

CISC271
Fall 2005
Homework for week 2
in preparation for quiz 1
Solutions

This homework will give you some practice with using Matlab and with floating point numbers.

1. Consider the floating point number system $F(10,2,-1,3)$. Using this floating point system what are the values for:
 - (a) `realmin`
 - (b) `realmax`
 - (c) `eps`
 - (d) the total number of floating point numbers in the system

Solution:

- (a) $\text{realmin} = .1 \times 10^{-1}$
 - (b) $\text{realmax} = .99 \times 10^3$
 - (c) $\text{eps} = .01 \times 10^1$
 - (d) the total number of positive floating point numbers in the system $= 90 \times 5$. We double this to add the negative values and then add 1 for zero. Thus the total is $2(90 \times 5) + 1$.
2. Any machine using the IEEE standard for floating point numbers will have the same value for *eps*. Prior to this one had to come up with a clever way to figure out the value of *eps* for any particular machine. Consider the two Matlab functions below. If you run them you will find that in both case the value of *e* is equal to *eps*. Do you understand why this is so? You can find out by reading section 1.7 of Mol and section 5.2.1 of Rec. Actually in the case of Recktenwald's function I modified it so it computes the correct value of *eps*.

```
function epsy2
```

```
a = 4/3;  
b = a-1;  
c = 3*b;  
e = 1-c
```

```
function epsy  
d = 1;  
b = 2;  
while b > 1  
    e = d;  
    d = e/2;  
    b = 1 + d;  
end  
e
```

Solution: I read both relevant texts and I (think) I understand what is going on.

3. Bonus question will not be tested on any quiz or exam. A semi-magic square is like a magic square except only the rows and columns of the square matrix need add up to the same value, and not the diagonals. The game of Sudoku is played on a 9x9 grid. If you have never heard of Sudoku just Google it and you are sure to get multiple hits with very good descriptions of the game. In any case, below you will find a 9x9 complete Sudoku board with the additional property that each of the 9 3x3 squares are semi-magic squares. I made this board using just a few lines of Matlab. Can you figure out how I did this?

```
>> SemiMagicSudoku
```

```
ans =
```

8	1	6	3	5	7	4	9	2
3	5	7	4	9	2	8	1	6
4	9	2	8	1	6	3	5	7
1	6	8	5	7	3	9	2	4
5	7	3	9	2	4	1	6	8
9	2	4	1	6	8	5	7	3
6	8	1	7	3	5	2	4	9
7	3	5	2	4	9	6	8	1
2	4	9	6	8	1	7	3	5

Solution: Here's my Matlab function.

```

function S = SemiMagicSudoku
%SemiMagicSudoku generates a completed Sudoku board by concatenating
%permuted versions of a 3X3 magic square.
%Each 3x3 section of the complete Sudoku board is a semi-magic square
%that is the row and columns add up to 15 but the diagonals may not.

S = eye(9);

m = magic (3);

for i = 0:2
    for j = 0:2
        S(3*i+1:3*i+3,3*j+1:3*j+3) = m;
        m = m( [2 3 1], :);
    end
    m = m(:, [2 3 1] );
end

```