Assignment 4

The due date for submitting this assignment has passed. As per our records you have not submitted this assignment.

Due on 2019-03-10, 23:59 IST.

1) Consider that you have received the vector \( r = \begin{bmatrix} -3.2, 2.6 \end{bmatrix} \). The maximum value allowed in the decoder is 4, and 6 bits are used to represent the finite precision values. Then, the received vector used by the finite precision decoder is:

- \([-25, 20]\)
- \([-24, 20]\)
- \([-3, 3]\)
- \([-3, 2]\)

No, the answer is incorrect.
Score: 0

Accepted Answers:
- \([-25, 20]\)

2) Consider a (512,256) polar code with successive cancellation list decoding. The number of CRC bits used for each codeword is 12. Then, the rate of the code is:

- \(1/2\)
- \(67/131\)
- \(64/125\)
- \(61/128\)

No, the answer is incorrect.
Score: 0

Accepted Answers:
Use the following information for questions 4 to 9:

Say a received vector from a coded-BPSK transmission using an (N, K) polar code over an AWGN channel, is being decoded using the successive cancellation list decoder with a list size of 4. Then, the binary tree representation of the code has a depth \( n = \log_2 N \). Consider a node \( x \) at depth \( n - 1 \). Let \( y \) and \( z \) be its left and right child respectively. During the decoding process, the list of belief vectors received by \( x \) from its parent are: \( L_1 = [3, -5] \), \( L_2 = [1, 4] \), \( L_3 = [-4, -2] \) and \( L_4 = [-3, 1] \). The corresponding path metrics are \( PM_1 = 12 \), \( PM_2 = 14 \), \( PM_3 = 16 \) and \( PM_4 = 18 \). Remember that the path metrics are always arranged in ascending order.

4) If the node \( y \) is frozen, then the updated belief vectors and the corresponding path metrics 1 point after the node \( y \) has been processed is:

- \( L_1 = [3, -5] \), \( L_2 = [1, 4] \), \( L_3 = [-4, -2] \) and \( L_4 = [-3, 1] \); \( PM_1 = 14 \), \( PM_2 = 15 \), \( PM_3 = 16 \) and \( PM_4 = 19 \)
- \( L_1 = [1, 4] \), \( L_2 = [3, -5] \), \( L_3 = [-4, -2] \) and \( L_4 = [-3, 1] \); \( PM_1 = 14 \), \( PM_2 = 15 \), \( PM_3 = 16 \) and \( PM_4 = 19 \)
- \( L_1 = [3, -5] \), \( L_2 = [1, 4] \), \( L_3 = [-4, -2] \) and \( L_4 = [-3, 1] \); \( PM_1 = 12 \), \( PM_2 = 14 \), \( PM_3 = 16 \) and \( PM_4 = 18 \)
- \( L_1 = [3, -5] \), \( L_2 = [1, 4] \), \( L_3 = [-4, -2] \) and \( L_4 = [-3, 1] \); \( PM_1 = 12 \), \( PM_2 = 15 \), \( PM_3 = 17 \) and \( PM_4 = 18 \)

No, the answer is incorrect.
Score: 0
Accepted Answers:
\( L_1 = [1, 4] \), \( L_2 = [3, -5] \), \( L_3 = [-4, -2] \) and \( L_4 = [-3, 1] \); \( PM_1 = 14 \), \( PM_2 = 15 \), \( PM_3 = 16 \) and \( PM_4 = 19 \)

5) (Assuming node \( y \) is frozen) If the node \( z \) corresponds to a message bit, then the updated 1 point path metrics after the node \( z \) has been processed is

- \( PM_1 = 14 \), \( PM_2 = 15 \), \( PM_3 = 16 \) and \( PM_4 = 19 \)
- \( PM_1 = 14 \), \( PM_2 = 15 \), \( PM_3 = 16 \) and \( PM_4 = 21 \)
6) (Assuming node $y$ is frozen) If node $z$ corresponds to a message bit, then the list of hard-decision vectors (corresponding to the ascending order of path metrics) that $z$ sends to its parent is:

- $u^{(1)} = [0, 0], u^{(2)} = [1, 1], u^{(3)} = [1, 1]$ and $u^{(4)} = [0, 0]$
- $u^{(1)} = [1, 1], u^{(2)} = [0, 0], u^{(3)} = [0, 0]$ and $u^{(4)} = [1, 1]$
- $u^{(1)} = [0, 1], u^{(2)} = [1, 0], u^{(3)} = [0, 1]$ and $u^{(4)} = [1, 0]$
- $u^{(1)} = [1, 0], u^{(2)} = [1, 0], u^{(3)} = [0, 1]$ and $u^{(4)} = [0, 1]$

No, the answer is incorrect.
Score: 0

Accepted Answers:
1. $u^{(1)} = [0, 0], u^{(2)} = [1, 1], u^{(3)} = [1, 1]$ and $u^{(4)} = [0, 0]$

7) If the node $y$ corresponds to a message bit, then the updated path metrics after the node $y$ has been processed is

- $PM_1 = 12, PM_2 = 14, PM_3 = 15$ and $PM_4 = 16$
- $PM_1 = 12, PM_2 = 14, PM_3 = 15$ and $PM_4 = 15$
- $PM_1 = 14, PM_2 = 15, PM_3 = 16$ and $PM_4 = 16$
- $PM_1 = 12, PM_2 = 14, PM_3 = 16$ and $PM_4 = 16$

No, the answer is incorrect.
Score: 0

Accepted Answers:
1. $PM_1 = 12, PM_2 = 14, PM_3 = 15$ and $PM_4 = 15$

8) (Assuming node $y$ corresponds to a message bit) If the node $z$ is frozen, then the updated path metrics after the node $z$ has been processed is

- $PM_1 = 14, PM_2 = 15, PM_3 = 17$ and $PM_4 = 21$
- $PM_1 = 14, PM_2 = 15, PM_3 = 17$ and $PM_4 = 17$
- $PM_1 = 14, PM_2 = 15, PM_3 = 21$ and $PM_4 = 22$
- $PM_1 = 14, PM_2 = 15, PM_3 = 17$ and $PM_4 = 20$

No, the answer is incorrect.
Score: 0
9) Let the list of belief vectors received by node $x$ from its parent be: $L_1 = [2, 4]$, $L_2 = [-4, 5], L_3 = [3, 2]$ and $L_4 = [1, 2]$ and let the corresponding path metrics be $PM_1 = 4, PM_2 = 7, PM_3 = 10$ and $PM_4 = 13$. If both $y$ and $z$ correspond to message bits, then the list of hard-decision vectors (corresponding to the ascending order of path metrics) that $x$ sends to its parent is:

- $u^{(1)} = [0, 0], u^{(2)} = [1, 0], u^{(3)} = [1, 0]$ and $u^{(4)} = [1, 1]$
- $u^{(1)} = [0, 0], u^{(2)} = [1, 0], u^{(3)} = [1, 0]$ and $u^{(4)} = [0, 1]$
- $u^{(1)} = [0, 1], u^{(2)} = [1, 0], u^{(3)} = [0, 1]$ and $u^{(4)} = [1, 0]$
- $u^{(1)} = [1, 0], u^{(2)} = [1, 0], u^{(3)} = [0, 1]$ and $u^{(4)} = [0, 1]$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$PM_1 = 14, PM_2 = 15, PM_3 = 17 \text{ and } PM_4 = 20$

10 Consider decoding a received vector from a coded-BPSK transmission using the $(32, 20)$ Polar code over an AWGN channel, with the successive cancellation list decoder. If the list size is 4, the codeword bit position (numbered from 1 to $N$) at which the fourth decoder gets activated is _______. (Use the same reliability sequence as mentioned in class).

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Numeric) 12