

3D User Interfaces for Games and Virtual Reality

Lecture #6: Human Computer Interaction
Spring 2026

Joseph J. LaViola Jr.

Spring 2026

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*

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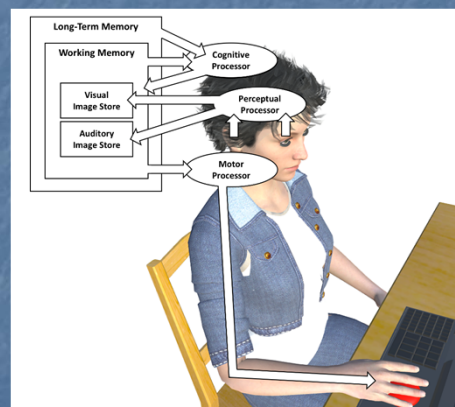
Overview

- 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

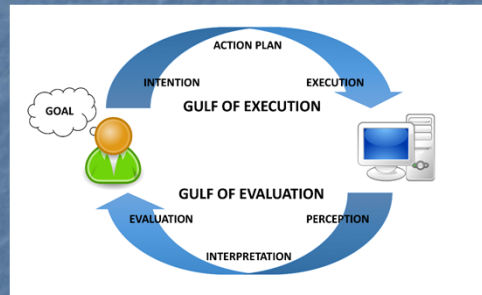
- Model human processor
- Keystroke-level model
- GOMS
- Touch-level model



Understanding UX

User Action Models

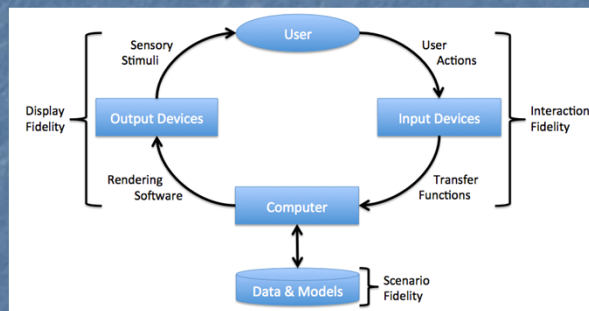
- Seven stages of action
- Gulfs of execution and evaluation
- User action framework



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

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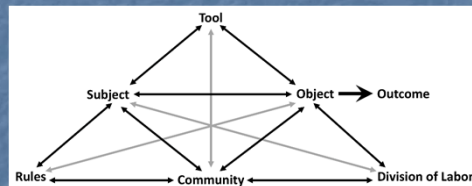
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Understanding UX

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



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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

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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



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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

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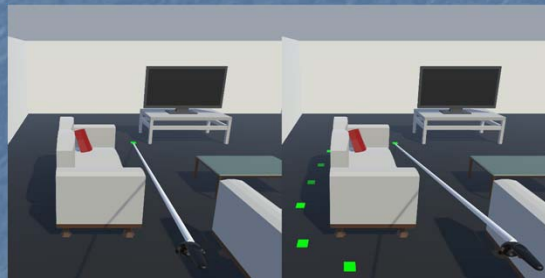
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Design Principles and Guidelines

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



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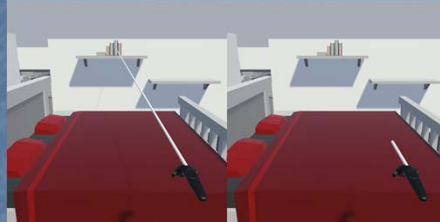
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Design Principles and Guidelines

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



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Design Principles and Guidelines

General Design Rules

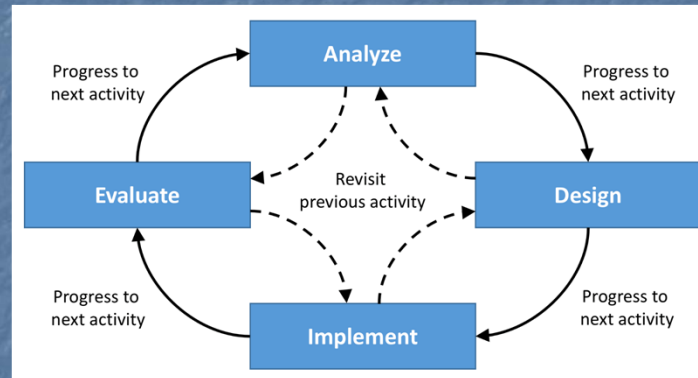
- *Accessibility*: make the UI usable by all intended users
- *Vocabulary*: use the terminology used by the intended users
- *Recognition*: Provide the knowledge required to interact instead of requiring users to recall it
 - Place needed information in the context of use
 - Let users know what their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

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Engineering the User Experience



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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)

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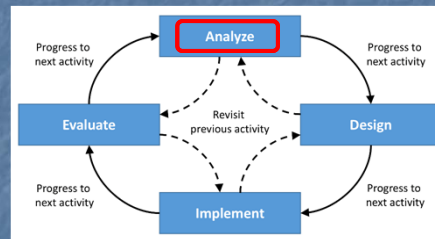
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Engineering the User Experience

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



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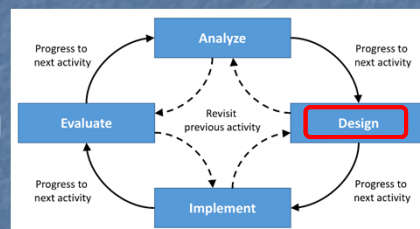
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Engineering the User Experience

The Design Process

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



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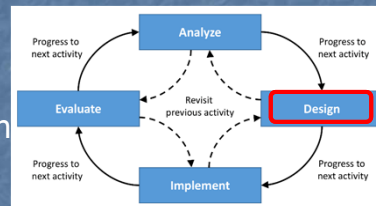
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Engineering the User Experience

The Design Process

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



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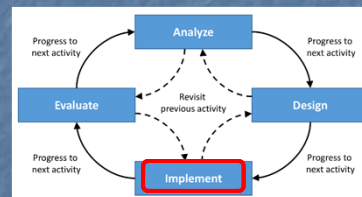
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Engineering the User Experience

Prototyping the Design

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



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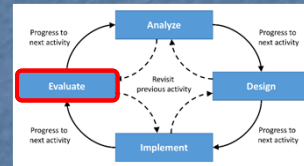
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Engineering the User Experience

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