

Q1 1

5 Points

True/False

Q1.1 1

1 Point

Support vector machines (SVMs) can be used directly to implement classifiers with a large number of classes.

☐ True☒ False**Q1.2 2**

1 Point

SVMs are a good choice for machine learning problems with a large number of features

☒ True☐ False**Q1.3 3**

1 Point

The advantage of decision trees for machine learning is that the classifiers produced can be easily implemented with rules.

☒ True☐ False**Q1.4 4**

1 Point

The ID3 decision tree learning algorithm always finds an optimal decision tree, i.e., one that minimizes the number of questions needed to classify a case.

- ☐ True
- ☒ False

Q1.5 5

1 Point

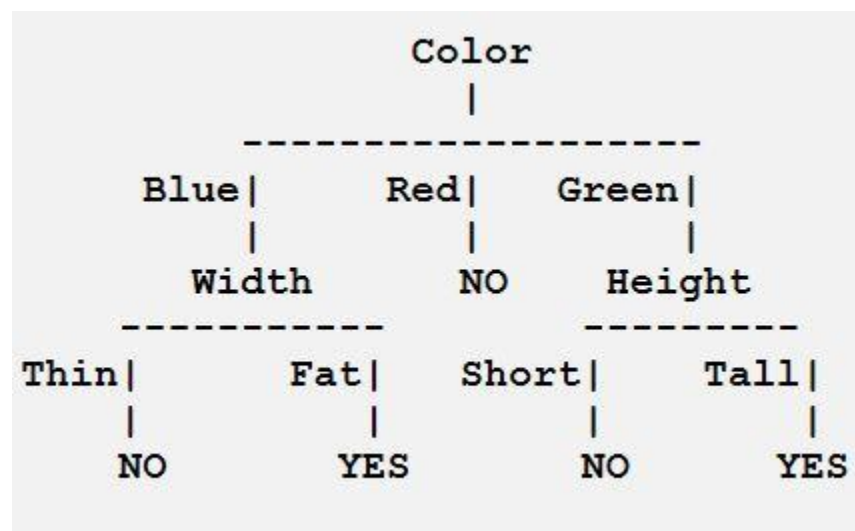
The ID3 decision tree learning algorithm only works for binary classification problems.

- ☐ True
- ☒ False

Q2 2

10 Points

Given the following decision tree, show how the new examples in the table would be classified by filling in the last column in the table. If an example cannot be classified, enter UNKNOWN in the last column.



Q2.1 1

2 Points

Example-> A
Color -> Red
Height -> Short
Width -> Thin

NO

Q2.2 2

2 Points

Example-> B
Color -> Blue
Height -> Tall
Width -> Fat

YES

Q2.3 3

2 Points

Example-> C
Color -> Green
Height -> Short
Width -> Fat

NO

Q2.4 4

2 Points

Example-> D
Color -> Green
Height -> Tall
Width -> Thin

YES

Q2.5 5

2 Points

Example-> E

Color -> Blue

Height -> Short

Width -> Thin

NO

Q3 3

25 Points

GPA	Studied	Passed
L	F	F
L	T	T
M	F	F
M	T	T
H	F	T
H	T	T

We will use the dataset below to learn a decision tree that predicts if people pass machine learning (Yes or No), based on their previous GPA (High, Medium, or Low) and whether or not they studied.

For this problem, you can write your answers using \log_2 , but it may be helpful to note that $\log_2 3 \approx 1.6$.

Q3.1 1

5 Points

What is the entropy $H(\text{Passed})$? $\log_2 3 - 2/3 = 0,93$ **Q3.2 2**

5 Points

What is the entropy $H(\text{Passed}|\text{GPA})$?

$2/3 = 0,66$

Q3.3 3

5 Points

What is the entropy $H(\text{Passed}|\text{Studied})$?

0.47

Q3.4 4

10 Points

Draw the full decision tree that would be learned for this dataset.
You do need to show the calculations.

▼ IMG_20210507_170110.jpg

 Download

3.1

$$H(\text{passed}) = -\left(\frac{6}{2} \log_2 \frac{2}{6} + \frac{4}{6} \log_2 \frac{4}{6}\right)$$

$$H(\text{passed}) = -\left(\frac{1}{3} \log_2 \frac{1}{3} + \frac{2}{3} \log_2 \frac{2}{3}\right)$$

$$H(\text{passed}) = \log_2 3 - \frac{2}{3} \Rightarrow 1.6 - \frac{66}{99} \approx 0.93$$

3.2

$$H(\text{Passed} | \text{GPA}) = -\frac{1}{3} \left(\frac{1}{2} \log_2 \frac{1}{2} + \frac{1}{2} \log_2 \frac{1}{2} \right) - \frac{1}{3} \left(\frac{1}{2} \log_2 \frac{1}{2} + \frac{1}{2} \log_2 \frac{1}{2} \right) - \frac{1}{3} (1 \log_2 1)$$

$$H(\text{Passed} | \text{GPA}) = \frac{1}{3} (1) + \frac{1}{3} (1) + \frac{1}{3} (0)$$

$$H(\text{Passed} | \text{GPA}) = \frac{2}{3} \Rightarrow 0.6$$

3.3

$$H(\text{Passed} | \text{Studied}) = -\frac{1}{2} \left(\frac{1}{3} \log_2 \frac{1}{3} + \frac{2}{3} \log_2 \frac{2}{3} \right) - \frac{1}{2} (1 \log_2 1)$$

$$H(\text{Passed} | \text{Studied}) = \frac{1}{2} \left(\log_2 3 - \frac{2}{3} \right)$$

$$H(\text{Passed} | \text{Studied}) = \frac{1}{2} (1.6 - 0.66) = 0.46 \text{ || } 0.47$$

3.4

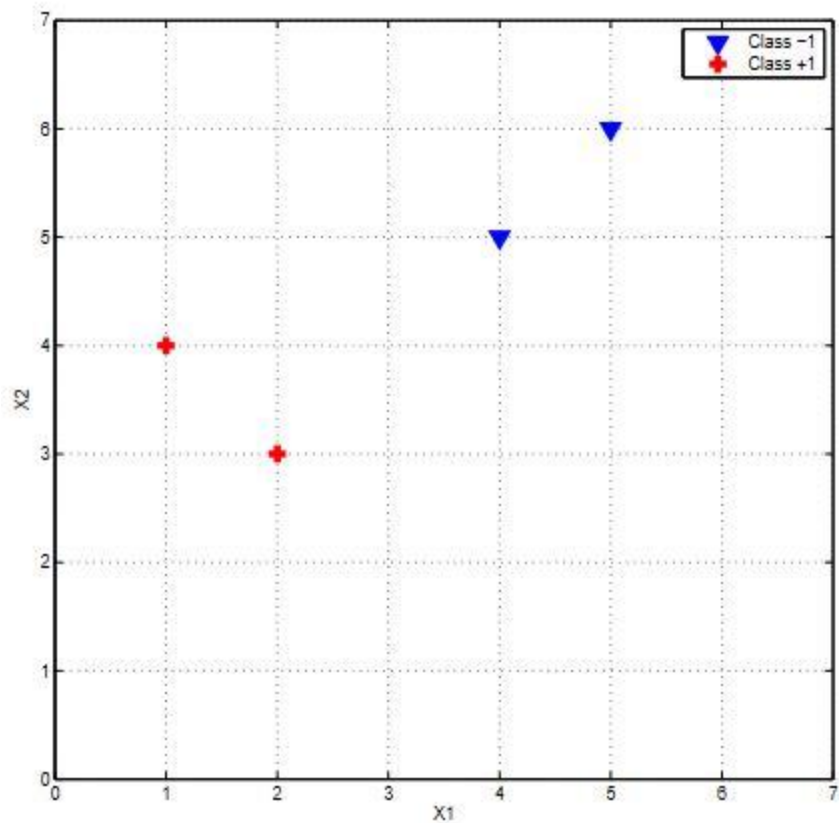
```

graph TD
    Studied[Studied] -- F --> GPA[GPA]
    Studied -- T --> T[T]
    GPA -- L --> F[F]
    GPA -- H --> T[T]
    GPA -- when --> F[F]
  
```

Q4 4

35 Points

Support vector machines learn a decision boundary leading to the largest margin from both classes. You are training SVM on a tiny dataset with 4 points shown in Figure. The dataset consists of two examples with class label -1 (denoted with plus), and two examples with class label +1 (denoted with triangles).

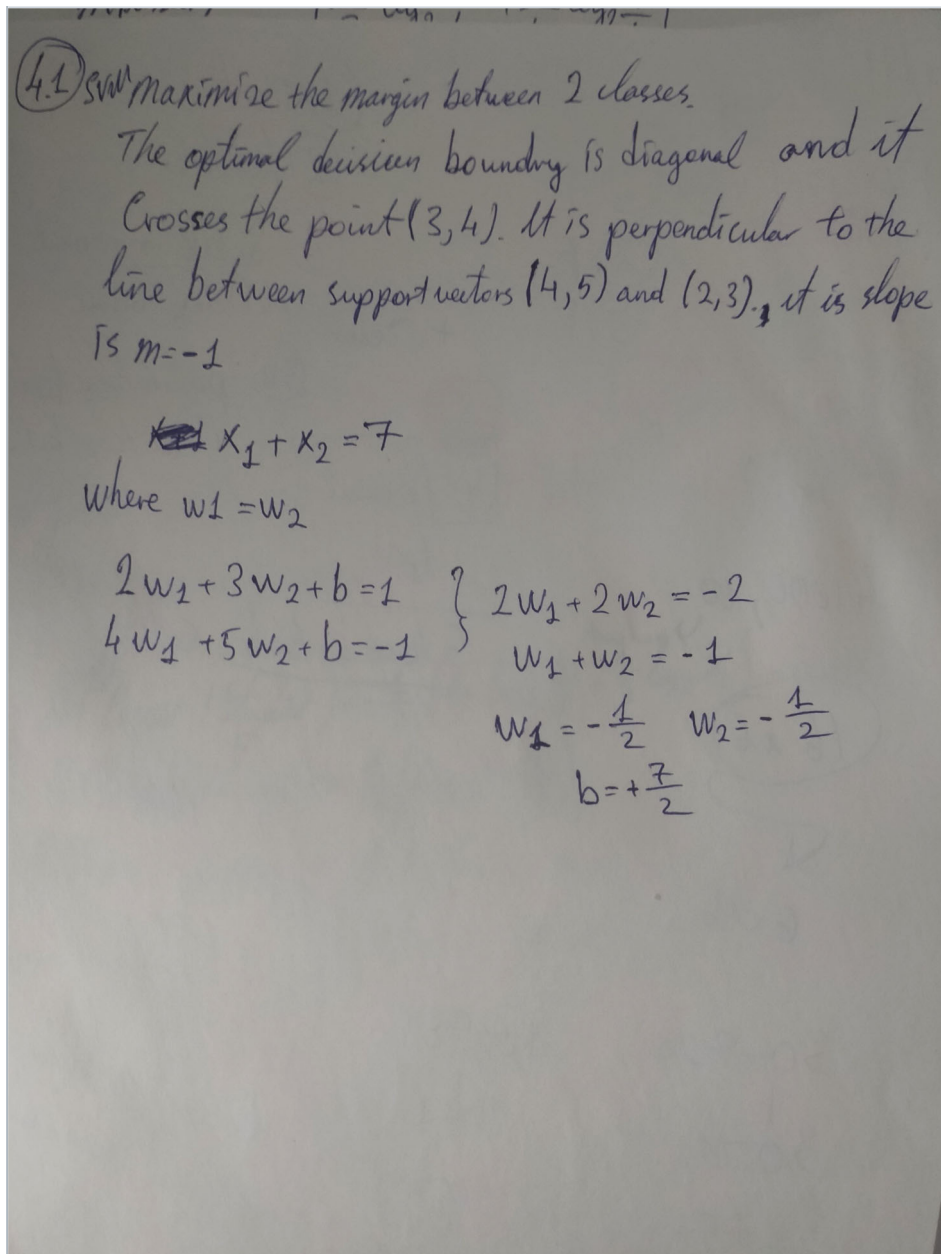
**Q4.11**

30 Points

Find the weight vector w and bias b . What's the equation corresponding to the decision boundary?

▼ IMG_20210507_170127_N.jpg

 Download

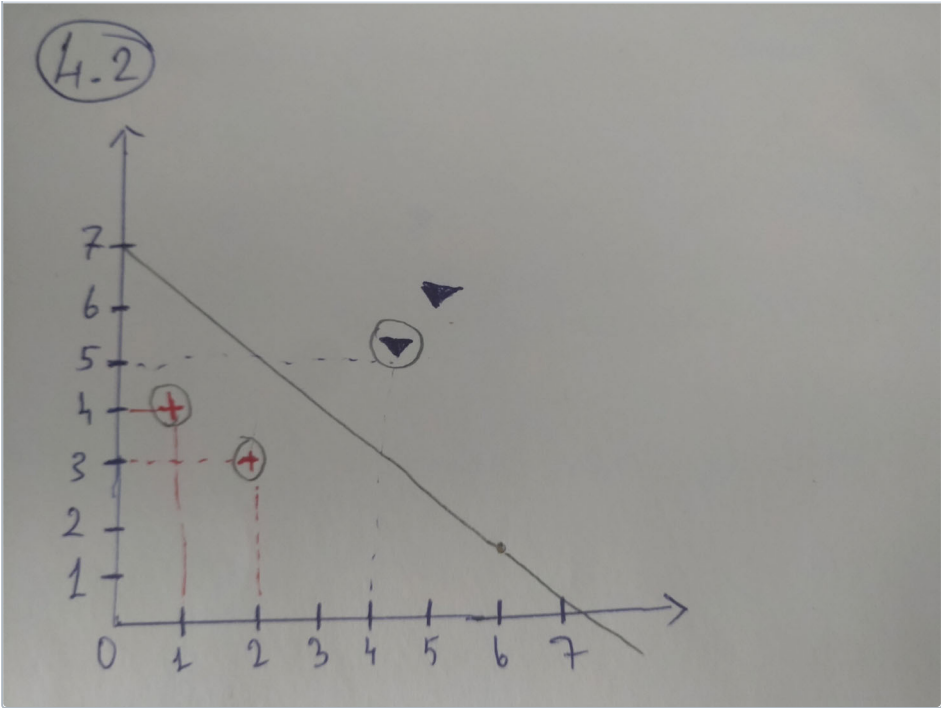
**Q4.2 2**

5 Points

Circle the support vectors and draw the decision boundary.

▼ IMG_20210507_170149_N.jpg

Download



Q5 5

25 Points

You are a robot in a lumber yard and must learn to discriminate Oakwood from Pinewood. You choose to learn a Decision Tree classifier. You are given the following examples:

Example	Density	Grain	Hardness	Class
Example #1	Heavy	Small	Hard	Oak
Example #2	Heavy	Large	Hard	Oak
Example #3	Heavy	Small	Hard	Oak
Example #4	Light	Large	Soft	Oak
Example #5	Light	Large	Hard	Pine
Example #6	Heavy	Small	Soft	Pine
Example #7	Heavy	Large	Soft	Pine
Example #8	Heavy	Small	Soft	Pine

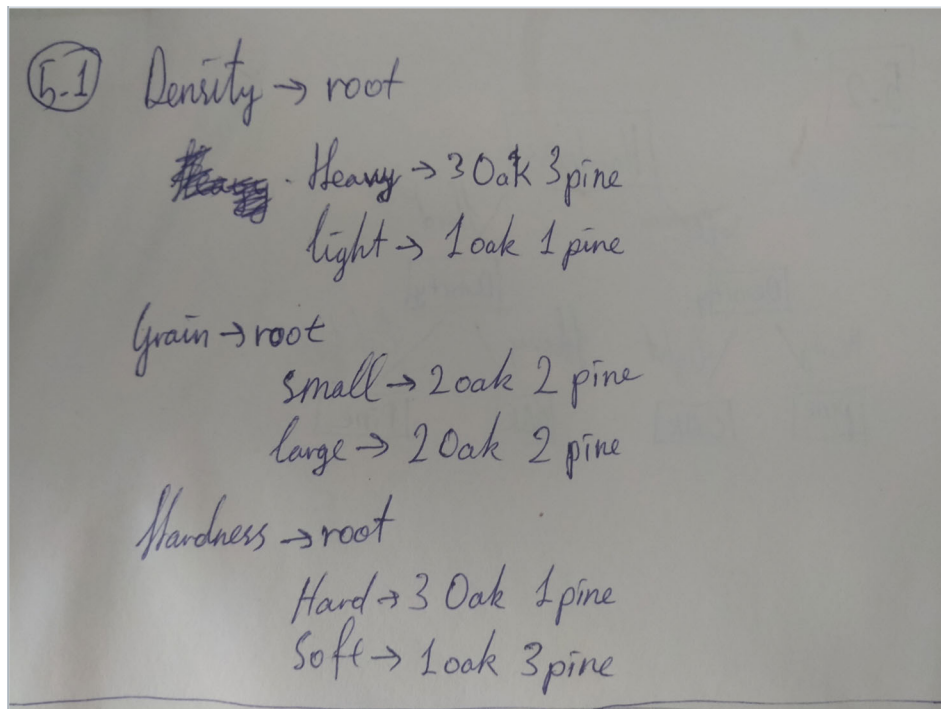
Q5.1 1

4 Points

Which attribute would information gain choose as the root of the tree? You need to show the calculations.

▼ IMG_20210507_170202_N.jpg

Download

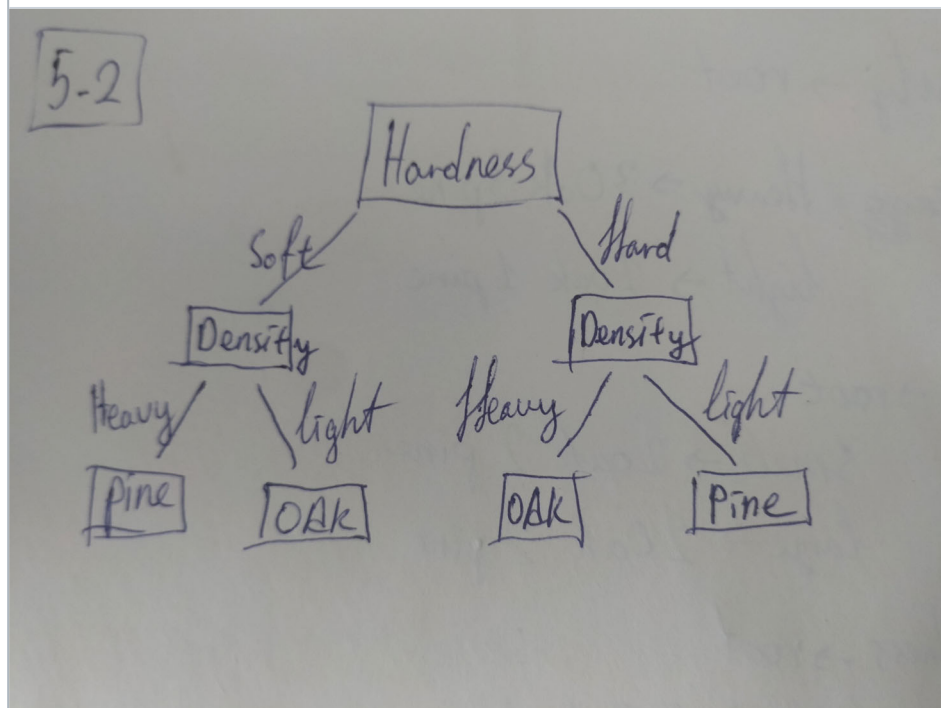
**Q5.2 2**

15 Points

Draw the decision tree that would be constructed by recursively applying information gain to select roots of sub-trees.

▼ IMG_20210507_170216_N.jpg

Download

**Q5.3 3**

3 Points

Classify the new example as
Oak or Pine using your decision tree.

What class is [Density=Light, Grain=Small, Hardness=Hard]?

Pine

Q5.4 4

3 Points

Classify the new example as
Oak or Pine using your decision tree.

What class is [Density=Light, Grain=Small, Hardness=Soft]?

OAK

Quiz-5

● GRADED

STUDENT
MEHMET TAHA USTA

TOTAL POINTS
86 / 100 pts

QUESTION 1

1		5 / 5 pts
1.1	1	1 / 1 pt
1.2	2	1 / 1 pt
1.3	3	1 / 1 pt
1.4	4	1 / 1 pt
1.5	5	1 / 1 pt

QUESTION 2

2		10 / 10 pts
2.1	1	2 / 2 pts
2.2	2	2 / 2 pts
2.3	3	2 / 2 pts
2.4	4	2 / 2 pts
2.5	5	2 / 2 pts

QUESTION 3

3		25 / 25 pts
3.1	1	5 / 5 pts
3.2	2	5 / 5 pts
3.3	3	5 / 5 pts
3.4	4	10 / 10 pts

QUESTION 4

4		35 / 35 pts
4.1	1	30 / 30 pts
4.2	2	5 / 5 pts

QUESTION 5

5		11 / 25 pts
5.1	1	0 / 4 pts
5.2	2	5 / 15 pts
5.3	3	3 / 3 pts
5.4	4	3 / 3 pts