

### Homework SET #1

Homework 1: Problems 2.1-2.6 at the end of Chapter 2 in the Nilsson textbook

Due Tuesday September 1, 2009, Lecture 4, in class

**2.1** Write the following Boolean function in DNF:

$$f = (x_1 + x_2)(x_3 + x_4)$$

**2.2** Show that

$$x_1x_2x_3 + \bar{x}_1x_2x_3 = x_2x_3$$

**2.3** Indicate which of the following Boolean functions of three input variables can be realized by a single threshold element with weighted connections to the inputs. You do *not* need to calculate the weight and threshold values:

1.  $x_1$
2.  $x_1x_2x_3$
3.  $x_1 + x_2 + x_3$
4.  $(x_1x_2x_3) + (\bar{x}_1\bar{x}_2\bar{x}_3)$
5. 1

**2.4** Prove that there are exactly  $3^n$  monomials of  $n$  dimensions and  $3^n$  clauses of  $n$  dimensions.

**2.5** Refer to the definitions of the features,  $x_1, x_2, x_3, x_4$  on page 24 and to the rules for action on page 25. Show that the assumption that there are no “tight spaces” in the two-dimensional grid world implies that no two of the action rules can be satisfied simultaneously.

**2.6** Design (by hand) a neural network that accepts as inputs the sensory signals  $s_1, s_2, \dots, s_8$  and produces as outputs the conditions needed by a network of TISA units to implement the action rules on page 25 for the wall-following robot.