The University of Western Ontario
Computer Science CS630a
Final Examination - December 10th, 2001

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This exam consists of 4 questions (5 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 hour 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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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) (25%) Consider the equation of a line, \( y = mx + b \) (in \( m - b \) space \( b = -mx + y \)) and three 2D points on a line: (1,1), (3,3) and (5,5). Show the contents of the accumulator array of \( m - b \) space for these 3 points (via a Hough transform). Round any float points to integers before modifying the accumulator array. \( m \) and \( b \) are in the range \([-2, 2]\) and are described by increments of 1. Fill in the A array below according to the Hough Transform processing required for this \( m - b \) space.

\[
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\end{array}
\]

The value of \( m \) is: _______________
The value of \( b \) is: _______________
Consider a 2D image of a spike function. Specifically, consider a 1024 × 1024 grayvalue image that is 0 (black) for all pixels but one, which has a grayvalue of 255 at pixel (512, 512). What is the effect of the Butterworth filter applied in the frequency domain on this image for:

$D_0 = 0.05$ and $n = 1$:

$D_0 = 0.05$ and $n = 10$:

Explain your answer in words with a diagram if you wish.
(3) (25%) What is the purpose of the `translate_to_origin` function in `fcts.c` as used on assignments 1 and 2?

Consider a modulation transfer function $H(u, v)$ in the frequency space where each $(u, v) \in (-0.5, 0.5)$. Without using the `translate_to_origin` function on the original image, what changes are required to be made to $H(u, v)$ to produce the same result.
(4) (25%) Give 2 distinct uses of the YIQ colour transformation with a brief explanation.

Use 1:

Use 2: