1Georgia Institute of Technology
College of Computing
CS 1371 Computing for Engineers
Final Exam Version D - Spring Semester 2007

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 **WebCT 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:_____

TA / Section: _____

Prob.	Poss. Pts	Earned Pts	Lost Pts	Grader
(cover)	-	-		
1	20			
2	20			
3	20			
4	20			
5	20			
6	20			
7	20			
TOTAL	140			

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:

`diag(m)` – returns the diagonal elements of the matrix m

`factorial(n)` – returns n!

`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 to find newy, the values of the underlying function Y at the points in newx.

`iscell(a)` – checks if `a` is of class cell (a cell array)

`ischar(a)` – checks if `a` is of class char (a string)

`isempty(here)` – checks if `here` is null (usually represented by [], the empty vector

`(x/y/z)label(str)` – labels the plot axes with the given string

`length(a)` – largest dimension of a

`length(a)` – largest dimension of a

`magic(n)` – builds a n * n magic square

`max(a)` – value and index of the max value in a

`mesh(x, y, z)` – plot the surface defined by the x, y and z arrays with colored lines and white faces

`[xx, yy] = meshgrid(x, y)` – compute the plaid from the x and y vectors

`min(a)` – value and index of the min value in a

`mod(a, b)` – the remainder when a is divided by b

`mod(a, b)` – the remainder when a is divided by b

`ones(rows, cols)` – generate a matrix filled with 1

`p = polyfit(x,y,n) -` Finds the coefficients of a polynomial P(X) of degree N that fits the data

`y = polyval(p,x)` - Evaluates the polynomial p, at all points in x

`prod(v)` – compute the product of all the elements in a vector v

`sin(th)` – sin of the angle in radians

`size(a)` – all the dimensions of a

`sort(v)` – arranges the vector `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.

`sum(v)` – total all the elements in the vector v

`surf(x, y, z)` – plot the surface defined by the x, y and z arrays with colored faces and black lines

`title(str)` – titles the plot with the given string

`[x, fs] = wavread(file) -` gives the waveform and sampling frequency for a .wav file

`[x, y, z] = xlsread(filename)` - Returns the numeric, text and raw data respectively from an .xls file

`xlswrite(filename, array)` - Writes the array to the .xls file

`zeros(rows, cols)` – generate a matrix filled with 0

Problem 1 – Sorting [20 Points]

I. What does the Big-O of any algorithm represent?

_____
_____
__

II. Write out the Big-O of the following sorting algorithms:

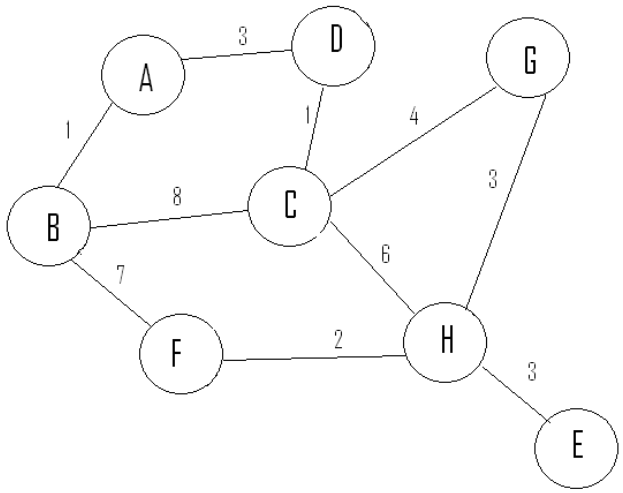
a. Insertion Sort: _____
b. Merge Sort: _____
c. Quick Sort: _____
d. Bubble Sort: _____

III. Sort the following vector using **Merge Sort**:

[9 1 18 20 5 8 2]

Problem 2 – Graphs [20 Points]

I. Point out one node, one edge, and one cycle in the graph below.



II. Use Dijkstra's algorithm to find the shortest path between **A** and **G** in the tree above. (You must show all your work to receive full credit).

Problem 3 – Plotting [20 Points]

I. Circle all of the following functions that can be used to plot a 3-dimensional surface in MATLAB.

A. `plot3(xx,yy,zz)`
B. `meshgrid(xx,yy,zz)`
C. `surf(xx,yy,zz)`
D. `mesh(xx,yy,zz)`

II. You want to plot a surface of rotation for z = f(x) around the x and z axes. Given the following commands:

```
v = linspace(1,10,50);
th = linspace(0,2*pi,36);
[vv tth] = meshgrid(v,th);
xx = vv;
rr = f(x);
yy = rr.*cos(tth);
zz = rr.*sin(tth);
surf(xx,yy,zz);
```

About which axis does this code make a surface of rotation? _____

III since it does not make sense to rotate it about the y axis, which of the following code blocks rotates f(x) about the other axis (circle the right answer)?

A:
```
xx = f(vv);
rr = vv;
yy = rr .* cos(tth);
zz = rr .* sin(tth);
surf(zz, yy, xx)
```

B:
```
xx = vv;
rr = f(vv);
yy = rr .* cos(tth);
zz = rr .* sin(tth);
surf(zz, yy, xx)
```

C:
```
xx = f(vv);
rr = vv;
yy = rr .* cos(tth);
zz = rr .* sin(tth);
surf(xx, yy, zz)
```

D:
```
xx = vv;
rr = f(vv);
yy = rr .* cos(tth);
zz = rr .* sin(tth);
surf(xx, yy, zz)
```

IV. Write the proper commands to make the plot above *smooth* and add appropriate titles and labels.

Problem 4 – Images/Sounds[20 Points]

I. Consider the following "image" (assume it is a perfect square), saved under the file 'mysquare.jpg':

1	2
3	4

And the following code:

```
b = imread('mysquare.jpg');
[n,m,l] = size(b);
a = b(1:end, 1:n/2, :);
c = b(1:end, (n/2 + 1):end, :);
b = [c; a];
image(b);
```

Which of these will the picture shown on the last line most resemble?

A.

3	4
1	2

B.

2	1
4	3

C.

1
2
3
4

D.

2
4
1
3

II. Given the file 'soundtest.wav', the following commands are executed in MATLAB:

```
[x fs] = wavread('soundtest.wav');
L = length(x);
```

The time duration in seconds of 'soundtest.wav' is:

A. fs*L/(L+1)
B. fs/L
C. L/fs
D. L*fs
E. fs*L/(fs+1)

III. Given an image file called 'american_flag.jpg' in which the colors are only red, white, and blue:

```
af = imread('american_flag.jpg');
[r1,c1] = find(af(:,:,1) == 255 ...
            && af(:,:,2) == 0 ...
            && af(:,:,3) == 0);
[r2,c2] = find(af(:,:,1) == 0 ...
            && af(:,:,2) == 0 ...
            && af(:,:,3) == 255);
[r3,c3] = find(af(:,:,1) == 255 ...
            && af(:,:,2) == 255 ...
            && af(:,:,3) == 255);
af(r1,c1,:) = 0;
af(r2,c2,:) = 255;
af(r3,c3,2:3) = 0;
image(af)
```

What happens in the resulting image?

A. The red sections become white, the blue sections become red, and the white sections become blue.
B. The white sections become red, the red sections become blue, and the blue sections become white.
C. The blue sections become red, the red sections become blue, and the white sections become black.
D. The blue sections become white, the red sections become black, and the white sections become red.

IV. The `fft()` function is used to analyze and convert the signal from:

A. Frequency domain to time domain
B. Time domain to frequency domain
C. Amplitude domain to power domain
D. Power domain to amplitude domain

Problem 5 – Vector Manipulations/Functions [20 Points]

Given the following function:

```
1     function [A B] = blackbox(input)
2     L = length(input)
3     A = []
4     B = 0
5     for ind = 1:L
6         if ischar(input{ind})
7             A = [A input(ind)]
8         elseif isnumeric(input{ind})
9             B = 0 + input{ind}
10        end
11    end
```

The following code is executed in MATLAB:

```
TEST1 = {'ES&T', [98 1 27], 'Woodruff', 'Smith', 1000, [-2]}
[A B] = blackbox(TEST1)
```

I. What is stored in the variable `A` after the code has been run?

II. What data type is `A`?

III. What is stored in `B` after the code has been run?

IV. If line 7 were changed to the following, what now would be stored in `A`?

```
A = [A input{ind}];
```

V. What is the data type of `A` now (after the change in line 7)?

Problem 6 – Structure Arrays [20 Points]

I. Which of the following are valid function headers? (Circle all that apply)

A. `function ret = myFunction(X)`
B. `function myFunction (X)`
C. `function = myFunction (X)`
D. `function myFunction (234)`
E. `function ret = myFunction()`

II. Read the code below and answer the questions that follow:

```
TA_List(1) = struct( 'Name', 'Shardul', 'Major', 'EcE', ...
     'Experience', 6)
TA_List(2) = setfield( TA_List(1), 'Experience', 4)
TA_List(2).Name = 'Ankit'
TA_List(3) = TA_List(1)
setfield( TA_List(3), 'Major', 'ME')
setfield( TA_List(3), 'Name', 'Tauhira')
rmfield( TA_List, 'Major')
TA_List(3).Age = 20
A = isfield( TA_List(1), 'Age')
[B, C] = size (getfield (TA_List(2), 'Name'))
D = TA_List(3).Name
E = fieldnames(TA_List(1))
```

What are the values of the following variables?

A:

B:

C:

D:

E:

Problem 7 – Miscellaneous [20 Points]

I. You are given the following linear equations:

```
x - 3y = 1
3x - y = 2
```

Now let's say you wanted to solve the equations simultaneously using MATLAB and store the solution vector in the variable named `solution` using the following code:

```
solution = unknown1\unknown2;
```

How must the variables `unknown1` and `unknown2` be defined in order to get the correct solution?

A. `unknown1 = [1 -3; 3 -1]; unknown2 = [2;1];`
B. `unknown1 = [2;1]; unknown2 = [1 -3; 3  1];`
C. `unknown1 = [3 -1; 1 -3]; unknown2 = [2;1];`
D. `unknown1 = [1;2]; unknown2 = [1 -3; 3 -1];`
E. `unknown1 = [1 -3; 3 -1]; unknown2 = [1 2];`

II. The following code is executed in MATLAB:

```
ca = {'abcd', 12, true, 37, pi}
x = ca(2)
```

What is the final value of the variable `x`?

A. `<1x1 struct>`
B. `12`
C. `[<1x1 struct>]`
D. `[12]`
E. None of the above

III. Given:

```
x = {2, 4, 6, 8, 10};
final = 0
for index = 1:length(x)-1
        <line of code goes here>
end
```

Which of the following lines of code will have final equal to 80 after the code above is executed in MATLAB?

A. `final = final + (x(index) * x(index+1))`
B. `final = final + (x{index} * x{index+1})`
C. `final = x(index) * x(index+1)`
D. `final = x{index} * x{index+1}`
E. None of the above

IV. Which of the following correctly define(s) the time domain axis for the following imported sound file?

```
[data fs] = wavread('foo.wav');
n = length(data);
```

A. `timedomain = 0:1/n:n/fs;`
B. `timedomain = 0:1/fs:n;`
C. `timedomain = 1/fs:1/fs:n/fs;`
D. `timedomain = 0:n*fs;`
E. `timedomain = 0:n/fs:n;`

This page intentionally left blank for any extra work.