

**Georgia Institute of Technology  
College of Computing  
CS 1171 Computing for Engineers  
Final Exam - Fall Semester 2008**

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0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9
A	A	A	A	A	A	A	A	A
B	B	B	B	B	B	B	B	B
C	C	C	C	C	C	C	C	C
D	D	D	D	D	D	D	D	D
E	E	E	E	E	E	E	E	E
F	F	F	F	F	F	F	F	F
G	G	G	G	G	G	G	G	G
H	H	H	H	H	H	H	H	H
I	I	I	I	I	I	I	I	I
J	J	J	J	J	J	J	J	J
K	K	K	K	K	K	K	K	K
L	L	L	L	L	L	L	L	L
M	M	M	M	M	M	M	M	M
N	N	N	N	N	N	N	N	N
O	O	O	O	O	O	O	O	O
P	P	P	P	P	P	P	P	P
Q	Q	Q	Q	Q	Q	Q	Q	Q
R	R	R	R	R	R	R	R	R
S	S	S	S	S	S	S	S	S
T	T	T	T	T	T	T	T	T
U	U	U	U	U	U	U	U	U
V	V	V	V	V	V	V	V	V
W	W	W	W	W	W	W	W	W
X	X	X	X	X	X	X	X	X
Y	Y	Y	Y	Y	Y	Y	Y	Y
Z	Z	Z	Z	Z	Z	Z	Z	Z

↑ Print your **T-Square username** in the spaces provided, and shade the boxes of the corresponding numbers and/or letters.

*I hereby signify that this examination paper contains my own work exclusively, and I have neither given nor received inappropriate help during the taking of this examination, in compliance with the letter and spirit of the Academic Honor Code of Georgia Tech.*

Name (print): \_\_\_\_\_

Signature: \_\_\_\_\_

Prob.	Poss. Pts	Earned Pts
(cover)	-	-
Part 1	60	
Part 2	30	
Part 3	20	
Part 4	40	
<b>TOTAL</b>	<b>150</b>	

**Please Note:** Failure to complete this front sheet correctly will cost you 5% of your grade.

**Please turn off (or silence) and put away any cell phones, beepers/pagers, personal radios or music players that you have in your possession**

**Good Luck!**

Academic misconduct (including - but not limited to - examples on the list below) could result in a zero score on this examination, an "F" final grade in the course, and/or other disciplinary action:

- Failure to cooperate with or follow directions given by a proctor.
- Failure to stop writing when the allotted time is up (as reported by a proctor).
- Communication with anyone other than a proctor for ANY reason in ANY language in ANY manner.
- Sharing of ANYTHING (e.g. pencils, erasers, paper).
- Writing on paper that is not given to you by a proctor.
- Using cell phones, beepers, personal radios or music players, etc. during the exam.
- Using calculators (unless explicitly permitted) or hand-held computers during the exam.
- Using books or other reference material during the exam.
- Disruption of the exam setting.

### Reference Section:

`all(x)` - checks if all of the elements of x are true  
`class(a)` - returns the class of a  
`cumsum(a)` - returns the cumulative sum of the elements in a  
`csvread(filename)` - reads in file of comma separated values  
`diag(m)` - returns the diagonal elements of the matrix m  
`diff(x)` - finds the difference of consecutive elements  
`dlmread(filename, D)` - reads in file with delimiter D  
`double(a)` - converts a to class double (numeric)  
`fieldnames(X)` - returns an array of fieldnames  
`find(m)` - returns the indices of the true elements of m  
`image(x)` - display the image from the matrix x  
`imread(filename)` - returns a matrix representation of an image  
`newy = interp1(x, y, newx)` - Interpolates on the underlying function Y at the points in newx.  
`isa(a, b)` - checks if a is of class b  
`length(a)` - largest dimension of a  
`linspace(A, B, N)` - creates a vector from A to B with N evenly spaced points  
`magic(n)` - builds a n \* n magic square  
`max(a)` - value and index of the max value in a  
`mean(v)` - returns the average value of v  
`mesh(x, y, z)` - plots a 3-D surface  
`mod(a, b)` - the remainder when a is divided by b  
`ones(rows, cols)` - generate a matrix filled with 1  
`polyfit(a, b, c)` - creates a polynomial fit to input vectors  
`polyval(a, b)` - evaluates values with the given coefficient vector  
`plot(x, y, S)` - plots y versus x; S specifies line style  
`prod(v)` - compute the product of all the elements in a vector v  
`rand(n, m)` - produces an n by m array of random numbers between 0 and 1  
`rmfield(S, X)` - removes field X from S  
`sin(th)` - sin of the angle in radians  
`size(a)` - all the dimensions of a  
`sort(v)` - arranges v in ascending numerical order  
`newy = spline(x, y, newx)` - Performs cubic spline interpolation to find newy, the values of the underlying function y at the points in newx  
`sprintf` - Write formatted data to string  
`strcmp(a, b)` - Compare strings a and b  
`struct(F, V, ...)` - creates a structure with field F and values V  
`sum(v)` - total all the elements in the vector v  
`xlsread(filename)` - reads in .xls file  
`zeros(rows, cols)` - generate a matrix filled with 0

**Part 1 – Multiple Choice [60 Points]**

1. Given the following code:

```
S = struct('Name', {'A', 'D', 'C'}, 'Number', {1, 2, 3});
X = setfield(S(2), 'Name', 'B');
```

What is the value of `x` after the above code is run in MATLAB?

- A. Name: 'B'
- B. Name: 'B'  
Number: 2
- C. 1x3 struct array with fields:  
Name  
Number
- D. 1x3 struct array with fields:  
Name
- E. Error

2. The following code is run in MATLAB:

```
x = [1 2 3 4 5 6];
y = [9 0 3 0 8 -1];
```

Which of the following lines of code is guaranteed to return 0?

- A. `interp1(x, y, 4)`
- B. `polyval(polyfit(x, y, 1), 4)`
- C. `spline(x, y, 4)`
- D. Both answers A and C
- E. All of the above

3. If the variable `B` is an RGB image matrix, which of the following will increase the brightness of the image stored in `B`?

- A. `B = B + 50`
- B. `B = B - 50`
- C. `B = B/3`
- D. `B = B*0`
- E. None of the above

4. Suppose 1371.xls looks like this:

	A	B	C
1	Name	Age	Graduated College
2	Greg	30	2000
3	Cedric	35	1995
4	Peter Parker	N/A	N/A
5	John	25	2005
6			

```
[num, txt, raw] = xlsread('1371.xls');
```

What will `num` look like?

- A.     NaN     NaN     NaN                    B.     30     2000                    C.     ''     ''     ''  
        NaN     30     2000                    35     1995                    ''     30     2000  
        NaN     35     1995                    NaN     NaN                    ''     35     1995  
        NaN     NaN     NaN                    25     2005                    ''     ''     ''  
        NaN     25     2005                    ''     25     2005
- D.     30     2000                    E. None of the above  
        35     1995  
        ''     ''  
        25     2005

5. You are given two vectors:  $\mathbf{x}$  with the x values of two points, and  $\mathbf{y}$  with the corresponding y values. If one wanted to draw a line segment between two points, which command should one NOT use, given that `newX = linspace(X(1), X(2), 100)`?

- A. `plot(newX, interp1(X, Y, newX))`  
 B. `C = polyfit(X, Y, 0)`  
    `plot(newX, polyval(C, newX))`  
 C. `C = polyfit(X, Y, 1)`  
    `plot(newX, polyval(C, newX))`  
 D. `plot(X, Y)`  
 E. All of the above plot a line segment

6. Consider the following recursive MATLAB function:

```
function ret = mystery(n)
abc = rand(1,1) * 10;
if abc < 5
    ret = 1 + mystery(n-1);
else
    ret = 1 + mystery(n);
end
```

What fundamental requirement is it missing?

- A. Terminating condition  
 B. Moving towards terminating condition  
 C. Calling clone of the function  
 D. There is nothing missing  
 E. It generates an error

7. Which of the following have best case  $N^2$  big O?

- I. Bubble Sort
  - II. Merge Sort
  - III. Quick Sort
  - IV. Insertion Sort
- A. I and II
  - B. I and IV
  - C. II and IV
  - D. I and III
  - E. I, III, and IV

8. Given:

```
vec = [12 3 4 7 8 10 12 14]
```

Which of the following removes all of the odd values from `vec`?

- A. `vec = mod(vec,2) == 0`
- B. `vec = mod(vec,2) == 1`
- C. `vec = vec(mod(vec,2)==1)`
- D. `vec = vec(mod(vec,2)==0)`
- E. `vec = vec(2:2:end)`

9. Given

```
A= [1 2 3 4;
    5 6 7 8;
    9 10 11 12];
```

Which of these will give `B = [6; 7]`?

- I. `B = A(6:7)'`
  - II. `B = [A(2,2); A(2,3)]`
  - III. `B = A'`  
`B = [B(6); B(7)]`
- A. I only
  - B. I and II
  - C. II and III
  - D. I and III
  - E. II only

10. Which of the following is NOT a valid function header?

- A. `function ret = FINALS(input)`
- B. `function FINALS`
- C. `function ret = FINALS`
- D. `function [ret1, ret2] = FINALS(input)`
- E. `function ret = FINALS([input1, input2])`

11. The function `sprintf` can be used to create strings that include variable values:

```
str = sprintf('My name is _____', x)
```

If `x` is a character array, which of the following characters should go into the blank?

- A. `%s`
- B. `%d`
- C. `%c`
- D. `\s`
- E. `\c`

12. Given the sound 'music.wav', how would you determine how long will the sound plays?

```
[data, Fs] = wavread('music.wav');
N = length(data);
```

- A. `time = data/Fs`
- B. `time = Fs/N`
- C. `time = data*Fs`
- D. `time = N/Fs`
- E. None of the above

13. Given a cell array:

```
C = {[1 2 3], true, 'funfunfun'}
```

Which of the following would replace 'funfunfun' with an empty cell (make `C = {[1 2 3], true, {}}`)?

- A. `C(3) = []`
- B. `C{3} = []`
- C. `C(3) = ''`
- D. `C{3} = {}`
- E. None of the above

14. Which pivot picking method can avoid the worst-case BigO() of quick-sort when presorted data is passed?

- A. Picking the pivot at the beginning
- B. Picking the pivot at the end
- C. Picking the middle value as the pivot
- D. Picking the pivot as a random number between 1 and 100.
- E. Nothing can be done

15. What kind of data types can be contained in the fields of a structure?

- A. Character Arrays
- B. Any data type, but only one kind for each individual structure
- C. Numerical data
- D. Any collection of data types
- E. None of the above

16. Given the following code:

```
counter = 0;
for a = 2*ones(1,3)
    b(a) = counter;
    counter = counter + 1;
end
```

What is the final value of b?

- A. [0 1 2]
- B. [2 2 2]
- C. [0 2]
- D. [0 1]
- E. Error

17. Given the following Matlab code:

```
romeo = true
paris = false
juliet = (romeo || paris) && romeo
if juliet
    output = 'to thine own heart be true'
else
    output = 0
end
```

What is the class of output?

- A. char
- B. double
- C. logical
- D. none of the above
- E. I hate Shakespeare

18. Which of the following would produce an error?

- A. `plot(1:10, 2:11, 'r')`
- B. `plot(1:10, 2:2:20, 5:10, 15:20)`
- C. `plot(1, 5)`
- D. `plot(1:10, 2:2:20, 'r', 'o')`
- E. `plot(1:10, 1:10, 'r', 10:20, 10:20, 'b')`

19. Which of the following is correct about `dlmread`?

- A. `dlmread` reads numeric data and outputs it in a double array
- B. `dlmread` reads numeric data and text and outputs it in a cell array
- C. `dlmread` only reads comma delimited text files
- D. `dlmread` is not a Matlab function
- E. `dlmread` is used to open a saved Matlab workspace

20. You are given a sound 'awesome.wav':

```
[soundA, Fs] = wavread('awesome.wav');  
soundB =soundA( round(linspace(1,length(soundA),2*length(soundA)))));
```

What is the new sampling frequency that will cause `soundB` to sound the same as `soundA`?

- A.  $F_s/2$
- B.  $2 * F_s$
- C.  $F_s$
- D.  $-2 * F_s$
- E.  $F_s^2$

**Part 2 – Tracing Questions [30 Points]**

A. Consider the following script:

```
A = struct('Name', {'Mark', 'Paul', 'Lisa'}, 'Height', {66, 72, 50});
field = 'Height';
C = [];
D = {};
setfield(A(3), 'Weight', 150);
for dummy = 1:length(A)
    B = A(1);
    foundAt = 1;
    for index = 2:length(A)
        if A(index).(field) < B.(field)
            B = A(index);
            foundAt = index;
        end
    end
    C = [C B.Height];
    D = [D B.Name];
    A(foundAt) = [];
end
```

21. How many fields does the structure array `A` have?

- A. 1          B. 2          C. 3          D. 4          E. None of the above

22. After the code is run, what is `C(2)`?

- A. 72          B. 'Paul'          C. 50          D. 'Mark'          E. 66

23. After the code is run, what is `D(end)`?

- A. 72          B. 'Lisa'          C. 'Paul'          D. 'Mark'          E. []

24. What is `length(D)`?

- A. 0          B. 1          C. 2          D. 3          E. 4

25. What is the final value of the variable `dummy`?

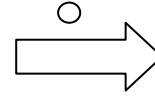
- A. 0          B. 1          C. 2          D. 3          E. `dummy` is no longer defined

B. 'Arrow.jpg' is a black and white 80 x 120 pixel picture shown below to the right. You are given the following script:

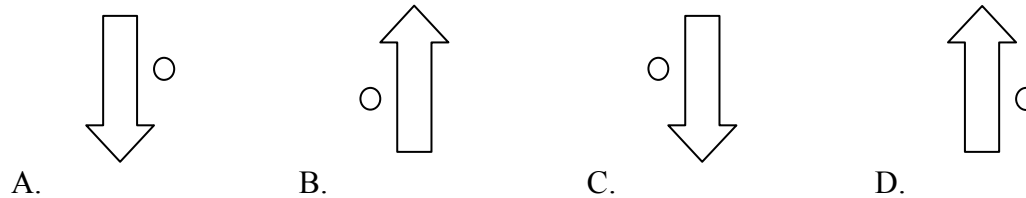
```

1   im=imread('Arrow.jpg');
2   im=double(im);
3   [r,c,l]=size(im);
4   im(1:r,1:c,3)=255;
5   for i = 1:3
6       A(:,:,i) = uint8(im(:,:,i)');
7   end
8   C = uint8(im(1:2:end,ceil(0.5:0.5:end),:));
9   x([1,2,3])=im(r,c,:);
10  for r1=2:3:r
11      for c2=2:3:c
12          im(r1-1:r1+1,c2-1:c2+1,:)=im(r1,c2,:);
13      end
14  end
15  im=uint8(im);

```



26. Which of the following images could represent image A?



E. None of the above

27. What is the size of image c?

- A. 240 x 40      B. 160 x 60      C. 40 x 240      D. 60 x 160

E. Not enough information given

28. What is the value stored in x?

- A. [0,0,255]      B. [255,255,255]      C. [0,0,0]      D. [255,0,0]      E. [0,255,0]

29. What do the pair of for loops starting in line 10 do to the image im?

- A. Shrink the width and height of the original image by 1/3  
 B. Set 9 x 9 blocks of pixels in the image to the same value  
 C. Make the image grayscale  
 D. Nothing – an error is produced  
 E. Nothing – no changes are made to the original image

30. What is the final color scheme of the arrow?

- A. Grayscale      B. Blue-tinted      C. Red-tinted      D. No change from original  
 E. None of the above

C. Consider the following code:

```
ca = {'donner', 1, 'prancer', 'rudolph', false, [1 0 0 1 0]};
r = 1;
A = [];
B = [];
C = [];
D = [];

while logical(double(ca{r})) == true
    if ischar(ca{r})
        if (sum(ca{r} == 114)) > 1 %hint: char(114) -> 'r'
            A = [A ca{r}];
        else
            B = [ca{r} B];
        end
    elseif length(ca{r}) >= r
        C = ca{r};
        C(r) = [];
    else
        D = sum([D ca{r}]);
    end
    r = r + 1;
end
```

31. What is the value of **A** after the code is run?  
 A. 'prancer'            B. 'donner'            C. 'rudolph'  
 D. 'donnerprancer'        E. None of the above
32. What is the value of **B** after the code is run?  
 A. 'rudolph'            B. 'donner'            C. 'prancer'  
 D. 'rudolphdonner'        E. 'donnerrudolph'
33. What is the value of **C** after the code is run?  
 A. [1 0 0 1 0]        B. [1 0 0 1]            C. [1 0 0 0]  
 D. []            E. None of the above
34. What is the value of **D** after the code is run?  
 A. 0            B. 1            C. 2            D. 3            E. 4
35. What is the value of **r** after the code is run?  
 A. 1            B. 4            C. 5            D. 6            E. 7

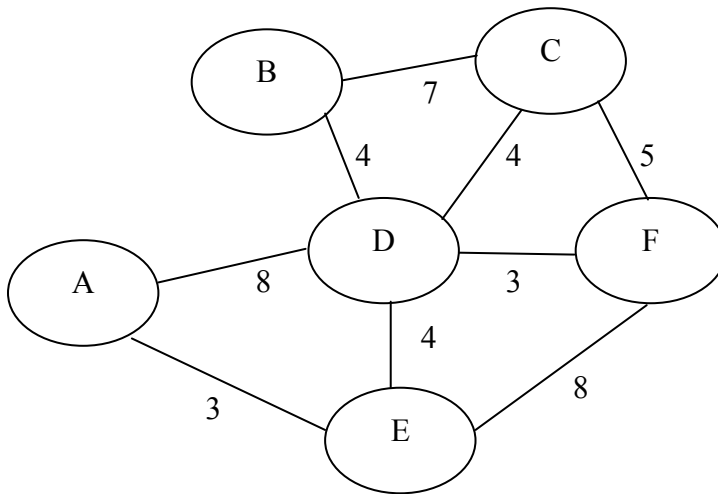
**Part 3 – Design Problem [20 Points]**

36. Given the following possible set of steps, construct Dijkstra's Algorithm (steps must be in the correct order). No step will be used more than once, but some steps may not be used at all. Write the sequence of letters below the list of steps

- A. End While.
- B. While the priority queue is not empty and a solution has not been found:
- C. Enqueue all nodes adjacent to the current node except for nodes in the history in the current path.
- D. Check if a solution has been found, if so return it.
- E. Pop the next element off the top of the stack.
- F. Push all nodes adjacent to the current node except for nodes in the history in the current path into the stack.
- G. Enqueue the starting node.
- H. Push the starting node into a stack.
- I. Dequeue the next element in the priority queue.

**Your answer here:**

37. Given the following graph with weighted edges:



**Use Dijkstra's Algorithm to compute the lowest cost path starting at A and ending at F using the weights given. You must show your priority queue and history, and cannot simply return the optimal solution.**

Your answer here:

**Part 4 – Coding Problems [40 Points]**

**You must complete ALL of the following coding questions. Your code should not exceed 7 lines for any individual question. These are NOT functions. A function header is NOT necessary.**

38. Write the code to plot the rotation the function  $f(x) = x + x^2$  around the x axis. The first few lines have been done for you.

```
u = linspace(0, 5);  
v = u + u.^2;  
th = linspace(0, 2*pi);  
[uu, tth] = meshgrid(u, th);  
[vv, tth] = meshgrid(v, th);
```

39. Given a vector  $v$ , write code that creates the following items (no hard coding!):
- $vecA$ , which contains all the elements of  $v$  which are greater than or equal to 4
  - $vecB$  which is  $v$  in reverse order
  - $vecC$ , which contains only the elements of  $v$  which are at odd indices
  - $D$ , which is the index of the minimum value in  $v$
  - $vecE$  which is a vector of length 5 with random values between 1 and 2.

40. You are given a sound of a piano playing a C-note – 'cNote.wav'. Write the lines of code to raise note this 1 whole step, and store it in the variable `dnote`. (Hint: the factor for 1 half step is  $2^{(1/12)}$ .)

41. Given vectors `x` and `y` of equal length containing x and y data values, please do the following:

- Compute the numerical derivative and store in the variable `deriv`
- Create a new x vector called `newx` with 800 values between `x(1)` and `x(end-1)`
- Compute a new y vector called `newy` using a spline interpolation of the derivative values for the values in `newx`
- Plot the derivative versus the original x values