Part I. Suppose you have a previously trained logistic regression model that predicts a patient's probability of dying during their ICU stay based on their age, sex, and temperature.

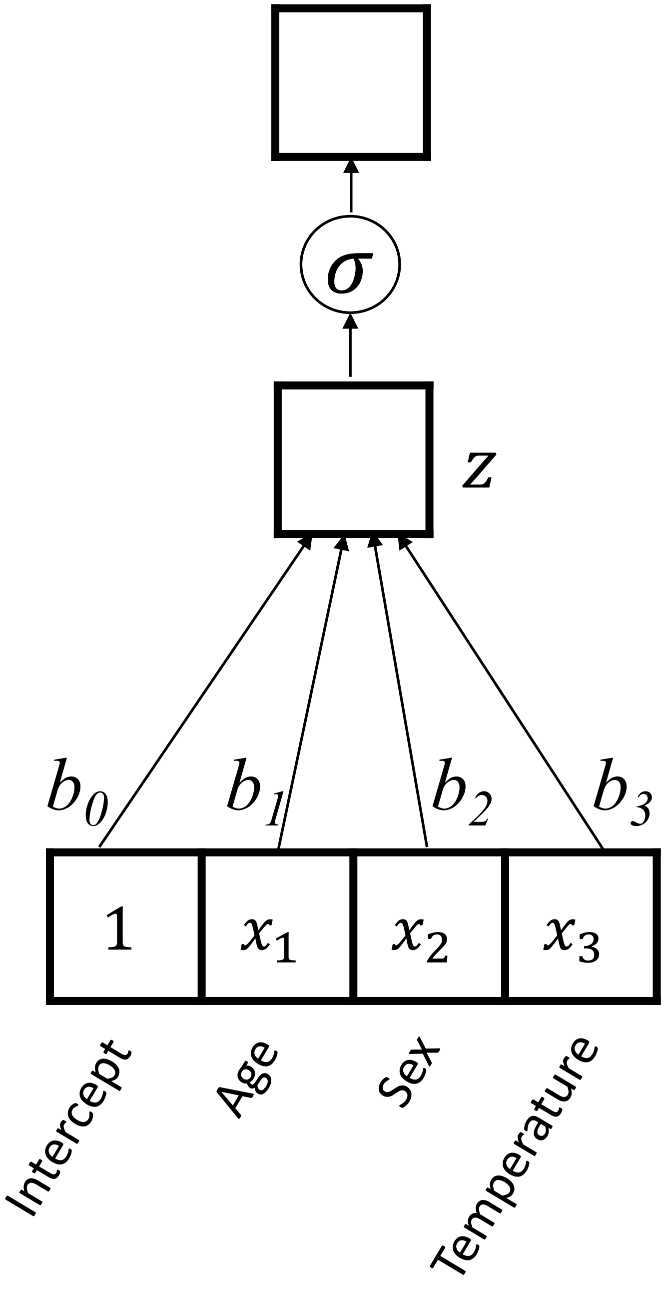
1. What are the *features* (i.e., *predictors*)?
   - Age, sex, and temperature (i.e., x_1, x_2, and x_3)

2. What is the associated *label* (y), and how does it relate to p in the diagram at right?
   - y is a binary random variable associated with dying during the stay (yes/no). p is the predicted probability of dying during the stay.

3. Which values in the diagram would we *learn* if we were to train this model, and what are they called?
   - The *parameters* or *coefficients* b_0, b_1, b_2, and b_3

4. Write the corresponding equation. You may use $\sigma(z)$ (or sigma(z)) to denote the *logistic* (i.e., *sigmoid*) function.

$$\sigma(b_0 + b_1x_1 + b_2x_2 + b_3x_3)$$



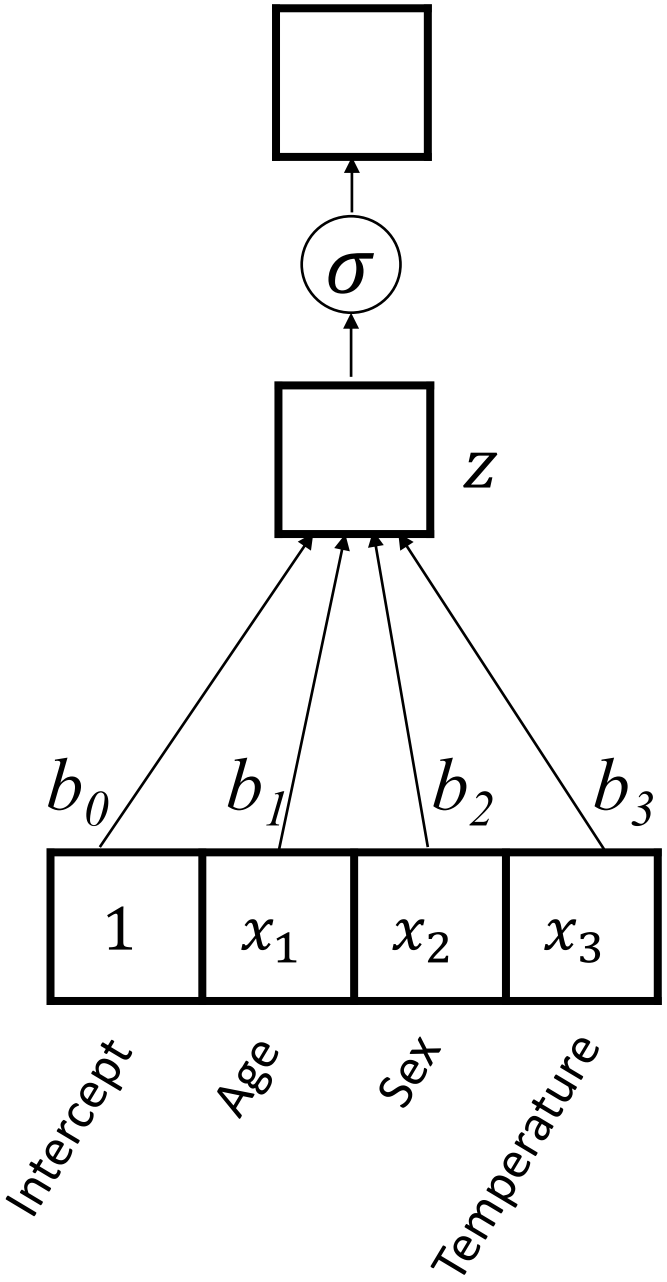
Part II. A 70-year old ($x_1 = 70$) woman (female sex; $x_2 = 1$) comes into the ICU. Her temperature is 39 degrees Celsius ($x_3 = 39$). Looking closely at your model, you find that the previously learned values of b are as follows:

$$b_0 = -20 \qquad b_1 = .1 \qquad b_2 = -.5 \qquad b_3 = .3$$

1. Calculate the model-predicted <u>log-odds</u> that this patient will die during her ICU stay.
   - $-20 + .1 * 70 + (-.5) * 1 + .3 * 39 = -1.8$

2. Calculate the model-predicted <u>odds</u> that this patient will die during her ICU stay.
   - $e^{-1.8} = 0.165$

3. Calculate the model-predicted <u>probability</u> that this patient will die during her ICU stay.
   - $\frac{0.165}{1+0.165} = 0.142$



Part III. Unfortunately, your patient's condition deteriorates, and despite everyone's best efforts, she passes away in the ICU.

1. Was your model's prediction *correct*? Why or why not?
    - It is impossible to know. We only see the outcome; we do not know how probable or improbable it was.

2. Was your model's prediction *good*? Why or why not?
    - Knowing that most patients do not die during a given ICU stay, the predicted probability of death was relatively high. Thus, the prediction appears to be consistent with the outcome. However, it is hard to be confident based on only one patient.

3. Is there any additional information you could collect to help you answer (1) and (2)?
    - One way to determine whether the prediction was good would be to observe outcomes for many similar patients (i.e., ~70-year old women with ~39 degree temperatures). If the proportion who die is similar to the model-predicted probability, then the model's prediction is good.