Tuesday 3. October Reykjavík University

Midterm test in Computer Graphics
Autumn 2006

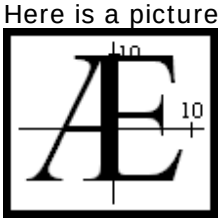
Name: _____

SSN: _____

Total value: 110%

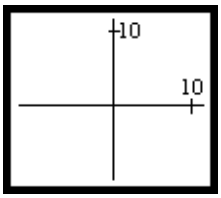
Allowed resources: pocket calculator
attached formula sheet

Here is a picture. The axes are not a part of the picture being transformed.

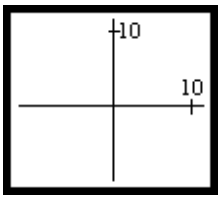


The points in this picture are all multiplied with a certain transformation matrix to get another picture. Approximate how the new picture looks like if the transformation matrix is:

(5%) $\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 5 \\ 0 & 0 & 1 \end{pmatrix}$



(5%) $\begin{pmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$



A system can only use 1 byte to represent each color the screen memory. But we can also use LUT indices to be able to select from the 16 million (24 bit true color) colors displayable at a time.
Draw a small overview of this system and calculate the size of a 1600x1200 screen memory and the LUT and therefore the total memory needed for this resolution.
10 %

In window – viewport transformations we have the equations:

$$sx = Ax + C$$

$$sy = By + D$$

create the matrix *M* which carries out this transformation such that

$$M\begin{bmatrix} x \\ y \\ 1 \end{bmatrix} = \begin{bmatrix} sx \\ sy \\ 1 \end{bmatrix}$$

5 %

Fill in the matrix (find the values) for:
World window with the lower left corner at (-200, -600) and both height and width 2400
and
Viewport with lower left corner at (0,0), height 600 and width 800
10 %

A window has the lower left corner at (-2,-3) and has width 6 and height 6. A line is drawn onto the window with the endpoints (-1,0) and (6,5).
Use the method of similar triangles just like the Cohen-Sutherland algorithm does to calculate the new endpoints of the line such that it lies inside the window.
You do not have to follow the algorithm, only show your calculations and the result.
15 %

A coordinate system is translated by (3,4,2) from its origin point and its axes the scaled by three.

```
glTranslated(3, 4, 2);
glScaled(3, 3, 3);
```

Create the matrix defining this transformation.
10 %

The coordinate system is rotated by 150° around its y-axis.

```
glRotated(150, 0, 1, 0);
```

How does the matrix look now?
10 %

How does the matrix look like if we now execute the code:

```
glTranslated(1, 3, 1);
```

5 %

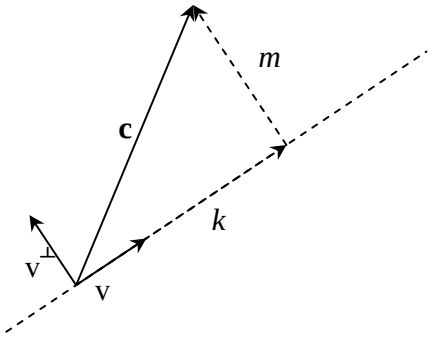
A plane is defined with a point *B* and a normal vector $\vec{n}$.
A ray is defined with a point *A* and direction vector $\vec{c}$.
To find the possible intersection point of these two objects we use amongst other things the formula:

$$t_{hit} = \frac{\vec{n} \circ (B - A)}{\vec{n} \circ \vec{c}}$$

What does this formula give us?
5 %

Find the intersection of the line going through the points A = (2, 5, 7) and P_2 = (3, 7, 4) and a plane containing the points B = (2, 3, 1), P_4 = (7, 3, 4) and P_5 = (5, 8, 2).
20 %

On the picture you can see the vector **c** which can be divided into two vectors, *k* and *m*. As the picture shows, *k* is parallel to the vector **v** but *m* is perpendicular to **v**.



We have: $k = \left(\frac{c \circ v}{|v|^2} \right) v$ **and** $m = \left(\frac{c \circ v^{\perp}}{|v|^2} \right) v^{\perp}$

How far does the point *C* = (-5, 2) lie from the line *L*(**t**) = (-2, -5) + (-3, 1)**t**?
(10%)