A vector-based display [redacted].

1

A pixel-based display [redacted].

2

In a graphics pipeline, what is a fragment?

3

What is the fundamental difference between a fixed and a programmable graphics pipeline?

4

Describe OpenGL in one sentence.

5

[redacted] *oversees the development of OpenGL.*

6

What kind of matrix does OpenGL use to encode 3D transformations?

7

Why do we use 4x4 transformation matrices in 3D graphics?

8

A vector-based display can draw lines, text and points.

1

A pixel-based display approximates shapes.

2

A candidate pixel, which or may not end up being displayed.

A loose definition of a fragment is a "potential pixel". The fragment (x,y) will be drawn on the screen only if it meets certain criteria, such as, it's nearer to the viewer than the pixel already recorded (if any) for position (x,y).

3

There are parts of a programmable pipeline that the user must program themselves.

4

An API for doing 3D computer graphics

5

Khronos oversees the development of OpenGL.

6

4×4

You can encode 3D scaling and 3D rotations in a 3x3 matrix, but if you want to include translations too, you need a 4x4.

7

They can encode translations as well as scales and rotations.

8

In 2D a rotation is defined with respect to a point. In 3D a rotation is defined with respect to .

9

Assuming we represent 3D points using column vector notation, if I take a point P and first transform it by matrix M1, then matrix M2, and finally matrix M3, whats the expression that gives P', the final value of P?

10

Given a matrix A and its inverse B, what is the result P' of applying the composite transformation (A x B) to a point P?

11

What is the effect on a vector V of normalising it?

12

Given two normalised 3D vectors V1 and V2, what gives the vector V3 which is perpendicular to both V1 and V2?

13

What is the purpose of the Z-buffer?

14

is the process of splitting a complex polygon into a set of separate convex ones.
an odd-shaped polygon guarantees that it can be rendered correctly.

15

What is the the purpose of "viewing" a model in computer graphics?

16

$$P' = M3 \times M2 \times M1 \times P$$

10

In 2D a rotation is defined with respect to a point. In 3D a rotation is defined with respect to a 3D vector.

9

Scaling V so that it has a magnitude of 1, without affecting its direction.

12

$$P' = P$$

Multiplying a matrix by its inverse results in the identity transformation, which transforms a point to itself (i.e., doesn't change it).

11

To almost guarantee that only pixels nearest to the camera are displayed. This is not always true as there can be some problems, such as Z-fighting.

14

$$V3 = V1 \times V2$$

Where $\times$ means cross product.

13

To enable the user to control how parts of the model are seen on screen.

16

Tessellation is the process of splitting a complex polygon into a set of separate convex ones. Tessellating an odd-shaped polygon guarantees that it can be rendered correctly.

15

In a simple 2D window-to-viewport view, we have 3 steps: M1 shifts the window to the origin; M2 scales the window to be the same size as the viewport; M3 shifts the viewport to the desired place. The overall view transformation is .

17

What best describes "the duality of modelling and viewing"?

18

When defining the coordinate system for the the camera, why do we not create a system with axes Q, V, and F, where Q = normalise(V x F)? (assume V and F are normalised).

19

What are the two main classes of projections?

20

In perspective projection a point (x, y, z) will project to (xp, yp, zp) on a projection plane. By what method can we find (xp, yp, zp)?

21

OpenGL combines a matrix for applying modelling transformations, M, with a matrix V for applying the camera. In which logical order are they applied to coordinates?

22

What is the view volume in parallel projection?

23

What is the main purpose of projection normalization?

24

Moving the model by some transformation is equivalent to applying the inverse transformation to the camera viewing it.

18

In a simple 2D window-to-viewport view, we have 3 steps: M1 shifts the window to the origin; M2 scales the window to be the same size as the viewport; M3 shifts the viewport to the desired place. The overall view transformation is $M3 * M2 * M1$.

17

Orthographic and perspective.

20

Because it would only work if V, which is specified by the user, is orthogonal to F. It may not be.

19

First M and then V.

22

Similar triangles.

21

It allows us to keep the z coordinates, which would otherwise have been set to the z-value of the projection plane.

24

A tetrahedron.

23

What is themselves difference between local and global illumination models?

25

[redacted] *makes materials look dull and matte.*

26

Ambient light is an approximation of the [redacted].

27

What is the function of the n exponent in the Phong specular term?

28

Does the use of Ks allow us to render metal accurately?

29

In Gouraud shading, the [redacted] *is interpolated along a scan line.*

30

In Phong shading, the [redacted] *is interpolated along a scan line.*

31

What is Mach banding?

32

Diffuse reflection makes materials look dull and matte.

26

A gobal model takes into account light interactions between objects; a local model doesn't.

25

It models how shiny a surface is. n small means not very shiny; n large means very shiny.

28

Ambient light is an approximation of the overall light level in an environment.

27

In Gouraud shading, the pixel colour is interpolated along a scan line.

30

No, because it doesn't capture the complex interactions between light and metals.

29

The illusion that changes of intensity are greater than they actually are.

32

In Phong shading, the normal vector is interpolated along a scan line.

31

What is the main purpose of mip-mapping?

33

What is the basic principle behind bump mapping?

34

Median smoothing is used to _____.

35

What is convolution of an image and a template? What is it used for?

36

Stretching the grey scale in a black and white image will _____.

37

In order to scan-convert a triangle, we must always _____.

38

What problem does the ***Z-buffer*** *solve?*

39

Homogeneous coordinates are used in Computer Graphics to provide a _____ *of transformations.*

40

To make a surface look bumpy by altering normals during rendering.

34

To deal with mismatches between texel and pixel resolutions.

33

Convolution is the process of adding each element of the image to its local neighbors, weighted by the kernel. It measures the similarity between image patches and the template.

36

Median smoothing is used to suppress noise in an image.

35

In order to scan-convert a triangle, we must always know the coordinates of the triangle's vertices.

38

Stretching the grey scale in a black and white image will increase the amount of contrast in the image.

37

Homogeneous coordinates are used in Computer Graphics to provide a consistent representation for different types of transformations.

40

The hidden-surface problem.

39

Explain the distinction between the activities of modelling and rendering, in Computer Graphics.

41

What is a limitation of using a 3×3 matrix to represent 3D transformations?

42

In 3D computer graphics, the function of a camera transforms coordinates to simulate the operation of a real camera which creates 2D images of a 3D world.

43

In viewing, what is meant by the near and far clip planes?

44

Explain how you would apply the local illumination model to a triangle mesh, such that it is smoothly shaded, and correctly takes into account specular reflection.

45

What is a normalized vector? Give an example of its use in computer graphics

46

What is the purpose of the OpenGL "matrix stack"? Illustrate your answer with a practical example of its use.

47

Why do textures usually need to be filtered during rendering? Describe the bilinear interpolation filter.

48

A 3×3 matrix cannot represent a 3D translation transformation.

42

Modelling is about constructing something to represent an idea; in CG the model is usually geometrical; rendering is the process of creating a visual representation of the model.

41

The near and far clip planes set the forward and rear boundaries of the view volume; geometry is clipped at these boundaries.

44

In 3D computer graphics, the function of a camera transforms coordinates to simulate the operation of a real camera which creates 2D images of a 3D world.

43

A vector with length one; common use: surface normal, to give the direction a triangle is facing, needed during rendering.

46

We deal with each triangle T in the mesh in the same way. First we need to compute the average normal vectors at each vertex V of T by averaging the surface normal of the triangles which also share V; then we process each scanline for the triangle; for the part of scanline S which covers T, we compute an averaged normal at the pixels at the start (P) and end (Q) of the scanline segment by averaging from the respective vertices; we then step along the scanline from P to Q, and apply the full local illumination model for each pixel, smoothly interpolating the normal for each pixel between P and Q.

45

Usually texel resolution does not match pixel resolution, therefore we need to apply a filter to resolve the mis-match; the bilinear interpolation filter is used when the texel resoluion is less than the pixel resolution; each pixel receives a colour averaged from adjacent texels.

48

The matrix stack is for saving the current transformation T; the user can modify T, and then reset T to the saved value. Example of uses: drawing an overlay on the screen for a framerate counter. We stack the current view, replace it with the overlay view, then unstack and restore the usual view.

47

The histogram of an image represents the .

49

What data would you use to identify coloured objects in a range of light intensities?

50

What is Nyquist's Theorem?

51

Chromaticities - either HS from HSV or normalized red and normalized green.

50

The histogram of an image represents the frequency of occurrence of each grey or colour value.

49

A periodic signal can be reconstructed if the sampling interval is half the period.
An object can be detected if two samples span the smallest dimension.

51