

Questions and Answers for the Lectures on HCI

Module 3

1. Discuss in brief the utility of models in HCI.

Answer: In interactive system design, iterative design cycle is necessary to take into account human factors. However, evaluating intermediate designs with users is difficult and costly (both on money and time). Consequently, it becomes imperative to use rapid design and evaluation techniques in the early design phase, before finalizing the design. Models help in achieving that objective; namely, they allow quick testing of design idea without rigorous user studies.

2. Suppose a model mentions that “our reading pattern is from left-to-right”. Is it a predictive model or prescriptive model? Answer with justification.

Answer: The model indicates how a user is supposed to behave on an interface. Consequently, it prescribes a design guideline, namely to put interface elements on the left side of the screen, as we are most likely to look at the left side first. Therefore, this is a prescriptive model, without any ability to make any prediction.

3. What is a mental operator in the **Keystroke Level Model (KLM)**? How it is different from physical operators?

Answer: The physical operators indicate the time required to perform physical (motor) tasks, such as moving hand between mouse and keyboard, dragging mouse pointer to a target and so on. However, the mental operator indicates the time required for cognitive (thinking) tasks, such as decision making, problem solving etc., which are internal activities of a user.

4. Discuss the steps involved in estimating task execution time using KLM. How we can use KLM to compare competing designs?

Answer: In order to build a KLM, we first identify a “representative task” for the system to be evaluated. Next, we list the operators in sequence to carry out the representative task with the system. Finally, we add up the operator times in the sequence to obtain the task completion time.

We can use KLM to compare two designs by comparing the completion times of the same (representative) task for the two designs.

5. Discuss the key differences between KLM and (CMN)GOMS.

Answer: Although KLM belongs to the GOMS family of models in which the (CMN)GOMS also belongs, there are some difference between the two. (CMN)GOMS is much more robust in modeling human cognitive behavior than KLM, which is a very simple and sequential cognitive model. In (CMN)GOMS, cognitive process is modeled as a hierarchy of goals, thus revealing more complexities than KLM. From the hierarchy, we can reason about the extent of memory recall and decision making involved. This gives us an extra way to compare to designs along with the task completion time measure.

6. How to measure difficulty of a target acquisition task?

Answer: According to the Fitts' law, the difficulty of a target acquisition task in a rapid, aimed movement can be measured in terms of the distance of the target (D) and the width of the target (W) as, $ID = \log_2(D/W+1)$. The unit of ID is in *bits*.

7. What is throughput? How it can be used in the design of interactive systems?

Answer: Throughput (TP) is a measure of the task execution performance of a system under rapid, aimed movement. It came from the idea of the “index of performance (IP)” proposed by Fitts and is defined as the ratio of the index of difficulty (ID) of a target acquisition task to that of the time to acquire the target (movement time or MT), i.e., $TP=ID/MT$.

For a design, we collect throughput data from a set of users for different task difficulties (by varying distance and target width). The mean throughput for all users over all task difficulties represents the average user performance for the test condition. We can compare this average throughput for alternative designs.

8. Discuss how the Fitts' law can be used to predict performance.

Answer: From the Fitts' law, an expression is derived to compute the movement time (MT) of a target acquisition task under rapid, aimed movement: $MT = a+b.\log_2(D/W+1)$. Using this expression, we can calculate average MT of the same set of tasks for two designs and then compare the two average values.

9. What is the speed-accuracy trade-off in the Fitts' law? How we can take care of it?

Answer: In the formulation of the index of difficulty (ID) according to the Fitts' law, it is assumed that there is no error in acquiring the target (i.e., the user makes no *miss* in pointing and clicking an icon in 100 attempts). However, it has been observed empirically that in a rapid aimed movement, in about 4% of the cases, the target is missed (i.e., the user fails to acquire the target). Consequently, there is a 4% margin of error in the computation of ID. This is popularly known as the speed-accuracy trade-off.

This can be taken care of by considering the *effective* width of the target, rather than the actual width. The effective target width can be determined from empirical data on the distribution of *hits* (i.e., successful target acquisition) on and around the target.

10. Explain the Hick-Hyman law. Describe the predictive formulation of the law.

Answer: The Hick-Hyman law is a law governing the “reaction time” of a human in the presence of “choices” (i.e., how long does a human take to react by making a selection from a set of choices). In HCI, the popular formulation of the law is: $RT = k \cdot \log_2 N$, where RT is the reaction time, k is a constant and N is the number of choices. In the above formulation, it is assumed that a person is equally likely to make any of the N choices.