HW 1
Due by lecture on Wed, Feb 1

Remember that you may (and should!) talk about the problems amongst yourselves, or discuss them with me or the TA, providing attribution for any good ideas you might get – but your final write-up should be your own.

1: On target Suppose we launch an object at an angle θ with an initial speed of v_0. Ignoring factors like air resistance and terrain, the object will land at distance

$$d = \frac{v_0^2}{g} \sin(2\theta),$$

where g is the acceleration due to gravity on earth (about $9.8\, m/s$). Suppose we compute the velocity needed to land a hundred meters away, and our launcher is pointed in exactly the right direction with a known launch angle.

1. What is the condition number for d as a function of v_0?
2. Suppose the launch angle has negligible error, but there is a 1% error in the launch velocity. If the target is a meter in radius, will we hit it?

Note: If you are bored and have free time, you might also consider how much error can be tolerated in the launch angle.

2: Cosine conundrum Complete the following MATLAB function

```
function f = hw1p2(x)

% Compute cos(x^2)-cos(x) accurately for x in [0,1],
% barring underflow.
```

You should obtain at least fourteen decimal digits of accuracy for all floating point values of $x \in [0, 1]$ for which f does not underflow. Your code should *not* use the variable precision features in MATLAB, though you may use variable precision arithmetic to test the correctness of your solution.

Note: There are multiple ways to solve this problem, but I used a series expansion for small values of x and an alternate formulation based on trig identities (e.g. cosine of a sum of angles) for larger values of x.