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BIOMED 201 - Programming & Modeling for BME

Midterm Exam, 2012.05.08, Instructor: Ahmet Sacan

Sign the honor code below. **No credit will be given for the exam without a signed pledge.**

I have neither given nor received aid on this examination.

Signed: _____

There are 9 questions in this exam. Turn in Questions 1-7 before you start working on Questions 8-9. Submit your programs for Questions 8-9 on ProgrammingBank, in addition to turning in your paper exam. Sign off your submission before exiting the room.

Q1 (5 pts). *Indexing.* Let **A** be a square matrix with at least 3 rows. Write a single statement that will assign into B, the 6 elements located in the first two rows and last 3 columns of **A**. After your statement executes, **B** should become a 2x3 matrix. Do not use loops.

```
B = ________________
```

Q2 (5 pts). *Linear Indexing.* If matrix **M** has 5 rows and 8 columns, **M(4,3)** can equivalently be expressed as **M(x)**. What is the value of **x**?

Q3 (5 pts). *Creating vectors.* Use colon operator "**:**" to create a vector **X** that has values [15 10 5 0 -5 -10]. Create another vector **Y** that has the same values, using the linspace function.

```
X = _____________
Y = linspace(  _____________   )
```

Q4 (5 pts). *Logical Indexing.* Let **X**, **Y**, and **Z** be numerical column vectors, each with **N** elements and let $\boldsymbol{X_i}$ denote the i[th] element of **X**. First construct a logical vector **I** that also has **N** elements and where $\boldsymbol{I_i}$ is **true** when $\boldsymbol{X_i} * \boldsymbol{Y_i} = \boldsymbol{Z_i}$ and $\boldsymbol{X_i} \leq \boldsymbol{Y_i}$; and **false** otherwise. Next, construct a matrix **M** that has 3 columns and contains in each column only those elements of X, Y, Z for which I_i is true.

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```
I = _____________________

M = _____________________
```

Q5 (10 pts). *Variable scope.* The function apple is as given below. Fill in the blanks in the output.

```
>> x = 5; y = 6;
>> y = apple( x );
>> a = 2; b = 3;
>> b = apple (a);

>> fprintf('x=%d  y=%d  a=%d  b=%d\n', x,y,a,b);


_____________________________________
```

```
function y = apple( x )
x = x * 2;
y = x * 2;
```

Q6 (10 pts). *Nested for loops.* Fill in the blanks in the output below.

```
>> x = zeros(2,0);
>> for a = [ 1 2 3 ]
>> for b = [ 4 5 ]
>> x(:,end+1) = [ a b ];
>> end
>> end
>> disp ( x )



_____________________________________
```

Q7 (5 pts). *Operator precedence.* Fill in the blanks in the output below.

```
>> x=0;
>> disp(-3 <= x <= 3 )


_________________
```

```
>> disp( 'e'=='d' + 1 )


_________________
```

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Q8 (5 pts). *Binary and hexadecimal numbers*. In the first box below, write down the binary representation of the decimal number **35**. In the second box, write down the decimal value of the number given in hexadecimal notation.

`35 = _____`	`0xF3 = _____`

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I have neither given nor received aid on this examination.

Time of submission: _____

Signed: _____

Q8 (25 pts). *Selection statements, loops or vectorized code*. A magic square is defined as a square matrix with n rows, containing numbers from 1 to n^2, and whose rows and columns sum up to the same number. Write a function **ismagic(M)** that takes a matrix **M** as input and returns true only if **M** is a magic square. Hints: sum, unique.

```
>> ismagic( [8 1 6; 3 5 7; 4 9 2] )
ans =
  1

>> ismagic( [2 2; 2 2] )
ans =
  0

>> ismagic( [8 1 6; 3 5 7] )
ans =
  0
```

Q9 (25 pts). *Loops* or *vectorized code.* Write a function **eulernumber(n)** that takes a positive number **n** and calculates an approximation to mathematical constant e, the base of the natural logarithm, using the following formula. Hints: sum, factorial.

$$e \approx 1 + \frac{1}{1} + \frac{1}{1*2} + \frac{1}{1*2*3} + \frac{1}{1*2*3*4} + \cdots + \frac{1}{1*2*\ldots*n}$$

```
>> disp( eulernumber(2) )
    2.5000
>> disp( eulernumber(4) )
    2.7083
```