Computer Graphics I - Mock Exam WS 20/21

1. Write down the 4x4 matrix in homogeneous coordinates describing **a rotation around the x-axis by β radians.** Hint: assume the sine/cosine of β radians is given by sin(β)/cos(β).
2. Write down a 4x4 matrix representing **the inverse of a translation of −7 along the x axis:**
3. Give the homogeneous 4x4 matrix describing a **object mirroring over the point (3,3,1):**
4. Write down the 4x4 matrix in homogeneous coordinates describing an **object mirroring along the plane described by x=y.**
5. Give a transformation matrix A in homogeneous coordinates such that: A≠I ,A^2≠I, A^4=Iwhere I is the identity matrix.
   (There is more than one correct solution)
6. Write down an inequality that characterizes that a point x lies inside of a sphere of radius r centered at point c.
7. We are looking for the intersection point of a ray and a triangle.Let a Ray R be defined as o+λ∗u and a triangle be defined by its three vertices a,b,c where o,u,a,b,c∈R3,λ∈RA point on the triangle is described in barycentric coordinates as: x=αa+βb+(1−α−β)c with α,β∈R.Write down a linear equation system in form of an equation involving the vectors above that can be solved for the coefficients α,β,λ that characterize the triangle ray intersection:

   Assume α,β∈[0,1]. which additional constraint needs to be fulfilled for the ray to intersect the triangle?
8. Which points are fixed points of a perspective transformation with a principle vanishing point at (0,0,z0) (the view direction is z)? (True | False)
   - The plane z=z0
   - The plane z=−z0
   - The plane z=0
   - The vanishing point (0,0,z0)
   - The origin (0,0,0)
9. Which points or collections of points are infinite after applying a perspective transformation with principle vanishing point (0,0,z0) (the view direction is z)?(z0>0) (True | False)
   - The plane given by z=z0
   - The origin (0,0,0)
   - The plane given by z=−z0
   - The vanishing point (0,0,z0)
   - The plane given by z=0
10. Give the homogeneous matrix of an isometric projection onto the xy plane.
11. Give the homogeneous matrix of a perspective transformation with a principle vanishing point at (0,−2,0):
12. The Cohen Sutherland Algorithm is an elegant way to check intersections between a line and a rectangular window and is used for clipping.

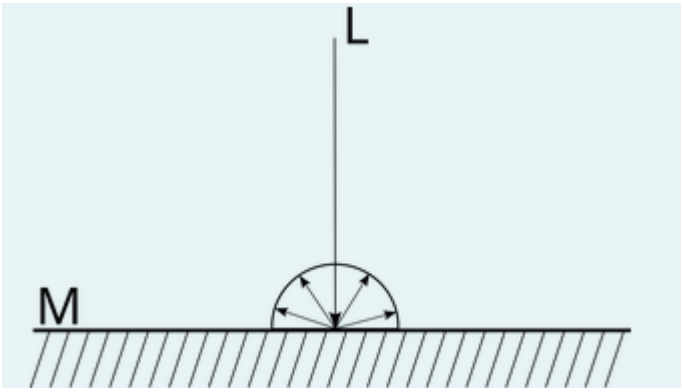
    Assume we are looking at bit codes in a 3x3 matrix, the middle cell represents the rectangular window.

    Which of the following statements about it are true:
    - The logical OR of two different bitcodes in the same row never results in "0000"
    - The logical OR of two bitcodes in the same column never contains more than one "1".
    - The algorithm can be extended to arbitrary dimension.

If two vertices lie in areas with different bitcodes, the line segment connecting them crosses the window.

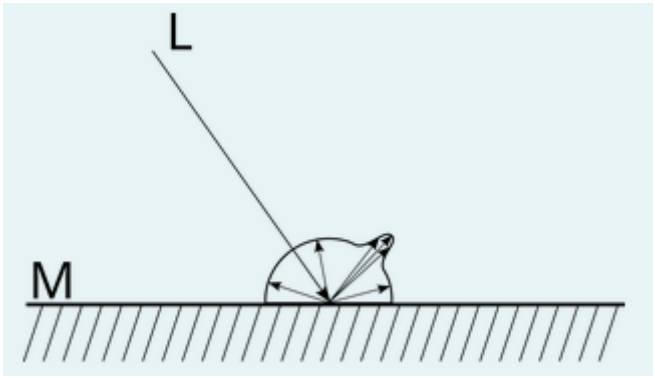
13. Which one of the following statements about the Sutherland-Hodgeman algorithm are true?
    - The Sutherland-Hodgeman algorithm only works for rendering convex polygons.
    - The Sutherland-Hogeman algorithm terminates after clipping once for each half-space.
    - The Sutherland-Hodgeman algorithm works on arbitrary window areas.
14. Some common color models are RGB, CYK, QIJ/QCrBr and HLS. All of them are based on slightly different approaches to code the colors. Match approaches to use cases: (Computer Screens, Intuitive Color Editing, Video Coding, Painting)
    - RGB: (Additive Colors)
    - CYK: (Subtractive Colors)
    - YIQ/YCrBr: (Separate Intensity and Color Values)
    - HLS: (Separate Intensity, Color and Saturation Values)
15. The Flat, Gouraud and Phong **Shading** methods differ in the primitive on which the light model is evaluated.

    Match for each of them the corresponding primitive: (Face Normal, Edge, Pixel, Triangle, Vertex)
    - Phong Shading
    - Gouraud Shading
    - Flat Shading
16. Given L a simple incoming light ray and M an ideal diffuse reflective material.

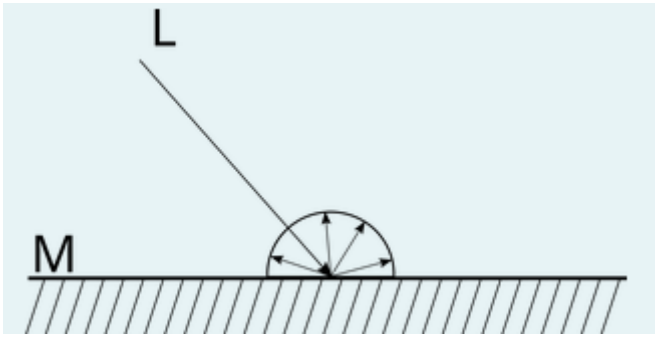


Choose the image that shows the corresponding reaction for a light that hits the surface at a smaller angle:

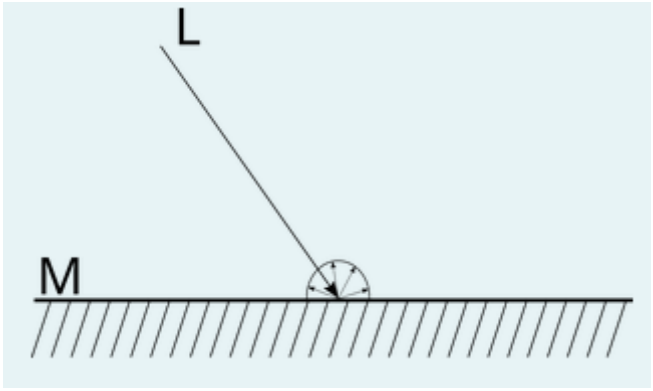
- a



- b

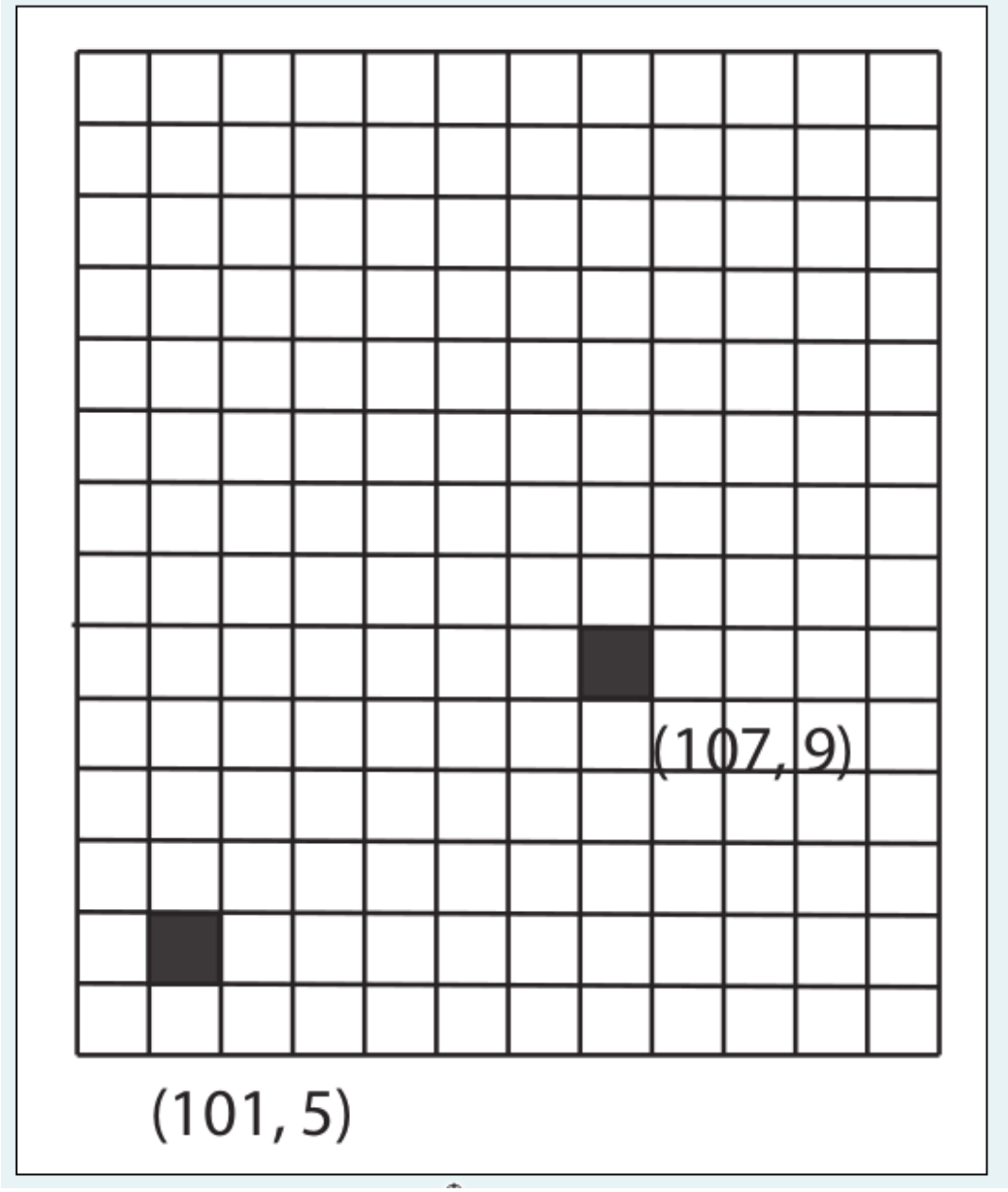


- c



17. What are the three terms that add to the Phong Illumination Model?

18. Given E'=2Δy−Δx, use the Bresenham's algorithm to draw the rasterized line in the following grid.



19. Why is the Bresenham's algorithm faster than evaluation the line equation at every pixel?
20. Mip-Mapping is a multi-scale approach for texturing. Which of the following statements are true:
    - Trilinear Filtering works with more than one level of the Mip-Map texture.
    - Mip-Map filtering can solve aliasing problems
    - A tradeof between storage space and the number of mipmap levels is necessary
21. Which kind of artifacts that occur when using bilinear filtering in the context of a mip-map texture can be reduced using trilinear filtering?
    - Aprupt changes of the level of detail visible as unwanted artefact lines on the texture.
    - Blurry Textures in the distant part of the scene.
    - Aliasing on sharp contours of the texture.
22. What differentiates trilinear from bilinear filtering?
    - The use of quadratic instead of linear functions.
    - The additional interpolation between the two nearest levels of detail of the mip-map texture.

- The individual blending for each of the three color channels.

23. Name a method that can reduce the necessary steps to test the shadow rays.
24. You want to generate an image which has u×v pixels. There are m objects in the scene and each of them has n triangles. How many ray triangle intersection calculations are necessary?
25. Which of the following statements are true in the context of discretization of the radiosity equation?
    - The continuous radiosity equation always has an analytical solution.
    - The common discretization assumes constant radiosity values over flat surface patches.
    - The common discretization assumes linear radiosity values over flat surface patches.
26. In the context of the radiosity equation, which statements on the factor Fij are true?
    - Fij is symmetric: Fij = Fji
    - Fij depends on the visibility of the patches i and j relative to teach other.
    - Fij takes into account the reflectivity of the patch i.
    - Fij is invariant to rotations of the patch j.
    - Fij depends on the geometry of the patches i and j: their position and orientation relative to each other as well as their area.
27. Describe one type of images for which JPEG is not suitable.
28. JPG is a lossy compression format that reduces high frequency components in the image.

    What is the motivation behind removing this kind of information?