

CSE 190 (VR Technology) Final Examination Spring 2020

⚠ This is a preview of the published version of the quiz

Started: Apr 21 at 12:35pm

Quiz Instructions

This is an open book exam. You are allowed to use books, electronic devices, internet web sites or other written materials.

You need to do this exam by yourself. Group work is not allowed.

You are also not allowed to use any information that was created after the exam was released (June 8th at 6pm PT). Specifically, this means that you are not allowed to consult class mates, or any other person after this point.

You can spend as much time as you would like to work on the exam, as long as you submit it by June 9th at 6pm PT.

If you require clarification about any of the exam questions, please post your request in response to [this Piazza note](https://piazza.com/class/k8804j6ig9l3uz?cid=147) [.\(https://piazza.com/class/k8804j6ig9l3uz?cid=147\)](https://piazza.com/class/k8804j6ig9l3uz?cid=147). Your instructor and TA are going to respond to it as soon as possible. The answers will be added to the note for everyone to see.

The School of Engineering asked us to post this note about academic integrity, which we fully support:

“We recognize that final exams are stressful in the best of times, and this is an unusually hard time. Please remember that despite the stress, we are counting on you to uphold academic integrity while you complete your final exam. Regrettably, there have been instances in engineering classes this quarter where students have violated our principles of integrity by posting or seeking exam questions or answers online, or by consulting unauthorized resources. This is a gross violation of our principles of integrity and it will not be tolerated. To be fair to all students, I will report any integrity violations discovered during the final exam. Please make sure you understand and follow the academic integrity guidelines for the exam. An honest effort, no matter what the outcome, is something to be proud of, especially in these difficult times. Good luck on the exam. I am proud of your commitment and resilience in these difficult times.”

Good luck with the exam!

Question 1

5 pts

Topic: Unity

1. What language are Unity scripts written in? (1 point)
2. What is a prefab in Unity? (1 point)
3. What asset handles the textures and coloring in Unity? (1 point)
4. Given a reference to an object, how would you access a component that's on a child of it? (1 point)
5. Does Unity use a right-handed or left-handed coordinate system (hint: what direction is +Z) (1 point)

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Question 2

7 pts





Topic: Homework Project 1

1. What type of VR device with how many degrees of freedom (DoF) did you use to do this project? (1 point)
2. How did we interact with the objects in the scene? (1 point)
3. Why did we need this interaction system? (1 point)
4. What are the purposes of the Start() and Update() functions? (1 point)
5. What Unity subsystem handles the collisions used for the project (and future ones)? (1 point)
6. What was the purpose of this project? (Short answer) (2 points)

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Question 3

8 pts

Topic: Homework Project 2

1. What would the image look like if the skybox was rendered in mono instead of stereo? (1 point)
2. Why is rendering scale important? (what happens if objects are bigger or smaller than intended?) (1 point)

3. Why do you feel nauseous or disorientated when there is rendering or tracking lag? (1 point)
4. Why is having the correct inter-ocular distance (IOD) important for a user viewing stereo images? (1 point)

Given this image:



5. What would happen to the left image if the IOD increased? (1 point)
6. What would happen to the right image if the IOD decreased? (1 point)
7. What was the purpose of this project? (Short answer) (2 points)

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Question 4

10 pts

Topic: Homework Project 3

1. What does adding colliders to real world locations add to the experience for the user? (1 point)
2. What sensors does your phone use for AR? (Name at least 3 and state their purpose) (3 points)
3. What is a feature point and how is it used in ARCore / ARKit? (2 points)
4. How would having additional sensors that could report depth information help AR detection? (1 point)
5. If the user moves behind a wall, occluded objects are still rendered. Why is this a problem? (1 point)
6. What was the purpose of this project? (Short answer) (2 points)

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Question 5

10 pts

Topic: Depth Cues

1. Name and briefly describe three monocular depth cues – these are cues which help us judge the distance of objects from our eyes, even if we're only using one eye. (6 points)
2. Describe the difference between accommodation and convergence. (2 points)
3. Describe what is meant by the "accommodation-convergence mismatch" in the context of most of today's VR displays. (2 points)

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Question 6

8 pts

Topic: Human Color Vision

1. How many different types of rods are in the retina? (1 point)
2. How many different types of cones are in the retina? (1 point)

3. Describe one difference between rods and cones (besides that there are different amounts of types). (2 points)
4. What is the tristimulus theory, and how does it help us with computer graphics? (2 points)
5. Can a VR headset produce all the colors our eyes can distinguish? Why/why not? (2 points)

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Question 7

10 pts

Topic: VR Displays

1. What is the difference between Field of View (FOV) and Field of Regard (FOR)? (2 points)
2. Compare front projected to rear projected screens: describe one advantage of each of them which it has over the other. (2 points)
3. Compare CAVE-type VR displays with head-mounted VR displays. Name three advantages of each of them which it has over the other. (6 points)

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Question 8

11 pts

Topic: High-End vs. Low-End VR Devices

1. Name and briefly describe 2 High-End (PC-Based) VR devices and 2 Low-End (Mobile) VR devices. (4 points)
2. Pick one High-End and one Low-End device from part 1 above and name one advantage for each of them which it has compared to the other (except price). (2 points)
3. Imagine that you want to create a VR design software tool for artists to do fast prototyping and visualization. **What** VR device will you design it for and **why** this one? (2 points)
4. Describe one problem today's High-End VR devices have, one for Low-End VR devices and one for both kinds of VR devices. (total: 3 problems) (3 points)

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Question 9

10 pts

Topic: The Time Warp Algorithm

1. What problem does the regular Time Warp algorithm (not the ATW) address? (2 points)
2. How does the regular Time Warp algorithm work? Make at least **four** correct statements. (4 points)
3. What does the Asynchronous Time Warp (ATW) algorithm add to the regular time warp algorithm? (2 points)
4. What does the Space Warp algorithm compensate for that the ATW algorithm cannot address? (2 points)

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Question 10

20 pts

Topic: In-Class Student App Presentations

In this question you need to compare the VR/AR app you presented to the class in this course to two other apps which were presented by other students. The three apps must be from the three categories below (one app from each category):

A - VR apps designed for smartphones without 3D controller

B - VR apps designed for 6 DOF headsets with 3D controllers

C - AR apps

Questions:

1. Name and briefly describe each of the three apps you chose. (6 points)
2. Which of the three apps would you spend the most time with? Why? (2 points)

3. Which do you think might have been the two biggest challenges during the implementation (programming, artwork, gameplay, etc.) of each of the apps? Explain your reasoning for each of them. (12 points)

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Question 11

17 pts

Topic: Stereo Imaging Techniques

1. The owner of a movie theater wants to start showing 3D movies and is torn between **anaglyphic**, **active** and **passive** stereo. The choice of which method to use is a trade-off between the different features of the methods. For each of the stereo methods, give a scenario in which it would clearly be the best choice of the three, based on at least one advantage it has over both others. (6 points)
2. Briefly describe how an **autostereoscopic** display with a **barrier** screen works. (4 points)
3. If money was not an object, under what circumstances would an

autostereoscopic display with a **barrier** screen be a good choice for a movie theater? What requirements would there be on the display and the layout of the theater? (3 points)

4. Many stereo imaging techniques suffer from **ghosting**. What is ghosting? (1 point)

5. Name an example for a 3D display which completely **avoids** ghosting. How does it avoid it? Why would or wouldn't it work well in a movie theater setting? (3 points)

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Question 12

1 pts

A light field is a function describing the radiance of light at every point in space, in every direction.

☐ True

☐ False

Question 13

1 pts

A light field camera captures a 3D scene so that a viewer can later virtually go to any point in the scene and get a correct 3D view from it.

☐ True

☐ False

Question 14

1 pts

Real-life scenes captured with light field cameras have to be static. It is not possible to capture real-life scenes with moving objects with a light field camera.

☐ True

☐ False

Question 15

1 pts

It is much easier to take panoramic photographs in mono than in 3D stereo.

☐ True

☐ False

Question 16

1 pts

A simple smart phone camera is sufficient to capture a monoscopic 360 degree panorama image of a static scene, by rotating it around its center of projection and taking many overlapping images.

☐ True

☐ False

Question 17

1 pts

Two synchronized cameras with 180 degree fisheye lenses are sufficient to record 360 degree panoramic video in 3D stereo.

☐ True

☐ False

Question 18

8 pts

Topic: The Future of VR/AR

Today's VR and AR devices have severe limitations for what is technically feasible, such as compute power, mobility, field of view, resolution, frame rate, input devices, battery capacity, etc. These technical shortcomings limit the type of software applications that can be created with them.





Come up with an application for VR or AR which is not possible to implement today, but that you think would be a big commercial success if it could be done.

1. What application are you thinking of? (2 points)
2. Which technical limitations of today's technology prevent this application from being feasible? Name the three most critical ones. (3 points)
3. Speculate about what innovations might be able to make the application a reality in the future. (3 points)

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