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PHYSICAL AND DEVICE MODELS

Keystroke-level model

The human motor system is well understood. KLM (Keystroke-Level Model) uses this understanding as a basis for detailed predictions about user performance. It is aimed at unit tasks within interaction - the execution of simple command sequences, typically taking no more than 20 seconds. Examples of this would be using a search and replace feature, or changing the font of a word. It does not extend to complex actions such as producing a diagram. The assumption is that these more complex tasks would be split into subtasks (as in GOMS) before the user attempts to map them into physical actions.
The task is split into two phases:

Acquisition of the task, when the user builds a mental representation of the task;
Execution of the task using the systems facilities.

During the acquisition phase, the user will have decided how to accomplish the task using the primitives of the system, and thus, during the execution phase, there is no high-level mental activity - the user is effectively expert. KLM is related to the GOMS model, and can be thought of as a very low-level GOMS model where the method is given.
The model decomposes the execution phase into five different physical motor operators, a mental operator and a system response operator:

– **Physical motor:**

K – Keystroking, actually striking keys, including shifts and other modifier keys.
B – Pressing a mouse button.
P – Pointing, moving the mouse (or similar device) at a target.
H – Homing, switching the hand between mouse and keyboard.
D – Drawing lines using the mouse.

– **Mental operator :**

M – Mentally preparing for a physical action.

– **System Response Operator:**

R – System Response

Times are empirically determined.

$$\mathbf{T_{execute} = TK + TP + TH + TD + TM + TR}$$

For instance, imagine we are using a mouse-based editor. If we notice a single character error we will point at the error, delete the character and retype it, and then return to our previous typing point.

This is decomposed as follows:

1. Move hand to mouse H[mouse]
2. Position mouse character PB[LEFT]
3. Return to keyboard H[keyboard]
4. Delete character MK[DELETE]
5. Type correction K[char]
6. Reposition insertion point H[mouse] MPB [LEFT]

T = HPBHMKKHMPB (8.70)

Buxton's **Three-state model**

Buxton has developed a simple model of input devices, three-state model, which captures some of the crucial distinctions Although the different input devices

– mouse, trackball, light pen
– are similar from the application‘s viewpoint, they have very different sensory–motor characteristics.

dragging

- If instead we consider a light pen with a button, it behaves just like a mouse when it is touching the screen. When its button is not depressed, it is in state 1
- when its button is down, state 2.
- However, the light pen has a third state, when the light pen is not touching the screen. In this state the system cannot track the light pen‘s position. This is called state 0.

COGNITIVE ARCHITECTURES

The concept of taking a problem and solving it by divide and conquer using subgoals is central to GOMS. CCT assumes the distinction between long- and short-term memory, with production rules being stored in long-term memory and matched against the contents of short-term (or working) memory to determine which fire. The values for various motor and mental operators in KLM were based on the Model Human Processor (MHP) architecture of Card, Moran and Newell. Another common assumption, it is the distinction between linguistic levels - semantic, syntactic and lexical - as an architectural model of the users understanding.

Architectural models:

- The problem space model
- Interacting Cognitive Subsystems

The problem space model Rational behavior is characterized as behavior that is intended to achieve a specific goal. This element of rationality is often used to distinguish between intelligent and machine-like behavior. In the field of artificial intelligence (AI), a system exhibiting rational behavior is referred to as a knowledge-level system. A knowledge-level system contains an agent behaving in an environment. The agent has knowledge about itself and its environment, including its own goals. It can perform certain actions and sense information about its changing environment. As the agent behaves in its environment, it changes the environment and its own knowledge.

Interacting cognitive subsystems (ICS) provides a model of perception, cognition and action, but unlike other cognitive architectures, it is not intended to produce a description of the user in terms of sequences of actions that he performs. ICS provides a more holistic view of the user as an information-processing machine. The emphasis is on determining how easy particular procedures of action sequences become as they are made more automatic within the user.
ICS attempts to incorporate two separate psychological traditions within one cognitive architecture. On the one hand is the architectural and general-purpose information-processing approach of short-term memory research. On the other hand is the computational and representational approach characteristic of psycholinguistic research and AI problem-solving literature.