1- ... suffer from a pixelization effect on zoom in.

i- Raster Images
ii- Vector Images
iii- Both of them
iv- None of them

Exp: See Slides 2.P(4)

2- To solve the issue of non-linear response on screens we use …

i- Deferred Correction
ii- Raster Correction
iii- Gamma Correction
iv- Bonferroni correction

Exp: See Slides 2.P(8-10)

3- Vector images are resolution-dependent.

i- True
ii- False

Exp: See Slides 2.P(5)

4- Given 3 triangles A, B, and C, with C being the nearest and A the furthest. Fill colors (RGBA) of each triangle are:

$$C_A = (0.5, 0.5, 0.5, 1)$$

$$C_B = (0.1, 0.7, 0.5, 0.5)$$

$$C_C = (0.7, 0.6, 0.9, 0.75)$$

Then the final color of a pixel covered by the 3 triangles: C =

i- $(0.5, 0.5, 0.5)$
ii- $(0.6, 0.6, 0.8)$

iii- $(0.3, 0.6, 0.5)$
iv- $(0.4333, 0.6, 0.6333)$

Exp: Use formula (Slides 2.P14) $C = \alpha C_{FG} + (1-\alpha)C_{BG}$ on C_A as Background(C_{BG}) and C_B as Foreground (C_{FG}) to get $C_{mid} = (0.3, 0.6, 0.5)$, then use it again on C_{mid} as Background and C_C as Foreground to get the result

---

5- For the line represented by f(x,y) = Ax + By + C = 0 and passing by (x_0, y_0) and (x_1, y_1), the values of A and B are

i- A = y_0 - y_1 and B = x_1 - x_0
ii- A = y_1 - y_0 and B = x_1 - x_0
iii- A = y_0 - y_1 and B = x_0 - x_1
iv- A = y_1 - y_0 and B = x_0 - x_1

Exp: substitute with the two points in the equation, you will get two equations then mins one from the other, in the equation substitute with A = y_0 – y_1 to get first answer and with A = y_1 - y_0 to get second answer

---

6- If we add an RGB color [255, 0, 0] to another color [0, 255, 0], the result is the color [255, 255, 0].

i- True
ii- False

Exp: The RGB color model is an additive color model.

7- for $f(x,y) = ax + by + c$, the vector $[a\ b]$ represents:

i- The normal vector on the line $f(x,y) = 0$
ii- the gradient vector of $f(x,y)$
iii- The direction in which the distance from the line doesn't change
iv- None of the above

Exp: See Slides 2.P(17)

8- The following line-drawing algorithm suffers from the following problems:

```
y = y_0
d = f(x_0 + 1, y_0 + 0.5)
for x = x_0 to x_1 do
  draw(x,y)
  if d < 0 then
    y = y + 1
    d = d + (x_1 - x_0) + (y_0 - y_1)
  else
    d = d + (y_0 - y_1)
```

i- Excessive evaluation for the function of the line
ii- Floating-point calculations
iii- Both of them
iv- None of them

Exp: See Slides 2.P(23-27)

9- Which of the following transformations has an orthonormal matrix?

i- Scaling
ii- Rotation
iii- Shearing
iv- Translation

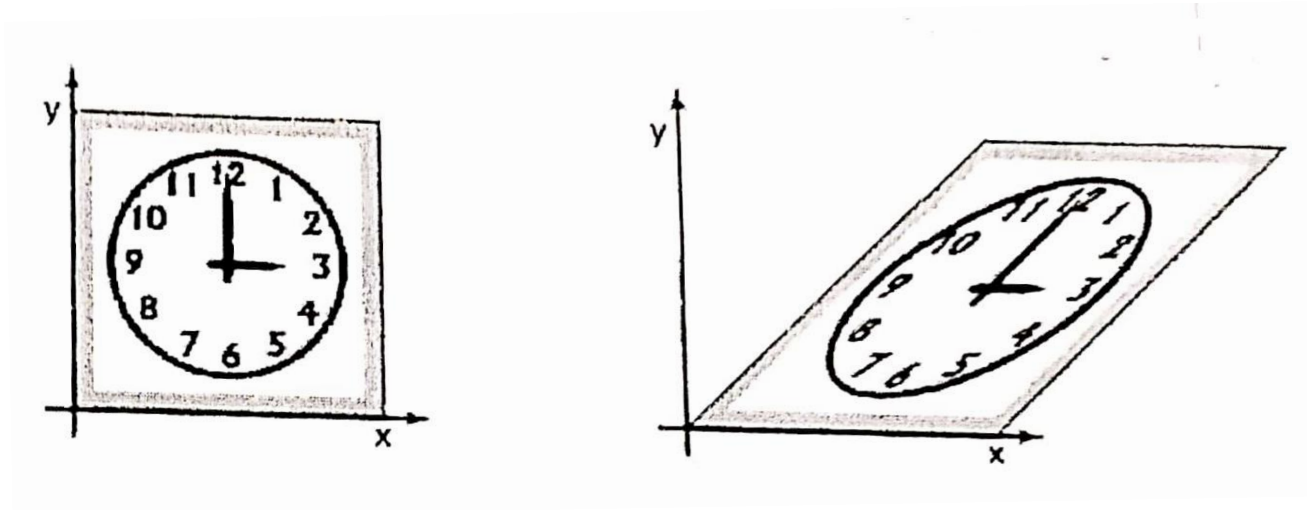
Exp: See Slides 3.P(13)

10- The 2D Reflection around the line y=x is orthonormal.

i- True
ii- False

Exp: the reflection matrix will be [0, 1; 1, 0] which is an orthonormal

11- To transform the shape on the left to the shape on the right (square -> skewed square), the following transformation matrix is needed.



i- [1, 0; 0, 1]
ii- [1, 2; 0, 1]
iii- [1, 1; 0, 1]
iv- [1, 0; 1, 1]

Exp: Same diminutions and sheering in x direction

12- The following triangle drawing algorithm can be optimized by modifying the line:

```
1 for all x[0:screen_width] do: for all y[0:screen_height] do:
2     compute (alpha, beta, gamma) for (x,y)
3     // Inside?
4     if (alpha in (0,1) AND beta in (0,1) AND gamma in (0,1)) then
5           c = alpha*c0 + beta*c1 + gamma*c2
6           drawpixel(x,y) with color c
```

i- #1
ii- #4

iii- Both of them
iv- None of them

Exp: we can modify line #1 to only work inside the bounding rectangle of triangle. we can modify line #4 to only check if all coefficients > 0. Then by definition, all coefficients < 1 (as they sum up to 1).

13- if a rectangle defined by the points A (1,1), B (3,1), C (1,3) and D (3,3) is transformed to the new points A' (5,2), B' (9,2), C'(6,4), D'(10, 4). What is the order of transformations needed to transform ABCD to A'B'C'D'?

i- Translation, Uniform Scaling, Shearing in x-direction, Translation.
ii- Translation, Non-uniform Scaling, Shearing in x-direction, Translation.
iii- Translation, Non-uniform Scaling, Shearing in y-direction, Translation.
iv- None of the above

Exp: Draw the two rectangles and you can notice that the scaling in not the same and the rectangle is sheered along x-axis

---

14-16 - Given triangle ABC, $A = \begin{bmatrix} 0 \\ 1 \end{bmatrix}, B = \begin{bmatrix} 1 \\ 0 \end{bmatrix}, C = \begin{bmatrix} 2 \\ 2 \end{bmatrix}$, With color values at each respectively: $C_A = \begin{bmatrix} 0.6 \\ 0.4 \\ 0.1 \end{bmatrix}, C_B = \begin{bmatrix} 0 \\ 0.5 \\ 0.7 \end{bmatrix}, C_C = \begin{bmatrix} 0.6 \\ 0.6 \\ 1 \end{bmatrix}$.
Given arbitrary point P:

14- if $\beta = 0$ and P is on the edge CA, $\gamma =$ .....

i- 0
ii- 0.5
iii- 1
iv- Not enough Information

Exp: "$\beta = 0$" and "P is on the edge CA" are redundant. We only know $\gamma + \alpha = 1$

15- Given $\beta = 0.5$ and P is inside ABC, $\gamma =$ .....

i- 0.0
ii- 0.3
iii- 0.5
iv- 0.7

Exp: at 0.0: P is on AB edge (not inside)
at 0.5: P is on BC edge as $\alpha = 0$ (not inside)
at 0.7: P is outside as $\alpha = -0.2 < 0$
So only 0.3 works, with $\alpha = 0.2$ (all coefficients ∈ $(0,1)$)

16- Given P = $\begin{bmatrix}1\\1\end{bmatrix}$, Color at point P ($C_P$) =

i- $[0.6\ 0.9\ 0.8]^T$
ii- $[0.3\ 0.3\ 0.5]^T$
iii- $[0.4\ 0.5\ 0.6]^T$
iv- Not enough Information

Exp: P = $\begin{bmatrix}1\\1\end{bmatrix} = \alpha A + \beta B + \gamma C = \frac{1}{3}(A + B + C) \rightarrow C_P = \frac{1}{3}(C_A + C_B + C_C) = \begin{bmatrix}0.4\\0.5\\0.6\end{bmatrix}$

- Can get β, γ as $\begin{bmatrix}x_B - x_A & x_C - x_A\\ y_B - y_A & y_C - y_A\end{bmatrix}\begin{bmatrix}\beta\\ \gamma\end{bmatrix} = \begin{bmatrix}x_P - x_A\\ y_P - y_A\end{bmatrix}$ (see slides: 9.P10)
- then $\alpha = 1 - (\beta + \gamma)$

17- If rotation R(θ) is applied to point P = (x,y), followed by reflection about the x-axis, followed by reflection about the y-axis and finally a uniform scaling is applied by factor σ to obtain the point P' then which of the following is correct about the transformation of point P to point P'?

i- P' = R(θ) * R(180) * S(σ) * P
ii- P' = S(σ) * R(-180) * R(θ) * P
iii- P' = S(σ) * R(90) * R(90) * R(θ) * P
iv- None of the above

Exp: Try to figure how the reelections can be expressed in terms of angles and find them. Also notice in general we wouldn’t choose the first answer (as order matters) but in our case this will result in the same transformation so you should be careful.

18- The off-diagonal elements in a transformation matrix may be non-zeros only if the transformation applied is:

i- Scaling
ii- Shearing
iii- Reflection
iv- Scaling followed by reflection.

Exp: check the transformation matrix for shearning

19-22- The next four questions are related:

19- What are the transformations needed for a reflection about an arbitrary line y = mx + c? (c>0) (regardless of the order of transformations).

i- Translation
ii- Scaling
iii- Reflection
iv- Rotation

20- if translation is needed, how many translation operations are needed?

i- 1
ii- 2
iii- 3
iv- Translation is not needed.

21- If scaling is needed, what are the scaling factors Sx and Sy?

i- Sx = m, Sy = 1
ii- Sx = 1, Sy = m
iii- Sx = m/c, Sy = 1/c
iv- Scaling is not needed.

22- If rotation is needed, what will be the absolute value of the angle of rotation?

i- |m|

ii- $|\tan^{-1}(m)|$

iii- $|\tan^{-1}(m/c)|$

iv- Rotation is not needed.

Exp 19-22: Shift the line so that c=0 then apply a rotation (negative angle to what it's making with x) to that m=0 now apply the reflection and then rotate and shift back to OG position.

23- The rotation matrix [cos θ, sin θ; -sin θ, cos θ]

i- Rotates points around the X-axis using an angle θ counter-clockwise.
ii- Rotates points around the Y-axis using an angle θ clockwise.
iii- Rotates points around the origin using an angle θ counter-clockwise,
<u>iv- Rotates points around the origin using an angle θ clockwise.</u>

Exp: Plug - θ in the original rotation matrix and you will get this matrix, this means the rotation is done in the clockwise direction

---

24- The transformation matrix [-1, 0; 0, 1]

i- Reflects points around the X-axis
<u>ii- Reflects points around the Y-axis</u>
iii- None of them

Exp: applying the transformation you will get –x + y which is equivalent to refelction around y axis

---

25- If we transform a point by a transformation matrix M_1 followed by another transformation matrix M_2 this is equivalent to the transformation matrix $M = M_1M_2$.

i- True
<u>ii- False</u>

Exp: we should multiply first by M_1 then M_2 so $M = M_2 M_1$

26- The inverse of [cos θ, -sin θ, sin θ cos θ] is

i- [cos θ, sin θ; -sin θ, cos θ]
ii- [cos θ, -sin θ; sin θ, cos θ]
iii- [cos -θ, -sin -θ; sin -θ, cos -θ]
iv- None of the above

Exp: for the first answer the inverse of any rotation matrix it’s transpose because it orthonormal matrix, for the second answer we can obtain this matrix from the first one and using the following identities sin -θ = -sin θ and cos θ = cos -θ

27- Given that R = [cos θ, -sin θ; sin θ, cos θ] and S = [cos α, -sin α; sin α, cos α]

i- RS != SR because the order of transformations matter.
ii- RS=SR
iii- It depends on θ and α.

Exp: for 2D case the order of rotations doesn’t matter, in 3D case they have to be around same axis

---

28- The 2D point [1 5] is represented in homogeneous coordinates as

i- [1 5 1]
ii- [1 5 0]
iii- [2 10 2]
iv- None of the above

Exp: for points we add a non-zero constant c as the extra component (and all other values are scaled by c).

29- The 2D vector [1 5] is represented in homogeneous coordinates as

i- [1 5 1]
ii- [1 5 0]
iii- [2 10 2]
iv- None of the above

Exp: for vectors we add 0 as the extra component

30- The following matrix represents

$$\begin{bmatrix} R_{2\times2} & t_{2\times1} \\ 0^T & 1 \end{bmatrix}$$

i- A translation then a rotation in the 2D space
ii- A translation then a rotation in the 3D space
iii- A rotation then a translation in the 3D space
iv- None of the above

Exp: This equivalent to Rotation then Translation in 2D

31- Given that xyz is the canonical frame, the following matrix

$$\begin{bmatrix} x_u & x_v & x_w \\ y_u & y_v & y_w \\ z_u & z_v & z_w \end{bmatrix}$$

i- Rotates uvw to xyz
ii- Rotates xyz to uvw
iii- Changes the coordinate system from uvw to xyz
iv- Changes the coordinatet system from xyz to uvw

Exp: See Slides 4.P(4-5)

32- Given the canonical frame xy and another arbitrary frame uv that is located at e, the following matrix represents

$$\begin{bmatrix} x_u & y_u & 0 \\ x_v & y_v & 0 \\ 0 & 0 & 1 \end{bmatrix}\begin{bmatrix} 1 & 0 & -x_e \\ 0 & 1 & -y_e \\ 0 & 0 & 1 \end{bmatrix}$$

i- The canonical to frame transformation
ii- The frame to canonical transformation
iii- Either of the above
iv- None of the above

Exp: See Slides 4.P(11)

33-if we rotate the points of a surface using the rotation matrix M, the surface normal vectors can be transformed by the matrix

i- M^{-1}
ii- MT
iii- <u>M</u>
iv- None of the above

Exp: For rotation matrix because it is an orthonormal $(M^{-1})^T = M$

34- A windowing transform may be obtained by

i- <u>Translation then scaling then translation</u>
ii- <u>Translation then scaling</u>
iii- <u>Scaling then translation</u>
iv- None of the above

Exp: The first answer is what we obtained in the lecture but it not the only answer as we can obtain a windowing transformation using any combination of translation and scaling

---

35- Which of the following projections have parallel lines remain parallel and never intersect?

i- <u>Orthographic projection</u>
ii- Perspective Projection
iii- None of them

Exp: See Slides 5.P(6)

36- In the perspective projection, there is a single vanishing point in any image because parallel lines intersect at this point.

i- True
ii- False

Exp: See Slides 5.P(6)

37- The modeling transformation converts points from object space into the world space.

i- True
ii- False

Exp: See Slides 5.P(14)

38- The viewport transformation is a

i- Rotation transformation
ii- Windowing transform
iii- Canonical to frame transformation
iv- Frame to canonical transformation

Exp: See Slides 5.P(33)

39- The camera transformation is a

i- Rotation transformation
ii- Windowing transform
iii- Canonical to frame transformation
iv- Frame to canonical transformation

Exp: See Slides 5.P(18)

40- The orthographic projection transformation is

i- Rotation transformation
ii- Windowing transform
iii- Canonical to frame transformation
iv- Frame to canonical transformation

Exp: See Slides 5.P(25)

41- The modeling transformation is a

i- Rotation transformation
ii- Windowing transform
iii- Canonical to frame transformation
iv- Frame to canonical transformation

Exp: Transform from coordinates relative to the object (frame) to the coordinates relative to the world (xyz or canonical)

42- Which transformation depends on the object position and orientation?

i- Camera transformation
ii- Viewport transformation
iii- Modeling transformation
iv- Projection transformation

Exp: The Modeling transformation responsible for position of the object, scale and orientation in the scene

---

43- Which transformation depends on the resolution of the output image?

i- Camera transformation
ii- Viewport transformation
iii- Modeling transformation
iv- Projection transformation

Exp: The Viewport transformation is responsible for Convert from 3D points in canonical space to 2D points on screen

---

44- if the camera was located at the origin of the world coordinates, then the camera transformation matrix must be the identity matrix.

i- True
ii- <u>False</u>

Exp: No translation but still we can have rotations

45- If the distance between point A and point B is 2. Assume that there is a camera at location (0, 10,0), looking at the origin and its up vector points in the direction (1,0,1). What will be the distance between A and B after applying the camera transform to them?

i- 4
ii- sqrt(2)
iii- <u>2</u>
iv- Cannot be determined using the given information.

Exp: No scaling in camera transformation

---

46 - $P = \alpha A + \beta B + \gamma C$ (In Barycentric Coordinates of Triangle ABC). We can calculate $\beta = \frac{Area(\Delta APC)}{Area(\Delta ABC)}$

<u>i- True</u>
ii- False

Exp: We know $\beta = \frac{Distance\ to\ P\ from\ AC = h_P}{Distance\ to\ B\ from\ AC = h_B}$ (From Slides 9.P11)

Now with simple algebra: $\beta = \frac{h_P * ||AC||/2}{h_B * ||AC||/2} = \frac{Area(\Delta APC)}{Area(\Delta ABC)}$ ■ ()

---

47 - Raster images are made up of Pixels and do not depend on the resolution. What is wrong about this sentence?

i- The first part is wrong. Instead, raster Images are made up of object description.
ii- The second part is wrong. Instead, raster images depend on the resolution.
iii- None of the above. The sentence is already correct.

Exp: Slides 2.P4

---

48 – Of the following components, which depend on the eye (viewpoint) position

i- diffuse
ii- specular
iii- ambient
iv- None of the above.

Exp: Slides 7

---

49 – Of the following components, which depend on the light source position

i- diffuse
ii- specular
iii- ambient
iv- None of the above.

Exp: Slides 7

---

50 – Rasterization is/does

i- Readily available in GPUs
ii- Produce realistic images
iii- Parallelizable
iv- Loop over pixels and for each, loops over each triangle.

Exp: Slides 8.P7

51- The factor of reflected light ray between entering a refractive medium depends on:

i- The normal vector of the surface separating the mediums

ii- The direction of the ray falling on the surface

iii- The intensity of the light

iv- The distance between light source and surface

Exp: Slides 9.P24 as θ_i is the angle between n and d

---

52 – As described in the Ray intersection with 2D boxes, we determine $t_{min} and\ t_{max}$ using $t_{xmin}, t_{xmax}, t_{ymin}, and\ t_{ymax}$. These four values can take ….. distinct value/s

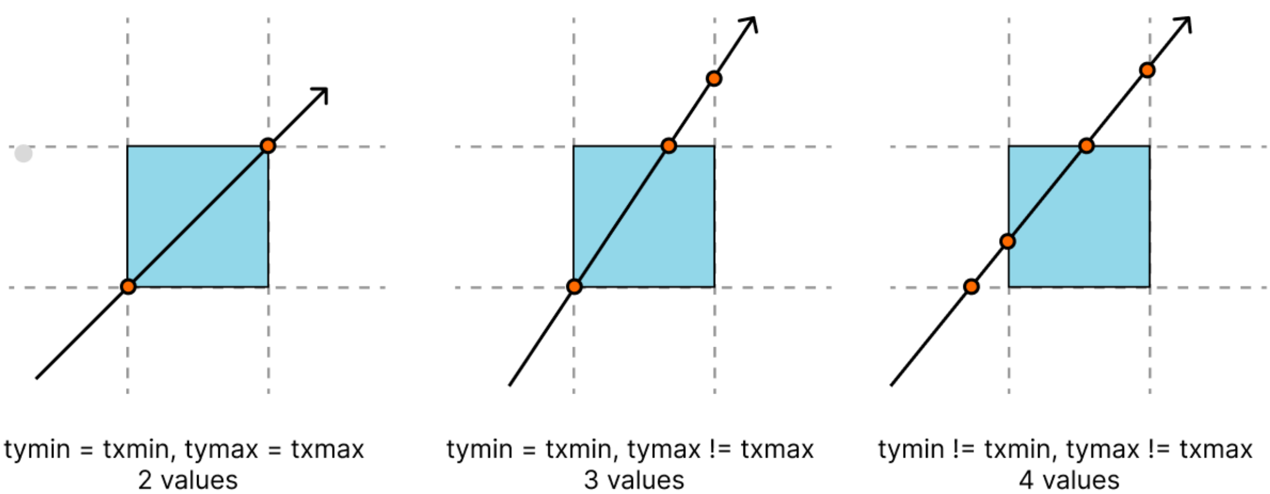
i- 1

ii- 2

iii- 3

iv- 4

Exp:



---

53 – We say that there is an intersection between the ray and a rectangle in 3D if ………………

i- The ranges $[t_{xmin}, t_{xmax}]$, $[t_{ymin}, t_{yman}]$ overlap

ii- $max(t_{xmin}, t_{ymin}) < min(t_{xmax}, t_{ymax})$

ii- $max(t_{xmin}, t_{ymin}) > min(t_{xmax}, t_{ymax})$
iv – The ranges $[t_{xmin}\ , t_{xmax}]$, $[t_{ymin}, t_{yman}]$ don't overlap

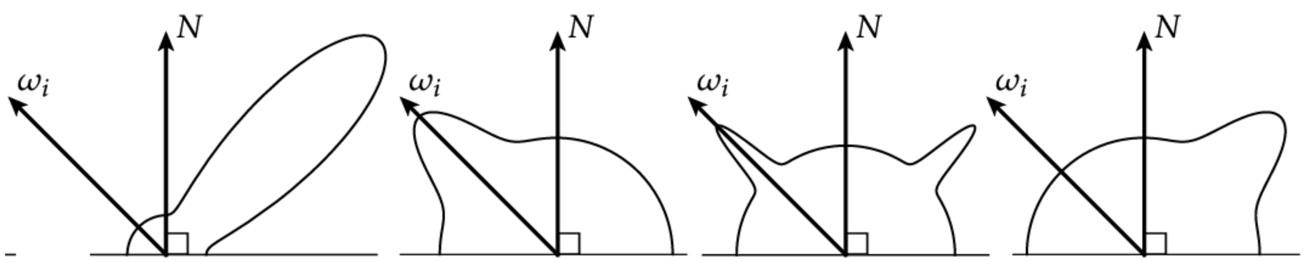
Exp: i, ii are correct as in [Slideset 8, 31]
Exp: Slides 8.P7 (can render anything that can be intersected with a ray, as opposed to rasterization).

54- To get the depth values for pixels inside a triangle, we use

i- Barycentric Coordinates
ii- Homogenous Coordinates
iii- None of the above

Exp: Slides 5.P27 (By interpolating between the depth values on each vertex).

55- To decorate your new bedroom, you decide to paint it with a unique painting. you first paint it with a bright white diffuse paint, then a dull glossy (specular) glaze. For a given light direction wi. Which material BRDF looks most like your paint?



(i) (ii) (iii) **(iv)**

Exp: Only the choices (i) and (iv) make sense as specular highlights should not be in the same direction from light but the direction mirrored by N.
(iv) is the right answer as the material should be a combination of a diffuse component and a specular component. The specular component is stated to be dull, this means it should not be very intense (as in (i)) and also not very narrow (it should have a spread).

56- To check for faces that will not be drawn (back face culling), A face is not drawn if: (n is the normal vector to the face, v_{cam} is the viewpoint vector)

i- $n \cdot v_{cam} > 0$
ii- $n \cdot v_{cam} < 0$
iii- $\|n + v_{cam}\| < 0$
iv- $\|n + v_{cam}\| > 0$

Exp: Slides 5.P23. As the normal and the viewpoint vector need to be facing against each other to be drawn, i.e. $n \cdot v_{cam} > 0$

57- Raytracing's runtime complexity scales with ...

i- Number of pixels (resolution)
ii- Number of objects
iii- Number of lights
iv- None of the above

Exp: Slides 8.P6, 7.P24

58- By using Z-Buffering in rasterization, for each pixel, we loop over all triangles to check the depth at this point and color it with triangle color having the minimum depth value

i- True
ii- False

Exp: The order of the loops is wrong. The right way is we loop over all triangles and then update the Z-buffer pixels of one triangle before moving to the next triangle.
-> Slides 8.P7, 5.P25

59- By using Z-Buffering in rasterization, for each pixel, we loop over all triangles to check the depth at this point and color it with triangle color having the minimum depth value

i- True
ii- False

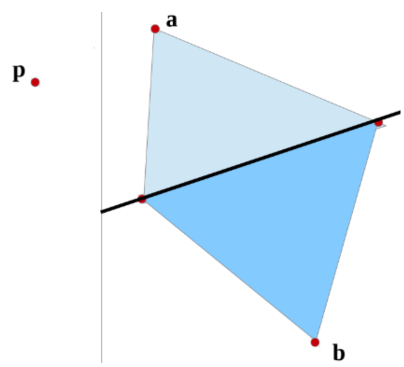
Exp: The order of the loops is wrong. The right way is we loop over all triangles and then update the Z-buffer pixels of one triangle before moving to the next triangle.
-> Slides 8.P7, 5.P25

60- A 2D vector can be written as a linear combination of any two non-parallel vectors. This is called …. And the two vectors are called …..

i- Non-linear Independence, origin vectors.
ii- Non-linear Independence, basis vectors.
iii- linear Independence, basis vectors.
iv- linear Independence, origin vectors.

Exp: Slides 5.P7

**61- What is the value of $f(b) \times f(p)$?



i- < 0
ii- > 0
iii- $= 0$
iv- Not enough information.

Exp: Slides 5.P17

\- In which step in the 3D viewing pipeline, we drop the z coordinate?

i- Modelling Transformation.
ii- Camera Transformation.
iii- Projection Transformation.
iv- Viewport Transformation.

Exp: Slides 4.P22

---

63 – To implement soft shadows using ray tracing you can……….

i- Shoot rays from each pixel to different points of the area light source
ii- Shoot rays from different pixels and average those meeting at the same point in the area light source
iii – Shoot rays from the light source to all other pixels
iv – Shoot one ray from the pixel to the middle of the light source

Exp: I is correct as in [Slideset 9, 40]

64- Flat shading

i- computes Shading Once per vertex
ii- is very cheap computationally
iii- results in a faceted appearance
iv- None of the above

Exp: Slides 7.P31

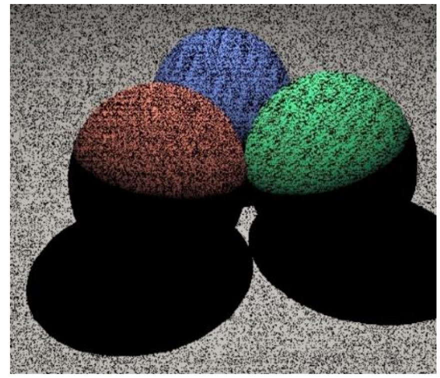
65- Gourard Shading ..

i- suffers from Mach banding
ii- is very fast
iii- is more realistic than Phong shading
iv- None of the above

Exp: Slides 7.P34

66- The following Code snippet produces a noisy result as shown below, which line can be changed to avoid this issue.

```
1 function ComputeShading(ray, t0, t1)
2     Get intersection of ray with scene
3     if intersection != NULL
4         Color = ambient
5         Get n, h, l
6         if !blocked(shadowray, 0, ∞)
7             Color += kd * max(0, <n,l>) + ks * <h,n> * p
8     else
9         Color = background
```



i- #6
ii- #7
iii- #9
iv- None of the above

Exp: Slides 9.P[9-11]: the shadow ray detects intersection with the object itself, we need to start checking for intersection after an offset in $t > \varepsilon$. So in line #6 we can replace 0 with ε

67- Raytracing handles objects:

i- With parameterized equations (Spheres, planes, etc..)
ii- With arbitrary shapes
iii- With meshes

Exp: Slides 8.P7. Notice that Some shapes are too complex to be handled by parametric equations. We approximate those with meshes.

68- Phong shading computes shading at each vertex using vertex normal then interpolates across triangle using Barycentric Coordinates.

i- True
ii- False

Exp: Slides 7.P(34,37). Phong interpolates the surface normals at each point before computing shading as opposed to Gourard for which the above statement is true.

69- BRDF stands for ….

i- Bidirectional Refraction Distribution Function
ii- Bidirectional Reflectance Distribution Function
iii- Bounded Refraction Distribution Function
iv- Bounded Reflectance Distribution Function

Exp: Slides 7.P8

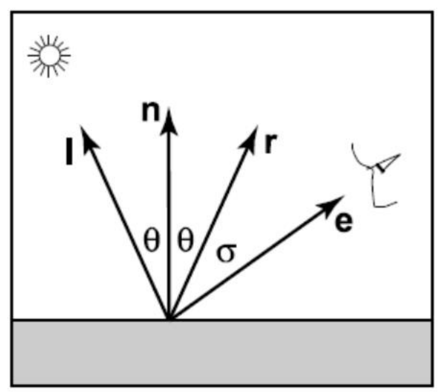
70- ….. is modelled as a constant lighting component depending on the material of the object

i- diffusion
ii- specular
iii- alpha
iv- ambient

Exp: Slides 7.P15

71-75: Next 5 questions are related: A light source hits a surface with, Given that:

$$I = [-0.707 \quad 0.707]$$
$$n = [0\ 1]$$
$$e = [0.8\ 0.6]$$
$$k_{spec} = 0.5, k_{diff} = 0.2, k_{amb} = 0.2$$
$$I = 0.5, I_a = 0.2, p = 4$$



l: Light direction n: Surface normal
e: To eye vector p: Specular exponent
I: Light source intensity I_a: Surrounding light intensity
k_{spec}, k_{diff}, k_{amb}: material constants for specular, diffusion and ambient components respectively.

71- r =

i- [0.707   0.707]

ii- [0.6 0.8]

iii- [0.354   0.354]

iv- [−0.354   0.354]

72- Specular Component of reflected light, $\boldsymbol{Rspec}$=

i- 0

ii- 0.2399

iii- 0.2475

iv- 0.9598

73- Diffuse Component of reflected light, $\boldsymbol{Rdiff}$=

i- 0

ii- 0.071

iii- 0.354

iv- 0.707

74-The total reflected light, $\boldsymbol{R}$=

i- 0.04

ii- 0.2238

iii- 0.3509

iv- 0.7802

75- If we were to add one more light ray falling on the same point, the … component/s of reflected light could be affected

i- diffusion

ii- specular

iii- ambient

iv- none

Exp: Using the Equations from slides 7.P[11-23]

76- Raytracing can approximate …... better than rasterization:

i- Shadows
ii- Reflections
iii- Refractions
iv- None of the above

Exp: Slides 8.P4

77- The sun can be modeled as a ….. for an observer on the earth

i- Point light source
ii- Directional light source
iii- Spot light source
iv- PBS light source

Exp: Since the sun is very far Compared to the dimensions of the earth. check slides 7.P27

78- Distribution raytracing can be used for ...

i- Anti-aliasing (super-sampling)
ii- Glossy reflections
iii- Glossy refractions
iv- Soft shadows

Exp: Slides 9.P31

79- One of the drawbacks of Ray tracing with single Ray is that it looks too clean and crisp

i- True
ii- False

Exp: Slides 9.P27

80- To compute the normal of a triangle face ABC, $\boldsymbol{n} =$

i- $A \bullet B$
ii- $(A - B) \bullet (A - C)$
iii- $A \times B$
iv- $(A - B) \times (A - C)$

Exp: We get edge vectors as $(A - B),\ and(A - C)$. Then a cross product results in the normal to the plane, i.e. the face. check slides 7.P29

81- In ray tracing, we can define the ray by its starting and ending points

i- True
ii- False

Exp: Rays don't have endpoints; we define them using a starting point and a direction vector.

82- The phenomenon of light being trapped in a material.

i- Inter-material trapping.
ii- Inter-material refraction.
iii- Total Internal Refraction.
iv- Total Internal Reflection.

Exp: Slides 9. P22

83- Ray tracing computation is mainly based on the .... concept

i- recursion
ii- parallelism
iii- memory sharing
iv- gamma correction

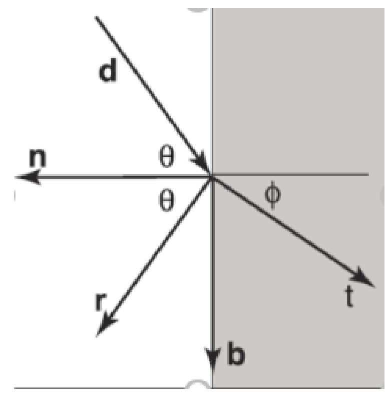
Exp: Mentioned in videos. Also, heavily used in refraction and reflection computations

---

84- Barycentric coordinates are only used with rasterization rendering.

i- True

ii- False



85-86 a light ray falls from medium ni onto a surface separating it from medium nt. Given

n=[−1 0]

ni=1.5 , nt=1

85- Of the following values for d, which causes a total internal reflection?

i- $[0 \quad -1]$
ii- $[0.707 \quad -0.707]$
iii- $[0.8 \quad -0.6]$
iv- $[0.6 \quad -0.8]$

86- given that $\boldsymbol{d}$=[0.8 −0.6], compute $\boldsymbol{t}$=

i- $[0.436 \quad -0.9]$
ii- $[0.9 \quad -0.436]$
iii- $[0.634 \quad -0.773]$
iv- $[0.773 \quad -0.634]$

Exp: we can use this equation from slides 9.P21:

$$t = \frac{n_i(d - (n \cdot d)n)}{n_t} - \sqrt{1 - \frac{n_i^2(1 - (n \cdot d)^2)}{n_t^2}}\, n$$

To check if d causes a total reflection, we check if the root part results in imaginary output.

87- It would be correct to apply perspective projection using the matrix
$\begin{pmatrix} n & 0 & 0 & 0 \\ 0 & n & 0 & 0 \\ 0 & 0 & a & b \\ 0 & 0 & 1 & 0 \end{pmatrix}$ on a point $\begin{pmatrix} x \\ y \\ z \\ 1 \end{pmatrix}$ if

i- a = 0 and b = 0

ii- a = 1 and b = -1

iii- a = 1 and b =0

iv- a = 2 and b = 0

Exp: By computing the matrix product and dividing by the homogenous coordinate we have $z_{new} = a + b/z$ which becomes $z_{new} = 1$, $z_{new} = 2$ for the last 2 choices and $z_{new} = 0$ for the first (we lost the value of z). Meanwhile, $z_{new} = (z-1)/z$ for the second option which clearly is an increasing function in z (hence would preserve its relative values)

88 – According the to the right answer in the question above, if the near plane is at z = 4 and the far plane is at z= 10 then an object whose z value satisfies …….. would not be rendered.

i- z < 0.75

ii- z > 0.9

iii- z > 0

iv- z < 0.8

Exp: Plug $4 < z < 10$ into $z_{new} = (z-1)/z$ to get $0.75 < z < 0.9$. Any z outside of this is not in the view volume.

---

89 – Projection lines are parallel to the camera's ……… in an orthographic projection

i- gaze direction
ii- turn-up vector
iii- w-axis
iv- u-axis

Exp: They are parallel to the camera's w which is also along the gaze direction ($w = -g/||g||$)

---

90 – An orthographic projection ………. on camera's position meanwhile a perspective projection ……….. on camera's position

i- depends, depends
ii- depends, does not depend
iii- does not depend, does not depend
iv- does not depend, depends

Exp: For orthographic projection, what matters only is the camera's orientation (w-axis) and for perspective its position matters because that's where the projection lines converge

---

91 – After the camera transformation, normalizing the view volume ………….

i- is a step incorporated in the projection transformation
ii- makes it such that objects with z > 1 or z < -1 should not be drawn
iii- is a windowing transformation
iv- can be ignored if that's taken into account in further steps

Exp: The near and far plane become at -1 and 1 after wo do it (so that's what we need to check for). The professor also mentioned that its not an essential pipeline step.

---

92 – If your height is 160 cm then your height becomes …………. after perspective projection with the near plane being at z = 10, far plane being at z = 20 and your feet having z = 15 and y = 0

i- 106.6 cm
ii- 125 cm

iii- 80 cm
iv- 160 cm

Exp: Recall that, $y_{(new)} = n * \frac{y}{z}$. Your foot is at $y_{foot} = 0$ so your top is at $y_{hair} = 160$ by applying perspective projection given that the near plane is at 10 we conclude that $y_{foot(new)} = 10 * \frac{0}{15} = 0$ and that $y_{hair(new)} = 10 * \frac{160}{15} = 106$.

---

93 – In ray tracing with orthographic projection, we shoot ……… rays if our display is 200x200 and all of them emerge from ……….. point in the near plane.

i- 40000, the same
ii- 400, the same
iii- 800, a different
<u>iv- 40000, a different</u>

Exp: Each pixel will correspond to a ray so that 40000 rays and each ray originates from the corresponding position in the near plane.

---

94 – In ray tracing with perspective projection, we shoot ……… rays if our display is 20x20 and we are using anti-aliasing with supersampling at 100 times the resolution and all of them emerge from ……….. point in the near plane.

<u>i- 40000, the same</u>
ii- 400, the same
iii- 800, a different
iv- 40000, a different

Exp: Each pixel will correspond to 100 rays so that 100*20*20 rays and each ray originates from the camera (same position).

---

95 – Ray Tracing is ………..

i- Readily supported by GPUs
ii- Includes a unified, parallelizable way of dealing with reflections
iii- For each triangle, it loops on every pixel to decide which color
<u>iv- Can be too slow for interactive applications</u>

Exp: ii does not work because the way it deals with reflections is not parallelizable (recursion) and iii is just rasterization. Rasterization is also what's supported by GPUs

---

96 – Each pixel on the screen corresponds one-to-one to a point on the near plane from which we shoot a ray and check where it hits.

<u>i- True</u>
ii- False

Exp: Yes. Via a windowing transformation!

---

97 – Once we shoot a ray through the near plane, its sufficient to stop at the first object hit and record its color in the corresponding pixel

i- True
<u>ii- False</u>

Exp: We must check intersection with all objects and "keep the closest hit"

---

98 – If there are 10 objects in the scene and 3 light sources then the number of total rays shot due to one pixel is ……….. assuming handling of shadows

i- 2
ii- 13
iii – at least 13
<u>iv – at most 4</u>

Exp: One ray for the pixel then if that hits something we need 3 more rays to see if we can reach each of the light sources without hitting anything

---

99 – A ray may have at most ……… intersections with a sphere, meanwhile at most ……. Intersections with a plane where the ray does not live

<u>i- 2, 1</u>
ii- 1, 2
iii – 1, 1
iv – 2, 2

Exp: The part "where the ray does not live" is just so that no one argues that it could have infinite intersections with the plane if coincidently it lies on it.

---

100 – To check the intersection between a ray and a triangle mesh, the efficient approach is to ………………

i- Start with each triangle's plane and inequalities for each of its sides
<u>ii- Use barycentric coordinates and find α, β, γ, t</u>
<u>iii – Breakdown the mesh into bounding boxes and check intersections there first</u>
iv – Find intersections between the ray and the three straight lines forming the triangles side

Exp: Once we find α, β, γ, t we can know whether or not its inside the triangle. The professor perhaps mentioned something like iii.
