CIS 32 Homework 1

1. The following training set is linearly separable:

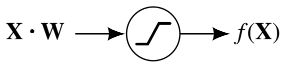
input	output
1 0 0	1
0 1 1	0
1 1 0	1
1 1 1	0
0 0 1	0
1 0 1	1

   By hand, train a TLU using this training set. You will need to have four inputs (including the one which implements the threshold). Start training with all weights equal to 0, and use the error correction procedure until it converges on a solution.

   Show the set of weights at each pass through the training cycle.

   (30 points)

2. Consider the TLU given in:



$$
\begin{aligned}
f(\mathbf{X}) &= 0 \text{ if } \mathbf{X} \cdot \mathbf{W} < -b \\
&= 1 \text{ if } \mathbf{X} \cdot \mathbf{W} > b \\
&= (1/2b)(\mathbf{X} \cdot \mathbf{W} + b) \text{ otherwise}
\end{aligned}
$$

   This has a ramp function rather than a sigmoid or a threshold function.

   (a) Derive the weight adjusting rule for the weight vector **W** which will give gradient descent to minimize the squared error ϵ between the actual output f and the desired output d.

   (b) Comment on your result.

   (30 points)

3. Specify fitness functions that could be used in evolving agents that:

   (a) Control an elevator

   (b) Control stop lights on a city street.

   (20 points)

4. The crossover operation used in GP selects a random subtree in both parents. Comment on what you think the effects would be of biasing the random selection according to:

   (a) Preferring those subtrees that were highly active during the fitness trials.

   (b) Preferring large subtrees to small subtrees.

   (c) Preferring small subtrees to large subtrees.

   (20 points)