LAB QUESTION A

Team ASIC

Q1. What happens to the result if you repeat the program?

Test Condition : W, b = random uniform([1], -1.0, 1.0), train_tot = 100, learning_rate = 0.05, test = 5
x_tr = [1, 2, 3], y_tr = [1, 2, 3]

#1.

0 error = 2.969 W = 0.780 b = -0.308
1 error = 0.593 W = 0.944 b = -0.234
2 error = 0.121 W = 1.017 b = -0.199
3 error = 0.027 W = 1.049 b = -0.183
4 error = 0.009 W = 1.063 b = -0.174
5 error = 0.005 W = 1.068 b = -0.169
6 error = 0.004 W = 1.070 b = -0.166
7 error = 0.004 W = 1.071 b = -0.163
8 error = 0.004 W = 1.070 b = -0.161
9 error = 0.004 W = 1.070 b = -0.159
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.
.
90 error = 0.001 W = 1.026 b = -0.060
91 error = 0.001 W = 1.026 b = -0.059
92 error = 0.000 W = 1.026 b = -0.058
93 error = 0.000 W = 1.025 b = -0.058
94 error = 0.000 W = 1.025 b = -0.057
95 error = 0.000 W = 1.025 b = -0.056
96 error = 0.000 W = 1.024 b = -0.056
97 error = 0.000 W = 1.024 b = -0.055
98 error = 0.000 W = 1.024 b = -0.054
99 error = 0.000 W = 1.024 b = -0.054

test = 5 guess = 5.064

Result #1.

#2.

0 error = 0.032 W = 0.891 b = 0.311
1 error = 0.017 W = 0.880 b = 0.301
2 error = 0.013 W = 0.876 b = 0.295
3 error = 0.012 W = 0.875 b = 0.291
4 error = 0.012 W = 0.875 b = 0.287
5 error = 0.012 W = 0.876 b = 0.283
6 error = 0.011 W = 0.877 b = 0.280
7 error = 0.011 W = 0.879 b = 0.276
8 error = 0.011 W = 0.880 b = 0.273
9 error = 0.011 W = 0.881 b = 0.269
.
.
.
90 error = 0.002 W = 0.955 b = 0.101
91 error = 0.001 W = 0.956 b = 0.100
92 error = 0.001 W = 0.957 b = 0.099
93 error = 0.001 W = 0.957 b = 0.098
94 error = 0.001 W = 0.958 b = 0.096
95 error = 0.001 W = 0.958 b = 0.095
96 error = 0.001 W = 0.959 b = 0.094
97 error = 0.001 W = 0.959 b = 0.093
98 error = 0.001 W = 0.960 b = 0.092
99 error = 0.001 W = 0.960 b = 0.091

test = 5 guess = 4.891

Result 2.

#3.

0 error = 3.617 W = 0.473 b = 0.307
1 error = 0.741 W = 0.658 b = 0.382
2 error = 0.170 W = 0.741 b = 0.412
3 error = 0.056 W = 0.779 b = 0.423
4 error = 0.033 W = 0.798 b = 0.425
5 error = 0.028 W = 0.807 b = 0.423
6 error = 0.026 W = 0.813 b = 0.419
7 error = 0.025 W = 0.816 b = 0.414
8 error = 0.025 W = 0.819 b = 0.410
9 error = 0.024 W = 0.822 b = 0.405
.
.
.
90 error = 0.003 W = 0.933 b = 0.152
91 error = 0.003 W = 0.934 b = 0.150
92 error = 0.003 W = 0.935 b = 0.148
93 error = 0.003 W = 0.935 b = 0.147
94 error = 0.003 W = 0.936 b = 0.145
95 error = 0.003 W = 0.937 b = 0.143
96 error = 0.003 W = 0.938 b = 0.141
97 error = 0.003 W = 0.939 b = 0.140
98 error = 0.003 W = 0.939 b = 0.138
99 error = 0.003 W = 0.940 b = 0.136

test = 5 guess = 4.836

Result 3.

A. Result is changing when the program is launching repeatedly. Because the Input data is random value. If the input data is keep constant, result will not change.

Q2. What is the impact of train_tot?

Test Condition : #1. W, b = random uniform([1], -1.0, 1.0), train_tot = 100, learning_rate = 0.05, test = 5
x_tr = [1, 2, 3], y_tr = [1, 2, 3]
#2. W, b = random uniform([1], -1.0, 1.0), train_tot = 200, learning_rate = 0.05, test = 5
x_tr = [1, 2, 3], y_tr = [1, 2, 3]
#3. W, b = random uniform([1], -1.0, 1.0), train_tot = 500, learning_rate = 0.05, test = 5
x_tr = [1, 2, 3], y_tr = [1, 2, 3]

#1.

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.
.
.
90 error = 0.001 W = 1.030 b = -0.067
91 error = 0.001 W = 1.029 b = -0.067
92 error = 0.001 W = 1.029 b = -0.066
93 error = 0.001 W = 1.029 b = -0.065
94 error = 0.001 W = 1.028 b = -0.064
95 error = 0.001 W = 1.028 b = -0.063
96 error = 0.001 W = 1.028 b = -0.063
97 error = 0.001 W = 1.027 b = -0.062
98 error = 0.001 W = 1.027 b = -0.061
99 error = 0.001 W = 1.027 b = -0.060

test = 5 guess = 5.073
```

#2.

```
.
.
.
190 error = 0.000 W = 1.003 b = -0.007
191 error = 0.000 W = 1.003 b = -0.007
192 error = 0.000 W = 1.003 b = -0.007
193 error = 0.000 W = 1.003 b = -0.007
194 error = 0.000 W = 1.003 b = -0.007
195 error = 0.000 W = 1.003 b = -0.007
196 error = 0.000 W = 1.003 b = -0.007
197 error = 0.000 W = 1.003 b = -0.007
198 error = 0.000 W = 1.003 b = -0.007
199 error = 0.000 W = 1.003 b = -0.007

test = 5 guess = 5.008
```

#3.

```
.
.
.
431 error = 0.000 W = 1.000 b = -0.001
432 error = 0.000 W = 1.000 b = -0.001
433 error = 0.000 W = 1.000 b = -0.001
434 error = 0.000 W = 1.000 b = -0.001
435 error = 0.000 W = 1.000 b = -0.001
436 error = 0.000 W = 1.000 b = -0.000
437 error = 0.000 W = 1.000 b = -0.000
438 error = 0.000 W = 1.000 b = -0.000
439 error = 0.000 W = 1.000 b = -0.000
440 error = 0.000 W = 1.000 b = -0.000
.
.
.

test = 5 guess = 5.000
```

A. If the train total is increase, accuracy of the result is become higher than previous result.
The train total must be set on suitable value, if you want to get accurate result.

Q3. What is the impact of learning_rate?

Test Condition : #1. W, b = random uniform([1], -1.0, 1.0), train_tot = 100, learning_rate = 0.05, test = 5
x_tr = [1, 2, 3], y_tr = [1, 2, 3]
#2. W, b = random uniform([1], -1.0, 1.0), train_tot = 100, learning_rate = 0.5, test = 5
x_tr = [1, 2, 3], y_tr = [1, 2, 3]
#3. W, b = random uniform([1], -1.0, 1.0), train_tot = 100, learning_rate = 0.005, test = 5
x_tr = [1, 2, 3], y_tr = [1, 2, 3]

#1.

```
90 error = 0.007 W = 0.906 b = 0.214
91 error = 0.007 W = 0.907 b = 0.211
92 error = 0.006 W = 0.908 b = 0.208
93 error = 0.006 W = 0.909 b = 0.206
94 error = 0.006 W = 0.911 b = 0.203
95 error = 0.006 W = 0.912 b = 0.201
96 error = 0.006 W = 0.913 b = 0.199
97 error = 0.006 W = 0.914 b = 0.196
98 error = 0.006 W = 0.915 b = 0.194
99 error = 0.005 W = 0.916 b = 0.192

test = 5 guess = 4.770
```

#2.

```
90 error = nan W = nan b = nan
91 error = nan W = nan b = nan
92 error = nan W = nan b = nan
93 error = nan W = nan b = nan
94 error = nan W = nan b = nan
95 error = nan W = nan b = nan
96 error = nan W = nan b = nan
97 error = nan W = nan b = nan
98 error = nan W = nan b = nan
99 error = nan W = nan b = nan

test = 5 guess = nan
```

#3.

```
90 error = 0.018 W = 0.845 b = 0.354
91 error = 0.018 W = 0.845 b = 0.354
92 error = 0.018 W = 0.845 b = 0.353
93 error = 0.018 W = 0.846 b = 0.353
94 error = 0.018 W = 0.846 b = 0.353
95 error = 0.018 W = 0.846 b = 0.352
96 error = 0.018 W = 0.846 b = 0.352
97 error = 0.018 W = 0.846 b = 0.351
98 error = 0.018 W = 0.846 b = 0.351
99 error = 0.018 W = 0.846 b = 0.350

test = 5 guess = 4.583
```

A. Learning rate impacts on system accuracy. Default condition of learning rate is 0.05 in this tests.
If the learning rate higher enough than reference(learning_rate = 0.5), system printout the output as 'Not A Number'. And the learning rate is too low(learning_rate = 0.005), it cannot approach to suitable value.

Q4. What happens if you drop (or add) more training data?

Test Condition : #1. W, b = random uniform([1], -1.0, 1.0), train_tot = 100, learning_rate = 0.05, test = 5
x_tr = [1, 2, 3], y_tr = [1, 2, 3]
#2. W, b = random uniform([1], -1.0, 1.0), train_tot = 100, learning_rate = 0.05, test = 5
x_tr = [1, 2, 3, 4, 5], y_tr = [1, 2, 3, 4, 5]
#3. W, b = random uniform([1], -1.0, 1.0), train_tot = 100, learning_rate = 0.05, test = 5
x_tr = [1, 2], y_tr = [1, 2]

#1.

90	error = 0.001	W = 1.039	b = -0.088
91	error = 0.001	W = 1.038	b = -0.087
92	error = 0.001	W = 1.038	b = -0.086
93	error = 0.001	W = 1.037	b = -0.085
94	error = 0.001	W = 1.037	b = -0.084
95	error = 0.001	W = 1.036	b = -0.083
96	error = 0.001	W = 1.036	b = -0.082
97	error = 0.001	W = 1.036	b = -0.081
98	error = 0.001	W = 1.035	b = -0.080
99	error = 0.001	W = 1.035	b = -0.079

test = 5 guess = 5.095

#2.

90	error = 0.007	W = 0.948	b = 0.186
91	error = 0.006	W = 0.949	b = 0.183
92	error = 0.006	W = 0.950	b = 0.180
93	error = 0.006	W = 0.951	b = 0.177
94	error = 0.006	W = 0.952	b = 0.174
95	error = 0.006	W = 0.953	b = 0.171
96	error = 0.005	W = 0.953	b = 0.168
97	error = 0.005	W = 0.954	b = 0.165
98	error = 0.005	W = 0.955	b = 0.163
99	error = 0.005	W = 0.956	b = 0.160

test = 5 guess = 4.938

#3.

90	error = 0.055	W = 0.548	b = 0.731
91	error = 0.054	W = 0.552	b = 0.725
92	error = 0.053	W = 0.555	b = 0.720
93	error = 0.052	W = 0.558	b = 0.715
94	error = 0.052	W = 0.561	b = 0.710
95	error = 0.051	W = 0.565	b = 0.704
96	error = 0.050	W = 0.568	b = 0.699
97	error = 0.049	W = 0.571	b = 0.694
98	error = 0.049	W = 0.574	b = 0.689
99	error = 0.048	W = 0.577	b = 0.684

test = 5 guess = 3.570

A. It is impacts on accuracy when adding or dropping data into training data array. If the case of data increase, accuracy of result has been improved. In Linear regression, the more training data derives more accurate result.

Q5. What happens if your test data is very big or small?

Test Condition : #1. W, b = random uniform([1], -1.0, 1.0), train_tot = 100, learning_rate = 0.05, test = 5
x_tr = [1, 2, 3], y_tr = [1, 2, 3]
#2. W, b = random uniform([1], -1.0, 1.0), train_tot = 100, learning_rate = 0.05, test = 1,000,000
x_tr = [1, 2, 3], y_tr = [1, 2, 3]
#3. W, b = random uniform([1], -1.0, 1.0), train_tot = 100, learning_rate = 0.05, test = 0.0000001
x_tr = [1, 2, 3], y_tr = [1, 2, 3]

#1.

```
90 error = 0.000 W = 1.027 b = -0.043
91 error = 0.000 W = 1.026 b = -0.043
92 error = 0.000 W = 1.026 b = -0.042
93 error = 0.000 W = 1.026 b = -0.042
94 error = 0.000 W = 1.026 b = -0.042
95 error = 0.000 W = 1.026 b = -0.041
96 error = 0.000 W = 1.025 b = -0.041
97 error = 0.000 W = 1.025 b = -0.041
98 error = 0.000 W = 1.025 b = -0.041
99 error = 0.000 W = 1.025 b = -0.040

test = 5 guess = 5.084
```

#2.

```
90 error = 0.023 W = 0.826 b = 0.396
91 error = 0.023 W = 0.828 b = 0.392
92 error = 0.022 W = 0.830 b = 0.387
93 error = 0.021 W = 0.832 b = 0.382
94 error = 0.021 W = 0.834 b = 0.378
95 error = 0.020 W = 0.836 b = 0.373
96 error = 0.020 W = 0.838 b = 0.369
97 error = 0.019 W = 0.840 b = 0.364
98 error = 0.019 W = 0.842 b = 0.360
99 error = 0.019 W = 0.844 b = 0.355

test = 1000000 guess = 843637.750
```

#3.

```
90 error = 0.003 W = 0.942 b = 0.131
91 error = 0.002 W = 0.943 b = 0.129
92 error = 0.002 W = 0.944 b = 0.128
93 error = 0.002 W = 0.944 b = 0.126
94 error = 0.002 W = 0.945 b = 0.125
95 error = 0.002 W = 0.946 b = 0.123
96 error = 0.002 W = 0.946 b = 0.122
97 error = 0.002 W = 0.947 b = 0.120
98 error = 0.002 W = 0.948 b = 0.119
99 error = 0.002 W = 0.948 b = 0.118

test = 1e-06 guess = 0.118
```

A. When the test value is very big or small, it cannot approach to its goal. Learning rate or train total must be adjust to approach the target value.

Q6. What happens if there is a outlier in the training data?

Test Condition : #1. W, b = random uniform([1], -1.0, 1.0), train_tot = 100, learning_rate = 0.05, test = 5
x_tr = [1, 2, 3], y_tr = [1, 2, 3]
#2. W, b = random uniform([1], -1.0, 1.0), train_tot = 100, learning_rate = 0.05, test = 5
x_tr = [1, 2, 3, 4, 5], y_tr = [1, 2, 3, 1, 3]
#3. W, b = random uniform([1], -1.0, 1.0), train_tot = 100, learning_rate = 0.05, test = 5
x_tr = [1, 5, 3, 4, 2], y_tr = [4, 2, 5, 3, 1]

#1.

```
90 error = 0.001 W = 0.961 b = 0.088
91 error = 0.001 W = 0.962 b = 0.087
92 error = 0.001 W = 0.962 b = 0.086
93 error = 0.001 W = 0.962 b = 0.085
94 error = 0.001 W = 0.963 b = 0.084
95 error = 0.001 W = 0.963 b = 0.083
96 error = 0.001 W = 0.964 b = 0.082
97 error = 0.001 W = 0.964 b = 0.081
98 error = 0.001 W = 0.965 b = 0.080
99 error = 0.001 W = 0.965 b = 0.079

test = 5 guess = 4.905
```

#1.

```
90 error = 0.620 W = 0.314 b = 1.051
91 error = 0.620 W = 0.313 b = 1.052
92 error = 0.620 W = 0.313 b = 1.052
93 error = 0.620 W = 0.313 b = 1.053
94 error = 0.620 W = 0.313 b = 1.054
95 error = 0.620 W = 0.313 b = 1.055
96 error = 0.620 W = 0.312 b = 1.055
97 error = 0.620 W = 0.312 b = 1.056
98 error = 0.620 W = 0.312 b = 1.057
99 error = 0.620 W = 0.312 b = 1.058

test = 5 guess = 2.616
```

#1.

```
90 error = 2.090 W = 0.063 b = 2.651
91 error = 2.084 W = 0.058 b = 2.667
92 error = 2.079 W = 0.054 b = 2.683
93 error = 2.073 W = 0.050 b = 2.698
94 error = 2.068 W = 0.046 b = 2.713
95 error = 2.063 W = 0.041 b = 2.728
96 error = 2.058 W = 0.037 b = 2.743
97 error = 2.054 W = 0.033 b = 2.758
98 error = 2.049 W = 0.029 b = 2.772
99 error = 2.045 W = 0.026 b = 2.786

test = 5 guess = 2.913
```

A. When the training data contain the outlier, result accuracy is not stable. I guess it can be improve by increase training total.