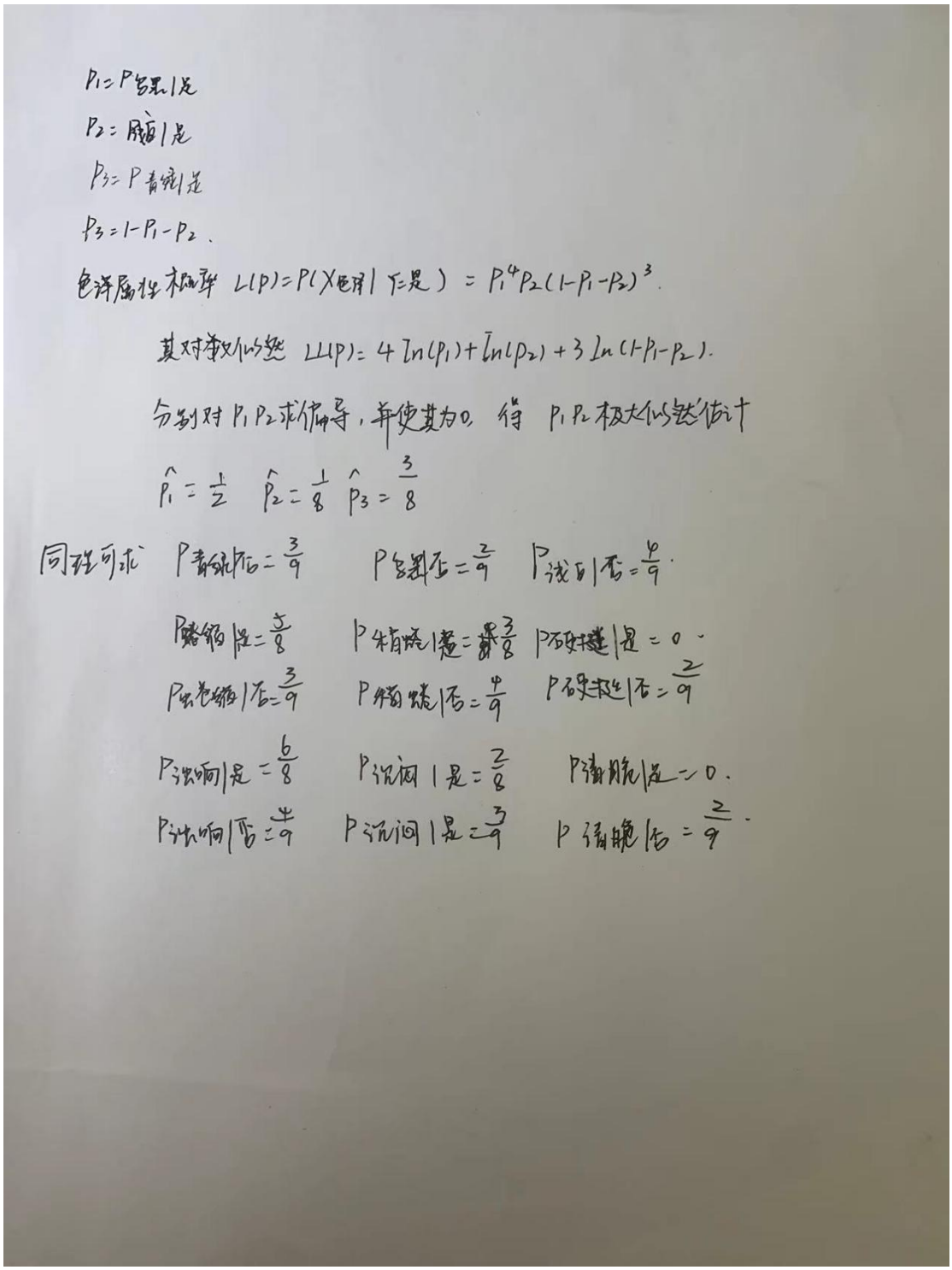
7.1 试使用极大似然法估算西瓜数据集 3.0 中前 3 个属性的类条件概率.

西瓜数据集

编号	色泽	根蒂	敲声	纹理	脐部	触感	密度	含糖率	好瓜
1	青绿	蜷缩	浊响	清晰	凹陷	硬滑	0.697	0.46	是
2	乌黑	蜷缩	沉闷	清晰	凹陷	硬滑	0.774	0.376	是
3	乌黑	蜷缩	浊响	清晰	凹陷	硬滑	0.634	0.264	是
4	青绿	蜷缩	沉闷	清晰	凹陷	硬滑	0.608	0.318	是
5	浅白	蜷缩	浊响	清晰	凹陷	硬滑	0.556	0.215	是
6	青绿	稍蜷	浊响	清晰	稍凹	软粘	0.403	0.237	是
7	乌黑	稍蜷	浊响	稍糊	稍凹	软粘	0.481	0.149	是
8	乌黑	稍蜷	浊响	清晰	稍凹	硬滑	0.437	0.211	是
9	乌黑	稍蜷	沉闷	稍糊	稍凹	硬滑	0.666	0.091	否
10	青绿	硬挺	清脆	清晰	平坦	软粘	0.243	0.267	否
11	浅白	硬挺	清脆	模糊	平坦	硬滑	0.245	0.057	否
12	浅白	蜷缩	浊响	模糊	平坦	软粘	0.343	0.099	否
13	青绿	稍蜷	浊响	稍糊	凹陷	硬滑	0.639	0.161	否
14	浅白	稍蜷	沉闷	稍糊	凹陷	硬滑	0.657	0.198	否
15	乌黑	稍蜷	浊响	清晰	稍凹	软粘	0.36	0.37	否
16	浅白	蜷缩	浊响	模糊	平坦	硬滑	0.593	0.042	否
17	青绿	蜷缩	沉闷	稍糊	稍凹	硬滑	0.719	0.103	否



7.3 试编程实现拉普拉斯修正的朴素贝叶斯分类器，并以西瓜数据集 3.0 为训练集，对 p.151“测 1”样本进行判别。


```
# coding=gbk
import math
import numpy as np

data_ = [
    ['青绿','蜷缩','浊响','清晰','凹陷','硬滑',0.697,0.460,'是'],
    ['乌黑','蜷缩','沉闷','清晰','凹陷','硬滑',0.774,0.376,'是'],
    ['乌黑','蜷缩','浊响','清晰','凹陷','硬滑',0.634,0.264,'是'],
    ['青绿','蜷缩','沉闷','清晰','凹陷','硬滑',0.608,0.318,'是'],
    ['浅白','蜷缩','浊响','清晰','凹陷','硬滑',0.556,0.215,'是'],
    ['青绿','稍蜷','浊响','清晰','稍凹','软粘',0.403,0.237,'是'],
    ['乌黑','稍蜷','浊响','稍糊','稍凹','软粘',0.481,0.149,'是'],
    ['乌黑','稍蜷','浊响','清晰','稍凹','硬滑',0.437,0.211,'是'],
    ['乌黑','稍蜷','沉闷','稍糊','稍凹','硬滑',0.666,0.091,'否'],
    ['青绿','硬挺','清脆','清晰','平坦','软粘',0.243,0.267,'否'],
    ['浅白','硬挺','清脆','模糊','平坦','硬滑',0.245,0.057,'否'],
    ['浅白','蜷缩','浊响','模糊','平坦','软粘',0.343,0.099,'否'],
    ['青绿','稍蜷','浊响','稍糊','凹陷','硬滑',0.639,0.161,'否'],
    ['浅白','稍蜷','沉闷','稍糊','凹陷','硬滑',0.657,0.198,'否'],
    ['乌黑','稍蜷','浊响','清晰','稍凹','软粘',0.360,0.370,'否'],
    ['浅白','蜷缩','浊响','模糊','平坦','硬滑',0.593,0.042,'否'],
    ['青绿','蜷缩','沉闷','稍糊','稍凹','硬滑',0.719,0.103,'否'],
]

is_discrete = [True] * 6 + [False] * 2

set_list = [set() for i in range(8)]
for d in data_:
    for i in range(8):
        set_list[i].add(d[i])
features_list = [[] for i in range(8)]
for i in range(8):
    features_list[i] = list(set_list[i])

data = np.mat(data_)
```

```
labels = np.unique(data[:, -1].A)
cnt_labels = [0] * len(labels)
for i in range(data.shape[0]):
    if data[i, -1] == labels[0]:
        cnt_labels[0] = cnt_labels[0] + 1
    elif data[i, -1] == labels[1]:
        cnt_labels[1] = cnt_labels[1] + 1

def train_discrete(data, labels, cnt_labels, features_list, xi):
    prob = np.ones([len(labels), np.unique(data[:, xi].A).shape[0]])
    for i in range(data.shape[0]):
        tmp = features_list[xi].index(data[i, xi])
        if data[i, -1] == labels[0]:
            prob[0, tmp] = prob[0, tmp] + 1
        elif data[i, -1] == labels[1]:
            prob[1, tmp] = prob[1, tmp] + 1
    for i in range(len(labels)):
        prob[i] = prob[i] / (cnt_labels[i] + len(features_list[xi]))
    return prob

def train_continuous(data, labels, xi):
    vec0, vec1 = [], []
    for i in range(data.shape[0]):
        if data[i, -1] == labels[0]:
            vec0.append(data[i, xi])
        elif data[i, -1] == labels[1]:
            vec1.append(data[i, xi])
    vec0, vec1 = np.array(vec0).astype(float), np.array(vec1).astype(float)
    u0, u1 = np.mean(vec0), np.mean(vec1)
    s0, s1 = np.var(vec0), (np.var(vec1))
    return np.mat([[u0, s0], [u1, s1]])

param = []
for i in range(8):
    if is_discrete[i]:
        param.append(train_discrete(data, labels, cnt_labels, features_list, i))
    else:
        param.append(train_continuous(data, labels, i))

p0 = (cnt_labels[0] + 1) / (len(data_) + 2)
p1 = (cnt_labels[1] + 1) / (len(data_) + 2)
d = data_[0]
for i in range(len(d) - 1):
    if is_discrete[i]:
```

```
            ind = features_list[i].index(d[i])
            p0 *= param[i][0, ind]
            p1 *= param[i][1, ind]
        else:
            p0 *= 1 / (math.sqrt(2 * math.pi * param[i][0, 1])) * math.exp(-(d[i] - param[i][0,
0])**2 / (2 * param[i][0,1]))
            p1 *= 1 / (math.sqrt(2 * math.pi * param[i][1, 1])) * math.exp(-(d[i] - param[i][1, 0])
** 2 / (2 * param[i][1, 1]))
print(p0, p1)
if p0 > p1:
    print(labels[0])
else:
    print(labels[1])

print()
err = 0
for d in data_:
    p0 = (cnt_labels[0] + 1) / (len(data_) + 2)
    p1 = (cnt_labels[1] + 1) / (len(data_) + 2)
    for i in range(len(d) - 1):
        if is_discrete[i]:
            ind = features_list[i].index(d[i])
            p0 *= param[i][0, ind]
            p1 *= param[i][1, ind]
        else:
            p0 *= 1 / (math.sqrt(2 * math.pi * param[i][0, 1])) * math.exp(
                -(d[i] - param[i][0, 0]) ** 2 / (2 * param[i][0, 1]))
            p1 *= 1 / (math.sqrt(2 * math.pi * param[i][1, 1])) * math.exp(
                -(d[i] - param[i][1, 0]) ** 2 / (2 * param[i][1, 1]))
    plabel = None
    if p0 > p1:
        plabel = labels[0]
    else:
        plabel = labels[1]
    if plabel != d[-1]:
        err += 1
print(1 - err / len(data_))
```