robot in e Oak w e appear aside ta		yard Pine given		#	Den	.			Scor	e:/_ <u>/</u>
e Oak w e appear aside ta	rood from	Pine given	;	#	Den					
e appear aside ta	ance of a	given				sity	(	rain	Hardness	Class
aside ta		rood by observing the appearance of a given iece of wood. The aside table shows the			Liç	ght	5	Small	Hard	Oak
algorit	raining data set.			2	He	avy	L	.arge	Hard	Oak
algorit	-			3	Liç	ght ¶	L	.arge	Hard	Oak
) (1.5pts) Use <b>ID3 algorithm</b> to build a decision tree from the given data. Fill in				4	He	avy	5	Small	Medium	Oak
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.				5	Liç	ght •	5	Small	Medium	Pine
				6	He	avy	L	.arge	Soft	Pine
				7	Liç	ght <b>=</b>	L	arge	Soft	Pine
				8	He	avy		Small	Soft	Pine
s and cir	cle the att	<u>ribute t</u>	hat i	s sele			oot	node of t	he ID3 decu	sion tree.
Whole	Density									
lataset	Heavy	Ligh	nt	La	rge	Sma	II	Hard	Mediur	n Soft
1	1					1		4		10
><	1				•	<u>J</u> !			925	
><		D				<b>O</b>			ו עו	75
still cont	tains a mi	xture o	f pos	sitive	and r	egativ	e ex	amples,	evaluate th	e remainin
<u>he attrib</u>	oute that is	selecto	ed fo	r the	<u>next n</u>	ode (yo	ou m	ay leave	irrelevant o	ells blank).
Whole	Dei	nsity			Grain			Hardness		s
subset	Heavy	Ligh	ìţ.	La	ge	Sma		Hard	Mediur	n Soft
1	O	C			•	1				
	J	-			1					
	1				1					
dnes	<sup>5</sup> ←		eren	ce) su	taro M Cy apervis	sed lear	nin	g and un	Supervised 1	sty learning.
	and cir Vhole ataset  till contine attrib Vhole ubset complete	and circle the att  Vhole Del  ataset Heavy  till contains a mine attribute that is  Vhole Del  ubset Heavy  complete decision	Attributes having the values are chosen in  and circle the attribute to the values. Heavy Light till contains a mixture of the attribute that is select. Whole Density ubset Heavy Light till complete decision tree.	Attributes having the values are chosen in  and circle the attribute that is the property of t	Attributes having the values are chosen in 7  8  and circle the attribute that is selected to the attribute that is selected for the the attribute that is selected for the the theorem attribute that is selected for the theorem at the t	Attributes having the values are chosen in 7 Lig 8 He  and circle the attribute that is selected for the large 1	Attributes having the values are chosen in 7 Light 8 Heavy  and circle the attribute that is selected for the restance Heavy Light Large Small Heavy Large S	Attributes having the values are chosen in 7 Light 1 Light 2 S and circle the attribute that is selected for the root.  Whole Density Grain ataset Heavy Light Large Small 1 Light 1 Large Small 2 Large Small 3 Large Small 2 Large Small 3 Large S	Attributes having the values are chosen in   Attribute the attribute that is selected for the root node of the value of the v	Attributes having the values are chosen in 7 Light Large Soft  8 Heavy Small Soft  and circle the attribute that is selected for the root node of the ID3 deex  Whole Density Grain Hardnes  ataset Heavy Light Large Small Hard Mediur  till contains a mixture of positive and negative examples, evaluate the eattribute that is selected for the next node (you may leave irrelevant of the selected for the next node (you may leave

0 = / 100			- /				
Student ID:				Durat	ion: 15 mins	Date:	18/04/2023
Student name:						Scor	e: / <u>3</u>
Question 1 (2pts	) We hav	ve some data					
about when peopl			#	Weekend?	Company?	Weather	Go Hiking?
takes into effect, w	_	_	1	Υ	N	R	N
weekend or not, if	the weath	er is rainy or	2	Υ	Υ	R	N
sunny, and if the	person	has company	3	Υ	Υ	S	Υ
during the hike.			4	Υ	N	S	Υ
a) (1.5pts) Use <b>ID</b>	3 algoritl	<b>nm</b> to build a	5	Υ	Υ	R	N
decision tree fro	_		6	Υ	Υ	S	Υ
the following tal	the following tables with your numerical				Υ	S	N
results, each o	8	N	Υ	R	IV		
three decimal p	9	N	N	S	N		
the same best n		es are chosen	1				!
in alphabetical o			_				
Evaluate all attributes and circle the attribu				<del></del>	<del></del>		
	Whole	Compar			ather	Week	1
	dataset	N	Y	R	S	N	Y
Entropy	4918	019/2	1910	0	2 .971	<u> </u>	1
Average Entropy	$\sim$		1/2	1012	59	01	66+
Information Gain		<u> </u>	2	01 2	79		1,251
For the branch that			_	_	_		_
attributes and circi				_		ve irrclevant ceils blank).  Weekend?	
	Whole	Compar	ny:	wea	ather	N	ena?
Fatrony	subset	IN	<del>-7. /1.</del>	1	3	IV	
Entropy	0 311	21	17171	<b>X</b> / \		U	U
Average Entropy		<u> </u>	1				<u> </u>
Information Gain		<u> </u>	)		•	-	<del>-11+/-</del>
b) (0.5pt) Draw th	e complete	e decision tree.		a ole	1 9, -		
			K -	7 440	MILIN	a	
VV.e[\{\P				<b>A A</b>	1	)	1
MIT		_		/ V	VAVICON !	-1	
		$\searrow$			(MPO V		
		> _	•				
Question 2 (1pt)	Compare (s	similarity and d	ifference)	supervised le	earning and re	einforcement	learning.
	1	,	,	1	J		Ü

C					D .: 4		<b>5</b>	10 1 10 000
Student ID:					Duration: 1	5 mins	Date: 18/	04/2023
Student name:							Score:	/ 3
Question 1 (2pt	-		<u> </u>	#	Hangover	Exam	Weekend	Party
whether to go to t								
about whether he				1	No	Easy	No	Yes
he next morning, whether the party is held at veekend, and how difficult the incoming exam				2	No	Hard	No	No
is.	- II			3	NI-	NI -	NI -	V
15.					No	No	No	Yes
a) (1.5pts) Use	ID3 algo	orithm to	build a	4	No	No	Yes	Yes
	decision tree from the given data. Fill in the					Easy	No	No
following tables with your numerical results,				5	Yes	-		
each of which is rounded to three decimal				6	Yes	Hard	No	No
•	places. Attributes having the same best metric values are chosen in alphabetical				Yes	No	No	No
	are chos	sen in alph	abetical	8	Yes	No	Yes	No
order.	_				1			
Evaluate all attrib						node of the		n tree.
	Whole	Hang			ekend		Exam	
	dataset	No	Yes	No	Yes	Easy	Hard	No
Entropy	4,954	0 411	U	-317		1	2	<u> </u>
Average Entropy		<b>√</b> 1	406	ا لارن	<u>5-567</u>		V 1 75	
		4,5	<u> 48/</u>		DAC		ركار	<u>) t</u>
For the branch th			_		_	-		
attributes and cire	1	I		1		<u>nay leave ir</u>		<u>s blank).</u>
	Whole	Hang			ekend		Exam	1
	subset	No	Yes	No	Yes	Easy	Hard	No
Entropy	<u>U XII</u>			5/1	<u>ل</u> ر ٥		U	U
Average Entropy					<u> 1699                                   </u>		TU TO	
				$\perp U, \perp 2$		Ц	N XI	
b) (0.5pt) Draw	the compl	ete decision	tree.	· · Z	4	\ ,	Λ	$\Delta Z$
		17		C	14	M	ns ->	11/4/15
Hamer	. 1		<b>\10</b>	1				1
Nooh in	-			1	1	· ·	Uril -	
J			<b>\</b>		\\.		. I	
	_	J		<b>つ</b>	W		M -	- )
Question 2 (1pt)		-			<b>0</b>		•	ı context.
State clearly the r	ewards an	id how the ag	gent uses t	that informa	ation to imp	rove its per	tormance.	

Student ID:		•			Duration	: 15 mins	Date: 1	18/04/202
Student name:				•			Scor	e:/_
Question 1 (2pts)				#	Shape	Skin	Hardness	Class
to determine whet Bad by observing th			١ ١	1	Round	Rough	Soft	Tasty
aside table shows th			-	2	Round	Rough	Hard	Tasty
a) (1.5pts) Use II	D3 algor	r <b>ithm</b> to b	ouild a	3	Oval	Smooth	Soft	Tasty
decision tree fro	om the giv	en data. Fil	l in the	4	Oval	Rough	Hard	Tasty
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.			5	Long	Rough	Soft	Bad	
			t t	6	Round	Smooth	Soft	Bad
			7	Round	Smooth	Hard	Bad	
Evaluate all attribu	toc and cir	clothoattr	ibuta that	is soloste	Long od for the re	Rough	Soft	Bad Sion from
Evaluate all attribu	Whole	Sk			ardness	JOE HEIGH ST	Shape	sion tree.
	dataset	Smooth	Rough	Hard	Soft	Long	<del></del>	Round
Entropy	1	2,218	1561	0.4		4 0	6	/
Average Entropy		0,4	51	0	V51		2,5.	<u> </u>
Information Gain		יט ר	4.9	P	1649	7	2 11	
For the branch tha			_		_		•	
attributes and circle	e the attril	bute that is	selected f	or the ne	xt node (yo	u may leav	e irrelevant c	<u>elis blank)</u>
	Whole	Sk	in	Н	ardness		Shape	
	subset	Smooth	Rough	Hard	Soft	Long	Oval	Round
Entropy	7 (	Ū	U					
Average Entropy		9		'				
Information Gain			كسر		0			
(0.5pt) Draw the Slupe and Open and Ope	Ovu	514 N	7800 TCL3	that we cl	hoose the si	mplest cor	isistent hypo	thesis?

## **SOLUTION**

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

**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 V	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		Gr	ain	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		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		Gr	ain	Hardness		
	subset	Heavy	Light	Large	Small	Hard	Medium	Soft
Entropy	1	0	0	0	1			
Average Entropy		0		1				
Information Gain		1	1		0			

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) Compare (similarity and difference) supervised learning and unsupervised learning.

Similarity: both requires training data to build the mode

Difference: SL requires labeled training data while USL works on unlabeled data. SL generalizes the mapping from features to labels, while USL groups data points based on their features.

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	Υ	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?		Wea	ther	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	ther	Weekend?	
	subset	N	Υ	R	S	N	Υ
Entropy	0.971	1	0.918			0	0
Average Entropy		0.951					
Information Gain		0.2				0.9	71

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

Weather = S

|----- Weekend? = No: No

|----- Weekend? = Yes: Yes

Weather = R: No

**Q2 (1pt)** Compare (similarity and difference) supervised learning and reinforcement learning.

Similarity: both has the feedback information, SL is guided by the difference between the actual value produced by the model and the ground truth, while RL is guided by the feedback from the environment

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 in RL is quite simple and not informative enough

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

**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.

c) (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		0				

d) (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)** Give an example of the reinforcement learning problem. Describe the problem context. State clearly the rewards and how the agent uses that information to improve its performance.

You are training your dog to get the stick. Each time the dog returns a stick successfully, you offer it favorite treats. Eventually, the dog understands that whenever the master throws a stick, it should get it as early as possible to gain a reward (a bone) from a master in a lesser time.

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

**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.

c) (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.

#	Hangover	Exam	Weekend	Party
1	No	Easy	No	Yes
2	No	Hard	No	No
3	No	No	No	Yes
4	No	No	Yes	Yes
5	Yes	Easy	No	No
6	Yes	Hard	No	No
7	Yes	No	No	No
8	Yes	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		

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

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

**Q2 (1pt)** What is a hypothesis? Why is it that we choose the simplest consistent hypothesis?

A hypothesis gives an estimation of the true underlying distribution of data, and it is needed to be verified.

The simplest consistent hypothesis can fit all the training data points while it is general enough to avoid overfitting