

Name: _____

Homework 1
15-462 Computer Graphics, Spring 2012
Due 2/28 at the beginning of class

60 points

Please show all of your work.

Please list any references that you used to research or obtain your solution.

1. **(5 points)** Write a parametric equation for a line between points $[1 \ 4]^T$ and $[2 \ 1]^T$
2. **(5 points)** Write an implicit equation for the same line.
3. **(5 points)** Suppose that we wish to align a 2D coordinate frame \mathbf{uv} to our world coordinate system \mathbf{xy} . Let $\mathbf{u} = [2 \ 3]^T$ and $\mathbf{v} = [3 \ -2]^T$. Give a matrix that maps \mathbf{u} to \mathbf{x} and \mathbf{v} to \mathbf{y} . Show your work and demonstrate that this matrix is correct.
4. **(5 points)** Is your matrix in part 3 a rotation matrix? Why or why not?
5. **(10 points)** Derive a 2D perspective projection matrix for a camera at the origin pointed in the x -direction, with y up, an image plane at $x=5$. You do not have to preserve depth order. Show your derivation.
6. **(5 points)** Give several pros and cons (at least five total) of working with a mesh vs. an implicit surface
7. **(5 points)** what properties of a surface or material are required for the Phong Illumination Model? (Give specific parameter names and explain their meaning, referencing the equation in the first slide of lecture 9.)
8. **(5 points)** Surface / material properties are captured in a BRDF as a function. What is that function? (Explain any parameters you use.)
9. **(6 points)** Give three different examples of properties that can be captured in a BRDF that are not well captured in the Phong Illumination Model. Including and explaining effects in photos can be a good way to answer this question.
10. **(5 points)** Write the following quadratic spline in matrix form, as we have done for cubic splines in the class.

$$p(u) = p_1 + p_2(u - 1)u + (p_3 - p_1)u$$

11. **(2 points)** What is required for two adjacent such splines to be C_0 continuous?
12. **(2 points)** What is required for two adjacent such splines to be C_1 continuous?