MACS441/F2007 Test 2

In some cases, the correct answer is a combination of (a)-(e) or (a)-(f): please read the questions carefully

questions answered	points out of 100
9	100
8	95
7	90
6	80
5	70
4	55
3	40
2	20
1	10
0	0

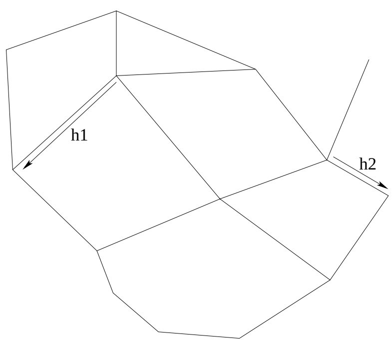
---

1. A manifold triangle mesh of genus 0 has 1000 vertices. How many triangles does it have?

(A) 498 | (B) 500 | (C) 502 | (D) 1002 | (E) 1502 | (F) some other number

---

2. Here is a planar subdivision with two half-edges h_1 and h_2:

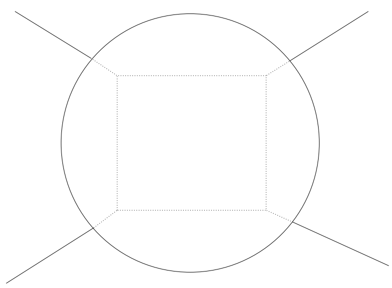


Which of the following are equal to h_2? Mark all that are.
[$h.o/h.p/h.n$=opposite/previous/next for h]

(A) $h_1.n.n.n.o.n.o.n.n.n.o$ | (B) $h_1.p.o.p.p.o.n.n.n.n$ | (C) $h_1.p.o.p.o.p.n.n.n$
(D) $h_1.n.o.n.n.n.n.n.n.n.n$ | (E) $h_1.n.n.o.p.o.n.n.o$ | (F) $h_1.o.n.n.o.n.n.n.n$

---

3. You are standing at the end of a long room (parallelliped-shaped one as most rooms are), facing one of the walls. There is a mirror ball in front of you, obscuring that wall (dotted lines are invisible):



Each of the walls, the ceiling and the floor have distinct uniform colors. How many colors can you see in the mirror ball (from where you are)?

(A) 6 | (B) 5 | (C) 4 | (D) 1 | (E) some other number of colors

4. You are rendering a textured triangle ΔABC with openGL (using 2D texture). Texture coordinates of the vertices A, B and C after all transformations are $(0,0)$, $(0.99,0)$ and $(0,0.99)$ (respectively) and the vertices project to pixels with coordinates $(0,0)$, $(99,0)$ and $(0,99)$ (respectively). The texture coordinates of the fragment corresponding to $(33,33)$ (i.e. the center of mass of the triangle) are:

(A) $(0.33, 0.33)$ (B) $(0.495, 0.495)$ (C) $(0.5, 0.5)$ (D) $(0.66, 0.66)$

(E) Not enough information was given to answer the question

---

5. You are given a manifold mesh (in particular, every edge has exactly two incident triangles). Assume the vertices are given unique integer IDs. For every triangle with vertex IDs a, b, c you write out three rows:
$\min(a,b)$, $\max(a,b)$, c
$\min(a,c)$, $\max(a,c)$, b
$\min(c,b)$, $\max(c,b)$, a.
Now, you sort these rows lexicographically. Which of the following statements are true (assume the rows are numbered from 0 to $N-1$, N being their number):

(A) The number of rows is always even

(B) The number of rows is always odd

(C) The first two entries of any even row and the immediately following row are the same

(D) If two triangles Δ_1 and Δ_2 share an edge but are not the same, then there are two adjacent rows in the sorted table such that one contains the vertices of Δ_1 and the other - the vertices of Δ_2

(E) Triples of vertices of triangles that share a vertex must come in adjacent rows of the sorted table

---

6. Which of the following statements are true for Bezier curves:

(A) The curve has to be contained in the convex hull of the control points

(B) If there are N control points, the curve is polynomial of degree no more than $N-1$

(C) The curve starts at the first and ends at the last control point

(D) The curve is tangent to the line passing through the first two control point at the starting point

(E) The curve is tangent to the line passing through the last two control point at the endpoint

(F) The curve always passes through all control points

---

7. Which of the following statements are true about a degree-2 B-spline (regardless of what the control points are):

(A) It passes through midpoints of all intervals forming the control polygon

(B) It is piecewise polynomial of degree 2 or less

(C) Its derivative is continuous

(D) It passes through every control point except for the first and the last

(E) Its derivative is a piecewise linear function

---

8. Two bezier curves have control points:

C1 : $(0,0)$, $(1,1)$, $(2,2)$, $(4,0)$

C2 : $(4,0)$, P, $(7,0)$, $(8,0)$

The curves join smoothly at $(4,0)$ for P equal to [mark all that would work]:

(A) $(3,1)$ | (B) $(5,-1)$ | (C) $(6,-2)$ | (D) $(1,3)$ | (E) $(5.5,0)$

---

9. Take a watertight triangle mesh. Watertight means that the mesh is a nice, manifold tiling of the surface of some 3D volume. Assume that the mesh is oriented for back-face culling and is entirely inside the view volume (in particular, between the front and back clipping planes). Let's say we do the following:

```
Make the depth buffer read-only
Set stencil values of all pixels to zero
Set stencil test to always pass
Set stencil operations to increment if depth and stencil tests pass and noop otherwise
Render the mesh with back face culling on
Set stencil operations to decrement if depth and stencil tests pass and noop otherwise
Render the mesh with back face culling on
```

What are the stencil values?

(A) All zero

(B) Zero if outside the projection of the mesh onto screen, one otherwise

(C) Zero if inside the projection of the mesh onto screen, one otherwise

(D) Equal to the number of intersections of the eye ray through the pixel with the mesh

(E) All one
