

CS 130

Practice Midterm

Winter 2018

Name	
Student ID	
Signature	

You may not ask any questions during the test. If you believe that there is something wrong with a question, write down what you think the question is trying to ask and answer that.

Question	Points	Score
True/False		
1	1	
2	1	
3	1	
4	1	
5	1	
6	1	
7	1	
8	1	
9	1	
10	1	
Multiple Choice		
11	2	
12	2	
13	2	
14	2	
15	2	
16	2	
Written Response		
17	6	
Total	28	

1 True/False

For each question, indicate whether the statement is true or false by circling T or F, respectively. You get -0.25 points for answering the question incorrectly and 0.5 points for leaving it blank. (It is statistically to your advantage to answer only if you are at least 60% confident that your answer is correct).

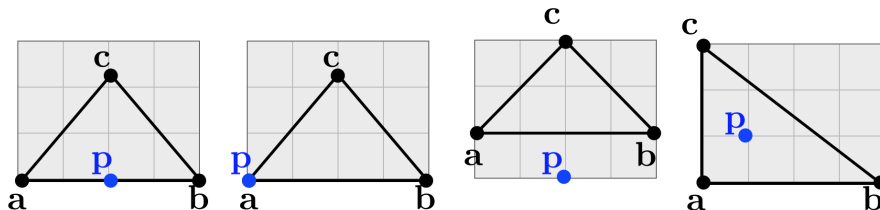
1. (☒T/☐F) Shaders are programs that run on the GPU.
2. (T/☒F) The fragment shader determines the position of the vertexes.
3. (T/☒F) For nonzero vectors $\mathbf{u}$ and $\mathbf{v}$, $\mathbf{u} \cdot \mathbf{v} = 0$ if and only if $\mathbf{u}$ and $\mathbf{v}$ are parallel.
4. (☒T/☐F) For nonzero vectors $\mathbf{u}$ and $\mathbf{v}$, $\mathbf{u} \times \mathbf{v} = \mathbf{0}$, if and only if $\mathbf{u}$ and $\mathbf{v}$ are parallel.
5. (T/☒F) For any vector $\mathbf{v}$, $\mathbf{v} \cdot \mathbf{v} = \|\mathbf{v}\|$.
6. (☒T/☐F) The product of a matrix with a vector is a vector.
7. (T/☒F) In ray tracing, view rays are cast from the world position of a pixel towards camera position.
8. (☒T/☐F) One can decide if a line is intersecting with a sphere by combining the sphere and line equations and evaluating the discriminant of the quadratic formula.
9. (☒T/☐F) The intersection of a ray with a cube can be calculated analytically given the plane equations of each side of the cube.
10. (☒T/☐F) Semi-transparent objects can be rendered with ray tracing.

2 Multiple Choice

For each question, circle exactly one of (a)-(e), unless otherwise stated.

11. Which of the following statements about mipmapping is true?
 - (a) ☒ Using mipmapping, minification artifacts far from the camera can be alleviated.
 - (b) A higher resolution texture is used further away from the camera, and a lower resolution texture is used closer to the camera.
 - (c) The use of n resolution levels requires n times the amount of memory.
 - (d) Magnification artifacts due to low texture resolution can be mitigated.
 - (e) None of the above.

12. Which of the following statements about extended uses of texture maps is true?
- (a) Bump mapping can be used to give the object a bumpy appearance in both the interior polygons and its silhouette.
 - (b) Normal mapping results in an increased polygon count.
 - (c) Shadow mapping can be used to add shadows in a z-buffer based rendering approach.
 - (d) Textures cannot be used to implement environment maps.
 - (e) None of the above.
13. Which statement about ray intersections is true?
- (a) If the direction of a ray is orthogonal to the normal of a plane, they can never intersect.
 - (b) A ray and a plane can intersect at most at one point.
 - (c) If the end point of a ray is inside a sphere, it intersects with the sphere exactly one time.
 - (d) All of the above.
 - (e) None of the above.
14. Given a ray tracing algorithm, if we add small random perturbations to each reflection ray, how will that change the resulting image?
- (a) It will blur reflections in the image.
 - (b) The image will be distorted beyond recognition.
 - (c) It will appear grainy.
 - (d) It will increase aliasing artifacts
 - (e) None of the above.
15. Which sentence completion is false? The Phong reflectance model
- (a) calculates the red, green, and blue color channels independently.
 - (b) captures ambient, diffuse, and specular components.
 - (c) does not consider the shadow of an object on itself in its calculations.
 - (d) does not consider the geometry of the object being shaded.
 - (e) requires the normal of the object at the point being shaded.
16. For each of the four triangles and points **p** shown below, give the barycentric coordinates of the point **p** with respect to the triangle.



3 Written Response

17. Consider a ray with endpoint $\mathbf{e}$ and direction $\mathbf{d}$, given by the ray equation

$$\mathbf{p}(t) = \mathbf{e} + t\mathbf{d},$$

and a triangle with vertices $\mathbf{a}, \mathbf{b}, \mathbf{c}$.

- (a) Find an implicit equation for the plane containing the triangle, of the form

$$f(\mathbf{p}) = \mathbf{N} \cdot (\mathbf{p} - \mathbf{q}) = 0$$

where $\mathbf{N}$ is a normal to the plane and $\mathbf{q}$ is a point in the plane. Specify $\mathbf{N}$ and $\mathbf{q}$ in terms of the triangle vertices.

- (b) Find the intersection point of the ray with the plane, if any, or specify how to determine that there is no intersection point.
- (c) How would you determine whether the ray intersects the original triangle or not? You do not need to give all the mathematical details, but simply outline in words a procedure.

