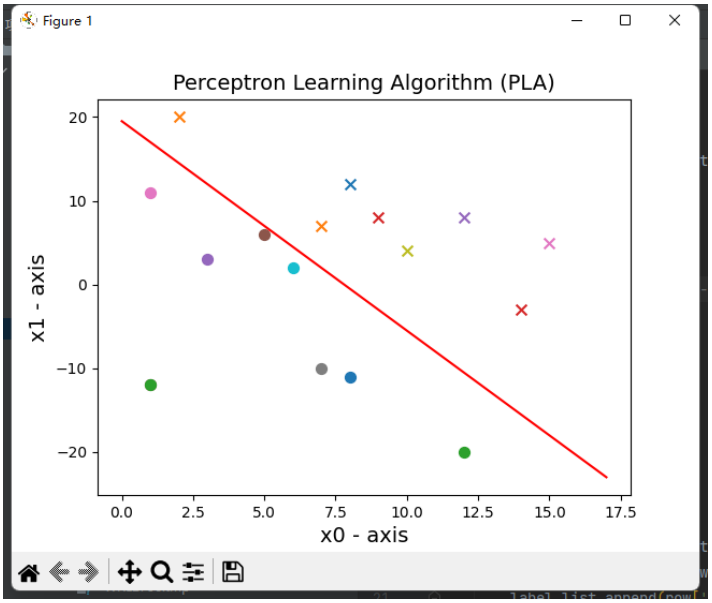
README

Perceptron

The perceptron learning algorithm (PLA).
'X' represents one label, while 'O' represents another one.



The csv file results1.csv output:

	A	B	C
1	0	0	0
2	8	3	3
3	3	9	6
4	12	6	10
5	6	1	12
6	7	9	15
7	5	2	16
8	5	-1	18
9	6	7	21
10	3	8	23
11	-1	-2	24
12	2	7	26
13	3	3	28
14	3	6	30
15	0	7	32
16	1	3	34
17	1	6	36
18	2	2	38
19	2	5	40
20	-5	-2	39

(the last line defines the decision boundary computed for the given dataset

Linear Regression

Implement linear regression with gradient descent.
The result of ten given alphas after 100 iterations, and calculate starting and final error by the least square method:

```
Running linear regression with gradient descend, with different alphas...

Alpha =  0.001 , staring error = 1.2237632728674144
After 100 iterations, bias = 0.05348806637222144, b_age = 0.0033840745545208103, b_weight = 0.0033840745545208103, final error = 1.1087662074117497

Alpha =  0.005 , staring error = 1.2237632728674144
After 100 iterations, bias = 0.2428035280485932, b_age = 0.01636435689738899, b_weight = 0.01636435689738899, final error = 0.7476370522917773

Alpha =  0.01 , staring error = 1.2237632728674144
After 100 iterations, bias = 0.4322572670802501, b_age = 0.03140598212727196, b_weight = 0.03140598212727196, final error = 0.4578577773741361

Alpha =  0.05 , staring error = 1.2237632728674144
After 100 iterations, bias = 1.0092732192307765, b_age = 0.11522296559332972, b_weight = 0.11522296559332972, final error = 0.015514712773842757

Alpha =  0.1 , staring error = 1.2237632728674144
After 100 iterations, bias = 1.089969183119605, b_age = 0.1645273415923606, b_weight = 0.1645273415923606, final error = 0.00561414678761948

Alpha =  0.5 , staring error = 1.2237632728674144
After 100 iterations, bias = 1.0964608113920533, b_age = 0.20056649045003316, b_weight = 0.20056649045003316, final error = 0.0051835968509425815

Alpha =  1 , staring error = 1.2237632728674144
After 100 iterations, bias = 1.0964608113924048, b_age = 0.20059412041313474, b_weight = 0.20059412041313474, final error = 0.005183727647646459

Alpha =  5 , staring error = 1.2237632728674144
After 100 iterations, bias = -4.4577839860091117e+17, b_age = -111.65860192393262, b_weight = -111.65860192393262, final error = 1.9871838065919276e+35

Alpha =  10 , staring error = 1.2237632728674144
After 100 iterations, bias = -1.7619445918655362e+60, b_age = -4.6831564916914316+44, b_weight = -4.6831564916914316+44, final error = 3.104448744804209 6e+120
```

From the result, we can see the minimum final error occur when alpha = 0.5 and 1. So I choose alpha between them, which is 0.75, as my choice for the tenth alpha value.

```
Alpha =  0.75 , staring error = 1.2237632728674144
After 100 iterations, bias = 1.0964608113924048, b_age = 0.20059388536014575, b_weight = 0.20059388536014575, final error = 0.005183726532166397
```

The csv file results2.csv output:

	A	B	C	D	E
1	0.001	100	0.053488066	0.003384075	0.003384075
2	0.005	100	0.242803528	0.016364357	0.016364357
3	0.01	100	0.432257267	0.031405982	0.031405982
4	0.05	100	1.009273219	0.115222966	0.115222966
5	0.1	100	1.089969183	0.164527342	0.164527342
6	0.5	100	1.096460811	0.20056649	0.20056649
7	1	100	1.096460811	0.20059412	0.20059412
8	5	100	-4.46E+17	-111.6586019	-111.6586019
9	10	100	-1.76E+60	-4.68E+44	-4.68E+44
10	0.75	100	1.096460811	0.200593885	0.200593885

The 3D plots for different alphas (on the next page):

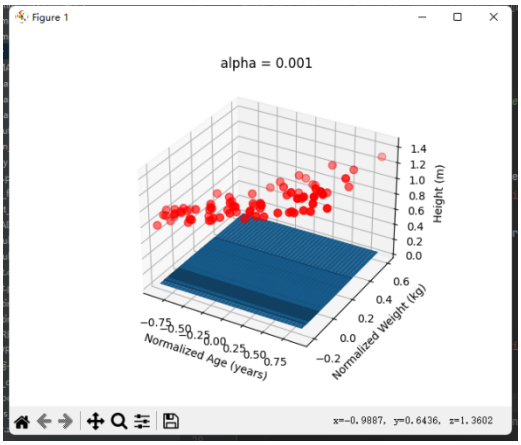


Figure 1
alpha = 0.001
Height (m)
Normalized Age (years)
Normalized Weight (kg)
x=-0.9887, y=0.6436, z=1.3602

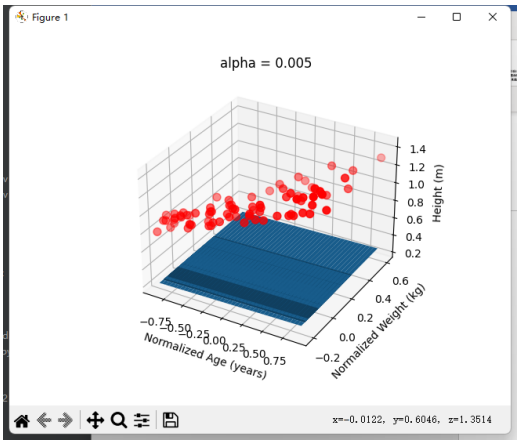


Figure 1
alpha = 0.005
Height (m)
Normalized Age (years)
Normalized Weight (kg)
x=-0.0122, y=0.6046, z=1.3514

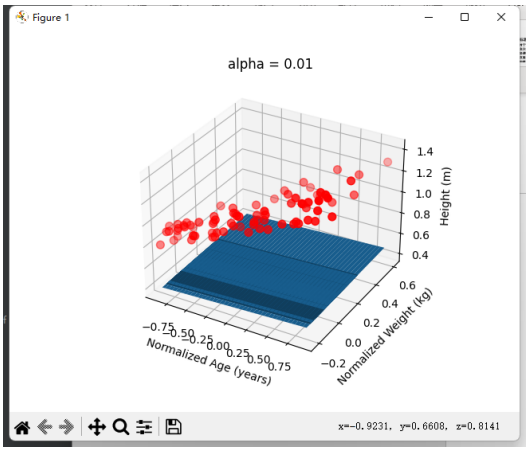


Figure 1
alpha = 0.01
Height (m)
Normalized Age (years)
Normalized Weight (kg)
x=-0.9231, y=0.6608, z=0.8141

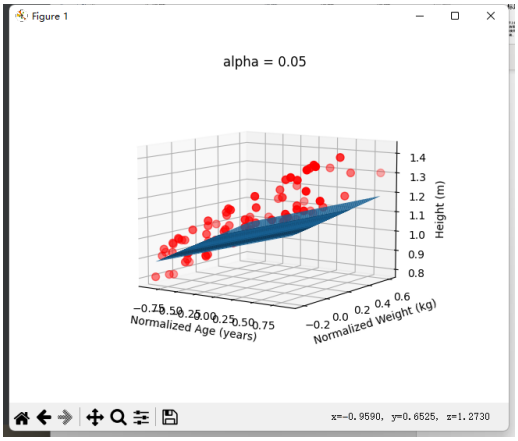


Figure 1
alpha = 0.05
Height (m)
Normalized Age (years)
Normalized Weight (kg)
x=-0.9590, y=0.6525, z=1.2730

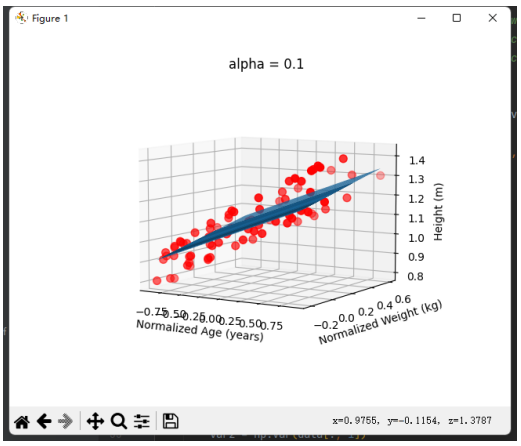


Figure 1
alpha = 0.1
Height (m)
Normalized Age (years)
Normalized Weight (kg)
x=0.9755, y=-0.1154, z=1.3787

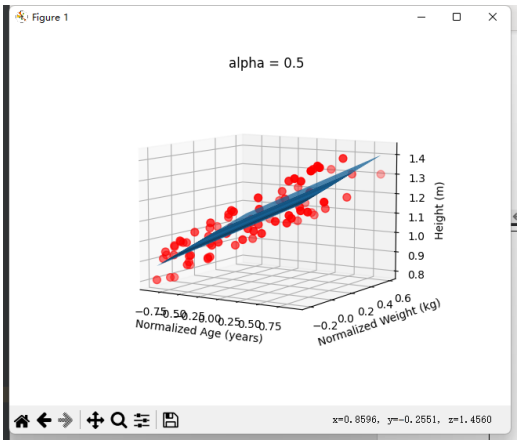


Figure 1
alpha = 0.5
Height (m)
Normalized Age (years)
Normalized Weight (kg)
x=0.8596, y=-0.2551, z=1.4560

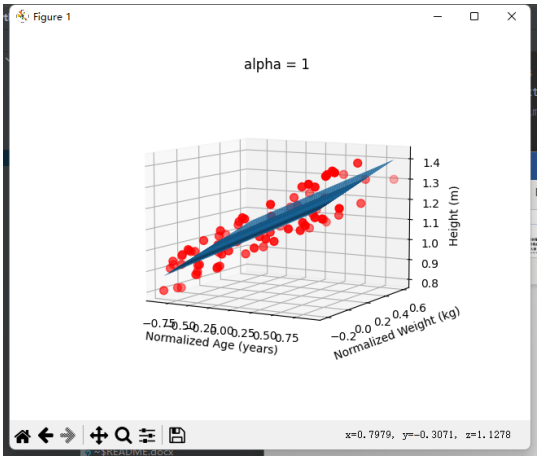


Figure 1
alpha = 1
Height (m)
Normalized Age (years)
Normalized Weight (kg)
x=0.7979, y=-0.3071, z=1.1278

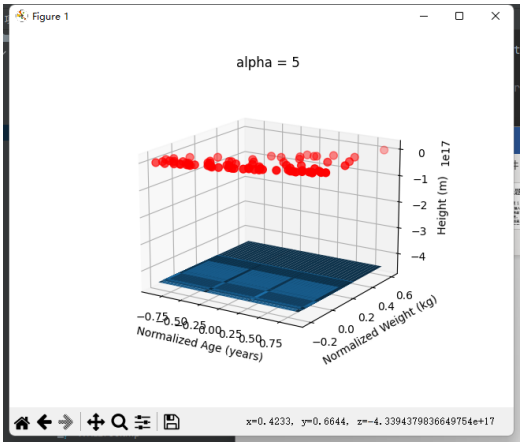


Figure 1
alpha = 5
1e17
Height (m)
Normalized Age (years)
Normalized Weight (kg)
x=0.4233, y=0.6644, z=-4.3394379836649754e+17

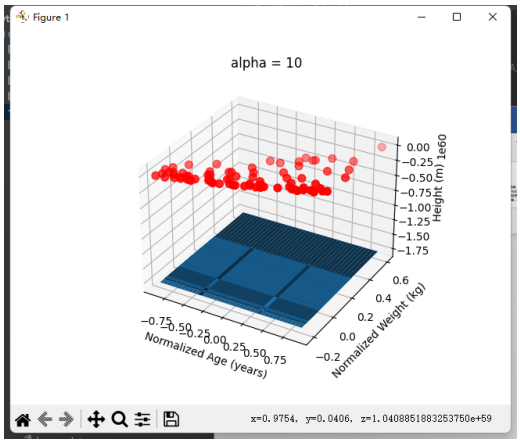


Figure 1
alpha = 10
Height (m) 1e60
0.00
−0.25
−0.50
−0.75
−1.00
−1.25
−1.50
−1.75
Normalized Age (years)
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
Normalized Weight (kg)
−0.2
0.0
0.2
0.4
0.6
x=0.9754, y=0.0406, z=1.0408851883253750e+59

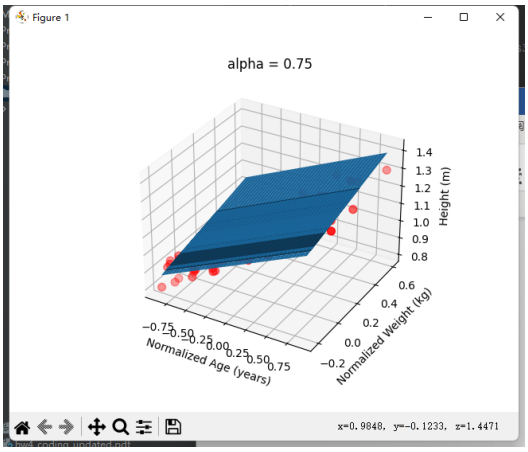


Figure 1
alpha = 0.75
Height (m)
1.4
1.3
1.2
1.1
1.0
0.9
0.8
Normalized Age (years)
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
Normalized Weight (kg)
−0.2
0.0
0.2
0.4
0.6
x=0.9848, y=-0.1233, z=1.4471