# THE BCS PROFESSIONAL EXAMINATIONS
# BCS Level 6 Professional Graduate Diploma in IT

## April 2008

## EXAMINERS' REPORT

## User Interface Design

### General Comments

Candidate's answers ranged widely in quality and amount of detail. In general students gave insufficient detail in their answers and did not let the number of marks allocated to the section guide them as to the depth of answer required. Candidates should ensure that their answers are presented in the context of the scenario stated in the question, and avoid repetition of general lists and theories recalled from text books. Answers should not begin by repeating the question as this wastes time.

### Question 1

Knowledge of the characteristics of human memory is important in the design of user interfaces. The currently accepted theory on the structure and function of human memory is known as the *Modal* Model of human memory. Using your knowledge of this model, answer the following questions:

a) What are the **three** main components of the *Modal* Model of human memory?

**(6 marks)**

b) What are the current ideas about information capacity and duration associated with each of these components?

**(6 marks)**

c) Loss of information can occur from any component of memory or during transfer of information between components. This can cause users problems and user interface designers must use their knowledge of human memory to anticipate and address such potential problems.

Briefly outline **four** sources of memory problems or bottlenecks which may occur when humans interact with computers and in each case give an example of how a designer of a user interface might overcome this.

**(13 marks)**

### Examiner's Comments

This question requires candidates to apply their knowledge of the most generally accepted theory of human memory to the practical issues involved in designing user interfaces. Answers to sections (a) and (b) were generally good, although the details, particularly of long-term memory, were not as well described. Answers to section (c) showed some candidates to be confused between cognitive overload and memory problems/bottlenecks. Some answers demonstrated confusion over the use of icons to take advantage of the "recognition better than recall" with long-term memory issues addressed by the question. Some candidates missed out on marks by failing to give examples of how designers can overcome problems described.

(a) The Modal Model of memory has 3 components:

- Sensory Memory (Iconic store) (2 marks)
- Short Term Memory (2 marks)
- Long Term Memory (2 marks)

(plus one bonus mark for any innovation)

(b) Sensory Memory
Capacity:

- Upper limits are not clearly understood.
- Key to capacity lies in duration and selection.
- 3-6 letters can be reported before decay destroys the contents.
- This serves as an operational definition of capacity. (1 mark)

Duration:

- Less than 1000 ms. (1 mark)

Short Term Memory.
Capacity:

- 7 +/-2 CHUNKS
- CHUNKS are semantically coherent collections of data which are based on highly active processing
- The contents of a single CHUNK can change depending on training and experience.

(1 mark)

Duration:

- Approx. 2-3 minutes. (1 mark)

Long Term Memory.
Capacity:

- No known upper limit - probably infinite. (1 mark)

Duration:

- No known upper limit - probably lifetime. (1 mark)

(c) The student can respond with any 4 of the following typical examples, or cite other reasonable examples. For each:

- Source of Problem (each 1 mark)
- Example of designer overcoming (each 2 marks)

**Possible Answers:**

**1. Sensory Memory**
**Source:**
Duration of stimuli may be too short for selection of "relevant" data.
**Example: (any of)**
Do not allow rapid display and disappearance of error message - require user to dismiss message
Pull-down menu does not disappear if mouse button released

**2. Sensory Memory**
**Source:**
Sensitivity to masking, i.e. secondary stimuli displace/destroy current content
**Example: (any of)**
Allow user to deal with each error recovery option sequentially
Prevent interruption of processes such as log-on with message.

**3. Short Term Memory**
**Source:**
The CHUNKING limit indicated by 7+/-2 is real – overloading causing displacement is a common problem.
**Example: (any of)**
Restrict number of options displayed in a menu (< 10)
Allow scrolling to reread serially displayed lines of text in CLI - e.g. Java Compiler error messages

**4. Short Term Memory**
**Source:**
Sensitivity to interpolated tasks (displaces, prevents rehearsal and re-coding).
**Example: (any of)**
Don't enforce interruption of user tasks with system status message that requires response
Don't allow interruption of task by other non-critical activities arrival of email
Do tasks such as choosing username/password (requiring user to think) at start or end of task not in the middle

**5. Short Term Memory**
**Source:**
Closure
**Example: (any of)**
Delay "goal" until all stages in a procedure are complete - e.g. dispensing money from ATM only after card has been taken

**6. Long Term Memory**
**Source:**
Recognition is superior to recall. Over-reliance on the latter results in problems.
**Example: (any of)**
Consistency of display of dialogue or error messages
Use of icons instead of commands
WWW page titles so bookmarks have meaningful names

**7. Long Term Memory**
**Source:**
Metaphor results in erroneous recognition
**Example: (any of)**
Careful analysis of user's mental model's to prevent poor metaphors
Use of confirmation dialogue box to enable recovery

**8. Long Term Memory**
**Source:**
Coherence, priming and facilitation problems .
**Example: (any of)**
Group similar items in menus - using dividers
Colour coding of material in search tasks
Keep to "depth of 2 - 8 options" rule of thumb for menus and dialogues

**9. Long Term Memory**
**Source:**
Interference problems relating to failure of coherence, priming and facilitation problems in UI design.
**Example: (any of)**
Decompose tasks into coherent steps
Sequencing should be meaningful e.g. maintain chronological sequences
User position in dialogue should be indicated (titles, numbers, maps ...)
Items kept brief and consistent

**Question 2**

Schneiderman's eight Golden Rules of interface design, which have been derived and refined over two decades, are:

- strive for consistency
- cater to universal usability
- offer informative feedback
- design dialogue to yield closure
- prevent errors
- permit easy reversal of actions
- support internal locus of control
- reduce short-term memory load

a) Choose **three** of these *Golden Rules* and briefly (one paragraph for each) describe the scientific (physiological, psychological etc) theories upon which they are based. Clearly reference the theories to which you refer.

**(9 marks)**

b) The *Golden Rules* provide a useful starting point for designers - however they have their limitations. Briefly (one paragraph each) identify and describe the limitations of **three** of the rules.

**(9 marks)**

c) Shneiderman (2005) suggests that each of the *Golden Rules* "must be interpreted, refined, and extended [according to] the environment".

*Interpret, refine* and *extend* **two** of the rules to accommodate and differentiate design for each of:
(i) mobile; and
(ii) desktop platforms.

**(7 marks)**

**Examiner's Comments**

In past years, questions suggesting *rules* for interface design have inevitably elicited from candidates a straightforward regurgitation of Schneiderman's eight Golden Rules – regardless of the question focus or specific instructions to avoid doing so. This year, the question deliberately set out the *Golden Rules* in the paper*,* in anticipation that candidates would avoid describing the rules and instead actually address the issues in the three parts of the question. In general, with one or two notable exceptions, this did not happen.
In part (a) a few candidates related their chosen three rules to scientific theories and most chose instead to describe three, and sometimes all, of the *Golden Rules*. In part (b), most candidates again chose to describe the rules rather than their limitations. Some candidates managed to write the description of the same three rules for part (a) and part (b). Part (c) of the question was the least well answered element of the question and candidates either failed to provide an answer at all, or demonstrated a lack of understanding of the question requirements.
Candidates should be aware that examiners are always looking for answers that address the question. Simply writing out everything the candidate knows about a subject (usually rote learned from a text book) will not be sufficient to achieve a pass grade. Candidates should also be aware of the instructions given: when asked to choose three rules, choosing more will not gain more marks and writing an answer to a question element worth 3 marks that extends over two sides of paper does not normally comply with the instruction for a 'brief paragraph'!

(a) 0-3 marks awarded for each paragraph according to the level of understanding displayed and the knowledge of specific theories supporting each of the *rules*, eg the Magic number seven theory of short-term memory.

(b) 0-3 marks awarded for each paragraph according to the level of understanding displayed and the knowledge of the limitations of each of the three chosen *rules*.

(c) 0-7 marks will be awarded according to the level of completeness and understanding exhibited in the answer. Highest marks will be awarded to those answers that compare and contrast differences in rules according to platform.

**Question 3**

The capture of user requirements is an essential component of user-centred design and is influential during all phases of the design of a system.

a) Give a brief definition (one or two sentences) of a requirement in the context of user-centred system design.

**(2 marks)**

b) Requirements are conventionally divided into two types: functional and non-functional. Describe the main characteristic of each of the two types and give a simple example for each.

**(6 marks)**

c) What factors should you consider in the selection of a user sample?

**(4 marks)**

d) Briefly describe the **four** main categories of data you need to collect about users.

**(8 marks)**

e) What type of data would you try and obtain from users through questionnaires?

**(3 marks)**

f) What are the common problems and limitations encountered when using questionnaires in user requirements capture?

**(2 marks)**

**Examiner's Comments**

In general, lack of detail in candidate's answers limited the number of marks earned. In section (b) candidates were generally successful in describing functional requirements, but few successfully described non-functional requirements. In general, answers to section (d) lacked specifics.
A significant number of candidates misunderstood the question in section (e), and described the differences between qualitative and quantitative data that may be gathered using questionnaires. Many candidates focused their answers to section (f) on the problems of users not being truthful in their responses and low questionnaire return rates and did not mention other issues.

a) A requirement is what the user needs or desires from a system, or any function, constraint, or property that the system must provide, meet, or satisfy in order to fulfil its purpose. (2 marks)

b) A functional requirement is what the user wants a system to do. A functional requirement also implies something about the need for system memory to support the function, i.e. the functional requirements define: behaviour (a function the system must perform) and state (memory that the system must maintain to coordinate behaviour).
Possible examples (any reasonable task):
summarize sales, create invoice, receive shipment, etc.

A non-functional requirement is a characteristic or constraint that might limit our choice of technology when functional requirements are implemented.

Possible examples (any reasonable restriction):
Availability - users might need to be able to access the system 24/7.
Capacity or performance - the system might need to be able to handle a peak loads with minimum response times.
Deadline - the system must be implemented in a fixed time.

(6 marks)

(c) The typical issues the student can discuss are:

Make the user sample as broad as possible in terms of:

- age
- general computer experience
- platforms used, amount of system experience
- purposes of system use, e.g. for business, education, personal (relative amounts).

The ratio of sexes should be balanced.

(4 marks)

(d) Four main categories:

(i) User characterisation:

- defining 'user group'
- job characteristics
- user backgrounds
- constraints
- preferences and traits

(ii) Task analysis/identification:

- each task identified in terms of goals, intrinsics, dependency/criticality, problems, performance and task criteria, discretion, demands.

(iii) Situational analysis:

- equipment - hardware and software
- availability
- overloads
- interruptions
- surroundings

(iv) Acceptance criteria:

- user perceptions of acceptability - minimum/maximum.

(e) Questionnaires should be targeted at gathering information needed for the categories in part (c) of the question and should help to place boundaries on user groups, e.g. "business user", "education", "home user" etc. (3 marks)

(f) Questionnaires are open to problems of sampling and generalisation and the usual survey problems of obtaining sample contacts and poor returns. (2 marks)

**Question 4**

SeeSaw, a small mobile communications company, is planning to build a screen-less mobile phone for the visually impaired. As well as being able to dial out and receive calls in the usual manner, the device will have a phone book facility, enable the user to send and receive SMS text messages and inform the user of the identity of a caller. Other regular functions such as indicating battery status, signal strength, call history, ring tone options and volume settings are also required.

Your brief, as an interaction designer working for SeeSaw, is to advise on initial design ideas and solutions.

a) A sound-based interface to the device could form part of the design solution. However, sound as an interface has problems; for example: *annoyance*, *discrimination* and *transience*. Annoyance is the affect on other people in the vicinity of the user. Discrimination is the issue of being able to distinguish between similar device sounds or between device sounds and background noise. Finally, sounds are transient in nature, i.e. they do not persist.

Sketch out the slides for a short PowerPoint® presentation to be presented to the product design team giving possible solutions to each of these problems (use one slide for each and use no more than six bullet points per slide).

**(9 marks)**

b) i) Briefly, what is an *earcon*?

**(2 marks)**

ii) Write a short report to the Project Director (no more than 250 words) on how earcons might be used as the principal form of interaction for navigating a typical mobile phone menu system.

**(5 marks)**

iii) What design considerations need to be taken into account when producing a coherent set of distinct earcons for such a task?

**(5 marks)**

c) The company CEO has emailed you asking for your view on the potential for using forms of interaction utilising sensory inputs other than sound, in a phone for the visually impaired. Draft your response using no more than 150 words. The CEO expects you to be creative in your thinking.

**(4 marks)**

**Examiner's Comments**

The guidance given for question 2 regarding addressing the requirements and following instructions applies equally well to this question. This question asks candidates to adapt and apply knowledge gained from texts and/or classes to a real world situation. The three sections expect candidates to present their knowledge and ideas in different styles and formats: visual presentation, report and email. Many candidates either ignored this requirement or failed to address it, choosing instead to write generic answers.
In part (a) of the question, several candidates demonstrated a lack of knowledge by making an assumption that an *earcon* was a piece of hardware. Parts (b) and (c) of the question produced some interesting answers, but in the main candidates failed to demonstrate an understanding of the issues involved with designing for something other than a visual interface. In part (c) the instruction to 'keep your response brief (no more than 150 words) and be prepared to think creatively' was largely ignored. Interestingly, only three candidates showed application of real world knowledge and discussed the possibility of haptic interaction based on the vibrating function of all mobile phones.

(a) 0-3 marks per slide according to clarity and completeness of each. Answers are not expected to include a description of each of the problems – this is included in the question itself!

(b) (i) musical tones that can be used as means to navigate menu structures.

(ii) 0-5 marks will be awarded according to the clarity and completeness of the answer. Answers that clearly exceed the word limit specified in the question will be penalised.

(iii) 0-5 marks will be awarded according to the clarity and completeness of the answer. Highest marks will be awarded to answers that show a thoughtful and creative design process and are likely to include descriptions of the possible earcon tones.
Answers that clearly exceed the word limit specified in the question will be penalised.

(c) 0-4 marks will be awarded according to the clarity and completeness of the answer. Answers will be expected to explore possibilities with the use of other forms of sensory communication, particularly haptic. Answers that clearly exceed the word limit specified in the question will be penalised.

**Question 5**

a) Briefly outline the meaning of each of the following terms as used in user-centred design:

i) mental model; and
ii) metaphor.

**(4 marks)**

b) Give two examples of metaphors currently used in user interface design.

**(4 marks)**

c) What are the main objectives of task identification as part of user needs analysis?

**(9 marks)**

d) Describe four criteria which might be used to define any system as being usable.

**(8 marks)**

**Examiner's Comments**

Candidates answers to sections (a) and (b) varied widely, with some giving very accurate definitions and good examples, but a number of answers did not address the question, but described icons instead. Candidates had some difficulty with the level of abstraction required by section (c), and many merely defined what a task analysis is. Answers to section (d) were generally good, although many candidates failed to mention attitude as a criteria for usability.

(a) (i) Mental Model**:** The personal cognitive model that a user has of how a system functions. (2 marks)

(ii) Metaphors: According to dictionaries, a metaphor is something which stands for or represents something else. More importantly, in the context of HCI, metaphors can be defined as relating to "how users acquire an appropriate mental model of a system". (2 marks)

(b) Any 2 reasonable examples - e.g.:

- Desktop metaphor
- Interactive furniture metaphor
- Rooms metaphor
- Tree metaphor

(c)

- To understand the user's goals.
- To understand the user's activities.
- To understand the tools used by users.
- To understand the environment users work in.

(2 marks each plus 1 mark bonus for good explanation)

(d) This is an open-ended question and students' answers will vary. The following points should be covered:

(i) Effectiveness:

- whether the software does the job it is intended to do
- the software supports the tasks that the user needs to do to carry out a specific job
- usually achieved through detailed task analysis relating e.g. to writing, careful design and subsequent evaluation of the software to ensure that the software supports the users' tasks. (2 marks)

(ii) Learnability:

- any usable system should be easy to learn and also easy for a user to come back to
- intermittent but regular users would benefit from learnability, enabling them to come back to the system with a minimum amount of effort.

(2 marks)

(iii) Flexibility:

- usable software needs to enable each and every user to work in slightly different ways
- also should allow some degree of customisation
- software should be designed in such a way as to cope with changing demands (e.g. tasks) from the user.

(2 marks)

(iv) Attitude:

- usable software should generate a positive attitude from the users
- users should feel satisfied that the tool they are using supports their work and enable their tasks
- it should result in a minimum amount of frustration

(2 marks)