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?

```
1 >> Q = true;
2 >> P = 1 < 0;
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

2. 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.

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) *∞

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

```
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

```
>> 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?

```
>> 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

```
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

```
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.

```
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) 3*s^3;
```
II
```
f = @(x) 3*x^3;
```
III
```
f = 3*x^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:

$$\begin{aligned} T(y) &= 3\,T(y/5) + 6\,T(y/7) \\ T(y) &= 4 \text{ for all } y \leq 1 \end{aligned}$$

and the following *incomplete* program for evaluating it:

```
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 <= 1`

    (b) `z == 1`

    (c) `*z <= 1`

    (d) `z == 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

```
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

```
>> 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?

```
function out = fnc(n)
  if n == 1 || n == 2
    out = 23;
  else
    out = fnc(n-1) + f(n-2);
    % <-- typo corrected during exam: f(n-2) should be fnc(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:

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

If one types

```
>> 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?

```
1 vals = 1:50;
2 vals = vals( vals > 25 );
3 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?

```
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:

```
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;
  if T.myMin == 60
    T.myMin = 0;
    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

24. Consider the following *incorrect* implementation of the method `addTimes`

```
1  function T = addTimes(T1,T2)
2    h = T1.myHrs + T2.myHrs;
3    m = T1.myMin + T2.myMin;
4    s = T1.mySec + T2.mySec;
5
6    if s >= 60
7      m = m + 1;
8      s = s - 60;
9    end
10
11   if m >= 60
12     h = h + 1;
13     m = m - 60;
14   end
15
16   T.h = h;
17   T.m = m;
18   T.s = s;
19 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 contructor 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 `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:

```
1  function [list1,list2] = fnc(listIN)
2  % Usage: [list1,list2] = fnc(listIN)
3  % Inputs: listIN -- list structure with root, node().next, node().value
4  % Output: list1 -- a list structure
5  %         list2 -- a list structure
6
7    cnt = 0;
8    pointer = listIN.root;
9    while pointer ~= 0
10     cnt = cnt + 1;
11     pointer = listIN(pointer).next;  <-- typo should be listIN.node(pointer).next
12   end
13
14   mid = listIN.root;
15   for i = 1:floor(cnt/2)
16     mid = listIN.node(mid).next;
17   end
18
19   list1 = listIN;
20   list1.root = listIN.root;
21   list1(mid).next = 0;  <-- typo should be listIN.node(mid).next
22
23   list2 = listIN;
24   list2.root = listIN.node(mid).next;
25
26 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.]