Assignment 2 (Due: May 8, 2016)

1. (Math) In the augmented Euclidean plane, there is a line \( x - 3y + 4 = 0 \), what is the homogeneous coordinate of the infinity point of this line?

2. (Math) \( A, B, C \) and \( D \) are four points in 3D Euclidean space, their coordinates are \( (x_i, y_i, z_i), i = 1, 2, 3, 4 \), respectively. Please prove that:

These four points are coplanar \( \iff \begin{vmatrix} x_1 & y_1 & z_1 & 1 \\ x_2 & y_2 & z_2 & 1 \\ x_3 & y_3 & z_3 & 1 \\ x_4 & y_4 & z_4 & 1 \end{vmatrix} = 0 \)

3. (Programming) RANSAC is widely used in fitting models from sample points with outliers. Please write a program to fit a straight 2D line from the following sample points:

\((-2, 0), (0, 0.9), (2, 2.0), (3, 6.5), (4, 2.9), (5, 8.8), (6, 3.95), (8, 5.03), (10, 5.97), (12, 7.1), (13, 1.2), (14, 8.2), (16, 8.5) (18, 10.1)\). Please show your result graphically.

4. (Programming) AdaBoost is a powerful classification tool, with which a strong
classifier can be learned by composing a set of weak classifiers. In our lecture, we use a vivid example to demonstrate the basic idea of AdaBoost. Now, your task is to implement this demo.

Training:
There are 10 samples on a 2-D image plane and information of the ith sample is given as \((x_i, y_i, l_i)\), where \((x_i, y_i)\) is its coordinate and \(l_i\) is its label. 10 samples are (80, 144, +1), (93, 232, +1), (136, 275, -1), (147, 131, -1), (159, 69, +1), (214, 31, +1), (214, 152, -1), (257, 83, +1), (307, 62, -1), (307, 231, -1). Weak classifiers are vertical or horizontal lines as described in our lecture. The final trained strong classifier actually is a function having the form,

\[
\text{Label} = \text{strongClassifier}(x, y)
\]

Finally, test your resultant strong classifier to verify whether it can correctly classify all the training samples.