Degree courses in Computer Science
University of Calabria, Italy

Written exam of Computer Graphics

Exam duration: **one hour**
NOTE: **The use of any documentation is forbidden**.

Name:_____

Surname:_____

Student' ID:_____

Signature (required at the bottom of each page,)_____

_____

Notes (optional):_____

(1) Mark the correct statement:
- (a) OpenGL currently has two forks, namely compatibility and core profiles; compatibility profile is deprecated
- (b) OpenGL currently has two forks, namely compatibility and core profiles; core profile is only used for computational purposes
- (c) OpenGL has had two forks, namely compatibility and core profiles; currently, only core profile is fully suported by vendors
- (d) OpenGL compatibility profile is a recent fork of OpenGL born to guaranty support for obsolete graphic hardware

(2) Mark the correct statement:
- (a) GPUs consist of large number of small programmable processors called *shader cores* which run mini-programs called *shaders*
- (b) GPUs consist of large number of small programmable processors called *cl cores* which run mini-programs called *fixed functions*
- (c) GPUs consist of a single big programmable processor called *macro core* which can run complex programs called *renderes*
- (d) GPUs consist of a single big programmable processor called *macro core* which can address up to 16 TB of *global memory*

(3) Which are the *Coordinate Spaces* commonly used in 3D Graphics? Mark the right answer
- (a) Model-World-Control Space, Clip-Normalized Space, and Window Space
- (b) 1D, 2D and 3D Window Space
- (c) Abstract Space, Vector Space, Raster Space, Clip Space, and Window Space
- (d) Model Space, World Space, View Space, Clip Space, Normalized Device Coordinate Space, and Window Space

(4) Model-View transformation:

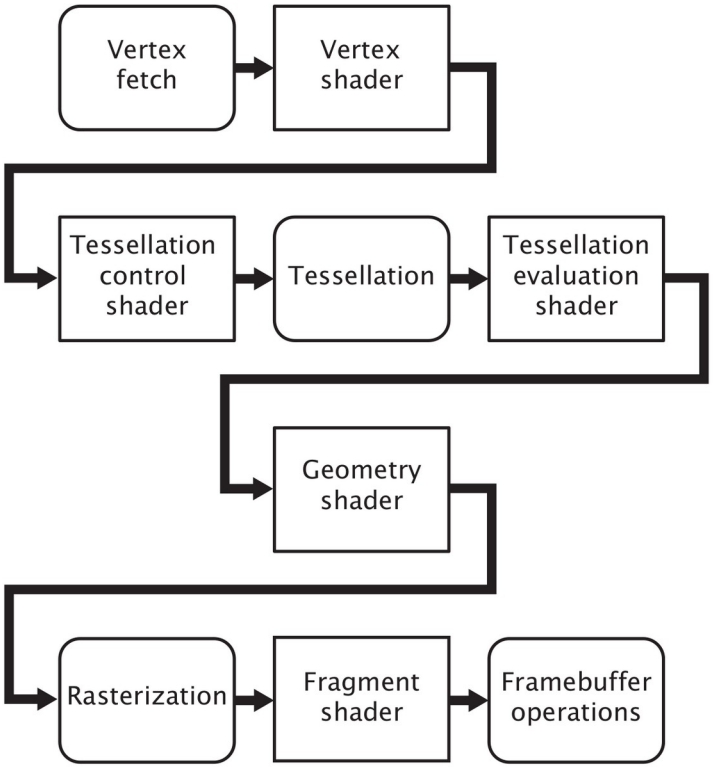
(a) are translations and rotations; they are generally used to transform vertices data from Model Space to World Space

(b) are translations, rotations, and scaling; they are generally used to transform vertices data from Model Space to World Space

(c) are translations, rotations, scaling, and perspective; they are generally used to transform vertices data from Model Space to World Space

(d) are translations, rotations, and scaling, perspective and Viewport; they are generally used to transform vertices data from Model Space to World Space

(5) Mark the programmable stages of the OpenGL Graphic Pipeline, by also graphically grouping stages belonging to its *front* and *back end*.



(6) The Vertex Shader:

(a) Processes fragments and patches by applying GLSL built-in transformation algorithms to obtain object space positions for the incoming vertices; fragments and patches are independent to each other and therefore they are generally processed in parallel by many different shader cores

(b) Processes objects' complex geometry to breack it into independent vertices ; Geometries for different objects are independent to each other and therefore they are generally processed in parallel by many different shader cores

(c) Processes raster fragments of the objects into the graphic scene by converting them into set of vertices in an ideal vectorial representation of the object itself; Fragments belonging to a single object are processed in parallel by different shader cores, while object are elaborated sequentially

(d) Processes vertex data, such as position, normal vector, etc., and is mainly used to apply to them model-view and projection transformations; vertices are independent to each other and therefore they are generally processed in parallel by many different shader cores

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(7) After the Rasterization stage:

(a) Vertices and normals have been transformed into world space coordinates
(b) Vertices and normals have been transformed into object space coordinates
(c) The geometry has been converted from what is essentially a vector representation into a large number of independent *fragments*
(d) A color is assigned to each *fragment*

(8) Write the general equation and comment, by also referring the modeled physical phenomena, the Phong lighting model used in OpenGL.

(9) Why the Phong lighting model is not able to generate shadows? Which is one simple shadow algoritm? Outline it below.

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(10) OpenGL can be used for general purpose computation on GPUs by means of the Compute Shader. The computational domain is subdivided in work groups, each one composed by work items. Work items:

(a) can only access a shared, generally small (at least 32KB) memory, and synchronize each other among the other shaders in the same work group by means of the GLSL `barrier()` function

(b) can both access the GPU's global memory and a generally small (at least 32KB) shared memory, and synchronize each other among the other shaders in the same work group by means of the GLSL `barrier()` function

(c) can only access the GPUs global memory and globally synchronize by means of the GLSL `barrier()` function; shared memory is reserved to graphic shaders

(d) cannot access any GPUs memory level and data are directly addressed CPU side; the can synchronize by means of Posix-like threads mechanisms.

Signature: _____