E7: Introduction to Computer Programming for Scientists and Engineers
University of California at Berkeley, Spring 2017
Instructor: Lucas A. J. Bastien

Midterm Exam
Date: Wednesday March 1, 2017
Duration: 50 minutes

Version: revision01

Full name: _____

Student ID: _____

Full name of primary GSI: _____

Lab section number: _____

By handing in your responses to this exam, you attest that you have neither given nor received any assistance in the taking of this exam.

Part 1: Overview

This exam is **16 pages long** (including this cover page) and contains **25 multiple-choice questions**. Please follow the instructions below:

- Fill in the required information above.
- **IMPORTANT:** On the front of your Scantron, write **very clearly**:
  ⋄ Your full name in the box labeled "NAME"
  ⋄ Your student ID number in the box labeled "SUBJECT"
  ⋄ The number 783257 in the box labeled "TEST NO."
  ⋄ Today's date in the box labeled "DATE"
- Bubble in your answers on the Scantron with a number 2 pencil. **There is one and only one correct answer for each question.** Multiple bubbles, incomplete bubbles, or stray marks will be marked incorrect.
- Scantrons will not be returned, so you may wish to mark your answers on these pages as well, for future reference (these pages will be returned to you).
- You may use one 8.5 inches by 11 inches (U.S. letter size) sheet of notes (both sides, typed or hand-written) for this exam.
- No electronic devices (including hand-held calculators) are permitted in your work area.

- There will be no questions regarding the exam during the examination time except in cases where there is a missing page or printing problem with your exam.

- Please do not get up to leave until the exam is over.

- At the end of the exam, hand in the completed Scantron **and** the questions (*i.e.* this document) to the instructor or to a GSI.

- When user-defined functions are mentioned in a question, and unless specified otherwise, you can assume that each of these functions is defined in an m-file that has the same name as the function, in a directory (also known as folder) where Matlab can find it (*i.e.* in a directory that is part of Matlab's path).

- Every array listed **in the multiple choices** of the questions below is of class `double` unless specified otherwise (if not of class `double`, the class of the array precedes the array, for example `logical [1, 0, 1, 1]`).

Part 2: Questions

1. What will the value of the variable `b` be after executing the following code at the command line?

```
a = [5, -3, 0, 11, 9, -4];
b = (a > 0);
```

A) `false` (*i.e.* `logical 0`)

B) `[5, 11, 9]`

C) `logical [1, 0, 0, 1, 1, 0]`

D) `[5, 0, 0, 11, 9, 0]`

E) Matlab throws an error

2. Assume that, in the workspace, are currently defined:

- a variable named `a` that is an $m \times n$ array of class `double` with $m > 0$ and $n > 0$
- two variables named `p` and `q`, respectively. They are scalars of class `double` that are neither `NaN`, `Inf`, nor `-Inf`

We wish to replace all the elements of the array `a` that are equal to `p` with the value of `q`. Which of the following commands can be used to achieve this goal?

A) `a(a=p) == q;`

B) `a(a=p) = q;`

C) `a(a==p) = q;`

D) `a(a==p) == q;`

E) None of the above

3. Consider the two following functions, defined in a single m-file (*i.e.* `my_function_2` is a sub-function of `my_function_1`)

```
function [out] = my_function_1(i, j)
j = my_function_2(k);
out = j - 2 * 1;
end

function [j] = my_function_2(k)
j = k + 1;
end
```

What will the value of the variable **out** be after executing the following code at the command line?

```
i = 2;
k = 1;
out = my_function_1(i, k);
```

A) `0`

B) `-1`

C) The variable **out** will not be defined because of the semi-colon at the end of the last line of the code above

D) Matlab throws an error with the message: Undefined function or variable 'k'.

E) Matlab throws an error with the message: Undefined function or variable 'j'.

4. Consider the following function:

```
function [c, d, e] = my_arrays(a, b)
c = a .* b;
d = a .^ b;
e = (a == b);
end
```

What will the values of the variables c, d, and e be, respectively, after executing the following code?

```
a = [1, 2; 3, 4];
b = [1, 0; 0, 1];
[c, d, e] = my_arrays(a, b);
```

A) `[1, 0; 0, 4]`, `[1, 1; 1, 4]`, and `logical 0`

B) `[1, 2; 3, 4]`, `[1, 2; 3, 4]`, and `logical 0`

C) `[1, 2; 3, 4]`, `[1, 0; 0, 4]`, and `logical 0`

D) `[1, 0; 0, 4]`, `[1, 2; 3, 4]`, and `logical [1, 0; 0, 0]`

E) `[1, 0; 0, 4]`, `[1, 1; 1, 4]`, and `logical [1, 0; 0, 0]`

For the next 2 questions:

Consider the following function:

```
function [out] = my_io_function(a, b)
out = 0;
if a > 5
    out = a;
else
    out = b;
    output = a + b;
end
end
```

5. What will the value of the variable `output` be after executing the following code?

```
a = 1;
b = 15;
output = my_io_function(a, b);
```

A) `1`

B) `15`

C) `16`

D) `0`

E) Matlab throws an error with the message: Output argument "output" (and maybe others) not assigned during call to "my_io_function".

6. What will the value of the variable `out` be after executing the following code?

```
a = 2;
b = 10;
out = my_io_function(b, a);
```

A) `0`

B) `2`

C) `10`

D) `12`

E) Matlab throws an error with the message: Output argument "out" (and maybe others) not assigned during call to "my_io_function".

7. We wish to define in the command window's workspace a variable that is a scalar of class `double` named `var` and that contains the value `1`. Executing which of the following sets of commands in the command window will yield the desired outcome?

A)
```
c = {@sin, @cos, @tan};
d = c{2};
var = d(0);
```
B)
```
sqr = @(n) n.^2;
var = sqr(-1);
```
C)
```
h = @zeros;
var = h(1, 1) + 1;
```
D) All of the above.

E) None of the above.

8. We execute the following commands in the command window:

```
a = [4, 5, 0; 1, 2, -3; 0, 0, 1];
b = [3, 6, 9; 2, 4, 6];
```

Which of the following commands will **not** produce an error when executed directly after the commands above?

A) `a(:, 1) + b;`

B) `a(1, :) + b(end, :);`

C) `a(:, 1) + b(:, end);`

D) `a + b;`

E) All of the above will produce an error.

9. What will the value of the variable `z` be after executing the following code?

```
array = [-1, 9, NaN, 0, NaN];
x = array > 0;
y = isnan(array);
z = (x == y);
```

A) `logical 0`

B) `logical 1`

C) `logical [0, 0, 1, 0, 1]`

D) `logical [1, 0, 0, 1, 0]`

E) Matlab throws an error

10. Assume that the variable `a` is a row vector of class `double` that has at least two values. Which of the following function calls will return the sum of the square of each element of `a`?

A) `sum(a^2)`

B) `sum(a.*a)`

C) `sum(a*a)`

D) Answers A and C

E) None of the above

11. What will the value of the variable **b** be after executing the following code?

```
v = [1, 5, 3, 6];
if v(2) > 10
    b = 10;
elseif v(3) > 1
    b = 1;
elseif v(4) > 5
    b = 5
else
    b = 0;
end
```

A) `10`

B) `1`

C) `5`

D) `0`

E) The variable **b** will be undefined.

12. Consider the following function:

```
function [answer] = my_combine(x, y)
answer = [];
for i = 1:numel(x)
    answer(end+1) = x(i);
    answer(end+1) = y(i);
end
end
```

What will the value of variable **c** be after executing the following code?

```
x = [1, 2, 3];
y = [4, 5, 6];
c = my_combine(x, y);
```

A) `[4, 1, 5, 2, 6, 3]`

B) `[1, 2, 3, 4, 5, 6]`

C) `[1, 4, 2, 5, 3, 6]`

D) `[4, 5, 6]`

E) Matlab throws an error with message: Undefined function or variable 'answer'.

13. What will the value of the variable `counter` be after executing the following code?

```
counter = 0;
for i = 1:10
    if i > 5
        counter = 0;
    end
    for j = 1:10
        counter = counter + 1;
    end
end
```

A) `10`

B) `25`

C) `50`

D) `100`

E) `9`

14. What will the value of the variable `c` be after executing the following code?

```
c = 2:2:12;
for i = 1:2:5
    for j = 2:2:8
        if j == c(i)
            c(i) = i;
        end
    end
end
```

A) `[1, 3, 5, 7, 9, 12]`

B) `[1, 3, 5]`

C) `[1, 4, 3, 8, 10, 12]`

D) `[2, 4, 6, 8, 10, 12]`

E) `[2, 1, 6, 8, 10, 3]`

15. What will the value of the variable i be after executing the following code?

```
i = 0;
array = [-1, -2, 0, 10, 1];
value = -1;
while value < i
    i = i + 1;
    value = array(i);
end
```

A) 0

B) 1

C) 3

D) 4

E) 10

16. Consider the following function:

```
function [i, j] = my_break(x, y)
for i = 1:x
    for j = 1:y
        if i*j == 12
            break
        end
    end
end
end
```

What will the values of the variables i and j be, respectively, after executing the following code?

```
[i, j] = my_break(12, 6)
```

A) 3 and 4

B) 6 and 2

C) 12 and 1

D) 2 and 6

E) 1 and 12

For the next 2 questions:

Consider the following code:

```matlab
x = 1:4;
y = 4:-1:1;
count1 = 0;
count2 = 0;
while ~isequal(x, y)
    for i = 2:numel(y)
        if y(i-1) > y(i)
            z = y(i-1);
            y(i-1) = y(i);
            y(i) = z;
        end
        count1 = count1 + 1;
    end
    count2 = count2 + 1;
end
```

17. What will the value of the variable y be after executing the code shown above?

A) [1, 2, 3, 4]

B) [4, 1, 2, 3]

C) [2, 3, 4, 1]

D) [4, 3, 2, 1]

E) [] (*i.e.* y will be an empty array of class **double**)

18. What will the values of the variables **count1** and **count2** be, respectively, after executing the code shown above?

A) 0 and 3

B) 9 and 3

C) 0 and 0

D) 3 and 9

E) 4 and 12

19. Consider the following function:

```
function out = my_function(in)
out = in;
if abs(in) > 0
    s = in / abs(in);
    out = out + my_function(in-s);
end
end
```

What will the value of the variable v be after executing the following code?

```
v = my_function(-3);
```

A) -3

B) -4

C) -6

D) -8

E) -10

20. Consider the following function:

```
function [result] = my_recursive_function(x)
if x <= 0
    x = 1 - x;
end
if x <= 0
    result = x;
else
    result = [x, my_recursive_function(x+1)]
end
end
```

What will happen when the function `my_recursive_function` is called using a scalar of class `double` as its input argument?

A) Matlab throws an error, which would not happen if the `else` keyword were replaced with the `elseif` keyword

B) Matlab throws an error, which would not happen if the comma between `x` and `my_recursive_function(x+1)` were replaced with a semi-colon

C) The function `my_recursive_function` will call itself indefinitely

D) Matlab throws an error because `my_recursive_function` is an invalid function name

E) None of the above

21. Assume that, in the workspace, is already defined a variable named **a** that is an $m \times n$ array of class **double**, with $m > 0$ and $n > 0$. What will the size of array **a** be after executing the following code?

```
try
    v = a(1, 15);
catch
    a = [a, a];
end
```

A) 1×15 if $m = 1$ and $n \leqslant 15$, and $m \times n$ otherwise

B) 1×15 in all cases

C) $m \times n$ in all cases

D) $m \times 2n$ if $n < 15$, and $m \times n$ otherwise

E) $2m \times 2n$ if $n < 15$, and $m \times n$ otherwise

22. What is the binary representation of the decimal number -15 (minus fifteen) using the 32-bit binary representation ("single precision") defined by the IEEE-754 standard?

A) 01011001011100000000000000000000

B) 11000001011100000000000000000000

C) 01000001000100000000000000000000

D) 01111001000100001000000010000000

E) 01001001011100001000000010000000

23. What will the values of the variables `c` and `d` be, respectively, after executing the following code?

```
a = {'good morning'; 'hi'; 'hello'; 'good afternoon'};
b = {a};
c = class(b{1});
d = size(b{1});
```

A) `'cell'` and `[1, 1]`

B) `'cell'` and `[1, 12]`

C) `'cell'` and `[4, 1]`

D) `'char'` and `[1, 12]`

E) `'char'` and `[4, 1]`

24. What is the decimal number represented by the unsigned 8-bit binary representation 10010110?

A) -106

B) 150

C) 22

D) -150

E) -22

25. What will the value of the variable v be after executing the following code?

```
x = 10000;
y = x/100;
z = eps(x)/100;
l1 = (x + eps(x)) == x;
l2 = (x + z) == x;
l3 = (y + eps(x)) == y;
v = [l1, l2, l3];
```

Note that the documentation of Matlab's built-in `eps` function (accessed using the command `help eps`) includes the following description: "D = eps(X), is the positive distance from ABS(X) to the next larger in magnitude floating point number of the same precision as X."

A) `logical [1, 1, 0]`

B) `logical [0, 0, 1]`

C) `logical [1, 0, 0]`

D) `logical [0, 1, 0]`

E) `logical [0, 0, 0]`