**UNIVERSITY OF BRISTOL**

**JANUARY EXAM PERIOD 2023**

**FACULTY OF ENGINEERING**

**COMPUTER SCIENCE**

Third Year Examination for the Degrees

Bachelor of Science and Master in Computer Science

# COMS30027-J

# HUMAN-COMPUTER INTERACTION

There are FOUR questions

Answer ALL questions

The maximum possible mark is 100

**Time Allowed:**
**2 hours**

Do not turn over until instructed to start

**This is an open book exam.**

**Question 1**

You have been hired by Mike & Oussama, a high-end hair and beauty brand, to implement a sales app which can run as a graphical user interface (GUI) on their desktop website. They later hope to implement the app on a walk-up-and-use touchscreen experience at their flagship store on Oxford Street in London.

(a) You are prototyping the desktop website for mouse users. You are debating whether you should place the basket checkout button either (1) in the centre of the screen or (2) in the top-right corner of the screen. The mouse cursor is motion-limited to the edge of the screen, you can assume this makes the width of the button in the direction of the cursor travel infinite in that case. Using Fitts' Law, derive in the general case (ie on average) why option (2) is better.

*Answer in 3-5 paragraphs*
*(8 marks)*

- According to Fitts' Law the target acquisition time is dependent on the distance to the target and the width of the target. (1 mark)
- In the first instance the distance to target is potentially large but the width of the target is infinite. This is because the target is positioned at the very edge of the screen in the top-right so the user can easily acquire the target using an open-loop motion. (3 marks for this explanation)
- In the second case (case B) the target is close to the user but the user needs to be careful with acquiring the target. (2 marks for this explanation)
- As Width tends to infinity, the index of difficulty tends to zero, so the case 2 will be preferred in any reasonably distant starting position. (2 marks)

(b) Compare and contrast the use cases of the store-based touchscreen and the web-based desktop GUI versions of the app. Explain why an optimal interface layout for pointing and selection might be different in the touchscreen case.

*Answer in 2-4 paragraphs*
*(6 marks)*

Three of the following (2 marks each):

- Pointing is more 'natural' with the hand than the mouse cursor, no clutching required, less friction on the surface.
- Pointing is more physically effortful in the touchscreen case – in 3d not 2d, and requiring active work against gravity; there is no 'acceleration' of movement in the real world.
- Selection requires greater physical force in the case of the touchscreen, and there is no haptic feedback showing it has been recognised by the UI (normally)
- There is no constraint at the edge of the screen, meaning pointing is slower in the physical case.

(c) Being incredibly stylish, Mike & Oussama want to stop their touchscreen getting dirty with fingerprints, so the store is also considering using a touchless camera-

based hand tracking system which offers users mid-air gestures. What additional variables or latencies are introduced into the Fitts' calculation in this scenario compared to the touchscreen case?

*Answer in 1-3 paragraphs*
*(5 marks)*

- The cursor visibly moves with the hand without touching the screen, this gives better feedback on the trajectory of movement. So, 'b' constant is likely smaller. (2)
- Selection is harder as there is no physical tap to select (assuming no contactless haptics). This adds to the 'a' constant as selection is less precise. (2)
- Touchless interfaces don't have as well-established grammar so gestures will need to be communicated/learnt (1)

(d) What is the positive value of using Fitts' Law for this job in the way you work with the client? Answer by naming three benefits of using Fitts calculations in this setting over more descriptive methods.

*Answer in 2-4 paragraphs*
*(6 marks)*

- Quantification allows easy numerical comparison to measure the design. (2)
- Communication for the client can be simpler to understand with data to back it up. (2)
- Use of the law reduces time and cost in running real-world user tests (2)

**Question 2**

After few months of deployment in their flagship store, Mike & Oussama call you back again, this time to relay to you the frustration that some of their clients have been experiencing when using the touchless interface in their store. You decide to examine the potential issues that customers may be experiencing by applying an analysis of affordances in the three systems to figure what could be going wrong.

(a) Using Gaver's notion of affordances, speculate on what could be working well and not so well on the desktop website, the touchscreen app, and the touchless camera-based hand tracking system. Answer by outlining Gaver's notion of affordances and giving one example for each notion as it could apply to each of the three systems.

*Answer in 3-5 paragraphs*
*(8 marks)*

- A definition of Gaver's notion of affordance in terms of separating affordances from the perceptual information available about them leading to four categories of affordances: False, Correct Rejection, Hidden and Perceptible. (2)
- An example of False Affordance, e.g. choosing to click on something that leads to nowhere (1.5)
- An example of Correct Rejection Affordance, an example of a non-existing function (1.5)
- An example of a Hidden Affordance, e.g. drop a pin not a location by tapping; affordance there but no information about it (1.5)
- An example of a Perceptible Affordance, e.g. buttons that convey click ability (1.5)

(b) Choose one of the examples you identified in (a) that might not be working well, and describe how you might re-design the interface to fix the affordance in that example

*Answer in 1-3 paragraphs*
*(5 marks)*

- An example of a re-design from, e.g. a hidden affordance by exposing information about how to act upon at, such as redesigning the visible depth of an interface element to convey click-ability
- Correct identification of the initial affordance state (1.5)
- Correct re-design strategy to expose information (2)
- Correct identification of the final affordance state (1.5)

(c) Discuss how Gaver's notion of affordances differs from Norman's notion and illustrate this with 3 examples from the touchscreen interface used at Mike & Oussama's flagship store.

*Answer in 2-4 paragraphs*
*(6 marks)*

- A discussion distinguishing between the four dimensions of Gaver's notions and Norman's notion of perceived vs real affordance (3), including sources of mapping constraints;
    - Cultural (1)

  - Physical (1)
  - Logical (1)

(d) Discuss where and how Gaver's and Norman's notions of affordances intersect with the theory of External Cognition. Answer by presenting 3 examples from one of the three interfaces that were deployed to highlight how the design of their interfaces fails or succeeds in implementing principles of External Cognition.

*Answer in 2-4 paragraphs*
*(6 marks)*

- Definition of External Cognition (1.5), and a reasonable discussion of how affordances relate to notions of:
  - Explicitness (1.5)
  - Visibility (1.5)
  - Constraining (1.5)
- OR
  - Consistency (1)
  - Explicit instructions (1)
  - Metaphors (1)
  - Coherence (1)

**Question 3**

The COVID pandemic hit while you were still in the design phase of the alpha version of the touchless camera-based hand tracking system. Under lockdown conditions, you and your team moved to working online using Teams and Miro (a collaborative whiteboard platform). You also used these two platforms to engage with key personnel from Mike & Oussama to collect design requirements, and to get feedback on your design iterations.

(a) Give a brief Distributed Cognition analysis of one the design meetings you would have had with your team. Describe the details of the distributed cognitive system in a scenario of your choice and explain your rationale for the analysis.

*Answer in 3-5 paragraphs*
*(8 marks)*

- Any analysis that contains a whole system/context as a unit of analysis (1.5)
- identifying what information/knowledge is necessary/flow in the system (1)
- where this information is stored in terms of i) external representation (1), ii) actors/agents internal representation (1), iii) physical interactions (1), iv) social interactions (1)
- any sensible representation of how information flows between these component (1.5)

(b) Give a brief Activity Theory analysis of one the meetings your team would have had with personnel from Mike & Oussama. Explain your rationale for the analysis to justify each element of your choice of activity system to analyse.

*Answer in 3-5 paragraphs*
*(8 marks)*

- Reasonable subject: agent performing activity (1)
- Reasonable object: thing to be transformed (1)
- Reasonable tool: things that mediate the transformation (1)
- Reasonable set of rules (1)
- Reasonable elements of a community (1)
- Reasonable division of labour (1)
- Any reasonable description of a rationale (2)

(c) Explain what primary and secondary contradictions in an activity system are, illustrate these two levels of contradiction with examples from the analysis you produced in (b).

*Answer in 1-3 paragraphs*
*(4 marks)*

- Correct definition of primary contradiction (1) and example (1)
- Correct definition of secondary contradiction (1) and example (1)

(d) Outline some of the design insights you may have gained from the Activity Theory and Distributed Cognition analyses and explain in what ways an Activity Theory analysis differs from a Distribution Cognition analysis.

*Answer in 1-3 paragraphs*
*(5 marks)*

- Reasonable examples (1)
- Description of differences between AT and DC in terms of:
    - What drives the analysis, high level motive (1) vs. Information processing (1)
    - The nature of design insights gained form each analysis: contradictions and their resolutions (1) identifying representational improvements (1)
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**Question 4**

Ultimately, your contacts at Mike & Oussama reported anecdotal evidence suggesting that their customers experienced misalignments between their identities, values and outlook, and the extent to which these were reflected and supported by the systems you developed.

(a) During one of the meetings with Mike & Oussama, you suggested that their clients may be experiencing *Breakdown* situations. How would you explain this notion to Mike & Oussama's personnel? Answer by defining *Breakdown* as grounded in Phenomenological analysis and include illustrative examples from the walk-up-and-use touchscreen system of *present-at-hand, unready-to-hand* and *ready-to-hand* modes of tool use.

*Answer in 3-5 paragraphs*
*(8 marks)*

- Breakdown definition (2)
- Definition of present-at-hand (1) and example (1)
- Definition of unready-to-hand (1) and example (1)
- Definition of ready-to-hand (1) and example (1)

(b) You debate what motivated costumers to engage in purchasing Mike & Oussama's beauty products. What design principles would you consider in order to help their customers to develop *intrinsic motivation* to use their app?

*Answer in 2-4 paragraphs*
*(6 marks)*

- Avoid external pressure (1)
- Avoid rewards (1)
- Provide informational feedback (1)
- Support identification with activity (1)
- Support sharing of experiences (1)
- Support relatedness (1)

(c) Contrast the approach you would take in (b) with an approach that targets Flow Experiences instead. What principles would guide your redesign in this case? and how do these principles contrast a Self-Determination Theory approach?

*Answer in 2-4 paragraphs*
*(6 marks)*

Provide support for:

- Focus on moment-to-moment engagement (1)
- Merging of actions with awareness (1)
- Increase sense of control and agency (1)
- Provide intrinsic rewards (1)

Discussing contrast in terms of focus on immediate pleasure in Flow, extending SDT in terms of Feeling in the moment, action merging, lost of reflective states, and track of time (2)

(d) Going back to the drawing board with a phenomenological analysis perspective, your team decide to explore intersections of phenomenological analysis and Flow to pin down experiences of breakdown. Where does the phenomenological notion of *Breakdown* intersect with that of Flow? How might you use the notion of *Breakdown* to your advantage in achieving a better re-design of the system?

*Answer in 1-3 paragraphs*
*(5 marks)*

A discussion highlighting the following:

- Focus on the texture of experience in both flow and phenomenology (1)
- Movement between backgrounding and foregrounding experience (1)

Use of breakdown in design:

- Breaking down illusion/interaction (1)
- Discovering hidden features of interaction (1)
- Devising more effective interaction strategies (1)

**THIS IS THE END OF THE EXAM**