 06	Update thompson_sampling.py	13 days ago
Chapter 07	Add files via upload	13 days ago
Chapter 08	Add files via upload	13 days ago
Chapter 09	Update predictor.py	11 days ago
Chapter 10	Add files via upload	13 days ago
Chapter 11	Add files via upload	13 days ago
Chapter 12	Delete .DS_Store	yesterday
Chapter 13	Update train.py	13 days ago
LICENSE	Initial commit	7 months ago
README.md	Initial commit	7 months ago

README.md

AI-Crash-Course

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A screenshot of a GitHub repository page for "AI-Crash-Course". The repository owner is "PacktPublishing". The page shows basic statistics: 0 issues, 0 pull requests, and 0 wiki pages. The branch is set to "master". A commit by user "hadelin2p" is listed, titled "Update thompson_sampling.py". A red arrow points from the bottom right towards the file name "thompson_sampling.py".

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hadelin2p Update thompson_sampling.py

..

thompson_sampling.py

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Branch: master AI-Crash-Course / Chapter 06 / thompson_sampling.py Find file Copy path

hadelin2p Update thompson_sampling.py e93e2d4 12 minutes ago

2 contributors

59 lines (52 sloc) 1.83 KB Raw Blame History

Jump to definition is still being calculated for this commit. Check back in a bit. [Beta] Learn more or give us feedback

```
1 # AI for Sales & Advertising - Sell like the Wolf of AI Street
2
3 # Importing the libraries
4 import numpy as np
5 import matplotlib.pyplot as plt
6 import random
7
8 # Setting the parameters
9 N = 10000
10 d = 9
11
12 # Building the environment inside a simulation
13 conversion_rates = [0.05, 0.13, 0.09, 0.16, 0.11, 0.04, 0.28, 0.08, 0.01]
14 X = np.array(np.zeros([N,d]))
15 for i in range(N):
16     for j in range(d):
17         if np.random.rand() <= conversion_rates[j]:
18             X[i,j] = 1
19
20 # Implementing Random Selection and Thompson Sampling
21 strategies_selected_rs = []
22 strategies_selected_ts = []
23 total_reward_rs = 0
24 total_reward_ts = 0
25 numbers_of_rewards_1 = [0] * d
26 numbers_of_rewards_0 = [0] * d
27 for n in range(0, N):
28     # Random Selection
29     strategy_rs = random.randrange(d)
30     strategies_selected_rs.append(strategy_rs)
31     reward_rs = X[n, strategy_rs]
32     total_reward_rs = total_reward_rs + reward_rs
33     # Thompson Sampling
```

The screenshot shows a Jupyter Notebook interface with the title "Untitled0.ipynb". The code cell contains the following Python script:

```
# AI for Sales & Advertising - Sell like the Wolf of AI Street
# Importing the libraries
import numpy as np
import matplotlib.pyplot as plt
import random

# Setting the parameters
N = 10000
d = 9

# Building the environment inside a simulation
conversion_rates = [0.05, 0.13, 0.09, 0.16, 0.11, 0.04, 0.20, 0.08, 0.01]
X = np.array(np.zeros([N, d]))
for i in range(N):
    for j in range(d):
        if np.random.rand() <= conversion_rates[j]:
            X[i, j] = 1

# Implementing Random Selection and Thompson Sampling
strategies_selected_rs = []
strategies_selected_ts = []
total_reward_rs = 0
total_reward_ts = 0
numbers_of_rewards_1 = [0] * d
numbers_of_rewards_0 = [0] * d
for n in range(0, N):
    # Random Selection
    strategy_rs = random.randrange(d)
    strategies_selected_rs.append(strategy_rs)
    reward_rs = X[n, strategy_rs]
    total_reward_rs += reward_rs
    # Thompson Sampling
    strategy_ts = 0
    max_random = 0
    for i in range(0, d):
        random_beta = random.betavariate(numbers_of_rewards_1[i] + 1, numbers_of_rewards_0[i] + 1)
        if random_beta > max_random:
            max_random = random_beta
            strategy_ts = i
    reward_ts = X[n, strategy_ts]
    if reward_ts == 1:
        numbers_of_rewards_1[strategy_ts] = numbers_of_rewards_1[strategy_ts] + 1
    else:
        numbers_of_rewards_0[strategy_ts] = numbers_of_rewards_0[strategy_ts] + 1
    strategies_selected_ts.append(strategy_ts)
    total_reward_ts += reward_ts

# Computing the Relative Return
relative_return = (total_reward_ts - total_reward_rs) / total_reward_rs * 100
print('Relative Return: {:.0f}'.format(relative_return))

# Plotting the Histogram of Selections
plt.hist(strategies_selected_ts)
plt.title('Histogram of Selections')
plt.xlabel('Strategy')
plt.ylabel('Number of times the strategy was selected')
plt.show()
```

The screenshot shows a Jupyter Notebook interface with the title "Untitled0.ipynb". A red arrow points to the play button icon in the toolbar above the code cell.

The code cell contains the following Python script:

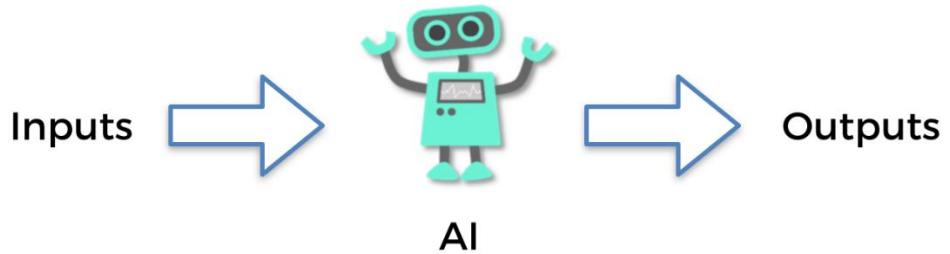
```
# AI for Sales & Advertising - Sell like the Wolf of AI Street
# Importing the libraries
import numpy as np
import matplotlib.pyplot as plt
import random
```

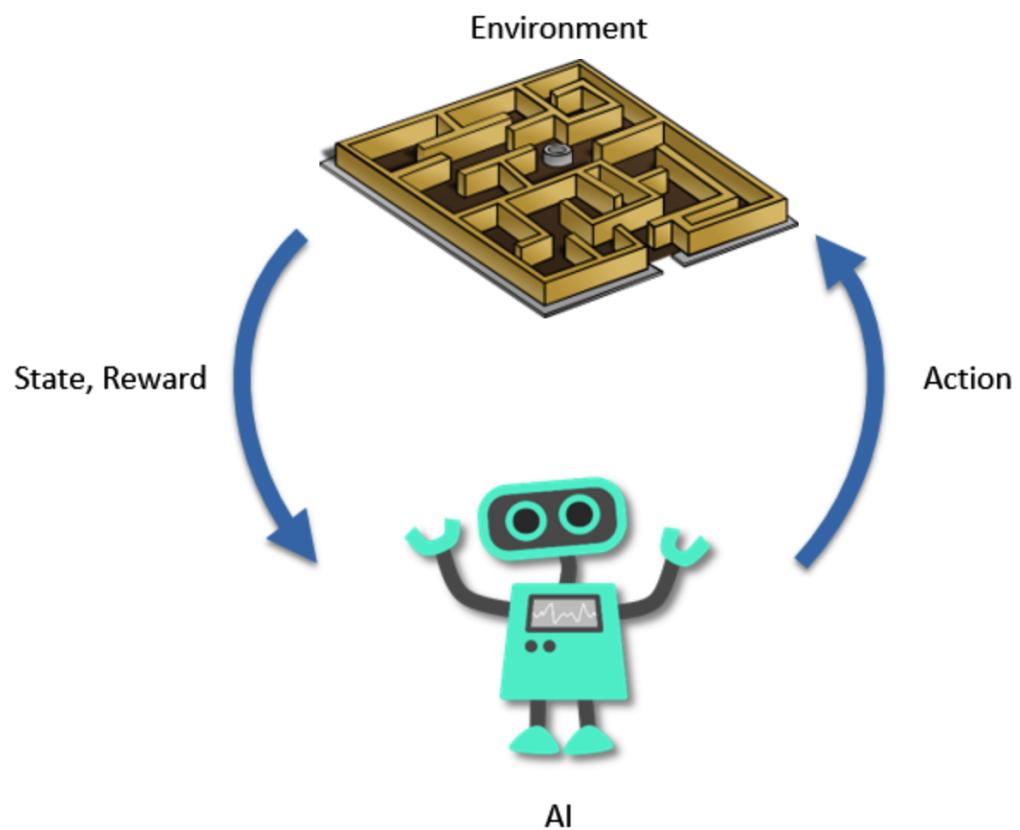
Chapter 3: Python Fundamentals – Learn How to Code in Python

3
4
1
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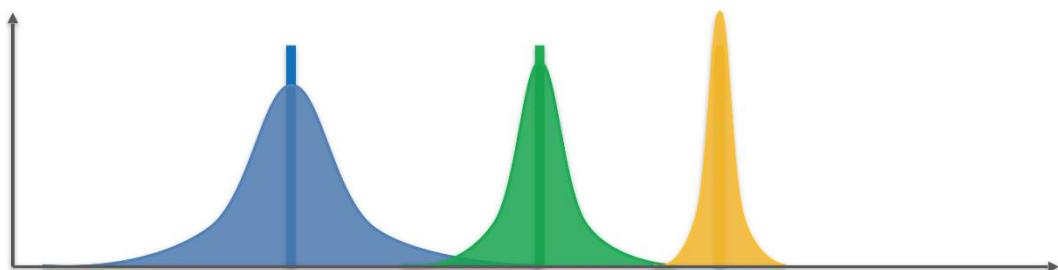
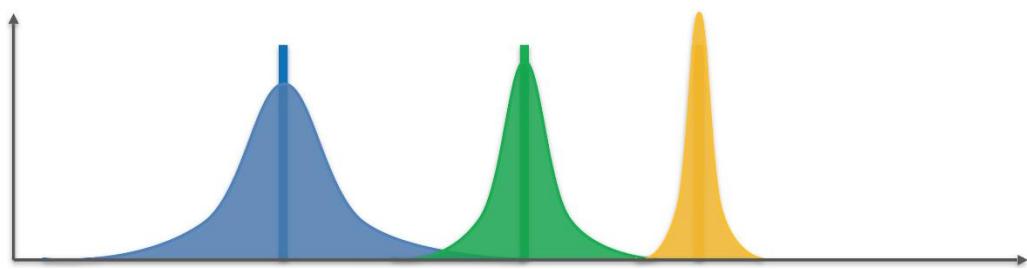
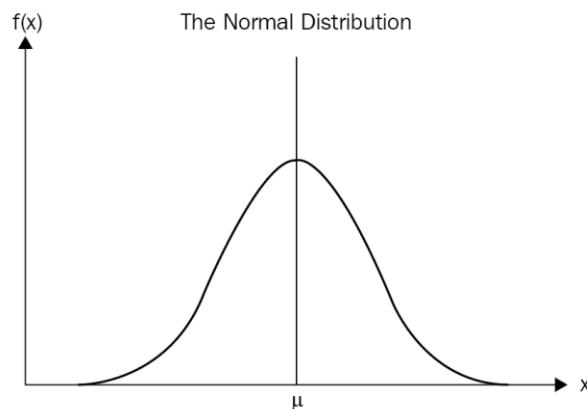
2	9	-5
-1	0	4
3	1	2

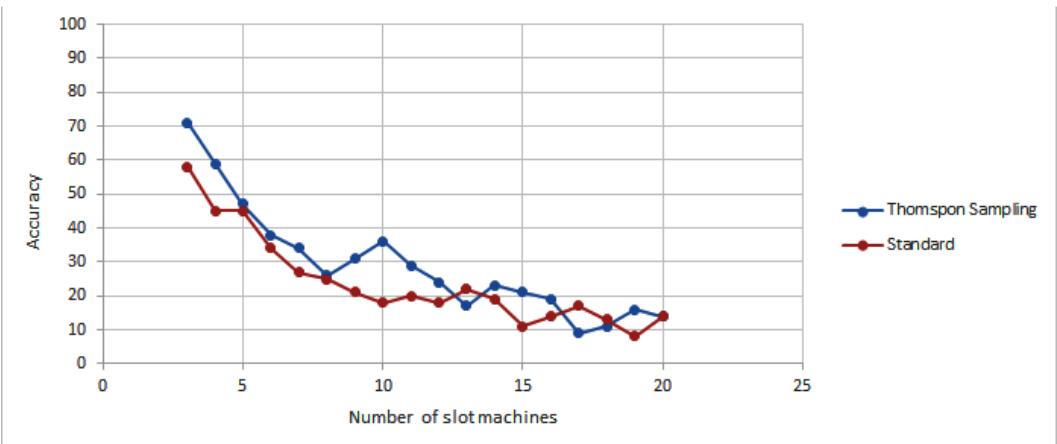
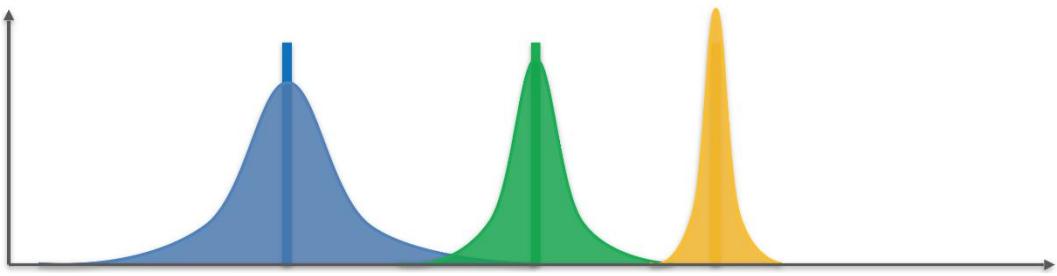
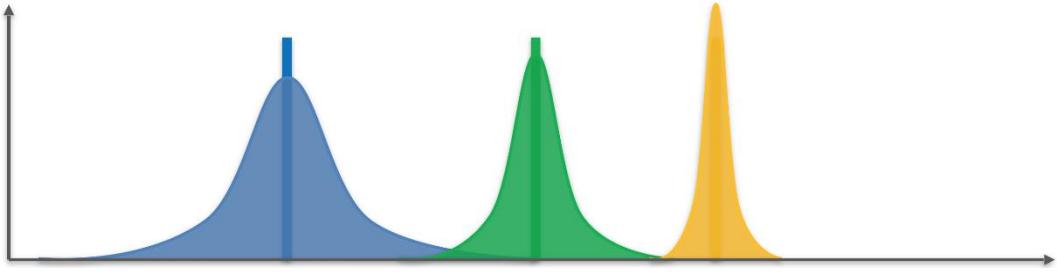
Chapter 4: AI Foundation Techniques

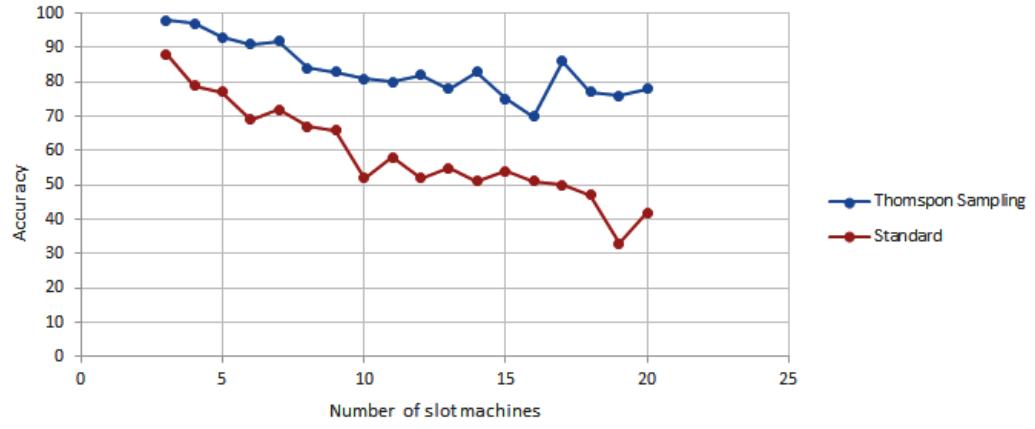




Chapter 5: Your First AI Model – Beware the Bandits!





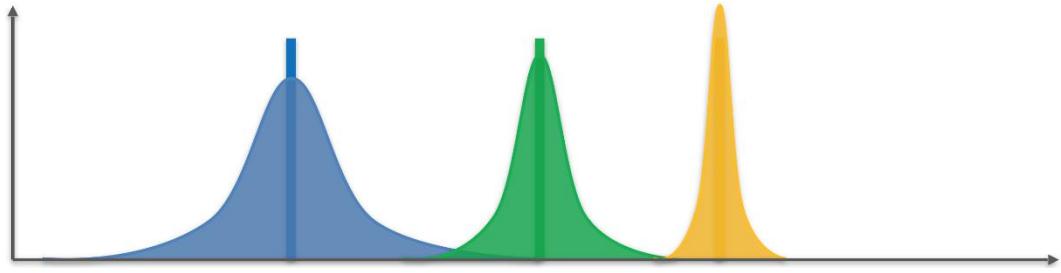


Chapter 6: AI for Sales and Advertising – Sell like the Wolf of AI Street

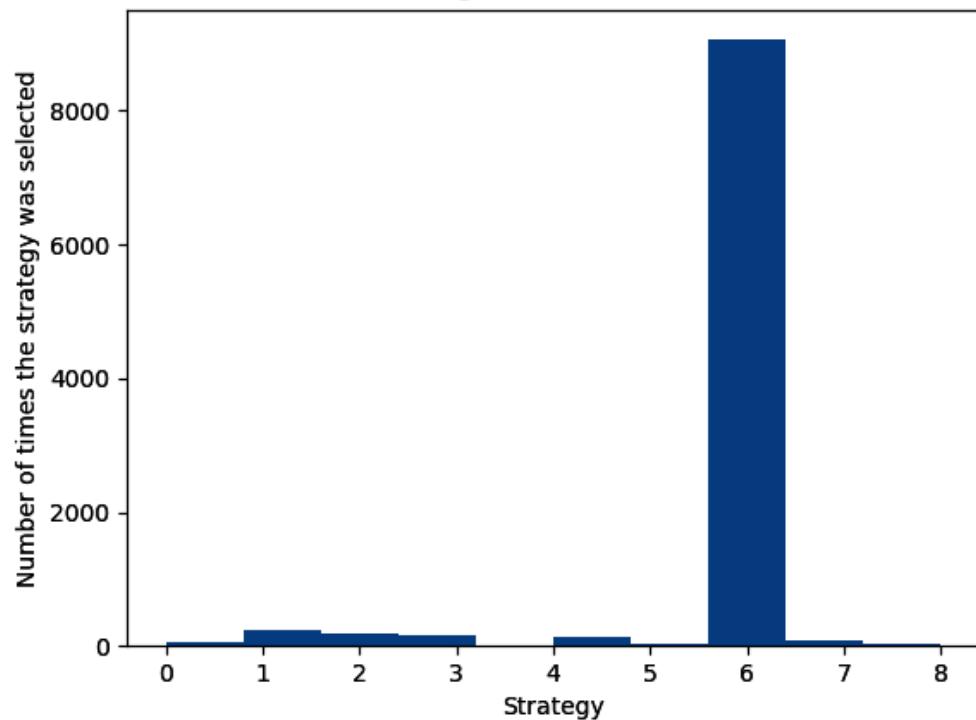
Strategy 1 <ul style="list-style-type: none">• Form 1• Package 1• Ad 1• Special Deal 1	Strategy 2 <ul style="list-style-type: none">• Form 2• Package 2• Ad 2• Special Deal 2	Strategy 3 <ul style="list-style-type: none">• Form 3• Package 3• Ad 3• Special Deal 3
Strategy 4 <ul style="list-style-type: none">• Form 4• Package 4• Ad 4• Special Deal 4	Strategy 5 <ul style="list-style-type: none">• Form 5• Package 5• Ad 5• Special Deal 5	Strategy 6 <ul style="list-style-type: none">• Form 6• Package 6• Ad 6• Special Deal 6
Strategy 7 <ul style="list-style-type: none">• Form 7• Package 7• Ad 7• Special Deal 7	Strategy 8 <ul style="list-style-type: none">• Form 8• Package 8• Ad 8• Special Deal 8	Strategy 9 <ul style="list-style-type: none">• Form 9• Package 9• Ad 9• Special Deal 9

Strategy	Conversion Rate
1	0.05
2	0.13
3	0.09
4	0.16
5	0.11
6	0.04
7	0.20
8	0.08
9	0.01

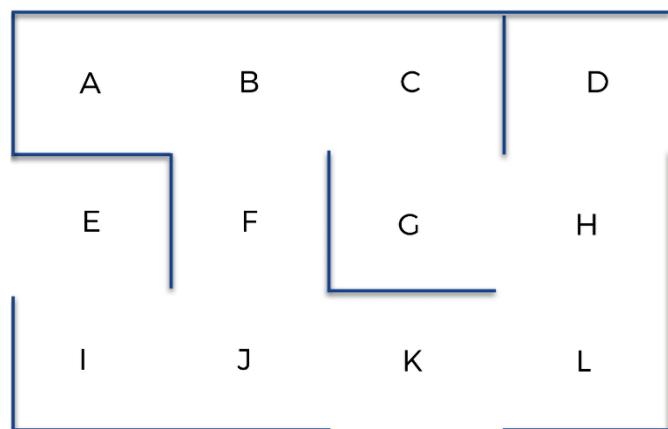
	0	1	2	3	4	5	6	7	8
0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	1	0	1	0	0
2	0	0	0	0	0	0	0	0	0
3	0	0	0	1	1	0	0	0	0
4	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0
6	0	0	1	0	0	0	1	0	0
7	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0



Histogram of Selections



Chapter 7: Welcome to Q-Learning



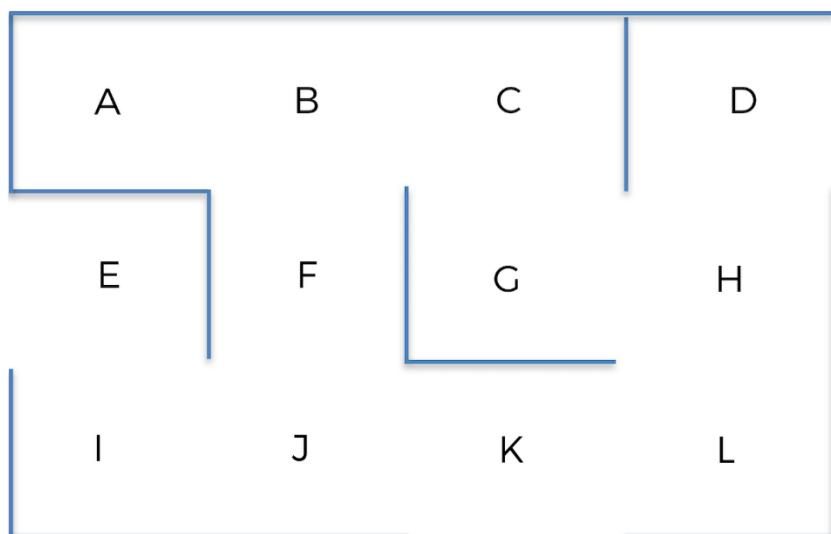
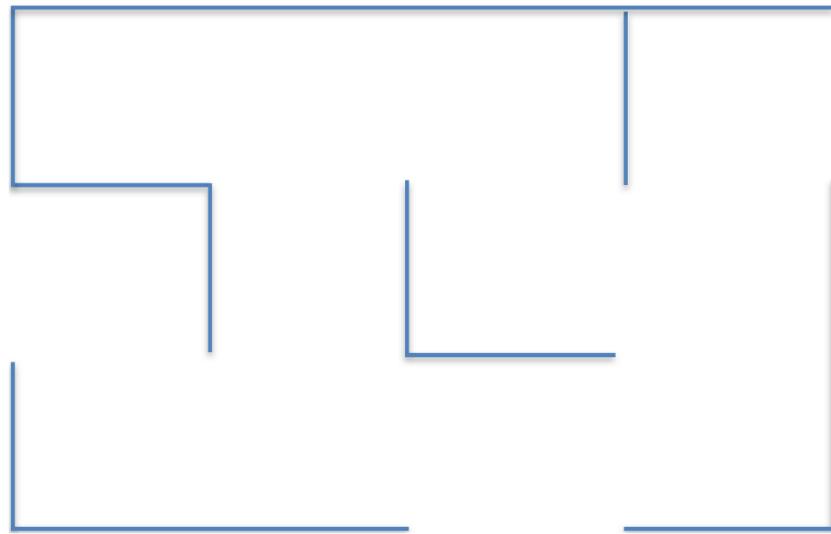
Location	State
A	0
B	1
C	2
D	3
E	4
F	5
G	6
H	7
I	8
J	9
K	10
L	11

	A	B	C	D	E	F	G	H	I	J	K	L
A	0	1	0	0	0	0	0	0	0	0	0	0
B	1	0	1	0	0	1	0	0	0	0	0	0
C	0	1	0	0	0	0	1	0	0	0	0	0
D												
E												
F												
G												
H												
I												
J												
K												
L												

	A	B	C	D	E	F	G	H	I	J	K	L
A	0	1	0	0	0	0	0	0	0	0	0	0
B	1	0	1	0	0	1	0	0	0	0	0	0
C	0	1	0	0	0	0	1	0	0	0	0	0
D	0	0	0	0	0	0	0	1	0	0	0	0
E	0	0	0	0	0	0	0	0	1	0	0	0
F	0	1	0	0	0	0	0	0	0	1	0	0
G	0	0	1	0	0	0	0	1	0	0	0	0
H	0	0	0	1	0	0	1	0	0	0	0	1
I	0	0	0	0	1	0	0	0	0	1	0	0
J	0	0	0	0	0	1	0	0	1	0	1	0
K	0	0	0	0	0	0	0	0	0	1	0	1
L	0	0	0	0	0	0	0	1	0	0	1	0

	A	B	C	D	E	F	G	H	I	J	K	L
A	0	1	0	0	0	0	0	0	0	0	0	0
B	1	0	1	0	0	1	0	0	0	0	0	0
C	0	1	0	0	0	0	1	0	0	0	0	0
D	0	0	0	0	0	0	0	1	0	0	0	0
E	0	0	0	0	0	0	0	0	1	0	0	0
F	0	1	0	0	0	0	0	0	0	1	0	0
G	0	0	1	0	0	0	1000	1	0	0	0	0
H	0	0	0	1	0	0	1	0	0	0	0	1
I	0	0	0	0	1	0	0	0	0	1	0	0
J	0	0	0	0	0	1	0	0	1	0	1	0
K	0	0	0	0	0	0	0	0	0	1	0	1
L	0	0	0	0	0	0	0	1	0	0	1	0

Chapter 8: AI for Logistics – Robots in a Warehouse



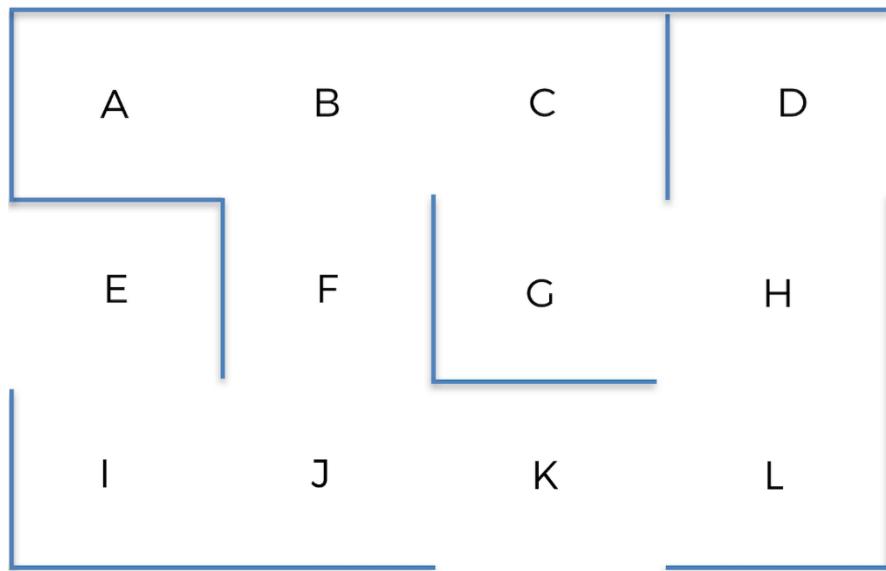


Priority Rank	Location
1	G
2	K
3	L
4	J
5	A
6	I
7	H
8	C
9	B
10	D
11	F
12	E

Location	State
A	0
B	1
C	2
D	3
E	4
F	5
G	6
H	7
I	8
J	9
K	10
L	11

	A	B	C	D	E	F	G	H	I	J	K	L
A	0	1	0	0	0	0	0	0	0	0	0	0
B	1	0	1	0	0	1	0	0	0	0	0	0
C	0	1	0	0	0	0	1	0	0	0	0	0
D	0	0	0	0	0	0	0	1	0	0	0	0
E	0	0	0	0	0	0	0	0	1	0	0	0
F	0	1	0	0	0	0	0	0	0	1	0	0
G	0	0	1	0	0	0	0	1	0	0	0	0
H	0	0	0	1	0	0	1	0	0	0	0	1
I	0	0	0	0	1	0	0	0	0	1	0	0
J	0	0	0	0	0	1	0	0	1	0	1	0
K	0	0	0	0	0	0	0	0	0	1	0	1
L	0	0	0	0	0	0	0	1	0	0	1	0

	0	1	2	3	4	5	6	7	8	9	10	11
0	0	1661	0	0	0	0	0	0	0	0	0	0
1	1247	0	2214	0	0	1247	0	0	0	0	0	0
2	0	1661	0	0	0	0	2970	0	0	0	0	0
3	0	0	0	0	0	0	0	2226	0	0	0	0
4	0	0	0	0	0	0	0	0	703	0	0	0
5	0	1661	0	0	0	0	0	0	0	931	0	0
6	0	0	2214	0	0	0	3968	2226	0	0	0	0
7	0	0	0	1661	0	0	2968	0	0	0	0	1670
8	0	0	0	0	528	0	0	0	0	936	0	0
9	0	0	0	0	0	1247	0	0	703	0	1246	0
10	0	0	0	0	0	0	0	0	0	936	0	1661
11	0	0	0	0	0	0	0	2226	0	0	1247	0



Chapter 9: Going Pro with Artificial Brains – Deep Q-Learning

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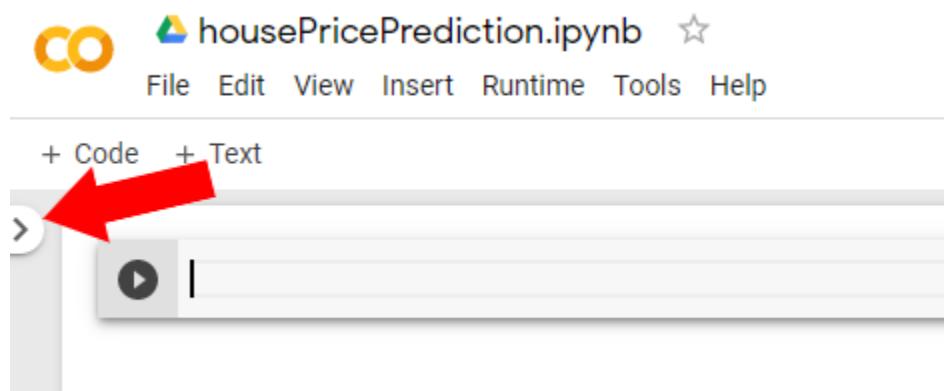
Code Issues Pull requests Security Insights

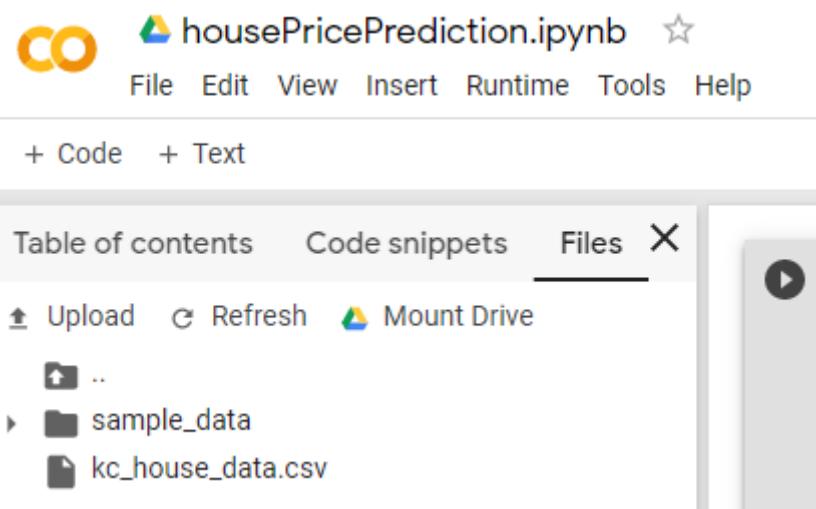
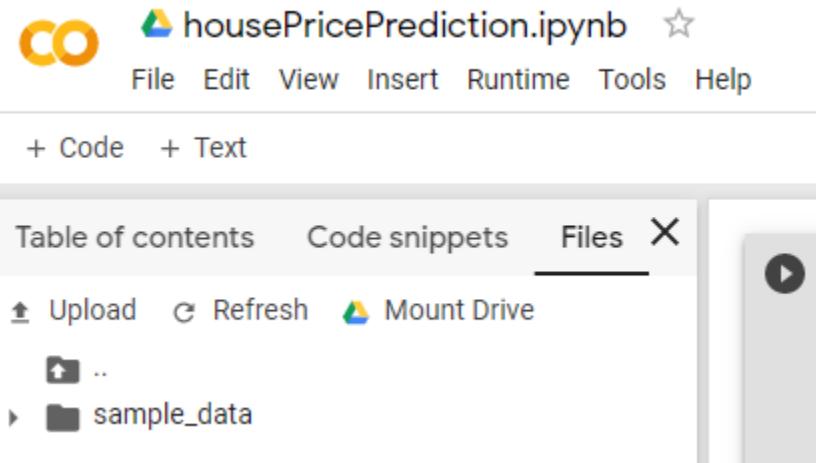
Branch: master ▾ AI-Crash-Course / Chapter 09 /

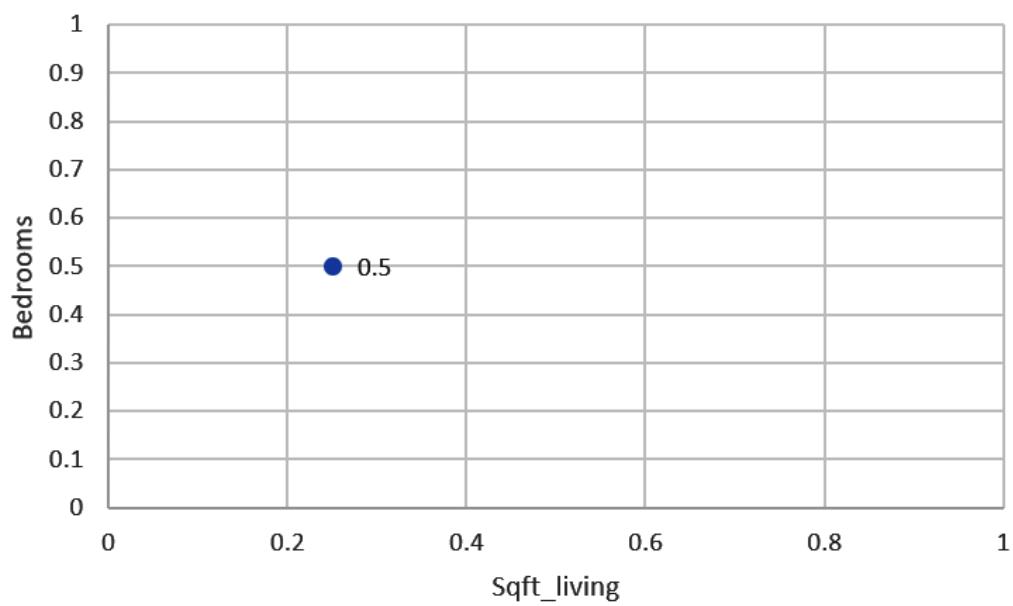
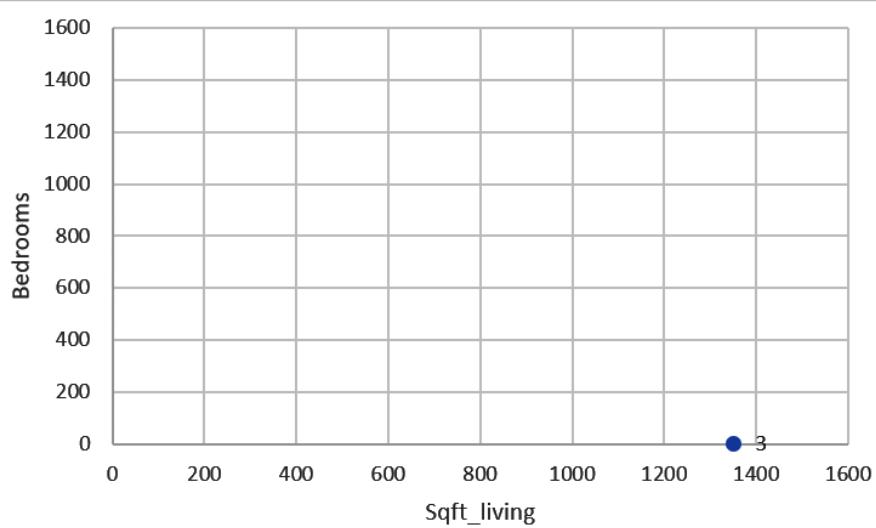
Create new file Find file History

Latest commit e6672d8 on Oct 10

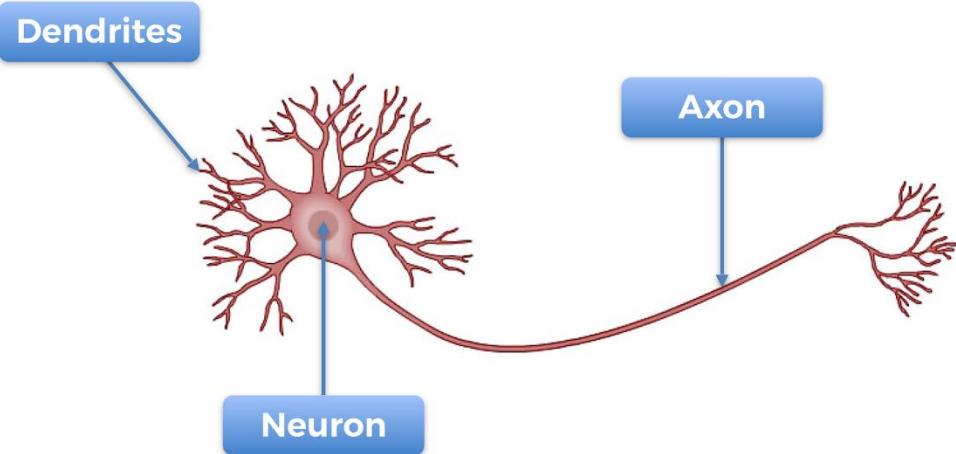
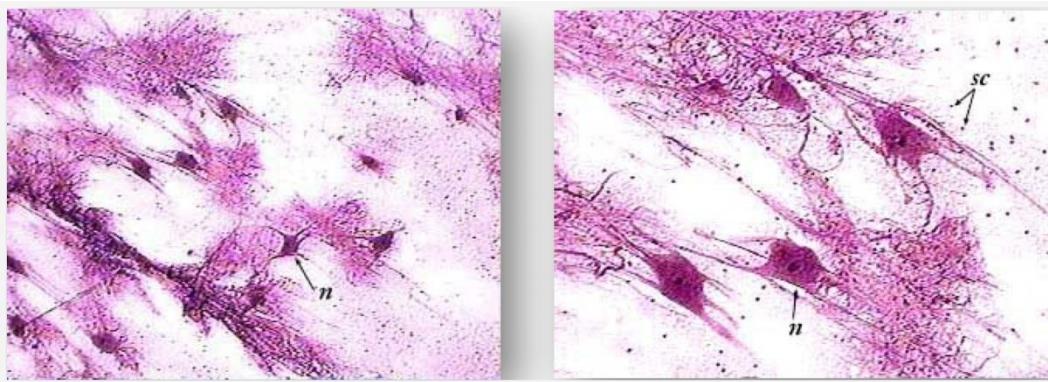
File	Action	Date
kc_house_data.csv	Add files via upload	2 months ago
predictor.py	Update predictor.py	2 months ago

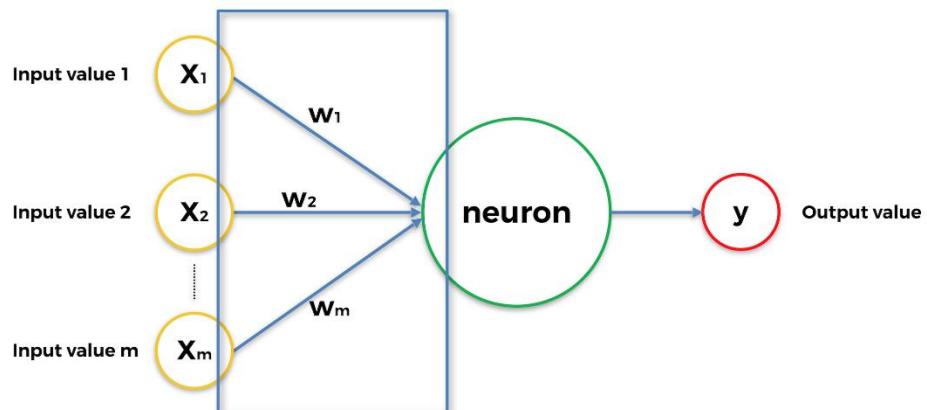
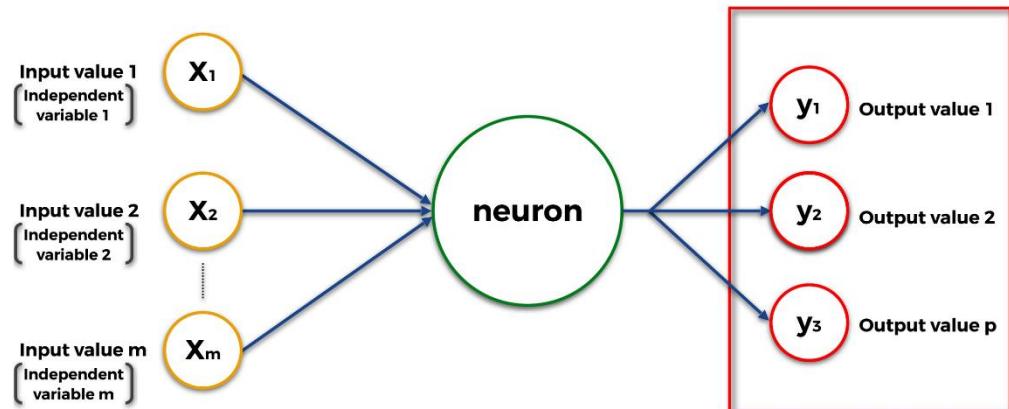
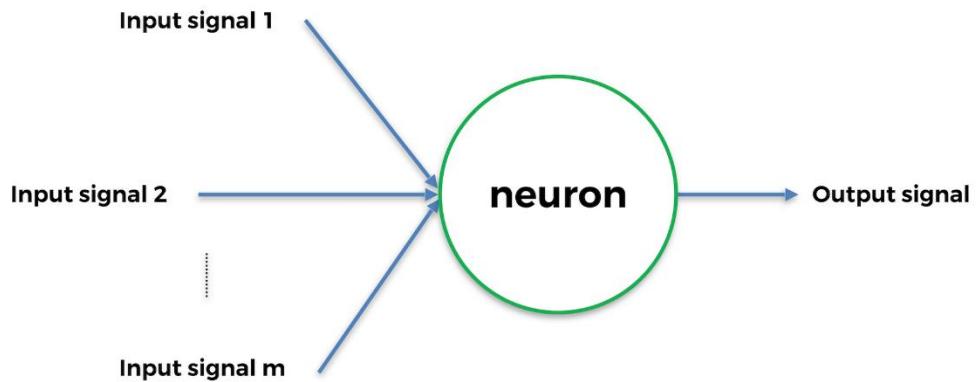


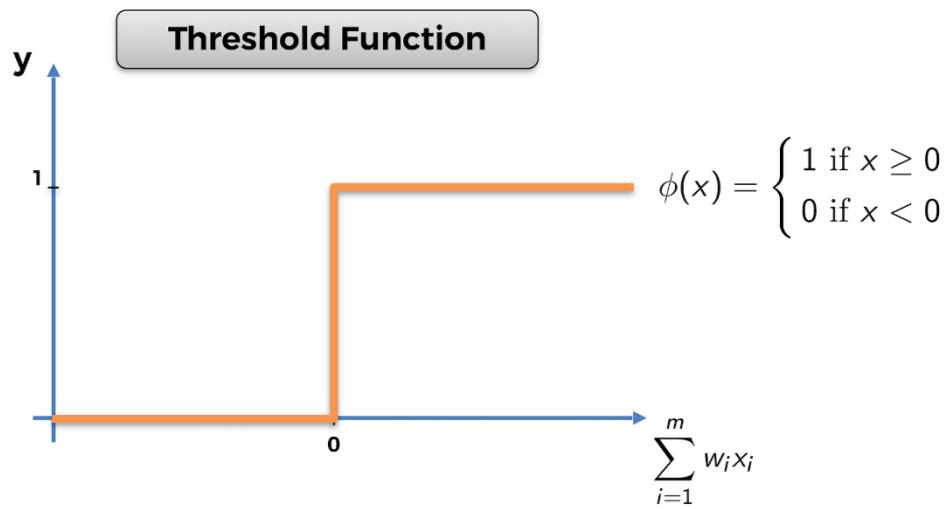
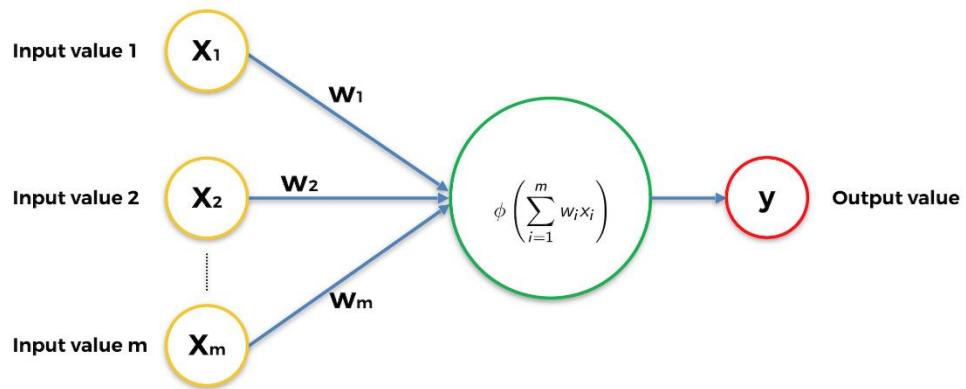


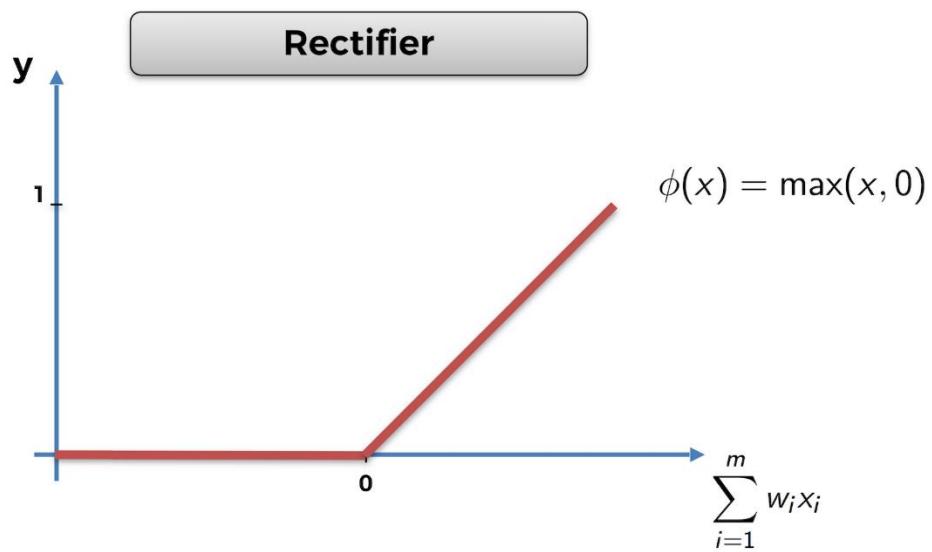
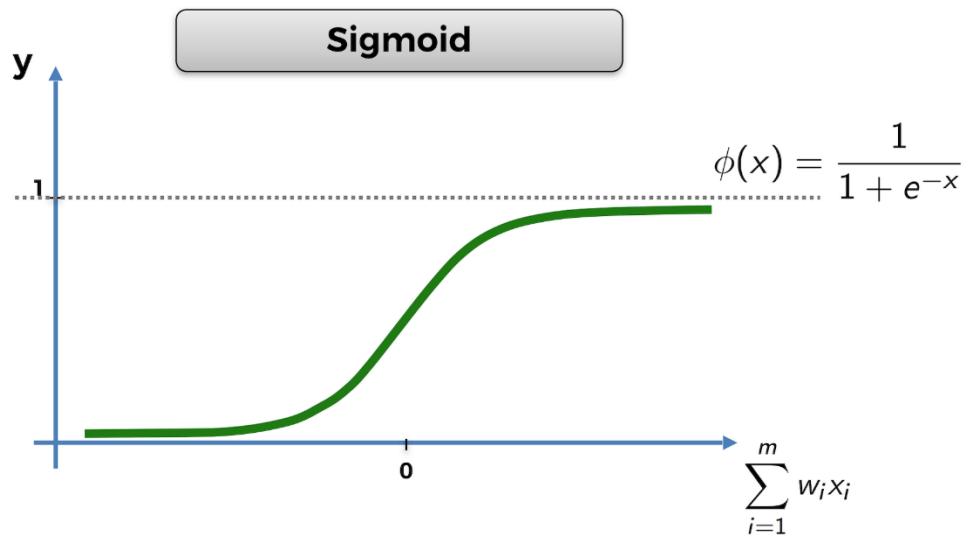


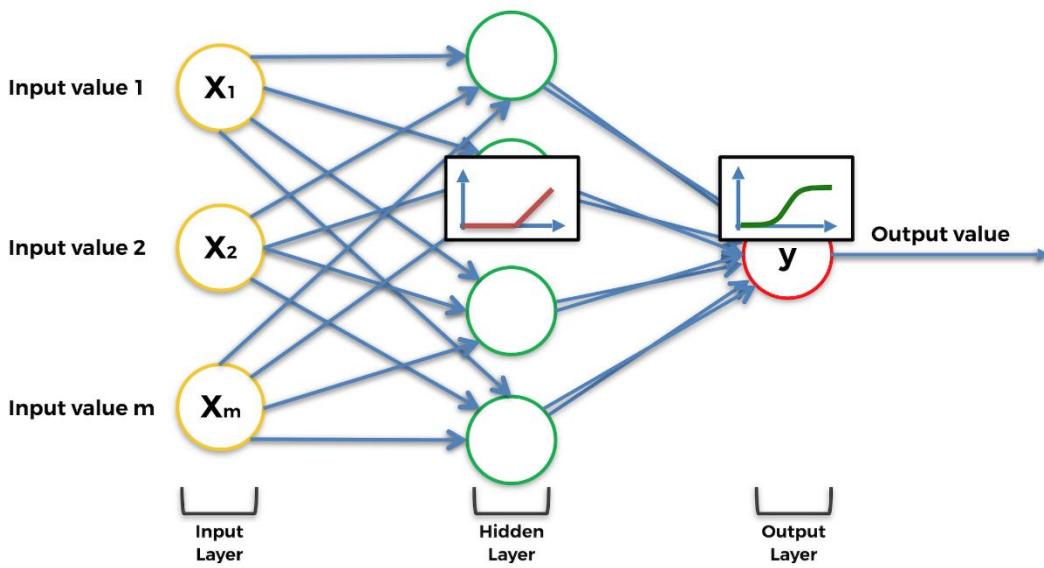
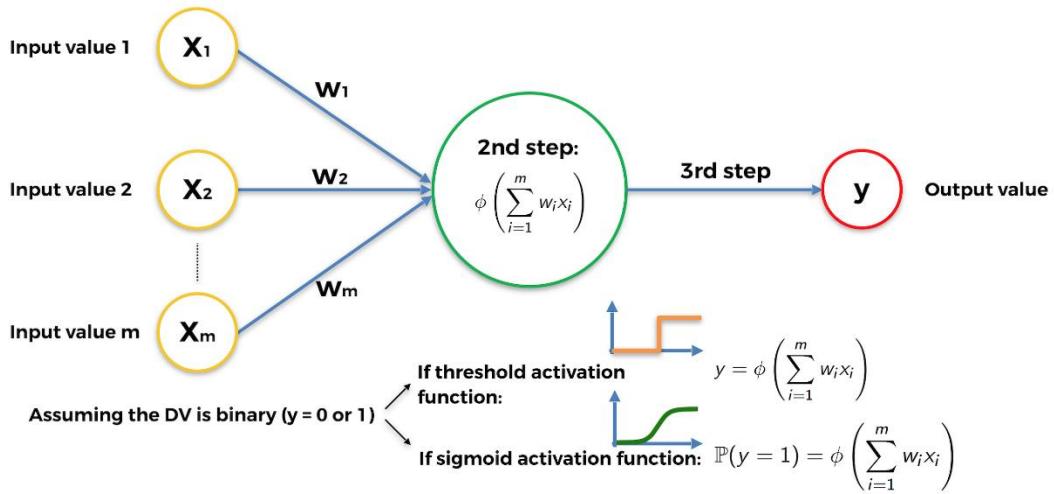
```
17290/17290 [=====] - 1s 42us/step - loss: 2.3576e-04 - mean_absolute_error: 0.0096 - val_loss: 2.4573e-04
Epoch 90/100
17290/17290 [=====] - 1s 42us/step - loss: 2.3229e-04 - mean_absolute_error: 0.0096 - val_loss: 2.5893e-04
Epoch 91/100
17290/17290 [=====] - 1s 42us/step - loss: 2.2763e-04 - mean_absolute_error: 0.0095 - val_loss: 2.9130e-04
Epoch 92/100
17290/17290 [=====] - 1s 42us/step - loss: 2.2835e-04 - mean_absolute_error: 0.0096 - val_loss: 2.8402e-04
Epoch 93/100
17290/17290 [=====] - 1s 43us/step - loss: 2.3680e-04 - mean_absolute_error: 0.0097 - val_loss: 2.5020e-04
Epoch 94/100
17290/17290 [=====] - 1s 43us/step - loss: 2.3185e-04 - mean_absolute_error: 0.0097 - val_loss: 2.5359e-04
Epoch 95/100
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Epoch 96/100
17290/17290 [=====] - 1s 40us/step - loss: 2.3863e-04 - mean_absolute_error: 0.0097 - val_loss: 2.7108e-04
Epoch 97/100
17290/17290 [=====] - 1s 38us/step - loss: 2.2833e-04 - mean_absolute_error: 0.0097 - val_loss: 2.5300e-04
Epoch 98/100
17290/17290 [=====] - 1s 40us/step - loss: 2.2590e-04 - mean_absolute_error: 0.0096 - val_loss: 2.4964e-04
Epoch 99/100
17290/17290 [=====] - 1s 40us/step - loss: 2.2953e-04 - mean_absolute_error: 0.0096 - val_loss: 2.8073e-04
Epoch 100/100
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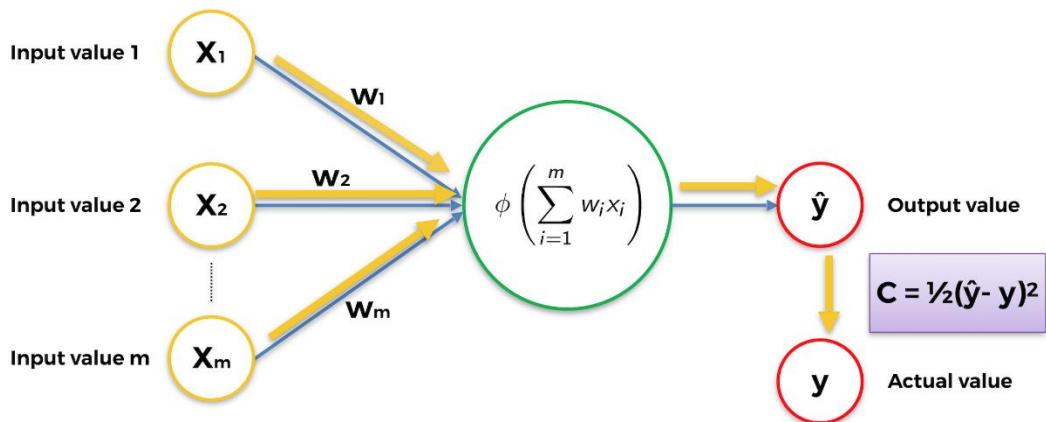
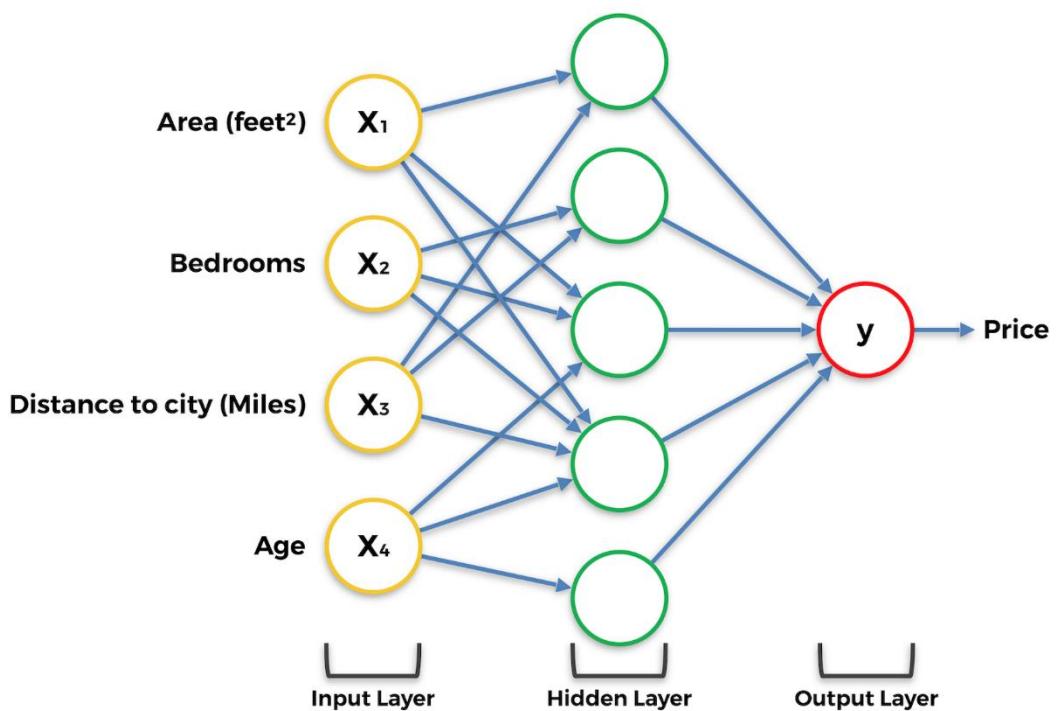


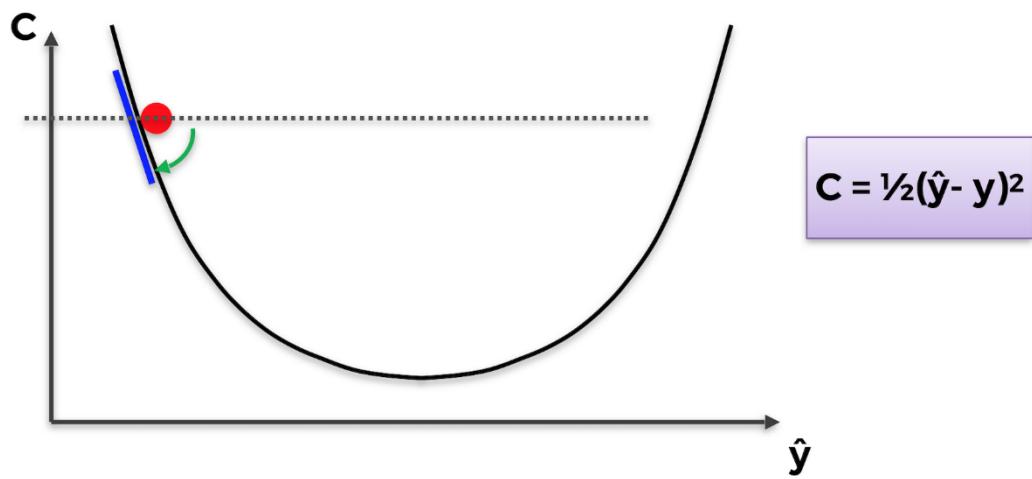
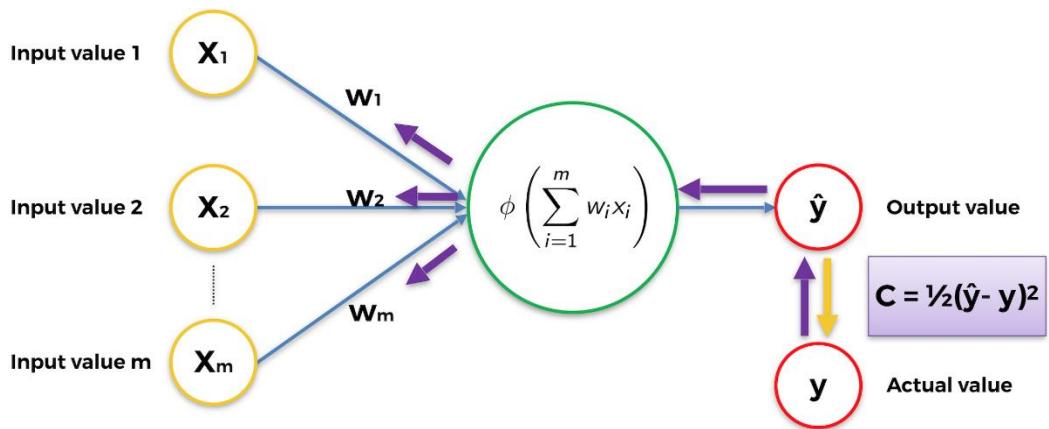


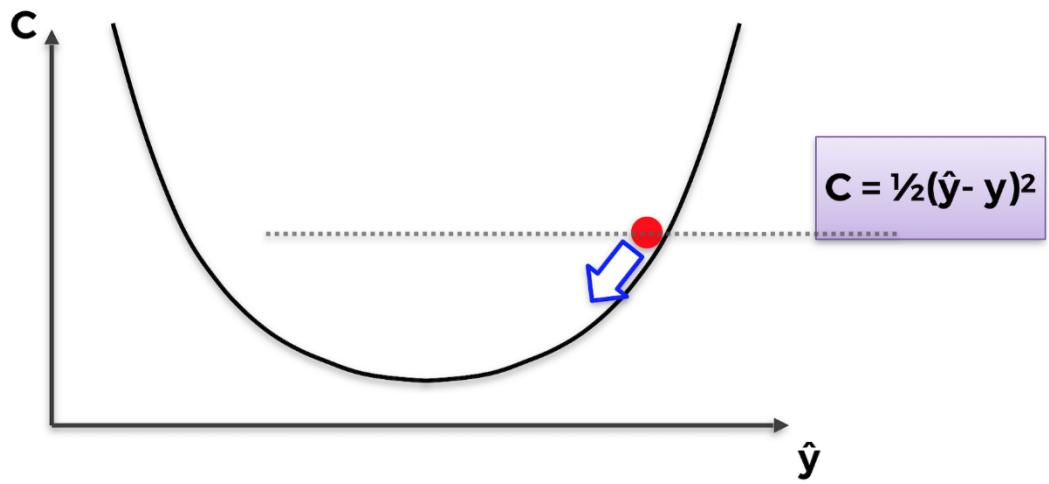
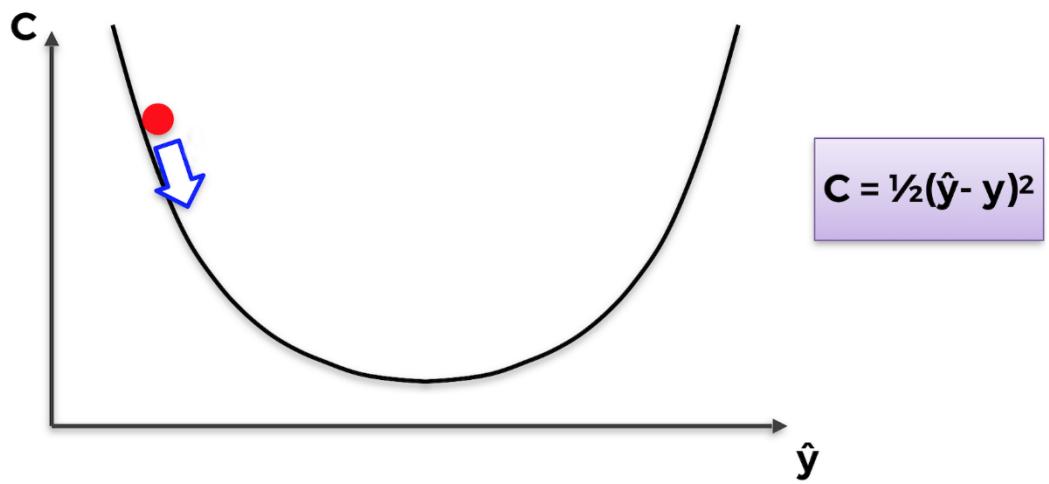


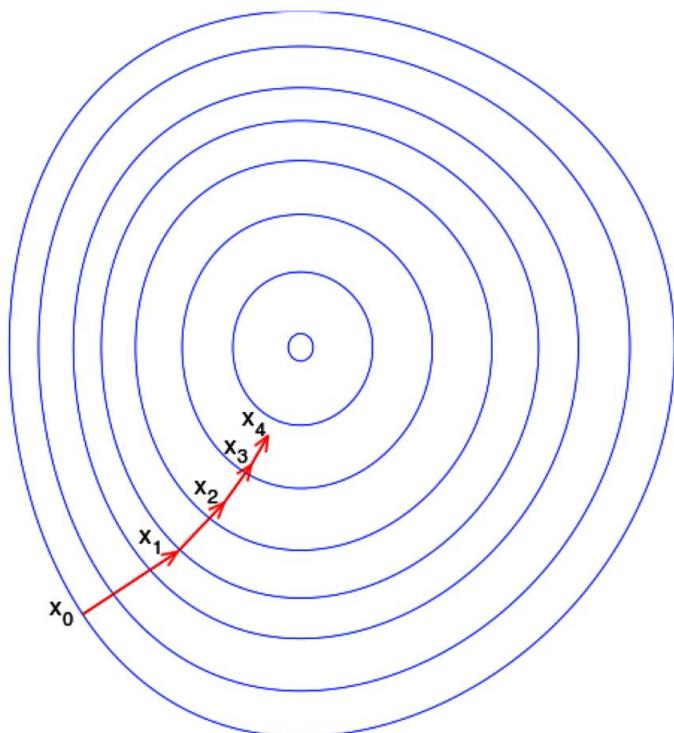
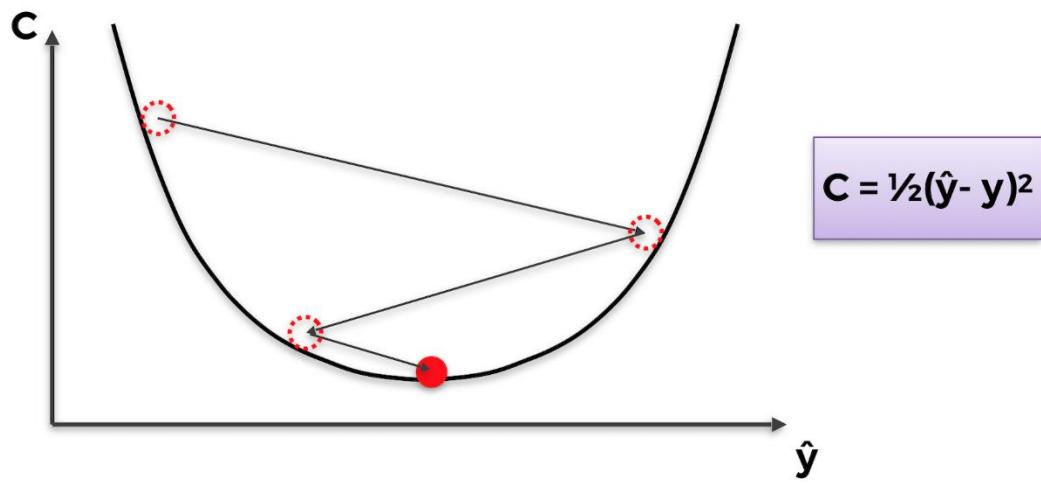


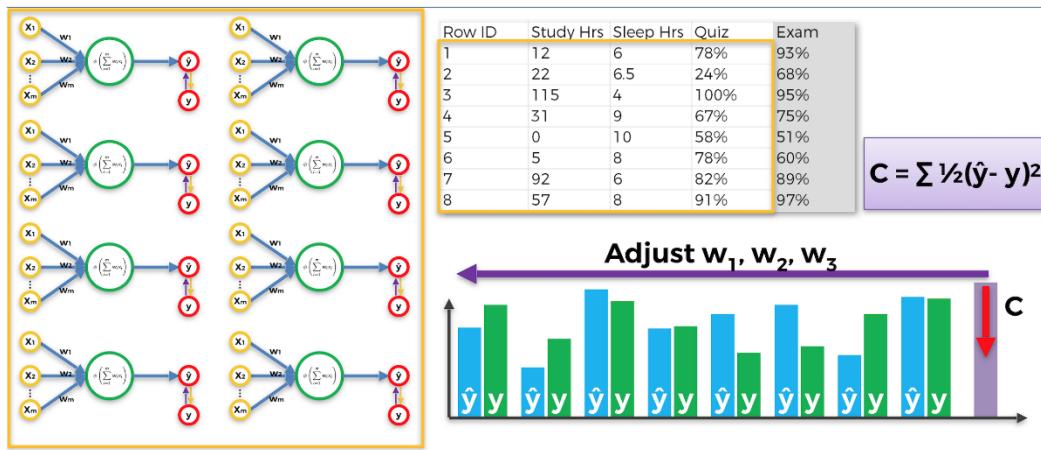
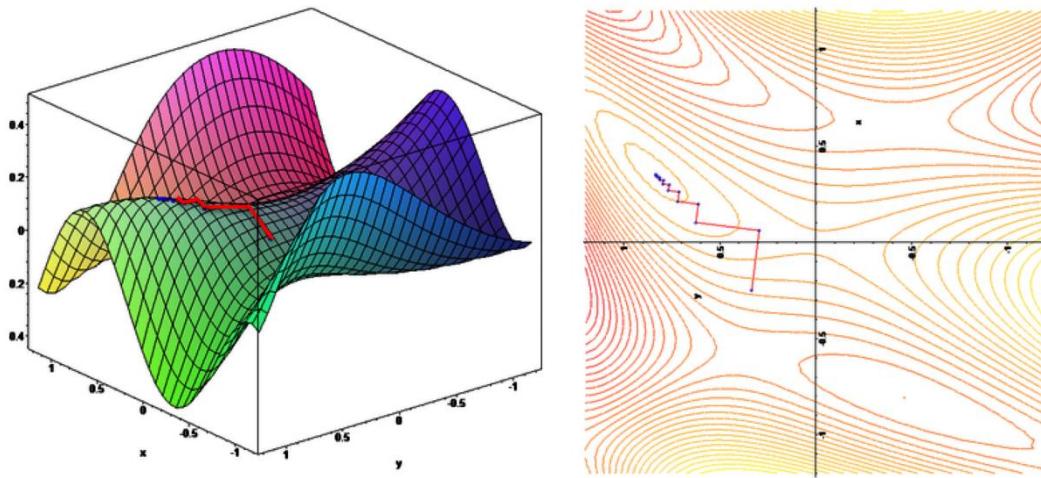


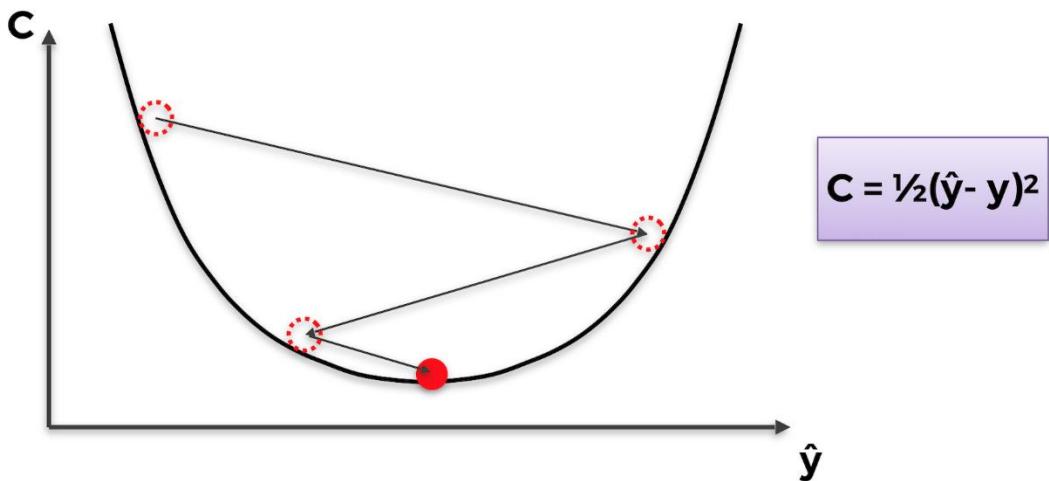
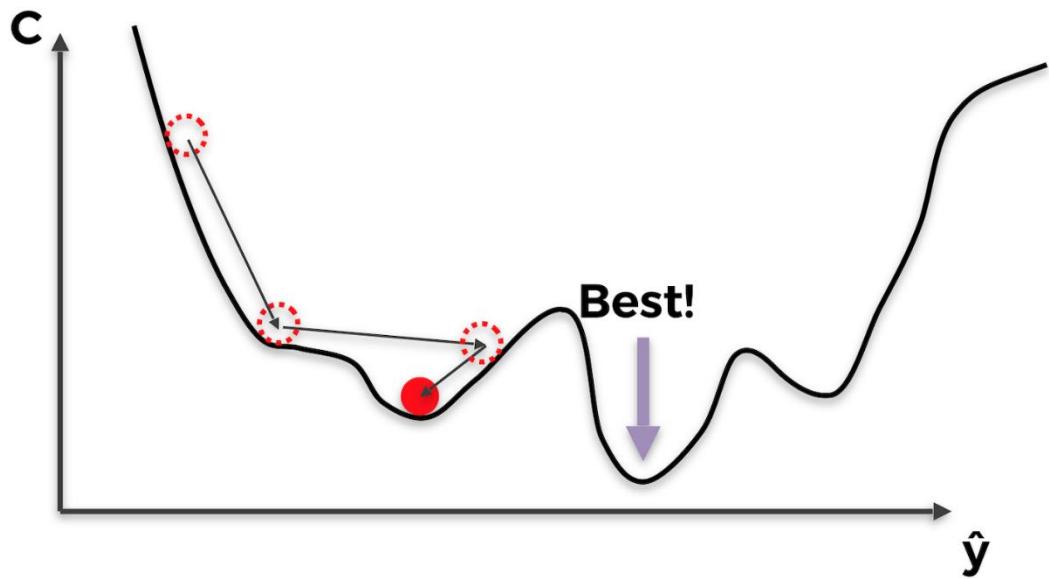


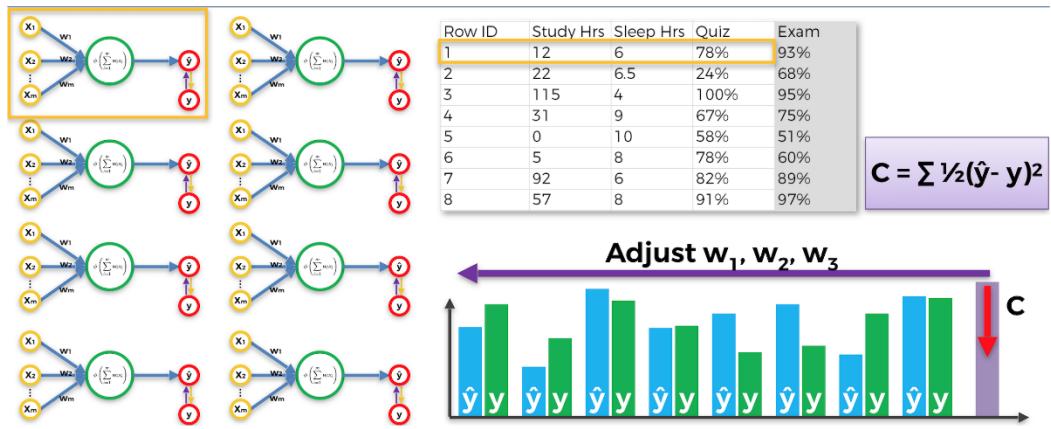
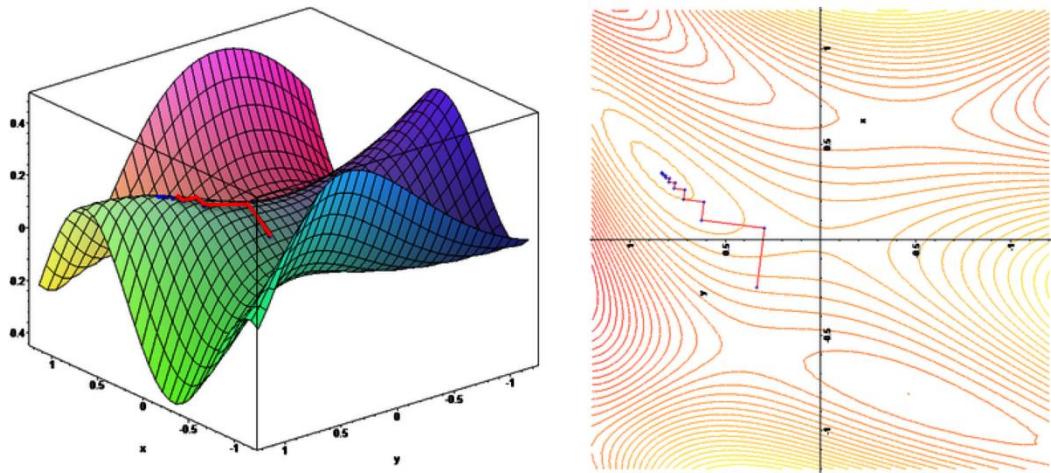












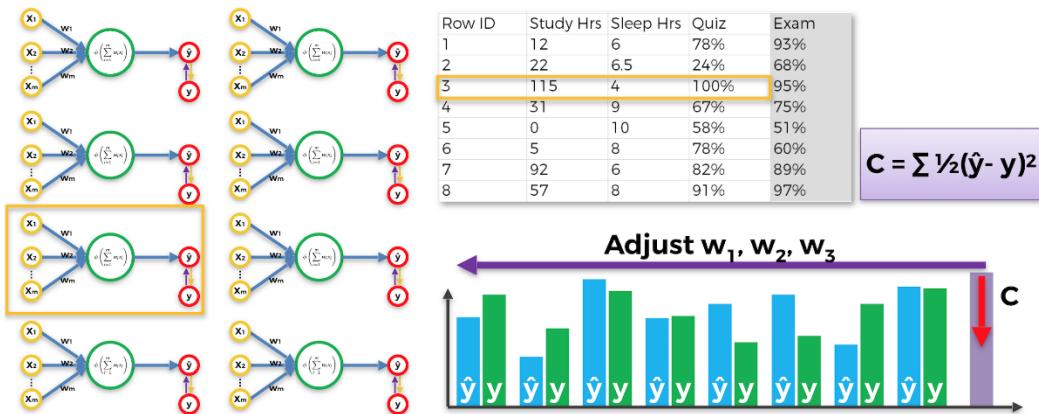
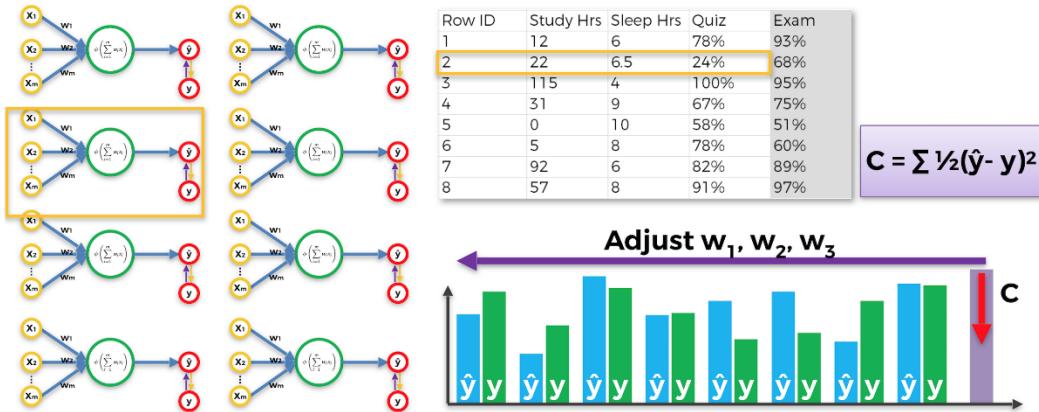


Diagram comparing Batch Gradient Descent and Stochastic Gradient Descent. It shows two tables of data. The left table shows the entire dataset with a purple arrow labeled "Upd w's" pointing to it. The right table shows the same data with individual rows highlighted in yellow, and purple arrows labeled "Upd w's" pointing to each row, indicating that weights are updated for each row sequentially.

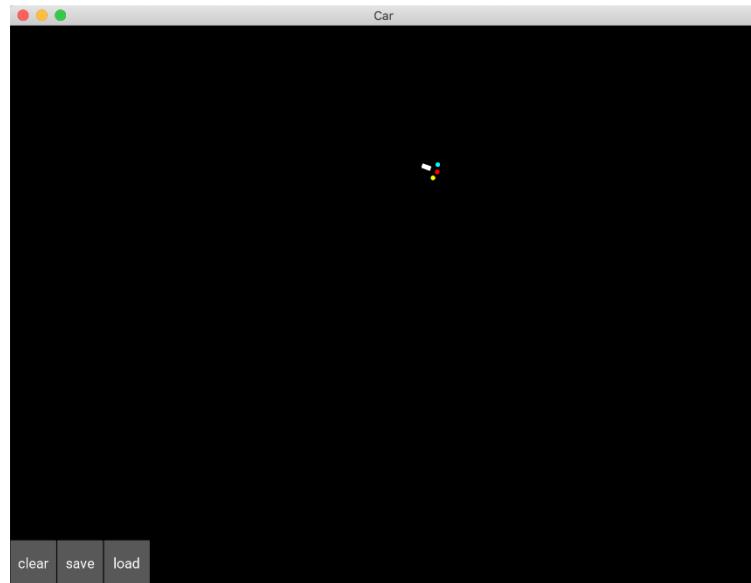
Row ID	Study Hrs	Sleep Hrs	Quiz	Exam
1	12	6	78%	93%
2	22	6.5	24%	68%
3	115	4	100%	95%
4	31	9	67%	75%
5	0	10	58%	51%
6	5	8	78%	60%
7	92	6	82%	89%
8	57	8	91%	97%

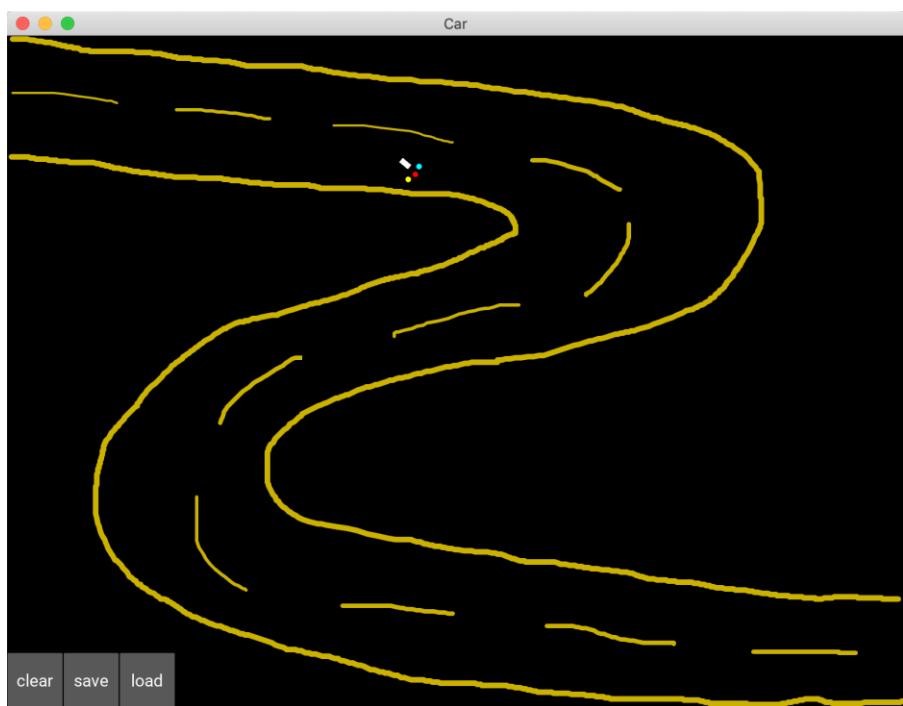
Row ID	Study Hrs	Sleep Hrs	Quiz	Exam
1	12	6	78%	93%
2	22	6.5	24%	68%
3	115	4	100%	95%
4	31	9	67%	75%
5	0	10	58%	51%
6	5	8	78%	60%
7	92	6	82%	89%
8	57	8	91%	97%

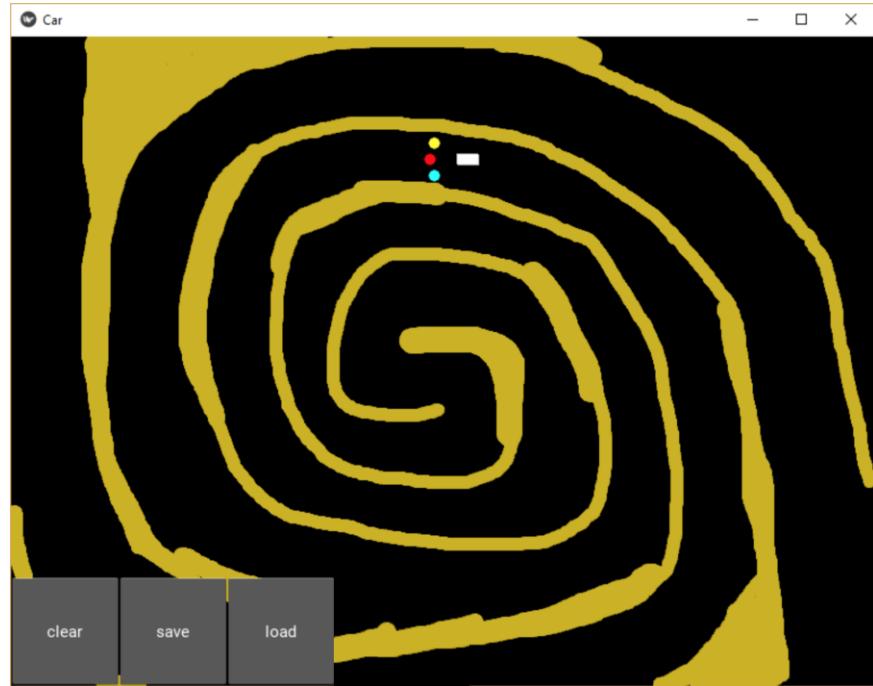
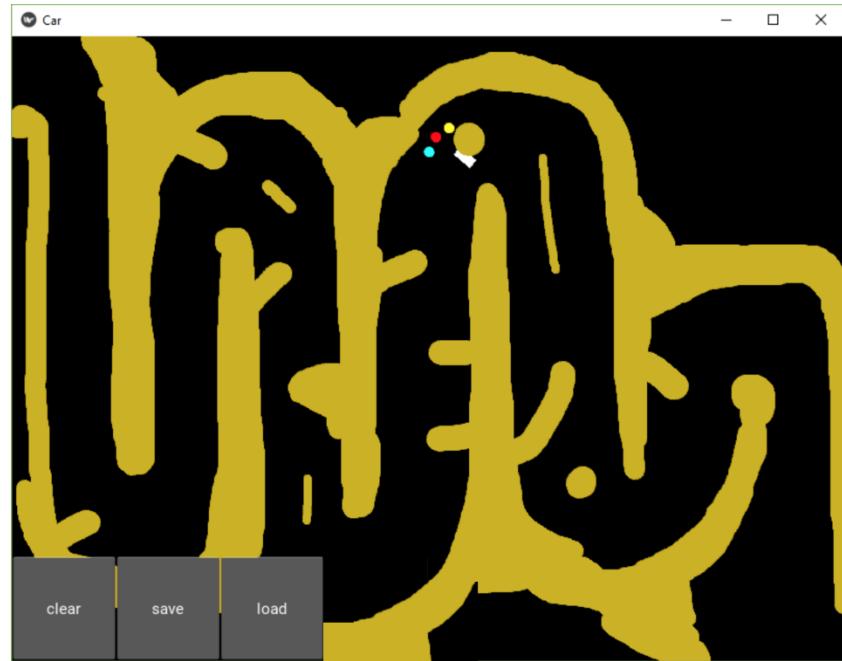
Batch Gradient Descent

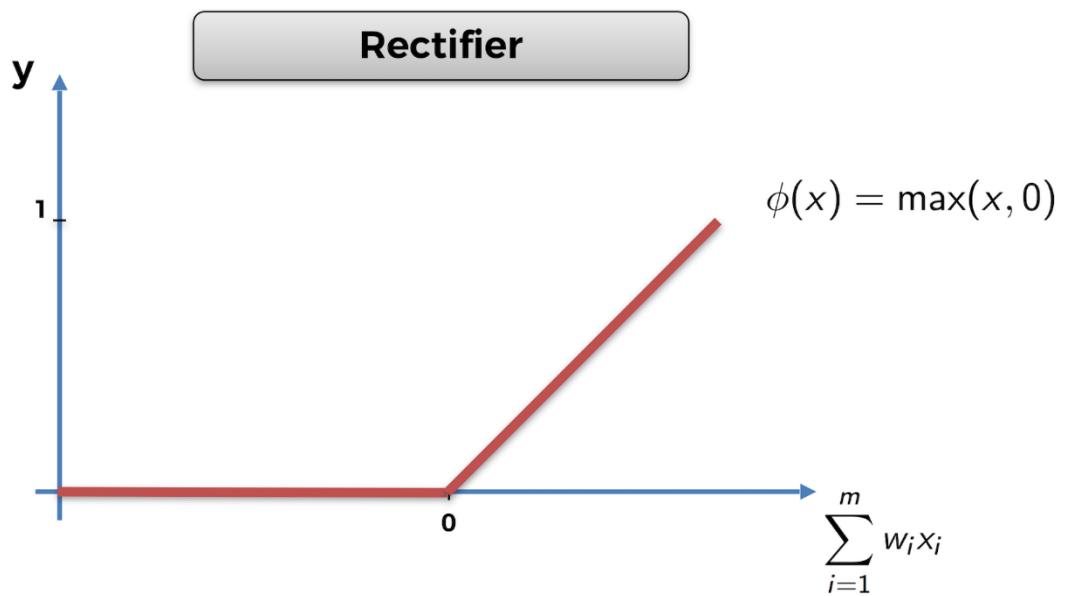
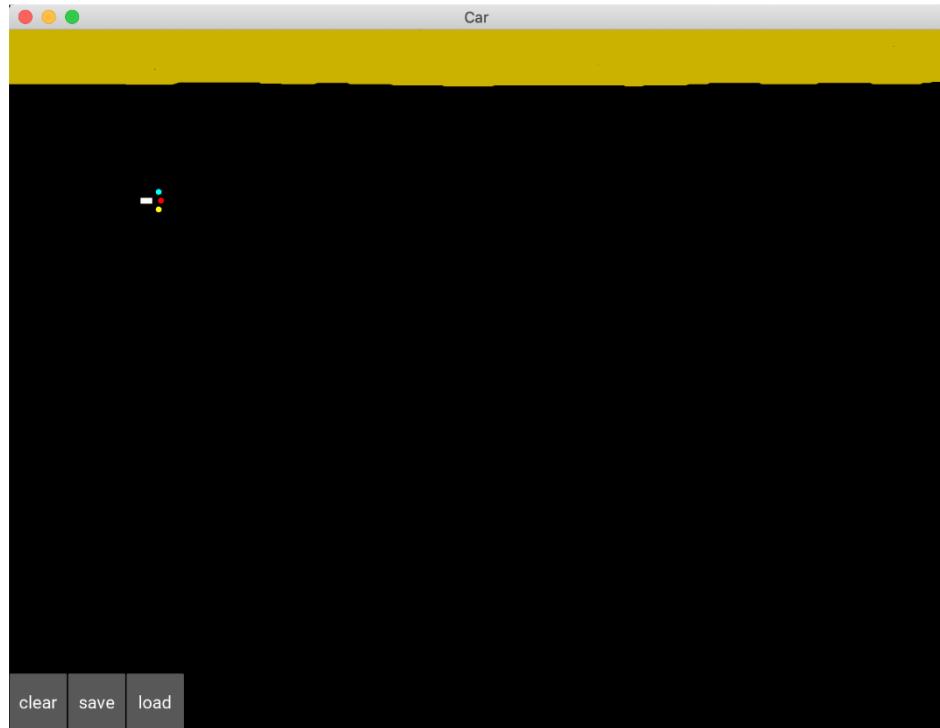
Stochastic Gradient Descent

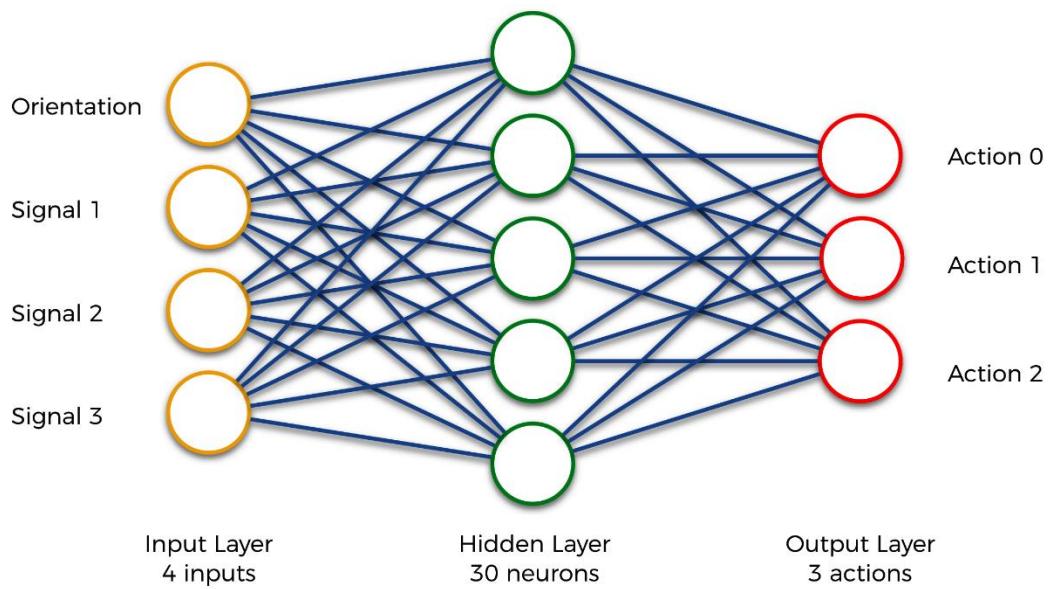
Chapter 10: AI for Autonomous Vehicles – Build a Self-Driving Car











Row ID	Study Hrs	Sleep Hrs	Quiz	Exam
1	12	6	78%	93%
2	22	6.5	24%	68%
3	115	4	100%	95%
4	31	9	67%	75%
5	0	10	58%	51%
6	5	8	78%	60%
7	92	6	82%	89%
8	57	8	91%	97%

Upd w's (Batch Gradient Descent) points to the first row of the table.

Row ID	Study Hrs	Sleep Hrs	Quiz	Exam
1	12	6	78%	93%
2	22	6.5	24%	68%
3	115	4	100%	95%
4	31	9	67%	75%
5	0	10	58%	51%
6	5	8	78%	60%
7	92	6	82%	89%
8	57	8	91%	97%

Upd w's (Stochastic Gradient Descent) points to the first row of the second table.

Batch Gradient Descent

Stochastic Gradient Descent

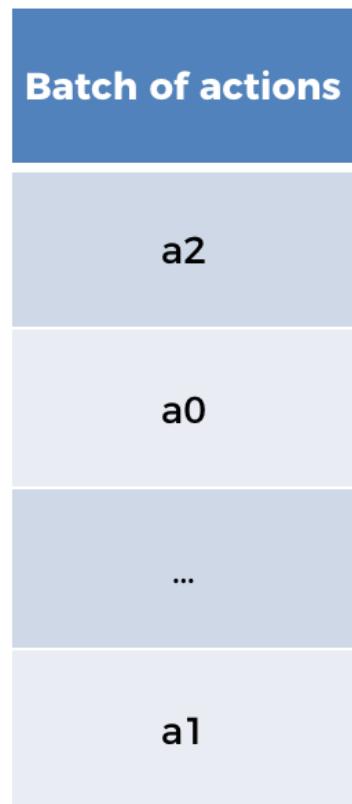
Batch of last states	Batch of actions	Batch of rewards	Batch of next states
Last State 1	Action 1	Reward 1	Next state 1
Last State 2	Action 2	Reward 2	Next state 2
...
Last State 100	Action 100	Reward 100	Next state 100

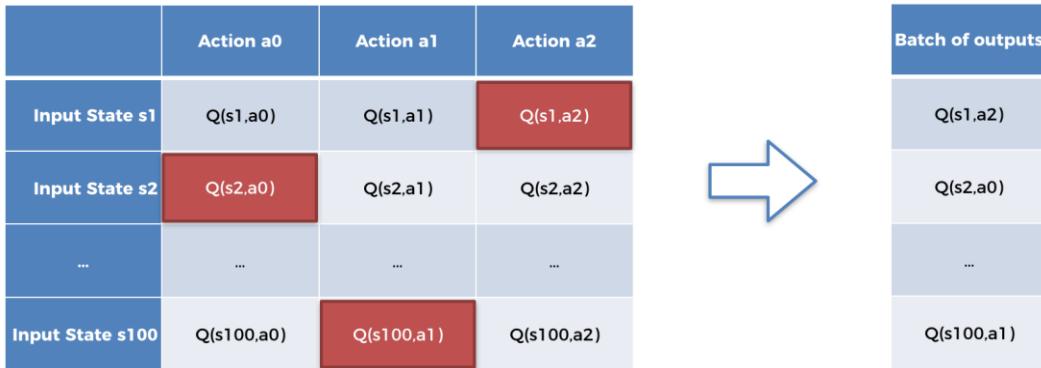
to this:



Dimension of the state	Dimension of the batch	Dimension of the state
Last State 1	Batch 1	Last State 1
Last State 2	Batch 1	Last State 2
...
Last State 100	Batch 1	Last State 100
Last State 101	Batch 2	Last State 101
Last State 102	Batch 2	Last State 102
...
Last State 200	Batch 2	Last State 200

	Action a0	Action a1	Action a2
Input State s1	$Q(s1,a0)$	$Q(s1,a1)$	$Q(s1,a2)$
Input State s2	$Q(s2,a0)$	$Q(s2,a1)$	$Q(s2,a2)$
...
Input State s100	$Q(s100,a0)$	$Q(s100,a1)$	$Q(s100,a2)$





Anaconda 2019.03 for macOS Installer

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```

● ○ ●
HOME Hadelin — -bash — 112x24
Last login: Wed Apr 10 14:39:40 on ttys000
(base) hadelin-macbook-pro:~ Hadelin$ conda create -n selfdrivingcar python=3.6

```

```
● ○ ● Hadelin — conda create -n selfdrivingcar python=3.6 — 112x24
Total: 23.2 MB
```

The following NEW packages will be INSTALLED:

ca-certificates	pkgs/main/osx-64::ca-certificates-2019.1.23-0
certifi	pkgs/main/osx-64::certifi-2019.3.9-py36_0
libcxx	pkgs/main/osx-64::libcxx-4.0.1-hcfea43d_1
libcxxabi	pkgs/main/osx-64::libcxxabi-4.0.1-hcfea43d_1
libedit	pkgs/main/osx-64::libedit-3.1.20181209-hb402a30_0
libffi	pkgs/main/osx-64::libffi-3.2.1-h475c297_4
ncurses	pkgs/main/osx-64::ncurses-6.1-h0a44026_1
openssl	pkgs/main/osx-64::openssl-1.1.1b-h1de35cc_1
pip	pkgs/main/osx-64::pip-19.0.3-py36_0
python	pkgs/main/osx-64::python-3.6.8-haf84260_0
readline	pkgs/main/osx-64::readline-7.0-h1de35cc_5
setuptools	pkgs/main/osx-64::setuptools-40.8.0-py36_0
sqlite	pkgs/main/osx-64::sqlite-3.27.2-ha441bb4_0
tk	pkgs/main/osx-64::tk-8.6.8-ha441bb4_0
wheel	pkgs/main/osx-64::wheel-0.33.1-py36_0
xz	pkgs/main/osx-64::xz-5.2.4-h1de35cc_4
zlib	pkgs/main/osx-64::zlib-1.2.11-h1de35cc_3

Proceed ([y]/n)? █

```
● ○ ● Hadelin — bash — 112x24
Proceed ([y]/n)? y

Downloading and Extracting Packages
python-3.6.8 | 20.5 MB | #####| 100%
wheel-0.33.1 | 39 KB | #####| 100%
pip-19.0.3 | 1.9 MB | #####| 100%
certifi-2019.3.9 | 155 KB | #####| 100%
setuptools-40.8.0 | 622 KB | #####| 100%
Preparing transaction: done
Verifying transaction: done
Executing transaction: done
#
# To activate this environment, use
#
#     $ conda activate selfdrivingcar
#
# To deactivate an active environment, use
#
#     $ conda deactivate
(base) hadelin-macbook-pro:~ Hadelin$ █
```



```
● ○ ● Hadelin — conda install pytorch==0.3.1 -c pytorch — 112x24
mkl_random-1.0.2          | py36h27c97d8_0           382 KB
numpy-1.16.2               | py36hacdac7b_0           49 KB
numpy-base-1.16.2          | py36h6575580_0           4.2 MB
pycparser-2.19              | py36_0                   173 KB
pytorch-0.3.1              | py36_cuda0.0_cudnn0.0_2   6.0 MB  pytorch
-----
Total:                      11.2 MB
```

The following NEW packages will be INSTALLED:

```
blas                  pkgs/main/osx-64::blas-1.0-mkl
cffi                 pkgs/main/osx-64::cffi-1.12.2-py36hb5b8e2f_1
intel-openmp          pkgs/main/osx-64::intel-openmp-2019.3-199
libgfortran           pkgs/main/osx-64::libgfortran-3.0.1-h93005f0_2
mkl                  pkgs/main/osx-64::mkl-2019.3-199
mkl_fft               pkgs/main/osx-64::mkl_fft-1.0.10-py36h5e564d8_0
mkl_random            pkgs/main/osx-64::mkl_random-1.0.2-py36h27c97d8_0
numpy                pkgs/main/osx-64::numpy-1.16.2-py36hacdac7b_0
numpy-base             pkgs/main/osx-64::numpy-base-1.16.2-py36h6575580_0
pycparser              pkgs/main/osx-64::pycparser-2.19-py36_0
pytorch               pkgs/main/osx-64::pytorch-0.3.1-py36_cuda0.0_cudnn0.0_2
```

Proceed ([y]/n)? █

```
● ○ ● Hadelin — bash — 112x24
numpy                pkgs/main/osx-64::numpy-1.17.2-py36h99e6662_0
numpy-base            pkgs/main/osx-64::numpy-base-1.17.2-py36h6575580_0
pycparser             pkgs/main/osx-64::pycparser-2.19-py36_0
pytorch               pytorch/osx-64::pytorch-0.3.1-py36_cuda0.0_cudnn0.0_2
six                  pkgs/main/osx-64::six-1.12.0-py36_0

Proceed ([y]/n)? y

Downloading and Extracting Packages
numpy-base-1.17.2      | 4.0 MB    | #####| 100%
mkl_random-1.1.0       | 287 KB    | #####| 100%
pycparser-2.19          | 170 KB    | #####| 100%
cffi-1.12.3            | 212 KB    | #####| 100%
mkl-service-2.3.0       | 202 KB    | #####| 100%
numpy-1.17.2            | 4 KB      | #####| 100%
pytorch-0.3.1           | 6.0 MB    | #####| 100%
mkl_fft-1.0.14          | 139 KB    | #####| 100%
six-1.12.0              | 22 KB     | #####| 100%
Preparing transaction: done
Verifying transaction: done
Executing transaction: done
(selfdrivingcar) hadelin-macbook-pro:~ Hadelin$
```

```
● ● ● Hadelin — conda install -c conda-forge kivy — 112×24
libiconv      conda-forge/osx-64::libiconv-1.15-h01d97ff_1005
libpng        conda-forge/osx-64::libpng-1.6.36-ha441bb4_1000
libtiff       conda-forge/osx-64::libtiff-4.0.10-h79f4b77_1001
olefile       conda-forge/noarch::olefile-0.46-py_0
pcre          conda-forge/osx-64::pcre-8.41-h0a44026_1003
pillow        conda-forge/osx-64::pillow-5.2.0-py36h2dc6135_1
pygments      conda-forge/noarch::pygments-2.3.1-py_0
SDL2          conda-forge/osx-64::SDL2-2.0.8-h0a44026_1001
SDL2_image    conda-forge/osx-64::SDL2_image-2.0.4-hacd bef4_0
SDL2_mixer    conda-forge/osx-64::SDL2_mixer-2.0.1-hfc679d8_1
SDL2_ttf      conda-forge/osx-64::SDL2_ttf-2.0.14-hdd9f355_1
smpeg2        conda-forge/osx-64::smpeg2-2.0.0-hfc679d8_1

The following packages will be UPDATED:

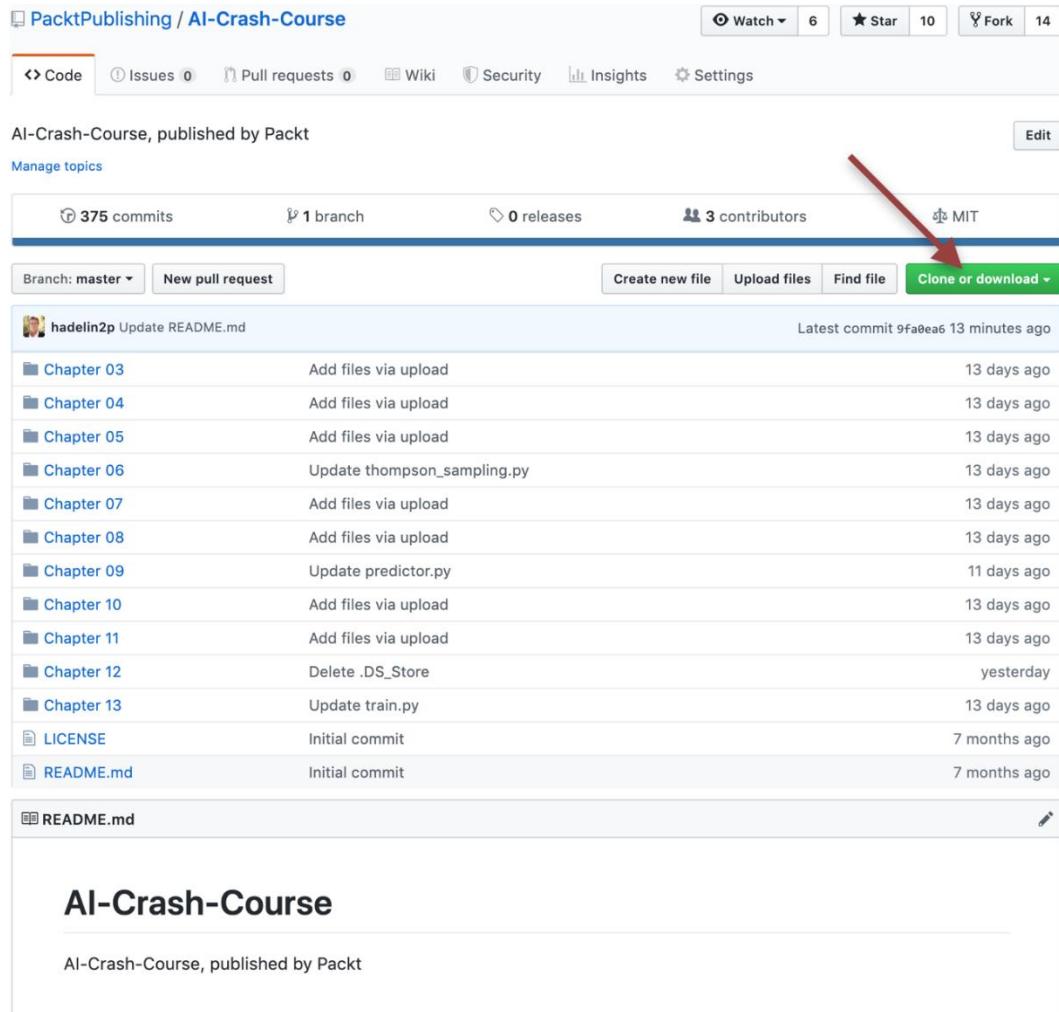
ca-certificates pkgs/main::ca-certificates-2019.1.23-0 --> conda-forge::ca-certificates-2019.3.9-hecc5488_0
openssl        pkgs/main::openssl-1.1.1b-h1de35cc_1 --> conda-forge::openssl-1.1.1b-h01d97ff_2

The following packages will be SUPERSEDED by a higher-priority channel:

certifi          pkgs/main --> conda-forge

Proceed ([y]/n)?
```

```
● ● ● Hadelin — -bash — 112x24
kivy-1.10.1 | 21.3 MB | #####| 100%
ca-certificates-2019 | 146 KB | #####| 100%
pcre-8.41 | 222 KB | #####| 100%
sdl2_mixer-2.0.1 | 151 KB | #####| 100%
olefile-0.46 | 31 KB | #####| 100%
libtiff-4.0.10 | 486 KB | #####| 100%
openssl-1.1.1b | 3.5 MB | #####| 100%
freetype-2.8.1 | 830 KB | #####| 100%
certifi-2019.3.9 | 149 KB | #####| 100%
smpeg2-2.0.0 | 158 KB | #####| 100%
gettext-0.19.8.1 | 3.3 MB | #####| 100%
libiconv-1.15 | 1.3 MB | #####| 100%
glib-2.58.3 | 3.1 MB | #####| 100%
jpeg-9c | 237 KB | #####| 100%
pygments-2.3.1 | 641 KB | #####| 100%
gst-plugins-base-1.1 | 2.1 MB | #####| 100%
gstreamer-1.14.4 | 1.7 MB | #####| 100%
libpng-1.6.36 | 306 KB | #####| 100%
pillow-5.2.0 | 542 KB | #####| 100%
sdl2_ttf-2.0.14 | 29 KB | #####| 100%
Preparing transaction: done
Verifying transaction: done
Executing transaction: done
(selfdrivingcar) hadelin@macbook-pro:~ Hadelin$
```

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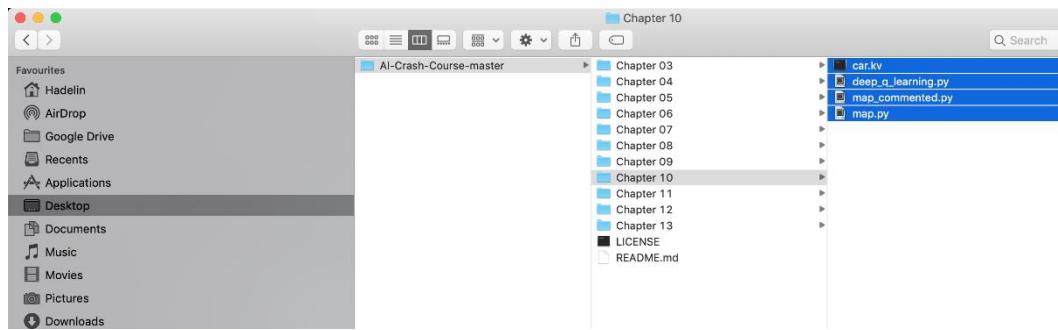
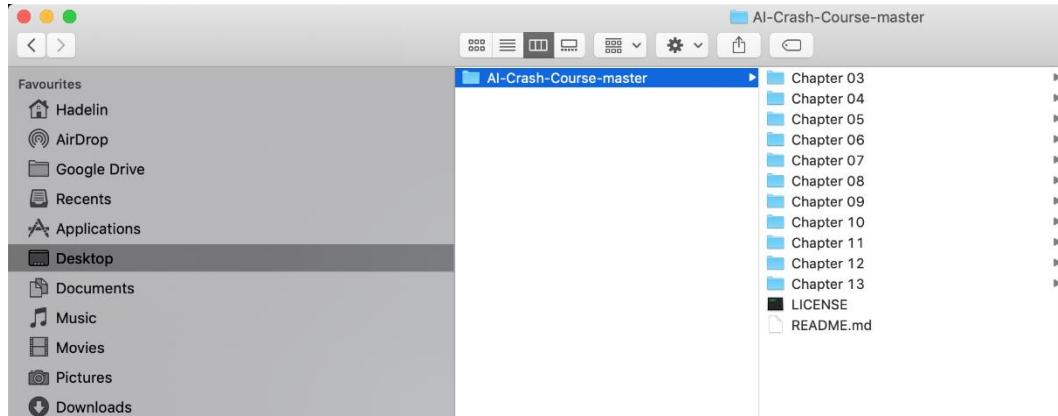
hadelin2p Update README.md Latest commit 9fa0ea6 13 minutes ago

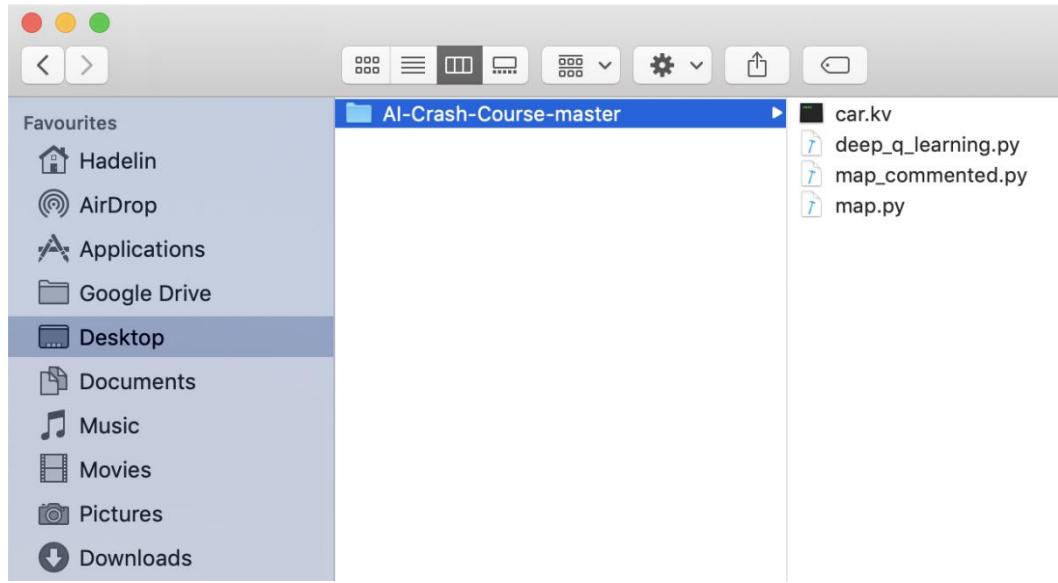
Chapter 03	Add files via upload	13 days ago
Chapter 04	Add files via upload	13 days ago
Chapter 05	Add files via upload	13 days ago
Chapter 06	Update thompson_sampling.py	13 days ago
Chapter 07	Add files via upload	13 days ago
Chapter 08	Add files via upload	13 days ago
Chapter 09	Update predictor.py	11 days ago
Chapter 10	Add files via upload	13 days ago
Chapter 11	Add files via upload	13 days ago
Chapter 12	Delete .DS_Store	yesterday
Chapter 13	Update train.py	13 days ago
LICENSE	Initial commit	7 months ago
README.md	Initial commit	7 months ago

README.md

AI-Crash-Course

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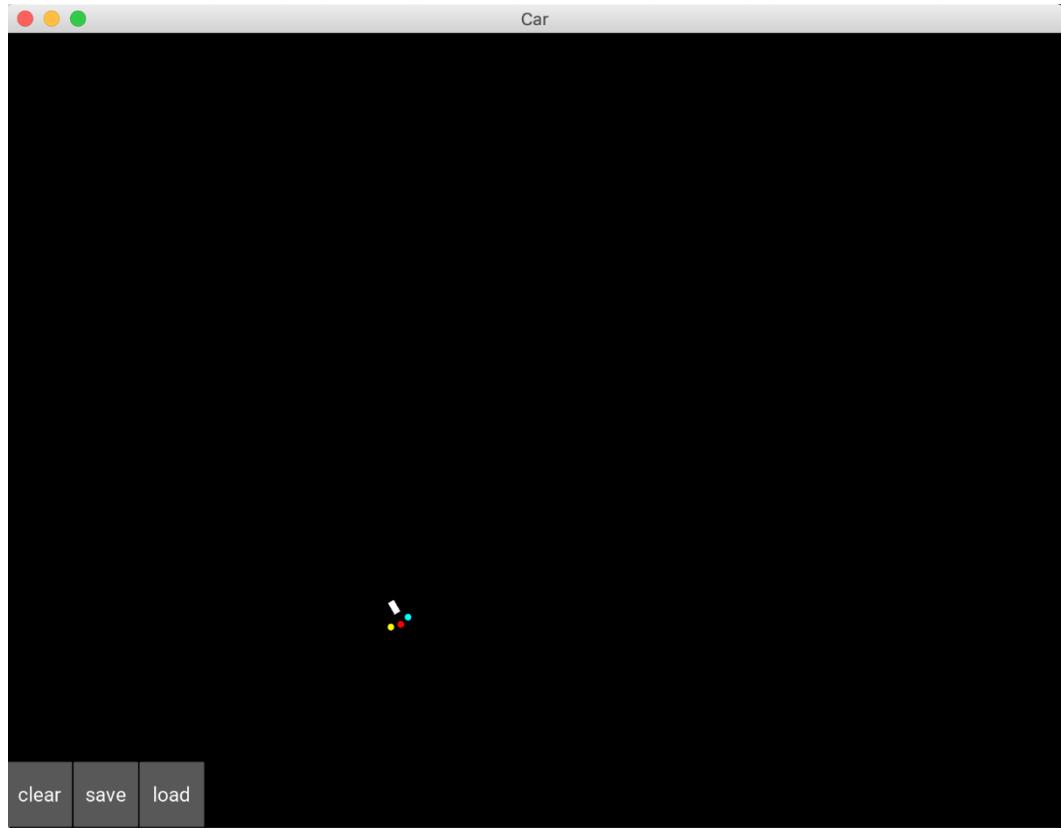
```
  Hadelin — bash — 112x24
sdl2_mixer-2.0.1      | 151 KB  | #####|#####
olefile-0.46          | 31 KB   | #####|#####
libtiff-4.0.10         | 486 KB  | #####|#####
openssl-1.1.1b        | 3.5 MB  | #####|#####
freetype-2.8.1         | 830 KB  | #####|#####
certifi-2019.3.9      | 149 KB  | #####|#####
smpeg2-2.0.0           | 158 KB  | #####|#####
gettext-0.19.8.1       | 3.3 MB  | #####|#####
libiconv-1.15          | 1.3 MB  | #####|#####
glib-2.58.3            | 3.1 MB  | #####|#####
jpeg-9c                | 237 KB  | #####|#####
pygments-2.3.1         | 641 KB  | #####|#####
gst-plugins-base-1.1    | 2.1 MB  | #####|#####
gstreamer-1.14.4        | 1.7 MB  | #####|#####
libpng-1.6.36           | 306 KB  | #####|#####
pillow-5.2.0             | 542 KB  | #####|#####
sdl2_ttf-2.0.14          | 29 KB   | #####|#####
Preparing transaction: done
Verifying transaction: done
Executing transaction: done
[(selfdrivingcar) hadelin-macbook-pro:~ Hadelin$ ls
Applications  Documents  Google Drive  Movies  Pictures
Desktop      Downloads  Library      Music   Public
(selfdrivingcar) hadelin-macbook-pro:~ Hadelin$ ]
```

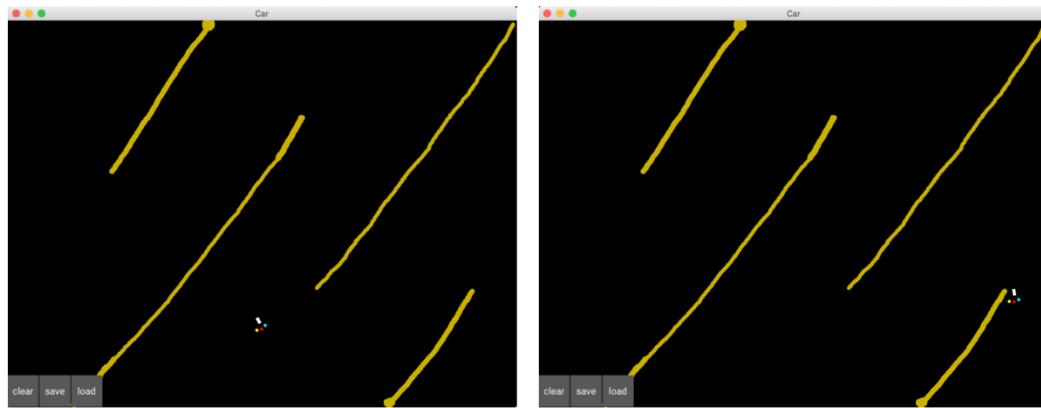
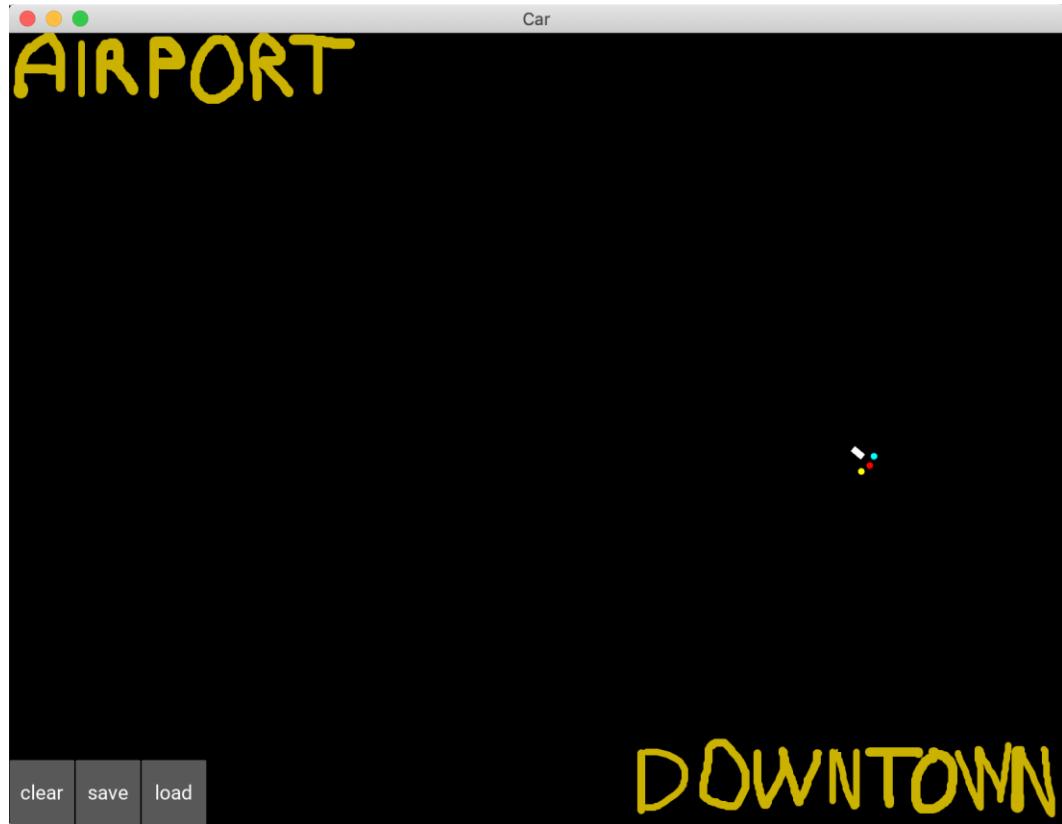
```
olefile-0.46          | 31 KB  | #####| 100%
libtiff-4.0.10        | 486 KB | #####| 100%
openssl-1.1.1b        | 3.5 MB | #####| 100%
freetype-2.8.1         | 830 KB | #####| 100%
certifi-2019.3.9       | 149 KB | #####| 100%
smpeg2-2.0.0           | 158 KB | #####| 100%
gettext-0.19.8.1       | 3.3 MB | #####| 100%
libiconv-1.15          | 1.3 MB | #####| 100%
glib-2.58.3             | 3.1 MB | #####| 100%
jpeg-9c                  | 237 KB | #####| 100%
pygments-2.3.1          | 641 KB | #####| 100%
gst-plugins-base-1.1     | 2.1 MB | #####| 100%
gstreamer-1.14.4        | 1.7 MB | #####| 100%
libpng-1.6.36            | 306 KB | #####| 100%
pillow-5.2.0              | 542 KB | #####| 100%
sdl2_ttf-2.0.14          | 29 KB | #####| 100%
Preparing transaction: done
Verifying transaction: done
Executing transaction: done
[(selfdrivingcar) hadelins-macbook-pro:~ Hadelin$ ls
 Applications    Documents    Google Drive    Movies    Pictures
 Desktop          Downloads   Library       Music     Public
 [(selfdrivingcar) hadelins-macbook-pro:~ cd Desktop/
 [(selfdrivingcar) hadelins-macbook-pro:Desktop Hadelin$ ]]
```

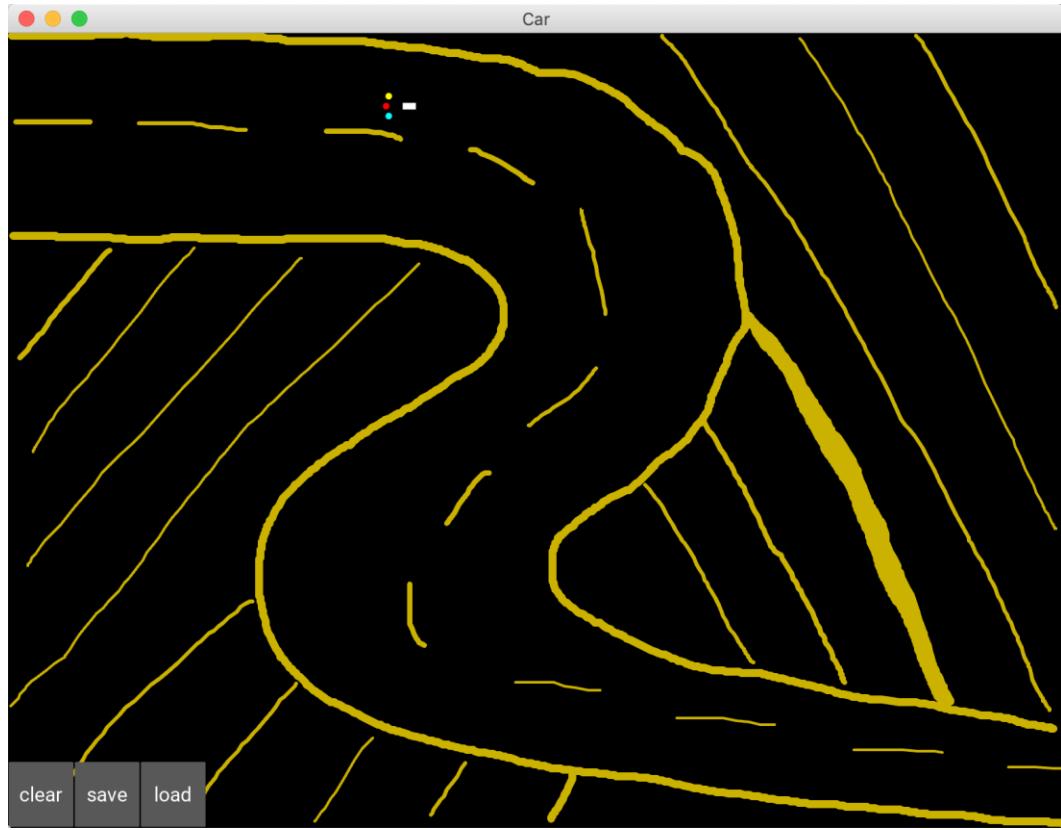
```
openssl-1.1.1b          | 3.5 MB | #####| 100%
freetype-2.8.1            | 830 KB | #####| 100%
certifi-2019.3.9           | 149 KB | #####| 100%
smpeg2-2.0.0               | 158 KB | #####| 100%
gettext-0.19.8.1            | 3.3 MB | #####| 100%
libiconv-1.15                | 1.3 MB | #####| 100%
glib-2.58.3                  | 3.1 MB | #####| 100%
jpeg-9c                     | 237 KB | #####| 100%
pygments-2.3.1                 | 641 KB | #####| 100%
gst-plugins-base-1.1           | 2.1 MB | #####| 100%
gstreamer-1.14.4                 | 1.7 MB | #####| 100%
libpng-1.6.36                  | 306 KB | #####| 100%
pillow-5.2.0                      | 542 KB | #####| 100%
sdl2_ttf-2.0.14                    | 29 KB | #####| 100%
Preparing transaction: done
Verifying transaction: done
Executing transaction: done
[(selfdrivingcar) hadelins-macbook-pro:~ Hadelin$ ls
 Applications    Documents    Google Drive    Movies    Pictures
 Desktop          Downloads   Library       Music     Public
 [(selfdrivingcar) hadelins-macbook-pro:~ cd Desktop/
 [(selfdrivingcar) hadelins-macbook-pro:Desktop Hadelin$ ls
 AI-Crash-Course-master
 [(selfdrivingcar) hadelins-macbook-pro:Desktop Hadelin$ ]]
```

```
AI-Crash-Course-master — bash — 112x24
freetype-2.8.1      |  830 KB  | #####|#####
certifi-2019.3.9   | 149 KB  | #####|#####
smpeg2-2.0.0        | 158 KB  | #####|#####
gettext-0.19.8.1   |  3.3 MB  | #####|#####
libiconv-1.15       | 1.3 MB  | #####|#####
glib-2.58.3         | 3.1 MB  | #####|#####
jpeg-9c             | 237 KB  | #####|#####
pygments-2.3.1     | 641 KB  | #####|#####
gst-plugins-base-1.1| 2.1 MB  | #####|#####
gstreamer-1.14.4    | 1.7 MB  | #####|#####
libpng-1.6.36       | 306 KB  | #####|#####
pillow-5.2.0        | 542 KB  | #####|#####
sdl2_ttf-2.0.14     | 29 KB   | #####|#####
Preparing transaction: done
Verifying transaction: done
Executing transaction: done
((selfdrivingcar) hadelins-macbook-pro:~ Hadelin$ ls
Applications      Documents      Google Drive      Movies          Pictures
Desktop           Downloads     Library          Music          Public
((selfdrivingcar) hadelins-macbook-pro:~ Hadelin$ cd Desktop/
((selfdrivingcar) hadelins-macbook-pro:Desktop Hadelin$ ls
AI-Crash-Course-master
((selfdrivingcar) hadelins-macbook-pro:Desktop Hadelin$ cd AI-Crash-Course-master/
((selfdrivingcar) hadelins-macbook-pro:AI-Crash-Course-master Hadelin$ ]
```

```
AI-Crash-Course-master — bash — 112x24
gettext-0.19.8.1   |  3.3 MB  | #####|#####
libiconv-1.15      | 1.3 MB  | #####|#####
glib-2.58.3         | 3.1 MB  | #####|#####
jpeg-9c             | 237 KB  | #####|#####
pygments-2.3.1     | 641 KB  | #####|#####
gst-plugins-base-1.1| 2.1 MB  | #####|#####
gstreamer-1.14.4    | 1.7 MB  | #####|#####
libpng-1.6.36       | 306 KB  | #####|#####
pillow-5.2.0        | 542 KB  | #####|#####
sdl2_ttf-2.0.14     | 29 KB   | #####|#####
Preparing transaction: done
Verifying transaction: done
Executing transaction: done
((selfdrivingcar) hadelins-macbook-pro:~ Hadelin$ ls
Applications      Documents      Google Drive      Movies          Pictures
Desktop           Downloads     Library          Music          Public
((selfdrivingcar) hadelins-macbook-pro:~ Hadelin$ cd Desktop/
((selfdrivingcar) hadelins-macbook-pro:Desktop Hadelin$ ls
AI-Crash-Course-master
((selfdrivingcar) hadelins-macbook-pro:Desktop Hadelin$ cd AI-Crash-Course-master/
((selfdrivingcar) hadelins-macbook-pro:AI-Crash-Course-master Hadelin$ ls
    car.kv              map.py
    deep_q_learning.py  map_commented.py ←
((selfdrivingcar) hadelins-macbook-pro:AI-Crash-Course-master Hadelin$ ]
```

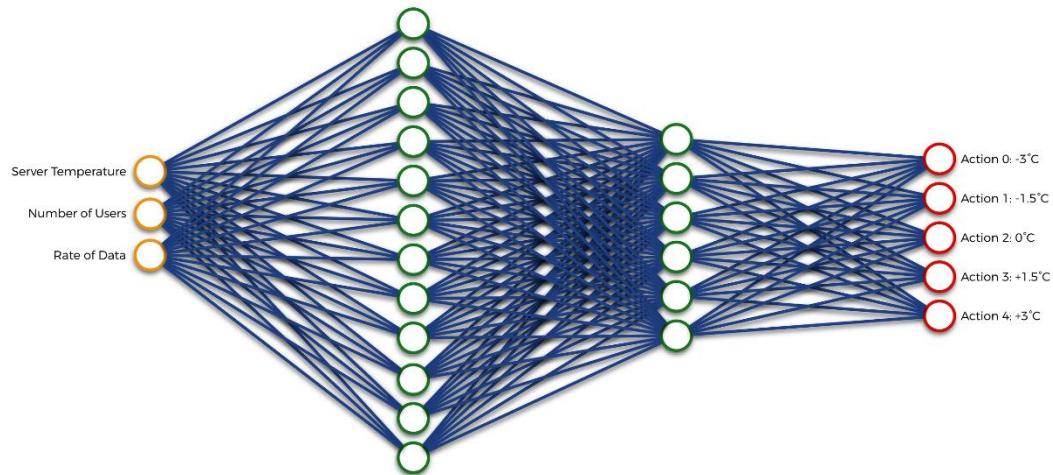



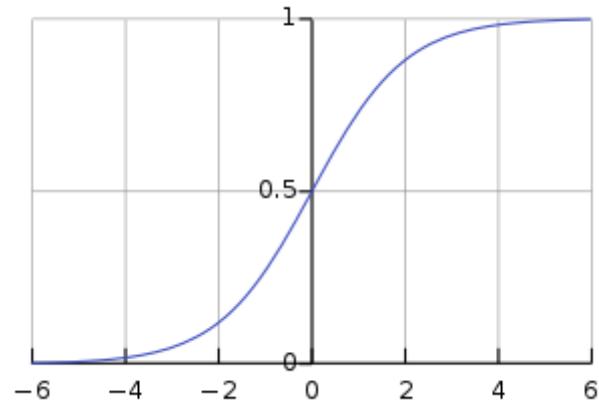
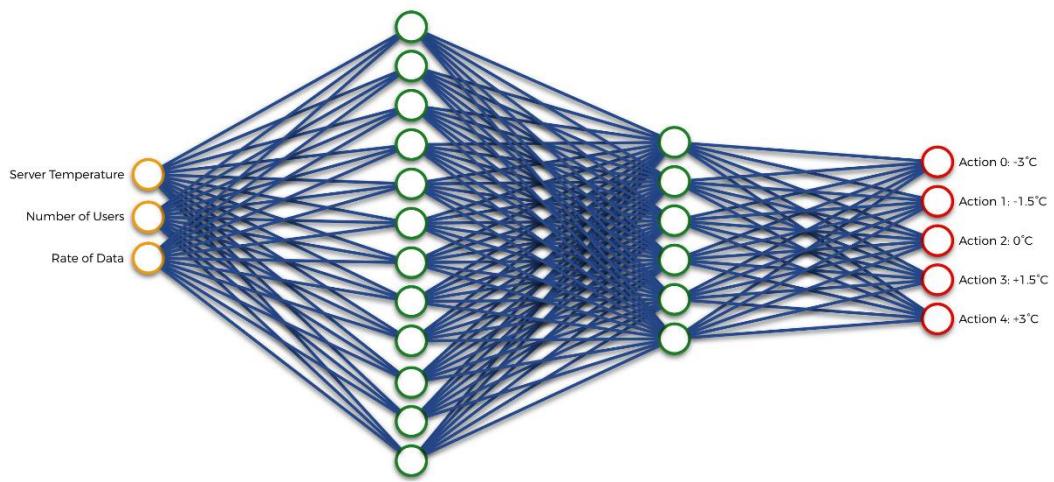




Chapter 11: AI for Business – Minimize Costs with Deep Q-Learning

Action	What it does
0	The AI cools down the server by 3°C
1	The AI cools down the server by 1.5°C
2	The AI does not transfer any heat to the server (no temperature change)
3	The AI heats up the server by 1.5°C
4	The AI heats up the server by 3°C





	Number of Users	Rate of Data	Server Temperature
Input State 1	0	0	0
Input State 2	0	0	0
Input State 3	0	0	0
Input State 4	0	0	0
Input State 5	0	0	0
Input State 6	0	0	0
Input State 7	0	0	0
Input State 8	0	0	0
Input State 9	0	0	0
Input State 10	0	0	0

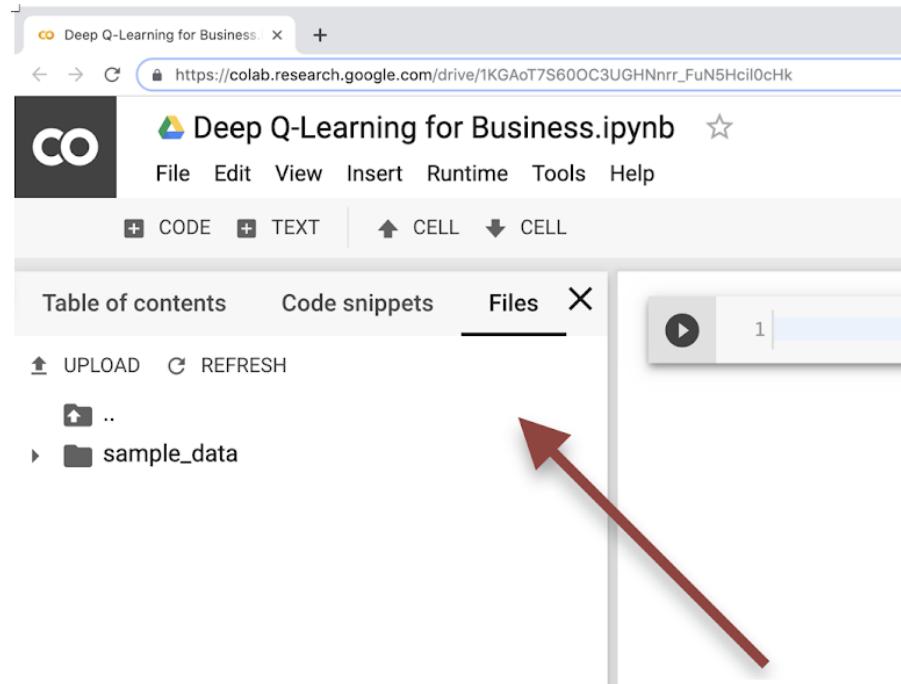
	Action 0	Action 1	Action 2	Action 3	Action 4
Target 1	0	0	0	0	0
Target 2	0	0	0	0	0
Target 3	0	0	0	0	0
Target 4	0	0	0	0	0
Target 5	0	0	0	0	0
Target 6	0	0	0	0	0
Target 7	0	0	0	0	0
Target 8	0	0	0	0	0
Target 9	0	0	0	0	0
Target 10	0	0	0	0	0

	Number of Users	Rate of Data	Server Temperature
Input State 1	U1	D1	T1
Input State 2	U2	D2	T2
Input State 3	U3	D3	T3
Input State 4	U4	D4	T4
Input State 5	U5	D5	T5
Input State 6	U6	D6	T6
Input State 7	U7	D7	T7
Input State 8	U8	D8	T8
Input State 9	U9	D9	T9
Input State 10	U10	D10	T10

	Action 0	Action 1	Action 2	Action 3	Action 4
Target 1	Q(State 1, Action 0)	Q(State 1, Action 1)	Q(State 1, Action 2)	Q(State 1, Action 3)	Q(State 1, Action 4)
Target 2	Q(State 2, Action 0)	Q(State 2, Action 1)	Q(State 2, Action 2)	Q(State 2, Action 3)	Q(State 2, Action 4)
Target 3	Q(State 3, Action 0)	Q(State 3, Action 1)	Q(State 3, Action 2)	Q(State 3, Action 3)	Q(State 3, Action 4)
Target 4	Q(State 4, Action 0)	Q(State 4, Action 1)	Q(State 4, Action 2)	Q(State 4, Action 3)	Q(State 4, Action 4)
Target 5	Q(State 5, Action 0)	Q(State 5, Action 1)	Q(State 5, Action 2)	Q(State 5, Action 3)	Q(State 5, Action 4)
Target 6	Q(State 6, Action 0)	Q(State 6, Action 1)	Q(State 6, Action 2)	Q(State 6, Action 3)	Q(State 6, Action 4)
Target 7	Q(State 7, Action 0)	Q(State 7, Action 1)	Q(State 7, Action 2)	Q(State 7, Action 3)	Q(State 7, Action 4)
Target 8	Q(State 8, Action 0)	Q(State 8, Action 1)	Q(State 8, Action 2)	Q(State 8, Action 3)	Q(State 8, Action 4)
Target 9	Q(State 9, Action 0)	Q(State 9, Action 1)	Q(State 9, Action 2)	Q(State 9, Action 3)	Q(State 9, Action 4)
Target 10	Q(State 10, Action 0)	Q(State 10, Action 1)	Q(State 10, Action 2)	Q(State 10, Action 3)	Q(State 10, Action 4)

	Action 0	Action 1	Action 2	Action 3	Action 4
Target 1	Q(State 1, Action 0)	$r1 + \gamma \max Q(next_state1.a)$	Q(State 1, Action 2)	Q(State 1, Action 3)	Q(State 1, Action 4)
Target 2	Q(State 2, Action 0)	Q(State 2, Action 1)	Q(State 2, Action 2)	$r2 + \gamma \max Q(next_state2.a)$	Q(State 2, Action 4)
Target 3	$r3 + \gamma \max Q(next_state3.a)$	Q(State 3, Action 1)	Q(State 3, Action 2)	Q(State 3, Action 3)	Q(State 3, Action 4)
Target 4	Q(State 4, Action 0)	Q(State 4, Action 1)	$r4 + \gamma \max Q(next_state4.a)$	Q(State 4, Action 3)	Q(State 4, Action 4)
Target 5	Q(State 5, Action 0)	Q(State 5, Action 1)	Q(State 5, Action 2)	Q(State 5, Action 3)	$r5 + \gamma \max Q(next_state5.a)$
Target 6	Q(State 6, Action 0)	$r6 + \gamma \max Q(next_state6.a)$	Q(State 6, Action 2)	Q(State 6, Action 3)	Q(State 6, Action 4)
Target 7	$r7 + \gamma \max Q(next_state7.a)$	Q(State 7, Action 1)	Q(State 7, Action 2)	Q(State 7, Action 3)	Q(State 7, Action 4)
Target 8	Q(State 8, Action 0)	Q(State 8, Action 1)	Q(State 8, Action 2)	$r8 + \gamma \max Q(next_state8.a)$	Q(State 8, Action 4)
Target 9	Q(State 9, Action 0)	Q(State 9, Action 1)	Q(State 9, Action 2)	Q(State 9, Action 3)	$r9 + \gamma \max Q(next_state9.a)$
Target 10	Q(State 10, Action 0)	$r10 + \gamma \max Q(next_state10.a)$	Q(State 10, Action 2)	Q(State 10, Action 3)	Q(State 10, Action 4)

	Action 0	Action 1	Action 2	Action 3	Action 4
Target 1	Q(State 1, Action 0)	$r1 + \gamma \max Q(next_state1.a)$	Q(State 1, Action 2)	Q(State 1, Action 3)	Q(State 1, Action 4)
Target 2	Q(State 2, Action 0)	Q(State 2, Action 1)	Q(State 2, Action 2)	$r2 + \gamma \max Q(next_state2.a)$	Q(State 2, Action 4)
Target 3	$r3 + \gamma \max Q(next_state3.a)$	Q(State 3, Action 1)	Q(State 3, Action 2)	Q(State 3, Action 3)	Q(State 3, Action 4)
Target 4	Q(State 4, Action 0)	Q(State 4, Action 1)	$r4 + \gamma \max Q(next_state4.a)$	Q(State 4, Action 3)	Q(State 4, Action 4)
Target 5	Q(State 5, Action 0)	Q(State 5, Action 1)	Q(State 5, Action 2)	Q(State 5, Action 3)	$r5 + \gamma \max Q(next_state5.a)$
Target 6	Q(State 6, Action 0)	$r6 + \gamma \max Q(next_state6.a)$	Q(State 6, Action 2)	Q(State 6, Action 3)	Q(State 6, Action 4)
Target 7	$r7 + \gamma \max Q(next_state7.a)$	Q(State 7, Action 1)	Q(State 7, Action 2)	Q(State 7, Action 3)	Q(State 7, Action 4)
Target 8	Q(State 8, Action 0)	Q(State 8, Action 1)	Q(State 8, Action 2)	$r8 + \gamma \max Q(next_state8.a)$	Q(State 8, Action 4)
Target 9	Q(State 9, Action 0)	Q(State 9, Action 1)	Q(State 9, Action 2)	Q(State 9, Action 3)	$r9 + \gamma \max Q(next_state9.a)$
Target 10	Q(State 10, Action 0)	$r10 + \gamma \max Q(next_state10.a)$	Q(State 10, Action 2)	Q(State 10, Action 3)	Q(State 10, Action 4)



Deep Q-Learning for Business.ipynb

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.. sample_data

Step 1: Building the Environment

```
[ ] # AI for Business - Minimize cost with Deep Q-Learning
# Building the Environment
# Importing the libraries
import numpy as np
# BUILDING THE ENVIRONMENT IN A CLASS
class Environment(object):
    # INTRODUCING AND INITIALIZING ALL THE PARAMETERS AND VARIABLES OF THE ENVIRONMENT
    def __init__(self, optimal_temperature = (18.0, 24.0), initial_month = 0, initial_number_users = 10, initial_rate_data = 60):
        self.monthly_atmospheric_temperatures = [1.0, 24.0, 7.0, 10.0, 11.0, 20.0, 23.0, 24.0, 22.0, 10.0, 5.0, 1.0]
        self.optimal_temperature = self.monthly_atmospheric_temperatures[initial_month]
        self.current_temperature = optimal_temperature
        self.max_temperature = 80
        self.min_number_users = 10
        self.intrinsic_temperature = 100
        self.max_update_users = 5
        self.min_rate_data = 20
        self.current_rate_data = 60
        self.max_update_data = 10
        self.initial_number_users = initial_number_users
        self.current_number_users = initial_number_users
        self.initial_rate_data = initial_rate_data
        self.current_rate_data = initial_rate_data
        self.intrinsic_temperature = self.atmospheric_temperature + 1.25 * self.current_number_users + 1.25 * self.current_rate_data
        self.temperature_noai = (self.intrinsic_temperature - self.optimal_temperature) / 2.0
        self.total_energy_noai = 0.0
        self.energy_noai = 0.0
        self.reward = 0.0
        self.game_over = 0
        self.vizcall = 1
    # MAKING A METHOD THAT UPDATES THE ENVIRONMENT RIGHT AFTER THE AI PLAYS AN ACTION
    def update_env(self, direction, energy_noi, month):
        # GETTING THE REWARD
        # Computing the energy spent by the server's cooling system when there is no AI
        energy_noai = 0
        if (self.temperature_noai < self.optimal_temperature[0]):
            energy_noai = self.optimal_temperature[0] - self.temperature_noai
            self.temperature_noai = self.optimal_temperature[0]
```

Deep Q-Learning for Business.ipynb

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Step 1: Building the Environment

Step 2: Building the Brain

```
[ ] 1 # AI for Business - Minimize cost with Deep Q-Learning
2 # Building the Brain with Dropout
3
4 # Importing the libraries
5 from keras.layers import Input, Dense, Dropout
6 from keras.models import Model
7 from keras.optimizers import Adam
8
9 # BUILDING THE BRAIN
10
11 class Brain(object):
12
13     # BUILDING A FULLY CONNECTED NEURAL NETWORK DIRECTLY INSIDE THE INIT METHOD
14
15     def __init__(self, learning_rate = 0.001, number_actions = 5):
16         self.learning_rate = learning_rate
17
18         # BUILDING THE INPUT LAYER COMPOSED OF THE INPUT STATE
19         states = Input(shape = (3,))
20
21         # BUILDING THE FIRST FULLY CONNECTED HIDDEN LAYER WITH DROPOUT ACTIVATED
22         x = Dense(units = 64, activation = 'sigmoid')(states)
23         x = Dropout(rate = 0.1)(x)
24
25         # BUILDING THE SECOND FULLY CONNECTED HIDDEN LAYER WITH DROPOUT ACTIVATED
26         y = Dense(units = 32, activation = 'sigmoid')(x)
27         y = Dropout(rate = 0.1)(y)
28
29         # BUILDING THE OUTPUT LAYER, FULLY CONNECTED TO THE LAST HIDDEN LAYER
30         q_values = Dense(units = number_actions, activation = 'softmax')(y)
31
32         # ASSEMBLING THE FULL ARCHITECTURE INSIDE A MODEL OBJECT
33         self.model = Model(inputs = states, outputs = q_values)
34
35         # COMPILED THE MODEL WITH A MEAN-SQUARED ERROR LOSS AND A CHOSEN OPTIMIZER
36         self.model.compile(loss = 'mse', optimizer = Adam(lr = learning_rate))
```

Step 3: Implementing Deep Q-Learning with Experience Replay

```
[ ] 1 # AI for Business - Minimize cost with Deep Q-Learning
2 # Implementing Deep Q-Learning with Experience Replay
3
4 # Importing the libraries
5 import numpy as np
```

Deep Q-Learning for Business.ipynb

Step 3: Implementing Deep Q-Learning with Experience Replay

```
[ ] 1 # AI for Business - Minimize cost with Deep Q-Learning
2 # Implementing Deep Q-Learning with Experience Replay
3
4 # Importing the libraries
5 import numpy as np
6
7 # IMPLEMENTING DEEP Q-LEARNING WITH EXPERIENCE REPLAY
8
9 class DQN(object):
10
11     # INTRODUCING AND INITIALIZING ALL THE PARAMETERS AND VARIABLES OF THE DQN
12     def __init__(self, max_memory = 100, discount = 0.9):
13         self.memory = list()
14         self.max_memory = max_memory
15         self.discount = discount
16
17     # MAKING A METHOD THAT BUILDS THE MEMORY IN EXPERIENCE REPLAY
18     def remember(self, transition, game_over):
19         if len(self.memory) > self.max_memory:
20             del self.memory[0]
21
22     # MAKING A METHOD THAT BUILDS TWO BATCHES OF INPUTS AND TARGETS BY EXTRACTING TRANSITIONS FROM THE MEMORY
23     def get_batch(self, model, batch_size = 10):
24
25         len_memory = len(self.memory)
26         num_inputs = self.memory[0][0].shape[1]
27         num_outputs = self.memory[0][0].shape[0]
28
29         inputs = np.zeros((min(len_memory, batch_size), num_inputs))
30         targets = np.zeros((min(len_memory, batch_size), num_outputs))
31
32         for i, idx in enumerate(np.random.randint(0, len_memory, size = min(len_memory, batch_size))):
33             current_state, action, reward, next_state = self.memory[idx][0]
34             game_over = self.memory[idx][1]
35             inputs[i] = current_state
36             targets[i] = model.predict(current_state)[0]
37             Q_sa = np.max(model.predict(next_state)[0])
38
39             if game_over:
40                 targets[i, action] = reward
41             else:
42                 targets[i, action] = reward + self.discount * Q_sa
43
44         return inputs, targets
```

Step 4: Training the AI

```
[ ] 1 # AI for Business - Minimize cost with Deep Q-Learning
```

Deep Q-Learning for Business.ipynb

Step 4: Training the AI

```
[ ] 1 # AI for Business - Minimize cost with Deep Q-Learning
2 # Training the AI with Early Stopping
3
4 # Importing the libraries and the other python files
5 import os
6 import numpy as np
7 from random import randint
8 import environment
9 import brain_dropout
10 import dqn
11
12 # Setting seeds for reproducibility
13 os.environ['PYTHONHASHSEED'] = '0'
14 np.random.seed(12345)
15
16 # SETTING THE PARAMETERS
17 epsilon = .3
18 number_actions = 5
19 direction_boundary = (number_actions - 1) / 2
20 number_epochs = 100
21 optimal_temperature = 3000
22 batch_size = 512
23 temperature_step = 1.5
24
25 # BUILDING THE ENVIRONMENT BY SIMPLY CREATING AN OBJECT OF THE ENVIRONMENT CLASS
26 env = environment.Environment(optimal_temperature = (18.0, 24.0), initial_month = 0, initial_number_users = 20, initial_rate_data = 30)
27
28 # BUILDING THE BRAIN BY SIMPLY CREATING AN OBJECT OF THE BRAIN CLASS
29 brain = brain_dropout.Brain(learning_rate = 0.00001, number_actions = number_actions)
30
31 # BUILDING THE DQN MODEL BY SIMPLY CREATING AN OBJECT OF THE DQN CLASS
32 dqn = dqn.DQN(max_memory = max_memory, discount = 0.9)
33
34 # CHOOSING THE MODE
35 train = True
36
37 # TRAINING THE AI
38 env.train = train
39 model = brain.model
40 early_stopping = True
41 patience = 10
42 best_total_reward = -np.inf
43 total_reward = 0
44
45 if (env.train):
46     # STARTING THE LOOP OVER ALL THE EPOCHS (1 Epoch = 5 Months)
47     for epoch in range(1, number_epochs):
48         # INITIALIZING ALL THE VARIABLES OF BOTH THE ENVIRONMENT AND THE TRAINING LOOP
49         total_reward = 0
```

```

1 # AI for Business - Minimize cost with Deep Q-Learning
2 # Testing the AI
3
4 # Installing Keras
5 # conda install -c conda-forge keras
6
7 # Importing the libraries and the other python files
8 import os
9 import numpy as np
10 import random as rn
11 from keras.models import load_model
12 import environment
13
14 # Setting seed for reproducibility
15 os.environ['PYTHONHASHSEED'] = '0'
16 np.random.seed(42)
17 rn.seed(12345)
18
19 # SETTING THE PARAMETERS
20 number_actions = 5
21 direction_boundary = (number_actions - 1) / 2
22 temperature_step = 1.5
23
24 # BUILDING THE ENVIRONMENT BY SIMPLY CREATING AN OBJECT OF THE ENVIRONMENT CLASS
25 env = environment.Environment(optimal_temperature = (18.0, 24.0), initial_month = 0, initial_number_users = 20, initial_rate_data = 30)
26
27 # LOADING A PRE-TRAINED BRAIN
28 model = load_model("model.h5")
29
30 # CHOOSING THE MODE
31 train = False
32
33 # RUNNING A 1 YEAR SIMULATION IN INFERENCE MODE
34 env.train = train
35 current_state_0 = env.observe()
36 for timestep in range(0, 12 * 30 * 24 * 60):
37     q_values = model.predict(current_state_0)
38     action = np.argmax(q_values[0])
39     if (action > direction_boundary < 0):
40         direction = -1
41     else:
42         direction = 1
43     energy_ai = abs(action - direction_boundary) * temperature_step
44     next_state, reward, game_over = env.update_env(direction, energy_ai, int(timestep / (30 * 24 * 60)))
45     current_state_0 = next_state
46
47 # PRINTING THE TRAINING RESULTS FOR EACH EPOCH
48 print("\n")
49 print("Total Energy spent with an AI: {:.0f}.".format(env.total_energy_ai))

```

▼ Step 4: Training the AI

```

1 # AI for Business - Minimize cost with Deep Q-Learning
2 # Training the AI with Early Stopping
3
4 # Importing the libraries and the other python files
5 import os
6 import numpy as np
7 import random as rn
8 import environment
9 import brain_dropout
10 import dqn
11

```

▼ Step 4: Training the AI

```
[4] 1 # AI for Business - Minimize cost with Deep Q-Learning
2 # Training the AI with Early Stopping
3
4 # Importing the libraries and the other python files
5 import os
6 import numpy as np
7 import random as rn
8
```

```
21 temperature_step = 1.5
22
23 # BUILDING THE ENVIRONMENT BY SIMPLY CREATING AN OBJECT OF THE ENVIRONMENT CLASS
24 env = environment.Environment(optimal_temperature = (18.0, 24.0), initial_month = 0, in
25
26
```

```
24 env = environment.Environment(optimal_temperature = (18.0, 24.0), initial_month = 0,
25
26 # BUILDING THE BRAIN BY SIMPLY CREATING AN OBJECT OF THE BRAIN CLASS
27 brain = brain_dropout.Brain(learning_rate = 0.00001, number_actions = number_actions)
28
29 # BUILDING THE DQN MODEL BY SIMPLY CREATING AN OBJECT OF THE DQN CLASS
30 dqn = dqn.DQN(max_memory = max_memory, discount = 0.9)
31
```

```
28
29 # BUILDING THE DQN MODEL BY SIMPLY CREATING AN OBJECT OF THE DQN CLASS
30 dqn = dqn.DQN(max_memory = max_memory, discount = 0.9)
31
32 # CHOOSING THE MODE
```

```
8 import os
9 import numpy as np
10 import random as rn
11 from keras.models import load_model
12 import environment
13
```

```
24 # BUILDING THE ENVIRONMENT BY SIMPLY CREATING AN OBJECT OF THE ENVIRONMENT CLASS
25 env = environment.Environment(optimal_temperature = (18.0, 24.0), initial_month = 0,
26
27 # LOADING A PRE-TRAINED BRAIN
28 model = load_model("model.h5")
```

```
... WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/tensorflow/python/framework/
Instructions for updating:
Colocations handled automatically by placer.
WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/keras/backend/tensorflow_bac
Instructions for updating:
Please use `rate` instead of `keep_prob`. Rate should be set to `rate = 1 - keep_prob`.
WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/tensorflow/python/ops/math_o
Instructions for updating:
Use tf.cast instead.

Epoch: 001/100
Total Energy spent with an AI: 30
Total Energy spent with no AI: 146

Epoch: 002/100
Total Energy spent with an AI: 0
Total Energy spent with no AI: 0

Epoch: 003/100
Total Energy spent with an AI: 4
Total Energy spent with no AI: 22

Epoch: 004/100
Total Energy spent with an AI: 28
Total Energy spent with no AI: 116

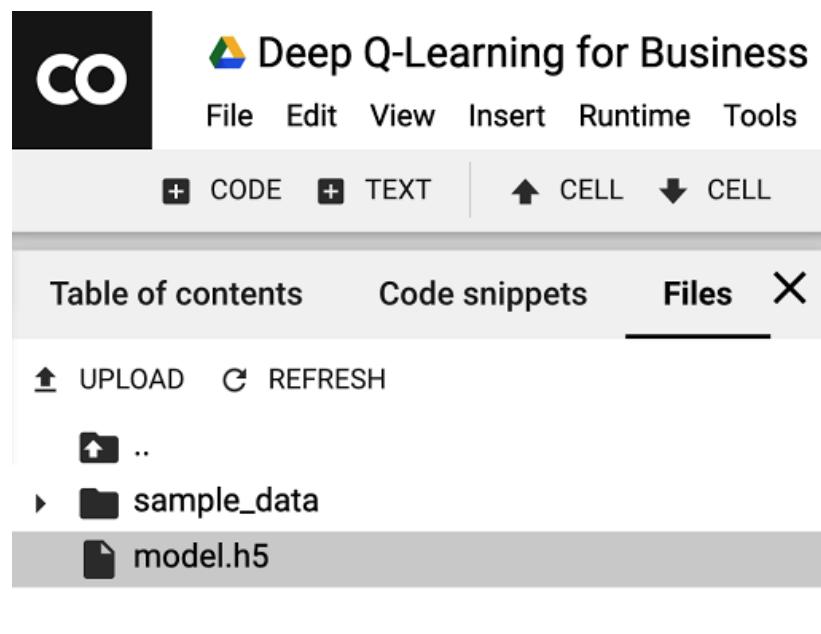
Epoch: 005/100
Total Energy spent with an AI: 46
Total Energy spent with no AI: 224
```

```
Epoch: 012/100
Total Energy spent with an AI: 0
Total Energy spent with no AI: 2
```

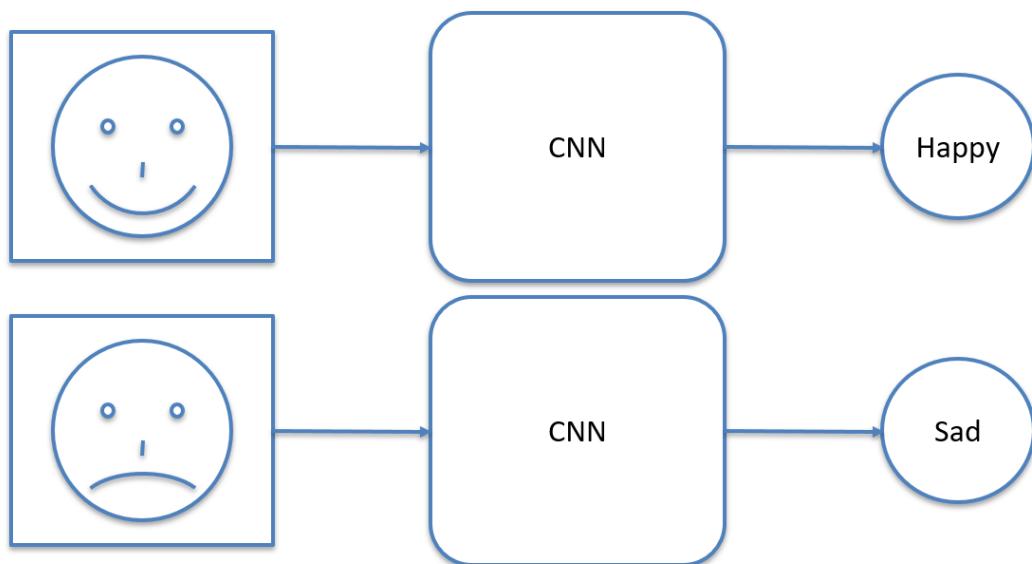
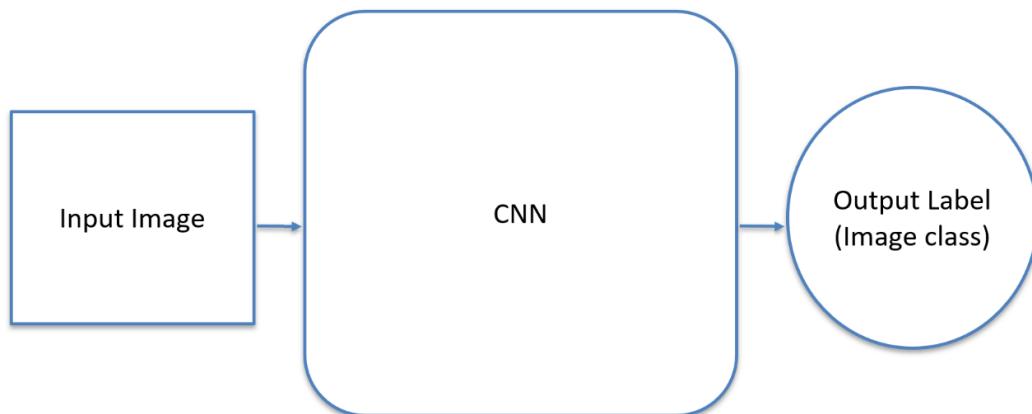
```
Epoch: 013/100
Total Energy spent with an AI: 3
Total Energy spent with no AI: 0
```

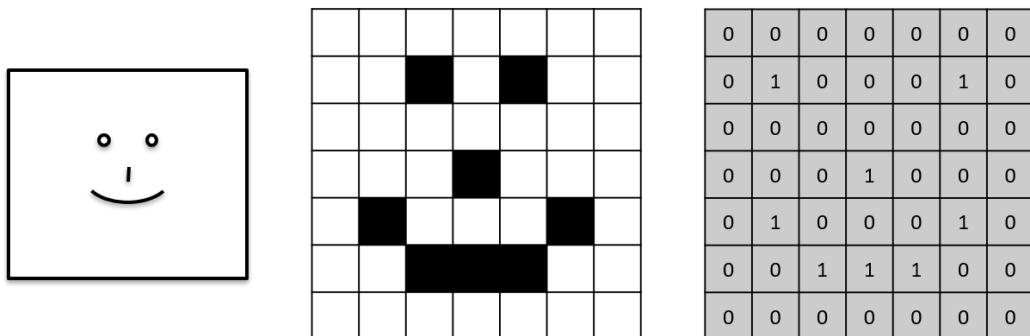
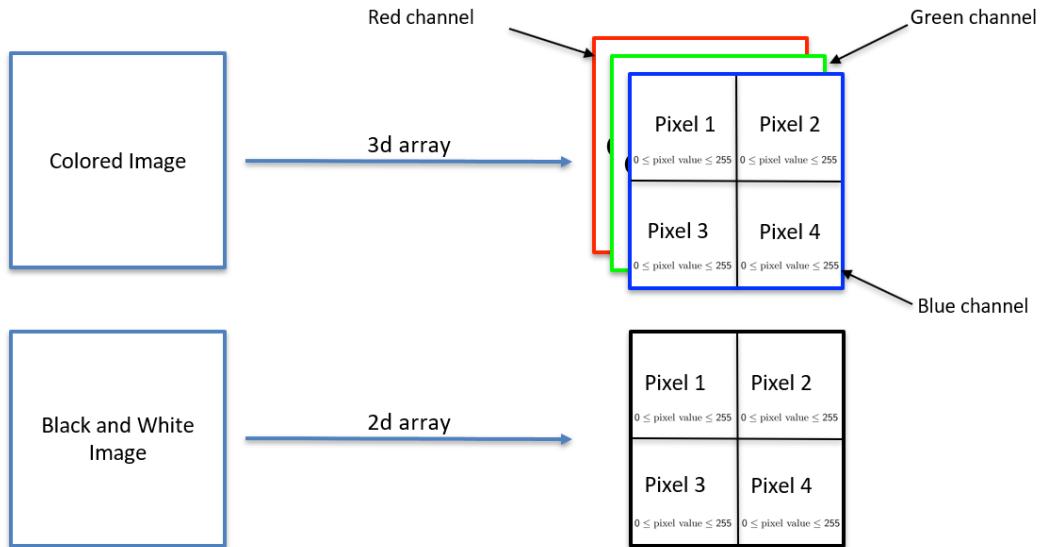
```
Epoch: 014/100
Total Energy spent with an AI: 0
Total Energy spent with no AI: 0
```

```
Epoch: 015/100
Total Energy spent with an AI: 0
Total Energy spent with no AI: 0
Early Stopping
```



Chapter 12: Deep Convolutional Q-Learning





0	0	0	0	0	0	0
0	1	0	0	0	1	0
0	0	0	0	0	0	0
0	0	0	1	0	0	0
0	1	0	0	0	1	0
0	0	1	1	1	0	0
0	0	0	0	0	0	0

Input Image

0	0	1
1	0	0
0	1	1

Feature Detector

0			

Feature Map

0	0	0	0	0	0	0
0	1	0	0	0	1	0
0	0	0	0	0	0	0
0	0	0	1	0	0	0
0	1	0	0	0	1	0
0	0	1	1	1	0	0
0	0	0	0	0	0	0

Input Image

0	0	1
1	0	0
0	1	1

Feature Detector

0	1		

Feature Map

0	0	0	0	0	0	0
0	1	0	0	0	1	0
0	0	0	0	0	0	0
0	0	0	1	0	0	0
0	1	0	0	0	1	0
0	0	1	1	1	0	0
0	0	0	0	0	0	0

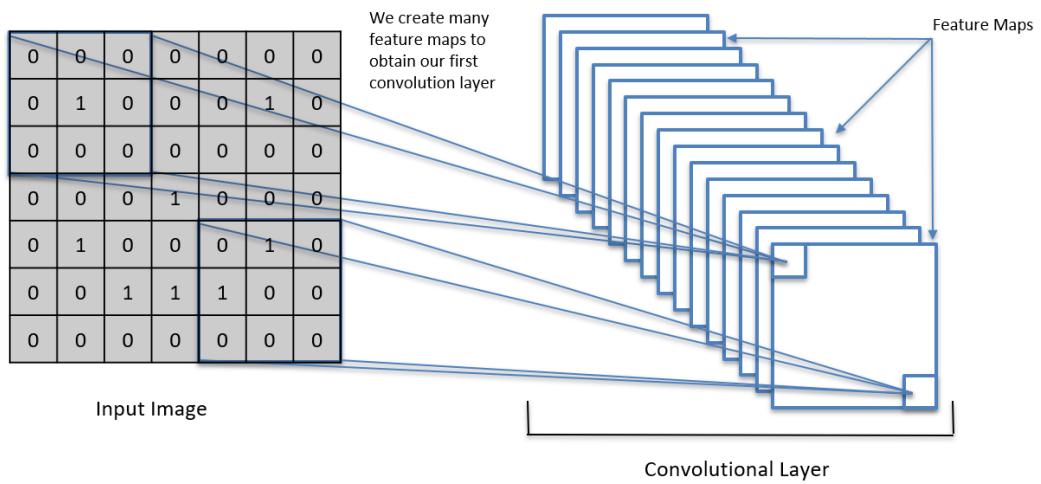
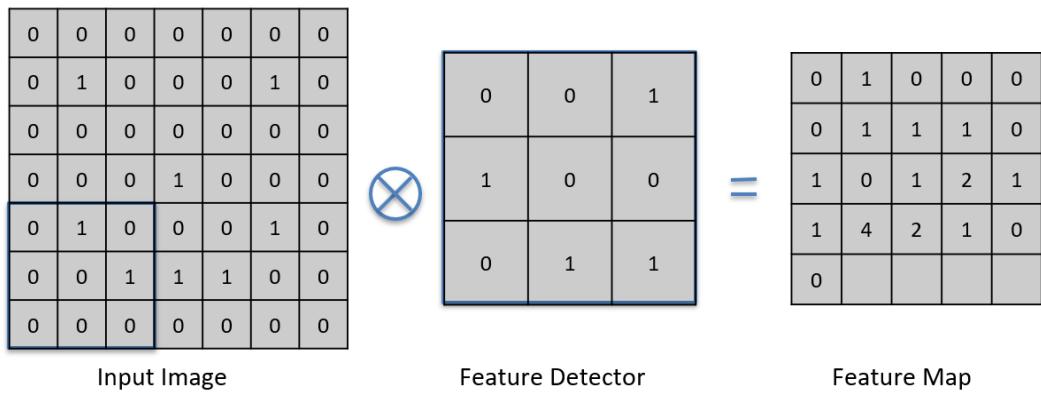
Input Image

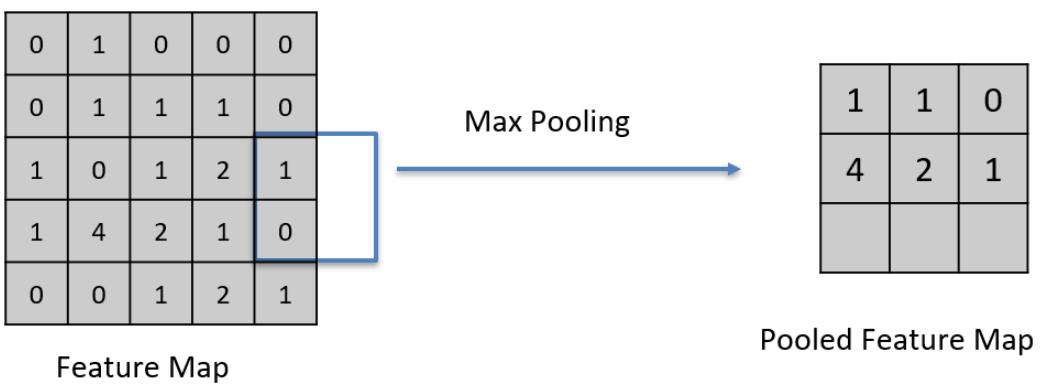
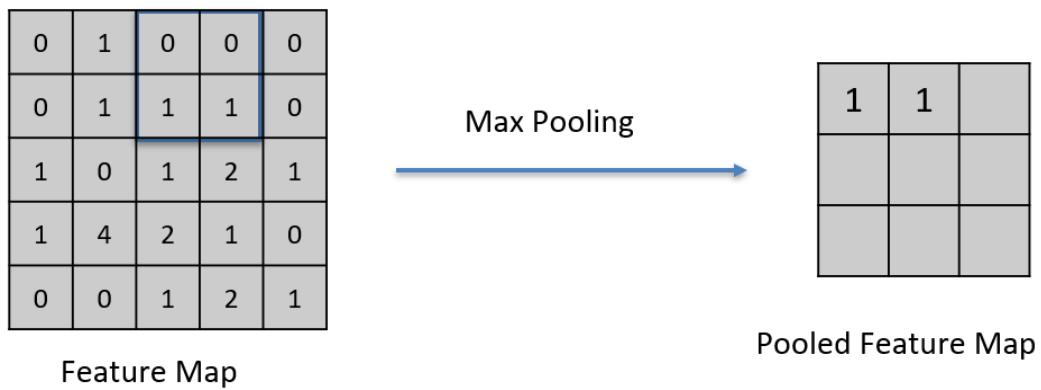
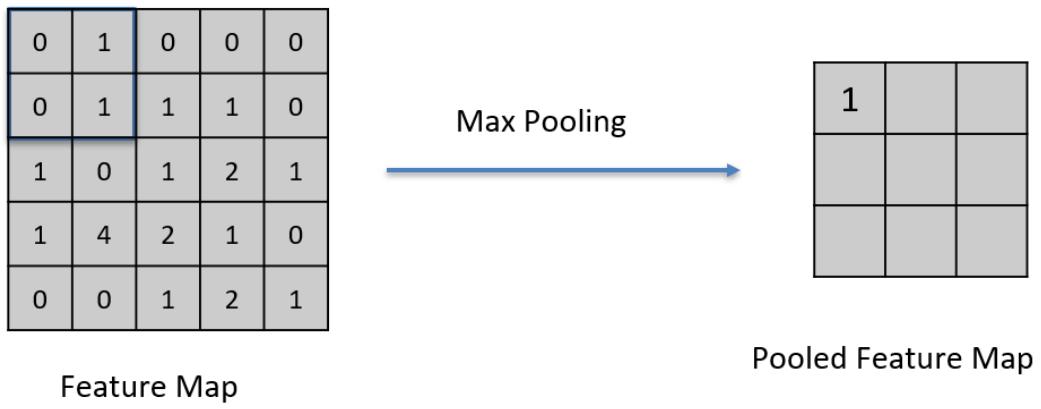
0	0	1
1	0	0
0	1	1

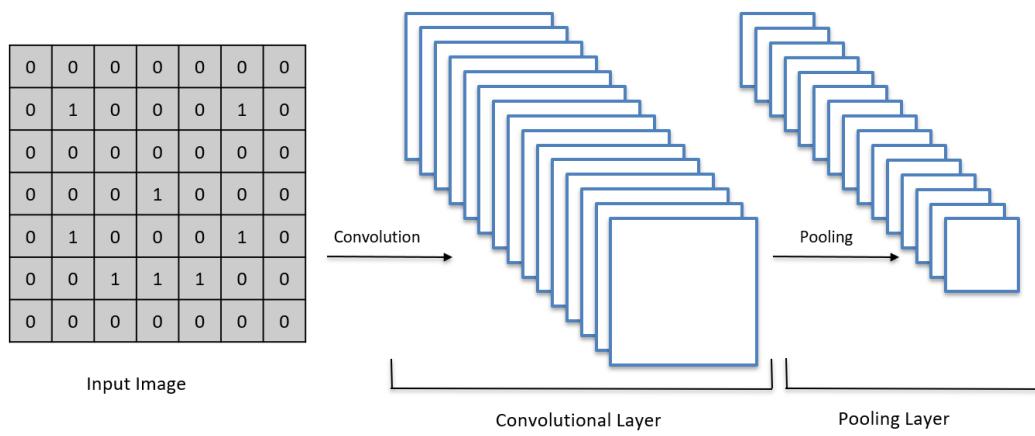
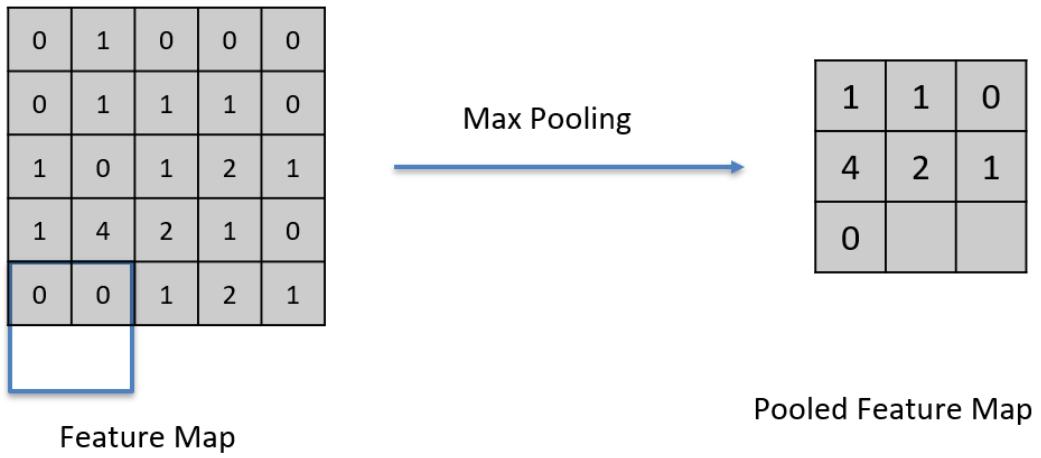
Feature Detector

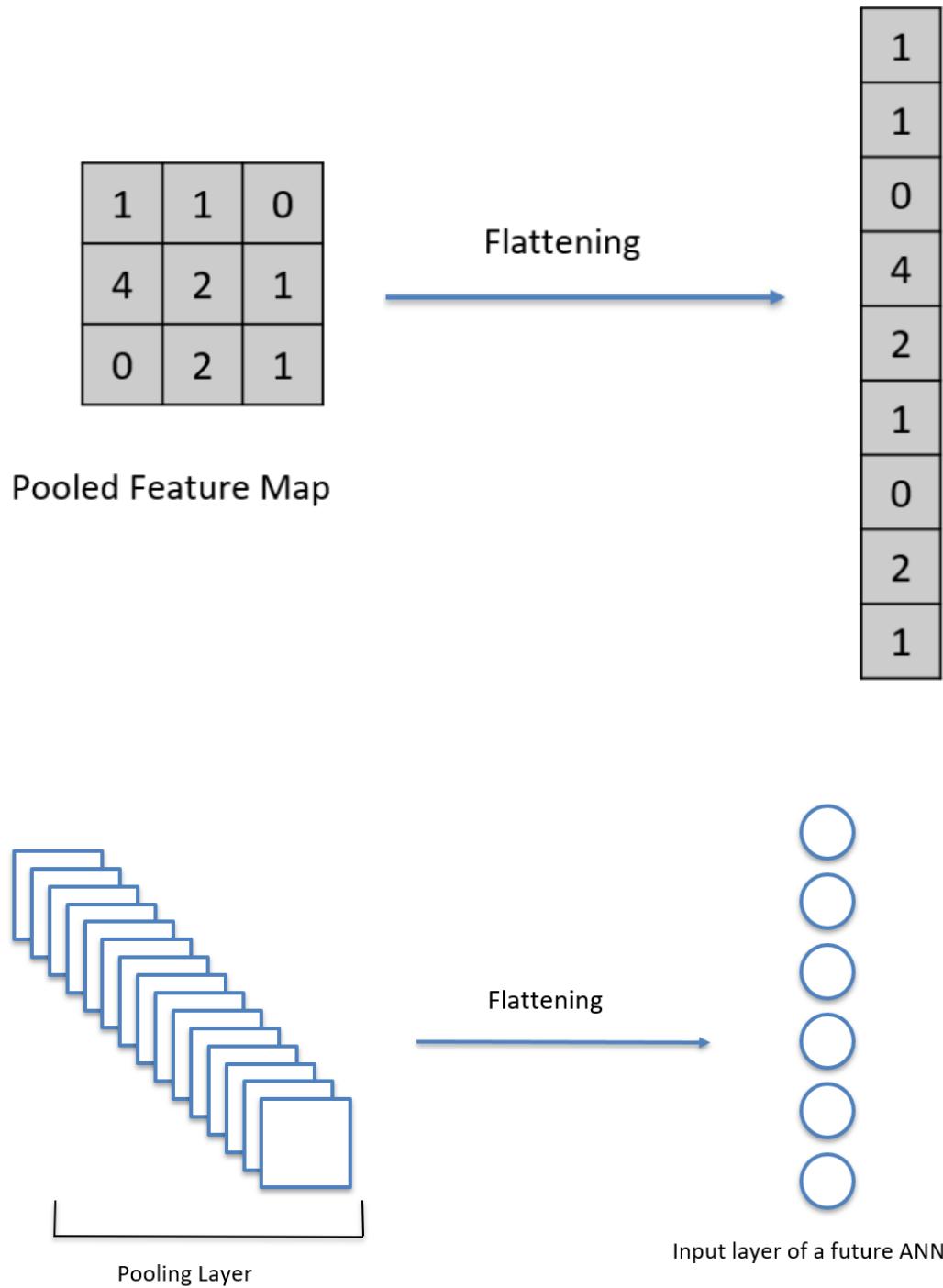
0	1	0	0	0
0	1	1	1	0
1	0	1	2	1
1	4	2	1	0

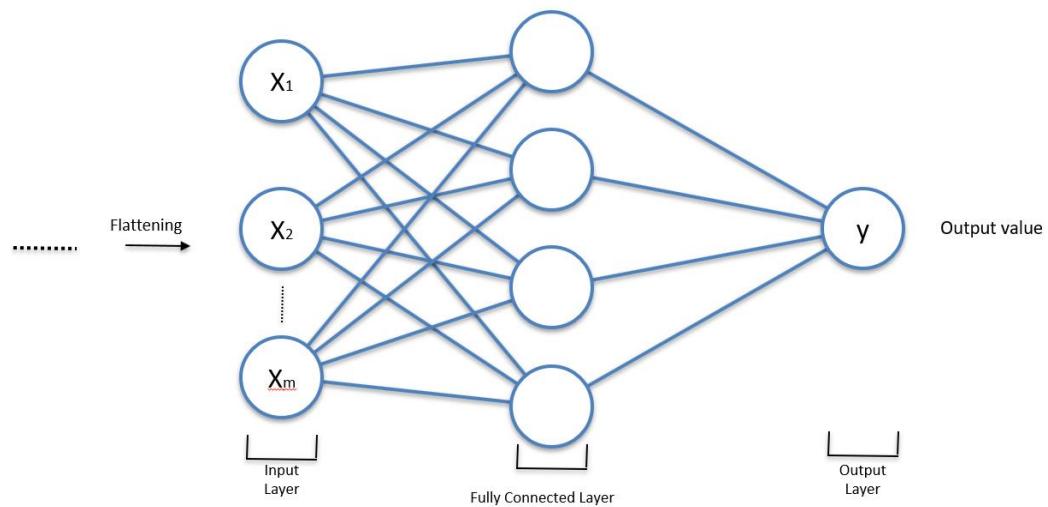
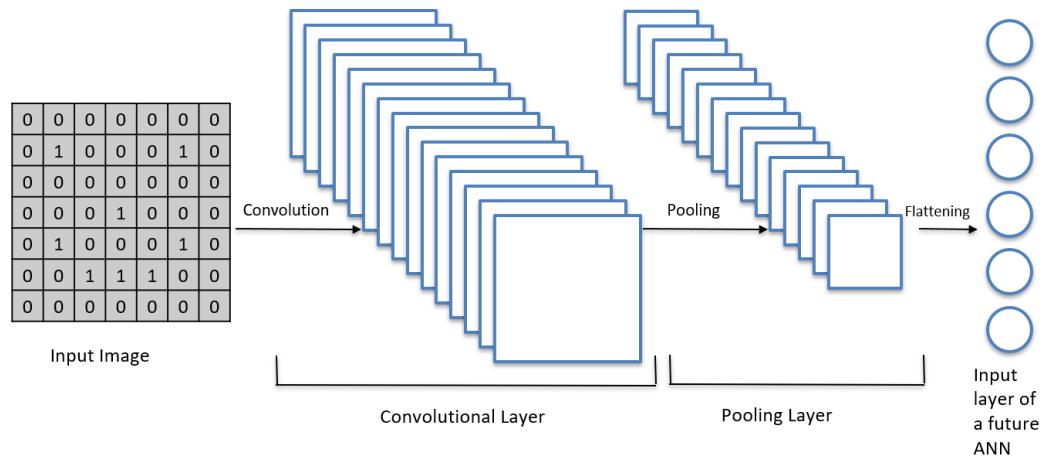
Feature Map

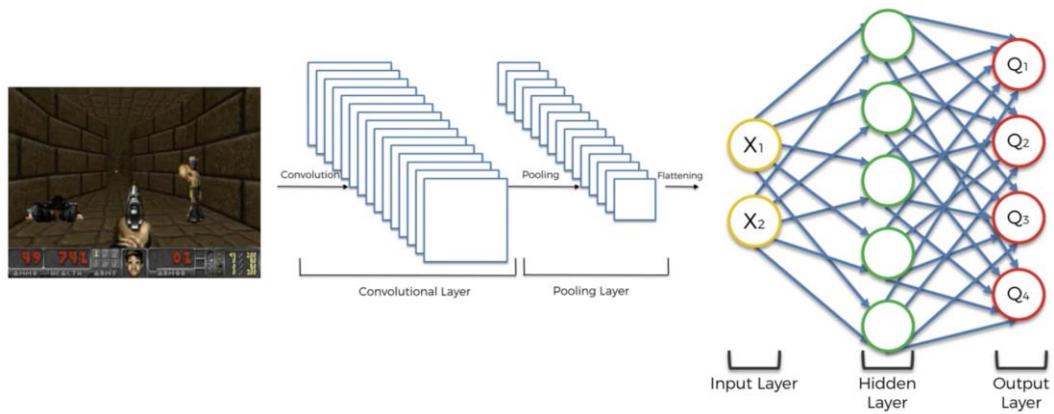




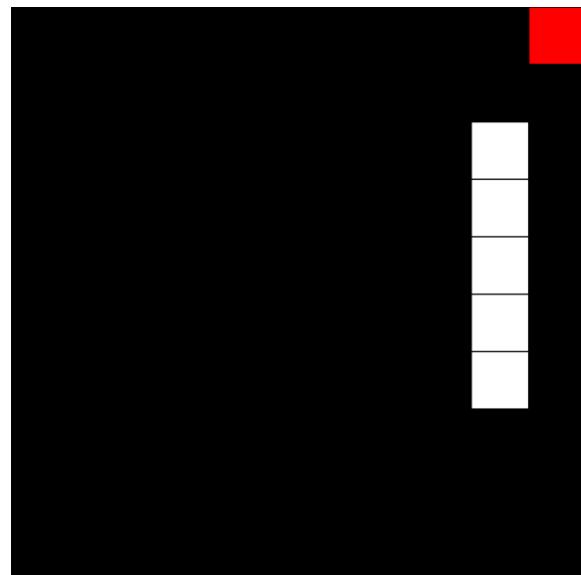
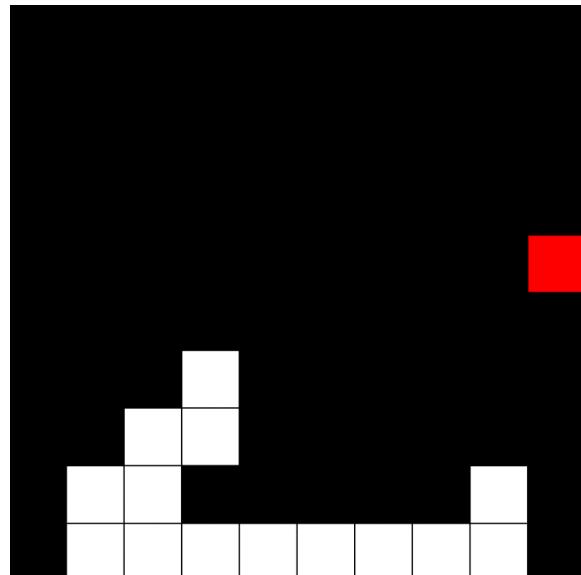


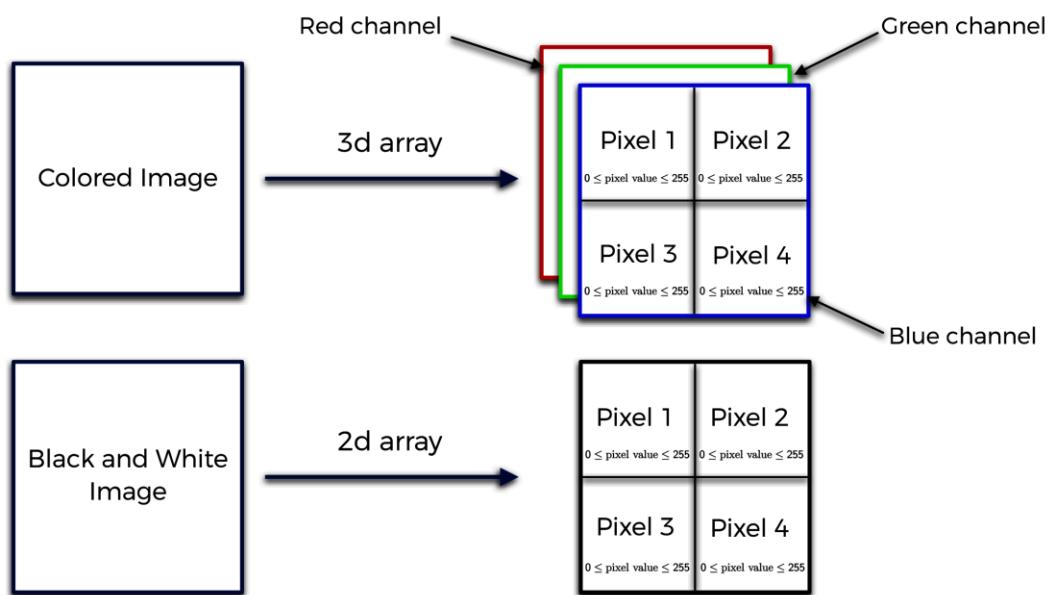
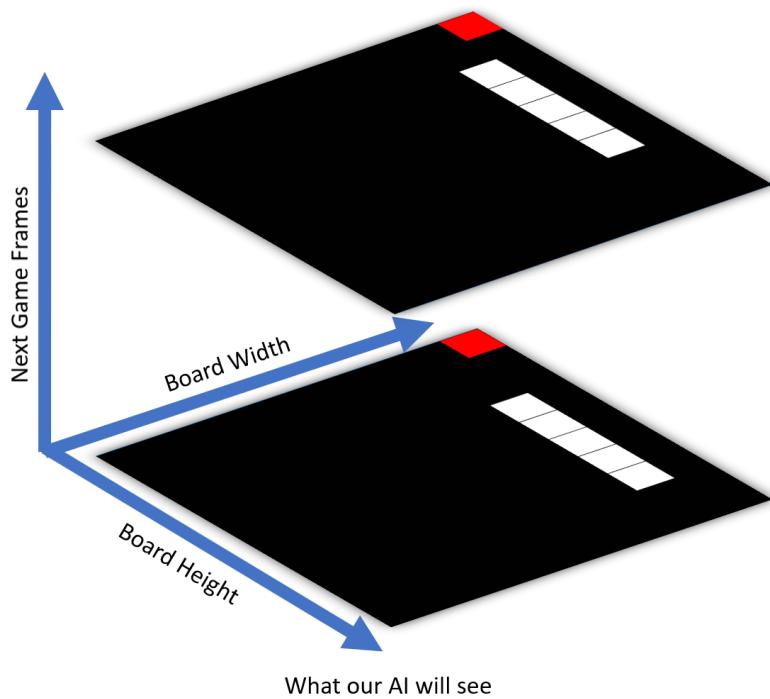






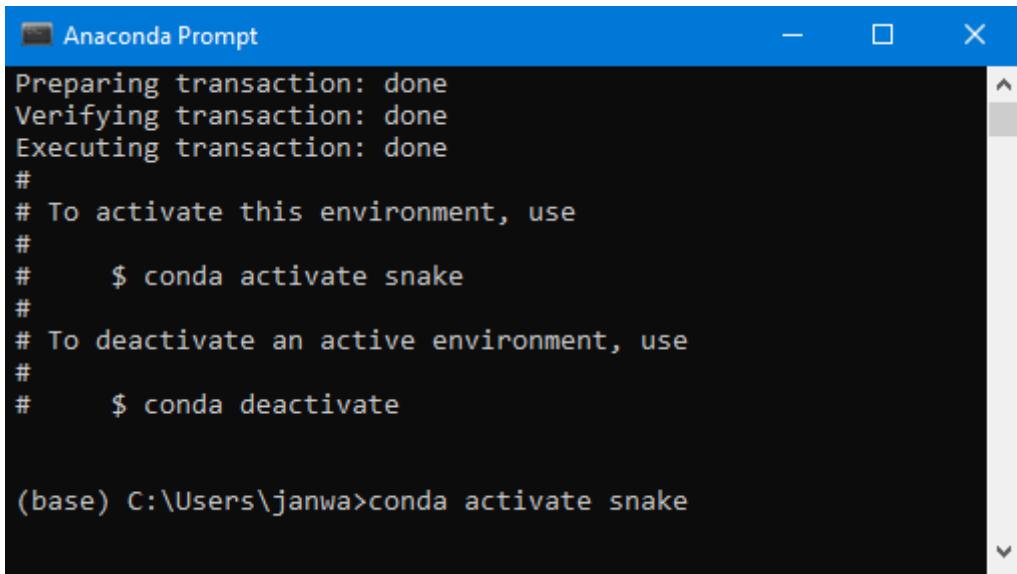
Chapter 13: AI for Games – Become the Master at Snake





```
Anaconda Prompt  
(base) C:\Users\janwa>conda create -n snake python=3.6
```

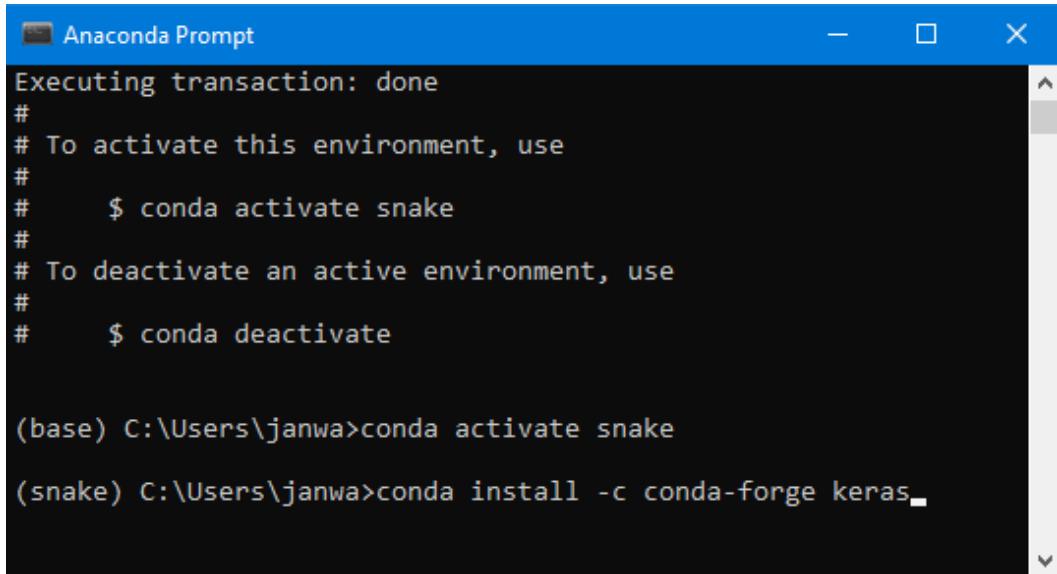
```
Anaconda Prompt - conda create -n snake python=3.6  
(base) C:\Users\janwa>conda create -n snake python=3.6  
Collecting package metadata (repodata.json): done  
Solving environment: done  
  
## Package Plan ##  
  
environment location: C:\Users\janwa\Anaconda3\envs\snake  
  
added / updated specs:  
- python=3.6  
  
The following NEW packages will be INSTALLED:  
  
certifi      pkgs/main/win-64::certifi-2019.6.16-py36_0  
pip          pkgs/main/win-64::pip-19.1.1-py36_0  
python        pkgs/main/win-64::python-3.6.8-h9f7ef89_7  
setuptools   pkgs/main/win-64::setuptools-41.0.1-py36_0  
sqlite        pkgs/main/win-64::sqlite-3.29.0-he774522_0  
vc            pkgs/main/win-64::vc-14.1-h0510ff6_4  
vs2015_runtime pkgs/main/win-64::vs2015_runtime-14.15.26706-h3a45250_4  
wheel         pkgs/main/win-64::wheel-0.33.4-py36_0  
wincertstore pkgs/main/win-64::wincertstore-0.2-py36h7fe50ca_0  
  
Proceed ([y]/n)?
```



Anaconda Prompt

```
Preparing transaction: done
Verifying transaction: done
Executing transaction: done
#
# To activate this environment, use
#
#     $ conda activate snake
#
# To deactivate an active environment, use
#
#     $ conda deactivate

(base) C:\Users\janwa>conda activate snake
```



Anaconda Prompt

```
Executing transaction: done
#
# To activate this environment, use
#
#     $ conda activate snake
#
# To deactivate an active environment, use
#
#     $ conda deactivate

(base) C:\Users\janwa>conda activate snake
(snake) C:\Users\janwa>conda install -c conda-forge keras■
```

```
Anaconda Prompt - conda install -c conda-forge keras
m2w64-gmp      pkgs/msys2/win-64::m2w64-gmp-6.1.0-2
m2w64-libwinpthread~ pkgs/msys2/win-64::m2w64-libwinpthread-git-5.0.0.4634.697f757-2
mako           conda-forge/noarch::mako-1.0.10-py_0
markdown        conda-forge/noarch::markdown-3.1.1-py_0
markupsafe     conda-forge/win-64::markupsafe-1.1.1-py36hfa6e2cd_0
mkl             pkgs/main/win-64::mkl-2019.4-245
msys2-conda-epoch pkgs/msys2/win-64::msys2-conda-epoch-20160418-1
numpy           conda-forge/win-64::numpy-1.16.4-py36hc71023c_0
openssl         conda-forge/win-64::openssl-1.0.2r-hfa6e2cd_0
protobuf        conda-forge/win-64::protobuf-3.9.0-py36he025d50_0
pygpu           conda-forge/win-64::pygpu-0.7.6-py36h452e1ab_1000
pyreadline      conda-forge/win-64::pyreadline-2.1-py36_1000
pyyaml          conda-forge/win-64::pyyaml-5.1.1-py36hfa6e2cd_0
scipy           pkgs/main/win-64::scipy-1.2.1-py36h29ff71c_0
six              conda-forge/win-64::six-1.12.0-py36_1000
tensorboard     conda-forge/win-64::tensorboard-1.10.0-py36_0
tensorflow      conda-forge/win-64::tensorflow-1.10.0-py36_0
termcolor        conda-forge/noarch::termcolor-1.1.0-py_2
theano          conda-forge/win-64::theano-1.0.4-py36h6538335_1000
vs2015_win-64   pkgs/main/win-64::vs2015_win-64-14.0.25420-h55c1224_11
werkzeug        conda-forge/noarch::werkzeug-0.15.5-py_0
yaml            conda-forge/win-64::yaml-0.1.7-hfa6e2cd_1001
zlib            conda-forge/win-64::zlib-1.2.11-h2fa13f4_1005

The following packages will be UPDATED:
certifi          pkgs/main::certifi-2019.6.16-py36_0 --> conda-forge::certifi-2019.6.16-py36_1

Proceed ([y]/n)?
```

```
Anaconda Prompt
(base) C:\Users\janwa>conda activate snake
```

```
Anaconda Prompt
python -c "import keras" 1>nul 2>&1
)
C:\Users\janwa>SET DISTUTILS_USE_SDK=1
C:\Users\janwa>SET MSSdk=1
C:\Users\janwa>SET platform=
C:\Users\janwa>IF /I [AMD64] == [amd64] set "platform=true"
C:\Users\janwa>IF /I [] == [amd64] set "platform=true"
C:\Users\janwa>if defined platform (set "VSREGKEY=HKEY_LOCAL_MACHINE\SOFTWARE\Wow6432Node\Microsoft\VisualStudio\14.0" )
ELSE (set "VSREGKEY=HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\VisualStudio\14.0" )
C:\Users\janwa>for /F "skip=2 tokens=2,*" %A in ('reg query "HKEY_LOCAL_MACHINE\SOFTWARE\Wow6432Node\Microsoft\Visual
dio\14.0" /v InstallDir') do SET "VSINSTALLDIR=%B"
ERROR: The system was unable to find the specified registry key or value.
C:\Users\janwa>if "" == "" (set "VSINSTALLDIR=" )
C:\Users\janwa>if "" == "" (
ECHO "WARNING: Did not find VS in registry or in VS140COMNTOOLS env var - your compiler may not work"
GOTO End
)
"WARNING: Did not find VS in registry or in VS140COMNTOOLS env var - your compiler may not work"
The system cannot find the batch label specified - End
(snake) C:\Users\janwa>
```

```
Select Anaconda Prompt
"WARNING: Did not find VS in registry or in VS140COMNTOOLS env var - your compiler may not work"
The system cannot find the batch label specified - End
(snake) C:\Users\janwa>cd Desktop
(snake) C:\Users\janwa\Desktop>
```

```
Anaconda Prompt
"WARNING: Did not find VS in registry or in VS140COMNTOOLS env var - your compiler may not work"
The system cannot find the batch label specified - End
(snake) C:\Users\janwa>cd Desktop
(snake) C:\Users\janwa\Desktop>cd Snake
(snake) C:\Users\janwa\Desktop\Snake>
```

```
Anaconda Prompt
"WARNING: Did not find VS in registry or in VS140COMNTOOLS env var - your compiler may not work"
The system cannot find the batch label specified - End

(snake) C:\Users\janwa>cd Desktop
(snake) C:\Users\janwa\Desktop>cd Snake
(snake) C:\Users\janwa\Desktop\Snake>python train.py
```

