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: A

The exam consists of 28 questions of equal weight.
1. What will the value of \( R \) be after the following lines are executed?

\[
\begin{align*}
1 & \quad \gg Q = \text{true;}
2 & \quad \gg P = 1 < 0;
3 & \quad \gg R = (\neg Q \lor \neg P) \land Q;
\end{align*}
\]

(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

2. After running the following script, what will the value of \( X \) be?

\[
\begin{align*}
X &= 7; \\
\text{if } X > 8 & \quad X = 10; \\
\text{elseif } X > 9 & \quad X = 17; \\
\text{else} & \quad \text{while } X \neq 1 \\
& \quad X = X-1; \\
\text{end} & \quad \text{end}
\end{align*}
\]

(a) 7
(b) 10
(c) 17
(d) 0
(e) *None of the above.
3. 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 

4. How many times will the following loop execute?

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

(a) 1  
(b) 0  
(c) 2  
(d) 10  
(e) *\( \infty \)
5. 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)

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. 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]*
8. What is the value of \( x \) after this program runs?

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

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

9. Consider the following function:

```
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 = @(z) z^-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
10. Consider the following function definition

```matlab
function f(x)
    y = x*x
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.

11. 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?

```
>> 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
12. 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.

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

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

(III) `total = sum(getVals(dset));`
(a) I only
(b) II only
(c) III only
(d) I and II only
(e) *I, II, and III

13. Which expression properly defines the function \( f(s) = 3s^3 \)?

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

(a) Only I
(b) Only II
(c) Only III
(d) *I and II only
(e) I, II, and III
Questions 14–16: 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:

```matlab
1 function [out] = T(z)
2   if z
3     \% Base Case
4   else
5     \% Recursive statement
6 end
```

14. 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

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

16. What is the proper completion for line 5?
   (a) \( T = 3*T(y/5) + 6*T(y/7); \)
   (b) \( out = 3*T(y/5) + 6*T(y/7); \)
   (c) \( *out = 3*T(z/5) + 6*T(z/7); \)
   (d) \( T = 4; \)
   (e) None of the above
17. 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

18. 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) + f(n-2);
    end
end
```

(a) \( O(n) \)
(b) \( O(\log n) \)
(c) *\( O(2^n) \)
(d) \( O(23) \)
(e) All of the above
19. 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

20. 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.
21. 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) $\sum_{k=1}^{n} s(k)$
Questions 22–25 refer to the following class definition:

```matlab
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
end
```
22. 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)  
\[
resetTime(T,h,m,s);
\]
23. 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) \[
T.mySec = T.mySec + 1;
if T.mySec == 60
    T.mySec = 0;
    T.myMin = T.myMin+1;
end
end
if T.myMin == 60
    T.myMin = 0;
    T.myHrs = T.myHrs + 1;
end
\]

(a) I only
(b) II only
(c) III only
(d) I and II only
(e) I, II, and III
24. 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
25. Consider a script with the following lines (assume a correct implementation of the constructor and \texttt{addTimes}): 

1 T1 = Time(5,0,1);
2 T2 = Time(1,1,1);
3 T3 = addTimes(T1,T2);
4 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
Questions 26–28 refer to the following function:

```matlab
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; <- typo should be listIN.node(pointer).next
end

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; <- typo should be listIN.node(mid).next

list2 = listIN;
list2.root = listIN.node(mid).next;
end
```
26. 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

27. 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

28. 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.

[Because of the typos in the program we accepted two possible answers to each of these 26–28.]