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

ECE 417 Multimedia Signal Processing
Fall 2017

EXAM 3

Friday, December 15, 2017

- 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 40 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	
Total	

Name: _____

Possibly Useful Formulas

Scaled Forward-Backward Algorithm

$$\begin{aligned}
\tilde{\alpha}_1(i) &= \pi_i b_i(\vec{x}_1) \\
g_t &= \sum_{i=1}^{N} \tilde{\alpha}_t(i) \\
\hat{\alpha}_t(i) &= \frac{1}{g_t}\tilde{\alpha}_t(i) \\
\tilde{\alpha}_t(i) &= \sum_{j=1}^{N} \hat{\alpha}_{t-1}(j) a_{ji} b_i(\vec{x}_t) \\
\hat{\beta}_T(i) &= 1 \\
\tilde{\beta}_t(i) &= \sum_{j=1}^{N} \hat{\beta}_{t+1}(j) a_{ij} b_j(\vec{x}_{t+1}) \\
\hat{\beta}_t(i) &= \frac{1}{g_{t+1}}\tilde{\beta}_t(i)
\end{aligned}$$

Adaboost Assume $y_i, h_j(x_i) \in \{0, 1\}$. For $t = 1, \ldots, T$:

$$\begin{aligned}
h_t^* &= \arg\min_j \sum_{i=1}^{n} w_{t,i} \left| h_j(x_i) - y_i \right| \\
\epsilon_t &= \sum_{i=1}^{n} w_{t,i} \left| h_t^*(x_i) - y_i \right| \\
\tilde{w}_{t+1,i} &= \begin{cases} \frac{\epsilon_t}{1-\epsilon_t} w_{t,i} & h_t^*(x_i) = y_i \\ w_{t,i} & \text{otherwise} \end{cases} \\
w_{t+i,i} &= \frac{\tilde{w}_{t+1,i}}{\sum_j \tilde{w}_{t+1,j}} \\
H(x) &= u\left(\sum_{t=1}^{T} \alpha_t (h_t^*(x) - \frac{1}{2}) \right) \\
\alpha_t &= \log \frac{1-\epsilon_t}{\epsilon_t}
\end{aligned}$$

Affine Transforms and Barycentric Coordinates

$$\begin{aligned}
\vec{x}_0 &= [\vec{x}_1, \vec{x}_2, \vec{x}_3]\vec{\lambda} \\
\vec{u}_i &= \begin{bmatrix} a & b & c \\ d & e & f \\ 0 & 0 & 1 \end{bmatrix} \vec{x}_i \\
\vec{u}_0 &= [\vec{u}_1, \vec{u}_2, \vec{u}_3]\vec{\lambda}
\end{aligned}$$