**Assignment5 ML2022**

| Taste | Farm climate | Visual defects | Size |
|---|---|---|---|
| Meh | Warm | Some | Small |
| Meh | Cold | None | Large |
| Meh | Cold | None | Large |
| Yummy | Cold | Many | Small |
| Yummy | Warm | Many | Small |
| Meh | Warm | Some | Large |
| Yummy | Warm | Many | Large |
| Yummy | Cold | None | Small |
| Yummy | Cold | None | Small |
| Meh | Warm | Some | Large |

# Question1:

Support you want to build a decision tree. What is the initial entropy of the target variable taste?

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

P(Taste=Meh) = ½,  P(Taste=Yummy) = ½,
H(Taste) = -½*log(½)-½*log(½) = 1

# Question2:

Consider that the variable Visual defects is chosen as the root of the decision tree. What is the information gain of the decision tree?

$$IG(X) = H(Y) - H(Y \mid X)$$

H(Taste| Visual Defect) = 4/10

IG(Visual defects) = H(Taste) - H(Taste| visual defect) = 1 - 4/10 = 6/10

# Question3:

What is entropy H(Taste|Visual Defect == Some) and the entropy H(Taste|Visual Defect == None)?

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

Solution:
P(Visual Defect == Some) = 3/10,

P(Visual Defect == None) = 4/10,
P(Visual Defect == Many) = 3/10,

P(Taste= Meh|Visual Defect = Some) = 1, P(Taste= Yummy|Visual Defect = Some) = 0
P(Taste= Meh|Visual Defect = None) = 1/2, P(Taste= Yummy|Visual Defect = Some) = ½
P(Taste= Meh|Visual Defect = Many) = 0, P(Taste= Yummy|Visual Defect = Some) = 1

H(Taste|Visual Defect == Some) =  -3/10 * (1log(1)+0*log(0)  = 0
H(Taste|Visual Defect == None) = - 4/10*(½*log(½)+ ½*log(½)) = 4/10
H(Taste|Visual Defect == Many) = -3/10*(0*log(0) + 1*log(1)) = 0

H(Taste| Visual Defect) = 4/10