

# CSCI 4972/6963 Advanced Computer Graphics — Quiz 1

## Tuesday February 27, 2006 — noon-1:30pm

Name:

RCS username:

This quiz is closed book & closed notes except for one 8.5x11 (double-sided) sheet of notes.

Please state clearly any assumptions that you made in interpreting a question.

Write your answer in the box provided below each question. Be sure to write neatly. If we can't read your solution, we won't be able to give you full credit for your work.

1	/ 8
2	/ 12
3	/ 9
4	/ 10
5	/ 11
Total	/ 50

### 1 Transformations & Matrix Representation [ /8]

Write down the simplest 3x3 matrix that transforms this set of 4 points:

A: (1, 0)   B: (1, 1)   C: (0, 0)   D: (0, 1)

to these new positions:

A': (1, 1)   B': (0, 1)   C': (1, 0)   D': (0, 0)

## 2 Vocabulary [ /12]

Write 1 or 2 complete sentences to define each term or pair of terms used in computer graphics.

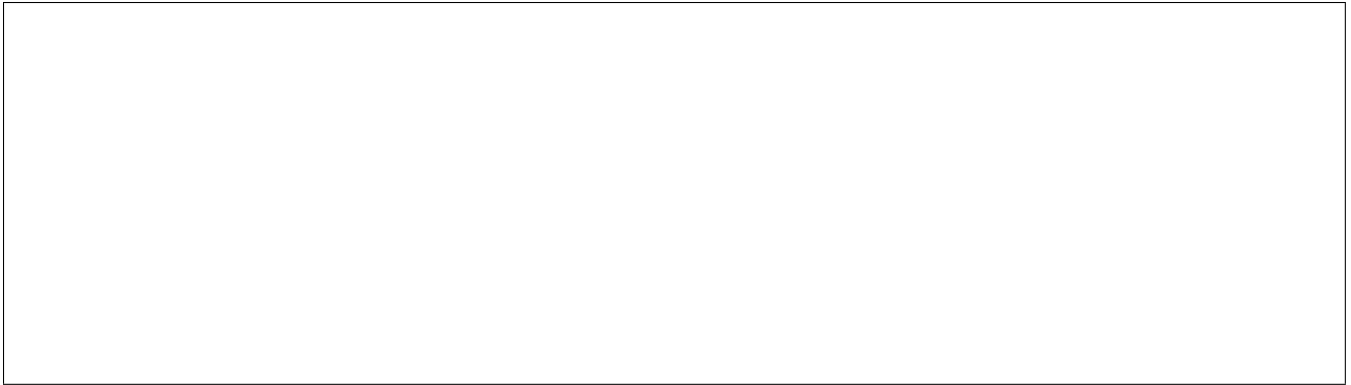
### 2.1 Haptics [ /1.5]

### 2.2 Isotropic vs. Anisotropic [ /1.5]

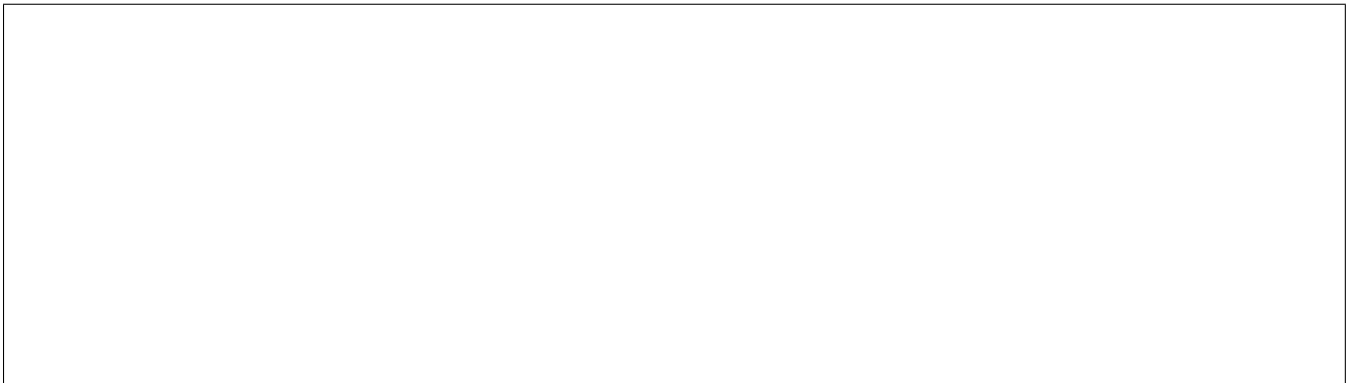
### 2.3 Valence [ /1.5]

### 2.4 Dihedral Angle [ /1.5]

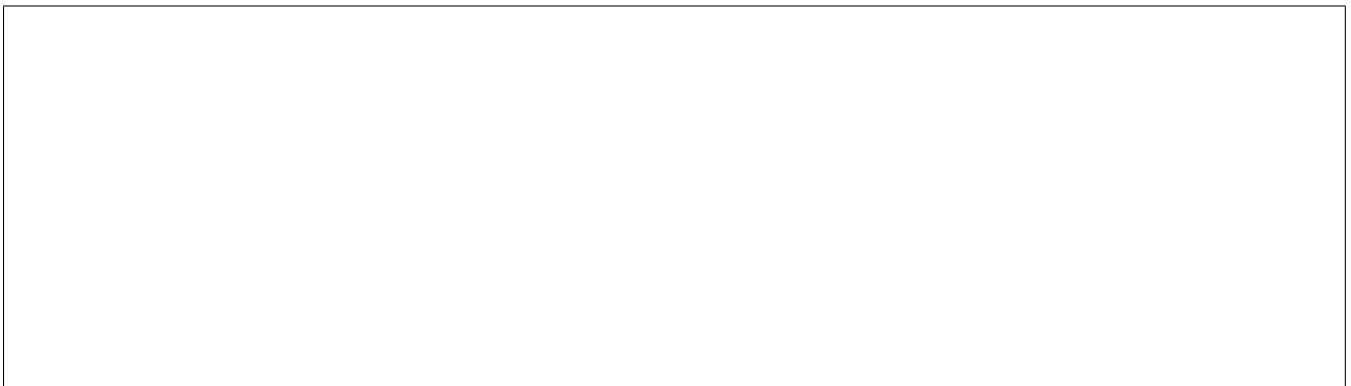
**2.5 Genus & Homeomorphic [ /1.5]**



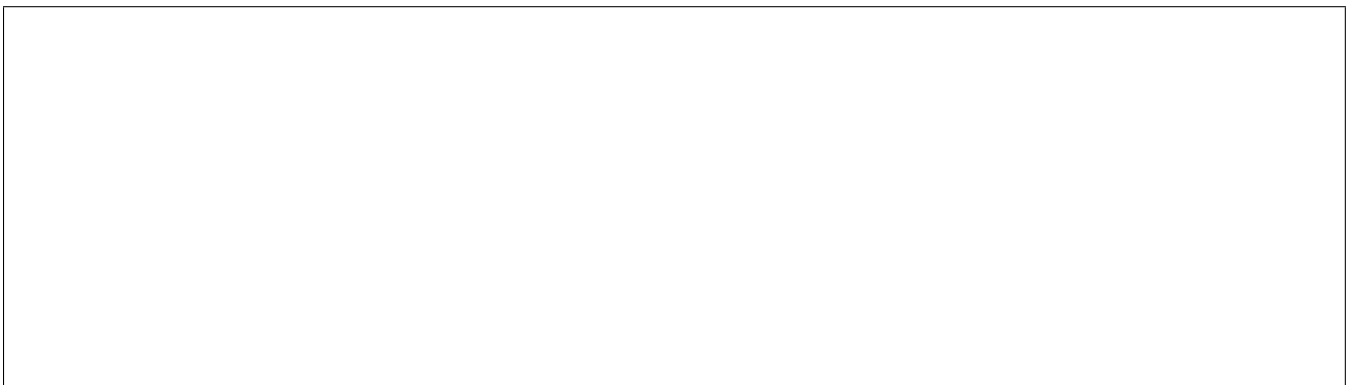
**2.6 Damping & Viscosity [ /1.5]**



**2.7 Elastic vs. Plastic Deformation [ /1.5]**



**2.8 Inverse Kinematics [ /1.5]**



### 3 Curves & Surfaces [ /9]

#### 3.1 Polynomial Degree [ /1]

If we want a single polynomial to pass through  $n$  points, what degree polynomial is required?

#### 3.2 Modeling with High-Order Polynomials [ /3]

Why can it be difficult to model with high-order interpolation polynomials? Write 1 or 2 sentences.

#### 3.3 Manifold Surface [ /5]

What is a manifold surface and what about the definition is important when implementing subdivision surfaces? Write 2 or 3 sentences.

## 4 Progressive Meshes [ /10]

### 4.1 Edge Collapse / Vertex Split [ /3]

What is the minimal information that must be stored in a progressive mesh to exactly invert each edge collapse operation (i.e., perform a *vertex split*)?

### 4.2 The Half Edge Data Structure [ /7]

Now write pseudo-code that implements the vertex split operation from this information. What elements of the half edge data structure (faces, edges, vertices) will be modified/added/removed and how are they modified during this inversion? Draw and label a simple diagram to illustrate your code.

## 5 Physical Simulation [ /11]

### 5.1 Stability [ /2]

What is the relationship between the timestep and spring stiffness in a mass-spring simulation?

### 5.2 Collision Detection [ /4]

Describe a simulation scenario for which a hierarchical spatial data structure will improve collision detection performance. Write 2 or 3 sentences.

### 5.3 Fluid Simulation [ /5]

What physical characteristics of water are best captured with a particle system? When is it important to model water flow using the Navier-Stokes equations? Write 2 or 3 sentences.