IT351 HUMAN COMPUTER INTERACTION

Assignment – 3&4 : Fitts' Law and Hick Hyman's Law

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Introduction:

Fitts' Law

Fitts' Law is a model of speed-accuracy tradeoffs used in human–computer interaction and ergonomics. It predicts time required to acquire a target on screen as a function of the distance to the target and the size of the target. Fitts's law is used to model the act of pointing, either by physically touching an object with a hand,finger or virtually or by pointing to an object on a computer monitor using a pointing device.

Mathematically it can be written as:

$$MT = a + b \log_2 (2A / W)$$

MT : Movement time (average) taken to complete the movement or point the target.

a : Start / Stop time of the device (y intercept)

b : Inherent speed of the device (slope of line)

W : Width of the target measured along the axis of motion, which corresponds to accuracy

A : Distance from the starting point to the center of the target

The term $\log_2 (2A / W)$ is called the **index of difficulty (ID)**. It describes the difficulty of the motor tasks. 1/b is also called the **index of performance (IP)** and measures the information capacity of the human motor system.

Thus

$$MT = a + b\, ID = a + ID / IP$$

Hick Hyman's Law

Hick's Law predicts the time it takes to make a decision in selecting among possible choices. The Hick-Hyman Law measures cognitive information capacity.

Given n equally probable choices, the average reaction time T required to choose among them is approximately:

$$T = b.\log_2(n+1)$$

The reaction time curve is logarithmic because for quick search we divide choices into categories, skipping half of choices at each step instead of considering each choice one-by-one.

Method

Fitt's Law

1. A GUI is designed using Tkinter library of Python.
2. The user has to click on the blocks and the response time of the user will be recorded and analyzed accordingly.
3. The User has the choice to change the Width of the Block as well as the distance between the blocks.
4. As the **Index of Difficulty, ID = $\log_2(2A/W)$** depends upon the width and the inter block distance, the ID changes at each selection.
5. The user can also select the **Counter value** which determines how many times he will perform the clicking operation on the clocks in one experiment iteration.
6. The user clicks on the start button after making his selection and the simulation starts.
7. The user has to click on the blocks and the time period between the subsequent clicks is recorded.
8. The counter is updated dynamically.
9. User also has the option to stop or reset the experiment.
10. After the counter has reached to zero, the user is provided with **graphical analysis** based on his results of **Movement Times v/s Index of Difficulty.**

Screenshots of the GUI

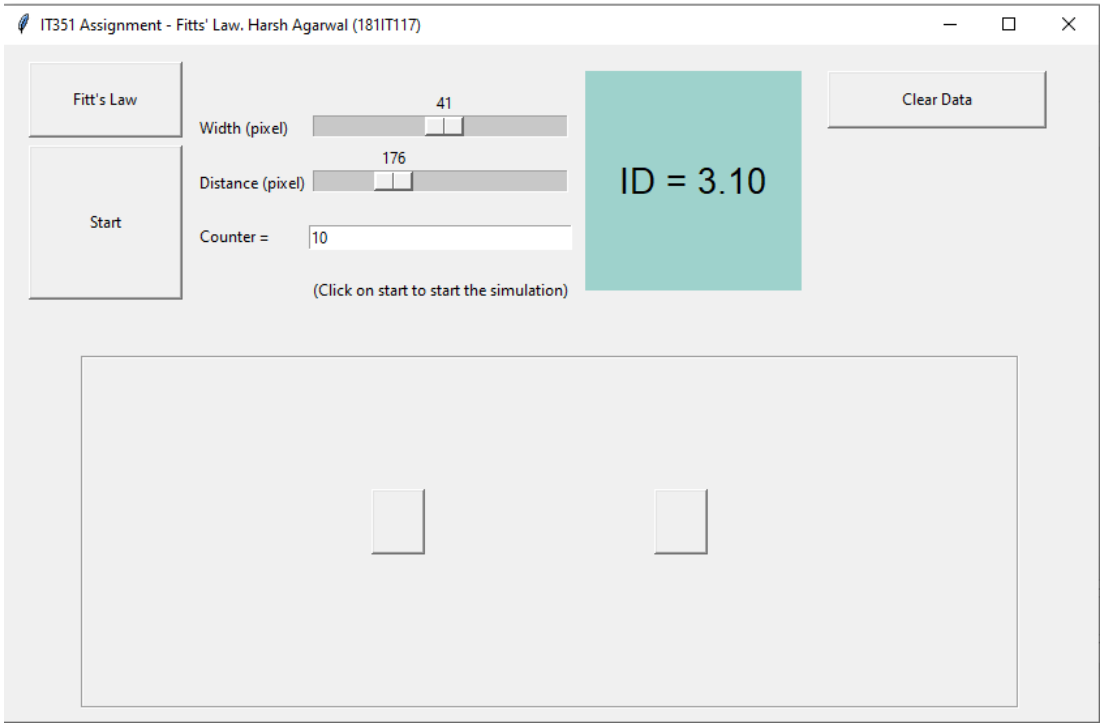


Fig. 1: User can select the Width, Distance and Counter and the ID value is updated based on values.

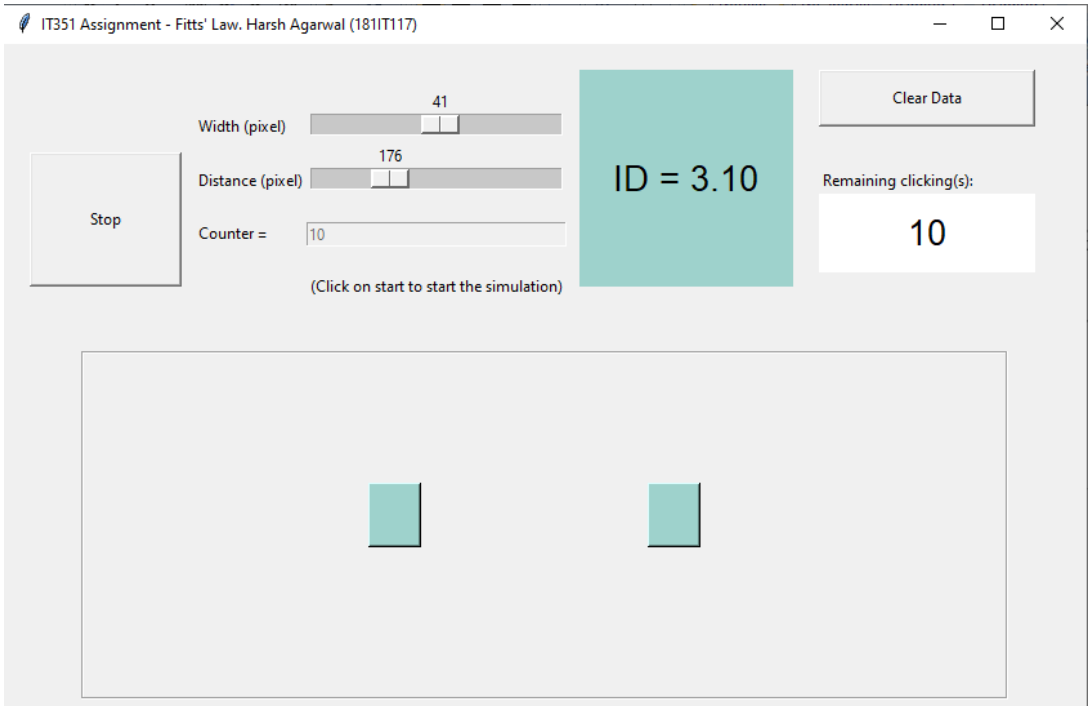


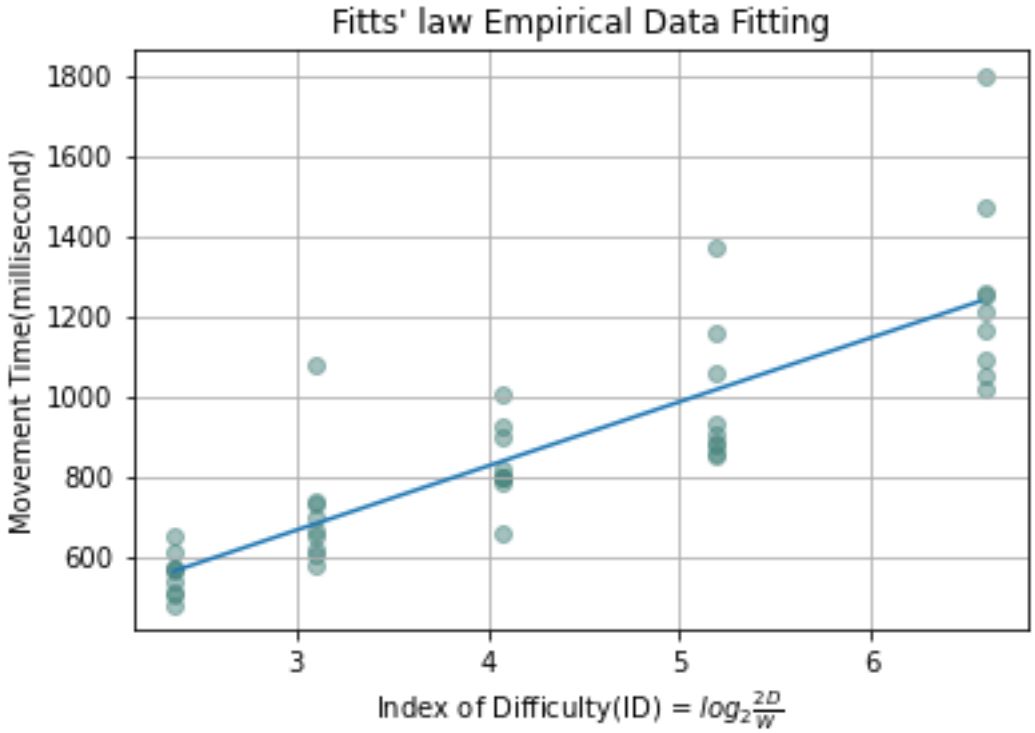
Fig.2: The numbers of clicks remaining are shown on right side and it keeps updating dynamically

Results of the Experiment

Fitt's Law experiment was carried out with a user for five (5) different and random values of Index of Difficulty.

The Graph depicting the Movement Time v/s ID was plotted and the obtained graph was a **linear graph**.

We can infer from the graph that the Movement Time varies linearly with the Index of Difficulty and Increasing the Index of Difficulty will increase the Movement Time.



NOTE: The Graph generation is automated from the program code and the code for graph generation is submitted in the program code itself.

Mathematical Results

```
Movement Time = y-intercept + Slope*Index of Difficulty

MT = 160.49 + 184.62 * ID
```

Hick Hyman's Law

1. A GUI is designed using Tkinter library of Python.
2. Eight (8) different keys are shown to user on the screen and the user is expected to type in the particular key which flashes on the screen.
3. The Response time of User in pressing that particular key is noted and analyzed.
4. The Simulation starts with Level 1 which has only 2 active Keys. This means that in Level 1, the user will be shown only a key from the 2 highlighted keys.
5. Once the user completes level 1, he/she proceeds to level 2 which has 3 active keys and so on.
6. The Final level has all the 8 keys active and the user could be shown any of the key from those set of 8 keys.
7. In this particular experiment, **the Degree of Choice (DOC) varies from 2 to 8**.
8. After the Final level is completed, the user is provided with a **graphical analysis** based on his results of **Reaction Times v/s Degree of Choice.**

Screenshots of the GUI

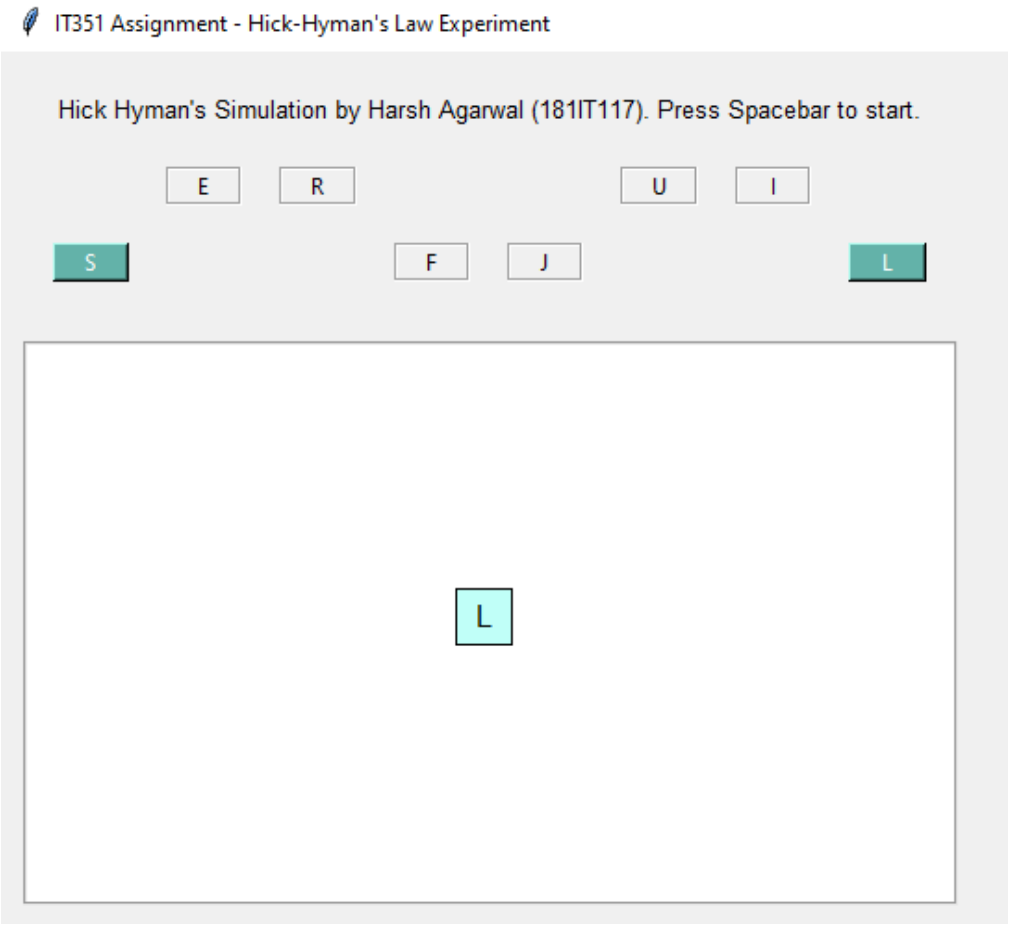


Fig. 4: Degree of choice is 2 and user has to type in letter 'L'

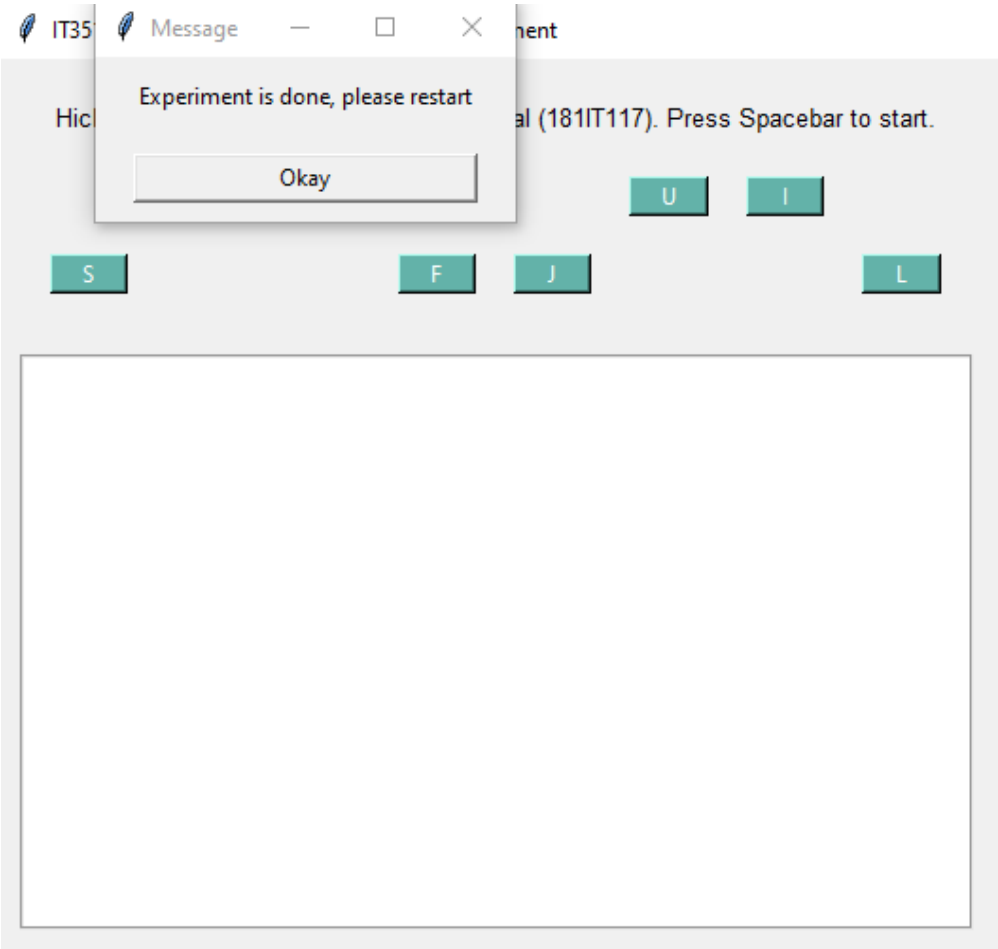


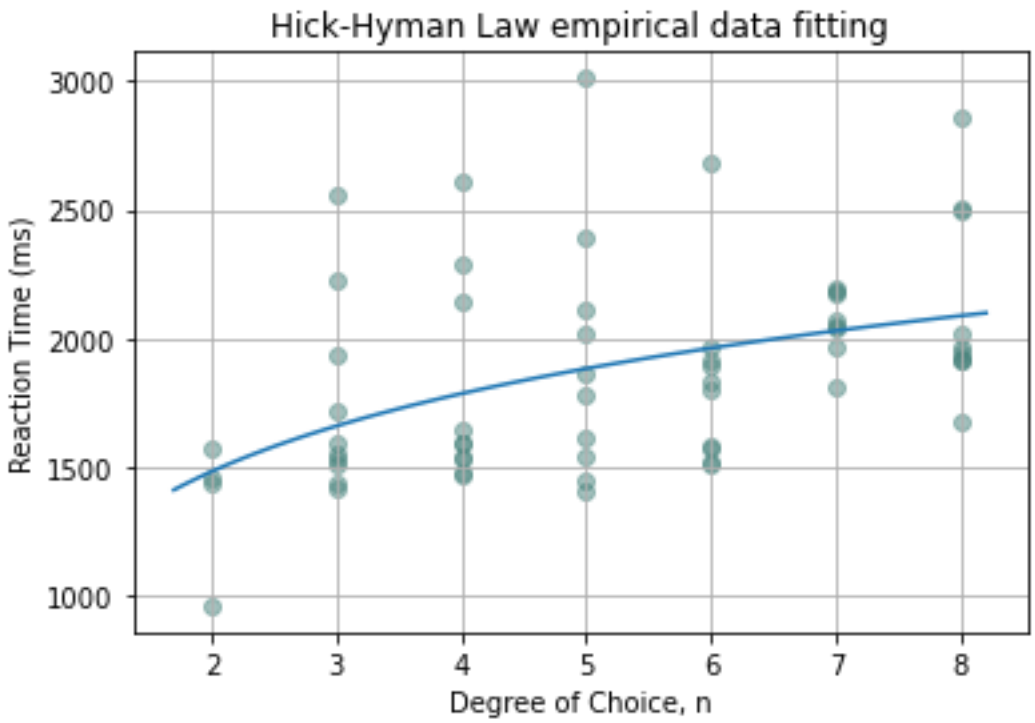
Fig. 5: After all the levels are completed, the user is shown a dialog box saying the experiment is done.

Results of the Experiment

Hick Hyman's Law was carried out for multiple users and they depicted varying reaction times for different keyboard letters.

The Graph depicting the Reaction Time v/s Degree of Choice was plotted and the obtained graph was a **logarithmic graph**.

We can infer from the graph that the Reaction Time varies logarithmically with the Degree of Choice and Increasing the Degree of Choice (n) will increase the Reaction Time very rapidly in the beginning but it will increase slowly as the value of n increases further.



NOTE: The Graph generation is automated from the program code and the code for graph generation is submitted in the program code itself.

Mathematical Results

```
Reaction Time = a + b*log(DOC)

RT = 302.7 log(DOC) + 1179.7
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Conclusions

We can conclude that the above mentioned Laws Fitt's Law and Hick's law are pivotal in designing an efficient, and appealing User Interface.

To ensure fast movement time and response times of users vising the website, it should be ensured that the Index of Difficulty is kept minimum by ensuring proper distance and size of buttons. Also the Degree of Choice should be maintained by reducing the variety of buttons present. With the homogeneity of buttons, the time taken is less.