Math 371 — Computing Project #1
August 31, 2018, Due Sept. 6, 2018

1. The object here is to reconstruct a polynomial from the knowledge of its roots using Horner's algorithm. Suppose a polynomial has roots $r_1, \ldots, r_n$. Then, $p_n(x) = c(x-r_1)(x-r_2)\cdots(x-r_n)$ where c is some arbitrary constant and we set $c = 1$. This implies that $p_n(x) = a_n x^n + a_{n-1}x^{n-1} + \ldots + a_1 x + a_0$. Note that $a_n = 1$ since we set $c = 1$.

   Write a code which takes as input any set $n, r_1, \ldots, r_n$ and outputs $a_n, a_{n-1}, \ldots, a_0$. To do this efficiently, express the coefficients of $p_n(x)$ in terms of those of $p_{n-1}(x)$. This is similar to Horner's algorithm. In particular, test your code with $r_1 = -2, r_2 = 4, r_3 = 7, r_4 = 11$.

2. Write a routine in double precision to implement the following algorithm for computing π.

```
integer k, double a, b, c, d, e, f, g;
a = 0; b = 1; c = 1/√2; d = 0.25; e = 1;
for k = 1 to 5
    a = b
    b = (b+c)/2
    c = √(ca)
    d = d − e(b − a)^2
    e = 2e
    f = b^2/d
    g = (b + c)^2/(4d)
    output k, f, |f −π|, g, |g−π|
end
```

   Which converges faster? f or g? How accurate are the final values? Use $\pi = 4\arctan(1)$.