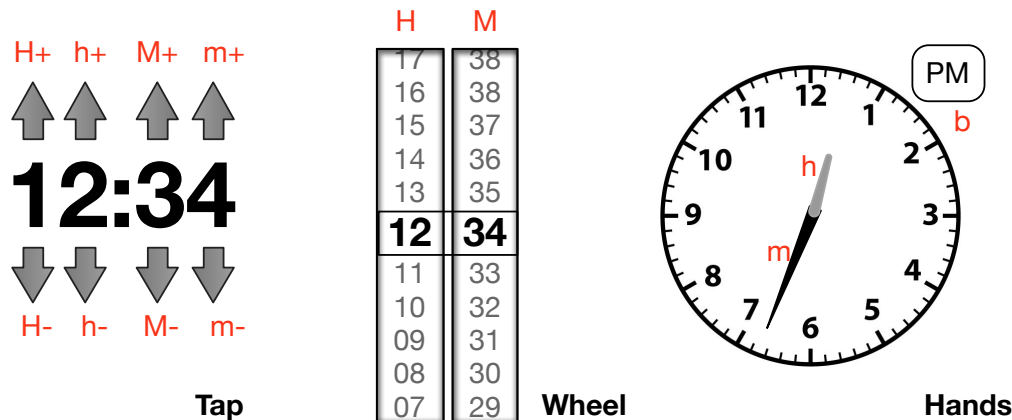


Master International, Interaction & HCID - Université Paris-Sud
Fundamentals of Human-Computer Interaction
Exam - 15 November 2017 - 3h

Authorized document: a single A4 handwritten sheet.
 Please read the questions carefully. Answer clearly, precisely and concisely.

A. Modeling interaction: Entering time (6 points)

You are asked to design an interface to set an alarm clock on a smartphone with a touch screen. The user must be able to select a time between 00:00 and 23:59. You are considering three designs: **Tap**, **Wheel** and **Hands**:



Tap: The time is displayed in the middle. Each digit can be changed independently by tapping the arrows above and below it. The buttons cycle around so that, for example, for the minutes, tapping the up arrow when 9 is displayed goes to 0, tapping the down button then goes back to 9.

Wheel: The hours and minutes are vertical scrolling wheels (00 to 23 for the hours, 00 to 59 for the minutes) that the user can drag up and down. The numbers cycle around the wheels: after 23 for the hours (59 for the minutes), the display goes to 00, 01, etc.

Hands: The display is an analog clock and the user can move the hours and minutes hands independently with their finger. An AM/PM toggle button in the corner switches between before and after noon.

You want to pick the design that is most efficient and decide to use the GOMS Keystroke-Level Model to assess the time it takes to set the time with each interface. The operators are as follows:

<i>Name</i>	<i>Description</i>	<i>Time</i>
M_t	Moving to area t (see below)	250ms
K_b	Tapping button b	100ms
$P_{D,W}$	Pointing to a target of size W at distance D	Fitts' Law (see table)
S	Swipe (see below)	250ms

M_t is the time taken to move the finger from one area of the screen to another area labeled t (the labels are indicated in red in the picture): from the starting position of the finger to the first target in all three interfaces, from one arrow button to the next in the **Tap** interface, from one scrolling wheel to the other in the **Wheel** interface, from one hand to the other in the **Hands** interface.

The time $P_{D,W}$ to reach a target of size W at distance D is given by Fitts' Law. The table below gives approximations of $P_{D,W}$ (in milliseconds) for various values of D/W , according to the formula $P_{D,W} = 100 + 150 \log_2(1 + D/W)$:

D/W	2	3	4	5	6	8	9	10	12	15	20	30	40	50	60
$P_{D,W}$	340	400	450	500	525	575	600	625	650	700	750	850	900	950	1000

In the **Wheel** interface, because of the limited size of the screen, the user can only drag the wheel by at most 10 items at a time. So to move from 00 to 15, the user first drags the wheel from 00 to 10, then moves the finger back, and finally drags the wheel from 10 to 15. The first drag (00 to 10) is counted as a Swipe (**S**), because it does not need to be precise; Moving the finger back for the next action is a move (M_h or M_m); The final adjustment (10 to 15 in this example) is counted as a Pointing operation ($P_{5,1}$). Note that there is no inertia when swiping or dragging the wheel: the wheel stops as soon as the user lifts the finger.

In the **Hands** interface, the time it takes to turn the hands is estimated using Fitts' Law by using *angular* distances and target sizes. For example, if the minute hand is on 12 and the user must put it on 3, the distance angle is 90° and the size is 6° (i.e. 360° divided by 60 minutes). Therefore $D/W = 90/6 = 15$ and the corresponding time from the table above is 700ms.

Questions:

1. First, you want to study the *worse case* for each interface. Assuming that the alarm clock is showing 12:00 and that the user is doing the optimal set of actions, describe which time requires the longest interaction for each of the three interfaces. Describe the sequence of operators necessary to achieve each interaction and calculate the three corresponding times, Tap_{max} , $Wheel_{max}$ and $Hands_{max}$. Which interface is fastest in the worse case?
2. Now, you want to study a *common case* for each interface. Assuming that the alarm clock is showing 8:00am, the user wants to change it to 6:30am. Describe the sequence of operators for each of the three interfaces and calculate the corresponding times: Tap_{avg} , $Wheel_{avg}$ and $Hands_{avg}$. Which interface is fastest in this common case?
3. A user study reveals that users do not need to set alarms with an accuracy of one minute, but that five minutes is sufficient. How does this affect the three interfaces? Revise the times calculated in questions 1 and 2 accordingly and conclude.

Next exercise on page 3

B. Conceptual modeling (7 points)

You are asked to create an interface for a simple e-book application running on a multitouch tablet. This interface must allow the user to:

- Show the available books and pick one to read;
- Read a book by turning pages;
- Bookmark a page;
- Highlight text and add comments to a page or to highlighted text.

The interface has three main displays:

- The **bookshelf**, showing miniatures of the covers of the available books;
- The **reader**, showing one or two pages of the book, depending on the orientation (one page in portrait, two in landscape);
- The **bookmarks and annotations**, showing the pages that are bookmarked and those that have annotations.

1. Identify the objects of interest and the operations of the conceptual model.
2. Sketch the layout of your interface for the three main displays, and explain the general design of the interface. **Justify your choice with the rules and principles seen in class.**
3. Fill out the objects and operations tables describing the conceptual model of the complete interface. For each operation, design two interactions to trigger the operation. To get you started, the tables below include one object and one operation (you can change those in your design).
4. Is your interface consistent? Explain.
Is your interface instrumental? Explain.

Objects table:

Objects	Representations	Properties	Operations
Book	Cover page in the Bookshelf	Title, author, last opened page	Open
...			

Operations table:

Operations	Commands	Feedback	Responses
Open a book	Double tap the book cover in the bookshelf	The book highlights	The book opens at the last opened page
...			

Next exercise on pages 5-6

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Answer part C questions on both sides of this page.

C. Course questions (7 points)

1. Who invented the mouse? (circle the answer)

Ivan Sutherland Doug Englebart Stu Card Steve Jobs

2. Link the features on the left with the historical systems on the right:

- | | |
|------------------------|---------------|
| Windows and icons • | |
| Geometric constraints• | • SketchPad |
| Videoconferencing • | • NLS/Augment |
| Bimanual interaction • | • Xerox Star |
| Direct manipulation • | |

3. The notion of affordance was introduced by

- Doug Engelbart James Gibson Don Norman

An affordance is (multiple answers are allowed):

- a property of an object
- the capability of an object for an action
- a relationship between the subject (the user) and the object
- the perceived capability of an object for action

Give an example of an affordance (not necessarily related to computers):

4. Describe two menu techniques other than the traditional linear menu and list one advantage and one drawback for each of them:

Technique 1: _____

Advantage: _____

Drawback: _____

Technique 2: _____

Advantage: _____

Drawback: _____

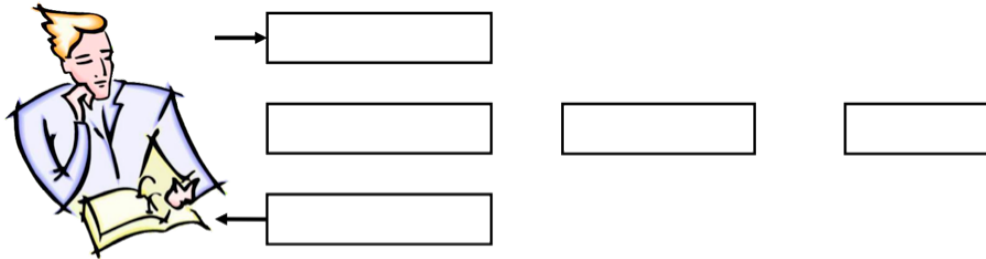
5. For each of the following pointing facilitation techniques, state how it takes advantage of Fitts' law:

Bubble cursor reduces target distance increases target size

Drag-and-pop reduces target distance increases target size

Auto-expansion reduces target distance increases target size

6. Add the missing arrows and labels to this diagram of the *conceptual model*:



7. List 4 **interaction styles** and give a short description for each:

1. _____

2. _____

3. _____

4. _____

8. List the 3 components of the sense of touch and briefly describe them:

1. _____

2. _____

3. _____
