CS 522 HW3 Report

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The link to the code, data and plots are https://github.com/Ramkiranch/HCI---Fitt-s-Law-Experiment

Fitt's Law Experiment Setup:

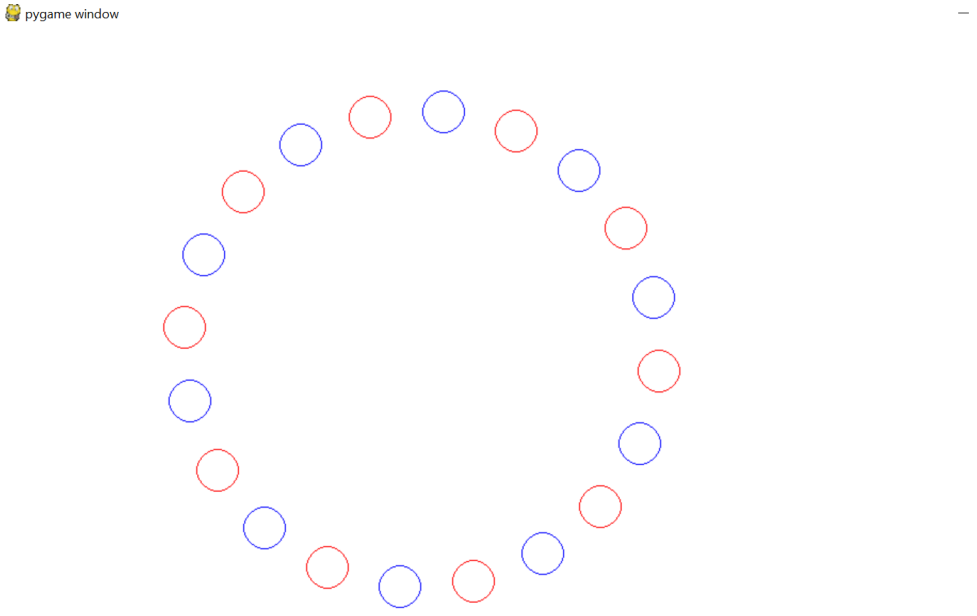
The experiment has been set up using python. The packages used to serve the purpose are 'pygame', 'pandas', 'numpy', 'math', 'matplotlib', 'sys', 'os' and 'random'. 'Pygame' is used for GUI. Pandas is used to export the data to csv, math is used for certain calculations, sys and os are used for the input parameters and file management. Matplotlib and numpy are used to generate plots and analysis purpose. 'random' is used to generate the random amplitude(D) and target sizes.

The centers of the target circles are generated using the formula:

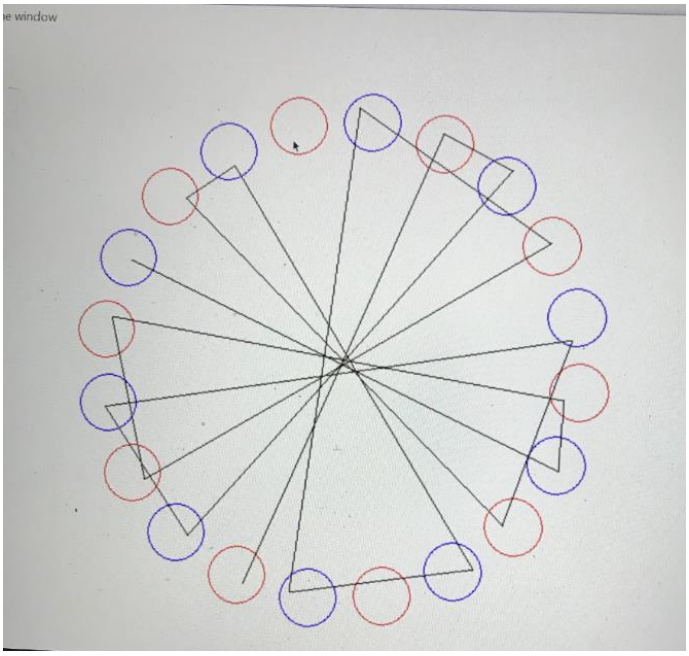
```
x = int(400 + (bradius[k] * math.cos(n + (i*(2/ncircles)*math.pi))))
y = int(300 + (bradius[k] * math.sin(n + (i*(2/ncircles)*math.pi))))
```

where 'bradius' is the amplitude(D), 'n' is 360 over number of circles. Here (400, 300) represents the pixel position of the center of the large circle around which the targets are placed. 'i' represents the circle number which ranges from 0 to number of 'circles – 1'.

The experiment is based on the mouse clicks. After the circles appear in the GUI as shown in the below figure, the user must click on one circle to the circle which is opposite and of diameter length with the same color.



The circle coverage will be represented using lines as shown in the figure below.



The user can select any random circles and select the amplitude length of the circle opposite and have to cover all the circles.
Note: The number of clicks should be equal to the number of circles.

Once the program starts executing, the user will be presented with 6 cases with 3 amplitudes X 2 target sizes. The movement time between clicks is calculated. The movement time is captured only for the pair of circles opposite to each other. For example, for 20 targets, 10 movement times will be captured among 10 pairs. As Index of Difficulty (ID) will be constant, the mean of the movement time is considered as the movement time(MT) for that particular ID. The same is captured for the all the six cases.

Then various parameters such as ID square, MT square , product of ID and MT, throughput are calculated. Some of these parameters were used to evaluate the regression coefficients.

The regression coefficients are calculated using the belong formula.

$$a = \frac{(\Sigma y)(\Sigma x^2) - (\Sigma x)(\Sigma xy)}{n(\Sigma x^2) - (\Sigma x)^2}$$

$$b = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{n(\Sigma x^2) - (\Sigma x)^2}$$

Here x is ID and y is MT.

Experimental Method:

Initially the experiment is conducted with random amplitude and target sizes using math.random function. Then to generate the plots and for uniform input parameters, fixed amplitude values and target sizes are considered. I did the experiment 5 times with 6 cases with 30 entries in data dump. One of my peers also did the experiment in the same way and total 60 entries were recorded in the data

dump. After that the mean of the movement time for the fixed ID is calculated for various test cases. The table is shown in the data analysis section. Prior to this number of attempts were made to check for the regression coefficients and plots. MT is measured in seconds.

Data Analysis:

The data extracted from the data is tabulated as below

ncircles	bradius	tradius	ID	MT	IDMT	IDsquare	MTsquare	Throughput
20	170	27	2.867164	1.34441	3.854644	8.2206312	1.80743825	2.132656197
20	216	27	3.169925	1.37724	4.365748	10.048425	1.89679002	2.301650403
20	223	27	3.210897	1.31342	4.217256	10.309858	1.7250721	2.444683942
20	170	20	3.247928	1.37881	4.478275	10.549033	1.90111702	2.355601942
20	216	20	3.560715	1.47698	5.259105	12.678691	2.18146992	2.410807834
20	223	20	3.602884	1.48072	5.334863	12.980776	2.19253172	2.433197639

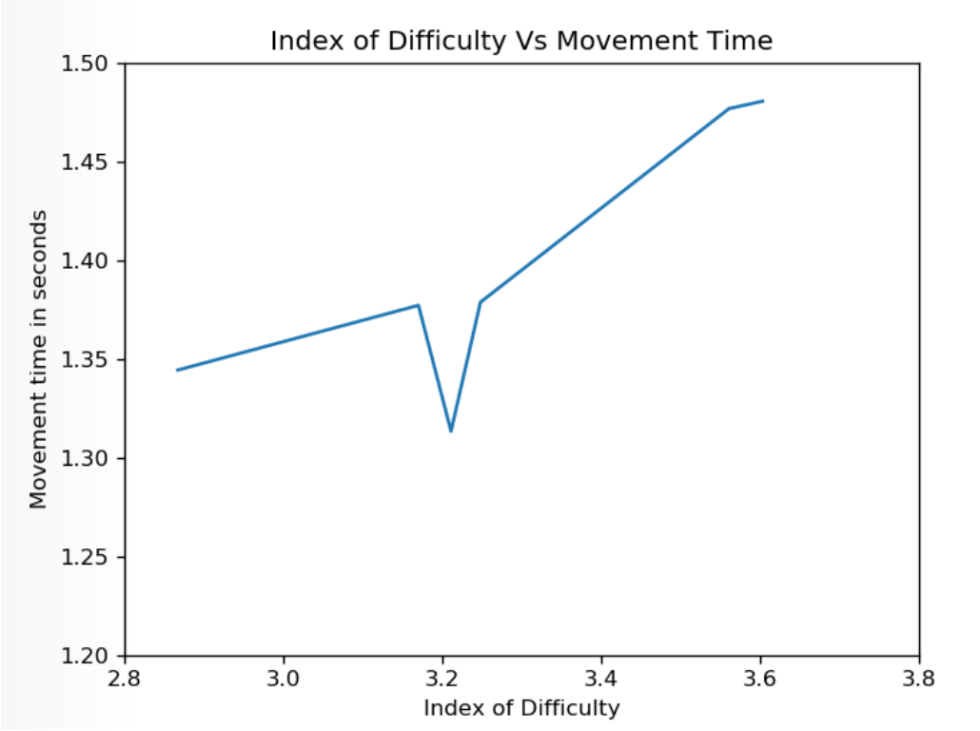
Ncircles - number of circles(passed as input parameter to the python script)

Bradius – Amplitude, tradius – target radius, IDMT – product of ID and MT

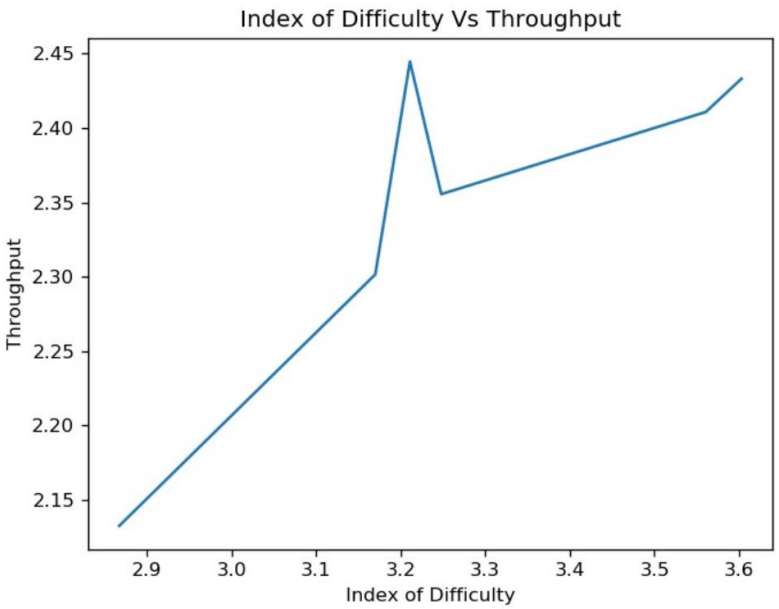
The regression coefficients are a = 0.6920754566111554 and b = 0.21460995831806337 respectively

The various graphs are as follows:

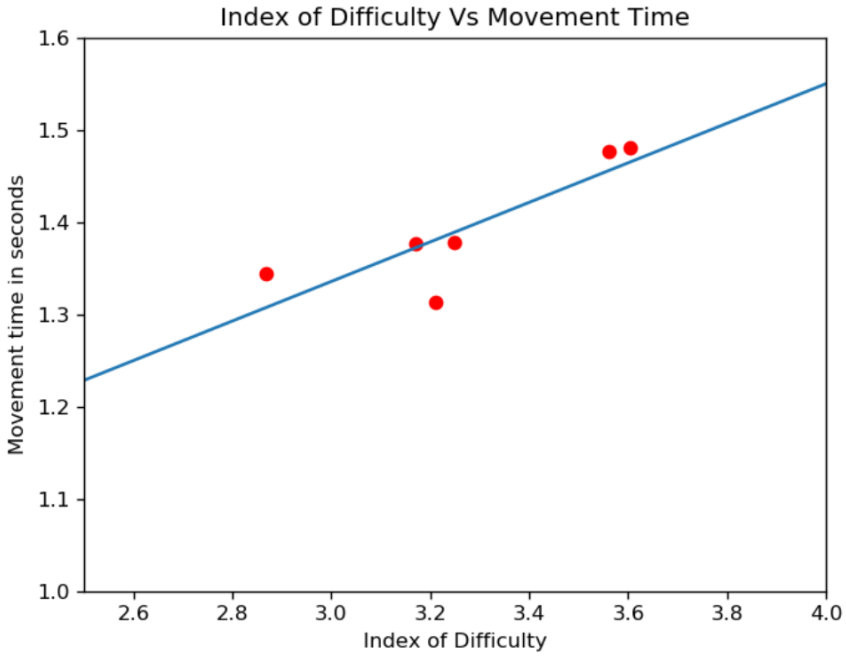
ID vs MT:



ID Vs Throughput:



ID Vs MT with regression equation:



Conclusion:

Hence from the data and plots, we can conclude that the Movement time is almost linear with the Index of Difficulty. As the ID increases, MT is also increasing except few outliers. From the last plot, we can observe that the points lie so close to the ideal regression line.