Subject: 19CSE305

Lab Session: 07

Notes:

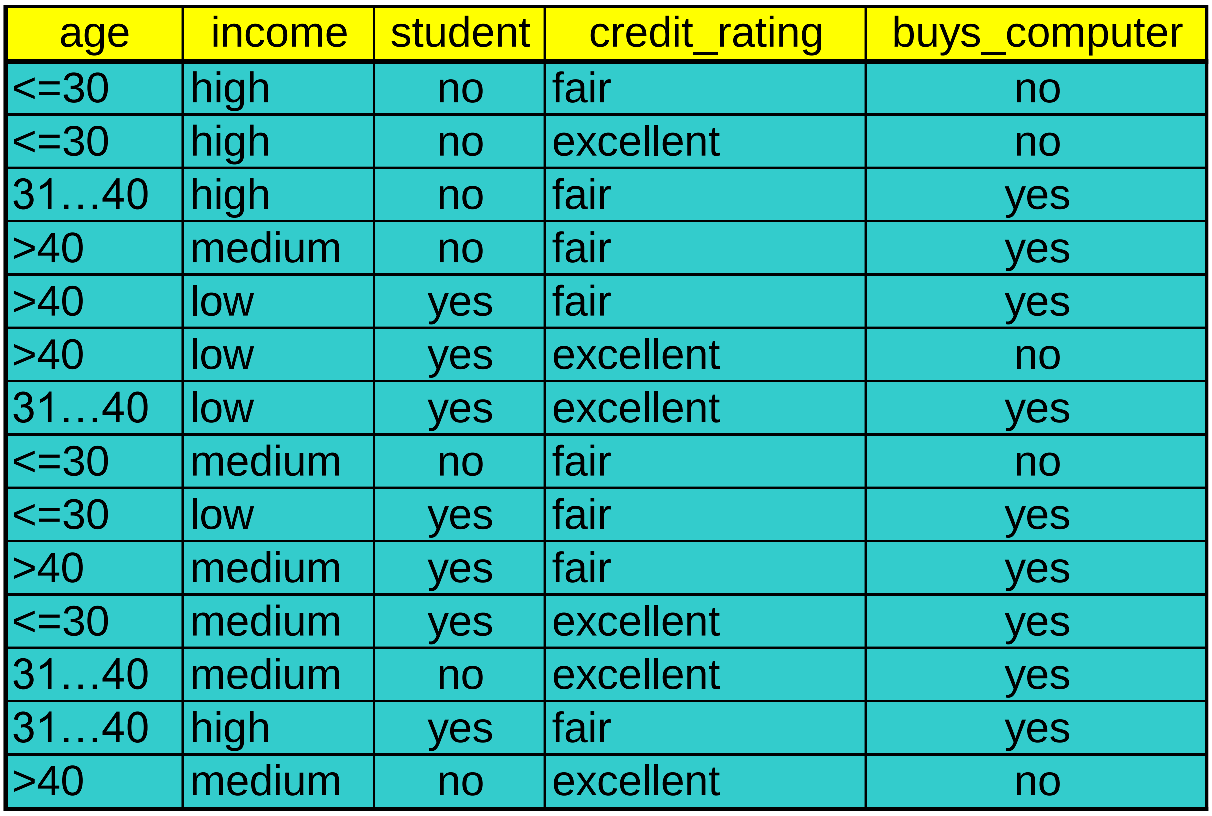
1. Please read the assignment notes carefully and comply to the guidelines provided.
2. Code should be checked into the GitHub and the report to TurnItIn. Once done, please submit your assignments in Teams.
3. Code non-availability in GitHub shall be marked as zero.
4. Any content copy (statements, figures, codes etc.) from anywhere shall attract a penalty of 10 marks. If you obtain content from anywhere for illustration purposes, please cite the source to avoid penalty.
5. Snapshot / screenshot of code and results not allowed in the report. You may copy content from your own code & results and add to the report.
6. Provide data, code snippets or illustrations to support your answer, as applicable.

Please use the data associated with your own project.

Refer: https://scikit-learn.org/stable/modules/tree.html

Main Section (Mandatory):

A1. For the data table provided below, calculate the entropy associated with each attribute / feature at the root node. Using this information, identify the first feature that you'd select for constructing the decision tree. Use Information Gain as the impurity measure to identify the root node. 'buys_computer' is the class label.



age	income	student	credit_rating	buys_computer
<=30	high	no	fair	no
<=30	high	no	excellent	no
31…40	high	no	fair	yes
>40	medium	no	fair	yes
>40	low	yes	fair	yes
>40	low	yes	excellent	no
31…40	low	yes	excellent	yes
<=30	medium	no	fair	no
<=30	low	yes	fair	yes
>40	medium	yes	fair	yes
<=30	medium	yes	excellent	yes
31…40	medium	no	excellent	yes
31…40	high	yes	fair	yes
>40	medium	no	excellent	no

A2. Create a Decision Tree for the above data. Get the depth of the constructed tree.

```
model = DecisionTreeClassifier()

model = ml_model.fit(Tr_X,Tr_y)

model.score(Tr_X, Tr_y)#Training Set accuracy

print(model.get_depth())#print the tree depth
```

A3. Visualize the constructed tree with plot_tree() command. Following code snippet for help.

```
import matplotlib.pyplot as plt

from sklearn import tree

plt.figure(figsize=(70,20))

plot_tree(model, filled=True)

plt.show()
```

A4. Create a Decision Tree classifier on your project data. Study the accuracy for training and test data and infer the accuracy of tree construction. Plot the Decision Tree obtained above. Below code for help.

```
model = DecisionTreeClassifier()

model = ml_model.fit(Tr_X,Tr_y)

model.score(Tr_X, Tr_y)#Training Set accuracy

model.score(Te_X,Te_y)#Test Set Accuracy
```

A5. Impose a max_depth constraint on the tree construction. Construct the tree again and check the accuracies. Visualize the tree constructed with max_depth constraint.

```
model = DecisionTreeClassifier(max_depth=5)
```

A6. Study the criterion of the DT in the above model. Change the criterion to “Entropy” and study the model & graph. Find the differences between the default criterion and entropy criterion. Refer code below for criterion.

```
DecisionTreeClassifier(criterion="entropy")
```

Optional Section:

O1. Perform hyper-parameter tuning on the decision tree. After hyper-parameter tuning, check the hyper-parameter values for criterion, depth etc. Following code for help.

```
from sklearn.model_selection import GridSearchCV

from sklearn.cross_validation import  cross_val_score

tree_para =
{'criterion':['gini','entropy'],'max_depth':[4,5,6,7,8,9,10]}
```

```
model = GridSearchCV(DecisionTreeClassifier, tree_para, cv=5)

model.fit(X, Y)
```

Report Assignment:

1. Justify why information gain is a suitable measure to select an attribute for DT construction. Refer to the class notes and the formula below.

$$Gain(S, A) \equiv Entropy(S) - \sum_{v \in Values(A)} \frac{|S_v|}{|S|} Entropy(S_v)$$

   Which classifier would you choose for your classification problem? Provide justifications for your choice. [2]

2. If a case of equal value for the criterion measure happens at a node, what would be your approach to resolve the conflict? [2]