

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN
Department of Electrical and Computer Engineering

ECE 417 MULTIMEDIA SIGNAL PROCESSING
Spring 2016

EXAM 3

Thursday, May 12, 2016, 7:00-10:00pm

- This is a **CLOSED BOOK** exam. You may use one sheet (front and back) of hand-written notes.
- No calculators are permitted. You need not simplify explicit numerical expressions.
- There are a total of 100 points in the exam. Each problem specifies its point total. Plan your work accordingly.
- You must **SHOW YOUR WORK** to get full credit.

Problem	Score
1	
2	
3	
4	
5	
Total	

Name: _____

Possibly Useful Formulas

One-Layer Neural Network

$$f_k(\vec{x}_i, W) = g \left(\sum_{j=1}^q w_{kj} x_{ji} \right)$$

Barycentric Coordinates

$$\begin{bmatrix} x_0 \\ y_0 \\ 1 \end{bmatrix} = \begin{bmatrix} x_1 & x_2 & x_3 \\ y_1 & y_2 & y_3 \\ 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} \lambda_1 \\ \lambda_2 \\ \lambda_3 \end{bmatrix}$$

Bilinear Interpolation

$$i(m+e, n+f) = (1-e)(1-f)i(m, n) + (1-e)f i(m, n+1) + e(1-f)i(m+1, n) + efi(m+1, n+1)$$

Integral Image

$$ii(x, y) = \sum_{x' \leq x} \sum_{y' \leq y} i(x', y')$$

AdaBoost

$$p_{it} \leftarrow \frac{w_{it}}{\sum_{j=1}^n w_{jt}}, \quad 1 \leq t \leq T, \quad 1 \leq i \leq n$$

$$P_E(t) = \sum_{i=1}^n p_{it} [y_i \neq h_t(\vec{x}_i)], \quad 1 \leq t \leq T, \quad 1 \leq i \leq n$$

$$\beta_t = P_E(t)/(1 - P_E(t)), \quad 1 \leq t \leq T$$

$$w_{i,t+1} \leftarrow \begin{cases} w_{it}\beta_t & h_t(\vec{x}_i) = y_i \\ w_{it} & h_t(\vec{x}_i) \neq y_i \end{cases}, \quad 1 \leq t \leq T, \quad 1 \leq i \leq n$$

$$\alpha_t = -\ln \beta_t, \quad 1 \leq t \leq T$$

Useful Angles			
θ	$\cos \theta$	$\sin \theta$	$e^{j\theta}$
0	1	0	1
$\pi/6$	$\sqrt{3}/2$	$1/2$	$\sqrt{3}/2 + j/2$
$\pi/4$	$\sqrt{2}/2$	$\sqrt{2}/2$	$\sqrt{2}/2 + j\sqrt{2}/2$
$\pi/3$	$1/2$	$\sqrt{3}/2$	$1/2 + j\sqrt{3}/2$
$\pi/2$	0	1	j
π	-1	0	-1
$3\pi/2$	1	-1	$-j$
2π	1	0	1