Lecture 10-1: Graphical User Interfaces

- **Elements of GUI Interaction Style**
  - Menus
    - Depth versus Breath
  - Icons
  - Windowing Systems
  - Direct Manipulation
    - Cognitive Account of Direction Manipulation
      - Gulf of Execution / Gulf of Evaluation

Direct Manipulation

Direct Manipulation

- All "programming" done graphically, my moving icons or graphics across screen
- Examples:
- Windows, Mac, Unix: Move and copy files and directories by dragging icons between windows or other icons
- Hutchins et al. (1986) example: draw lines between column and rows of spreadsheet and Y and X axes of graph icon, graph/scatterplot is then automatically generated
- Direct manipulation vs. other methods: Delete a file
  - Drag file icon for myfile.txt to trash can
  - Type: del myfile.txt
  - Open Explorer window, see list of files, highlight myfile.txt, choose "Delete" off the file menu
  - Open Explorer window with icons, click on icon for myfile.txt, hit "Delete" key on keyboard

Definition

- Shneiderman (1983) IEEE article, and book "Designing the User Interface"

- Definition of Direct Manipulation:
  - Continuous representation of the object of interest
  - Physical actions or labeled button presses instead of complex syntax
  - Rapid incremental reversible operations whose impact on the object of interest is immediately visible
  - (Shneiderman, 1983, also see Preece et al. P. 270)

- Which methods of deleting a file could be classified as direct manipulation?

Advantages

- Novices can learn basic functionality quickly, usually through a demonstration by a more experienced user

- Experts can work extremely rapidly to carry out a wide range of tasks, even defining new functions and features

- Knowledgeable intermittent users can retain operational concepts

- Error messages are rarely needed

- Users can see immediately if their actions are furthering their goals, and if not, they can simply change the direction of their activity

- Users have reduced anxiety because the system is comprehensible and because actions are so easily reversible
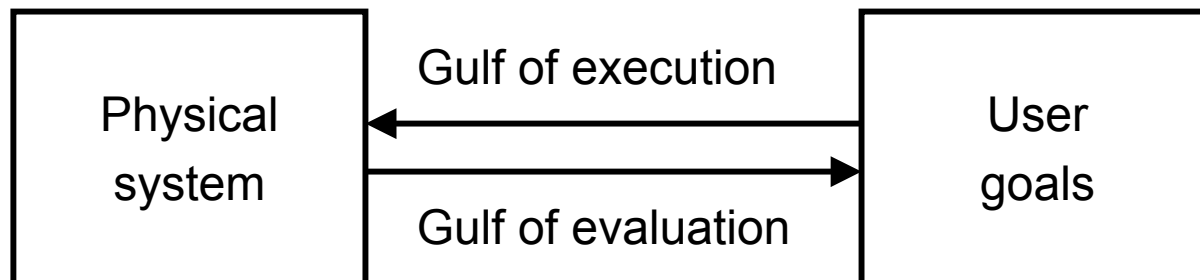
Shneiderman (1983) IEEE article, and book "Designing the User Interface"
and see Preece et al., page 271

Cognitive Account of Direct Manipulation

- Hutchins, Hollan, & Norman "Direct Manipulation Interfaces", In Norman & Draper *User Centered System Design*, 1986.

- What makes "directness" in direct manipulation?
  - Distance
    - "distance" between the users' thoughts and the physical requirements of the system
    - short distance means thoughts are simply and straightforwardly translated into actions required by the system
  - Engagement
    - qualitative feeling
    - user feels that they are directly manipulating objects of the task domain themselves
    - "direct engagement"

- Distance: Gulf between users' goals and knowledge and the way they must be specified to the system(s)
  - mismatch between users' thinking and the system model

Gulfs of Execution and Evaluation

- Distance: Gulf between users' goals and knowledge and the way they must be specified to the system(s) -- *Two components*
- Gulf of Execution
  - Distance between users' goals and means of achieving them in the system
  - Make commands and mechanisms of system (*input*) match goals and thoughts of user
- Gulf of Evaluation
  - Distance between system's behavior and users' goals
  - Make *output* displays present a good mental model that is easy to interpret

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┌──────────────┐        Gulf of execution        ┌──────────┐
│              │  ◄──────────────────────────     │          │
│   Physical   │                                  │   User   │
│   system     │  ──────────────────────────►     │   goals  │
│              │        Gulf of evaluation        │          │
└──────────────┘                                  └──────────┘
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Direct Engagement

- Feeling of first person-ness, direct contact with objects
  - Not with programs or the computer but with "semantic" objects related to goals and task
- "Model world" or metaphor
  - Desktop metaphor
- Input-output relationship
  - Can refer to output objects in input statements
- Output (display) shows semantic concepts directly
  - Move from line-oriented editor to screen oriented editor
  - To WYSIWYG editors / word processors
    - What You See is What You Get

Pinball Construction Set (1980s)
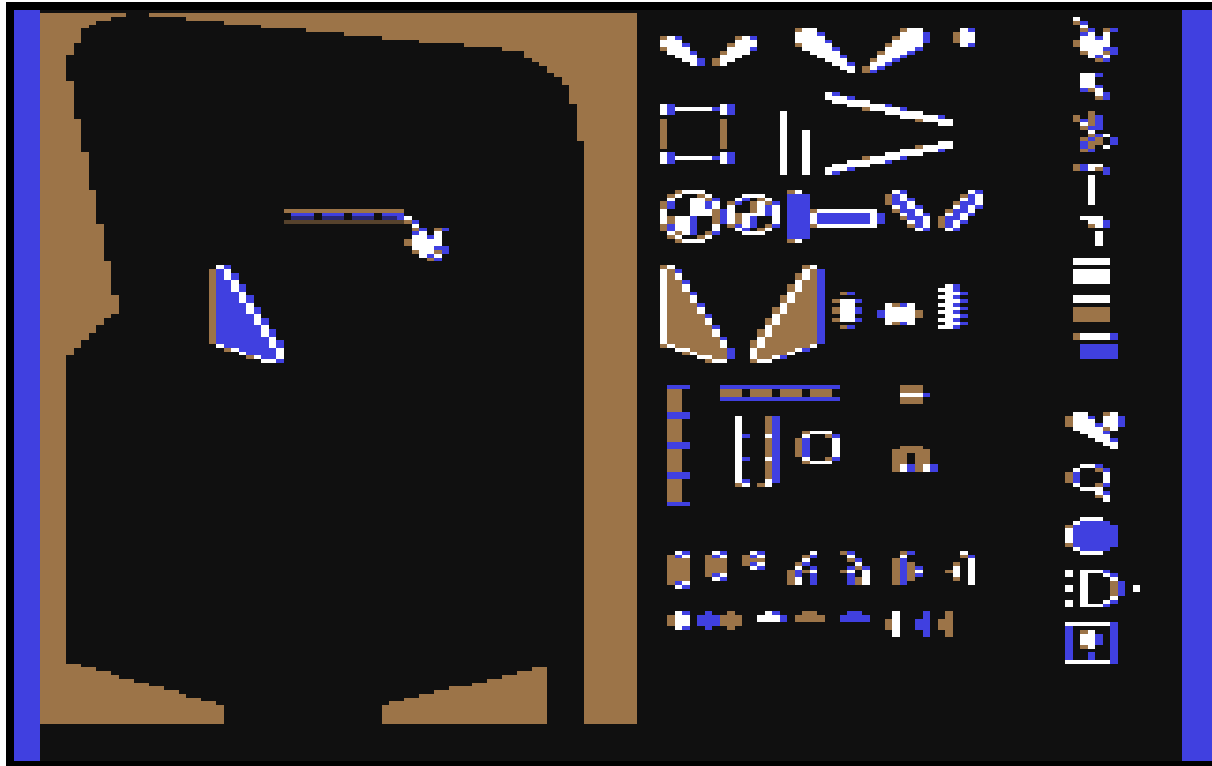
Are GUIs Better?

- Example study: Margono & Shneiderman (1987)
  - Commands versus direct manipulation
  - File manipulation functions
  - Apple MacIntosh versus MS-DOS / IBM PC (command)
- Procedure
  - Subjects provided with instruction sheets
  - creating, copying, renaming, and erasing a file
  - copy first.txt second.txt Vs. select "first" and choose Duplicate from menu
  - Measured time and errors; ratings questionnaire
- Results
  - Less time to perform tasks on Mac GUI
  - 18 preferred Mac, 10 preferred PC