 Nome _____ Número _____

COMPUTAÇÃO GRÁFICA E INTERFACES

MIEI/FCT/UNL – Ano letivo 2015/2016
Teste 1 – 2015.11.02

Notice

Answer in the spaces reserved.
In case you need to correct some answer and the alloted space is not enough, you can use the back, as long as the appropriate mentions are made.
Do not remove the staples!
The test has a duation of **1H30**!

1. (3 valores)

Classify as True (T) or False (F) each of the following sentences. Each wrong answer will deduct 25%.

The introduction of raster devices allowed the visualization of models represented in wireframe, which was something not possible before using vector devices.	
The use of the single buffer technique prevents the visualization of partial frames.	
The hidden surfaces removal technique knows as backface culling is only applicable to scences with a single convex polyhedron.	
In a WebGL program, the fragment shader is responsible for assigning a final color to the pixel to be written in the framebuffer.	
In a WebGL program, the vertex shader has access to all the vertices of the primitive being assembled.	
A variable in a GLSL program, declared with the **attribute** modifier, represents a value that changes on a per vertex basis.	
A variable in a GLSL program, declared with the varying modifier, represents a value that is changing on a per vertex basis.	
A variable declared with the uniform modifier represents a constant value to the program and is unknown to the javascript application.	

2. (4 valores)

In a certain 2D graphics system, the programmer specifies in World Coordinates (WC) the limits of a rectangular window, aligned with the axis, containing the graphics that are to be visualized, by calling the function setWindow(*xmin*, *xmax*, *ymin*, *ymax*). Besides that, in that same system, there is also another function setViewport(*x0*, *y0*, *width*, *height*), used to define the screen área (visor), aligned with the screen axis, where those graphics are to be visualized. The lower left corner of this region is located at the point (x0, y0) and its dimensions are *width* x *height*. The screen origin is located at the lower left corner of the screen.

a) Write, using the adopted notation (P'=M.P), the composition of elementary 2D geometric transformations (S, R or T), that will make the transformation M, as the transformation from WC to device coordinates. Don't forget to provide the values for all the parameters.

M =

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b) Imagine that in the same system, there is salso the possibility to define an arbitrary orientation for the visor, by providing and angle, θ, that the base of the visor will make wth the horizontal axis of the screen. Note that nothing is changed in the window defined in WC. Write, in a similar way to a), the necessary transformation in this situation:

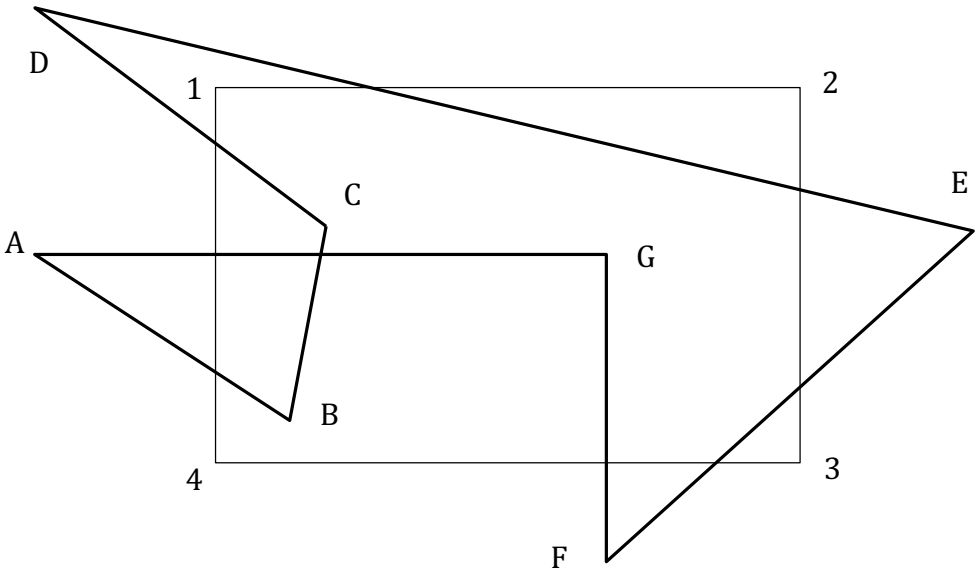
M =

c) Under the circumstances described in a), what would be the necessary transformation to offer a pick procedure to the user where he could select the graphical primitives on the screen?

Mpick =

3. (5 valores)

The polygon P=[A,B,C,D,E,F,G] will be clipped by the window Q=[1,2,3,4], through the use of the Sutherland-Hodgeman algorithm. Consider the following order of the its stages: Clip Top→Clip Right→Clip Left →Clip Bottom. In the answers below **don't rename the points already identified** in the figure and **don't forget to label any aditional points** created by the execution of the algorithm.



a) Write the polygons after each of the following stages:

Clip Top: [

Clip Right: [

b) How many edges will the clipped polygon P' contain after the 4 stages? _____

c) Consider now the Cohen-Sutherland line segment clipping algorithm. Assume the following order to assign the bits of code to the vertices (left to right): Top, Right, Left, Bottom. Fill the table below, as the result of apllying the algorithm to some of the edges of the polygon P.

Edge (XY)	Code of X	Code of Y	Decision or equation of line used for 1st intersection
BC			
DE			
FG			

4. (5 valores)

a) Consider a point P, in 3D, with the following homogeneous coordinates: (2,4,3,1). Fill the table below with the 3D coordinates of the image of that point, after the referred projection:

Front view	Top view	Left Side	Perspective –proj. plane at z=0 and C=(0,0,4)

b) Consider the following additional points: Q=(4,8,0,2), R=(3,4,0,1) and S=(2,0,0,1), as well as the point P from a). Fill the table below by writing the length and orientation (angle formed with the horizontal axis) of the line segments on the left, after being projected with an oblique projection on the z=0 plane, with the following parameters: l=0.5, α=45°:

Line segment	Length	Orientation
PQ		
QR		
QS		

c) What can you say about angle and distance preservation using the projection referred in b)?

_____

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5. (3 valores)

In a certain application, the programmer uses the function lookAt(eye, at, up) to position and orientate the camera that is used to capture the scene. Let the matrix returned by that call be Mview.

a) Explain how that transformation can be decomposed in other, simpler, transformations, in what order they are applied and what is the objective of each of them.

b) The application is a game where the player can shoot a weapon. The weapon is located 0.5 units below the camera and 0.3 units to the right. Write an expression that can be used to compute the initial coordinates of the projectiles in WC (world coordinates):

Boa sorte!