		•			Duration: 1	.5 1111115	Date. 10/	/08/2023
Student name:							Score:	/ 3
Question 1 (2pts)		-		#	Density	Grain	Hardness	Class
to discriminate Oa			-	1	Light	Small	Hard	Oak
observing the appea The aside table sho				2	Heavy	Large	Hard	Oak
				3	Light	Large	Hard	Oak
a) (1.5pts) Use <b>ID</b> 3	O							
tree from the g			_	4	Heavy	Small	Medium	Oak
which is round				5	Light	Small	Medium	Pine
Attributes havir			•	6	Heavy	Large	Soft	Pine
are chosen in al	_			7	Light	Large	Soft	Pine
				8	Heavy	Small	Soft	Pine
Evaluate all attribu	tes and cir	cle the attr	ibute that is	s selected	for the root	node of th	⊥ e ID3 decisio	n tree.
	Whole				rain	Hardness		11 61 661
	dataset	Heavy	Light	Large	Small	Hard	Medium	Soft
Entropy			_	<del>_</del>				
Average Entropy								
Information Gain								
For the branch tha	t still con	tains a mix	xture of pos	itive and	negative e	xamples, ev	valuate the r	emaining
attributes and circl	<u>e the attril</u>	bute that is	selected for	the next	node (you ı	<u>nay leave ii</u>	rrelevant cell	s blank).
	Whole	Der	nsity	Grain		Hardness		
	subset	Heavy	Light	Large	Small	Hard	Medium	Soft
Entropy								
Average Entropy								
Information Gain								
Question 2 (1pt) I choice. The farmer and "6 Ri". His cur commands a distinct	dentify wh is currently rent task	nich type of y in his duri involves ar	f learning sh ian orchard, ranging the	which con durians,	tains two vo getting the	arieties of d m ready fo	urians: "Muso r sale, as eac	ang King" h variety

Student ID:				Durat	ion: 15 mins	Date:	16/08/2023
Student name:						Sco	re: <u>/ 3</u>
Question 1 (2pts	) We hav	ve some data	#	Weekend?	Company?	Weather	Go Hiking?
about when peopl	_	_	1	Υ	N N	R	N
takes into effect, w			2	Υ	Υ	R	N
weekend or not, if sunny, and if the		•	3	Υ	Υ	S	Υ
during the hike.	person	nas company	4	Υ	N	S	Υ
_	2 algoriti	<b>hm</b> to build a	5	Υ	Υ	R	N
a) (1.5pts) Use <b>ID</b> decision tree from	_		6	Υ	Υ	S	Υ
the following tal	•		7	N	Υ	S	N
results, each o			8	N	Y	R	N
three decimal p	laces. Attr	ributes having	9	N	N	S	N
the same best n	netric valu	es are chosen					
in alphabetical o	order.						
Evaluate all attribu	tes and cir	cle the attribu	te that is s	selected for the	e root node of	the ID3 deci	sion tree.
	Whole Compan		iny?	Weather		Weekend?	
	dataset	N	Υ	R	S	N	Υ
Entropy							
Average Entropy							
Information Gain							
For the branch tha			-	_	-		_
attributes and circl	Whole	Compa			ather		kend?
	subset	N	Υ Υ	R	S	N	Υ
Entropy	50.2501						•
Average Entropy							
Information Gain							
	1						
b) (0.5pt) Draw th	e complete	e decision tree	•				
Question 2 (1pt) I	dontify wł	nich type of lea	rning cho	uld he used to	solve the foll	owing tack 1	Evnlain vour
choice. A marketing	-		_			_	
who exhibit similar	_		_				_
This analysis enhan			-			=	
-	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	- <del>-</del>		-	-	•	

Student ID:				I	Ouration: 15	mins	 Date: 16	5/08/2023
Student name:							Score	: /3
Question 1 (2p	-		•	#	Hangover	Exam	Weekend	Party
whether to go to about whether he	1 0		J	1	No	Easy	No	Yes
next morning, w	-		_	1	INO	Lasy	INO	163
weekend, and how				2	No	Hard	No	No
weekend, and now	difficult	ine meomm	5 CAMIII 13.	3	No	No	No	Yes
a) (1.5pts) Use <b>ID</b>	3 algorit	<b>hm</b> to build	a decision	4	No	No	Yes	Yes
tree from the	given data	a. Fill in the	following					
tables with yo	our nume	erical result	s, each of	5	Yes	Easy	No	No
which is rour	nal places.	6	Yes	Hard	No	No		
Attributes havi	7	Yes	No	No	No			
are chosen in alphabetical order.				0				
	. 1		21	8	Yes	No	Yes	No
Evaluate all attrib		ı			ı	noae of the		on tree.
	Whole	Hang		Wee	ı	F	Exam	
<b>.</b>	dataset	No	Yes	No	Yes	Easy	Hard	No
Entropy								
Average Entropy	$\sim$							
For the branch th			•		o .	•		•
attributes and circ		I				<u>ay leave ii</u>		<u>lis blankj.</u>
	Whole	Hang		Wee	ı	Exam		
	subset	No	Yes	No	Yes	Easy	Hard	No
Entropy								
Average Entropy	$\sim$							
	$\nearrow$							
Question 2 (1pt) choice. You are at facing it. After seven throughout the base.	Identify v the final s eral trials,	vhich type o tage of a via , you have fo	f learning sh leo game. Th bund that the	e boss is so	mighty tha	t you cann	not defeat it i	by directly
facing it. After sev	eral trials,	, you have fo	ound that the				-	points. You focus on th

Student ID.		•			D	uration:	15 mins	Date: 1	.6/08/2023
Student name:			•••••	•				Scor	e: <u>/</u> 3
Question 1 (2pts)				#	SI	hape	Skin	Hardness	Class
to determine whet Bad by observing th			-	1	R	ound	Rough	Soft	Tasty
aside table shows th			,	2	R	ound	Rough	Hard	Tasty
a) (1.5pts) Use <b>I</b>	D2 algor	rithm to l	auild a	3		Oval	Smooth	Soft	Tasty
decision tree from	_			4		Oval	Rough	Hard	Tasty
following tables	•						_		
each of which i	s rounded	l to three o	decimal	5	L	.ong	Rough	Soft	Bad
places. Attribu				6	R	ound	Smooth	Soft	Bad
metric values order.	are chose	n in alpha	abetical	7	R	ound	Smooth	Hard	Bad
order.				8	L	.ong	Rough	Soft	Bad
Evaluate all attribu	tes and cir	cle the attr	ibute that	is selecte	ed fo	r the roo	ot node of t	he ID3 decis	ion tree.
	Whole	Sk			lardr			Shape	
	dataset	Smooth	Rough	Hard		Soft	Long	Oval	Round
Entropy									
Average Entropy									·
Information Gain									
For the branch tha	<u>at still con</u>	tains a mix	kture of p	ositive ai	nd n	egative (	examples,	evaluate the	remaining
attributes and circl	4	1					may leave		<u>ells blank).</u>
	Whole	Sk	Г		lardness			Shape	
	subset	Smooth	Rough	Hard		Soft	Long	Oval	Round
Entropy									
		i							
Average Entropy									
Average Entropy Information Gain b) (0.5pt) Draw th	ve gammalat	o de sision d	two o						

# **SOLUTION**

Student ID:	Duration: 15 mins	Date: 12/04	/2023
Student name:		Score:	/ 3

**Question 1 (2pts)** A robot in a lumber yard learns to discriminate Oak wood from Pine wood by observing the appearance of a given piece of wood. The aside table shows the training data set.

a) (1.5pts) Use **ID3 algorithm** to build a decision tree from the given data. Fill in the following tables with your numerical results, each of which is rounded to three decimal places. Attributes having the same best metric values are chosen in alphabetical order.

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

Evaluate all attributes and circle the attribute that is selected for the root node of the ID3 decision tree.

	Whole	Density		Gra	Grain		Hardness		
	dataset	Heavy	Light	Large	Small	Hard	Medium	Soft	
Entropy	1	1	1	1	1	0	1	0	
Average Entropy		1		1		0.25			
Information Gain		(	)	0		0.75			

For the branch that still contains a mixture of positive and negative examples, evaluate the remaining attributes and circle the attribute that is selected for the next node (you may leave irrelevant cells blank).

	Whole	Density		Gra	Grain		Hardness		
	subset	Heavy	Light	Large	Small	Hard	Medium	Soft	
Entropy	1	0	0	0	1				
Average Entropy	$\backslash$	0		1					
Information Gain		1	L	(	)				

b) (0.5pt) Draw the complete decision tree.

Hardness = Hard: Class = Oak Hardness = Soft: Class = Pine

Hardness = Medium

|----- Density = Heavy: Class = Oak |----- Density = Light: Class = Pine

**Question 2 (1pt)** Identify which type of learning should be used to solve the following task. Explain your choice. *The farmer is currently in his durian orchard, which contains two varieties of durians: "Musang King" and "6 Ri". His current task involves arranging the durians, getting them ready for sale, as each variety commands a distinct price. He determines the type of durian by observing the fruits' shapes, colors, and spikes.* 

**Supervised learning.** The number of classes is known in advanced, which are "Musang King" and "6 Ri". The objects in each class are distinguished by their shapes, colors, and spikes.

Student ID:	Duration: 15 mins	Date: 20/04	/2023
Student name:		Score:	/ 3

**Q1 (2pts)** We have some data about when people go hiking. The data takes into effect, whether the hike is on a weekend or not, if the weather is rainy or sunny, and if the person has company during the hike.

a) (1.5pts) Use **ID3 algorithm** to build a decision tree from the given data. Fill in the following tables with your numerical results, each of which is rounded to three decimal places. Attributes having the same best metric values are chosen in alphabetical order.

		+		
#	Weekend?	Company?	Weather	Go Hiking?
1	Υ	N	R	N
2	Υ	Υ	R	N
3	Υ	Υ	S	Υ
4	Υ	N	S	Υ
5	Υ	Υ	R	N
6	Υ	Υ	S	Υ
7	N	Υ	S	N
8	N	Y	R	N
9	N	N	S	N

Evaluate all attributes and circle the attribute that is selected for the root node of the ID3 decision tree.

	Whole	Company?		Weather		Weekend?	
	dataset	N	Υ	R	S	N	Υ
Entropy	0.918	0.918	0.918	0	0.971	0	1
Average Entropy		0.918		0.539		0.667	
Information Gain		0		0.379		0.252	

For the branch that still contains a mixture of positive and negative examples, evaluate the remaining attributes and circle the attribute that is selected for the next node (you may leave irrelevant cells blank).

	Whole	Company?		Wea	Weather		end?	
	subset	N	Υ	R	S	N	Υ	
Entropy	0.971	1	0.918			0	0	
Average Entropy		0.951				0		
Information Gain		0.3	0.2				0.971	

b) (0.5pt) Draw the complete decision tree.

Weather = S |----- Weekend? = No: No |----- Weekend? = Yes: Yes Weather = R: No

**Question 2 (1pt)** Identify which type of learning should be used to solve the following task. Explain your choice. A marketing representative is examining the customer data, aiming to pinpoint clusters of customers who exhibit similar behaviors. The number of clusters is inherent to the data and cannot be predetermined. This analysis enhances the efficacy of customer outreach for introducing new marketing campaigns.

**Unsupervised learning.** The number of clusters cannot be predetermined. Customers of the same cluster have similar behaviors, while those of different behaviors are separated to other clusters.

Student ID:	Duration: 15 mins	Date: 12/04/2023		
Student name:		Score:	/ 3	

**Question 1 (2pts)** A robot in a fruit farm learns to determine whether an avocado is Tasty or Bad by observing the avocado's appearance. The aside table shows the training data set.

a) (1.5pts) Use **ID3 algorithm** to build a decision tree from the given data. Fill in the following tables with your numerical results, each of which is rounded to three decimal places. Attributes having the same best metric values are chosen in alphabetical order.

#	Shape	Skin	Hardness	Class
1	Round	Rough	Soft	Tasty
2	Round	Rough	Hard	Tasty
3	Oval	Smooth	Soft	Tasty
4	Oval	Rough	Hard	Tasty
5	Long	Rough	Soft	Bad
6	Round	Smooth	Soft	Bad
7	Round	Smooth	Hard	Bad
8	Long	Rough Soft		Bad

Evaluate all attributes and circle the attribute that is selected for the root node of the ID3 decision tree.

	Whole	Skin		Hardness		Shape		
	dataset	Smooth	Rough	Hard	Soft	Long	Oval	Round
Entropy	1	0.918	0.971	0.918	0.971	0	0	1
Average Entropy		0.951		0.951		0.5		
Information Gain		0.049		0.049		0.5		

For the branch that still contains a mixture of positive and negative examples, evaluate the remaining attributes and circle the attribute that is selected for the next node (you may leave irrelevant cells blank).

	Whole	Skin		Hardness		Shape		
	subset	Smooth	Rough	Hard	Soft	Long	Oval	Round
Entropy	1	0	0	1	1			
Average Entropy		0		1				
Information Gain		1	l	(	)			

b) (0.5pt) Draw the complete decision tree.

Shape = Oval: Class = Tasty Shape = Long: Class = Bad

Shape = Round

|----- Skin = Rough: Class = Tasty |----- Skin = Smooth: Class = Bad

**Question 2 (1pt)** Identify which type of learning should be used to solve the following task. Explain your choice. You are at the final stage of a video game. The boss is so mighty that you cannot defeat it by directly facing it. After several trials, you have found that the boss has some death points. You focus on those points throughout the battle, and then you are done.

**Reinforcement learning.** It is a trial-and-error process in which the agent only receives signal indicating success or failure and itself determines how to update the policy (no specific measurement of how to adjust the error)

Student ID:	Duration: 15 mins	Date: 20/04/2023		
Student name:		Score: /3		

**Q1 (2pts)** A student is considering whether to go to the party or not. He is thinking about whether he may have a terrible hangover the next morning, whether the party is held at weekend, and how difficult the incoming exam is.

a) (1.5pts) Use **ID3 algorithm** to build a decision tree from the given data. Fill in the following tables with your numerical results, each of which is rounded to three decimal places. Attributes having the same best metric values are chosen in alphabetical order.

ekend Party
No Yes
No No
No Yes
Yes Yes
No No
No No
No No
Yes No

Evaluate all attributes and circle the attribute that is selected for the root node of the ID3 decision tree.

	Whole	Hangover		Weekend		Exam		
	dataset	No	Yes	No	Yes	Easy	Hard	No
Entropy	0.954	0.811	0	0.918	1	1	0	1
Average Entropy		0.406		0.939		0.75		
		0.548		0.015		0.204		

For the branch that still contains a mixture of positive and negative examples, evaluate the remaining attributes and circle the attribute that is selected for the next node (you may leave irrelevant cells blank).

	Whole	Hangover		Weekend		Exam		
	subset	No	Yes	No	Yes	Easy	Hard	No
Entropy	0.811			0.918	0	0	0	0
Average Entropy				0.689		0		
				0.123			0.811	

b) (0.5pt) Draw the complete decision tree.

Hangover = No |----- Exam = Easy: Yes |----- Exam = Hard: No |---- Exam = No: No Hangover = Yes: No

**Question 2 (1pt)** Both supervised learning and reinforcement learning have feedback to the learner. Point out the difference between two types of feedback and thus how this difference affects the learning process.

Difference: SL can precisely adjust the model based on the difference between the actual value produced by the model and the ground truth, while the feedback from the environment in RL is quite simple and not informative enough to calculate the adjustments