Due: Wednesday, November 5, 3PM EST

This assignment is worth 15% of the final grade. Each question or subquestion is worth a multiple of 5 points. If you have no idea how to answer a question (or part of a question), you will receive 20% of the credit for that question (or subquestion) by leaving the question (or subquestion) blank. If your answer makes no sense, you will not receive any credit. Any answer that shows some understadning of the question will receive some credit.

1. (5 points) From what you know, is the 2-COLOUR problem an NP complete decision problem? Explain your answer briefly.

2. In each of the following questions, you are asked to describe a polynomial time transformation.

   (a) (5 points) Show that $3SAT \leq^{poly}_{trans}$ exact $4SAT$
   Note: That is, show how to polynomial time transform a formula F with at most 3 literals per clause to a formula F' with exactly 4 literals per clause so that F is satisfiable if and only if F' is satisfiable.

   (b) (5 points) Show the $3Colouring \leq^{poly}_{trans} 4Colouring$
   Note: It is helpful to note that a 4-Clique is 4-colourable but not 3-colourable. A clique on k nodes is a graph with k nodes $v_1, v_2, \ldots v_k$ such that there is an edge (v_i, v_j) for all $i \neq j$.

3. (10 points) In Chris Maddison's presentation, he gave an example of how features need to be identified and represented (as vectors, often high dimensional) for machine learning and classification. He gave a simple example of distinguishing between pointy-petalled vs round-petalled flowers. Now consider the following problem: describe 3 features that you would use to distinguish between an adult male or female face. (If you wish to add additional features, you may do that.) Let's assume the male is clean shaven. Briefly explain whether or not these features would be sufficient to predict gender with some reasonable accuracy; for example, correctly 90% of images.
   You will be graded on how well you explain your answer.