trees

2018 年 1 月 8 日

In [1]:
```
from math import log
def calcShannonEnt(dataSet): # 计算信息熵
    numEntries=len(dataSet)
    labelCounts={}
    for featVec in dataSet:
        currentLabel=featVec[-1]
        if currentLabel not in labelCounts.keys():
            labelCounts[currentLabel]=0
        labelCounts[currentLabel]+=1
        shannonEnt=0.0
    for key in labelCounts:
        prob=float(labelCounts[key])/numEntries# 计算类标签发生的概率
        shannonEnt-=prob*log(prob,2)
    return shannonEnt
```

In [2]:
```
def createDataSet():# 创建一个训练集
    dataSet=[[1,1,'yes'],
             [1,1,'yes'],
             [1,0,'no'],
             [0,1,'no'],
             [0,1,'no']]
    labels=['no surfacing','flippers']
    return dataSet,labels
```

In [3]:
```
myDat,labels=createDataSet()# 测试训练集的信息熵
calcShannonEnt(myDat)
```

Out[3]:
```
0.9709505944546686
```

In [4]:
```
myDat[0][-1]='maybe'
calcShannonEnt(myDat)
```

Out[4]: 1.3709505944546687

In [5]:
```
def splitDataSet(dataSet,axis,value):# 根据给定的参数划分数据集
    retDataSet=[]
    for featVec in dataSet:
        if featVec[axis] == value:
            reducedFeatVec=featVec[:axis]
            reducedFeatVec.extend(featVec[axis+1:])
            retDataSet.append(reducedFeatVec)
    return retDataSet
```

In [6]:
```
def chooseBestFeatureToSplit(dataSet):# 根据最大信息增益划分数据集
    numFeatures=len(dataSet[0])-1
    baseEntropy=calcShannonEnt(dataSet)
    #print(baseEntropy)
    bestInfoGain=0.0
    bestFeature=-1
    for i in range(numFeatures):# 计算信息熵
        featList=[example[i] for example in dataSet]
        #print(featList)
        uniqueVals=set(featList)
        #print(uniqueVals)
        newEntropy=0.0
        for value in uniqueVals:
            subDataSet=splitDataSet(dataSet,i,value)
            #print(subDataSet)
            prob=len(subDataSet)/float(len(dataSet))
            newEntropy+=prob*calcShannonEnt(subDataSet)
        infoGain=baseEntropy-newEntropy
        if(infoGain>bestInfoGain):# 寻找最大增益
            bestInfoGain=infoGain
            bestFeature=i
    return bestFeature
```

In [7]:
```
myDate,labels=createDataSet()
print(myDate)
chooseBestFeatureToSplit(myDate)# 测试
```

```
[[1, 1, 'yes'], [1, 1, 'yes'], [1, 0, 'no'], [0, 1, 'no'], [0, 1, 'no']]
```

```
Out[7]: 0

In [8]: import operator
        def majorityCnt(classList):# 绘制数图
            classCount={}
            for vote in classList:
                if vote not in classCount.keys():
                    classCount[vote]=0
                    classCount[vote]+=1
            sortedClassCount=sorted(classCount.items(),key=operator.itemgetter(1),r
            return sortedClassCount[0][0]

In [9]: def createTree(dataSet,labels):# 创建决策树
            #print(dataSet)
            classList=[example[-1] for example in dataSet]
            #print(classList)
            #print(classList.count(classList[0]))
            if classList.count(classList[0])==len(classList):# 判断所有标签是否都相同
                return classList[0]# 结束递归
            if len(dataSet[0])==1:# 判断所有标签都使用完毕
                return majorityCnt(classList)# 返回次数最多的标签
            bestFeat=chooseBestFeatureToSplit(dataSet)
            #print(bestFeat)
            bestFeatLabel=labels[bestFeat]
            myTree={bestFeatLabel:{}}
            #print(myTree)
            #print(labels)
            del(labels[bestFeat])
            #print(labels)
            featValues=[example[bestFeat] for example in dataSet]
            uniqueVals=set(featValues)
            for value in uniqueVals:
                subLabels=labels[:]
                #print(subLabels)
                #print (myTree)
                myTree[bestFeatLabel][value]=createTree(splitDataSet(dataSet,bestFe
```

```
            #print(mytree)
        return myTree
```

In [10]:
```
myDat,labels=createDataSet()
createTree(myDat,labels)
```

Out[10]:
```
{'no surfacing': {0: 'no', 1: {'flippers': {0: 'no', 1: 'yes'}}}}
```

In [11]:
```
import matplotlib.pyplot as plt

import matplotlib

# 定义自定义字体，文件名是系统中文字体
myfont = matplotlib.font_manager.FontProperties(fname='C:/Windows/Fonts/si
# 解决负号'-' 显示为方块的问题
matplotlib.rcParams['axes.unicode_minus']=False




decisionNode = dict(boxstyle="sawtooth", fc="0.8")
leafNode = dict(boxstyle="round4", fc="0.8")
arrow_args=dict(arrowstyle='<-')


def plotNode(nodeTxt, centerPt, parentPt, nodeType):# 绘制节点
    createPlot.ax1.annotate(nodeTxt, xy=parentPt,  xycoords='axes fraction
             xytext=centerPt, textcoords='axes fraction',
             va="center", ha="center", bbox=nodeType, arrowprops=arrow_arg

def plotMidText(cntrPt,parentPt,txtString):# 绘制每个
    xMid=(parentPt[0]-cntrPt[0])/2.0+cntrPt[0]
    yMid=(parentPt[1]-cntrPt[1])/2.0+cntrPt[1]
    createPlot.ax1.text(xMid,yMid,txtString)

def plotTree(myTree,parentPt,nodeTxt):# 绘制树
    numLeafs=getNumLeafs(myTree)
```

```
        depth=getTreeDepth(myTree)
        firstStr=list(myTree.keys())[0]
        cntrPt=(plotTree.xOff+(1.0+float(numLeafs))/2.0/plotTree.totalw,plotTr
        plotMidText(cntrPt,parentPt,nodeTxt)
        plotNode(firstStr,cntrPt,parentPt,decisionNode)
        secondDict=myTree[firstStr]
        plotTree.yOff=plotTree.yOff-1.0/plotTree.totalD
        for key in secondDict.keys():
            if type(secondDict[key]).__name__=='dict':
                plotTree(secondDict[key],cntrPt,str(key))
            else:
                plotTree.xOff=plotTree.xOff+1.0/plotTree.totalw
                plotNode(secondDict[key],(plotTree.xOff,plotTree.yOff),cntrPt,
                plotMidText((plotTree.xOff,plotTree.yOff),cntrPt,str(key))
        plotTree.yOff=plotTree.yOff+1.0/plotTree.totalD


    def createPlot(inTree):
        fig = plt.figure(1, facecolor='white')
        fig.clf()
        axprops=dict(xticks=[],yticks=[])
        createPlot.ax1 = plt.subplot(111, frameon=False,**axprops) #ticks for
        plotTree.totalw=float(getNumLeafs(inTree))
        plotTree.totalD=float(getTreeDepth(inTree))
        plotTree.xOff=-0.5/plotTree.totalw
        plotTree.yOff=1.0
        plotTree(inTree,(0.5,1.0),'')
        #plotNode(' 决策节点', (0.5, 0.1), (0.1, 0.5), decisionNode)
        #plotNode(' 叶节点', (0.8, 0.1), (0.3, 0.8), leafNode)
        plt.show()
```

In [13]:
```
import matplotlib
matplotlib.matplotlib_fname()
```

Out[13]:
```
'C:\\Anaconda3\\lib\\site-packages\\matplotlib\\mpl-data\\matplotlibrc'
```

In [14]:
```
def getNumLeafs(myTree):# 获得叶子数
    numLeafs=0
```

```
    firstStr=list(myTree.keys())[0]
    secondDict=myTree[firstStr]
    for key in secondDict.keys():
        if type(secondDict[key]).__name__=='dict':
            numLeafs+=getNumLeafs(secondDict[key])
        else:
            numLeafs+=1
    return numLeafs

def getTreeDepth(myTree):# 获得树深
    maxDepth=0
    firstStr=list(myTree.keys())[0]
    secondDict=myTree[firstStr]
    for key in secondDict.keys():
        if type(secondDict[key]).__name__=='dict':
            thisDepth=1+getTreeDepth(secondDict[key])
        else:
            thisDepth=1
        if thisDepth>maxDepth:
            maxDepth=thisDepth
    return maxDepth


def retrieveTree(i):# 测试树
    listOfTrees=[{
        'no surfacing':{
            0:'no',
            1:{
                'flippers':{0:'no',1:'yes'}
            }
        }
    },
                 {
        'no surfacing':{
            0:'no',
            1:{
                'flippers':{
```

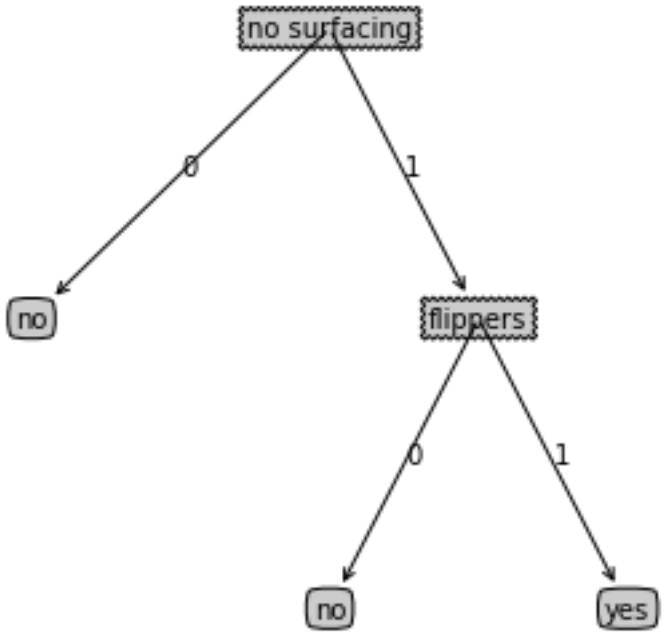
```
                                0:{
                                    'head':{0:'no',1:'yes'}
                                },
                                1:'no'
                            }
                        }
                    }
                }
                ]
                return listOfTrees[i]
```

```
In [15]: print(retrieveTree(1))
         myTree=retrieveTree(0)
         myTree
         print(getNumLeafs(myTree))
         print(getTreeDepth(myTree))
```

```
{'no surfacing': {0: 'no', 1: {'flippers': {0: {'head': {0: 'no', 1: 'yes'}}, 1: 'n
3
2
```

createPlot(myTree)

```
In [16]: createPlot(myTree)# 绘制决策树
```



```
In [17]: def classify(inputTree,featLabels,testVec):# 通过输入的决策数对 testVec 进行分
             firstStr=list(inputTree.keys())[0]
             secondDict=inputTree[firstStr]
             featIndex=featLabels.index(firstStr)
             for key in secondDict.keys():
                 if testVec[featIndex]==key:
                     if type(secondDict[key]).__name__=='dict':
                         classLabel=classify(secondDict[key],featLabels,testVec)
                     else:
                         classLabel=secondDict[key]
             return classLabel

In [18]: labels

Out[18]: ['flippers']

In [19]: myDat,labels=createDataSet()# 创建数据集
         labels

Out[19]: ['no surfacing', 'flippers']

In [20]: myTree=retrieveTree(0)# 创建测试树
         myTree

Out[20]: {'no surfacing': {0: 'no', 1: {'flippers': {0: 'no', 1: 'yes'}}}}

In [21]: classify(myTree,labels,[1,0])# 测试

Out[21]: 'no'

In [22]: classify(myTree,labels,[1,1])# 测试

Out[22]: 'yes'

In [23]: # 对决策树
         def storeTree(inputTree,filename):
             import pickle
             fw=open(filename,'w')
```

```
            pickle.dump(inputTree,fw)
            fw.close()
        def grabTree(filename):
            import pickle
            fr=open(filename)
            return pickle.load(fr)
```

In [ ]: