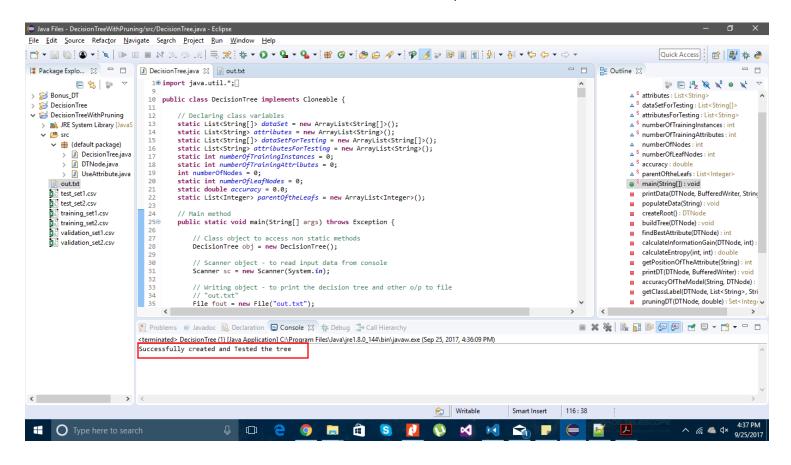1. Below is the screen shot, where we can see the code has ran successfully

2. Below is the output in out.txt –

```
XO = 0 :
|  XM = 0 :
|  |  XF = 0 :
|  |  |  XB = 0 :
|  |  |  |  XG = 0 : 0
|  |  |  |  XG = 1 :
|  |  |  |  |  XD = 0 :
|  |  |  |  |  |  XS = 0 : 0
|  |  |  |  |  |  XS = 1 :
|  |  |  |  |  |  |  XC = 0 : 1
|  |  |  |  |  |  |  XC = 1 :
|  |  |  |  |  |  |  |  XH = 0 : 0
|  |  |  |  |  |  |  |  XH = 1 : 1
|  |  |  |  |  XD = 1 :
|  |  |  |  |  |  XP = 0 :
|  |  |  |  |  |  |  XE = 0 : 0
|  |  |  |  |  |  |  XE = 1 : 1
|  |  |  |  |  |  XP = 1 : 0
|  |  |  XB = 1 :
|  |  |  |  XD = 0 : 0
|  |  |  |  XD = 1 :
```

```
| | | | | | XI = 0 : 0
| | | | | | XI = 1 :
| | | | | | | XN = 0 : 0
| | | | | | | XN = 1 : 1
| | XF = 1 : 0
| XM = 1 :
| | XB = 0 :
| | | XF = 0 :
| | | | XG = 0 : 0
| | | | XG = 1 :
| | | | | XD = 0 : 1
| | | | | XD = 1 :
| | | | | | XC = 0 :
| | | | | | | | XS = 0 : 0
| | | | | | | | XS = 1 :
| | | | | | | | | XR = 0 : 1
| | | | | | | | | XR = 1 : 0
| | | | | | | XC = 1 : 0
| | | XF = 1 :
| | | | XS = 0 :
| | | | | XQ = 0 :
| | | | | | | XI = 0 : 0
| | | | | | | XI = 1 :
| | | | | | | | XP = 0 : 0
| | | | | | | | XP = 1 : 1
| | | | | XQ = 1 :
| | | | | | XI = 0 : 1
| | | | | | XI = 1 :
| | | | | | | | XL = 0 : 1
| | | | | | | | XL = 1 :
| | | | | | | | | XT = 0 : 0
| | | | | | | | | XT = 1 : 1
| | | | XS = 1 :
| | | | | XR = 0 :
| | | | | | XD = 0 : 1
| | | | | | XD = 1 :
| | | | | | | | XP = 0 :
| | | | | | | | XT = 0 :
| | | | | | | | | | XQ = 0 : 0
| | | | | | | | | | XQ = 1 : 1
| | | | | | | | | XT = 1 : 1
| | | | | | | | XP = 1 : 0
| | | | | XR = 1 :
| | | | | | XI = 0 :
| | | | | | | XU = 0 : 1
| | | | | | | XU = 1 : 0
| | | | | | XI = 1 :
| | | | | | | XG = 0 :
| | | | | | | | XQ = 0 :
| | | | | | | | | XJ = 0 :
| | | | | | | | | | | XU = 0 : 1
```

```
| | | | | | | | | | XU = 1 : 0
| | | | | | | | | | XJ = 1 : 1
| | | | | | | | | | XQ = 1 : 0
| | | | | | | | | XG = 1 : 1
| | XB = 1 :
| | | XI = 0 : 0
| | | XI = 1 :
| | | | XK = 0 :
| | | | | XD = 0 : 0
| | | | | XD = 1 :
| | | | | | XP = 0 : 1
| | | | | | XP = 1 :
| | | | | | | XS = 0 :
| | | | | | | | XG = 0 : 1
| | | | | | | | XG = 1 :
| | | | | | | | | XN = 0 : 0
| | | | | | | | | XN = 1 : 1
| | | | | | | XS = 1 : 0
| | | | XK = 1 : 0
XO = 1 :
| XI = 0 :
| | XM = 0 :
| | | XQ = 0 :
| | | | XF = 0 :
| | | | | XH = 0 :
| | | | | | XS = 0 : 0
| | | | | | XS = 1 :
| | | | | | | XP = 0 : 0
| | | | | | | XP = 1 : 1
| | | | | XH = 1 : 1
| | | | XF = 1 : 0
| | | XQ = 1 :
| | | | XJ = 0 :
| | | | | XN = 0 :
| | | | | | XP = 0 : 1
| | | | | | XP = 1 :
| | | | | | | XU = 0 : 0
| | | | | | | XU = 1 :
| | | | | | | | XF = 0 : 0
| | | | | | | | XF = 1 : 1
| | | | | XN = 1 : 0
| | | | XJ = 1 :
| | | | | XL = 0 :
| | | | | | XH = 0 : 0
| | | | | | XH = 1 :
| | | | | | | XU = 0 : 1
| | | | | | | XU = 1 :
| | | | | | | | XK = 0 : 0
| | | | | | | | XK = 1 : 1
| | | | | XL = 1 : 1
| | XM = 1 :
```

```
| | | XQ = 0 :
| | | | XF = 0 :
| | | | | XL = 0 :
| | | | | | XC = 0 : 1
| | | | | | XC = 1 :
| | | | | | | XH = 0 : 1
| | | | | | | XH = 1 :
| | | | | | | | XU = 0 :
| | | | | | | | | XR = 0 :
| | | | | | | | | | XT = 0 : 0
| | | | | | | | | | XT = 1 : 1
| | | | | | | | | XR = 1 : 0
| | | | | | | | XU = 1 : 1
| | | | | XL = 1 :
| | | | | | XP = 0 : 0
| | | | | | XP = 1 :
| | | | | | | XT = 0 : 1
| | | | | | | XT = 1 :
| | | | | | | | XJ = 0 : 1
| | | | | | | | XJ = 1 : 0
| | | | XF = 1 : 0
| | | XQ = 1 : 0
| XI = 1 :
| | XT = 0 :
| | | XH = 0 :
| | | | XP = 0 :
| | | | | XF = 0 : 0
| | | | | XF = 1 :
| | | | | | XR = 0 :
| | | | | | | XL = 0 :
| | | | | | | | XU = 0 : 0
| | | | | | | | XU = 1 : 1
| | | | | | | XL = 1 : 1
| | | | | | XR = 1 :
| | | | | | | XQ = 0 : 1
| | | | | | | XQ = 1 : 0
| | | | XP = 1 :
| | | | | XS = 0 :
| | | | | | XD = 0 :
| | | | | | | XC = 0 :
| | | | | | | | XU = 0 :
| | | | | | | | | XQ = 0 : 1
| | | | | | | | | XQ = 1 : 0
| | | | | | | | XU = 1 :
| | | | | | | | | XG = 0 : 1
| | | | | | | | | XG = 1 : 0
| | | | | | | XC = 1 : 0
| | | | | | XD = 1 :
| | | | | | | XM = 0 :
| | | | | | | | XJ = 0 : 0
| | | | | | | | XJ = 1 : 1
```

```
| | | | | | | | XM = 1 : 1
| | | | | | XS = 1 : 1
| | | XH = 1 :
| | | | XJ = 0 :
| | | | | XC = 0 :
| | | | | | | XN = 0 : 1
| | | | | | | XN = 1 :
| | | | | | | | XG = 0 :
| | | | | | | | | XF = 0 : 1
| | | | | | | | | XF = 1 : 0
| | | | | | | | XG = 1 : 0
| | | | | XC = 1 :
| | | | | | XM = 0 : 0
| | | | | | XM = 1 :
| | | | | | | XS = 0 :
| | | | | | | | XR = 0 : 1
| | | | | | | | XR = 1 : 0
| | | | | | | XS = 1 : 1
| | | | XJ = 1 :
| | | | | XS = 0 : 1
| | | | | XS = 1 :
| | | | | | XG = 0 :
| | | | | | | XB = 0 : 0
| | | | | | | XB = 1 :
| | | | | | | | XN = 0 : 1
| | | | | | | | XN = 1 :
| | | | | | | | | XU = 0 : 1
| | | | | | | | | XU = 1 : 0
| | | | | | XG = 1 :
| | | | | | | XQ = 0 : 1
| | | | | | | XQ = 1 :
| | | | | | | | XU = 0 : 1
| | | | | | | | XU = 1 : 0
| | XT = 1 :
| | | XS = 0 :
| | | | XQ = 0 :
| | | | | XK = 0 :
| | | | | | XC = 0 :
| | | | | | | XR = 0 :
| | | | | | | | XH = 0 :
| | | | | | | | | XE = 0 : 0
| | | | | | | | | XE = 1 : 1
| | | | | | | | XH = 1 : 1
| | | | | | | XR = 1 :
| | | | | | | | XU = 0 : 0
| | | | | | | | XU = 1 :
| | | | | | | | | XL = 0 : 0
| | | | | | | | | XL = 1 : 1
| | | | | | XC = 1 : 1
| | | | | XK = 1 :
| | | | | | XD = 0 :
```

```
| | | | | | | XJ = 0 : 0
| | | | | | | XJ = 1 : 1
| | | | | | | XD = 1 : 0
| | | | XQ = 1 :
| | | | | XM = 0 :
| | | | | | XN = 0 :
| | | | | | | XU = 0 : 1
| | | | | | | XU = 1 : 0
| | | | | | XN = 1 :
| | | | | | | XR = 0 : 1
| | | | | | | XR = 1 :
| | | | | | | | XL = 0 : 1
| | | | | | | | XL = 1 : 0
| | | | | | XM = 1 : 0
| | | XS = 1 :
| | | | XL = 0 :
| | | | | XD = 0 :
| | | | | | XU = 0 : 1
| | | | | | XU = 1 :
| | | | | | | XQ = 0 :
| | | | | | | | XG = 0 : 1
| | | | | | | | XG = 1 : 0
| | | | | | | XQ = 1 :
| | | | | | | | XH = 0 : 0
| | | | | | | | XH = 1 : 1
| | | | | XD = 1 :
| | | | | | XG = 0 : 0
| | | | | | XG = 1 : 1
| | | | XL = 1 :
| | | | | XH = 0 :
| | | | | | XQ = 0 :
| | | | | | | XD = 0 : 0
| | | | | | | XD = 1 :
| | | | | | | | XR = 0 : 0
| | | | | | | | XR = 1 : 1
| | | | | | XQ = 1 :
| | | | | | | XM = 0 : 1
| | | | | | | XM = 1 : 0
| | | | | XH = 1 : 0
```

Pre Prunned Accuracy

Total number of nodes in the tree = 265
Number of leaf nodes in the tree = 133
Number of training instances = 600
Number of training attributes = 20
Accuracy of the model on the training dataset = 100.00%

Number of validation instances = 2000
Number of validation attributes = 20
Accuracy of the model on the validation dataset = 74.30%

Number of testing instances = 2000
Number of testing attributes = 20
Accuracy of the model on the testing dataset = 75.15%

Post Prunned Accuracy

XO = 0 :
| XM = 0 :
| | XF = 0 :
| | | XB = 0 :
| | | | XG = 0 : 0
| | | | XG = 1 :
| | | | | XD = 0 :
| | | | | | XS = 0 : 0
| | | | | | XS = 1 :
| | | | | | | XC = 0 : 1
| | | | | | | XC = 1 : 1
| | | | | XD = 1 :
| | | | | | XP = 0 : 0
| | | | | | XP = 1 : 0
| | | XB = 1 :
| | | | XD = 0 : 0
| | | | XD = 1 :
| | | | | XI = 0 : 0
| | | | | XI = 1 :
| | | | | | XN = 0 : 0
| | | | | | XN = 1 : 1
| | XF = 1 : 0
| XM = 1 :
| | XB = 0 :
| | | XF = 0 :
| | | | XG = 0 : 0
| | | | XG = 1 :
| | | | | XD = 0 : 1
| | | | | XD = 1 :
| | | | | | XC = 0 :
| | | | | | | XS = 0 : 0
| | | | | | | XS = 1 : 1
| | | | | | XC = 1 : 0
| | | XF = 1 :
| | | | XS = 0 :
| | | | | XQ = 0 :
| | | | | | XI = 0 : 0
| | | | | | XI = 1 : 1
| | | | | XQ = 1 :
| | | | | | XI = 0 : 1
| | | | | | XI = 1 :

```
| | | | | | | | XL = 0 : 1
| | | | | | | | XL = 1 : 1
| | | | | XS = 1 :
| | | | | | XR = 0 :
| | | | | | | XD = 0 : 1
| | | | | | | XD = 1 :
| | | | | | | | XP = 0 :
| | | | | | | | | XT = 0 : 1
| | | | | | | | | XT = 1 : 1
| | | | | | | | XP = 1 : 0
| | | | | | XR = 1 :
| | | | | | | XI = 0 : 0
| | | | | | | XI = 1 :
| | | | | | | | XG = 0 :
| | | | | | | | | XQ = 0 :
| | | | | | | | | | XJ = 0 : 1
| | | | | | | | | | XJ = 1 : 1
| | | | | | | | | XQ = 1 : 0
| | | | | | | | XG = 1 : 1
| | XB = 1 :
| | | XI = 0 : 0
| | | XI = 1 :
| | | | XK = 0 :
| | | | | XD = 0 : 0
| | | | | XD = 1 :
| | | | | | XP = 0 : 1
| | | | | | XP = 1 :
| | | | | | | XS = 0 :
| | | | | | | | XG = 0 : 1
| | | | | | | | XG = 1 : 0
| | | | | | | XS = 1 : 0
| | | | XK = 1 : 0
XO = 1 :
| XI = 0 :
| | XM = 0 :
| | | XQ = 0 :
| | | | XF = 0 :
| | | | | XH = 0 :
| | | | | | XS = 0 : 0
| | | | | | XS = 1 :
| | | | | | | XP = 0 : 0
| | | | | | | XP = 1 : 1
| | | | | XH = 1 : 1
| | | | XF = 1 : 0
| | | XQ = 1 :
| | | | XJ = 0 :
| | | | | XN = 0 :
| | | | | | XP = 0 : 1
| | | | | | XP = 1 :
| | | | | | | XU = 0 : 0
| | | | | | | XU = 1 : 1
```

```
| | | | | XN = 1 : 0
| | | | | XJ = 1 :
| | | | | | XL = 0 :
| | | | | | | XH = 0 : 0
| | | | | | | XH = 1 :
| | | | | | | | XU = 0 : 1
| | | | | | | | XU = 1 : 1
| | | | | | XL = 1 : 1
| | XM = 1 :
| | | XQ = 0 :
| | | | XF = 0 :
| | | | | XL = 0 :
| | | | | | XC = 0 : 1
| | | | | | XC = 1 :
| | | | | | | XH = 0 : 1
| | | | | | | XH = 1 :
| | | | | | | | XU = 0 :
| | | | | | | | | XR = 0 :
| | | | | | | | | | XT = 0 : 0
| | | | | | | | | | XT = 1 : 1
| | | | | | | | | XR = 1 : 0
| | | | | | | | XU = 1 : 1
| | | | | XL = 1 :
| | | | | | XP = 0 : 0
| | | | | | XP = 1 :
| | | | | | | XT = 0 : 1
| | | | | | | XT = 1 : 0
| | | | XF = 1 : 0
| | | XQ = 1 : 0
| XI = 1 :
| | XT = 0 :
| | | XH = 0 :
| | | | XP = 0 :
| | | | | XF = 0 : 0
| | | | | XF = 1 :
| | | | | | XR = 0 :
| | | | | | | XL = 0 :
| | | | | | | | XU = 0 : 0
| | | | | | | | XU = 1 : 1
| | | | | | | XL = 1 : 1
| | | | | | XR = 1 : 0
| | | | XP = 1 :
| | | | | XS = 0 :
| | | | | | XD = 0 :
| | | | | | | XC = 0 :
| | | | | | | | XU = 0 : 0
| | | | | | | | XU = 1 : 1
| | | | | | | XC = 1 : 0
| | | | | | XD = 1 :
| | | | | | | XM = 0 :
| | | | | | | | XJ = 0 : 0
```

```
| | | | | | | | XJ = 1 : 1
| | | | | | | | XM = 1 : 1
| | | | | | XS = 1 : 1
| | | XH = 1 :
| | | | XJ = 0 :
| | | | | XC = 0 :
| | | | | | | XN = 0 : 1
| | | | | | | XN = 1 :
| | | | | | | | XG = 0 : 1
| | | | | | | | XG = 1 : 0
| | | | | XC = 1 :
| | | | | | | XM = 0 : 0
| | | | | | | XM = 1 :
| | | | | | | | XS = 0 : 1
| | | | | | | | XS = 1 : 1
| | | | XJ = 1 :
| | | | | XS = 0 : 1
| | | | | XS = 1 :
| | | | | | | XG = 0 :
| | | | | | | | XB = 0 : 0
| | | | | | | | XB = 1 :
| | | | | | | | | XN = 0 : 1
| | | | | | | | | XN = 1 : 1
| | | | | | XG = 1 :
| | | | | | | XQ = 0 : 1
| | | | | | | XQ = 1 : 1
| | XT = 1 :
| | | XS = 0 :
| | | | XQ = 0 :
| | | | | XK = 0 :
| | | | | | XC = 0 :
| | | | | | | XR = 0 :
| | | | | | | | XH = 0 :
| | | | | | | | | XE = 0 : 0
| | | | | | | | | XE = 1 : 1
| | | | | | | | XH = 1 : 1
| | | | | | | XR = 1 :
| | | | | | | | XU = 0 : 0
| | | | | | | | XU = 1 :
| | | | | | | | | XL = 0 : 0
| | | | | | | | | XL = 1 : 1
| | | | | | XC = 1 : 1
| | | | | XK = 1 :
| | | | | | XD = 0 : 1
| | | | | | XD = 1 : 0
| | | | XQ = 1 :
| | | | | XM = 0 :
| | | | | | XN = 0 : 0
| | | | | | XN = 1 :
| | | | | | | XR = 0 : 1
| | | | | | | XR = 1 : 1
```

```
| | | | | XM = 1 : 0
| | | XS = 1 :
| | | | XL = 0 :
| | | | | XD = 0 :
| | | | | | XU = 0 : 1
| | | | | | XU = 1 :
| | | | | | | XQ = 0 : 1
| | | | | | | XQ = 1 : 0
| | | | | XD = 1 : 0
| | | | XL = 1 :
| | | | | XH = 0 :
| | | | | | XQ = 0 :
| | | | | | | XD = 0 : 0
| | | | | | | XD = 1 : 1
| | | | | | XQ = 1 : 1
| | | | | XH = 1 : 0
```

Total number of nodes in the tree = 211
Number of leaf nodes in the tree = 106
Number of training instances = 600
Number of training attributes = 20
Accuracy of the model on the training dataset = 95.00%

Number of validation instances = 2000
Number of validation attributes = 20
Accuracy of the model on the validation dataset = 76.95%

Number of testing instances = 2000
Number of testing attributes = 20
Accuracy of the model on the testing dataset = 76.65%