Review and Final Exam Info

Final Exam

- Time: Sat, 20 Dec 2014, 09:00
- Location: TEL 0011, TEL 0014

- Duration: 120 minutes (not 180)

Final Exam Format

- 12–13 questions
- No programming questions

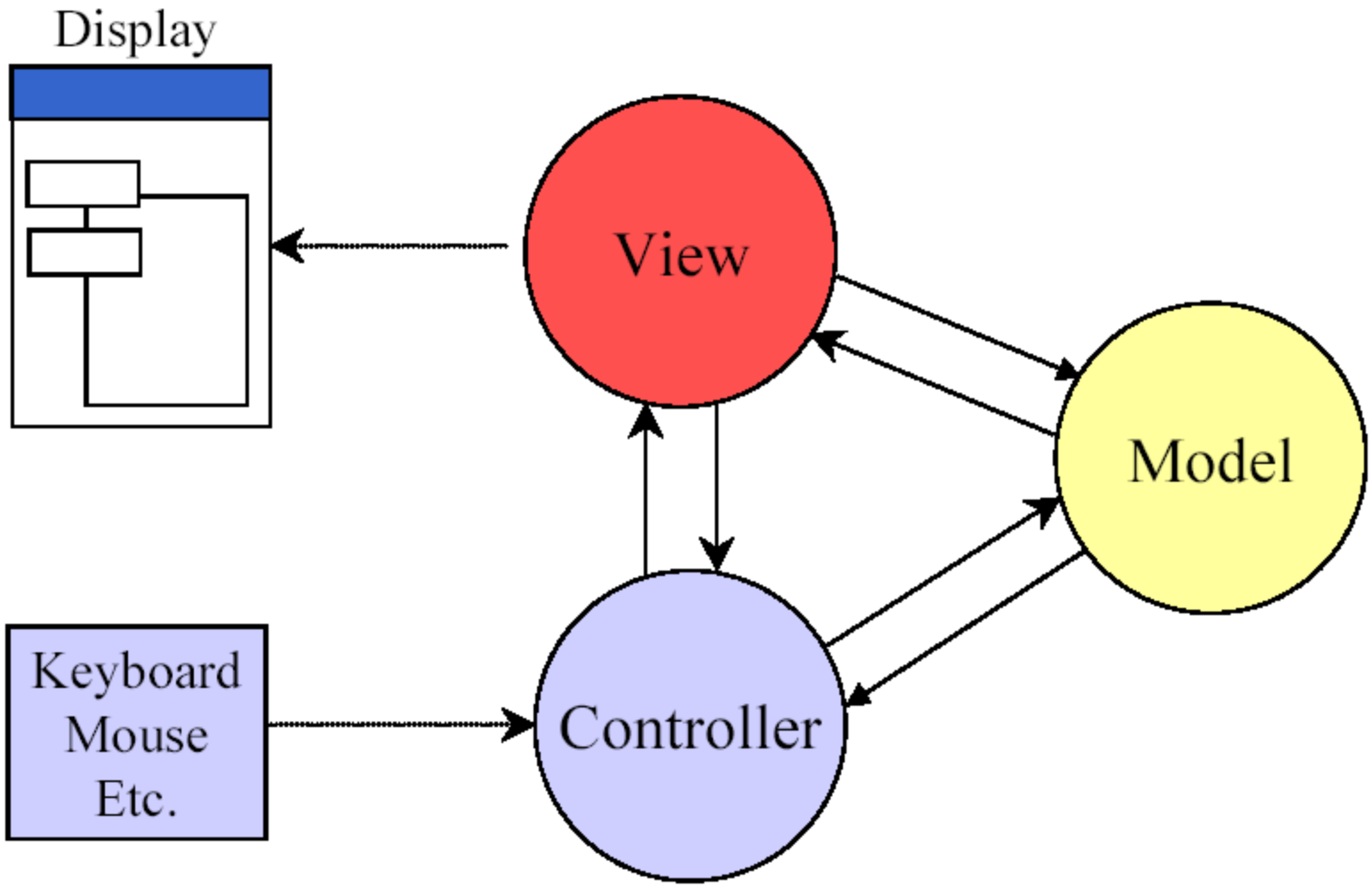
Final Exam Topics (tentative)

- MVC
- Human Factors, Control-Display relationships, etc.
- Usability Evaluation, Experimental Design
- User-Centred Design, Prototyping
- Mobile Devices, Designing for Mobile Devices
- Usability Methods

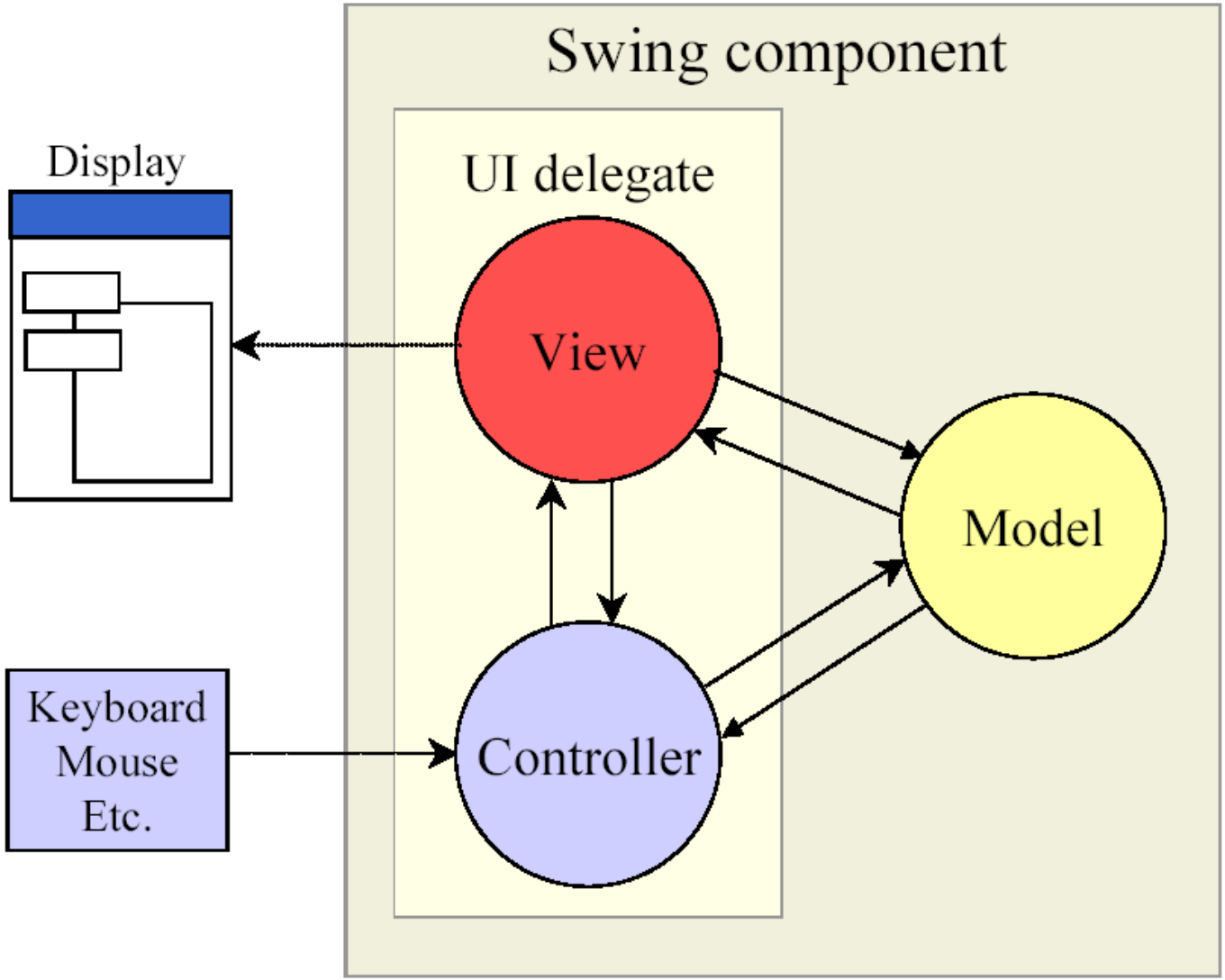
- *Possibly:* Latency; Displays, Colour, Text

Condensed Review

MVC Schematic



MVC and Swing

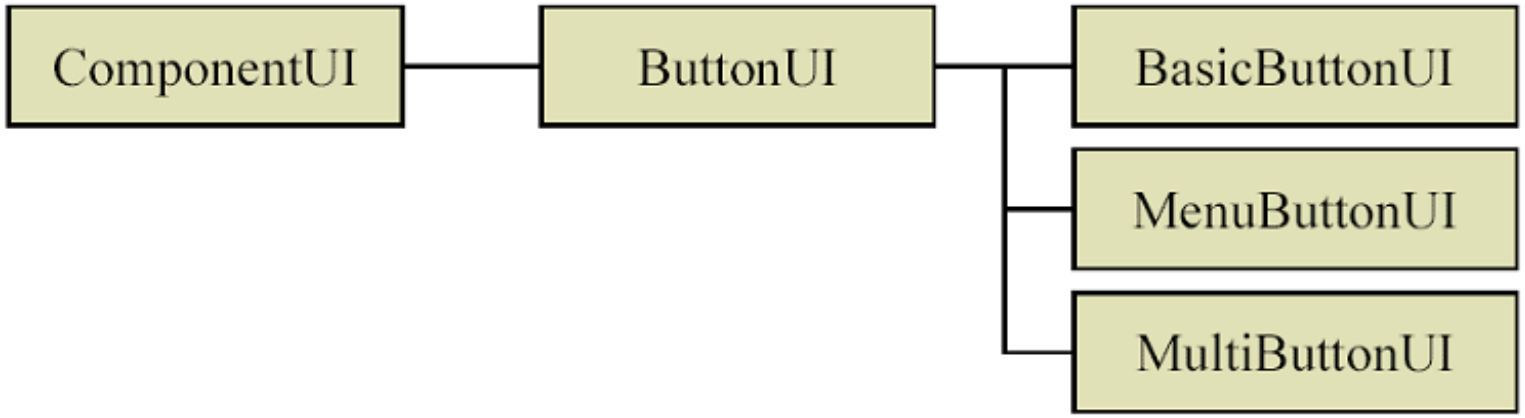


M - Swing Models

- In Swing, many models exist as interfaces
  - Eg., ButtonModel, BoundedRangeModel, ComboBoxModel, ListModel, ListSelectionModel, TableModel, Document
- The interface is implemented in model classes
- Usually there is a default model class that is automatically associated with a component (whew!)
  - E.g., DefaultButtonModel implements ButtonModel
  - E.g,, AbstractDocument implements Document (PlainDocument is a subclass of AbstractDocument)

ComponentUI Class

- The delegate part of a component is derived from an abstract class named ComponentUI
- Naming convention: remove the “J” from the component’s class name, then add “UI” to the end (e.g., JButton ButtonUI)



Controls and Displays

- “Control”
  - An input device actuated/manipulated by a human
  - Examples: keyboard, mouse, joystick, button, microphone, etc
- “Display”
  - An output device stimulating a human sense
  - Visual display (e.g., LCD, CRT, any light)
  - Auditory display (e.g., speaker)
  - Tactile display (e.g., a solenoid-driven pins)
  - Smell display (?)

Control-Display Compatibility

- Compatibility refers to the “correctness” of the relationship between the way the control is manipulated and the way the display responds
- “Correct” example:
  - Move a mouse right, cursor moves right
- “Incorrect” example:
  - Move a mouse right, cursor moves left

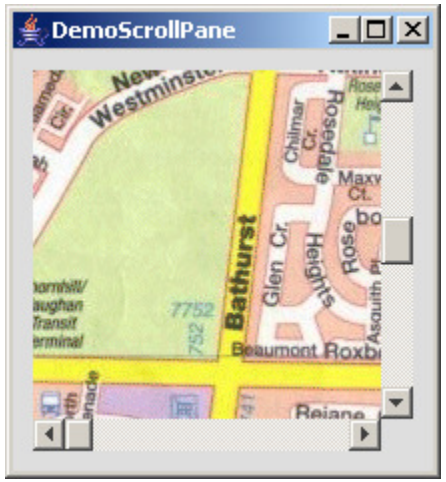
Next slide

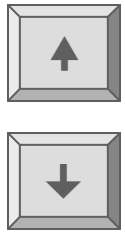
Compatibility

- Compatibility is (arguably) not inherent
- It is a learned relationship
- “Learned” examples:

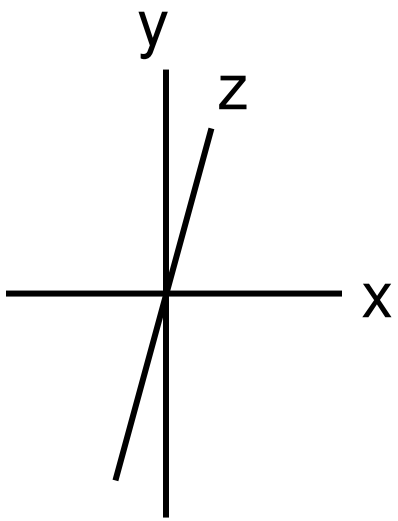
Move mouse forward,
cursor moves up

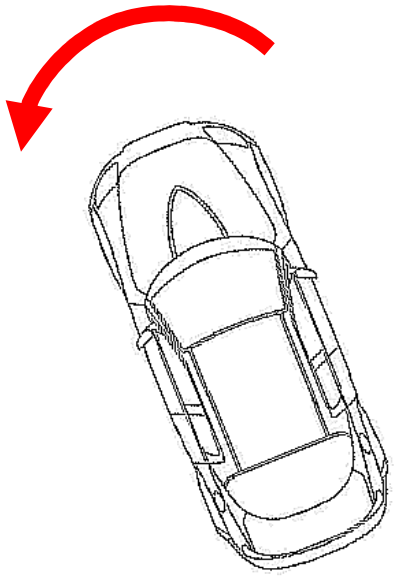
Press down key,
image moves up





Compatibility (2)





Dimensions vs. Degrees of Freedom

- In 2D there are 3 dof (degrees of freedom)
  - x position or displacement
  - y position or displacement
  - Θz – z-axis angle or rotation
- A mouse is a 2 dof device
  - Senses x displacement
  - Senses y displacement
  - Does not sense z-axis rotation
- The problem: generating z-axis rotation data with a mouse

Human Performance Model

- People performing in systems have in common that they are each somebody, doing something, someplace" (Bailey, 1996)

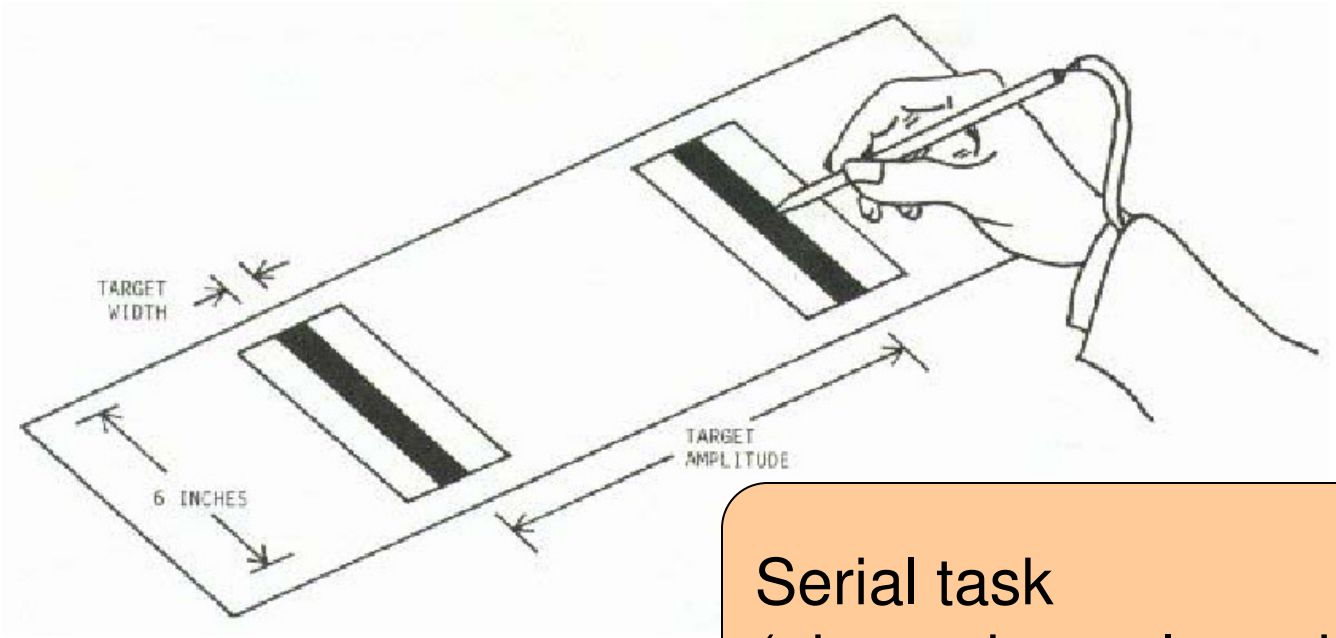
Sound Localization

- Interaural Level Differences
  - Dominate for higher frequencies (> 1600 Hz)
- Interaural Time Differences
  - Dominate for lower frequencies (< 800 Hz)
  - Phase difference for sound arrival
- Group Delay Differences
  - Sound onset, etc. Higher frequencies
- Spectral Differences
  - Shape of head, pinna + ear canal modify the sound

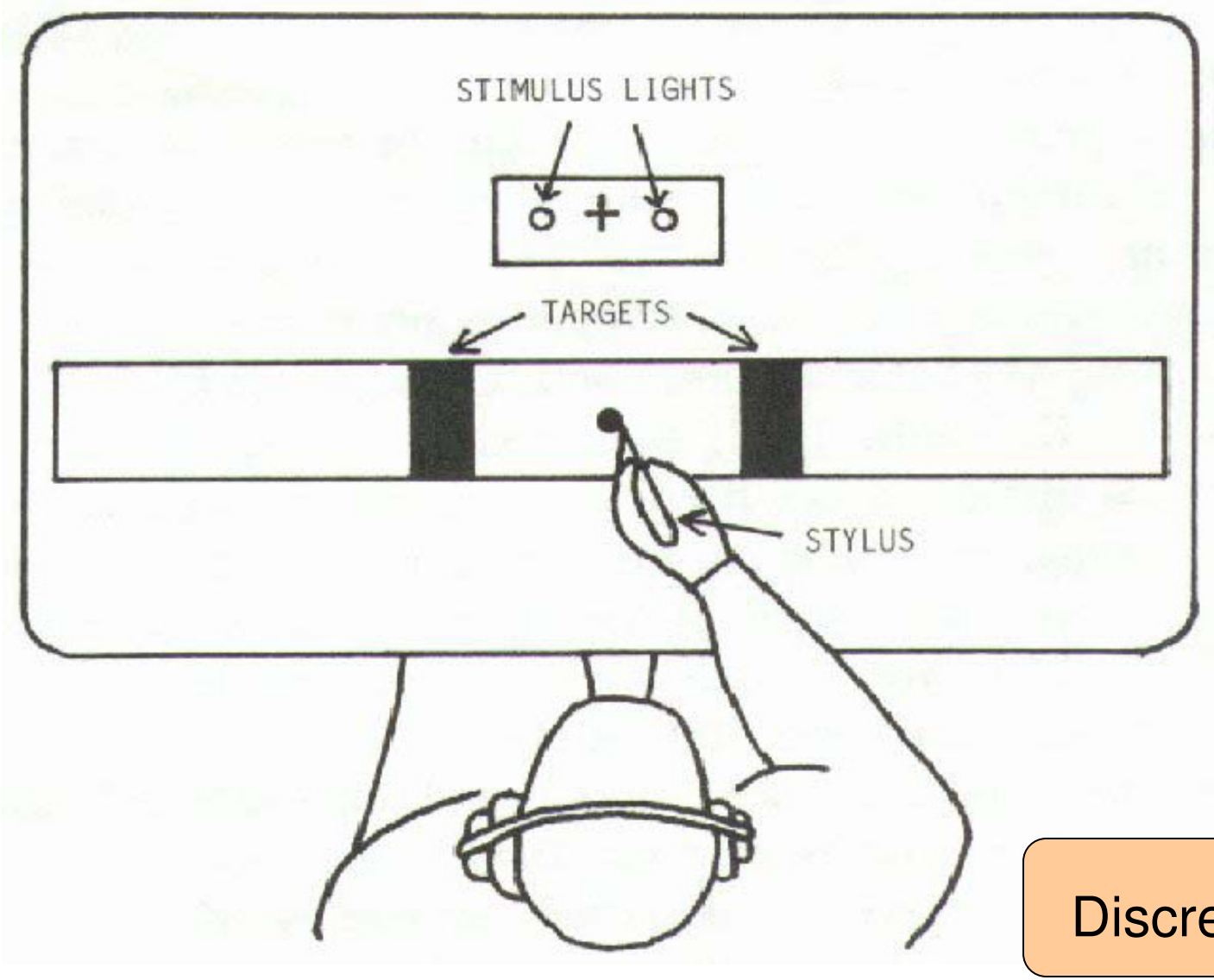
Kinesthesia and Proprioception

- Definition
  - Kinesthetic sense:
    - a sense mediated by receptors located in muscles, tendons, and joints and stimulated by bodily movements and tensions; also : sensory experience derived from this sense
  - Proprioception:
    - the reception of stimuli produced within the organism
- Probably 3rd most important, next to vision and audition
- To control our actions, we need to know the position of body parts both before and after movements
- Kinesthesia and proprioception provide information on the position of limbs, how far they have moved, etc.

Fitts' Law



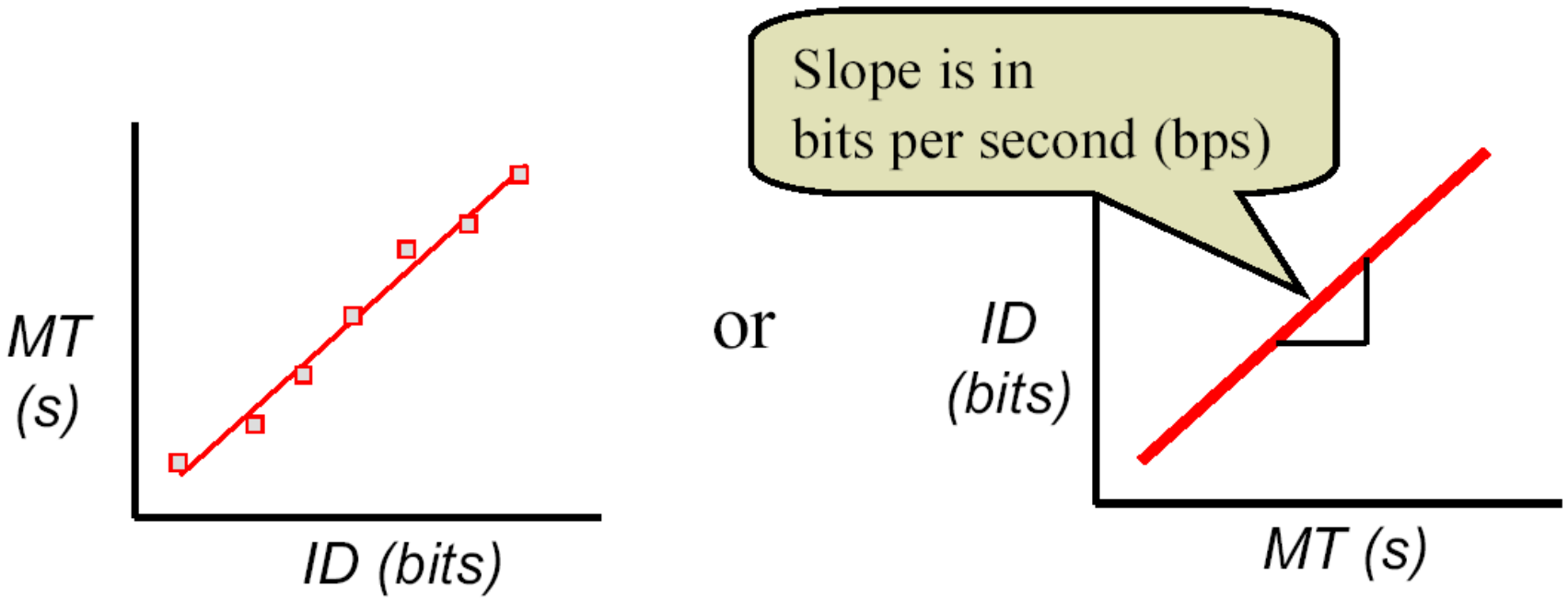
Serial task
(aka reciprocal tapping task)



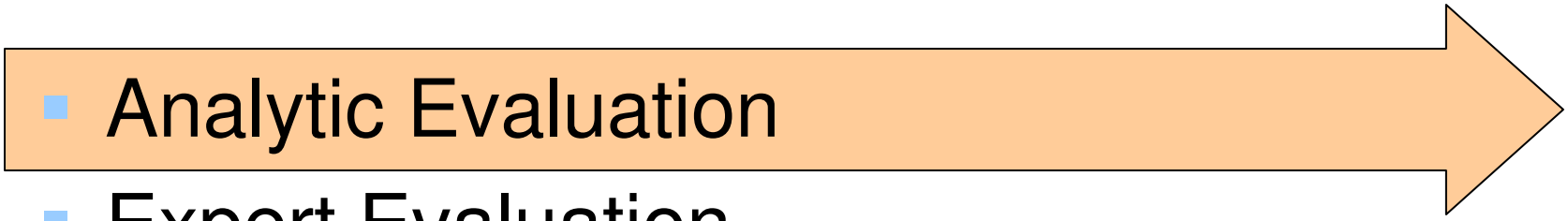
Discrete task

Movement Time

- proposed that the movement time (*MT*) to select a target is linearly related to *ID*:



Usability Evaluation



- Analytic Evaluation
- Expert Evaluation
- Observational Evaluation
- Survey Evaluation
- Experimental Evaluation

Participants

- Formerly “subjects”
- Participants should match the user population
  - Age
  - Education
  - Experience with computers
  - Experience with systems of that type
  - Experience of the task domain
- Generally at least 10 participants required

Independent / Dependent Variables

- Independent variables
  - Manipulated through the design of the experiment; e.g.,
  - interface style (e.g. GUI vs command-line)
  - level of help (e.g., tool tips vs F1)
  - number of menu items (e.g., 4, 8, 16)
  - icon design (e.g., static vs. animated)
- Dependant variables
  - Performance measurements; e.g.,
    - time to complete a task
    - number of errors made
    - user preferences
    - quality of users performance
  - Must be measurable
  - Must be effected by the independent variable
  - As far as possible, must be unaffected by other factors

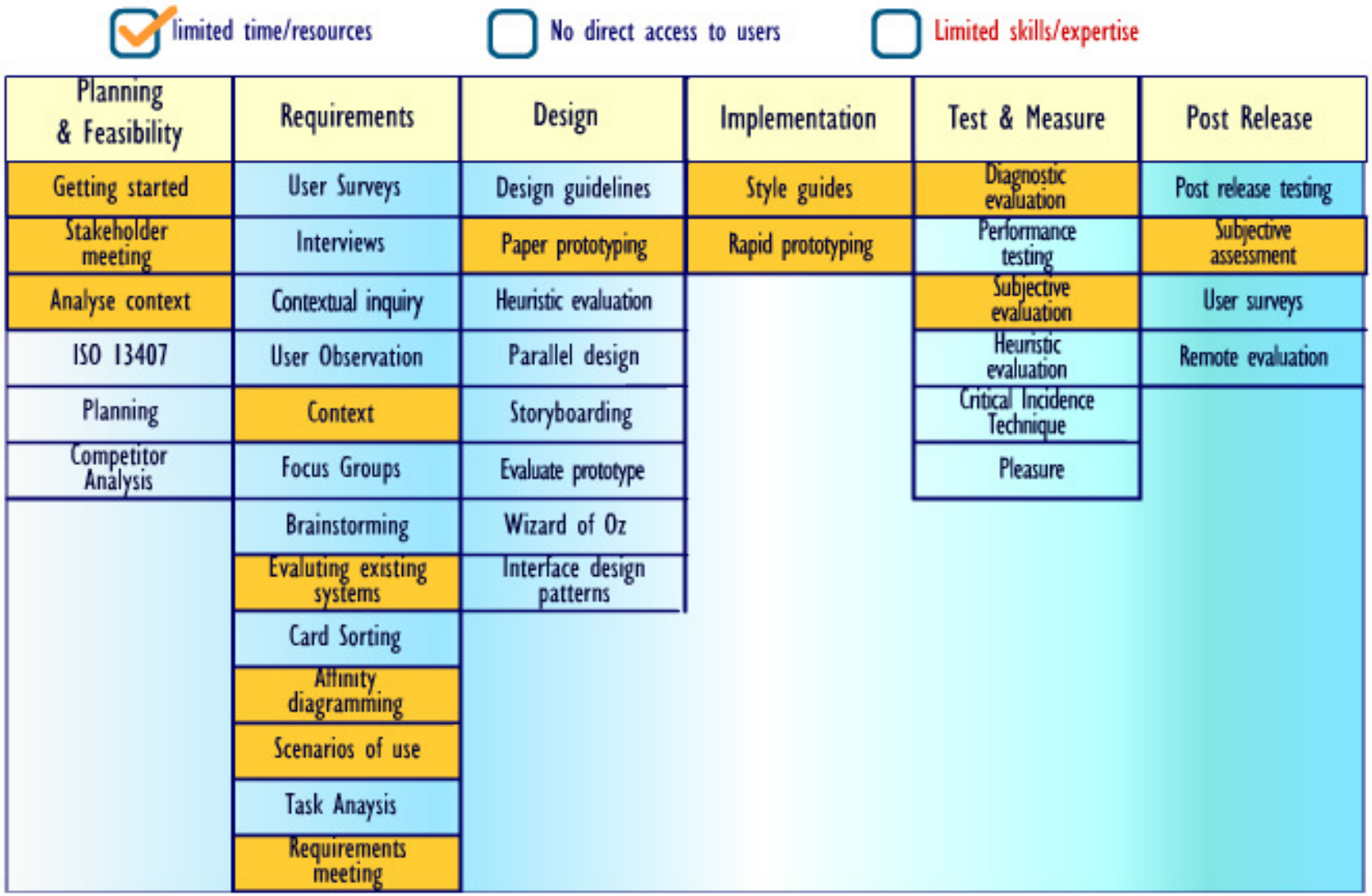
User Centered Design

- A way to force yourself to identify and consider the relevant human factors in your design
- Helps reduce the number of decisions made, and helps focus design activities
- Helps document and defend decisions

UCD: 9 Step Overview

- 1. Define the Context
- 2. Describe the User
- 3. Needs Analysis and Task Analysis
- 4. Function Allocation
- 5. System Layout / Basic Design
- 6. Mockups & Prototypes
- 7. Usability Testing
- 8. Iterative Test & Redesign
- 9. Updates & Maintenance

Methods Table 1/3
(here and further ©UsabilityNet 2006)



Latency in Computing Systems

- Time from when device physically moved, to time the corresponding update appears on screen
- Reduces performance
  - Drops in mouse throughput with added lag
  - Errors in 3D tracking
  - Simulator sickness in VR

Lag: Tracking and Measurement Technology Induced Delays

- Sample rate of sensors
  - Speed of sound in acoustic sensors
  - Video camera frame rates
- Noise processing
  - Processing-intensive, sometimes in time-domain
- Physics limitations
  - Inertia
  - Signal propagation

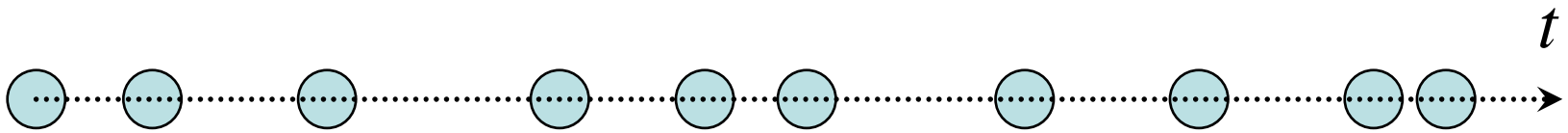
Latency Jitter

- Fluctuations of latency with time

- E.g.,

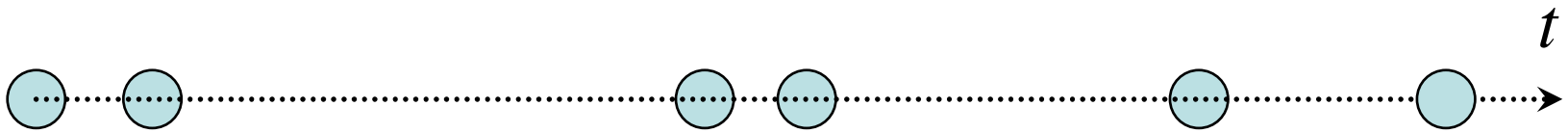
  Packet 1 is delayed by 18 ms, packet 2 – by 39 ms

  Cursor speeds up and slows down



Dropouts

- Some movement actions are lost
  - UDP packets, unreliable link
- Some actions are delayed by large amounts
  - Useless by the time they arrive
  - Extreme latency jitter, technically
- Cursor freezes in place and then jumps



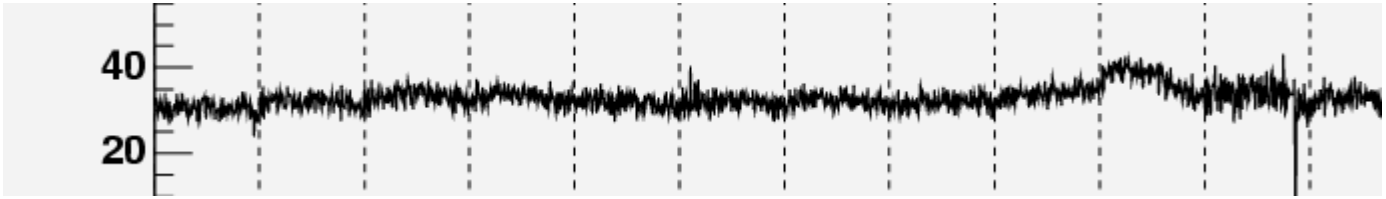
Spatial Jitter

- Some spatial offset from the norm

- E.g.,

  Move mouse along a straight line

  Cursor moves along a jagged path



Trading Jitter for Lag

- Both lag and spatial jitter affect performance
- May have to choose between low jitter or low latency
- How much filtering to apply against jitter?
  - Removing jitter via software filtering increases latency
  - Smoothing can afford better accuracy

- Need to consider existing error rate and cost of correcting errors

Trading Jitter for Lag (2)

- Based on our study,
  - decrease of jitter for small or medium targets 12 →4 pixels ≡ change in latency of 50 ms
  - (i.e., we're ☺ if we introduce < 50 ms of latency)
- Averaging filter
  - assume noise is random (uncorrelated)
  - reducing jitter by a factor of 3 requires averaging of $3^2 = 9$ samples

Change in latency due to filtering

- Sampling rate = 125 Hz (e.g., USB mouse)
  - 9 samples averaged

    1/125 · 9 = 72 ms of additional delay! ☹

- ☺ Gain more accuracy
  - desirable for small target sizes
  - may not be needed for large targets
    - harmful for some games