CENG 3331 Intro to Telecommunication and networks- Homework 4

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Problem 1: $R_B = \frac{1}{T}$ $R_b = R_B * \log_2 M = R_B * H(x)$ $H(x) = \Sigma(P_i * \log_2 \frac{1}{Pi})$

A. $R_B = \frac{1}{T} = \frac{1}{.005\ s}$ = 200 baud

$R_b = R_B * \log_2 M = 200 * \log_2(2) = 200$ bps

B. $R_B = \frac{1}{T} = \frac{1}{.005\ s}$ = 200 baud

$H(x) = \Sigma(P_i * \log_2 \frac{1}{Pi}) =$

$\frac{1}{5} * \log_2(5) + \frac{1}{4} * \log_2(4) + \frac{1}{4} * \log_2(4) + \frac{3}{10} * \log_2 \frac{10}{3} = 1.99$ bits

$R_b = R_B * H(x) = 200 * 1.99 = 398$ bps

Problem 2: $H(x) = \Sigma(P_i * \log_2 \frac{1}{Pi})$ $\bar{k} = \Sigma(P_i * L_i)$ $n = \frac{H(x)}{\bar{k}}$

A. $H(x) = \Sigma(P_i * \log_2 \frac{1}{Pi}) = .2 * \log_2 \frac{1}{.2} + .19 * \log_2 \frac{1}{.19} + .18 * \log_2 \frac{1}{.18} + .17 * \log_2 \frac{1}{.17} +$

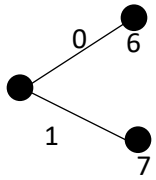
$.15 * \log_2 \frac{1}{.15} + .1 * \log_2 \frac{1}{.1} + .01 * \log_2 \frac{1}{.01} = 2.61$ bits

B.

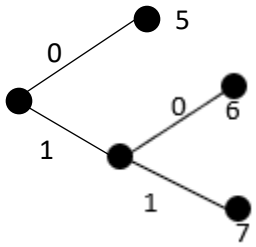
Step 1) $X:\{X_1, X_2, X_3, X_4, X_5, X_6, X_7\}$

Step 2) $P_1 \geq P_2 \geq P_3 \geq P_4 \geq P_5 \geq P_6 \geq P_7 \rightarrow .2 \geq .19 \geq .18 \geq .17 \geq .15 \geq .1 \geq .01$

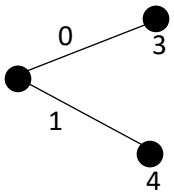
Step 3-5)



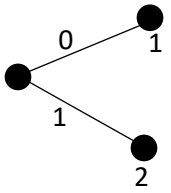
$P_1 \geq P_2 \geq P_3 \geq P_4 \geq P_5 \geq P_{67}$ → $.2 \geq .19 \geq .18 \geq .17 \geq .15 \geq .11$



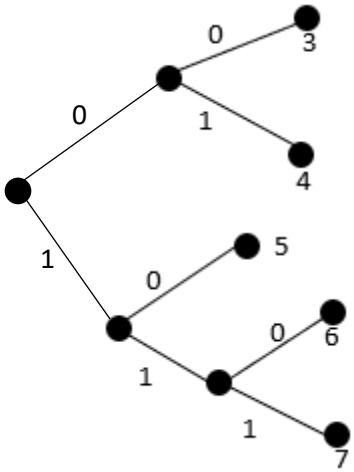
$P_{567} \geq P_1 \geq P_2 \geq P_3 \geq P_4$ → $.26 \geq .2 \geq .19 \geq .18 \geq .17$



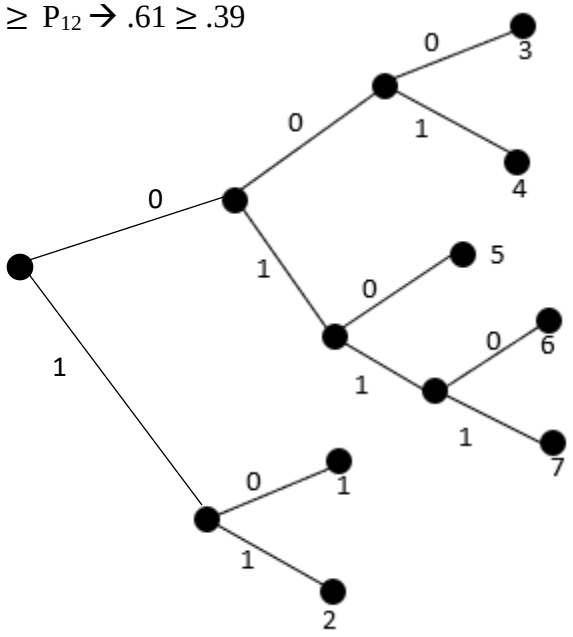
$P_{34} \geq P_{567} \geq P_1 \geq P_2$ → $.35 \geq .26 \geq .2 \geq .19$



$P_{12} \geq P_{34} \geq P_{567}$ → $.39 \geq .35 \geq .26$



$P_{34567} \geq P_{12} \rightarrow .61 \geq .39$



Character	Probability	Code	Length
X_1	.2	10	2
X_2	.19	11	2
X_3	.18	000	3
X_4	.17	001	3
X_5	.15	010	3
X_6	.1	0110	4
X_7	.01	0111	4

$\bar{k} = \Sigma(P_i * L_i) =$

$.2(2) + .19(2) + .18(3) + .17(3) + .15(3) + .1(4) + .01(4) = 2.72$ bit/symbol

$H(x) = \Sigma(P_i * \log_2\frac{1}{Pi}) =$

$.2 * \log_2\frac{1}{.2} + .19 * \log_2\frac{1}{.19} + .18 * \log_2\frac{1}{.18} + .17 * \log_2\frac{1}{.17} + .15 * \log_2\frac{1}{.15} +$

$.1* \log_2\frac{1}{.1} + .01* \log_2\frac{1}{.01} = 2.61$ bit/symbol

$n = \frac{H(x)}{\bar{k}} = \frac{2.61}{2.72} = .96$

Problem 3: $H(x) = (P_i * \log_2 \frac{1}{Pi})$

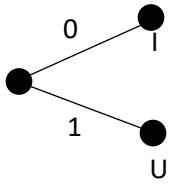
A. $H(x) = (P_i * \log_2 \frac{1}{Pi}) = .25 * \log_2 \frac{1}{.25} = .50$ bits/symbol

B.

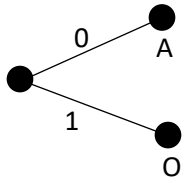
Step 1) X:{A, E, I, O, U}

Step 2) $P_E \geq P_A \geq P_O \geq P_I \geq P_U \rightarrow .34 \geq .22 \geq .19 \geq .17 \geq .08$

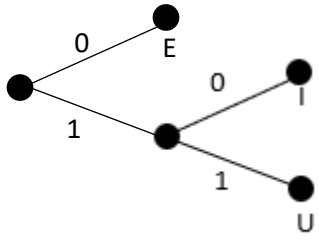
Step 3-5)



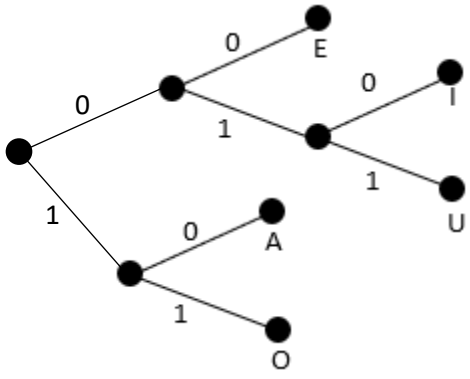
$P_E \geq P_{IU} \geq P_A \geq P_O \rightarrow .34 \geq .25 \geq .22 \geq .19$



$P_{AO} \geq P_E \geq P_{IU} \rightarrow .41 \geq .34 \geq .25$

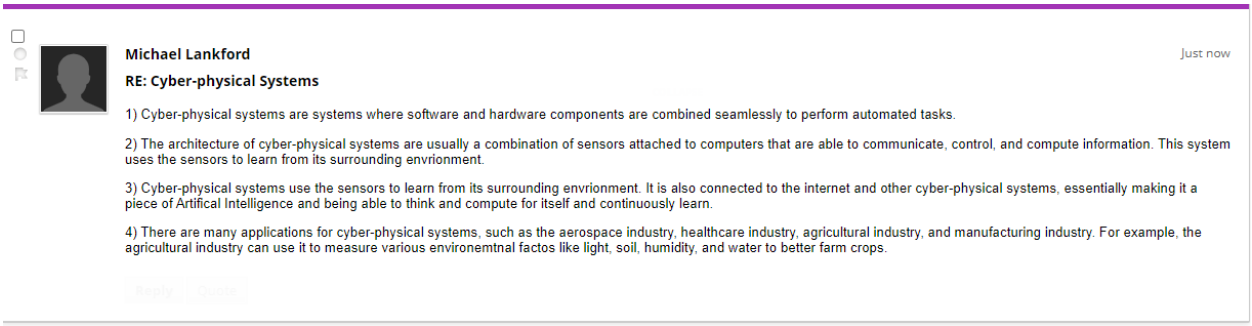


$P_{EIU} \geq P_{AO} \rightarrow .59 \geq .41$



Character	Probability	Code	Length
A	.22	10	2
E	.34	00	2
I	.17	010	3
O	.19	11	2
U	.08	011	3

Problem 4:



Michael Lankford Just now

RE: Cyber-physical Systems

1) Cyber-physical systems are systems where software and hardware components are combined seamlessly to perform automated tasks.

2) The architecture of cyber-physical systems are usually a combination of sensors attached to computers that are able to communicate, control, and compute information. This system uses the sensors to learn from its surrounding envrionment.

3) Cyber-physical systems use the sensors to learn from its surrounding envrionment. It is also connected to the internet and other cyber-physical systems, essentially making it a piece of Artifical Intelligence and being able to think and compute for itself and continuously learn.

4) There are many applications for cyber-physical systems, such as the aerospace industry, healthcare industry, agricultural industry, and manufacturing industry. For example, the agricultural industry can use it to measure various environemtnal factos like light, soil, humidity, and water to better farm crops.

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