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Question 1

$H(Y) = -\sum_{i=1}^{k} P(Y=y_i) \log_2 P(Y=y_i)$

$P(Y=\text{Meh}) = 5/10 = 1/2$

$P(Y=\text{Yummy}) = 5/10 = 1/2$

$H(Y) = -1/2 \log_2 1/2 - 1/2 \log_2 1/2 = 1/2 + 1/2 = 1$

Question 2

$IG(X) = H(Y) - H(Y|X)$

$IG(X=\text{Visual Defects}) = H(Y) - H(Y|X=\text{Visual Defects})$

$H(Y) = 1$

$H(Y|X) = -\sum_{j=1}^{v} P(X=x_j) \sum_{i=1}^{k} P(Y=y_i|X=x_j) \log_2 P(Y=y_i|X=x_j)$

$P(\text{Visual Defects} = \text{some}) = 3/10$

$P(\text{Visual Defects} = \text{none}) = 4/10$

$P(\text{Visual Defects} = \text{many}) = 3/10$

X

	some	None	many
Y=Meh	3	2	0
Y=Yummy	0	2	3

$-3/10(1\log_2 1 + 0\log_2 0) - 4/10(1/2 \log_2 1/2 + 1/2 \log_2 1/2) - 3/10(0\log_2 0 + 1\log_2 1)$

$= 4/10 = 0.4$

$IG(X) = 1 - 0.4 = 0.6$

Question 3

$H(\text{Taste} \mid \text{Visual Defect} == \text{some})$

$= -P(X=\text{some})(P(Y=\text{Meh}|X=\text{some}) \log_2 P(Y=\text{Meh}|X=\text{some}) + P(Y=\text{Yummy}|X=\text{some}) \log_2 P(Y=\text{Yummy}|X=\text{some}))$

$= -3/10(1\log_2 1 + 0\log_2 0) = 0$

$H(\text{Taste} \mid \text{visual Defect} == \text{None})$

$= -P(X=\text{none})(P(Y=\text{meh}|X=\text{none}) \log_2 P(Y=\text{meh}|X=\text{none}) + P(Y=\text{Yummy}|X=\text{none}) \log_2 P(Y=\text{Yummy}|X=\text{none}))$

$= -4/10(1/2 \log_2 1/2 + 1/2 \log_2 1/2) = -4/10(-0.5 - 0.5) = -4/10(-1)$

$= 4/10 = 0.4$