Human-Computer Interaction IS4300

P6 – Computer Prototyping Due

- Must
  - Be easily installable on CCIS lab machines
  - Work for your three sample tasks
  - *Without you being there to help!*
- Set up a separate web page with
  - A link to your prototype (your prototype must remain frozen and accessible at this location for two weeks after the due date).
  - Startup instructions. Specify the platform and browser requirements for your prototype. Give any special instructions for installing and starting it up.
  - Briefing (from P5).
  - Description of 3 tasks (from P5)
- Post link to your project page

Evaluation methods

- Expert/Inspection methods
  - Heuristic evaluation
  - Cognitive walk-through
  - Modeling
- User Testing
  - qualitative methods (interviews, questionnaires)
  - observation in the field
  - controlled experiments (same environment & task with 2 or more alternative designs)

Models

Categories of User Models

1. Hierarchical structuring of user goals and tasks
   - GOMS & CCT
2. Syntax of user-system ‘dialog’
   - BNF & TAG
3. Human motor system (no planning)
   - KLM

Norman’s Interaction Framework

1. user establishes the goal
2. formulates intention
3. specifies actions at interface
4. executes action
5. perceives system state
6. interprets system state
7. evaluates system state with respect to goal

User Models

- Competence vs. Performance
  - Competence – idealized, logical models
  - Performance – take into account messy details, such as reaction times, perception, context
- Granularity
  - How much detail?
  - How high level?

GOMS - Card, Moran, and Newell

- Goals, Operators, Methods, Selection Rules
- Models task decomposition & execution
- Good for assessing usability for skilled users
- Methods
  - achieve goals
  - composed of Methods & Operators (atomic ops)
- Selection rule
  - conflict resolution if >1 method available for the current goal

GOMS example

```
GOAL: ICONIZE-WINDOW
      [select GOAL:USE-CLOSE-METHOD
                   MOVE-MOUSE-TO-WINDOW-HEADER
                   POP-UP-MENU
                   CLICK-OVER-CLOSE-OPTION
              GOAL: USE-L7-METHOD
                   PRESS-L7-KEY]


Rule 1: Use the CLOSE-METHOD unless another rule applies
Rule 2: If the application is 'blocks' use the L7-METHOD
```

- What is this useful for?
- What are the limitations?

GOMS
KLM – Keystroke Level Model

- One flavor of GOMS
- Operators (ea has defined execution time):
  - K - to press a key
  - B – to press mouse button
  - P - to point with a mouse to a target on a display
  - H - to home hands on keyboard or other device
  - D - to draw a line segment on a grid
  - M - to mentally prepare to do an action or closely related series of primitive actions
  - R - to symbolize the system response time during which the user has to wait for the system

KLM example

```
GOAL: ICONISE-WINDOW
[select
   GOAL: USE-CLOSE-METHOD
   .     MOVE-MOUSE-TO- FILE-MENU
   .     PULL-DOWN-FILE-MENU
   .     CLICK-OVER-CLOSE-OPTION
   GOAL: USE-CTRL-W-METHOD
         PRESS-CONTROL-W-KEY]
```

- compare alternatives:
  - USE-CTRL-W-METHOD vs.
  - USE-CLOSE-METHOD
- assume hand starts on mouse

USE-CTRL-W-METHOD		USE-CLOSE-METHOD	
H[to kbd]	0.40	P[to menu]	1.1
M	1.35	B[LEFT down]	0.1
K[ctrlW key]	0.28	M	1.35
		P[to option]	1.1
		B[LEFT up]	0.1
Total	**2.03 s**	**Total**	**3.75 s**

Exercise

- Groups
- Pick the simplest task from one of your projects
- Create a GOMS model
- Do a KLM estimate of minimum time to perform, given the estimates on Dix Table 12.1

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Dix Table 12.1

Operator	Remarks	Time (s)
K	Press key	
	good typist (90 wpm)	0.12
	poor typist (40 wpm)	0.28
	non-typist	1.20
B	Mouse button press	
	down or up	0.10
	click	0.20
P	Point with mouse	
	Fitts' law	$0.1 \log_2(D/S + 0.5)$
	average movement	1.10
H	Home hands to and from keyboard	0.40
D	Drawing – domain dependent	–
M	Mentally prepare	1.35
R	Response from system – measure	–

wpm = words per minute

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Cognitive Complexity Theory

- Hierarchy of user goals
  - Described in production rules
- System behavior
  - Described in generalized (hierarchical) transition network
- Assumption:
  - more rules => more difficult to learn

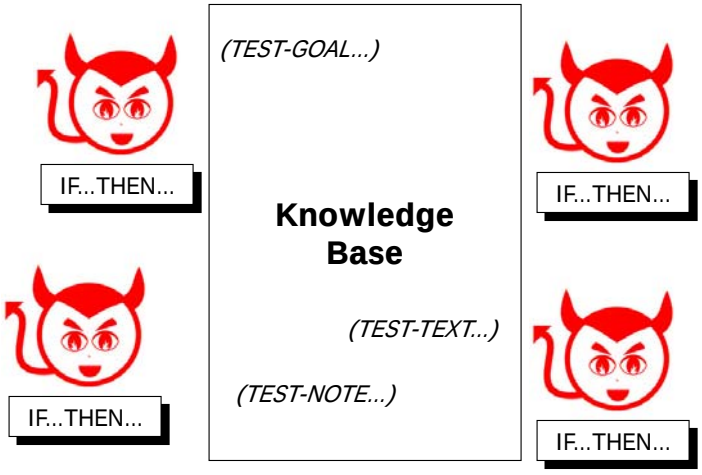
CCT Production Rules

- Working memory – collection of unordered facts
- Rules – unordered, fire one at a time

```
(SELECT-INSERT-SPACE
 IF (AND    (TEST-GOAL perform unit task)
            (TEST-TEXT task is insert space)
            (NOT (TEST-GOAL insert space))
            (NOT (TEST-NOTE executing insert space)))

 THEN (     (ADD-GOAL insert space)
            (ADD-NOTE executing insert space)
            (LOOK-TEXT task is at %LINE %COL)))
```

Rules as Demons



General Production System Architecture

- Fact list
  - Dynamic knowledge state of the system
- Rule base
  - Usually conjunction of conditions stated on fact list
- Inference Engine
  - Repeatedly:
    1. Find all applicable rules (matching
    2. Select a rule to “fire” (conflict resolution)
    3. “Fire” the rule (executes its actions)
  - Each iteration is an “inference cycle”

A Simple Example of Forward Chaining

- Initial fact list:
  P123 is-a patient
  P123 fasting-blood-sugar 130
  P123 blood-pressure 112 97

- Rules (simplified for example):
  IF a patient’s fasting blood sugar is over 120 mg/dl
  THEN patient has diabetes

  IF a patient’s blood pressure is over 90 diastolic
  THEN patient is hypertensive

  IF a patient has diabetes
  AND the patient is hypertensive
  AND the patient has not been prescribed ACE inhibitors
  THEN suggest ACE inhibitors

BNF & TAG models

- Backus-Naur Form

```
position-mouse ::= empty |
                   MOVE-MOUSE + position-mouse
```

- Task Action Grammar (BNF+cognitive stuff)

```
file-op[op] ::= command[op] + filename + filename
```

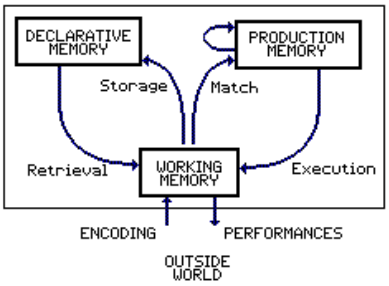
- Complexity of interface ~ number of rules

SOAR
Newell et al/CMU

- A general cognitive architecture
- Parts
  - Problem spaces (states & operators)
  - Productions (LTM)
  - Objects (temporary knowledge)
  - Automatic Subgoaling (goal generation)
  - Chunking (learning)

ACT/ACT*/ACT-R John Anderson/CMU

- a general theory of cognition that focuses on memory processes



Free tools for CCT-style production systems

- CLIPS
  - http://clipsrules.sourceforge.net/
- JESS
  - http://www.jessrules.com/

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So what?

- Limitations of cognitive models?
- When to use cognitive models
  1. Research
  2. When a lot is at stake
     - Significant number of users
     - Significant $
     - Justifies doing very detailed, meticulous comparison of two or more interfaces

Heuristic Evaluation & I7

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Nielsen's Heuristics
1. Simple and Natural Dialogue

- "Less is More" / KISS
  - Omit extraneous info, graphics, features

Nielsen's Heuristics
2. Speak the User's Language

- Use common words, not techie jargon
  - But use domain-specific terms where appropriate
- Don't put limits on user defined names
- Allow aliases/synonyms in command languages
- Metaphors are useful but may mislead

Nielsen's Heuristics
3. Minimize User Memory Load

- Use menus, not command languages
- Use combo boxes, not textboxes
- Use generic commands where possible (Open, Save, Copy Paste)
- All needed information should be visible

Nielsen's Heuristics
4. Consistency

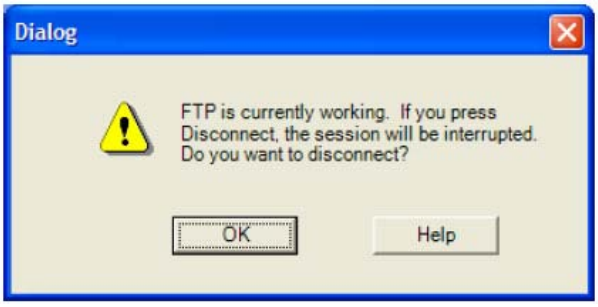
- Principle of Least Surprise
  - Similar things should look and act similar
  - Different things should look different
- Other properties
  - Size, location, color, wording, ordering, …
- Command/argument order
  - Prefix vs. postfix
- Follow platform standards
- Kinds of Consistency
  - Internal
  - External
  - Metaphorical

Nielsen's Heuristics
5. Feedback

- Keep user informed of system state
  - Cursor change
  - Selection highlight
  - Status bar
- Response time
  - < 0.1 s: seems instantaneous
  - 0.1-1 s: user notices, but no feedback needed
  - 1-10 s: display busy cursor or other feedback
  - > 10 s: display progress bar

Nielsen's Heuristics
6. Clearly Marked Exits

- Provide undo
- Long operations should be cancelable
- All dialogs should have a cancel button



Nielsen's Heuristics
7. Shortcuts

- Provide easily-learned shortcuts for frequent operations
  - Keyboard accelerators
  - Command abbreviations
  - Styles
  - Bookmarks
  - History

Nielsen's Heuristics
8. Good Error Messages

- Be precise; restate user's input
  - Not "Cannot open file", but "Cannot open file named paper.doc"
- Give constructive help
  - why error occurred and how to fix it
- Be polite and non-blaming
  - Not "fatal error", not "illegal"
- Hide technical details (stack trace) until requested

Nielsen's Heuristics
9. Prevent Errors

- Selection is less error-prone than typing
- Disable illegal commands
- Description Error
  - different things/commands should look and act different
- Mode Error
  - Eliminate modes
  - Visibility of mode
  - Spring-loaded or temporary modes

Nielsen's Heuristics
10. Help and Documentation

- Model
  1. Searching
  2. Understanding
  3. Applying
- Important features
  - Index
  - Overview map
  - Help visible while user is applying
  - Describe confirmatory feedback

CHI 2008 Proceedings · Game Zone April 5-10, 2008 · Florence, Italy

Heuristic Evaluation for Games: Usability Principles for Video Game Design

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ABSTRACT
Most video games require constant interaction, so game designers must pay careful attention to usability issues. However, there are few formal methods for evaluating the usability of game interfaces. In this paper, we introduce a new set of heuristics that can be used to carry out usability inspections of video games. The heuristics were developed to help identify usability problems in both early and

In this paper, we define game usability as *the degree to which a player is able to learn, control, and understand a game*. Our definition is based on an early informal survey of usability problems cited in critical game reviews and on playability heuristics described by Federoff [12] and Desurvire et al. [7]. Game usability does not address issues of entertainment, engagement, and storyline, which are strongly tied to both artistic issues (e.g. voice acting,

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Homework I7
Heuristic Evaluation

- Each of you will evaluate three projects (each project gets 4-5 reviews).
- ASAP – check to make sure you can run the interface.
  - Contact me and the project members if any problems.
- You are to evaluate using heuristic evaluation as covered in Nielsen.
  - Answer how well the interface meets each of the criteria.
  - Write 1-2 page report on each project covering at least **12** issues (positive or negative). Clarity is important (screen shots where possible).
  - Post each review on a separate web page and email the relevant URL to the appropriate team members.
  - Work through the 3 tasks used in paper prototyping, unless otherwise specified

		Project	Reviewers
1	Stephanie, Elise	Mood Recommender	Craig,Luke,Gregory,Bobby,Elizabeth
2	Michael R.	Task Tracker	Bobby,Jeff,Courtney,Luke
3	William, Alex	D&D Character Editor	Elise,Jonathan,Sam,Martha,Michael R.
4	Daniel P.	NU Registration	Joey,Martha,Chris,Jonathan,Michael R.
5	Will, Chris	Cloud Services Market	DJ, Daniel,Clayton,Sarah
6	Joey	MBTA alerts	Alex,Stephanie,Andrew,Daniel
7	Michael O.	File Backup	William,Gregory,Nnamdi,Clayton
8	Brendan, Daniel J	Course Scheduler	Sam,Chris,Michael O.,Danny
9	Sam	BudgeTool	Clayton,Andrew,Danny,DJ,Brendan
10	Courtney, Dean	Cosplay Helper	Nnamdi,Michael O.,Sarah,Stuart
11	Martha	Monster Creator	Danny, Sarah, Stuart,Andrew
12	Elizabeth, Gregor	Cards Against Humanity	Stuart,Michael R.,Dean,Michael O.
13	Bobby, Nnamdi	Archive for Desktops	Elizabeth, Dean, Will,Alex
14	Sarah	Everyday Victory Tracker	Courtney,Will,Jeff,Nnamdi
15	Andrew	Treatment Tracker	Brendan,Craig,Elizabeth,Elise
16	Jonathan	Medication Tracker	Luke,Bobby,Luke,Gregory
17	DJ	Pomodoro	Jeff,Elise,Dean,William
18	Jeff	Blackjack	Jonathan,Joey,Courtney,Sam
19	Stuart	Task tracker	Martha,DJ,Will,Stephanie
20	Craig	Roommate Dashboard	Daniel,Alex,Brendan,Joey
21	Clayton	Magic Collection Manager	William,Stephanie,Craig,Chris

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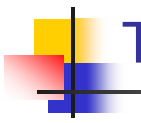

To Do

- Read
  - Embedded & Mobile UIs
  - Dix Ch 20
  - Leung, Chaudry papers
- Finish I7 by next class (1 week)
  - Heuristic evaluation

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