Answers to HW Set #1

1.2 ISO standard A4 paper.
297/210 = 1.4143 ≈ sqrt(2).
Folding A4 paper in half preserves its aspect ratio.
(A4 is A3 folded in half, A5 is A4 folded in half.)

1.3. How many terms in the continued fraction?

```
goldfract(24)
err = 7.9e-11.
for n = 37:39
  goldfract(n)
end
err = [-eps, eps, 0]
```

1.4 Use backslash to compute coefficients.

Numerically:

```
phi = (1 + sqrt(5))/2;
A = [ 1 1; phi 1-phi]
b = [ 1; 1]
c = A\b
= [0.7236; 0.2764]
```

Symbolically:

```
syms phi
A = [ 1 1; phi 1-phi]
b = [ 1; 1]
c = A\b
= 1/(2*phi-1)*[phi; 1-phi]
```

1.8. Repeat X = A*X.

$A^n = \begin{bmatrix} f_n & f_{n-1} \\ f_{n-1} & f_{n-2} \end{bmatrix}$

A^{1475} does not overflow, but A^{1476} does.

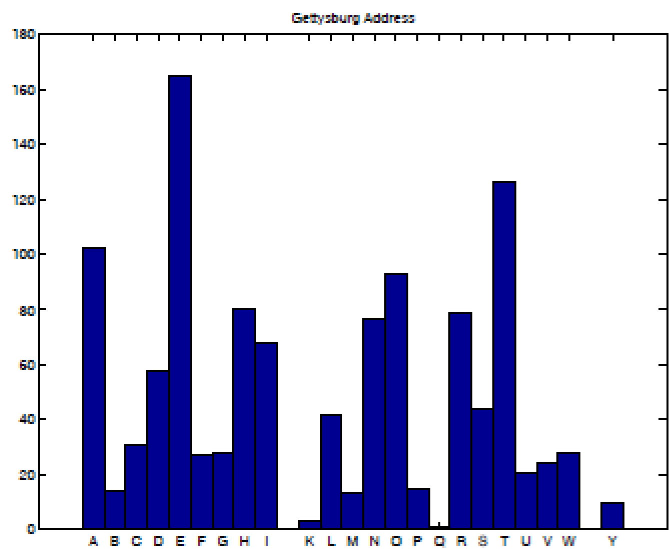
1.19. 4-by-4 magic square is singular.

```
A = magic(4)
null(A)
null(A,'r')
null(sym(A))
rref(A)
```

These four statements are four different ways to discover that the 4-by-4 magic square is singular and that the linear combination of its columns
A(:,1) + 3*A(:,2) - 3*A(:,3) - A(:,4)
is the zero vector.

1.20. Permuting the rows and columns of a magic square preserves the row sums, the column sums, and the matrix rank, but not the diagonal sums. (Symmetric permutations, A = A(p,p), also preserves the diagonal sums.)

1.25 Analyze the text of the Gettysburg address.




```
nchar = 1463
uniq = ,-.BFGINTWabcdefghiklmnopqrstuvwy
nuniq = 35
nblank = 255
nperiod = 10
ncomma = 19
ndash = 7
most = E
missing = JXZ
```

Don't forget to re-label the x-axis with the alphabet!

1.35 What does each of these programs do?

```
x = 1; while 1+x > 1, x = x/2, pause(.02), end
```

Exhibits roundoff Exhibits roundoff. The program produces 53 lines of output. The last two values of x are eps and eps/2.

```
x = 1; while x+x > x, x = 2*x, pause(.02), end
```

Exhibits overflow. The program produces 1024 lines of output. The last two values of x are 2^1023 ≈ realmax/2 and Inf.

```
x = 1; while x+x > x, x = x/2, pause(.02), end
```

Exhibits underflow. The program produces 1075 lines of output. The last two values of x are eps*realmin and 0. (On computers without subnormal floating point numbers, this program would produce 1023 lines of output. The last two values would be realmin and 0).

1.38. Quadratic formula.

With $b = -10^8$, you get few if any accurate digits out of −b-sqrt(b^2-4) unless you compute the intermediate results to very high precision. In Matlab there is no trouble with

x1 = (10^8 + sqrt(10^6-4))/2 = 1.0000e+008

But

x2 = (10^8 - sqrt(10^16-4))/2 = 7.4506e-009

when it should be 1.0000e-008; you subtract two big numbers around eps apart.

Clearly

x2 = 1/x1

works well in this situation.

Alternatively, roots([1 -10^8 1]) gives two good roots, 1.0000e+008 and 1.0000e-008.

1.39. Power series for computing sin *x*.

The loop test in powersin terminates when s+t == t, that is when t is so small compared to s that the computed value of s+t is equal to s.

Change the first line of powersin.m to

```
function [s,tmax,cnt] = powersin(x)
```

Insert these lines before the start of the while loop.

```
tmax = abs(t);
cnt = 0;
```

Insert these lines in the loop.

```
tmax = max(tmax,abs(t));
cnt = cnt+1;
```

Here is a table of x, sin(x)-powersin(x), tmax, and cnt.

pi/2	11*pi/2	21*pi/2	31*pi/2
2.2204e-016	-2.1287e-010	-1.3324e-004	-5.8210e+003
1.5708e+000	3.0665e+006	1.4673e+013	7.9890e+019
11	37	60	78

We see that when the largest term is about 10^p, the computed value looses about *p* digits. The power series is OK for *x* less than *pi/2*. But as *x* increases, the power series requires more work and yields less accuracy. Again the problem of subtracting two big numbers less then eps apart.

-FIN-