

Master Recherche Informatique - Université Paris-Sud
Fundamentals of Human-Computer Interaction
Exam - 26 November 2013 - 3h

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

A. Modeling interaction: Color selection (6 points)

The Keystroke model is used to compare the times to execute interactive tasks by decomposing them into actions called “operators”. In this exercise, we consider the following two operators:

<i>Name</i>	<i>Description</i>	<i>Time</i>
$P_{D,W}$	Point or drag-and-drop	Fitts' Law (see table)
K	Type a key or push a button	100ms

The time in milliseconds to reach a target of size W at distance D is given by the table below. D/W is the ratio of target distance to target size; MT is the movement time in milliseconds, computed as $MT = 100 + 150 \log_2(1 + D/W)$.

<i>D/W</i>	4	5	6	8	10	15	20	30	40	50
<i>MT</i>	448	488	521	575	619	700	759	843	904	951

For the rest of the exercise, when you describe an interaction, make sure to explain what each operator corresponds to and to specify the distance and width used for each P operator.

We consider an interface for editing drawings made of geometric shapes (circles, rectangles, etc.). A shape is selected by clicking within it. Multiple shapes can be selected by clicking the first one and shift-clicking the rest.

1. The following interactions are available to change the color of an object:
 - a) Select one or more shapes, then select a color in the Colors menu from the menu bar;
 - b) Select a shape, then right-click to display a contextual menu and select a color in the Colors sub-menu;
 - c) Select a color in the color palette on the left of the screen, then apply the color to one or more shapes by clicking on each shape.

The layout of the display is as follows:

- The height of each menu item is 1cm, the width is 4cm;
- The height of a menu is 10cm on average and the target item is in the middle of the menu;
- The size of each color palette item is 1cm;
- The menu bar is 30cm away from the shapes;
- The color palette is 30cm away from the shapes;
- The shapes are 2cm wide on average, and are 10cm apart on average.

- 1a.** Draw the content of the display and show the trajectory of the cursor for each of the above three techniques.
- 1b.** Calculate the time to change the color of *one* shape with each of the above techniques. Which technique is fastest?
- 1c.** Calculate the time to assign the *same* color to 5 shapes with each of the above techniques. Which technique is fastest? Compare with the results of 1b.
- 1d.** Calculate the time to assign a *different* color to 5 shapes with each of the above techniques. Which technique is fastest? Compare with the results of 1c.
- 2.** We want to create a color instrument that is efficient in all the above scenarios. First we use a toolglass, i.e. a semi-transparent floating palette manipulated with the non-dominant hand. The toolglass contains the color swatches. To apply a color to a shape, the user moves the toolglass over the shape with the non-dominant hand so that the desired color swatch is over the shape, then moves the cursor with the dominant hand over the color swatch to “click-through” it.
- 2a.** Draw the interaction and specify any new hypothesis about the layout that you may need.
- 2b.** Calculate the time to assign the *same* color to 5 shapes with this technique.
- 2c.** Calculate the time to assign a *different* color to 5 shapes with this technique.
- 3.** We create a second instrument to set the color. This instrument is located in the tool palette, and shows the last color that was used.
- To apply this color, simply select the tool and then click one or more shapes (as in method c).
 - To change the color used by the tool, right click while the tool is selected. This displays a palette of color swatches. Click a swatch to select that color. The palette disappears. Clicking outside the palette closes it without changing the color.
- 3a.** Draw the interaction and specify any new hypothesis about the layout that you may need.
- 3b.** Calculate the time to assign the *same* color to 5 shapes with this technique.
- 3c.** Calculate the time to assign a *different* color to 5 shapes with this technique.
- 4. Compare the results from questions 1, 2 and 3. What do you conclude?**

Next exercise on pages 3-4

B. Conceptual modeling: Split the bill (8 points)

When going out to a restaurant or a bar, splitting the bill is often an awkward moment. The easiest solution is to divide the bill equally, but some people may feel frustrated because they did not eat or drink as much as the others. Also, what if one person offers to pay for the wine or for the first round of drinks? Even when people agree on how to split the bill, not everybody has the exact change. And after everybody has put in their money, someone realizes that the tip was not included...

Your job is to design a smartphone app that helps to solve these problems. The app should have a simple mode for when the bill is split evenly, and an advanced mode for when each person wants to pay their fair share.

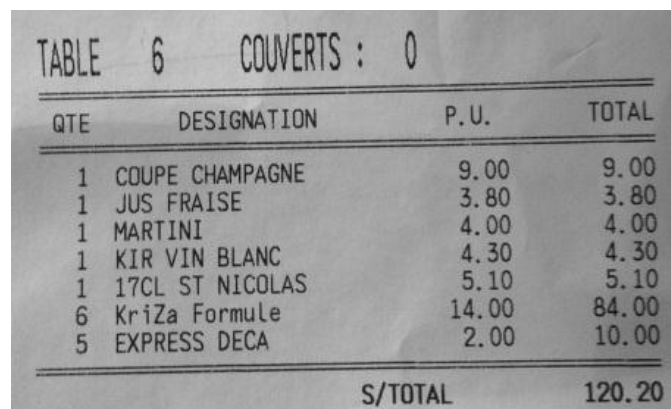
1. Splitting the bill equally

When splitting the bill equally, you need an easy way to enter the key information (number of persons, total amount, tip), and an easy way to adjust the tip to round out the individual amount. You want to see (and edit) the tip as an amount *and* as a percent of the bill. You also want to make it easy for someone to pay for two or more people.

- 1a. Design an interface for a touch-enabled smartphone that fulfills these requirements. Draw the interface and describe the various interactions.
- 1b. Show how your design design works for an amount of 150€ for 9 people, with an initial tip of 10%, adjusted to 8% (12€) to get to a round result (18€ per person).
- 1c. Count the number of elementary actions (touch, drag, etc.) for the scenario above, and compare it with the number of actions you would need to get to the same result on a regular calculator.

2. Each person for themselves

To split the bill according to what each person has consumed, the system needs to know the list of items and their prices. We assume that the smartphone has a powerful image recognition program that can turn a snapshot of the paper bill into a list of items with their price. For example, for this bill:



QTE	DESIGNATION	P. U.	TOTAL
1	COUPE CHAMPAGNE	9.00	9.00
1	JUS FRAISE	3.80	3.80
1	MARTINI	4.00	4.00
1	KIR VIN BLANC	4.30	4.30
1	17CL ST NICOLAS	5.10	5.10
6	KriZa Formule	14.00	84.00
5	EXPRESS DECA	2.00	10.00
S/TOTAL			120.20

the system will create a table with a list of items and, for each item:

- The quantity;
- The text description;
- The unit price;
- The total price.

You need to create an interface that lets users:

- Take a snapshot of the bill and turn it into a list of items;
- Enter the number of people and, optionally, their names;
- Assign each entry in the list of items to the person paying for it;
- Enter the tip and adjust it; and
- Show the amounts owed by each person.

Create a conceptual model of the interface. Make sure to follow the principles of direct manipulation and to justify your choices.

2a. Identify the objects and operations of the conceptual model.

2b. Design the visual aspect of the interface. Use drawings to illustrate your descriptions. Keep in mind typical use cases, and try to make the interface playful (a spreadsheet is probably not a good idea!) and efficient. You can use gestures, voice recognition, etc.

2c. Fill out the objects and operations tables to describe the complete conceptual model of the interface. The tables below include one object and one operation, with a rather boring interaction: it is up to you to improve it!

Objects table:

Objects	Representations	Properties	Operations
Item	Line in table	Quantity, Name, Price	Assign to user

Operations table:

Operations	Commands	Feedback	Responses
Assign item	Tap the item	A menu of people's name appears	The person's name appears next to the item
	Tap the person's name		

Next exercise on pages 5-6

Answer part C questions on both sides of this page.

C. Course questions (6 points)

1. Check all that apply:

	used a mouse	used bimanual interaction	had windows
SketchPad	[]	[]	[]
NLS/Augment	[]	[]	[]
Xerox Star	[]	[]	[]

2. List 3 important aspects of human vision for HCI and briefly explain why:

1. _____

2. _____

3. _____

3. Briefly describe the 3 design principles of Instrumental Interaction:

1. Reification: _____

2. Polymorphism: _____

3. Reuse: _____

4. Indicate the type of task (from the list of six basic interaction tasks seen in class) corresponding to each of these interactions:

Click the OK button in a Print dialog: _____

Use the scrollwheel when reading a document: _____

Drag a file icon to the trash: _____

Select the Cut command in the Edit menu: _____

Click and drag to specify the position and size of a rectangle: _____

Click and drag to move a corner of a rectangle: _____

5. Cite the formula for Fitts' Law and 3 techniques that improve pointing:

Fitts' Law: _____

Technique 1: _____

Technique 2: _____

Technique 3: _____

6. Add the names of the 6 stages of Norman's Action Theory:

