First we load the libraries we will need for reading and formatting the input data (pandas for the dataframe structure, train_test_split from sklearn to split the data into test and training sets). Then we load DecisionTreeClassifier from Sklearn to use the decision tree model.

```
[37] import pandas as pd
     import matplotlib.pyplot as plt
     from sklearn.model_selection import train_test_split
     from sklearn.tree import DecisionTreeClassifier
```

The loaded data is parsed like a csv file into a pandas dataframe structure

```
[38] df = pd.read_csv('Mushrooms.01.txt', sep="  ", encoding='latin-1')  #invisible separator is some kind of utf arrow in the source file
     df
```

	Id	Odorant	Anneaux	Chapeau bombé	Pied large	Tâches	Comestible
0	champignon 1	1	0	1	1	0	1
1	champignon 2	1	0	1	1	1	1
2	champignon 3	0	0	1	1	1	1
3	champignon 4	1	0	0	1	1	0
4	champignon 5	0	0	1	1	0	1
5	champignon 6	1	0	1	1	0	1
6	champignon 7	0	0	1	1	0	1
7	champignon 8	1	1	0	1	0	1
8	champignon 9	0	0	1	1	0	0
9	champignon 10	1	1	1	1	0	1
10	champignon 11	0	0	1	0	1	1
11	champignon 12	0	1	1	1	0	0
12	champignon 13	1	1	1	1	0	0
13	champignon 14	1	0	1	1	0	1
14	champignon 15	0	0	0	1	1	1
15	champignon 16	0	0	1	1	0	1
16	champignon 17	0	1	0	0	1	0
17	champignon 18	1	0	1	1	1	1
18	champignon 19	1	0	1	1	0	1
19	champignon 20	0	0	1	1	0	1
20	champignon 21	1	1	1	0	1	1
21	champignon 22	1	0	1	1	1	1
22	champignon 23	0	0	1	1	1	1
23	champignon 24	0	0	1	0	0	0

We then isolate the label "Comestible" as the desired predictions "y" :

```
[39] y = df.Comestible #these are the labels we want to predict
     y
```

```
0     1
1     1
2     1
3     0
4     1
5     1
6     1
7     1
8     0
9     1
10    1
11    0
12    0
13    1
14    1
15    1
16    0
17    1
18    1
19    1
20    1
21    1
22    1
23    0
Name: Comestible, dtype: int64
```

Here, we drop useless input columns from our dataset x.

```
[40] x = df.drop("Comestible", axis=1) #this is the input data, so we remove the "truth" column (now stored in "y" variable)
     x = x.drop("Id", axis=1) #the id is useless as we already have ids and it is not a mushroom caracteristic
     x
```

	Odorant	Anneaux	Chapeau bombé	Pied large	Tâches
0	1	0	1	1	0
1	1	0	1	1	1
2	0	0	1	1	1

3	1	0	0	1	1
4	0	0	1	1	0
5	1	0	1	1	0
6	0	0	1	1	0
7	1	1	0	1	0
8	0	0	1	1	0
9	1	1	1	1	0
10	0	0	1	0	1
11	0	1	1	1	0
12	1	1	1	1	0
13	1	0	1	1	0
14	0	0	0	1	1
15	0	0	1	1	0
16	0	1	0	0	1
17	1	0	1	1	1
18	1	0	1	1	0
19	0	0	1	1	0
20	1	1	1	0	1
21	1	0	1	1	1
22	0	0	1	1	1
23	0	0	1	0	0

Our data has been cleaned up and separated into x (inputs) and y (desired outputs). We must split it for cross-validation.

```
[41] X_train, X_test, y_train, y_test = train_test_split(x, y, test_size=0.3) #separate the data into train and test variables
```

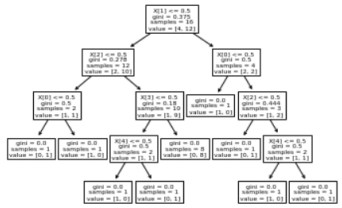
Our clean mushroom data is then used to fit the decision tree

```
[62] clf = DecisionTreeClassifier().fit(X_train, y_train)
```

We then display the decision tree

```
[63] from sklearn import tree
     tree.plot_tree(clf)
```

```
[Text(167.4, 195.696, 'X[1] <= 0.5\ngini = 0.375\nsamples = 16\nvalue = [4, 12]'),
 Text(103.01538461538462, 152.208, 'X[2] <= 0.5\ngini = 0.278\nsamples = 12\nvalue = [2, 10]'),
 Text(51.50769230769231, 108.72, 'X[0] <= 0.5\ngini = 0.5\nsamples = 2\nvalue = [1, 1]'),
 Text(25.753846153846155, 65.232, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
 Text(77.26153846153846, 65.232, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
 Text(154.52307692307693, 108.72, 'X[3] <= 0.5\ngini = 0.18\nsamples = 10\nvalue = [1, 9]'),
 Text(128.76923076923077, 65.232, 'X[4] <= 0.5\ngini = 0.5\nsamples = 2\nvalue = [1, 1]'),
 Text(103.01538461538462, 21.744, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
 Text(154.52307692307693, 21.744, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
 Text(180.27692307692308, 65.232, 'gini = 0.0\nsamples = 8\nvalue = [0, 8]'),
 Text(231.7846153846154, 152.208, 'X[0] <= 0.5\ngini = 0.5\nsamples = 4\nvalue = [2, 2]'),
 Text(206.03076923076924, 108.72, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
 Text(257.53846153846155, 108.72, 'X[2] <= 0.5\ngini = 0.444\nsamples = 3\nvalue = [1, 2]'),
 Text(231.7846153846154, 65.232, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
 Text(283.2923076923077, 65.232, 'X[4] <= 0.5\ngini = 0.5\nsamples = 2\nvalue = [1, 1]'),
 Text(257.53846153846155, 21.744, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
 Text(309.04615384615386, 21.744, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]')]
```



```
[74] print("We compare the predicted with true results : ")
     print("Predicted : " + str(clf.predict(X_test)) + " \n Truth :    "  + str(y_test.values))
```

```
We compare the predicted with true results :
Predicted : [1 1 1 0 0 1 1 1]
 Truth :    [1 1 0 0 1 1 1 1]
```

```
[77] percentage = clf.score(X_test, y_test)
     percentage
```

```
0.75
```

We can then show a confusion matrix : in this case, we have a lot of predictions falling outside of the diagonal, which indicate a low accuracy (as the accuracy score confirms).

```
[79] from sklearn.metrics import confusion_matrix
     res = confusion_matrix(y_test, clf.predict(X_test)) #create a confusion matrix to display TN/TP/FP/FN
     print("Confusion Matrix : ")
     print(res)
     print(f"Test Set : {len(X_test)}")
     print(f"Accuracy = {percentage*100} %")
```

```
Confusion Matrix :
[[1 1]
```

```
 [1 5]]
Test Set : 8
Accuracy = 75.0 %
```

The decision tree gives worse results than the SVM as the split between test and train samples is decisive in the tree classifier structure fitting process. Depending on this split, the accuracy varies between 30% and 85%. This indicates an unbalanced dataset (not enough poisonous mushrooms) and not enough data. If we run this notebook several times, we can emultate a ksplit validation and observe that the variance is too high.