Xi'an Jiaotong-Liverpool University

西交利物浦大学

Department of Computer Science and Software Engineering

Semester 1
2018-19

CSE209 Computer Graphics

for Year 3 students

Examiner:

Instructions to Candidates:

1) Total time allowed: Two hours.

2) Total marks available: 100.

3) Answer ALL questions in the booklet provided.

THIS PAPER IS NOT TO BE REMOVED FROM THE EXAM ROOM.

Question 1.   Fundamentals   **[Total 20 marks]**

1.1. List two input devices used with computer graphics applications.   [2 marks]

1.2. Briefly describe what a frame buffer is.   [2 marks]

1.3. What is a pixel in computer graphics?   [2 marks]

1.4. A straight line is represented as $x - 2y + 10 = 0$. Work out its y-intercept.   [2 marks]

1.5. For the vectors $V_1 = 3i - 5j$ and $V_2 = 5i + 3j$, work out their dot product.   [2 marks]

1.6. Explain what an identity matrix is with an example.   [2 marks]

1.7. What would the following fragment of code do?   [2 marks]

```
int y = y0;
while (y <= y1)
do {
   DrawPoint(x,y);
   y = y + 1;
}
```

1.8. How can an object in the 2D space be reflected about the y-axis?   [2 marks]

1.9. An object in a 2D space is transformed by two rotations around the same point. Will the
      result be the same if the order of the two rotations is changed?   [2 marks]

1.10. What would glClear3f(1.0, 0.0, 1.0) in OpenGL do?   [2 marks]

Question 2.   Modelling and generation of geometry   [Total 20 marks]

2.1.   Given the B-Rep (Boundary Representation) model for the pyramid with 4 vertices ([v0] to
       [v4]) shown below, its base is a square of side length 10 units; the tip of the pyramid is 10
       units above the base.   [12 marks]

         a) Draw the diagram in your answer book and label the edges and faces (e.g. with e0, e1, ...
            and f0, f1, ...).
         b) Annotate your diagram with the (x,y,z) values of the vertices.
         c) Produce a table or graph to show the B-Rep of the model.
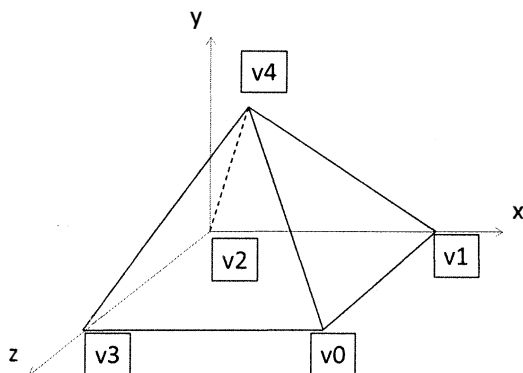
2.2.   Discuss wireframe modelling and its main drawbacks.   [4 marks]

2.3.   Describe the *interpolation curves* and their applications.   [4 marks]

Question 3.   Transformation and viewing   [Total 20 marks]

3.1.   Describe the three main types of transformation. 2D space and diagrams can be used to aid
       your answer.
                                                                                       [9 marks]

3.2.   Discuss why homogeneous co-ordinates are used in computer graphics, and the values
       assigned to the homogeneous parameter.   [3 marks]

3.3.   Orthogonal projection is one of the projection techniques for computer graphics.   [8 marks]

         a) Briefly explain the orthogonal projection.
         b) Briefly explain the orthogonal projection viewing volume and implementation with
            OpenGL **gluOrtho()**.

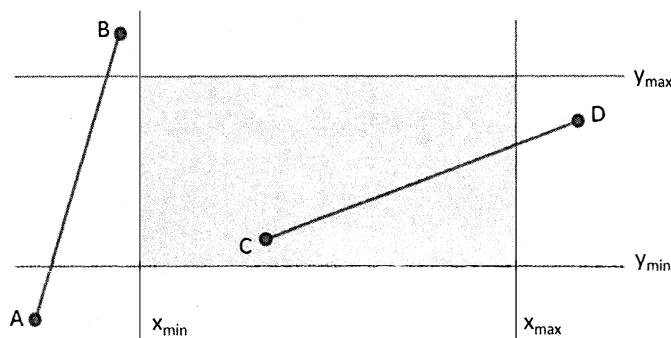**Question 4.   Lighting and texture mapping**   **[Total 20 marks]**

4.1.   Briefly describe the three main types of light source.   [9 marks]

4.2.   Show the combined lighting effect of two light sources, (1.0, 0.5, 0.1) and (0.1, 0.5, 0.2), that are applied to a scene.   [4 marks]

4.3.   Describe the concepts and process of texture mapping.   [7 marks]

Question 5.   Clipping and hidden-surface removal   **[Total 20 marks]**

5.1.   Describe and compare clipping and hidden-surface removal.   [6 marks]

5.2.   Explain the clipping window, viewport and display window relating to OpenGL where appropriate.   [6 marks]

5.3.   Provide your answer to the following two questions about the Cohen-Sutherland line clipping algorithm.   Diagrams can be used to aid your answer.   [8 marks]

   a) Taking the 2D space as an example, explain how the space is divided with outcodes.
   b) Describe the steps of clips that the Cohen-Sutherland algorithm would perform for each of the two lines shown in the figure below.

THIS IS THE END OF THE EXAM.