E 7
Midterm Exam
1:10 – 2:00pm; March 13, 2013

Closed Everything
You may only have out a #2 pencil, eraser, and your scantron form

Exam Version: D

The exam consists of 28 questions of equal weight.
1. How many times will the following loop execute?

```matlab
>> x = 5;
>> while x < 10
>>     y = y + 3*x;
>> end
```

(a) 1  
(b) 0  
(c) 2  
(d) 10 
(e) $\infty$

2. What is the variable C equal to after the following lines are executed?

```matlab
>> A = [1 4 6];
>> B = [9 6 4];
>> C = A + B;
```

(a) [1 4 6]  
(b) [9 6 4]  
(c) 10  
(d) These lines will not execute; Matlab will have an error.  
(e) [10 10 10]
3. After running the following script, what will the value of \( X \) be?

```
x = 7;
if X > 8
  X = 10;
elseif X > 9
  X = 17;
else
  while X ~= 1
    X = X-1;
  end
end
```

(a) 7
(b) 10
(c) 17
(d) 0
(e) None of the above.

4. Consider following statement and its output:

```
>> disp(x);
1   2   3   4   5   6   7   8   9   10
```

How could \( x \) have been set?

I \( x = 1:10 \)
II \( x = linspace(1,10,10) \)
III \( x = logspace(0,1,10) \)

(a) Only I
(b) Only II
(c) Only III
(d) I and III only
(e) I and II only
5. What is the value of x after this program runs?

```matlab
x = 18;
y = 5;
while x >= y
    x = x - y;
end
```

(a) 3  
(b) 18  
(c) 5  
(d) 0  
(e) 8

6. Consider the following statements

```matlab
>> A = 1:100;
>> A(end)
```

What will be their output?

(a) 100  
(b) An error saying end is not defined  
(c) The numbers from 1 to 100 printed in order  
(d) 101  
(e) None of the above

7. Consider a script with the following lines. What will happen when the script is run?

```matlab
1 s.str = 'Student X';
2 s.cell = 5551212;
3 s.var = 7;
4 s(str)
```

(a) Only Student x will print to the screen  
(b) Only 7 will print to the screen  
(c) Matlab will have an error when trying to execute line 2.  
(d) Matlab will have an error when trying to execute line 4  
(e) Both (c) and (d)
8. What will the value of R be after the following lines are executed?

```matlab
1 >> Q = true;
2 >> P = 1 < Q;
3 >> R = (~Q || ~P) && Q;
```

(a) Matlab will have an error on line 1
(b) false
(c) Matlab will have an error on line 2
(d) true
(e) Matlab will have an error on line 3

9. Consider the following function:

```matlab
function A = f(B)
    A = B^2;
end
```

If one types

```matlab
>> A = 7;
>> B = 3;
>> B = f(A);
```

What will the value of the variable A be in the workspace after all the lines finish executing.

(a) 9
(b) 49
(c) 7
(d) 3
(e) None of the above
10. Consider the `diceset` class definition from Assignment 5. We would like to add a method to the class definition that totals up the values on the dice in the set.

```plaintext
classdef diceset
    properties (Access-protected)
        dice;
        sides;
        vals;
    end

    methods
        function d = diceset(dice, sides, initvals)
            d.dice = dice;
            d.sides = sides;
            d.vals = initvals(1:dice);
        end

        function disp(dset)
            disp(dset.vals);
        end

        function dset = roll(dset)
            dset.vals = randi(dset.sides, 1, dset.dice);
        end

        function vals = getVals(dset)
            vals = dset.vals;
        end

        function total = sumVals(dset)
            # method body
        end
    end
end
```

Which of the following are correct replacements for `# method body`?

(I) ```plaintext
total = 0;
for i=1:dset.dice
    total = total + dset.vals(i);
end
```  

(II) ```plaintext
total = sum(dset.vals);
```  

(III) ```plaintext
total = sum(getVals(dset));
```
11. Which expression properly defines the function \( f(s) = 3s^3 \)?

I \( f = \Theta(s) \ 3 \cdot s^3 \);
II \( f = \Theta(x) \ 3 \cdot x^3 \);
III \( f = 3 \cdot x^3 \);

(a) Only I
(b) Only II
(c) Only III
(d) I and II only
(e) I, II, and III

12. Consider the following function definition

```
function f(x)
    y = x*x^2
end
```

What will happen when the statement below is executed at the command prompt?

```
>> f(3);  
```

(a) Matlab will have an error, because \( y \) is undefined in the command window.
(b) The line will execute, 'y = 9' will print in the command window, and \( y \) will be undefined in the workspace.
(c) The line will execute, 'y = 9' will print in the command window, and \( y \) will have the value 9 in the workspace.
(d) Matlab will have an error, because the function \( f(x) \) has no return arguments.
(e) None of the above.
13. Consider the following function

```matlab
function y = f(x)
    if x == 1
        y = 1;
    else
        f(x-1) + x
    end
end
```

What will the value of the variable \( y \) be in the command window workspace after the following statements are executed

```matlab
>> x = 3;
>> y = f(x)
```

(a) 6
(b) 5
(c) 1
(d) Matlab will have an error
(e) None of the above
14. The following function represents which mathematical operation?

```matlab
function out = s(n)
    if n == 1
        out = 2;
    else
        out = 2*n-2 + s(n-1);
    end
end
```

(a) $2n^2$
(b) $\sum_{k=1}^{n} 2k^2$
(c) $\sum_{k=0}^{n} n^2$
(d) $\prod_{k=1}^{n} 2k^2$
(e) $\sum_{k=1}^{n} s(k)$

15. What will occur if a script with the following lines is executed?

```matlab
vals = 1:50;
vals = vals( vals > 25 );
disp(vals);
```

(a) The script will run but there will be no output since each line is terminated by a semi-colon.
(b) The script will throw an error when it tries to execute line 2.
(c) The word `vals` will print in the command window.
(d) The script will throw an error at line 3 because `disp` is not a valid method for objects of class `double`.
(e) The numbers from 26 to 50 will print in the command window.
16. Consider the following function:

```matlab
function out = mySummer(f,tol)
    out = 0;
    k = 1;
    nextTerm = f(k);
    while abs(nextTerm) > tol*abs(out)
        out = out + nextTerm;
        k = k + 1;
        nextTerm = f(k);
    end
end
```

If the following statements are issued at the command prompt

1
   >> g = @(x) x^2-3;
2
   >> mySummer(g,10.^-5)

which of the following statements are true?
(a) Matlab will produce an error when line 2 is executed
(b) Matlab will enter an infinite loop when line 2 is executed
(c) Matlab will produce an error when line 1 is executed
(d) 0 will be output in the command window
(e) None of the above

17. What is the big-O run time complexity of the following function in terms of n?

```matlab
function out = fnc(n)
    if n == 1 || n == 2
        out = 23;
    else
        out = fnc(n-1) + 5*(n-2);
    end
end
```

(a) $O(n)$
(b) $O(\log n)$
(c) $O(2^n)$
(d) $O(23)$
(e) All of the above
18. Consider the following function

```matlab
function [b] = fnc(f,x)
    b = f(x)+f(x);
end
```

What will the output of the following expression be?

```matlab
>> fnc(@(y) y+y, 6)
```

(a) The expression will not run; it will cause an error to occur.
(b) 12
(c) 72
(d) b
(e) None of the above
Questions 19–21: Consider the following recurrence relation:

\[ T(y) = 3T(y/5) + 6T(y/7) \]
\[ T(y) = 4 \text{ for all } y \leq 1 \]

and the following *incomplete* program for evaluating it:

```c
function [out] = T(z)
if z
    # Base Case
else
    # Recursive statement
end
```

19. What is the proper completion for line 2?
(a) \( y \leq 1 \)
(b) \( z = 1 \)
(c) \( z \leq 1 \)
(d) \( z = \text{baseCase} \)
(e) None of the above

20. What is the proper completion for line 3?
(a) \( \text{out} = 4; \)
(b) \( z = 4; \)
(c) \( \text{out} = 4; \)
(d) \( T = 4; \)
(e) None of the above

21. What is the proper completion for line 5?
(a) \( T = 3T(y/5) + 6T(y/7); \)
(b) \( \text{out} = 3T(y/5) + 6T(y/7); \)
(c) \( \text{out} = 3T(z/5) + 6T(z/7); \)
(d) \( T = 4; \)
(e) None of the above

Questions 22–24 refer to the following function:
function [list1, list2] = fnc(listIN)
% Usage: [list1, list2] = fnc(listIN)
% Inputs: listIN — list structure with root, node().next, node().value
% Output: list1 — a list structure
% list2 — a list structure

cnt = 0;
pointer = listIN.root;
while pointer ~= 0
    cnt = cnt + 1;
    pointer = listIN(pointer).next;
end

node

mid = listIN.root;
for i = 1:floor(cnt/2)
    mid = listIN.node(mid).next;
end

list1 = listIN;
list1.root = listIN.root;
list1(mid).next = 0;

list2 = listIN;
list2.root = listIN.node(mid).next;
end
22. After executing lines 7–12, the variable cnt represents
   (a) The length of the listIN.node structure array
   (b) The index of the last entry in the list listIN
   (c) The number of entries in the list listIN
   (d) Both (a) and (c)
   (e) None of the above

23. After executing lines 14–17, the variable mid represents
   (a) The index of a node approximately halfway through list listIN.
   (b) Approximately length(listIN.node)/2.
   (c) The index for the root of list list1
   (d) The index for the root of list list2
   (e) None of the above

24. Which statement is true?
   (a) The two output lists are the same as the input list.
   (b) The root of list1 is the same as the root of list2.
   (c) list1 is equal to the first half of listIN and list2 is equal to the second half
       of listIN.
   (d) list2 does not have a properly terminated end node.
   (e) None of the above are true.
Questions 25–28 refer to the following class definition:

classdef Time

properties (Access = protected)
myHrs $ Hours — integer
myMin $ Minutes — integer < 60
mySec $ Seconds — integer < 60
end

methods
function T = Time(h,m,s)
  % Implementation not shown
end

function T = resetTime(T,h,m,s)
  % Implementation not shown
end

function T = increment(T)
  % Implementation not shown
end

function T = addTimes(T1,T2)
  % Implementation not shown
end
end
25. Which of the following represents a correct implementation of the constructor?

(a) T.myHrs = h;
    T.myMin = m;
    T.mySec = s;

(b) myHrs = h;
    myMin = m;
    mySec = s;

(c) T.myHrs = 0;
    T.myMin = 0;
    T.mySec = 0;

(d) T = Time(h, m, s);

(e) resetTime(T, h, m, s);
26. Which of the following represents a correct implementation of the method increment, which increments the time by 1 second?

(I) \( T.mySec = T.mySec + 1; \)

(II) \( mySec = mySec + 1; \)

(III) 
\[
T.mySec = T.mySec + 1; \\
if T.mySec == 60 \\
\quad T.mySec = 0; \\
\quad T.myMin = T.myMin+1; \\
if T.myMin == 60 \\
\quad T.myMin = 0; \\
\quad T.myHrs = T.myHrs + 1; \\
end \\
end
\]

(a) I only
(b) II only
(c) III only
(d) I and II only
(e) I, II, and III
27. Consider the following incorrect implementation of the method `addTimes`

```matlab
function T = addTimes(T1,T2)
    h = T1.myHrs + T2.myHrs;
    m = T1.myMin + T2.myMin;
    s = T1.mySec + T2.mySec;
    if s >= 60
        m = m + 1;
        s = s - 60;
    end
    if m >= 60
        h = h + 1;
        m = m - 60;
    end
    T.h = h;
    T.m = m;
    T.s = s;
end
```

The error with this implementation is that

(a) The properties of `T1` and `T2` have been incorrectly accessed.

(b) Matlab will have errors on lines 16, 17, and 18 because one can not have structure field names with the same name as a local variable.

(c) The output object `T` has not been properly instantiated. One needs to call the constructor to create `T` from `h, m, s` instead of lines 16, 17, and 18.

(d) All of the above

(e) None of the above
28. Consider a script with the following lines (assume a correct implementation of the constructor and `addTimes`):

```matlab
T1 = Time(5, 0, 1);
T2 = Time(1, 1, 1);
T3 = addTimes(T1, T2);
T3.myHrs
```

When line 4 executes the output will be

(a) 6  
(b) A Matlab error  
(c) [6 1 2]  
(d) myHrs  
(e) None of the above