

CS 5984: Virtual Environments Final Exam

Instructions: Read questions carefully before answering. Write all your answers using complete sentences. Put your name and student ID number on the exam you turn in. The exam is due by 5:00 PM on May 3. The preferred method of turn-in is by attaching an MS Word or PDF file to an email and sending it to bowman@vt.edu. If you prefer to write your exam by hand, you must turn it in outside Dr. Bowman's office in the box marked for that purpose. This take-home exam is open-book, open-notes, but you may not consult with others. All work is to be your own. Please write the following pledge on the last page of your exam: "I have neither given nor received aid on this exam." Following the pledge, type or sign your name.

Part I: Short Answer. Answer all eight questions. Answers should be 1-2 paragraphs long. It is not necessary to cite your sources. Each question is worth 5 points.

1. In general there is a tradeoff between rendering speed and model realism. Name and describe two different techniques for increasing realism while maintaining an interactive frame rate.
2. What is *immersion* in a VE system? What is the difference between perceived immersion and spatial/physical immersion? How would you characterize the levels of immersion in a typical head-mounted display (HMD) vs. a typical 4-wall CAVE?
3. Give examples of VE systems that would be: a) local and not collaborative, b) local and collaborative, c) distributed and not collaborative, and d) distributed and collaborative.
4. Define *lag* or *latency* as it applies to VE systems. What are some of the sources of latency? What problems does it cause for the user?
5. What is the difference between an *input device* and an *interaction technique*? Give an example of two different interaction techniques that can be implemented using the same input device. Give an example of two input devices that can be used to implement the same interaction technique.
6. Why should VE software systems support development by novices? How is novice usage supported differently in the SVE and Alice systems? What VE development concept do you think is most difficult for novices to understand?
7. Name and describe at least three steps that might be used in a usability engineering approach to VE usability evaluation. What types of results are produced by each step? Can these results be used again or are they only relevant to the application being evaluated? Why or why not?
8. Define a *volume representation* as it applies to 3D computer graphics. What are some of the advantages to using volume graphics? Why are volume graphics so rare in current VE applications?

Part II: Essay. Answer three (3) of the four questions. Answers should be 1-2 pages long. Cite relevant articles or books in your answer. Each question is worth 20 points.

1. We discussed several categories of immersive VE applications that are not yet in common use, such as VEs for education (learning of concepts), VEs for information or scientific visualization, and VEs for interactive architectural design. Choose one of these categories and discuss the reasons why, in your opinion, this category of applications is not yet common. Include technological, theoretical, philosophical, or practical reasons. In your opinion, will these obstacles be overcome within the next five years? Why or why not?
2. Suppose that you are designing the user interface for an interactive space planner for the Department of Computer Science. This application will display a model of the 5th and 6th floors of McBryde Hall, and will allow the user to navigate within this model, add or remove furniture, change the location of furniture, choose different carpets and paint colors for each room, and add annotations to each room. Describe the user interface you would recommend for this system, including input and output devices, interaction techniques for travel, selection, manipulation, and system control, and aids to wayfinding and spatial orientation. Justify your choices based on the characteristics of the application.
3. Discuss the concept of user comfort in VE systems. What are some of the types of comfort issues that arise in VEs? Are these issues the same ones you would find in other types of human-machine interfaces, or are they unique to VEs? One way to improve user comfort is to design more ergonomic and lightweight input devices. Describe at least three other types of research that aim to improve levels of user comfort in VEs. For each type, discuss the issues it is addressing and its current level of impact in producing more comfortable VEs.
4. There are many ways in which an immersive VE experience is different than the experience of viewing a 3D model on a standard computer monitor. One of these differences is the improved sense of scale (size) of objects. Why is the proper perception of scale important? Why, from the human perceptual point of view, do VEs offer a sense of true scale? Discuss the relative importance of the following factors in producing a proper sense of scale: large displays and field of view, head tracking, the proprioceptive sense, virtual body representations, and stereo graphics.