CompSci 373 S1 C 2010
Computer Graphics

Mid Term Test – Tuesday, 27th April 2009, 6.30 pm – 7.30 pm

VERSION CODE 00000001

Instructions:

1. Enter your *name*, *student ID* and the *version number* shown on the top left into the teleform sheet supplied. Your name should be entered left aligned. If you have a middle initial, enter it under MI. If your name is longer than the number of boxes provided, truncate it.
2. Use a dark pencil to mark your answers on the teleform sheet supplied. If you spoil your sheet, ask the exam supervisor for a replacement. Writing on this question book will **NOT be marked**.
3. If you want to change your answer **erase the previously filled in box completely** using an eraser.
4. All questions must be answered in the multiple choice answer boxes on the teleform sheet corresponding to the respective question number. There is only one correct answer for each question.
5. **Questions total 50 Marks**. Each question is worth 2 marks.
6. Attempt **ALL** questions.
7. The test is for 60 minutes.
8. This is a **closed book** test.
9. Calculators and electronic devices are **NOT** permitted.
10. This test is worth 20% of your final marks for CompSci373 S1 C

Question 1:
Which statement about digital images is *false*?

 (a) Computer Vision analyzes images to get information about them
 (b) Computer Vision can be used to recognize objects in images
 (c) Image Processing is about transforming images into new images
 (d) Computer Graphics is about generating digital images
 (e) None of the others

Question 2:
Which statement about 3D models is *false*?

 (a) Vertices are the 3D points used to define a model
 (b) Faces are polygons made up of edges
 (c) Edges are the lines between the vertices
 (d) A mesh is a sequence of vertices that define a polygon
 (e) None of the others

Question 3:

A spectral response function specifies

 (a) How much percent of each wavelength is absorbed, reflected or transmitted
 (b) The density of the reflected colors in a given wavelength
 (c) The color of each wavelength in absorbed, reflected or transmitted light
 (d) The power of a light that is absorbed, reflected or transmitted
 (e) None of the others

Question 4:
How do we calculate the spectral density function (SDF) of reflected light using a spectral response function (SRF)?

 (a) Multiply each SDF value of the incoming light with the corresponding SRF value of the reflection surface
 (b) Divide each SDF value of the incoming light by the corresponding SRF value of the reflection surface
 (c) Subtract each SRF value of the reflection surface from the corresponding SDF value of the incoming light
 (d) Add each SRF value of the reflection surface to the corresponding SDF value of the incoming light
 (e) None of the others

Question 5:
What is a color gamut?
 (a) The visible colors in a color space
 (b) The visible parts of the CIE chromaticity diagram
 (c) The subset of colors that can be represented on a device
 (d) A set of colors that can be seen by the human eye.
 (e) None of the others

Question 6:

The dot product of $\mathbf{u} = \begin{pmatrix} 1 \\ -2 \\ 3 \end{pmatrix}$ and $\mathbf{v} = \begin{pmatrix} 0 \\ 4 \\ -1 \end{pmatrix}$ equals

(a) -11
(b) 5
(c) -7
(d) 10
(e) None of the others

Question 7:

The vector product $\mathbf{u} \times \mathbf{v}$ where $\mathbf{u} = \begin{pmatrix} 2 \\ 1 \\ 3 \end{pmatrix}$ and $\mathbf{v} = \begin{pmatrix} 2 \\ -1 \\ 2 \end{pmatrix}$ equals

a) $\begin{pmatrix} 5 \\ 10 \\ 4 \end{pmatrix}$

b) $\begin{pmatrix} 4 \\ 0 \\ 5 \end{pmatrix}$

c) $\begin{pmatrix} 4 \\ -1 \\ 6 \end{pmatrix}$

d) $\begin{pmatrix} 5 \\ 2 \\ -4 \end{pmatrix}$

e) None of the others

Question 8:

A plane with the following plane equation is given: $2x + y - 2z = 3$.
How far is the point (3,6,3) away from the plane?

(a) 0
(b) 2
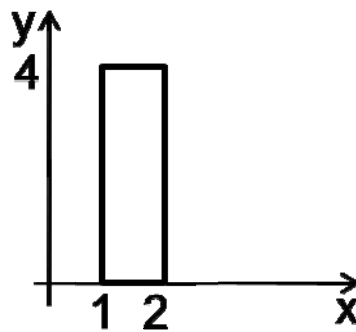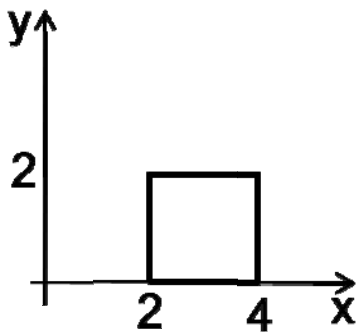(c) 3
(d) 8/3
(e) None of the others [Correct answer is 1]

Question 9:

Assume **A** and **I** are 4x4 matrixes, and **I** is the identity matrix.
Which of the following formulas is *false*?

    (a) $\mathbf{A\,I} = \mathbf{I\,A} = \mathbf{A}$
    (b) $\mathbf{I\,A}^T = \mathbf{I}^T\mathbf{A}$
    (c) $(\mathbf{A}^T)^T = \mathbf{A}$
    (d) $\mathbf{A\,A}^{-1} = \mathbf{A}^{-1}\mathbf{A} = \mathbf{I}$
    (e) None of the others

Question 10:

Which homogeneous 2D matrix transforms the figure on the left side to the figure on the right?

(a) $\begin{pmatrix} 1 & 0 & -2 \\ 0 & 2 & 0 \\ 0 & 0 & 1 \end{pmatrix}$

(b) $\begin{pmatrix} 1 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 1 \end{pmatrix}$

(c) $\begin{pmatrix} 0.5 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 1 \end{pmatrix}$

(d) $\begin{pmatrix} 0.5 & 0 & 2 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$

(e) None of the others

Question 11:

In OpenGL graphical primitives are defined by vertices which are transformed by the OpenGL pipeline. Which sequence of operations is correct?

   (a) Illumination → PROJECTION transformation → Clipping → MODELVIEW transformation → Viewport transformation
   (b) Illumination → MODELVIEW transformation → PROJECTION transformation → Clipping → Viewport transformation
   (c) PROJECTION transformation → Illumination → MODELVIEW transformation → Viewport transformation → Clipping
   (d) MODELVIEW transformation → Clipping → Illumination → PROJECTION transformation → Viewport transformation
   (e) None of the above
       [MODELVIEW transformation → Illumination → PROJECTION transformation → Clipping → Viewport transformation]

Question 12:

Which of the following statements is *false*?

   (a) `glutCreateWindow(char* s)` creates a window with the title s.
   (b) `glutCreateWindow(char* s)` initiates a windowing session with the underlying operating system.
   (c) `glutCreateWindow(char* s)` creates a window whose size, location, and mode are specified by the current state of the OpenGL program.
   (d) `glutCreateWindow(char* s)` returns a unique window identifier.
   (e) `glutCreateWindow(char* s)` is called once for each OpenGL window we want to create.

Question 13:

Assume the point P lies on a line connecting the points A and B. Assume you have another line given by the points U and W and you want to define a point Q on the line UW such that Q divides UW in the same proportion as P divides AB. Which formula for Q is correct?

   (a) $Q = \frac{|W-U|}{|P-A|}(B-A) + P$

   (b) $Q = \frac{|P-A|}{|B-A|} + (W-U)$

   (c) $Q = \frac{|B-A|}{|W-U|} + P$

   (d) $Q = \frac{|P-A|}{|B-A|}(W-U) + U$

   (e) None of the above

Question 14:

Which of the following representations is most suitable for smoothing edges and corners of a 3D object represented by its boundary surface?

    (a) Implicit surfaces
    (b) Subdivision surfaces
    (c) Parametric surfaces
    (d) Extruded surfaces
    (e) CSG objects

Question 15:

Given is a display method which draws three triangles. The triangles are centered on the z-axis and parallel to the xy-plane. The corresponding vertices of the three triangles have the same x- and y-coordinates, but different z-values. The first triangle drawn by the display method is red and closest to the view point. The second triangle is green, and the third triangle blue and furthest from the view point. The view point is on the z-axis and a perspective projection is used to render the scene.
Which of the following statements is *true*?

    (a) If the depth buffer is disabled then the resulting image shows only a blue triangle.
    (b) If the depth buffer is disabled then the resulting image shows only a red triangle.
    (c) If the depth buffer is disabled then the resulting image shows a blue triangle, with a smaller green triangle inside it, and an even smaller red triangle inside the green triangle.
    (d) If the depth buffer is disabled then the resulting image shows a red triangle, with a smaller green triangle inside it, and an even smaller blue triangle inside the green triangle.
    (e) None of the above statements is true

Question 16:

How many quadrilaterals are drawn if we use the drawing mode `GL_QUAD_STRIP` with ten vertices between `glBegin(GL_QUAD_STRIP)` and `glEnd()`?
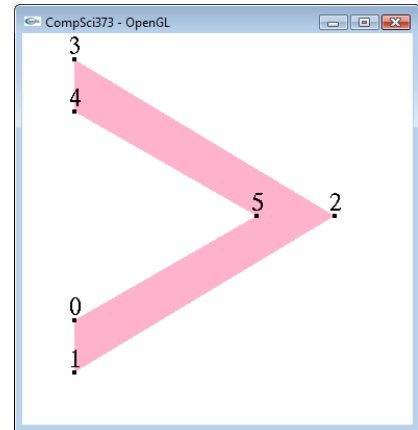
    (a) 2
    (b) 3
    (c) 4
    (d) 5
    (e) None of the above

Question 17:

Given are the vertices

```
const int numVertices=6;
const float vertices[numVertices][2] =
   {{50,100},{50,50},{300,200},
    {50,350},{50,300},{225,200}};
```

Which calling sequence of these vertices (using glVertex2fv) results in the shape on the right if we use the OpenGL commands glBegin(GL_QUAD_STRIP) and glEnd()?
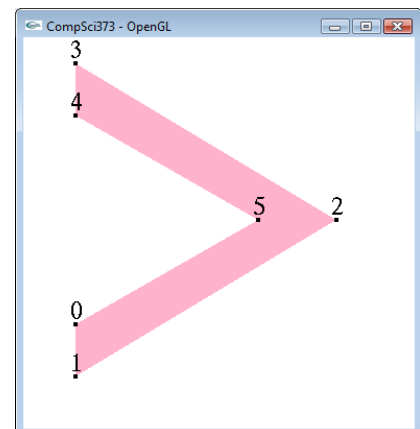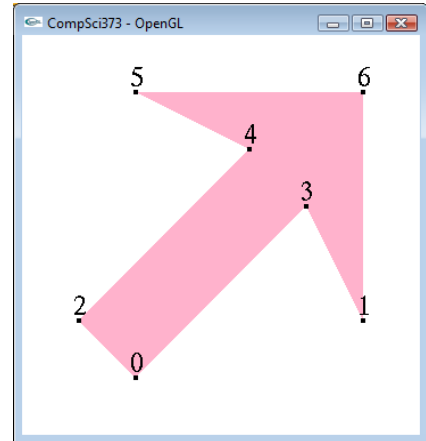
(a) 0, 1, 2, 3, 4, 5
(b) 0, 1, 5, 2, 4, 3
(c) 0, 1, 2, 5, 3, 4
(d) 1, 2, 0, 5, 4, 3
(e) None of the above

Question 18:

Given are the vertices

```
const int numVertices=6;
const float vertices[numVertices][2] =
   {{50,100},{50,50},{300,200},
    {50,350},{50,300},{225,200}};
```

Which calling sequence of these vertices (using glVertex2fv) results in the shape on the right if we use the OpenGL commands glBegin(GL_TRIANGLE_STRIP) and glEnd()?

(a) 3, 4, 2, 5, 1, 0
(b) 4, 3, 2, 5, 0, 1
(c) 4, 3, 2, 1, 0, 5
(d) 3, 4, 5, 0, 1, 2
(e) None of the above

Question 19:

Given are the vertices

```
const int numVertices=7;
const float vertices[numVertices][2] =
   {{100,50},{300,100},{50,100},{250,200},{
    200,250},{100,300},{300,300}};
```

Which calling sequence of these vertices (using `glVertex2fv`) results in the shape on the right if we use the OpenGL commands `glBegin(GL_TRIANGLE_FAN)` and `glEnd()`?
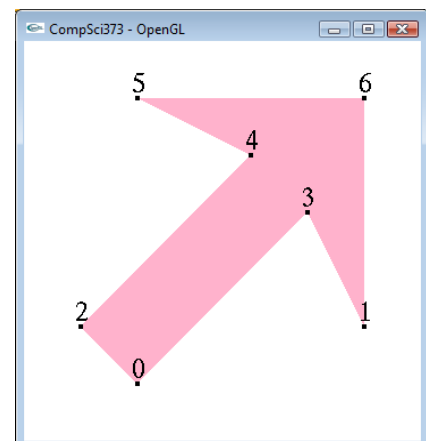

(a) 0, 1, 2, 3, 4, 5, 6
(b) 0, 3, 1, 6, 5, 4, 2
(c) 6, 5, 4, 2, 0, 3, 1
(d) 4, 5, 1, 6, 3, 0, 2
(e) None of the above

Question 20:

Given are the vertices

```
const int numVertices=7;
const float vertices[numVertices][2] =
   {{100,50},{300,100},{50,100},{250,200},{
    200,250},{100,300},{300,300}};
```

Which calling sequence of these vertices (using `glVertex2fv`) results in the shape on the right if we use the OpenGL commands `glBegin(GL_TRIANGLES)` and `glEnd()`?


(a) 0, 2, 4, 0, 4, 3, 1, 6, 5
(b) 4, 5, 6, 0, 4, 3, 3, 6, 1
(c) 0, 2, 4, 5, 6, 1, 3, 0, 4
(d) 0, 2, 3, 2, 4, 3, 1, 5, 6
(e) None of the above

Question 21:

Given is the following code segment:

```
glBegin(GL_TRIANGLE_STRIP);
glColor3f(0.2, 0.2, 0.2);
glVertex3f(0, 0, 0);
glColor3f(0.8, 0.8, 0.8);
glVertex3f(0, 2, 3);
glVertex3f(3, 2, 0);
glColor3f(0.2, 0.2, 0.2);
glVertex3f(0, 4, 0);
glEnd();
```

Which of the answers below shows the scene generated by this code segment? Note that the coordinate system has been added for illustration.

(a)

(b)

(c)

(d)

(e)
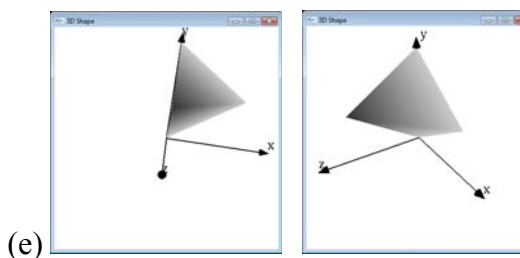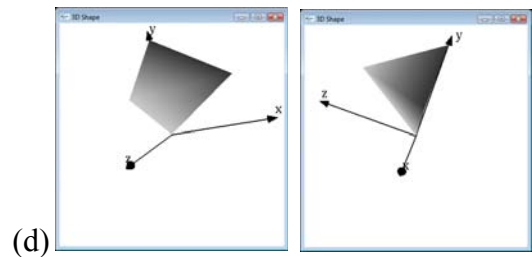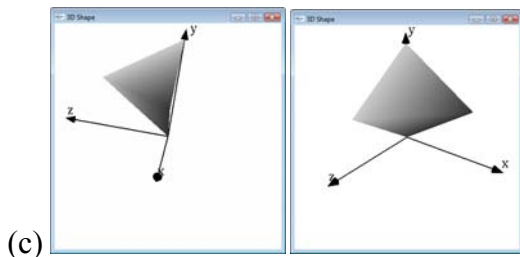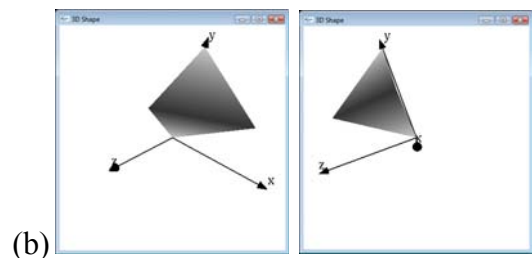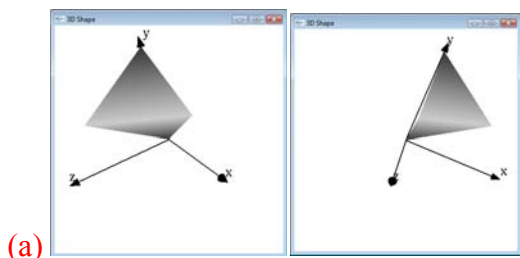
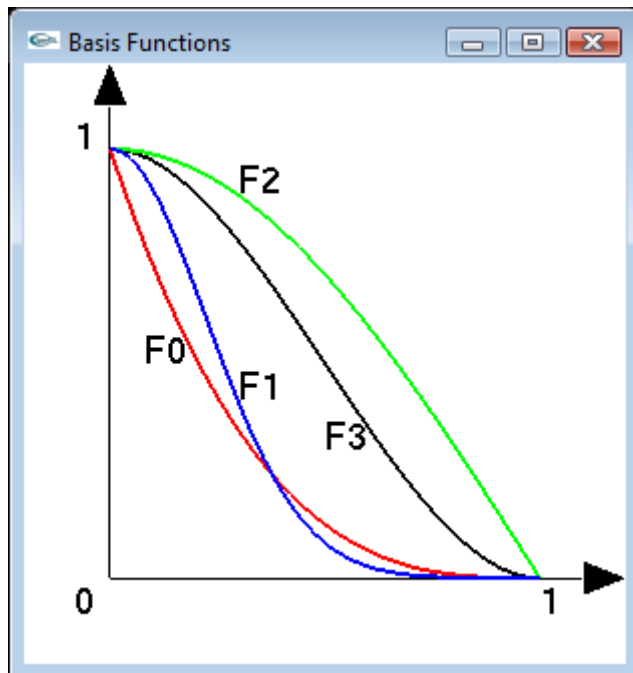**Question 22:**

Which code segment generates the modelview matrix $\begin{pmatrix} \cos\varphi & -\sin\varphi & 0 & 0 \\ \sin\varphi & \cos\varphi & 0 & 2 \\ 0 & 0 & 3 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$?

(a)
```
glMatrixMode(GL_MODELVIEW);
glLoadIdentity();
glTranslatef(0, 2, 0);
glScalef(1, 1, 3);
glRotatef(φ, 1, 0, 0);
```

(b)
```
glMatrixMode(GL_MODELVIEW);
glLoadIdentity();
glTranslatef(0, 2, 0);
glScalef(1, 1, 3);
glRotatef(φ, 0, 0, 1);
```

(c)
```
glMatrixMode(GL_MODELVIEW);
glLoadIdentity();
glRotatef(φ, 1, 0, 0);
glScalef(1, 1, 3);
glTranslatef(0, 2, 0);
```

(d)
```
glMatrixMode(GL_MODELVIEW);
glLoadIdentity();
glRotatef(φ, 0, 0, 1);
glScalef(1, 1, 3);
glTranslatef(0, 2, 0);
```

√

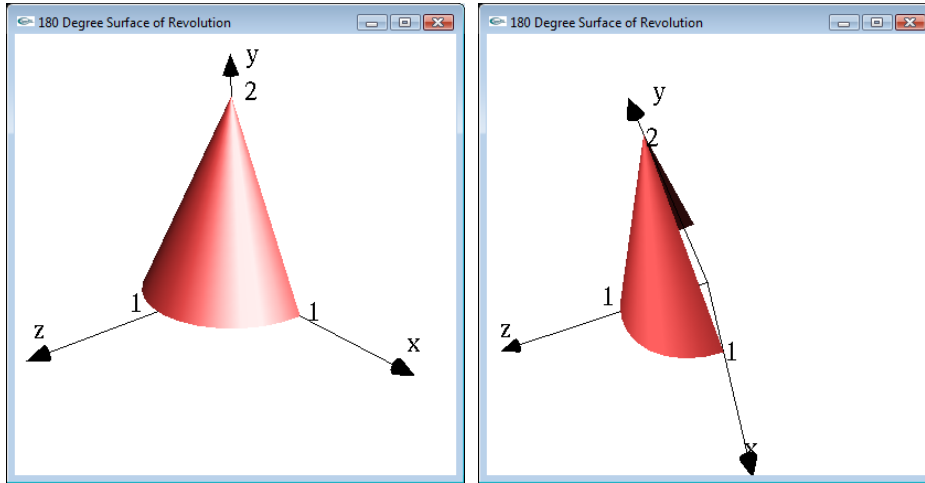(e)   None of the above

Question 23:

Which of the functions in the image on the right represents the first basis function of a Hermite curve? (i.e. the basis function which is multiplied with the start point of the curve)

(a) F0
(b) F1
(c) F2
(d) F3
(e) None of the above

CONTINUED

Question 24:

The pictures below show a surface of revolution which was generated by rotating a profile curve $(x(t), y(t), 0)$ by 180 degree around the y-axis. The resulting half-cone has a height of two units and a radius of one unit. What is the parametric equation of the resulting surface?

(a) $\mathbf{p}(s,t) = \begin{pmatrix} t\cos(\pi s) \\ 2t \\ t\sin(\pi s) \end{pmatrix}$

(c) $\mathbf{p}(s,t) = \begin{pmatrix} t\cos(\pi s) \\ t\sin(\pi s) \\ 2t \end{pmatrix}$

(b) $\mathbf{p}(s,t) = \begin{pmatrix} t\cos(\pi s) \\ 2 - 2t \\ t\sin(\pi s) \end{pmatrix}$

(d) $\mathbf{p}(s,t) = \begin{pmatrix} t\cos(\pi s) \\ t\sin(\pi s) \\ 2 - 2t \end{pmatrix}$

(e) None of the above

CONTINUED

Question 25:

Given is the texture shown in the image below on the left. The texture is used to texture map a unit cube (i.e. cube with side length one) resulting in the scene shown in the image on the right. Assume the texture coordinate of the vertex A is (0,0) and the texture parameters GL_REPEAT are set for both texture parameter directions. Which texture coordinates do we have to define for the vertices C and D in order to get the image shown below on the right?
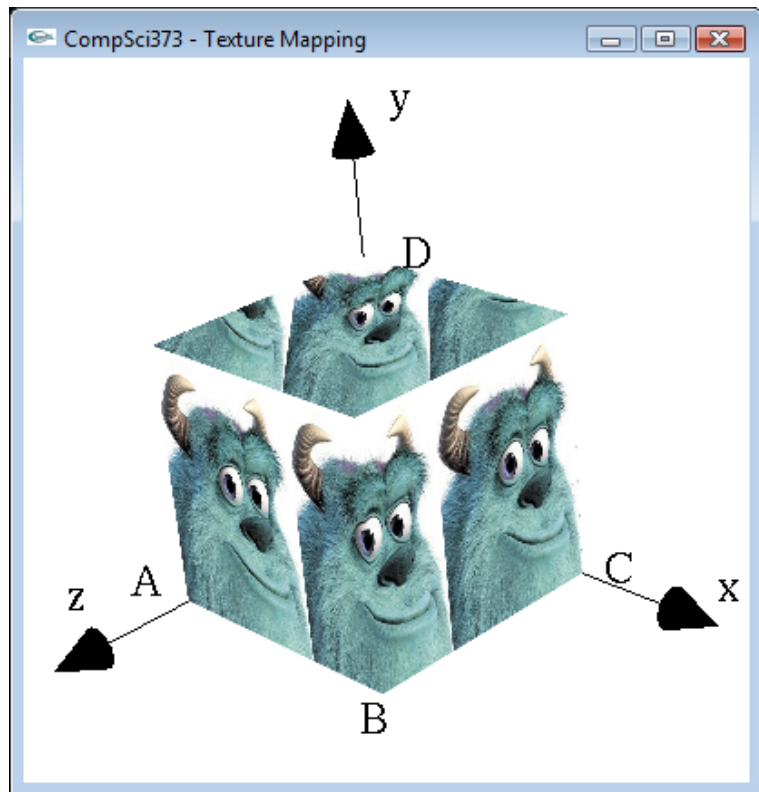
    (a) Texture coordinate at C is (1, 0) and at D (1, 1)
    (b) Texture coordinate at C is (1, 0) and at D (0, 1)
    (c) Texture coordinate at C is (3, 0) and at D (1, 1)
    (d) Texture coordinate at C is (3, 0) and at D (2, 1)
    (e) None of the above [Texture coordinate at C is (3, 0) and at D (1.5, 2)]