

2010 Exam Summer Answers [Usability]

1. (a) The World-Wide Web Consortium has proposed a number of guidelines as part of its Web Accessibility Initiative (WAI). Guideline number 5 of version 1.0 of the guidelines states:

Create tables that transform gracefully.

Explain what is meant by *transform* in this context.

Using an example (e.g., a calendar), discuss how you would create a table that transforms gracefully.

Transformable allows content to be used by different means, for example in the context of the web content accessibility guidelines it should be perceivable meaning the content can be presented in different ways without losing structure. It should also be operable, for example if you want to navigate to a calendar it should allow you to navigate each day by left and right key presses.

- (b) State Fitts' Law and explain its significance.

Compare the use of menus in Microsoft Windows and the Macintosh OS in the light of Fitts' Law.

(9 marks)

Fitts' Law states that, for a given system, the time taken to move a pointer onto a target varies as a function of:

- The distance the pointer has to be moved
- The size of the target.

Fitts' Law is normally stated as follows:

$$t_m = a + b \log_2 \left(\frac{d}{s} + 1 \right)$$

Where:

t_m	=	movement time
a	=	start/stop time
b	=	device tracking speed
d	=	distance moved
s	=	target size (relative to the direction of movement)

- In the windows operating system menu's for programs that are opened are placed at the edge of the programs window. This makes it more difficult to point to the programs menu to perform an action because the program window could be of any size. This style is not an infinite menu, which could cause problems for navigation times.
- In a Mac operating system however, it is much easier to point to the currently opened programs menu because it is always in the top left corner of the screen and this fact will be known to the user in advance of performing a menu-based action. For this reason it is an infinite menu because the mouse pointer can go no further off the screen once it has reached the menu.

(c) Using KLM, the task of closing a window by selecting 'close' from a menu is modelled as follows:

P[to menubar] B[LEFT down] M P[to option] B[LEFT up]

T_{execute} = 2t_P + 2t_B + t_M

Explain the meaning of each of the terms.

Suggest ways in which accuracy of the KLM model of this task could be improved.

(12 marks)

- The KLM defines five types of motor operation:
 - K keystroking, i.e., striking a key, including a modifier key such as shift
 - B Pressing a mouse button
 - P Pointing, using the mouse or other pointing device, at a target
 - H Homing, i.e., switching the hand between mouse and keyboard
 - D Drawing lines using the mouse
- The KLM also provides mental response and system response operators:
 - M Mentally preparing for a physical action
 - R Response from the system: may be ignored in some cases, e.g., copy-typing
- The KLM model of this task could be improved by getting more accurate times for the button clicks, i.e. actually timing the user clicking the button, also by using Fitts law to change the P variable to actual times.

2. (a) Explain the major differences between the following interaction styles, indicating the type(s) of application each is suited to.

- **Command-Line**
- **Form-Fill**
- **Menu-Selection**
- **Direct-Manipulation**

Suggest some guidelines for use with each style of interaction.

(10 marks)

- Command line requires recall to use the system to its full potential.
 - A trained system administrator could use command line to manage user's profiles on a remote server.
 - A guideline that should be implemented is easy reversal of actions.
- Form-fill can be used by anyone with little experience. The form text box is a metaphor for a form field on a paper form.
 - Form-fill is used for data-input on websites or in programs.
 - Do not allow typing of alphabetic characters into numeric fields.
- Menu-selection does not allow mistakes to be made and has limited flexibility but can be used by an untrained user.
 - Menu-selection presents multiple options with the user being able to choose one of them.
 - Menus should provide brief descriptions of the action carried out when the user hovers over a menu item.
- Direct-manipulation deals with icons representing data, users see changes happening as they carry out an action. Errors can be undone easily.
 - This would be used in gaming, e-learning applications and ecommerce websites.
 - All selectable icons should have consistent layout.

(b) Explain the meaning of the following terms:

- **Re-engineering and mental models**
- **Task Analysis and Cognitive Modelling**
- **Normative, Expressed and Felt needs**

(10 marks)

- **Re-engineering** involves changing an existing model to suit the needs of its users.
- **Mental Models** is an explanation of someone's thought process about how something works in the real world. Eg a taxi driver has a mental model of the streets.

- **Task analysis**
 - models only what happens - or is observable - during interaction
- **Cognitive models**
 - Designed to incorporate some representation of the user's abilities, understanding, knowledge, etc. E.g. KLM model uses the M operator.
- Needs identified by professional designers/developers.
 - These are often referred to as **normative needs**
- The needs of the end-user. These can be difficult to determine. It often helps to think in terms of:
 - **Expressed needs** - what end-users SAY they want
 - **Felt needs** - what end-users ACTUALLY want(or would like) from the system but might not realize it can be implemented.

(c) A used-car dealer has commissioned you to develop an interface for its new, online search tool. The tool will allow customers to search the company's database and obtain a set of results matching broad criteria (make and model of car, price, colour, age, mileage, etc.). Users will then be able to interactively sort and filter the data on the client-machine.

Describe an interface that would allow interactive sorting and viewing of such data. Include a sketch or diagram if appropriate.

Explain how your proposed solution would provide/support:

- **Overview**
 - The overview should provide information on the cars such as the price and make of every car, colour, mileage etc. Each section on a different car should also have a relevant picture showing what the car actually looks like.
- **Filter**
 - The user should be able to select certain criteria and have all the cars that match that criteria displayed dynamically, for example having a range slider to indicate price should display more expensive cars when the slider is moved to the right and cheaper cars when it is moved to the left. Also check boxes for selecting colour and engine size could be implemented in order to show cars that match those criteria.
- **Zoom**
 - A nice implementation for the images of the cars would be a mouse over zoom; whenever the mouse is hovered over an image, the image would display in a temporary pop up window

showing the larger version of the image and once the mouse is moved away from the image the temporary pop up window would close.

➤ **details-on-demand**

- Here we would like to provide an easier way for users to see details of the car as quickly and as compact as possible. For example, when a user hovers over the image of a car, dynamically opening a temporary pop up window which displays information on the car such as price, mileage, engine size etc.

(10 marks)

3 (a) You have been asked to evaluate the data from a usability study. The aim of the study was to compare two user-interfaces, A and B, which were designed for use on a piece of medical equipment. The subjects were all medical doctors and they were divided into two groups. Each subject performed the same task, but those in one group used interface A while those in the other group used interface B. The data collected represents the number of errors made by each group while performing the task a set number of times. The subjects who used interface A made fewer errors on average than those who used interface B. In order to determine if the difference in error-rates is significant, it is proposed that the data be analysed using a statistical test.

State which statistical test you would use, and explain the reasons for your choice.

(9 marks)

- I would use the Mann-Whitney statistical test. The reasons for my choice are:
 - It is a 2-sample test: In this case we are testing only two interfaces.
 - It is an independent test: The groups from which we are gathering the data are not related because total IQ could differ between both groups.
 - It is ordinal scaled because two errors are worse than one error but not necessarily twice as bad as one as the errors could differ greatly.

(b) Explain the meaning of the following terms:

- **Nominal, Ordinal and Interval data**
- *** Normal Distribution**
- **One-tailed and Two-tailed predictions**

(9 marks)

- **Nominal-scaled data**
 - There is no numerical relationship between scores
 - e.g., a score of 2 is not necessarily higher than a score of 1.
- **Ordinal-scaled data**
 - A score of 2 is higher than a score of 1, but not necessarily twice as high.
 - Data obtained from questionnaires is usually ordinal-scaled.
- **Interval-scaled data**
 - A score of 2 is exactly twice as high as a score of 1.
 - Timing data is usually interval-scaled.

If we were to take samples from an *infinite* number of subjects and then chart the frequency distribution, we would probably find that the results show a *normal distribution*.

The normal distribution has the following features:

- It is symmetrical, with most of the scores falling in the central region.
- Because it is symmetrical, all measures of central tendency (mean, mode, median) have the same value.
- It can be defined using only the *mean* and the *standard deviation*.

In formulating our prediction (on whether differences occur by chance or not in our tests), we must also decide whether to predict the *direction* of any observed difference or not.

- If we predict only that there *will* be a difference, we are using a two-tailed test.
- If we predict the *direction* of the difference, we are using a one-tailed test.

(c) It has often been predicted that we will one day be able to interact with computers entirely through speech. However, despite enormous advances in speech recognition and related technologies, speech-based interaction remains confined to a few specialised applications.

Describe the major problems involved in creating speech-based interfaces to interactive systems, and discuss their significance for the future development of such systems.

(12 marks)

- Speech relies heavily on non-grammatical sentence forms(minor sentences)
- There is no punctuation
- Repetition and re-phrasing are common.

- Efficient speech communication relies heavily on other communication channels - gesture, facial expression, etc.
- Until a system is developed through which facial expressions can also be recorded while a command is being spoken, speech-based interaction systems will be quite error prone.