

# 3D User Interfaces for Games and Virtual Reality

Lecture #6: Human Computer Interaction

Spring 2020

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*

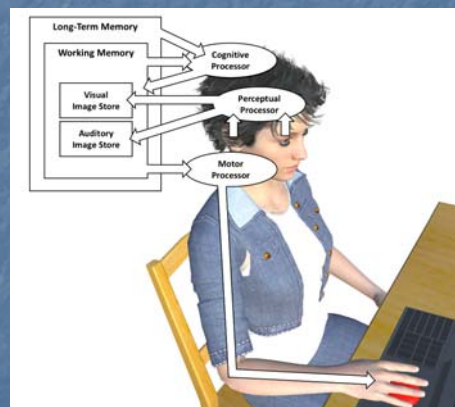
# Overview

- 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



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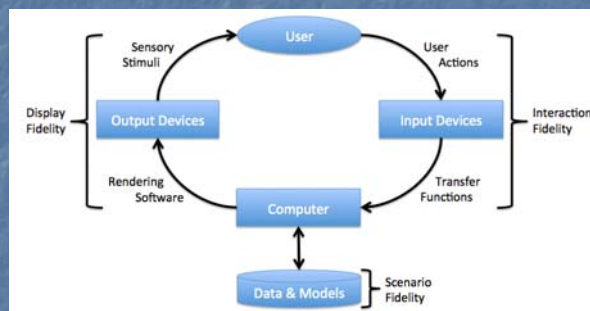
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# Understanding UX

## User Action Models

- User-system loop



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# 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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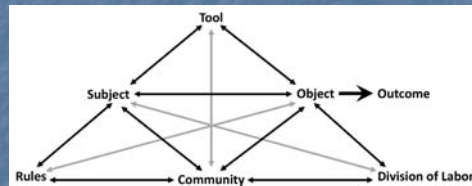
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# Understanding UX

## 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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# 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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# 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

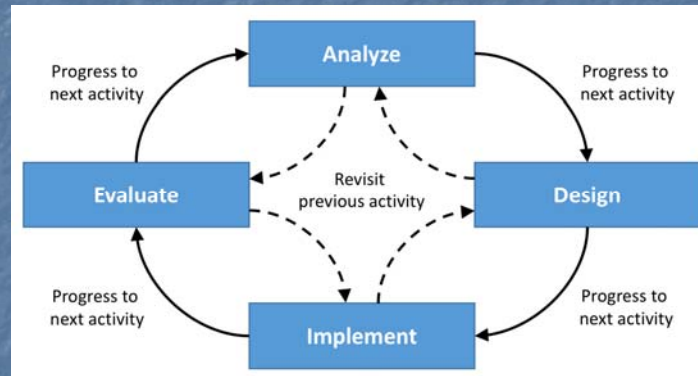
- *Accessibility*: make the UI usable by all intended users
- *Vocabulary*: use the terminology used by the intended users
- *Recognition*: Provide the knowledge required to interact instead of requiring users to recall it
  - Place needed information in the context of use
  - Let users know what their 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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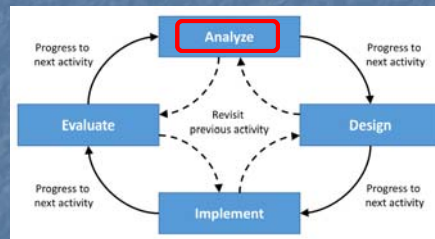
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# Engineering the User Experience

## 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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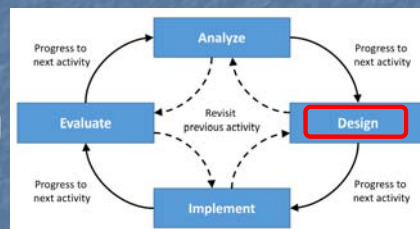
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# Engineering the User Experience

## The Design Process

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



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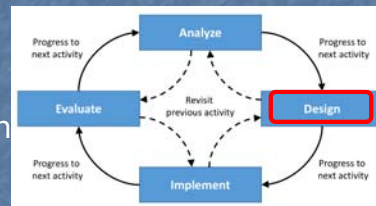
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# Engineering the User Experience

## The Design Process

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



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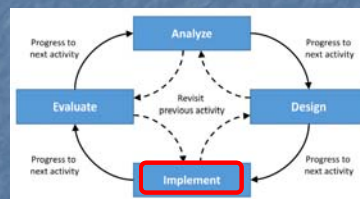
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# Engineering the User Experience

## Prototyping the Design

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



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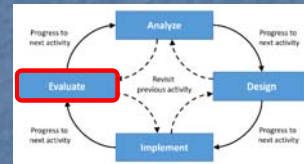
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# Engineering the User Experience

## 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