Machine Learning Homework 2

1. Calculate the gradient of the following multivariate function:

(1) $u = xy + y^2 + 5$

(2) $u = \ln\sqrt{x^2 + y^2 + z^2}$, at (1,2,-2).

2. As we all know, whether to sleep in is a complex question that depends on multiple variables. The following is a random selection of student A's 12-day data on sleeping in. Please build a decision tree based on this data, and use the information gain to divide the attributes. An illustration of the calculation process and the final decision tree is required. Hint: For some nodes, you may not need to calculate conditional entropy, but directly make decision by observing the data.

Season	After 8:00	Wind	Sleep in
spring	no	breeze	yes
winter	no	no wind	yes
autumn	yes	breeze	yes
winter	no	no wind	yes
summer	no	breeze	yes
winter	yes	breeze	yes
winter	no	gale	yes
winter	no	no wind	yes
spring	yes	no wind	no
summer	yes	gale	no
summer	no	gale	no
autumn	yes	breeze	yes

（P.S. Sleeping in is not a good habit 😎）

3. Given the following data：

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
x (1)	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3
x (2)	S	M	M	S	S	S	M	M	L	L	L	M	M	L	L
y	-1	-1	1	1	-1	-1	1	1	1	1	1	1	1	1	-1

where x is a 2D vector, the first dimension takes values in (1, 2, 3), the second dimension takes values in (S, M, L), and y takes values in (-1, 1). Given new data x = (2,S), try the Naive Bayes method to predict the value of y at this time.

Submission

1. **Format**: Please submit a pdf/doc/docx file and name it in this format:

   HW2+Student_ID+Name. Example: HW2+1234567+张三.pdf

2. **Deadline**: 2025/6/13 23:59. You have 2 weeks.
3. Please submit your homework to **Canvas**.
4. **Late policy**: **7** free late days

    a) Use up to 4 late days per assignment.

    b) Afterwards, 25% off per day late.