

# Midterm Prep

CSE165 - Discussion 5

# Agenda

- Midterm Introduction
- Last Year's Exam
- Review
  - 3D UI Overview
  - Selection and Manipulation
  - Input Devices
  - Wayfinding & Travel
  - System Control
- Tips and Advice

# Midterm Introduction

- Worth 20% of your grade!
- Many questions come directly from lecture, so study slides carefully!
- Question types may include multiple choice, short answer, and long answer
- Some questions will require you to just list info from lecture
- Some questions will require you to think/design a system
- **You won't be required to write Unity/C# codes in the exam.**

# Last Year's Exam Review

- Link: <http://ivl.calit2.net/wiki/images/9/90/CSE165W18Midterm.pdf>
- 8 questions total (80 points)
- Includes short response, long-answer.
- Some questions are directly from lecture, so study the slides!
- Other questions require you to think/design a system
- Actually DO last year's exam! Will help prepare you for this year's

# Last Year's Exam Review

- Question 1: Universal 3D Interaction Tasks
- Be familiar with their definitions and come up with examples for each tasks
  - Navigation (Travel and Wayfinding)
  - Selection
  - Manipulation
  - System Control
  - Symbolic Input

# Last Year's Exam Review

- Question 2: VR Application Domains
- Very subjective, just make sure your argument makes sense and have a good example correspondingly
  - Game
  - Architecture / CAD
  - Education
  - Medicine
  - Manufacturing
  - Simulation / Training
  - Design / Prototyping
  - Information / Scientific Visualization
  - Collaboration / Communication
- Think of the applications in video presentations and lecture slides.

# Last Year's Exam Review

- Question 3: Selection
- Know all of the different selection methods and prepare examples for each method
  - You'll need to be able to distinguish/identify between each and all of them
- Comparisons from last year:
  - Isomorphic vs. Non-isomorphic
  - Ray Casting vs. Virtual Hand
- Be able to choose selection methods for given tasks, subjective but still need to provide good justifications.
  - Selection Goal/Performance and Canonical Parameters

# Last Year's Exam Review

- Question 4: Manipulation
- Know all of the different manipulation methods and prepare examples for each method
  - You'll need to be able to distinguish/identify between each and all of them
- Ones from last year:
  - Ray Casting
  - Virtual Hand
  - Voodoo Doll
- Be able to choose manipulation methods for given tasks, subjective but still need to provide good justifications.
  - Justification based on reasons from the slides pretty much guarantees a right answer



# Last Year's Exam Review

- Question 5: Degrees of Freedom
- Know the definition of degrees of freedom (DOF) and be able to analyze DOF of a given devices
- Having some devices with different DOF in mind can be helpful
  - 2-DOF devices: Relative-Mouse, Absolute-Some tablet
  - Relative 6-DOF devices: Space Navigator
  - Absolute 6-DOF devices: Oculus Rift

# Last Year's Exam Review

- Question 6: Input Devices
- Know the pros/cons of all the types of devices mentioned in class
  - Questions may be fairly specific or refer to a specific device, so review well!
  - You should understand ALL the devices mentioned, including the examples
- Have a general idea of each one works so you can explain their differences
  - Ex. Electromagnetic vs. optical tracking
- Relate the capability/restriction of input device to their uses in 3D applications
  - Think about the user scenarios of the application
  - And why 3D manipulation can be necessary/better in this application

# Last Year's Exam Review

- Question 7: Wayfinding
- Use your creativity. There is no universal perfect answer to this question.
- Some tips:
  - Understand the requirements (Important!)
  - Try to make a list in mind about all possible scenarios first.
  - Think about the customers using the App (User experience, etc)
  - Utilize what you learnt when doing programming assignments.
- Complete sentences are not needed. You may use bullet points as long as it fully expresses your ideas.

# Last Year's Exam Review

- Question 8: System Control
- Primarily focused on justification and knowing different system control types
  - Review the slides to know what's possible, and the reasons for each different one!
  - If you can justify your answer well, you're in a good place
- Examples may be required for some questions, so know these in practice
  - Review examples from slide and recall those for best luck
  - Otherwise, review system control techniques in real VR apps and use those

# Review: 3D UI Intro

- Goals of 3D UI's:
  - Performance (Efficiency, Accuracy, Productivity)
  - Usability (Ease of use, ease of learning, user comfort)
  - Usefulness (System goals, transparency)
- Difficulties of 3D Interaction
  - Spatial input, lack of constraints/standards/tools/precision, fatigue, scene layout
- Universal Tasks
  - Navigation, Selection, Manipulation, System Control, Symbolic Input
- Approaches/Philosophies
  - Artistic approach: Decisions based on aesthetics/heuristics/common sense
  - Scientific approach: Quantitative evaluation, performance requirements
- Interaction workflow
  - User (actions) -> Input Device (signals) -> System (display) -> Output Device (perceptual info)

# Review: Selection and Manipulation

- Selection: Specifying one or more objects from a set
  - Goals: Indicate action, query object, make object active, travel to object, prep manipulation
- Manipulation: Modifying object properties
- Parameters for selection
  - Object distance, object size, object density, presence of occluding objects
  - Number of control dimensions (DOFS), simultaneously?
  - Form factor and impact on accuracy
- Parameters for manipulation
  - Position, rotation, distance
- Isomorphic (real) vs. Non-Isomorphic (magic)
- Selection methods
  - Raycasting, Two-Handed Pointing, Flashlight, Image Plane, Virtual Hand, Gogo, WIM, voodoo
- Technique Classification: Egocentric vs. exocentric vs. hybrid

# Review: Input Devices

- Degrees of Freedom: 2-DOF, 3-DOF, 6-DOF
  - Know their meanings, examples, differences, pros/cons, and use cases.
- Ways of tracking: the information collected to understand user's physical input.
  - Inertial, optical, ultrasonic, electromagnetic, infrared, etc.
  - Advantages and restrictions of different tracking methods.
- Modern 3D User Input Device:
  - Wii Remote, Kinect, Leap Motion, Oculus Touch, Gear VR Remote, PlayStation Move, HiBall, etc.
  - What's the DOF? Types of Tracking? Their best use case?
- Special purpose and application specific input device:
  - Cubic mouse, virtual canoe, etc.
- Haptic Feedback:
  - Different types: controller vibration, finger pinch, force feedback, etc.
  - Use cases: grab stuff, play piano, user notification, etc.

# Review: Wayfinding

- Wayfinding: Cognitive component of navigation
  - Cognitive process of defining a path through an environment
  - Often unconscious activity
- Information: Landmarks, signs, maps, direction, etc.
- Issues with virtual worlds
  - Less constrained movement (only 6DOF max), physical constraints, no motion cues
- Advantages of virtual worlds
  - Potential for more information, distractions aren't a huge deal
- Wayfinding goals
  - Exploration (browse environment and build cognitive map)
  - Search (spatial knowledge acquired and used)
  - Naive search: Not enough info for cognitive map. Primed search: Use of cognitive map



# Review: Wayfinding

- Useful spatial knowledge
  - Landmark knowledge: Environment, shape/size/texture, relative positioning
  - Procedural knowledge: Sequence of actions to follow a path
  - Survey knowledge: Maps/topographical info
- Reference frames: Egocentric (first person) vs. Exocentric (third person)
  - Egocentric happens the first time, creates landmarks/etc
  - Exocentric happens later, when we already have an internal representation of the world
- User-centered wayfinding
  - Large FOV allows for more info. Motion cues enable depth/direction
  - Presence/immersion helps as well.
- Environment-centered wayfinding support
  - Environment design: Create distinct parts of the environment that are recognizable
  - Artificial aids: Maps/compasses/trails/etc (HW3!). Can be local or global
  - Reference objects (well-known objects for reference)

# Review: Travel

- Travel: Motor component of navigation (may integrate wayfinding)
  - Movement between two locations
  - Most common virtual interaction technique
- Tasks
  - Exploration: travel with no specified target
  - Search: Naive - travel to find target with no position. Primed - travel to known target
- Maneuvering: Traveling to a position viewpoint for a task. Short & precise
- Characteristics/aspects of travel
  - Distance, turns
  - Target visibility
  - DOFs available and accuracy required
  - Active v. Passive
  - Physical v. virtual

# Review: Travel

- Physical locomotion (i.e. “real-world”)
  - Walking, treadmills, bicycles, other physical motion. Ex: Roomscale VR, Virtuix Omni
- Steering techniques: Continuous motion
  - Eye gaze, head direction, hand pointing, torso direction, or physical hardware
  - Often involves going in direction of a certain device. Know advantages of each method!
- Route-planning: Specification of a path
  - Draw entire paths, move points along the path. Specify entire route in advance
- Target-based techniques: Teleportation
  - Directly move to a specified location, usually by selecting that location on the ground
  - Visualize via a line or arc or WIM
- Map-based techniques: Select new position on a map and move there
- Manual manipulation: Hand gesture travel (ex. Rope pulling)

# Review: System Control

- Commands are issued to accomplish some task or change some state
- Graphical menus: 2D and 3D
  - Placement matters! What reference point? Head? World? Controller?
  - Selection: DOFs and constraints
  - Form, size, space, and hierarchy of the menu
- Voice commands
  - Speech recognition/voice dialogue Requires a good microphone and speech engine
- Gestures
  - Posture - static hand, and Dynamic - specific movement
- Tools
  - Possible actual physical object to manipulate
  - Virtual tools as well, such as a virtual toolbelt
- Multimodal input: Allow for different types of inputs. Makes it easier for users

# Tips and Advice

- Majority of questions come from knowing lecture/reviewing the slides
  - Know the slides REALLY well... especially when there are lists of things to know!
  - Input devices and travel/wayfinding are especially critical
- Assignments and projects should've prepared you for design questions
  - Always just think about what's easiest for the user to do. Advantages? Disadvantages?
  - Know all the different options and other ways you could've implemented something
  - Maybe even review your projects and question what you could've done better!

# Questions?

Feel free to ask on Piazza!

*(Making your questions public is helpful to everyone!)*

