import numpy as np

import math

from data\_loader import read\_data

class Node:

def init (self, attribute):

self.attribute = attribute

self.children = []

self.answer = ""

def str (self):

return self.attribute

def subtables(data, col, delete):

dict = {}

items = np.unique(data[:, col])

count = np.zeros((items.shape[0], 1), dtype=np.int32)

for x in range(items.shape[0]):

for y in range(data.shape[0]):

if data[y, col] == items[x]:

count[x] += 1

for x in range(items.shape[0]):

dict[items[x]] = np.empty((int(count[x]), data.shape[1]), dtype="|S32")

pos = 0

for y in range(data.shape[0]):

if data[y, col] == items[x]:

dict[items[x]][pos] = data[y]

pos += 1

if delete:

dict[items[x]] = np.delete(dict[items[x]], col, 1)

return items, dict

def entropy(S):

items = np.unique(S)

if items.size == 1:

return 0

counts = np.zeros((items.shape[0], 1))

sums = 0

for x in range(items.shape[0]):

counts[x] = sum(S == items[x]) / (S.size \* 1.0)

for count in counts:

sums += -1 \* count \* math.log(count, 2)

return sums

def gain\_ratio(data, col):

items, dict = subtables(data, col, delete=False)

total\_size = data.shape[0]

entropies = np.zeros((items.shape[0], 1))

intrinsic = np.zeros((items.shape[0], 1))

for x in range(items.shape[0]):

ratio = dict[items[x]].shape[0]/(total\_size \* 1.0)

entropies[x] = ratio \* entropy(dict[items[x]][:, -1])

intrinsic[x] = ratio \* math.log(ratio, 2)

total\_entropy = entropy(data[:, -1])

iv = -1 \* sum(intrinsic)

for x in range(entropies.shape[0]):

total\_entropy -= entropies[x]

return total\_entropy / iv

def create\_node(data, metadata):

if (np.unique(data[:, -1])).shape[0] == 1:

node = Node("")

node.answer = np.unique(data[:, -1])[0]

return node

gains = np.zeros((data.shape[1] - 1, 1))

for col in range(data.shape[1] - 1):

gains[col] = gain\_ratio(data, col)

split = np.argmax(gains)

node = Node(metadata[split]

metadata = np.delete(metadata, split, 0)

items, dict = subtables(data, split, delete=True)

for x in range(items.shape[0]):

child = create\_node(dict[items[x]], metadata)

node.children.append((items[x], child))

return node

def empty(size):

s = ""

for x in range(size):

s += " "

return s

def print\_tree(node, level):

if node.answer != "":

print(empty(level), node.answer)

return

print(empty(level), node.attribute)

for value, n in node.children:

print(empty(level + 1), value)

print\_tree(n, level + 2)

metadata, traindata = read\_data("tennis.csv")

data = np.array(traindata)

node = create\_node(data, metadata)

print\_tree(node, 0)

**Data\_loader.py**

import csv

def read\_data(filename):

with open(filename, 'r') as csvfile:

datareader = csv.reader(csvfile, delimiter=',')

headers = next(datareader)

metadata = []

traindata = []

for name in headers:

metadata.append(name)

for row in datareader:

traindata.append(row)

return (metadata, traindata)