The University of Western Ontario
Computer Science CS630a
Final Examination - December 9th, 2002

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This exam consists of 5 questions (6 pages, including this page) worth a total of 100%. It is an open book exam. All answers are to be written in this booklet. Scrap work may be done on the back of each page; this will not be marked. The exam is 2 hours long and comprises 30% of your final mark. Assignments 1 and 2 are each worth 35% respectively, for a total of 70%.

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<th>(1) 20%</th>
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Professor: John Barron
Answer the following questions briefly and concisely and show all relevant work. Where possible, use point-form. Generally, correct answers will be short.

(1) (20%) Consider the following two polygons. The center of masses are at \( C_1 = (2, 7) \) and \( C_2 = (5, 10) \).

![Polygon 1](image1.jpg)  \hspace{1cm}  ![Polygon 2](image2.jpg)

Sketch out the signature graphs for these 2 polygons, using the given center of mass on the graphs provided below. Measure any angles with respect to the positive X axis and start with angle 0 in your plots. In the event that there are 2 function values for an angle, plot both values. Describe any problems you have in computing/comparing the signatures.
(2) (20%) You are watching a TV program on the Discovery channel where a snake is watching a rat. The frame rate for TV is about 30 frames per second. Suddenly the rat falls over dead (the rat did not die from fright!). Explain with image processing concepts what probably happened. Give a credible time-line for your chain of events.
(3) (20%) Consider a 1D signal, $f(x)$ with 4096 discrete values. Consider performing a 1D FT, $F(u) = \text{FT}(f(x))$ on this signal (with translation to $(0,0)$). What is the maximum positive frequency in the $u$ dimension. Show and explain your calculations.
(4) (20%) How would you do histogram equalisation of a colour image? Assume you have a correct equalisation function `equalize` as in `fcts.c`. 
(5) (20\%) Answer these two questions:

(a) What is the most significant advantage of edge detection using $2^{nd}$ order derivatives over edge detection using $1^{st}$ order derivatives?

(b) What is the most significant advantage of edge detection using $1^{st}$ order derivatives over edge detection using $2^{nd}$ order derivatives?