CISC 271
HOMEWORK: WEEK 1. Solutions

Note: Matlab output has been edited to make it easier to read.

2 - 1 Use max to find the largest entry in a matrix.

```
EDU>> A = [1 -5 -2 ; 3 4 -9 ; -7 2 6]

A =

    1   -5   -2
    3    4   -9
   -7    2    6

EDU>> MA = max(max(A))
MA =  6

EDU>> B = [ sin(1) sin(-5) sin(-2) ; sin(3) sin(4) sin(-2) ; sin(-7) sin(2) sin(6)]
B =
   0.8415    0.9589   -0.9093
    0.1411   -0.7568   -0.9093
   -0.6570    0.9093   -0.2794

EDU>> MB = max(max(B))
MB = 0.9589
```

2 - 3 Use colon notation to create vectors identical (approximately) to those obtained with linspace

a)

```
EDU>> x = linspace(0,10,5)

x = 0    2.5000    5.0000    7.5000   10.0000

EDU>> xx = 0:2.5:10

xx = 0    2.5000    5.0000    7.5000   10.0000

EDU>> norm(xx-x)

ans =  0
```

2 - 3 (b)

```
EDU>> r = 10/99

r = 0.1010

EDU>> xx = -5:r:5;
EDU>> x = linspace(-5,5);
EDU>> norm(x-xx)

ans =  0.0058
```

Surprisingly the results are different! The function linspace actually fudges things so that 100 "almost equally" spaced values are generated. There is no exact way to divide the interval [-5 ... 5] into 99 even pieces.

2 - 4 Repeat question 3 but now create a column vector.

```
EDU>> x = linspace(0,10,5);
EDU>> xcol = x'

xcol =

         0
    2.5000
    5.0000
    7.5000
   10.0000

EDU>> xx = 0:2.5:10;
EDU>> xxcol = xx'

xxcol =

         0
    2.5000
    5.0000
    7.5000
   10.0000
```

2 -12 Extract columns from a matrix.

```
EDU>> s = C(:,1)

s =

    11
     2
    18

EDU>> t = C(:,2)

t =

     5
     1
     7
```

2 - 15 Use eye and fliplr or flipud to create a matrix.

```
EDU>> E = fliplr(eye(3))

E =

     0     0     1
     0     1     0
     1     0     0

EDU>> F = flipud(eye(3))

F =

     0     0     1
     0     1     0
     1     0     0
```

2 - 20 For several different matrices

```
EDU>> A = [ 9 -2 ; 3 1; -3 7]

A =

     9    -2
     3     1
    -3     7
```

```
EDU>> B = [ 2 -2 ; -1 1 ; 4 4]

B =

     2    -2
    -1     1
     4     4

EDU>> C = A+B

C =

    11    -4
     2     2
     1    11

EDU>> D = A - B.^2

D =

     5    -6
     2     0
   -19    -9

EDU>> E = A ./ B

E =

    4.5000    1.0000
   -3.0000    1.0000
   -0.7500    1.7500


EDU>> max(abs(C))
ans = 11    11

EDU>> max(max(abs(C)))
ans = 11

EDU>> min(min(abs(C)))
ans = 1
```

and similarly for the matrices D and E.

2 -24 Plot sin(theta) versus theta

```
EDU>> theta = linspace(0,2*pi,60);
EDU>> plot(theta, sin(theta),'o',theta,sin(theta),'--')
```

5 - 1 Base two equivalents of integers 1, ..., 8

8 - 1000, 7 - 0111 etc..

5 - 10 What is the difference between realmax and the first double precision less than realmax?

realmax * eps

5 - 14 Find absolute and relative errors for approximations of sin and cos.
Here is my Matlab code for solving the problem

1st cos(x) (Note: I decided to do this problem for -2 ... 2 radians, not degrees.
Note: that I used inline functions rather than m-file functions.

```
>> c = inline('1 - x.^2 ./ 2 + x.^4 / 24')

c = Inline function:   c(x) = 1 - x.^2 ./ 2 + x.^4 / 24

>> X = -2:2

X =  -2    -1     0     1     2

>> abserr = abs(c(X) - cos(X))

abserr =  0.0828    0.0014         0    0.0014    0.0828

>> relerr = abserr ./ abs(cos(X))

relerr =  0.1990    0.0025         0    0.0025    0.1990

>> Table = [X ; abserr ; relerr]

Table =

   -2.0000   -1.0000         0    1.0000    2.0000
    0.0828    0.0014         0    0.0014    0.0828
    0.1990    0.0025         0    0.0025    0.1990
```

And for sin(x)

```
>> s = inline('x - x.^3 ./ 6 + x.^5 ./ 120')

s =

     Inline function:
     s(x) = x - x.^3 ./ 6 + x.^5 ./ 120

>> abserr = abs(s(X) - sin(X))

abserr = 0.0240    0.0002         0    0.0002    0.0240

>> relerr = abserr ./ abs(sin(X))

Warning: Divide by zero.

relerr =  0.0264    0.0002       NaN    0.0002    0.0264

>> Table = [X ; abserr ; relerr]

Table =

   -2.0000   -1.0000         0    1.0000    2.0000
    0.0240    0.0002         0    0.0002    0.0240
    0.0264    0.0002       NaN    0.0002    0.0264
```

The NaN value appears because we divide by 0. The actual relative error should be 0.

Convert the following binary numbers to decimal

a) 11 -- 3
b) 101 -- 5
c) 0.1 -- 1/2 = 0.5
d) 0.101 -- 5/8 = 0.625

Suppose we are using a floating point number system with Base 2, using a 4 bit mantissa and an exponent in the range -3 .. 4. What are the values for eps, realmin and realmax in this system?

eps = $2^{-3} = 1/8$
realmin = $2^{-4} = 1/16$
realmax = $2^{4} - 2^{0} = 15$