Using a computer, MATLAB and your noggin, consider the following problems.

1. The famous "quadratic equation" ($ax^2+bx+c=0$) is just a second-order polynomial and has the familiar roots $x = \frac{-b\pm\sqrt{b^2-4ac}}{2a}$. A bit of algebra will convince you that $x = \frac{2c}{-b\pm\sqrt{b^2-4ac}}$ also represent roots of the polynomial.
   (a) Write your own MATLAB function that calculates the roots of a second-order polynomial using either of the formulae, above.
   (b) Let $a = c = \epsilon/2$, where $\epsilon \ll 1$ and $b = 1$. Show that, to second order in ϵ, the roots are given by $x \approx -\frac{\epsilon}{2}, -\frac{2}{\epsilon}$. (Hint: Taylor expand the square root, keeping the first non-trivial ϵ term in the expansion.)
   (c) Let $\epsilon = 10^{-10}$ and find x via your MATLAB code and the approximate results, above.
   (d) Also find x via the code `quadratic.m` (posted on the course web site).
   (e) Compare your results. Which code yields a better result (when compared to the analytic results to first order in ϵ)? Discuss your findings.
   (f) MATLAB has a native function `roots.m`. Use it and compare the results with what you found, above.

2. Consider the kinematic equations for a simple projectile (under constant gravitational acceleration, the projectile is launched from and lands on a plane).
   (a) Write a MATLAB function that will calculate numerical solutions of the kinematic equations for a simple projectile (launched from and lands on a plane) given:
      - $g = -9.81$ m/s^2
      - *inputs:* launch angle (°), launch velocity (m/s)
      - *outputs:* range and peak height (m), time-of-flight (s)
   (b) Use the function to find the launch angle(s) required for a 50 m/s launch to travel 100 m. If you can write a script to do this for you, please do so.