Midterm Test

March 2nd, 2011

CSC320H1S : Introduction to Visual Computing

Duration: 50 minutes

No aids allowed

There are 6 pages total (including this page)

Given name(s): _____

Family name: _____

Student number: _____

Question	Marks
1	_____/15
2	_____/7
3	_____/18
4	_____/10
Total	_____/50

1 Matting (15 marks total)

(a) **[4 Marks]** State the matting equation and define all terms.

(b) **[6 Marks]** Suppose you are given a grayscale composite image $C(x, y)$ that satisfies the matting equation. Use your answer in (a) to express the gradient of C in terms of the foreground, background and alpha.

$\nabla C(x, y) \; =$

(c) **[5 Marks]** Now you are told that the pixel intensities of the foreground and background in (b) are nearly constant but that their actual values are unknown. What information about the gradient of the alpha matte can we obtain from the composite C in this case? Be as specific as possible.

2 Camera Response Functions (7 marks total)

Which of the following correspond to reasonable camera response functions? You may assume that sensor exposure X is expressed in the range $[0, 1]$ and that pixel intensities Z are normalized to the range $[0, 255]$ **after** the camera response function has been applied.

Note: No explanations are necessary. You will lose 1/2 mark for every incorrect answer, but your total marks for this question cannot go below zero.

(a) **[1 Marks]** $Z = X^2$

(b) **[1 Marks]** $Z = -\log[\,(X + 0.001)^2\,]$

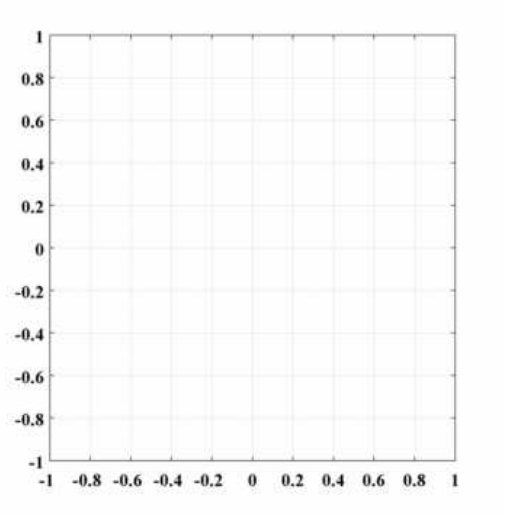
(c) **[2 Marks]** $Z = \sin^2(2\pi X)$

(d) **[2 Marks]** $Z = \exp(X^2)$

(e) **[1 Marks]** $Z = 2^X$

3 2D Curves (18 marks total)

(a) **[5 Marks]** Draw the curve $\gamma(s) = (\sin s, \cos 2s)$ on the graph below.



(b) **[4 Marks]** Is the curve $\gamma(s)$ in (a) parameterized by arc length? Explain briefly. No marks will be awarded without an explanation.

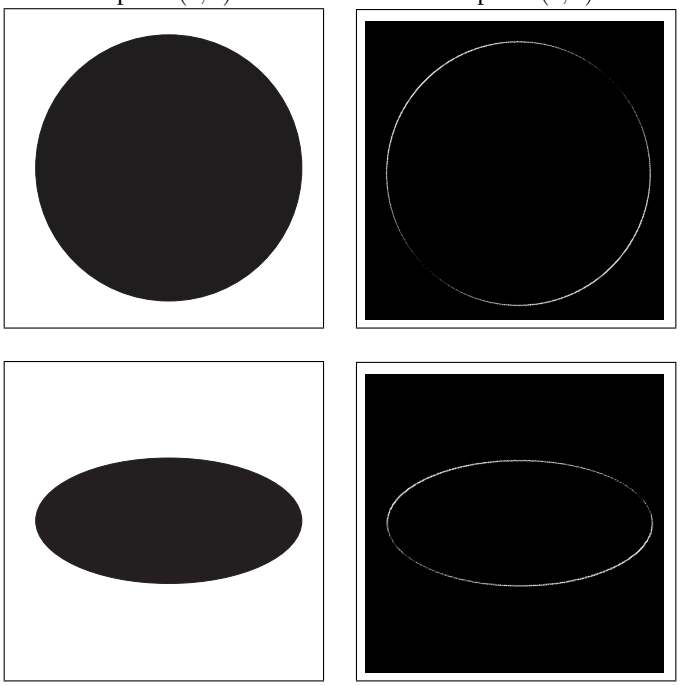
(c) **[9 Marks]** If $\mathbf{N}(s)$ and $\mathbf{T}(s)$ are the unit normal and tangent, respectively, of a curve parameterized by arc length, prove that

$$\frac{d\mathbf{T}}{ds}(s) \text{ and } \mathbf{N}(s) \text{ are parallel.}$$

4 Mystery Processing (10 marks total)

Consider the original images on the left and the processed results on the right. The same mathematical operation was used to obtain both these results. What was it? Be as precise as possible, *i.e.*, give an appropriate mathematical expression for pixel intensities $B(r, c)$ and explain your reasoning.

Input $A(r, c)$ Output $B(r, c)$



$B(r, c) \;=$

END OF EXAM