Assignment 1

Problem 1

Find the derivative of the sigmoid function with respect to x where the sigmoid function $\sigma(x)$ is given by,

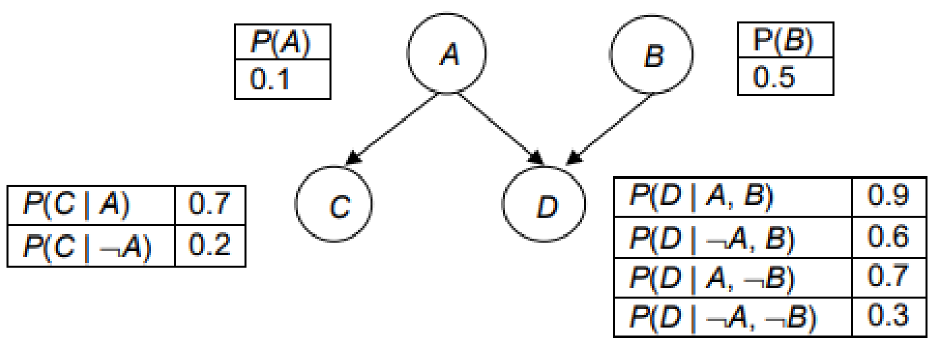
$$\sigma(x) = \frac{1}{1 + e^{-x}}$$

Problem 2

1. When are two vectors $\mathbf{u}$ and $\mathbf{v} \in \mathbb{R}^n$ said to be orthogonal ?
2. Are the following vectors orthogonal to each other?
$$v_1 = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} \; v_2 = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} \; v_3 = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$$

Problem 3

Consider the following Bayesian Network containing four Boolean random variables.



1. Compute P$(A|C)$
2. Compute P$(\neg A, B, \neg C, D)$

Problem 4

In order to get an unbiased estimate of how well your ML algorithm is doing. A typical split is 60/20/20 split in terms of 60% train, 20% test and 20% validation. And several years ago this was widely considered best practice in machine learning. Do you still agree such ratios in the modern big data era? Why or why not?

Assignment 1

Problem 5

Suppose you're training a neural network in an unusual, nondeterminstic domain: The training set consists of N copies of the same example, a fraction $p > 0.5$ of which are positive and a fraction $1 - p$ of which are negative. Suppose we decide we want to optimize the *absolute error* function

$$E = \sum_{i=1}^{N} |T_i - O|$$

where T_i is the correct value for example i and O is the network's output for this example. Suppose that O must also be in the range [0,1]. By writing out an expression for the error in terms of O, find the value of O that minimizes the error.