LIN 313: Language and Computers
Perceptron Practice

You are building a tiny classifier that decides whether a written sentence is a **question** (+1) or a **statement** (−1). It is a perceptron with three features:

- x_1: Does the sentence end with a question mark? (1 = yes, 0 = no)
- x_2: Does the sentence *start* with a wh-word (*who, what, where, when, why, how*)? (1 = yes, 0 = no)
- x_3: Does an auxiliary verb come before the subject, as in *Is she…*, *Can you…*, *Did they…*? (1 = yes, 0 = no)

The weights are $\mathbf{w} = [2, 3, 4]$ and the bias is $b = -5$. The perceptron computes the weighted sum $z = \mathbf{w} \cdot \mathbf{x} + b = w_1x_1 + w_2x_2 + w_3x_3 + b$, and then applies the activation function

$$\text{sign}(z) = \begin{cases} +1 & \text{if } z \geq 0 \\ -1 & \text{otherwise} \end{cases}$$

where +1 means question and −1 means statement. (There is no learning on this sheet: the weights stay fixed.)

Q1. "Where did you park?" Write down x, compute z, and give the perceptron's output.

Q2. "Can you pass the salt?" Write down x, compute z, and give the output.

Q3. Each row below is a sentence with its three features filled in. Compute z and the perceptron's output for each one, and say whether the perceptron is right. How many features need to be present before it says *question*?

Sentence	x_1	x_2	x_3	z	Output	Right?
"The cat is asleep."	0	0	0			
"You're leaving?"	1	0	0			
"Where she went is a mystery."	0	1	0			
"Never have I seen such a mess."	0	0	1			
"Who knows?"	1	1	0			
"Is it raining?"	1	0	1			
"Where are you going." (no "?")	0	1	1			
"Where did you park?"	1	1	1			

Q4. Based on the weights, which feature does the perceptron rely on most? How can you tell? Is that feature enough on its own to make the perceptron say *question*?