

Assignment 1 CS 6375: Machine Learning Reports File with the Output Accuracies

Course: CS6375.003

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Accuracies For data_sets2:

(L, K)	INFORMATION GAIN HEURISTIC		VARIANCE IMPURITY HEURISTIC	
	Before Pruning	After Pruning	Before Pruning	After Pruning
(9, 2)	72.33333333333333 34%	78.0%	72.5%	76.66666666666666 67%
(10, 3)	72.33333333333333 34%	77.83333333333333 33%	72.5%	76.66666666666666 67%
(11, 4)	72.33333333333333 34%	78.83333333333333 33%	72.5%	76.66666666666666 67%
(12, 5)	72.33333333333333 34%	78.0%	72.5%	76.66666666666666 67%
(15, 5)	72.33333333333333 34%	78.5%	72.5%	76.66666666666666 67%
(15, 10)	72.33333333333333 34%	79.5%	72.5%	76.66666666666666 67%
(2, 2)	72.33333333333333 34%	77.16666666666666 66%	72.5%	76.66666666666666 67%
(3, 4)	72.33333333333333 34%	78.0%	72.5%	76.66666666666666 67%
(5, 10)	72.33333333333333 34%	77.5%	72.5%	76.66666666666666 67%

(2, 10)	72.33333333333333 34%	77.33333333333333 33%	72.5%	76.66666666666666 67%
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Accuracies For data_sets1:

(L, K)	INFORMATION GAIN HEURISTIC		VARIANCE IMPURITY HEURISTIC	
	Before Pruning	After Pruning	Before Pruning	After Pruning
(15, 3)	75.85%	76.5%	75.35%	75.75%
(14, 2)	75.85%	77.5%	75.35%	75.35%
(13, 1)	75.85%	76.05%	75.35%	75.75%
(15, 2)	75.85%	76.25%	75.35%	75.75%
(17, 2)	75.85%	77.7%	75.35%	75.75%
(20, 5)	75.85%	78.05%	75.35%	75.75%
(5, 10)	75.85%	75.9%	75.35%	75.75%
(22, 10)	75.85%	76.6%	75.35%	75.75%
(15, 7)	75.85%	77.4%	75.35%	75.75%
(15, 9)	75.85%	76.9%	75.35%	75.75%

Decision trees for L = 10, K = 3:

INFORMATION GAIN HEURISTIC

Pre-Pruned Tree

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

```

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

```

```

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

```

```

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

```

```

| | | | | XP = 1 : 1
| XK = 1 :
| | XD = 0 :
| | | XT = 0 :
| | | | XF = 0 :
| | | | | XB = 0 :
| | | | | | XR = 0 : 0
| | | | | | XR = 1 :
| | | | | | | XO = 0 : 1
| | | | | | | XO = 1 :
| | | | | | | XL = 0 : 1
| | | | | | | XL = 1 : 0
| | | | | XB = 1 :
| | | | | | XO = 0 : 0
| | | | | | XO = 1 : 1
| | | | XF = 1 :
| | | | | XO = 0 : 1
| | | | | XO = 1 :
| | | | | | XH = 0 :
| | | | | | | XL = 0 :
| | | | | | | | XE = 0 : 0
| | | | | | | | XE = 1 :
| | | | | | | | XG = 0 : 1
| | | | | | | | XG = 1 : 0
| | | | | | | XL = 1 : 1
| | | | | | XH = 1 :
| | | | | | | XE = 0 : 1
| | | | | | | XE = 1 :
| | | | | | | XL = 0 : 1
| | | | | | | XL = 1 : 0
| | | | XT = 1 :
| | | | | XB = 0 :
| | | | | | XC = 0 :
| | | | | | | XM = 0 : 1
| | | | | | | XM = 1 :
| | | | | | | | XJ = 0 : 0
| | | | | | | | XJ = 1 :
| | | | | | | | XE = 0 : 0
| | | | | | | | XE = 1 : 1
| | | | | XC = 1 :
| | | | | | XH = 0 : 1
| | | | | | XH = 1 :
| | | | | | | XL = 0 : 1
| | | | | | | XL = 1 :
| | | | | | | XN = 0 : 1
| | | | | | | XN = 1 : 0
| | | | XB = 1 : 0
| | XD = 1 : 0

```

Post-Pruned Tree

```

-----
XI = 0 :
| XU = 0 :
| | XQ = 0 :
| | | XF = 0 :
| | | | XO = 0 :
| | | | | XB = 0 :
| | | | | | XJ = 0 : 0
| | | | | | XJ = 1 :
| | | | | | XG = 0 : 0
| | | | | | XG = 1 : 1
| | | | | XB = 1 : 0
| | | | XO = 1 :
| | | | | XB = 0 :
| | | | | | XD = 0 : 1
| | | | | | XD = 1 : 0

```

```

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

```



```

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

```

					XM = 0	:	0	
					XM = 1	:		
					XQ = 0	:		
					XB = 0	:	1	
					XB = 1	:		
						XF = 0	:	
						XH = 0	:	0
						XH = 1	:	1
						XF = 1	:	1
					XQ = 1	:	0	
				XJ = 1	:			
					XO = 0	:		
					XF = 0	:		
					XE = 0	:	0	
					XE = 1	:	1	
					XF = 1	:	1	
				XO = 1	:			
					XR = 0	:		
					XB = 0	:		
					XH = 0	:	0	
					XH = 1	:	1	
					XB = 1	:	1	
					XR = 1	:	1	
				XD = 1	:			
					XF = 0	:	0	
					XF = 1	:		
					XO = 0	:	0	
					XO = 1	:		
					XP = 0	:	0	
					XP = 1	:	1	
				XK = 1	:			
					XD = 0	:		
					XT = 0	:		
					XF = 0	:		
					XB = 0	:		
					XR = 0	:	0	
					XR = 1	:		
					XO = 0	:	1	
					XO = 1	:		
					XL = 0	:	1	
					XL = 1	:	0	
					XB = 1	:		
					XO = 0	:	0	
					XO = 1	:	1	
				XF = 1	:			
					XO = 0	:	1	
					XO = 1	:		
					XH = 0	:		
					XL = 0	:		
					XE = 0	:	0	
					XE = 1	:		
					XG = 0	:	1	
					XG = 1	:	0	
					XL = 1	:	1	
				XH = 1	:			
					XE = 0	:	1	
					XE = 1	:		
					XL = 0	:	1	
					XL = 1	:	0	
				XT = 1	:			
					XB = 0	:		
					XC = 0	:		
					XM = 0	:	1	
					XM = 1	:		
					XJ = 0	:	0	
					XJ = 1	:		

```

| | | | | | | | XE = 0 : 0
| | | | | | | | XE = 1 : 1
| | | | | | | | XC = 1 :
| | | | | | | | XH = 0 : 1
| | | | | | | | XH = 1 :
| | | | | | | | XL = 0 : 1
| | | | | | | | XL = 1 :
| | | | | | | | XN = 0 : 1
| | | | | | | | XN = 1 : 0
| | | | | | | | XB = 1 : 0
| | | | | | | | XD = 1 : 0

```

```

*****
VARIANCE IMPURITY HEURISTIC
*****

```

Pre-Pruned Tree

```

-----
XI = 0 :
| XU = 0 :
| | XQ = 0 :
| | | XF = 0 :
| | | | XO = 0 :
| | | | | XB = 0 :
| | | | | | XJ = 0 : 0
| | | | | | XJ = 1 :
| | | | | | XG = 0 : 0
| | | | | | XG = 1 : 1
| | | | | XB = 1 : 0
| | | | XO = 1 :
| | | | | XB = 0 :
| | | | | | XD = 0 :
| | | | | | XM = 0 : 1
| | | | | | XM = 1 : 0
| | | | | XD = 1 : 0
| | | | | XB = 1 :
| | | | | | XH = 0 :
| | | | | | XS = 0 :
| | | | | | | XJ = 0 :
| | | | | | | | XN = 0 : 1
| | | | | | | | XN = 1 : 0
| | | | | | | XJ = 1 : 1
| | | | | | XS = 1 :
| | | | | | | XL = 0 : 1
| | | | | | | XL = 1 : 0
| | | | | | XH = 1 : 1
| | | | | XF = 1 : 0
| | | | XQ = 1 :
| | | | | XB = 0 :
| | | | | | XF = 0 :
| | | | | | XG = 0 : 0
| | | | | | XG = 1 :
| | | | | | XL = 0 :
| | | | | | | XS = 0 : 0
| | | | | | | XS = 1 : 1
| | | | | | XL = 1 : 0
| | | | | XF = 1 :
| | | | | | XT = 0 :
| | | | | | | XL = 0 :
| | | | | | | XS = 0 : 1
| | | | | | | XS = 1 :
| | | | | | | | XC = 0 : 0
| | | | | | | | XC = 1 : 1
| | | | | | XL = 1 :
| | | | | | | XC = 0 :
| | | | | | | XH = 0 : 1

```

```

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

```

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

```

```

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

```

```

| | XD = 0 :
| | | XT = 0 :
| | | | XF = 0 :
| | | | | XB = 0 :
| | | | | | XR = 0 : 0
| | | | | | XR = 1 :
| | | | | | | XO = 0 : 1
| | | | | | | XO = 1 :
| | | | | | | XL = 0 : 1
| | | | | | | XL = 1 : 0
| | | | | XB = 1 :
| | | | | | XO = 0 : 0
| | | | | | XO = 1 : 1
| | | | XF = 1 :
| | | | | XO = 0 : 1
| | | | | XO = 1 :
| | | | | | XH = 0 :
| | | | | | | XL = 0 :
| | | | | | | | XE = 0 : 0
| | | | | | | | XE = 1 :
| | | | | | | | | XG = 0 : 1
| | | | | | | | | XG = 1 : 0
| | | | | | | XL = 1 : 1
| | | | | | XH = 1 :
| | | | | | | XE = 0 : 1
| | | | | | | XE = 1 :
| | | | | | | | XL = 0 : 1
| | | | | | | | XL = 1 : 0
| | | | XT = 1 :
| | | | | XB = 0 :
| | | | | | XC = 0 :
| | | | | | | XM = 0 : 1
| | | | | | | XM = 1 :
| | | | | | | | XJ = 0 : 0
| | | | | | | | XJ = 1 :
| | | | | | | | | XE = 0 : 0
| | | | | | | | | XE = 1 : 1
| | | | | | XC = 1 :
| | | | | | | XE = 0 :
| | | | | | | | XF = 0 : 0
| | | | | | | | XF = 1 : 1
| | | | | | | XE = 1 :
| | | | | | | | XM = 0 :
| | | | | | | | | XQ = 0 : 1
| | | | | | | | | XQ = 1 : 0
| | | | | | | XM = 1 : 1
| | | | | XB = 1 : 0
| | XD = 1 : 0

```

Post-Pruned Tree

```

-----
| | XI = 0 :
| | | XU = 0 :
| | | | XQ = 0 :
| | | | | XF = 0 :
| | | | | | XO = 0 :
| | | | | | | XB = 0 :
| | | | | | | | XJ = 0 : 0
| | | | | | | | XJ = 1 :
| | | | | | | | | XG = 0 : 0
| | | | | | | | | XG = 1 : 1
| | | | | | | XB = 1 : 0
| | | | | XO = 1 :
| | | | | | XB = 0 :
| | | | | | | XD = 0 :
| | | | | | | XM = 0 : 1

```

				XM = 1	: 0
				XD = 1	: 0
				XB = 1	:
				XH = 0	:
				XS = 0	:
				XJ = 0	:
				XN = 0	: 1
				XN = 1	: 0
				XJ = 1	: 1
				XS = 1	:
				XL = 0	: 1
				XL = 1	: 0
				XH = 1	: 1
				XF = 1	: 0
				XQ = 1	:
				XB = 0	:
				XF = 0	:
				XG = 0	: 0
				XG = 1	:
				XL = 0	:
				XS = 0	: 0
				XS = 1	: 1
				XL = 1	: 0
				XF = 1	:
				XT = 0	:
				XL = 0	:
				XS = 0	: 1
				XS = 1	:
				XC = 0	: 0
				XC = 1	: 1
				XL = 1	:
				XC = 0	:
				XH = 0	: 1
				XH = 1	:
				XE = 0	: 1
				XE = 1	: 0
				XC = 1	:
				XJ = 0	: 0
				XJ = 1	:
				XK = 0	: 1
				XK = 1	:
				XM = 0	: 1
				XM = 1	: 0
				XT = 1	:
				XH = 0	:
				XO = 0	: 1
				XO = 1	:
				XL = 0	: 0
				XL = 1	:
				XC = 0	:
				XD = 0	: 0
				XD = 1	: 1
				XC = 1	: 1
				XH = 1	: 1
				XB = 1	:
				XO = 0	: 0
				XO = 1	:
				XM = 0	:
				XF = 0	:
				XP = 0	:
				XL = 0	:
				XC = 0	: 1
				XC = 1	:
				XK = 0	:
				XE = 0	:
				XD = 0	:


```

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

```

				XT = 1 :
				XR = 0 :
				XQ = 0 :
				XD = 0 :
				XE = 0 : 0
				XE = 1 : 1
				XD = 1 : 0
				XQ = 1 : 1
				XR = 1 :
				XQ = 0 : 1
				XQ = 1 : 0
				XG = 1 :
				XO = 0 : 1
				XO = 1 :
				XH = 0 : 0
				XH = 1 :
				XL = 0 : 1
				XL = 1 : 0
				XS = 1 :
				XR = 0 :
				XN = 0 : 1
				XN = 1 :
				XH = 0 :
				XJ = 0 :
				XM = 0 :
				XD = 0 : 0
				XD = 1 : 1
				XM = 1 : 1
				XJ = 1 : 1
				XH = 1 :
				XT = 0 : 0
				XT = 1 :
				XF = 0 : 0
				XF = 1 : 1
				XR = 1 :
				XG = 0 :
				XM = 0 :
				XH = 0 : 0
				XH = 1 :
				XB = 0 : 1
				XB = 1 :
				XF = 0 : 1
				XF = 1 : 0
				XM = 1 :
				XD = 0 : 0
				XD = 1 : 1
				XG = 1 : 0
				XC = 1 :
				XD = 0 :
				XS = 0 :
				XF = 0 :
				XB = 0 : 0
				XB = 1 :
				XE = 0 : 0
				XE = 1 : 1
				XF = 1 :
				XP = 0 : 1
				XP = 1 :
				XH = 0 : 1
				XH = 1 :
				XL = 0 :
				XJ = 0 : 1
				XJ = 1 :
				XN = 0 : 0
				XN = 1 : 1
				XL = 1 : 0

```

XS = 1 :
  XJ = 0 :
    XM = 0 : 0
    XM = 1 :
      XQ = 0 :
        XB = 0 : 1
        XB = 1 :
          XF = 0 :
            XH = 0 : 0
            XH = 1 : 1
            XF = 1 : 1
          XQ = 1 : 0
        XJ = 1 :
          XO = 0 :
            XF = 0 :
              XE = 0 : 0
              XE = 1 : 1
              XF = 1 : 1
            XO = 1 :
              XR = 0 :
                XB = 0 :
                  XH = 0 : 0
                  XH = 1 : 1
                  XB = 1 : 1
                XR = 1 : 1
              XD = 1 :
                XF = 0 : 0
                XF = 1 :
                  XO = 0 : 0
                  XO = 1 :
                    XP = 0 : 0
                    XP = 1 : 1
                XK = 1 :
                  XD = 0 :
                    XT = 0 :
                      XF = 0 :
                        XB = 0 :
                          XR = 0 : 0
                          XR = 1 :
                            XO = 0 : 1
                            XO = 1 :
                              XL = 0 : 1
                              XL = 1 : 0
                            XB = 1 :
                              XO = 0 : 0
                              XO = 1 : 1
                            XF = 1 :
                              XO = 0 : 1
                              XO = 1 :
                                XH = 0 :
                                  XL = 0 :
                                    XE = 0 : 0
                                    XE = 1 :
                                      XG = 0 : 1
                                      XG = 1 : 0
                                  XL = 1 : 1
                                XH = 1 :
                                  XE = 0 : 1
                                  XE = 1 :
                                    XL = 0 : 1
                                    XL = 1 : 0
                                XT = 1 :
                                  XB = 0 :
                                    XC = 0 :
                                      XM = 0 : 1
                                      XM = 1 :

```

								XJ = 0	:	0
								XJ = 1	:	
								XE = 0	:	0
								XE = 1	:	1
								XC = 1	:	
								XE = 0	:	
								XF = 0	:	0
								XF = 1	:	1
								XE = 1	:	
								XM = 0	:	
								XQ = 0	:	1
								XQ = 1	:	0
								XM = 1	:	1
								XB = 1	:	0
								XD = 1	:	0