Problem 1: Suppose that we have three binary random variables X, W, and H, which indicate whether a person exercises regularly (X), whether they are overweight (W), and whether they have heart disease (H). Discuss several causal structure involving these variables.

We first might believe that X is a confounding variable in the relationship between W and H, meaning the causal graph has the form $W \leftarrow X \rightarrow H$. This means a person's decision to exercise has a direct influence on both their weight and whether they have heart disease, and that any statistical correlation between the latter variables is the result of this common cause and not a result of a direct cause and effect relationship between the two. Alternatively, we might believe that X serves as a mediating variable between W and H, meaning the causal graph has the form $W \rightarrow X \rightarrow H$. This means that a person's weight directly influences their decision to exercise, and then this latter decision directly influences whether they have heart disease. However, this causal model still assumes there is not a direct cause and effect relationship between W and H.

Problem 2: Let X and Y be binary random variables that indicate whether a person has *hydromechanical trepidation syndrome* (X) and whether they test positive (Y) for it. Suppose that

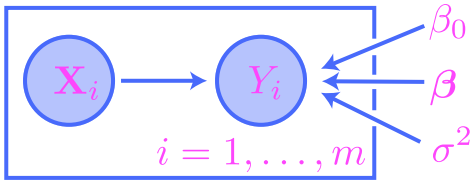
$$p(y = 1|x = 1) = 0.98 \quad \text{and} \quad p(y = 1|x = 0) = 0.1.$$

Express the flow of information from X to Y as a stochastic link by explicitly writing down a link function.

The link from X to Y is given by

$$Y \mid X \sim \mathcal{B}er(\theta), \quad \theta = g(x) = 0.1(1 - x) + 0.98x.$$

Problem 3: Explicitly draw the full graphical structure for a plated linear regression model



when $m = 3$.

See your solutions from class.