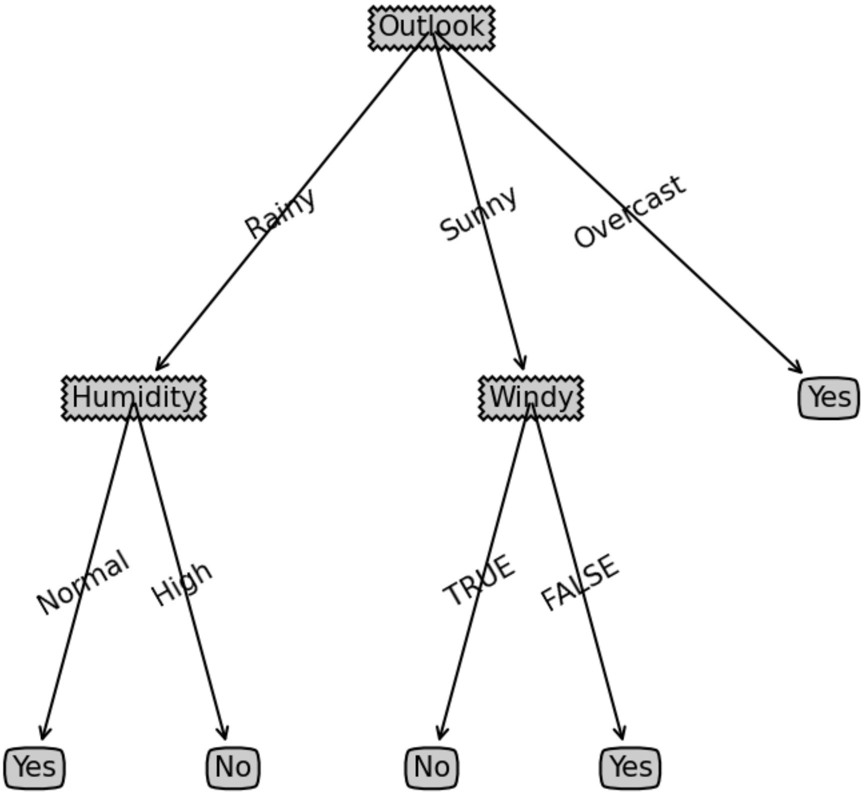
Assignment 4:

1)



2) Implemented code:

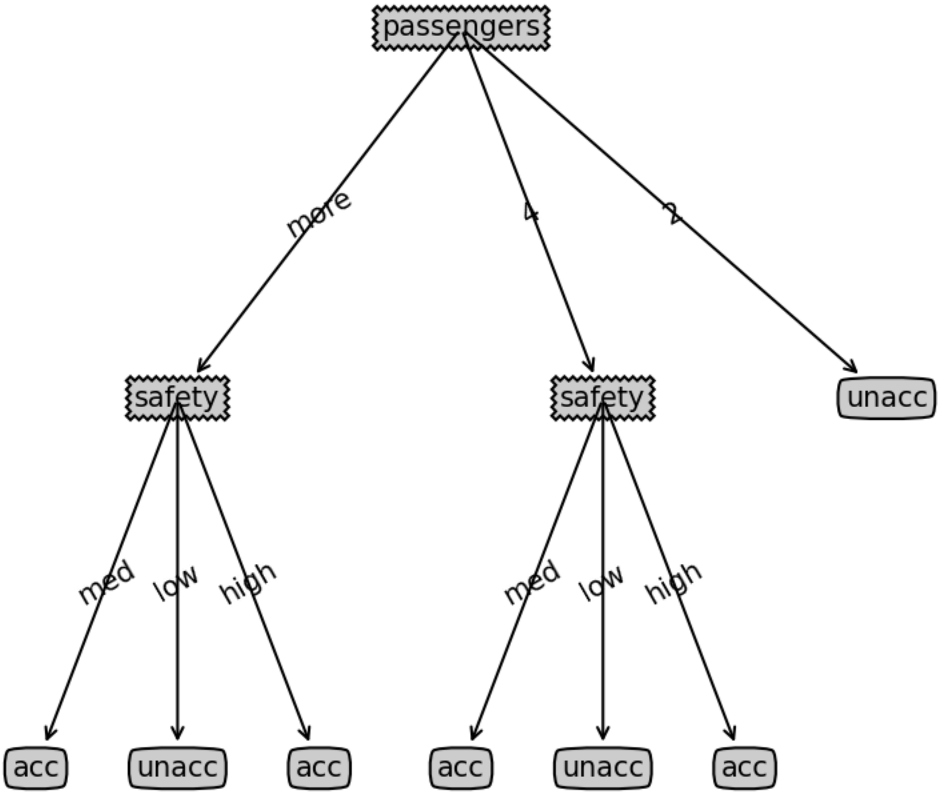
```
def gini_index(Splitting_Feature):
    """
    Given the observations of a Feature, calculating the GINI index (measure
for impurity)
    """

    observations = list()

    for unq_values in np.unique(Splitting_Feature):
        y_count = 0
        for values in Splitting_Feature:
            if values == unq_values:     # example: Unique Attribute Values
for Labels: Yes, No
                y_count = y_count + 1
        observations.append(y_count)

    if(len(np.unique(Splitting_Feature)) != 1):
        n = sum(observations)
        p1 = observations[0]/n
        p2 = observations[1]/n
        gini_ind = (1.0 - ((p1**2)+(p2**2)))

    else:
        n = sum(observations)
        p1 = observations[0]/n
        gini_ind = (1.0 - p1**2)

    return gini_ind
```

```
def chooseBestFeature(dataSet):
    '''
    choose best feature to split based on Gini index

    Parameters
    -----------------
    dataSet: 2-D list
        [n_sampels, m_features + 1]
        the last column is class label

    Returns
    ------------------
    bestFeatId: int
        index of the best feature
    '''
    classlabels = list()
    classlabels = [row[len(dataSet[0])-1] for row in dataSet]

    gini_classlabels = gini_index(classlabels)

    # Initialization
    InfoGain = list()
    bestFeatId = 999
    bestInfoGain = -1

    for index in range(len(dataSet[0])-1):
        feature = list()      # contains attribute values
        gini_ind = list()     # to store the required gini index values accordingly

        for row in dataSet:
            feature.append(row[index])
        n = len(feature)      # no. of values

        for fval in np.unique(feature):      # Consider only unique attribute
values
            value = list()     # contains unique attribute values
            value.append(fval)
            subset1 = list()      # to find the subset based on the given axis
and feature values
            value = set(value)

            for row in dataSet:
                if value.issubset(row):
                    subset1.append(row[len(dataSet[0])-1])

            n1 = len(subset1)     # no. of values in subset

            gini = gini_index(subset1)
            gini_ind.append((n1/n)* gini)

        gini_feature = sum(gini_ind)
        InfoGain.append(gini_classlabels - gini_feature)

    bestFeatId = InfoGain.index(max(InfoGain))
    bestInfoGain = max(InfoGain)

    # Find best gain and corresponding feature ID
    return bestFeatId
```

```
def stopCriteria(dataSet):
    '''
    Criteria to stop splitting:
    1) if all the classe labels are the same, then return the class label;
    2) if there are no more features to split, then return the majority label
of the subset.

    Parameters
    -----------------
    dataSet: 2-D list
        [n_sampels, m_features + 1]
        the last column is class label

    Returns
    ------------------
    assignedLabel: string
```

```
        if satisfying stop criteria, assignedLabel is the assigned class
label;
        else, assignedLabel is None
    '''
    assignedLabel = None
    no_of_columns = len(dataSet[0])
    classlabels = []
    classlabels = [row[no_of_columns - 1] for row in dataSet]


    # A set cannot have duplicates.
    # So if all the elements in the original list are identical,
    # the set will have just one element.
    if len(set(classlabels)) == 1:
        assignedLabel = classlabels[0]

    # Finding Feature Space:
    bestFeatId = chooseBestFeature(dataSet)

    features = [index for index in range(len(dataSet[0])-1) if index !=
bestFeatId]

    if len(features) == 0:  # Implies: no more features to split
        assignedLabel = max(set(classlabels), key = classlabels.count)   #
Finding Mode of the classlabels list - Python: Naive Approach


    return assignedLabel
```

3) Car data set:


passengers
more
4
2
safety
safety
unacc
med
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med
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