Problem 1. Neural Networks [30]

(a) (i) Let $f(a) = \frac{1}{1 + e^{-a}}$
Output of node $i_1 = f(0 \times (2.5) + 1 \times 2 + 1 \times (-0.5)) = f(1.5) = 0.8176$
Output of node $i_2 = f(0 \times (-1) + 1 \times (-3.5) + 1 \times 1.5) = f(-2) = 0.1192$
Output of node $O = f(0.8176 \times (-1.5) + 0.1192 \times 2.5 + 1 \times 0.5) = f(-0.4284) = 0.3945$

(ii) $\delta_o = (O - y)O(1 - O) = (0.3945 - 1) \times 0.3945 \times (1 - 0.3945) = -0.1446$
$w_{o11} = -1.5 - \alpha \delta_o y = -1.5 - 0.1 \times (-0.1446) \times 0.8176 = 1.4882$
$w_{o12} = 2.5 - \alpha \delta_o y = 2.5 - 0.1 \times (-0.1446) \times 0.1192 = 2.5017$
weight between bias and $o = 0.5 - \alpha \delta_o y = 0.5 - 0.1 \times (-0.1446) \times 1 = 0.5145$

(b) There are, obviously, multiple solutions for this problem. One of these is given below. Here the number of hidden layers is 1, containing 2 hidden units. The hidden units perform the logical function “OR” while the output unit performs the logical function “AND.”
Problem 2. Constraint Satisfaction Problem [20]

(a) $A=\{1\}, B=\{1,2,3\}, C=\{3\}, D=\{1,2,3\}, E=\{2\}, F=\{1,3\}, G=\{1,3\}$

(b) The following search tree shows the search until a solution is found. Nodes show only variables whose domains changed with respect to its parent’s domain. Answers that only showed the final solution were also accepted.

(c) $A=\{1\}, B=\{1\}, C=\{2\}, D=\{3\}, E=\{3\}, F=\{2\}, G=\{\}$
or $A=\{1\}, B=\{1\}, C=\{2\}, D=\{2,3\}, E=\{3\}, F=\{\}, G=\{2\}$
or $A=\{1\}, B=\{1\}, C=\{2\}, D=\{3\}, E=\{\}, F=\{\}, G=\{2\}$

(d) The following search tree shows the search until a solution was found. Nodes show only variables whose domains changed with respect to its parent’s domain. Answers that only showed the final solution were also accepted.