Fundamentals of Human Computer Interaction (HCI)

PART THREE

Basics of HCI

- Modality of Interaction
- Interaction Models
- Architectures for Interactions

Interaction and Visualization

Operating on Visual Representations

- Visualization for Visual Analytic should facilitate the manipulation of visually represented data
  - A series of feedback loop

  - Overview
  - Zoom in/out
  - Select
  - Filter
  - Find relevant info

- Facilitate exploration of data space.

Types of Interaction

- Selection and Manipulation
  - Directly working on visual representations of data.
- Exploration and Navigation
  - Understand and walk through a visually represented space.

Selection and Manipulation

Choosing an item from a list

- Hick-Hyman Law : the time it takes to reach the decision is proportional to the number of available choices

$$RT = c + k \log_2 b$$

- RT: Reaction Time,
  c, k: constants
  b: number of choices
- one menu window with many choices is better than many menu windows, each of which has small choices

Choosing an item from a list (cont.)

- Humans tend not to do binary search
- Often use linear search
- Usually use mixed approach...but
  - for example, when you have 256 choices
  - do you present one menu window with 256 choices, or
  - do you present nested 8-level binary choice menues?

Searching an item

- nested menu windows might get a user confused, but allow small number of comparisons

$$TST = (bt + k + c)\frac{\log_2 N}{\log_2 b}$$

TST: Total Search Time
k, c: response time of a user and a system
t: the time it takes for each selection
b: number of selections
d: depth of the nest

- b = 3-8: optimal at k=0.5-1sec, t=0.25-2sec and c=0.5-1.35sec

Objects Arrangements (Fitt's Law)

- the time it takes to reach a target using a pointing device depends on the size of and distance to the target
- $$ID = \log_2 \frac{2A}{W}$$

  ID: index representing difficulty of pointing
  A: distance to the object
  W: width of the object

Objects Arrangements (updated Fitt's Law)

- ID is proportional to the sum of
  - time it takes to recognise the target/pointer,
  - time it takes to recognise the distance between the target and pointer,
  - time it takes for action

$$ID = \log_2\left(\frac{A}{W} + 0.5\right)$$

Path Tracing

- Interaction with Visualization may require “continuous tracing/steering” of a visual cue.

- Performance of the tracing act is influenced by
  - Width of the path, and
  - Difficulty in the type of motor control you need to carry out

  - Velocity = width of the path / motor control coefficient

Accot, J. and Zhai., S. (1997). Beyond Fires' law: Models lor trajectory-based HC1 tasks. Proceedings of CHI '97. ACM, 295-302.

Control Compatibility

- If the control required for the interaction is not compatible with what you already know,
  - It might take some time to learn the interaction,
- Make the interaction (or user interface in general)
  - Intuitive
  - Familiar to the wider audience
  -
- Utilize good metaphors

Exploration and Navigation

Interactions for Exploration and Navigation

- Visually sift through massive and complex data to reach something interesting
  - Change the visual appearance through interactions

- Moving around in the visually represented data space
  - Change the viewing location/orientation/direction in/on the visual landscape through interactions.

Changing Visual appearance

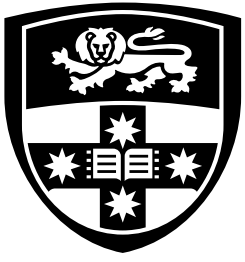
- Changing the focus of visual attention by
  - Spatial Scaling:
    - Changing the level of details within the visually represented space
      - Spatial behavior of individual fish within the school of fish, vs
      - Its impact from *continental shelf and the boundary between cold Arctic water and the warm waters of the Gulf Stream*
  - Structural Scaling
    - Switch between different levels of hierarchy withing the complex data.
  - Temporal Scaling
    - Different time scale.

eg yearly-basis, monthly-basis

Moving around inside the visualized space

- Typically uses “spatial navigation metaphors”
  - Landscape : visually represent data points on 2D/3D space like a map/landscape
    - Utilize the real-world navigation knowledge/capability.
    - Familiar interactions
  - Provision of the reference point is important
    - Provide the know obvious reference points, or
    - Let a user easily identify/create own reference points.

- Dimension mismatch
  - Different dimension between Visualization space vs Interaction space.
    - 3D visualization space controlled by the mouse movement in 2D
  - Different physical visualization space vs interaction space.
    - Visualization on a computer scree controlled by the mouse on a desk.



THE UNIVERSITY OF
SYDNEY