CVEN 489-502 (302 - Socolofsky)

Special Topics in Computer Applications in Engineering and Construction

Exam #1: Introduction to Programming and Numerical Methods
October 9, 2009, 10:20 am–12:10 pm in Zachry 127B

Name: ______________________________

UIN: ________________________________

Instructions:

Fill in your name and UIN in the space above. There should be two packets: one with true/false and multiple choice questions, and a second with workout problems.

The exam is closed book, and only one double-sided sheet of notes is permitted. No collaboration with others!

For multiple choice questions, choose the single, best answer.

For short answer and workout problems, write down all steps necessary to solve the problem: show all your work. Failure to do so will result in a lower score. Be sure to answer all parts of all problems. Do not leave any problems blank.

Certification:

“An Aggie does not lie, cheat, or steal or tolerate those who do.” By my signature below, I certify that the work contained in this exam is my own and that I did not receive help from other students.

Signature: ________________________________ Date: ____________________________
A. True or False

For each of the following statements, check the box with the most appropriate response. Worth 20 point: problems are 2 points each.

1. Two Matlab commands to get help from the command line are help and lookfor
   □ True □ False

2. A proper Matlab statement to evaluate
   \[ \frac{x^2 \sqrt{y^2 + x^2}}{\sin(\omega t - \phi)} \]
   is ans = x^2 * sqrt(y^2 + x^2) / sin(w*t - phi), where x, y, w, t, and phi are variables storing a single number.
   □ True □ False

3. If x = 7, y = 10, and z = 3.5782, then the following statement evaluates to
   \( ( x == y || y > z ) && \neg(x > y) \)
   □ True □ False

4. The Matlab load command can load data from text files containing numbers and letters.
   □ True □ False

5. It is good programming practice to use arbitrary variable names that are not descriptive since they are less likely to overwrite built-in Matlab functions.
   □ True □ False

6. An IF-block executes the code under each statement that evaluates true. For instance, the result of this code
   
   ```matlab
   x = 5; y = 2;
   if x > 0
       x = 7;
   elseif y < 10
       y = 5;
   end
   
   will be to set x = 7 and y = 5.
   □ True □ False

7. It is good programming practice to indent code to show the structure of loops and branches.
   □ True □ False
8. Use a **for**-loop to repeat sections of code when you do not know in advance how often the
    loop will be executed.
    □ True □ False

9. When indexing an array, be sure to use the [ and ] brackets. For instance, use \texttt{x = A[3,4]} to
    set \texttt{x} equal to the value in \texttt{A} stored in the 3rd row and 4th column.
    □ True □ False

10. The following commands are valid in a Matlab program:
    \begin{align*}
    i &= i+1; \quad x = x^2; \quad y = \sin(y); \\
    \end{align*}
    □ True □ False

B. Multiple Choice

For each of the following questions, circle the answer that is most appropriate or closest numerically
    to your answer. Be sure to clearly mark only one answer. Worth 30 points: problems are 2 points
    each.

11. You can clear the contents of the workspace (erase all your variables) using the command
    \begin{itemize}
    \item a. \texttt{clc}
    \item b. \texttt{clf}
    \item c. \texttt{erase}
    \item d. \texttt{clear}
    \item e. \texttt{delete}
    \end{itemize}

12. To calculate the function
    \begin{equation}
    f(x) = \frac{x^3}{\sqrt{5^2 - x^2}}
    \end{equation}
    given that \( x = 0:0.01:10 \), you could use the command
    \begin{itemize}
    \item a. \texttt{f(x) = x^3/sqrt(5^2 - x^2)}
    \item b. \texttt{f = x^3/sqrt(5^2 - x^2)}
    \item c. \texttt{f[x] = x.^3/(5^2 - x.^2)^(1/2)}
    \item d. \texttt{f = x.^3./sqrt(5^2 - x.^2)}
    \item e. \texttt{f = (((x).^3))./(sqrt(((5)^2) - ((x)^2))))}
    \end{itemize}
For problems 13 through 15, refer to the following code:

```matlab
t = -2*pi:pi/10:2*pi;
x = zeros(length(t),1);
for i = 1:length(t)
    x(i) = t(i) * sin(t(i));
end
plot(t,x,’ro-’)
```

13. The FOR-loop could be replaced by the vectorized command
   a. `x = t * sin(t)`
   b. `x .= t .* sin(t)`
   c. `x = t .* sin(t)`
   d. `x(:) = t(:) * sin(t)`
   e. You can never replace a FOR-loop with a single line of code.

14. The command `x = zeros(length(t),1)`
   a. is not required for the code to run.
   b. preallocates memory for x.
   c. speeds up the FOR-loop since the array x is not growing inside a loop.
   d. all of the above
   e. generates an error since `length(t)` is undefined.

15. After this code is run, which of the following statements is not true
   a. Both x and t will be one-dimensional arrays
   b. The length of i will equal the length of t
   c. The figure window will contain a plot of x versus t as a red line with circle-symbols at each data point
   d. If executed as a program, all variables will remain stored in the workspace
   e. If executed as a function, all variables will be deleted when complete
16. Which of the following is good programming practice?

a. Never modify the values of a FOR-loop index while inside the loop
b. Do not test your program until it is complete in all of its components
c. Copy and paste code whenever you need to reuse it
d. Ignore formatting conventions: Matlab does not read them anyway
e. Name all variables after Disney characters since they are easy to remember

17. Which of the following is an acceptable thing to do in good Matlab programming?

a. Name your program plot.m
b. Clear the memory before running a new program
c. Type $f(x) = x^2$ in the command window
d. Name your program lab-1.m
e. Type $y + 7 = x$ in the command window

18. You have the following code:

```matlab
x = 0:0.01:10;
n = length(x);
A = zeros(n,n);
A(:,1) = 1;
for id = 2:n
    A(:,id) = A(:,1) + x(id+1);
end
```

What is wrong with this code?

a. $A(:,1) = 1$ is not a valid Matlab command
b. $id$ is not a valid name for a loop variable: use $i$ instead
c. The code inside the loop will overrun the number of data points in the variable $x$
d. $A = zeros(n,n)$ is unnecessary since the FOR-loop will fill the components of $A$
e. The code contains no errors
19. Given the following array in Matlab:

\[ A = [1 17 8 4; 24 3 0 \text{NaN}; 35 27 \text{Inf} 9]; \]

what is \( A(2,3) \)?

a. 0  
b. Inf  
c. NaN  
d. 27  
e. The expression for \( A \) is not valid since it contains letters and numbers

20. Which of the following statements is false about a .m-file whose first line of executable code is

\[
\text{function } [f0, \text{test}] = \text{my\_function}(x, p, \omega)
\]

a. \( \omega \) is an input to the function  
b. The body of the function must have a line that sets the value of \( f0 \)  
c. An acceptable usage of this function at the Matlab prompt would be  
   \([f, \text{test}] = \text{my\_function}(10, 7, w)\)  
d. The filename must be \text{my\_function.m}  
e. An appropriate command inside the function would be \( x = 7 \)

21. Which of the following is an acceptable variable name in well-written Matlab code?

a. \text{n-iter}  
b. \text{number-of-iterations}  
c. \text{number>iterations}  
d. \text{n\_iterations}  
e. \text{n iterations}

22. Which of the following is true about a Matlab \text{FOR} loop

a. \text{FOR} loops can run forever if you are not careful  
b. The loop variable will be an array  
c. Matlab automatically changes the value of the loop variable each time the loop iterates  
d. You cannot put other loop structures inside a \text{FOR} loop  
e. \text{FOR} loops are faster than their vectorized equivalents
23. Which of the following is not a Matlab keyword
   a. iter
   b. end
   c. for
   d. while
   e. if

24. Which of the following is a poor use of commenting in well-written Matlab code?
   a. Including a variable dictionary at the top of your code
   b. Giving the units of variables as they are defined
   c. Providing comments that will be echoed to the command window when the help command is invoked by the user
   d. Keeping a record of revision edits to your program
   e. Collecting all comments to the top of a file so that Matlab commands are not cluttered with comments

25. You have the following code, where xx.dat is a file consisting of a single column of numbers:

   ```matlab
   x_data = load('xx.dat');
   n = length(x_data);
   j = 0;
   for k = 1:n
       if x_data(k) < -9990
           x_data(k) = NaN;
           j = j+1;
       end
   end
   ``

   What does this code do?
   a. Scans the data in x_data for values less than -9990 and replaces them with the not-a-number flag
   b. Counts the number of flagged data points using the variable j
   c. Generates an error from the load command if the file xx.dat has any missing rows
   d. All of the above
   e. Only a. and b.
C. Short Answer

For each of the following questions, provide a short, written answer. Please make your statements clear, your writing legible, and show your work. Write your solution on the page provided. Worth 20 points.

For these problems, the following equation

\[ y(t) = \begin{cases} 
1 & t \leq 0 \\
-\sqrt{t} & t > 0 
\end{cases} \quad (3) \]

gives the voltage \( y \) in V measured by a strain gauge in a bridge at a time \( t \) in s after a loading event occurs.

26. (7 points) Write the Matlab statements required to plot \( y(t) \) given in Equation (3) for values of \( t \) between -1 and 1 in steps of 0.01. Use a `FOR`-loop with a nested `IF`-block to perform the calculation.
27. (7 points) Write the Matlab statements that would go in a file named volts.m to compute $y(t)$ given in Equation (3) for a single value of $t$. For example, the correct function could be used as follows: $y = \text{volts}(0.2)$;

28. (6 points) A data file contains two columns: the time in s in column 1 and voltage in V in column 2 measured for an actual experiment. Write the Matlab statements required to load that data file named exp_1.dat and plot the data points as circles with no line on top of the plot generated in Problem 26 above (assume the previous plot is already plotted). Include labels on the axes of your plot.
D. Workout Problem

For the workout problem, please show all your work and submit your solution in the space provided. Do not forget any parts of the problem. Worth 30 points.

29. A data file `grades.dat` contains 11 columns of data: The first column is a list of student UIN numbers, the remaining columns report the grades (on a scale of 0 to 100) for each student on 10 assignments.

Write a Matlab Program that does the following

a. Read in the data file

b. Scan through each row to find the lowest grade for each student. Then scan through the data a second time to replace the lowest grade with the value -2. Excused absences are already recorded as -1 in the data file. Values less than zero indicate grades that are not to be counted in the average.

c. Compute the average grade for each student using the remaining valid scores (filter out all negative scores). The average $\bar{x}$ for a set of data points $x$ should be computed from

$$\bar{x} = \frac{1}{n} \sum_{i=1}^{n} x_i$$

(4)

Be sure to divide by the correct number $n$ of counted assignments for each student.

The remainder of this page is provided for your own notes and brainstorming. This page will NOT be graded!
i. Write the code here to load the data, find the lowest grade, and replace the lowest grade with the value -2 (15 points).
ii. Write the code here to compute the average (15 point).