ITC IAT-1

Answer any 5 full questions.
Make use of workbook for solving all the questions.
Write your USN in each page of the workbook in the left top corner.
At the end of the test you'll be asked to upload the same to this form.
* Required

1. Email address *

Student details

2. Name *

3. USN *

4. Section *

Mark only one oval.

- A
- B
- C
- D
- E

Q1.

Find the relationship between Hartleys, nats and bits.

5. 1 Hartley = 2 points

Mark only one oval.

- 2.303 nats
- 3.32 nats
- 1 nat
- 0 nat

6. 1 Hartley = 2 points

Mark only one oval.

- 2.303 bits
- 3.32 bits
- 1 bits
- 0 bit

7. 1 nat= 2 points

Mark only one oval.

- 2.303 Hartley
- 3.32 Hartley
- 0.434 Hartley
- 1.442 Hartley

8. 1 nat= 2 points

Mark only one oval.

- 2.303 bits
- 3.32 bits
- 0.434 bits
- 1.442 bit

9. 1 bit= 2 points

Mark only one oval.

- 0.301 Hartley
- 3.32 Hartley
- 0.434 Hartley
- 1.442 Hartley

Q2. A code is composed of dots and dashes. Assuming that a dash is 4 times as long as a dot and dash has one fourth the probability of a dot. Calculate,

10. pdot = _____ 1 point

Mark only one oval.

- 1/5
- 2/5
- 3/5
- 4/5

11. pdash = _____ 1 point

Mark only one oval.

- 1/5
- 2/5
- 3/5
- 4/5

12. ldot= _____ 1 point

Mark only one oval.

- 0.321 bits
- 0.390 bits
- 1 bit
- 2 bits

13. ldash= _____ 1 point

Mark only one oval.

- 0.321 bits
- 0.390 bits
- 1 bit
- 2 bits

14. H(S)= _____ 2 points

Mark only one oval.

- 0.07575 bits/symbol
- 0.7575 bits/symbol
- 0.07575 bits/sec
- 2 bits/sec

15. rs = _____ 2 points

Mark only one oval.

- 41.667 symbol/ sec
- 41.667 bits/symbol
- 0.07575 symbol/sec
- 2 bits/sec

16. Rs = _____ 2 points

Mark only one oval.

- 41.667 symbol/ sec
- 31.5628 bits/symbol
- 31.5628 symbol/sec
- 31.5628 bits/sec

Q3. A binary source is emitting an independent sequence of 0's and 1's with probabilities p and 1-p respectively. compute H(S) when. Note: After decimal . give only 3 digits.

17. p=0.1 ==> H(S) =_____ bits/symbol 1 point

18. p=0.2 ==> H(S) =_____ bits/symbol 1 point

19. p=0.3 ==> H(S) =_____ bits/symbol 1 point

20. p=0.4 ==> H(S) =_____ bits/symbol 1 point

21. p=0.5 ==> H(S) =_____ bits/symbol 1 point

22. p=0.6 ==> H(S) =_____ bits/symbol 1 point

23. p=0.7 ==> H(S) =_____ bits/symbol 1 point

24. p=0.8 ==> H(S) =_____ bits/symbol 1 point

25. p=0.9 ==> H(S) =_____ bits/symbol 1 point

26. p=1 ==> H(S) =_____ bits/symbol 1 point

Q4. In a facsimile transmission of picture, there are about 2.25 X 1000000 pixels/frame. For a good reproduction 12 brightness levels are necessary. Assume all these levels are equally likely to occur.

27. Hmax = _____ 3 points

Mark only one oval.

- 8.066 X 10^6 bits/picture
- 8.066 X 10^5 bits/picture
- 8.066 X 10^4 bits/picture
- 8.066 X 10^2 bits/picture

28. Find the rate of information if one picture is to be transmitted every 3 minutes. (rs = _____ picture/sec) 3 points

Mark only one oval.

- 1/(3X60)
- 3 X 60
- 8.066
- 0

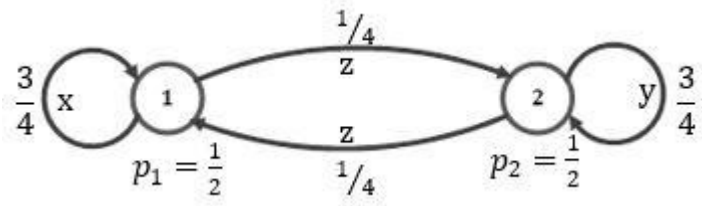
29. Average rate of information. 4 points

Mark only one oval.

- 44812 bits/sec
- 44812 bits/symbol
- 44812 bits/picture
- 44812 picture/sec

Q5. For the Markov model shown in the figure 5. Calculate the entropy of the each state, entropy of the source and also show that $G1 \geq G2 \geq H$

Markov model figure 5.



30. Entropy of state 1. H1 = _____ 1 point

Mark only one oval.

- 0.8113 bits
- 0.8113 bits/symbol
- 0.8113 symbol

31. Entropy of state 2. H2 = _____ 1 point

Mark only one oval.

- 0.8113 bits
- 0.8113 bits/symbol
- 0.8113 symbol

32. Entropy of the source. H = _____ 2 points

Mark only one oval.

- 0.8113 bits
- 0.8113 bits/symbol
- 0.8113 symbol

33. G1 = _____ 2 points

Mark only one oval.

- 1.56 bit/symbol
- 1.56 symbol/bit
- 1.56 bit/sec
- 1.56 symbol/symbol

34. G2 = _____ 2 points

Mark only one oval.

- 1.28 bit/symbol
- 1.56 symbol/bit
- 1.56 bit/sec
- 1.56 symbol/symbol

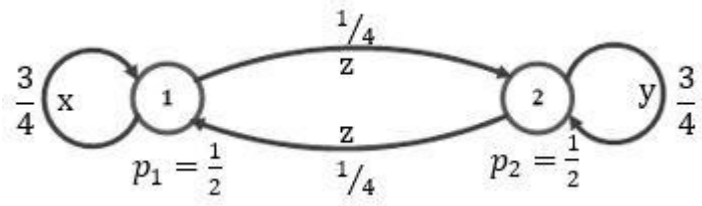
35. Which is the following relationship is true among these 2 points

Mark only one oval.

- $G1=G2=H$
- $G1 \geq G2 \geq H$
- $G1 < G2 < H$
- $G1 > G2 > H$

Q5. For the Markov model shown in the figure 5. Calculate the probability of the said symbols with help of tree diagram.

Markov model figure 5.



36. Prob(x) = 1 point

37. Prob(y) = 1 point

38. Prob(z) = 1 point

39. Prob(xx) = 1 point

40. Prob(xy) = 1 point

41. Prob(xz) = 1 point

42. Prob(yx) = 1 point

43. Prob(yy) = 1 point

44. Prob(yz) = 1 point

45. Prob(zz) = 1 point

Upload all pages of the workbook that you have used to solve all this test.

46. PDF of the workbook only is allowed *

Files submitted:

Q.1

~~Hartley~~ =

$I = -\log_{10} p(x)$ hartleys

$I = -\log_e p(x)$ nats

$I = -\log_2 p(x)$ bits.

1 hart = $\frac{I}{-\log_{10} p(x)}$

$= \frac{-\log_e p(x)}{-\log_{10} p(x)}$

$= \frac{-\log_p (10)}{-\log_p (e)} = \log_e (10) = 2.303$ nats

1 hart = $\frac{I}{-\log_{10}(p)}$

$= \frac{-\log_2 (p)}{-\log_{10} p} = \frac{-\log_p (10)}{-\log_p (2)} = \log_2 (10)$

$= 3.321$ bits.

1 nat = $\frac{I}{-\log_e p} = \frac{-\log_{10} p}{-\log_e p} = \frac{-\log_p e}{-\log_p (10)}$

$= \log_{10} (e) = 0.434$ hart

1 nat = $\frac{I}{-\log_e p} = \frac{-\log_2 p}{-\log_e p} = \frac{-\log_p e}{-\log_p 2} = \log_2 (e)$

$= 1.442$ bits //

1 bit = $\frac{I}{-\log_2 p(x)} = \frac{-\log_{10} p}{-\log_2 p} = \frac{-\log_p 2}{-\log_p 10} = \log_{10} (2)$

$= 0.301$ hart

Q.2.

• Given -

dash = 4 times as a dot.

$P(\text{dash}) = \frac{1}{4}$ th $P(\text{dot})$.

$P(\text{dot}) + P(\text{dash}) = 1$

$P(\text{dot}) + \frac{1}{4} P(\text{dot}) = 1$

$\frac{5}{4} P(\text{dot}) = 1$

(i) $P(\text{dot}) = \frac{4}{5}$ //

(ii) $P(\text{dash}) = \frac{1}{4} \times \frac{4}{5} = \frac{1}{5}$ //

(iii) $I_{dot} = \log_2\left(\frac{1}{P_{dot}}\right)$

$= \log_2 \frac{5}{4} = 0.321$ bits

(iv) $I_{dash} = \log_2 5 = 2.32$ bits

≈ 2 bits

(v) $H(S) = \sum_{i=1}^{2} P_i \log_2(1/P_i)$

$= \frac{4}{5} \times \log_2\left(\frac{5}{4}\right) + \frac{1}{5} \times \log_2(5)$

$= 0.7208$ bits/symbol

(vi) $r_s =$

$\frac{10^m}{10^m \text{ sec}}$

5 symbols in 120×10^{-3} sec

1 sec

$2 = 5$ $r_s = 41.66$ symbol/sec

$R_s = H \times r_s = 0.720 \times 41.66$

$= 30.04$ bits/sec.

Q.3.

0's & 1's

p & 1-p.

$H(S) = p \log \frac{1}{p} + (1-p) \log \frac{1}{1-p}$.

$p = 0.1$

$H(S) = 0.33219 + 0.13680$

$= 0.469$ bits/symbol.

$p = 0.2$

$H(S) = 0.464 + 0.257$

$= 0.721$ bits/symbol

$p = 0.3$

$H(S) = 0.521 + 0.360$

$= 0.881$ bits/symbol

$p = 0.4$

$H(S) = 0.529 + 0.442$

$= 0.971$ bits/symbol

$p = 0.5$

$H(S) = \log_2(2) = 1$

$p = 0.6$

$p = 0.6$

$H(S) = 0.442 + 0.529$.

$= 0.971$

$P(0.7) = H(S)$ when $p = 0.3$

$= 0.881$ //

$= (0.521 + 0.360)$

$P(0.8) = H(S)$ when $p = 0.2$

$= 0.721$ //

$= (0.464 + 0.257)$

$P(0.9) = H(S)$ when $p = 0.1$

$= 0.469$ //

$= (0.33219 + 0.13680)$.

Q.4

2.25×10^6 pixels/frame.

12 brightness levels

$$q = 12^{2.25 \times 10^6}$$

$$H_{max} = \log_2 q$$

$$= 2.25 \times 10^6 \times \log_2 12$$

$$= 8.066 \times 10^6 \text{ bits/picture}$$

1 pic → 3 minutes = 180 sec.

x → 1 sec

$$x = \frac{1}{180} = \frac{1}{3 \times 60}$$

$$r_s = \frac{1}{3 \times 60} = \text{pictures/sec}$$

$$R = r_s \cdot H_{max}$$

$$= 44812 \text{ bits/sec}$$

Q.5

(i). H_1.

$$H_1^\circ = \sum_{j=1}^{2} P_{1j}^\circ \log_2 \left(\frac{1}{P_{1j}^\circ}\right)$$

$$H_1 = \sum_{j=1}^{2} P_{1j}^\circ \log_2 \left(\frac{1}{P_{1j}^\circ}\right)$$

$$= P_{11} \log_2 \left(\frac{1}{x}\right) + P_{12} \log_2 \left(\frac{1}{\quad}\right)$$

$= \frac{3}{4}\log_2\left(\frac{4}{3}\right) + \frac{1}{4}\log_2 4$

$= 0.8113$ bits/symbol

(ii) H_2

$= P_{21}\log_2\left(\frac{1}{P_{21}}\right) + P_{22}\log_2\left(\frac{1}{P_{22}}\right)$

$= \frac{1}{4}\log_2 4 + \frac{3}{4}\log_2\left(\frac{4}{3}\right)$

$= 0.8113$ bits/symbol

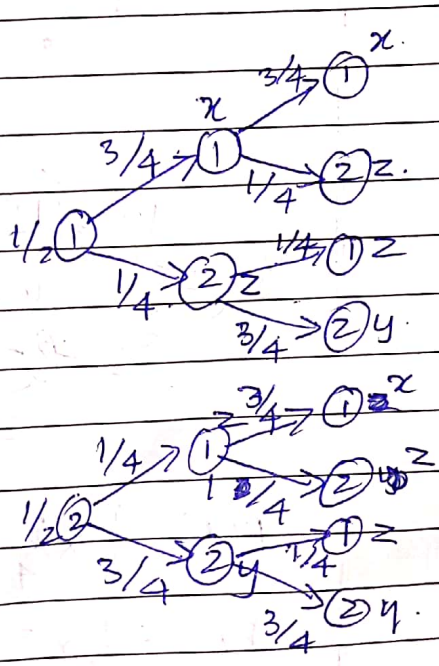
(iii) $H = P_1H_1 + P_2H_2$.

$= \frac{1}{2} \times 0.8113 + \frac{1}{2} \times 0.8113$

$= 0.8113$ bits/symbol

(iv) $G_1 =$

$H_1 = \sum_{i=1}^{2} P_i \left(\log \frac{1}{P_i}\right)$



length - 1 3 symbols

$P(z) = \frac{3}{4} \times \frac{1}{2} = \frac{3}{8}$

$P(z) = 1/2 \times \left(\frac{1}{2}\right)$

$P(y) = 3/4 \times \frac{1}{2}$

$H_1 = \frac{3}{8} \times 2 \log\left(\frac{8}{3}\right) + \frac{1}{4}\log_2 4.$

$= 1.56$ bits/symbol.

$G_1 = 1.56$ bit/symbol.

(v) $P(xx) = P(xy) = P(yx) = P(yy) = 3/32.$

$P(zx) = P(zy) = 9/32$ $P(zz) = 2/32.$

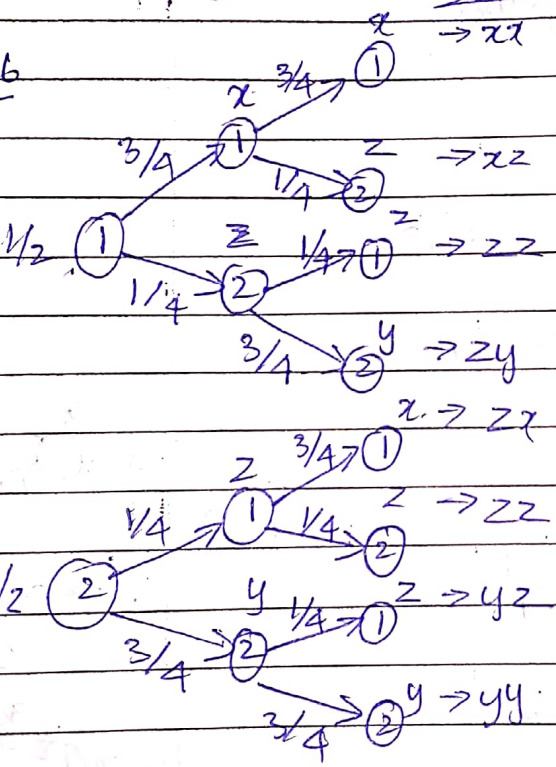
$$H_2 = \frac{9}{32}\log_2\left(\frac{32}{9}\right) \times 2 + \frac{3}{32}\log_2\left(\frac{32}{3}\right) \times 4$$

$$+ \frac{2}{32} \times 4 \log_2\left(\frac{32}{2}\right)$$

$$= 2.56 \text{ bits/symbol}$$

$$G_2 = \frac{2.56}{2} = 1.28 \text{ bits/sym}$$

Q.6



$$P(x) = \frac{1}{2} \times \frac{3}{4} = \frac{3}{8} = 0.375$$

$$P(y) = \frac{1}{2} \times \frac{3}{4} = \frac{3}{8} = 0.375$$

$$P(z) = 2 \times \frac{1}{4} \times \frac{1}{2} = \frac{1}{4} = 0.25$$

$$P(xx) = \frac{1}{2} \times \frac{3}{4} \times \frac{3}{4} = \frac{9}{32}.$$

$P(xy) = 0$

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$P(xxz) = \frac{1}{2} \times \frac{3}{4} \times \frac{1}{4} = \frac{3}{32}$

$P(yx) = 0$

$P(yy) = \frac{1}{2} \times \frac{3}{4} \times \frac{3}{4} = \frac{9}{32}$

$P(yz) = \frac{1}{2} \times \frac{3}{4} \times \frac{1}{4} = \frac{3}{32}$

$P(zz) = \frac{1}{2} \times \frac{1}{4} \times \frac{1}{4}$

$= \frac{2}{32}$