3D User Interfaces for Games and Virtual Reality

Lecture #6: Human Computer Interaction
Spring 2019
Joseph J. LaViola Jr.

Introduction

- Human factors (perceptual, cognitive, ergonomic capabilities) vs. HCI (how humans use those capabilities to interact with systems)
- HCI seeks to:
    - understand the relationship between human users and digital technological artifacts (science)
    - design new, effective ways for humans to use technologies (engineering, art)
- "Computer" in HCI has a very broad definition
- "Effectiveness" in HCI can also mean many things
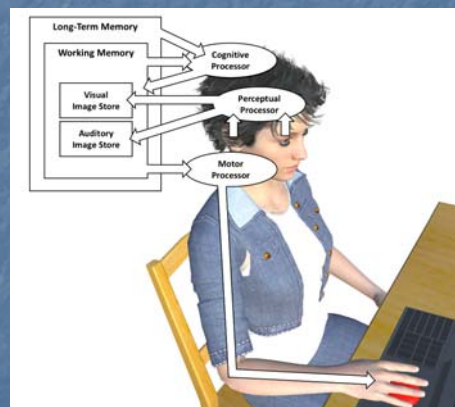- UX design as a series of *tradeoffs*

Overview

- Understanding the user experience (models and theories of HCI)
- Design principles and guidelines
- Engineering the user experience (UX engineering process)

Understanding UX

Human Processor Models
- Model human processor
- Keystroke-level model
- GOMS
- Touch-level model

Understanding UX

User Action Models

- Seven stages of action
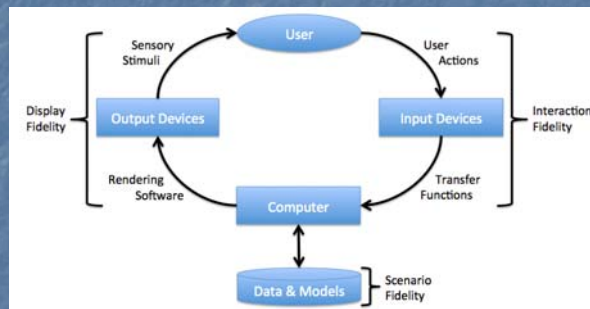- Gulfs of execution and evaluation
- User action framework

Understanding UX

User Action Models

- User-system loop

Understanding UX

Conceptual Models and Affordances
- Designer's model
  - Correct, complete, systematic
- User's model
  - Incomplete mental model formed through ad hoc interaction
- Affordances
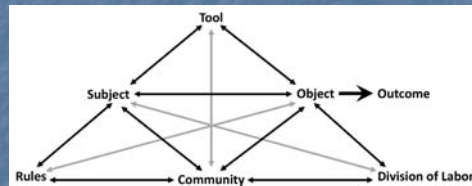 - Cognitive
  - Physical
  - Functional
  - Sensory

Understanding UX

Activity Theory
- Framework considering interaction within complex real-world contexts
- Principles:
  - Object-orientedness
  - Activities are hierarchical
  - Internalization and externalization
  - Mediation and development
- Activity system model

Understanding UX

Embodied Interaction

- Interaction with computer systems that occupy our physical and social world and that exploit this fact in how they interact with us
- Tangible computing
- Social computing, CSCW

Design Principles and Guidelines

Goal-Oriented Design Rules

- Simplicity
    - Reduce clutter
    - Provide customizability
- Structure
    - Break complex tasks into simpler subtasks
    - Sequence actions logically
    - Group related or comparable functions
- Visibility
    - Make controls perceivable
    - Employ familiar visual icons and symbols

Design Principles and Guidelines

Execution-Oriented Design Rules

- Affordance
  - Leverage familiarity
  - Provide direct manipulation
  - Be consistent
- Ergonomics
  - Clearance
  - Reach
  - Posture
  - Strength

- Error prevention
  - Valid actions
  - Confirm irreversible actions
  - Offer to complete common outcomes

Design Principles and Guidelines

Outcome-Oriented Design Rules

- Automation
  - Avoid requiring tedious input
  - Complete common action sequences automatically
  - Allow completion of similar actions all at once
- Control
  - Avoid too much automation
  - Facilitate both novice and expert use
  - Avoid missing or incorrect functionality

Design Principles and Guidelines

Evaluation-Oriented Design Rules
- Feedback
  - Respond immediately to every user action
  - Provide informative feedback
- Error recovery
  - Provide easy-to-reverse actions
  - Provide undo and redo

# Design Principles and Guidelines

General Design Rules
- *Accessibility*: make the UI usable by all intended users
- *Vocabulary*: use the terminology used by the intended users
- *Recognition*: Provide the knowledge required to interact instead of requiring users to recall it
  - Place needed information in the context of use
  - Let users know what their options are
  - Use visual representations when possible
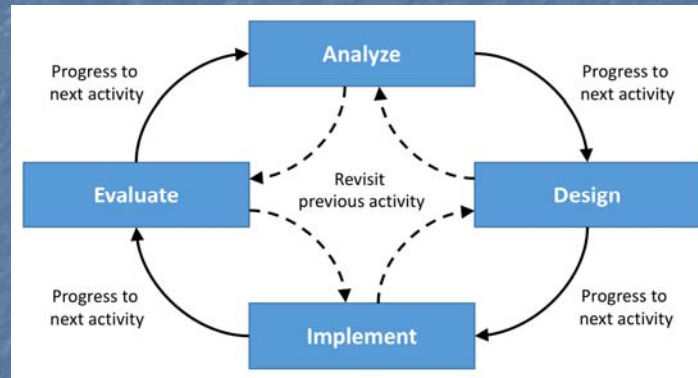
Engineering the User Experience

Engineering the User Experience

System Goals and Concepts
- Goals:
  - Improving usability
  - Striving for usefulness
  - Emotionally impacting the user
- System concept: concise summary of the goals of an envisioned system or product (i.e., mission statement)

Engineering the User Experience

Requirements Analysis
- Contextual inquiry
  - In the field
  - Interviews/observations
- Contextual analysis
  - Model stakeholders
  - Model work activities/tasks
  - Model work environment
  - Represent findings with problem scenarios, personas, and claims
- Requirements extraction
  - Functional requirements
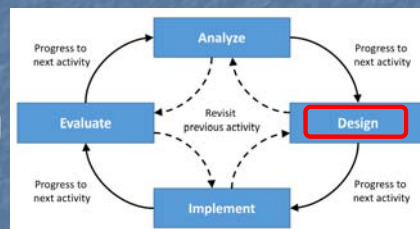 - Performance requirements
  - Interface requirements
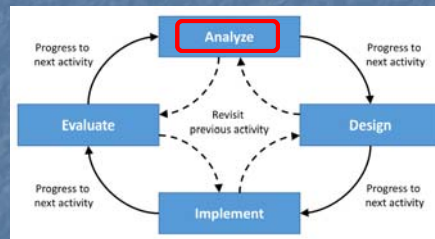
Engineering the User Experience

The Design Process
- Design tools
  - Ideation and sketching
  - Critiquing
- Design perspectives
  - Interaction perspective
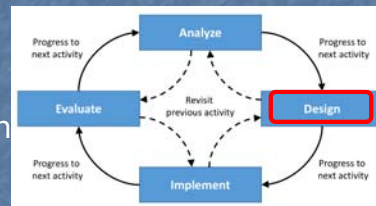 - Ecological perspective
  - Emotional perspective

Engineering the User Experience

The Design Process
- Design approaches
  - Activity design
  - Information/interaction design
  - Participatory design
- Design representations
  - Metaphors
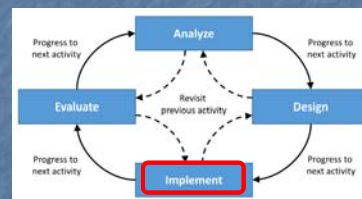 - Design scenarios
  - Storyboards
  - Physical mockups

Engineering the User Experience

Prototyping the Design
- Breadth vs. depth
- Prototype fidelity
- Prototype interactivity
  - Animated
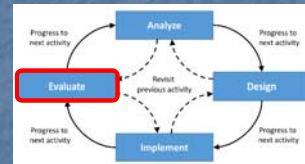 - Scripted
  - Fully programmed
  - Wizard of Oz

Engineering the User Experience

Evaluating Prototypes

- Formative vs. summative
- Rapid vs. rigorous
- Analytic vs. empirical
- See chapter 11 for much more on evaluation

Conclusion

- HCI is a mature and rich interdisciplinary field, offering:
  - Models and theories
  - Design principles and guidelines
  - Systematic design and development processes
- 3D UI design should be built on HCI foundations

Next Class

- **Visual Displays**
- **Readings**
  - LaViola – Chapter 4

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