1Georgia Institute of Technology
College of Computing
CS 1371 Computing for Engineers
Final Exam Version M - Fall Semester 2006

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	10			
2	20			
3	20			
4	20			
5	20			
6	20			
7	20			
8	20			
TOTAL	150			

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 - Computing [10 Points]

Match the terms described below to the statements further below:

A. Ethernet connection	**B. Processor**	**C. RAM memory**	**D. Disk storage**
E. Printer	**F. Monitor**	**G. Keyboard**	**H. Sound System**

1. __"I'm the real brain of the computer—the part that does computation and comparisons."

2. __ "I'm the part of the computer that takes in digital data and turns that into voltages that go to the speaker."

3. __ "Plug a cable into me and you can use me for reaching the Internet, other computers, printers, and other resources."

4. __ "I'm where the computer stores short-term data—when the power stops, I forget everything."

5. __ "I'm an input device—users can enter text into the computer through me."

6. __ "I'm your main output device—it's where graphical information is displayed."

7. __ "I'm a secondary output device—I take digital data and convert it to marks on paper."

8. __ "I'm where the computer stores longer-term data—I'm where data gets stored that's to last even when the power is turned off."

Problem 2 – Sorting [20 Points]

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

_____
_____
__

II. Write out the Big-O (algorithm efficiency) of the following sorting algorithms:

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

II. Sort the following vector using Quick Sort:

[9 1 18 20 5 8 2]

Problem 3 – Images/Sounds [20 Points]

1. 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,c1,1) = 0;
af(r2,c2,1) = 255;
af(r1,c1,3) = 255;
af(r2,c2,3) = 0;
af(r3,c3,:) = 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.

2. You are given the following code:

```
[snd, Fst] = wavread('Sound.wav');
```

Which of the following lines of code will play an amplified version of Sound.wav

```
A. sound(snd, Fst*3);
B. sound(snd(round(1:half^2:end)), Fst)
C. sound(snd*3, Fst);
D. z= fft(Snd)
   z(1:floor(length(z)/2)) = 255;
   sound(ifft(z), Fst);
```

3. 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.

3
4
1
2

4. Consider this code that reads in an image saved as 'myimage.jpg':

```
b = imread('myimage.jpg');
[m,n,l] = size(b);
count = 0;
for i = 1:m
  for j = 1:n
     if (  <A>  (double(b(i, j, <B> ))) == <C>
           count = count + 1;
     end
  end
end
```

Which of the following could you put in the places of <A>, <B> and <C> to give you the number of completely white pixels in the image?

```
A.   <A>: any     <B>:  j       <C>: 255
B.   <A>: all     <B>:  :       <C>: 255
C.   <A>: sum     <B>:  :       <C>: 255
D.   <A>: sum     <B>:  j       <C>: 765
E.   <A>: sum     <B>:  :       <C>: 765
```

Problem 4 – Vector Manipulations [20 Points]

Answer the following questions with regard to vector manipulations:

1. Which of the two commands produces an error (if any)? If so, explain why.

```
a)  cat = [1 2 3 4 5 6];
    dog = [1 2 3 4 5];
    cat(dog > 3)

b)  cat = [1 2 3 4 5 6];
    dog = [1 2 3 4 5];
    cat(find(dog < 3))
```

ANSWER: _____

2.
```
pie = [1 2 3 4 5]
z = pie(pie < 4);
y = pie([1 1 1 0 0])
```

"z and y produce the same result"
Is this statement true or false? If false, why?

ANSWER: _____

3.
```
salt = [1 9 2 8 3 7 4 6];
pepper = find(salt < 7);
curry = pepper(end:-1:1);
teehee = salt(curry)
```

What are the contents of **teehee**?

ANSWER: _____

4.
```
chocolate = [9 8 7 6 5 4 3 2 1 0];
vanilla = [1 2 3 4 5 6 7 8];
ice_cream = chocolate(mod(chocolate,2) == 0);
ice_cream = [ice_cream, vanilla(2:2:end)];
```

What are the contents of **ice_cream**?

ANSWER: _____

Problem 5 – Plotting [20 Points]

1. 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)
```

2. You want to plot a surface of rotation for $y = -5x^4 + 2x^2 - 9x + 13$ 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);
```

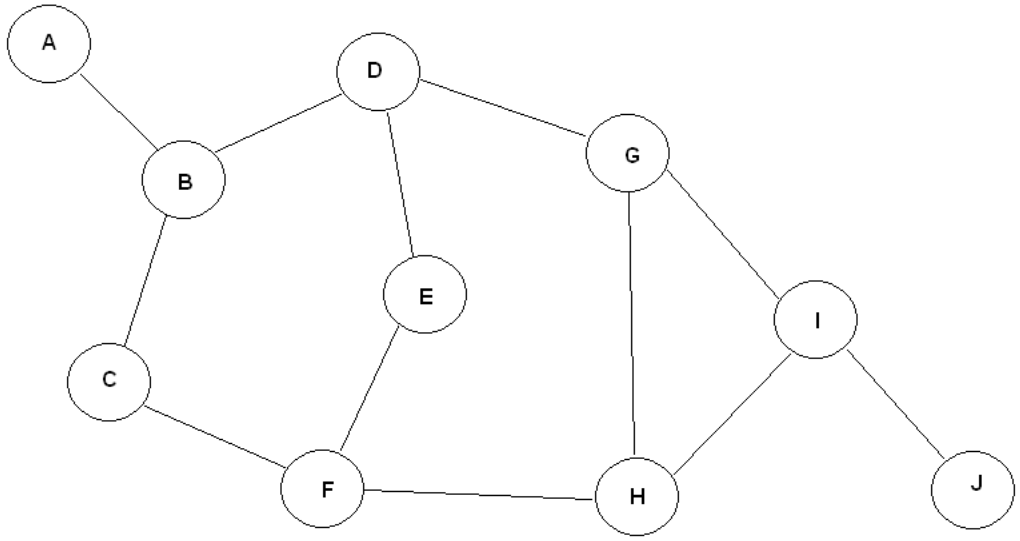
About which axis does the following code make a surface of rotation? _____

```
rr = vv;
xx = rr.*cos(tth);
yy = rr.*sin(tth);
zz = -5rr.^4 + 2*rr.^2 - 9*rr + 13;
surf(xx,yy,zz);
```

3. Write the commands that will make a rotational surface of this function around the other axis.

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

Problem 6 – Graph Traversal [20 Points]



Starting with node A and ending at node J, perform a Breadth First Search on the given graph. Visit adjacent nodes in alphabetical order. Show your work in the space below.

Final Path: _____

Problem 7 – Miscellaneous [20 Points]

1. You are given the following information:
   A = true
   B = false

Evaluate:

i) (A && B) || (A && B)

_____

ii) (A || B) && (A || B)

_____

iii) (~(A || B)) || (A && B)

_____

2. Ackermann's Function is "a function to end all functions."
The work done by the function ack grows much faster than polynomials or exponentials.
Given the following recursive method:

```
function ret = ack(x,y)
     if (x == 0)
          ans = y + 1;
     elseif (y == 0)
             ans = ack(x - 1, 1);
     else
             ans = ack(x - 1, ack(x, y - 1));
      end
```

What is the result of `ack(1, 4)`?

_____

3. Given a vector of coefficients a, mark the code fragments below that will evaluate the following function for a single value of x (not a vector):

$$y = a(1) + a(2) * x + a(3) * x^2 + ... a(n) * x^{n-1}.$$

A.
```
polyval(x, a)
```

B.
```
n = 1:length(a)

  a(n) * x.^(n-1)'
```

C.
```
polyval(a, x)
```

D.
```
polyval(a(end:-1:1), x)
```

4. Which of the following correctly solves for X in the equation AX = B, knowing that A is a 4x4 matrix of known values, B is a 4x1 column vector of known values, and X is a 4x1 column vector of unknown values?

```
A. X = inv(B)*A
B. X = B\A
C. X = inv(A)*B
D. X = A/B
```

Problem 8 – Structures [20 Points]

The following code is run in Matlab:

```
honda1 = …
struct('model','S2000','exterior','silver',‘spoiler',wing');
honda1.interior = 'red';
honda2 = …
struct('model','Accord','exterior','grey','spoiler','none');
honda2 = setfield(honda2, 'interior', 'tan');
honda1.exterior = 'white';
honda3 = setfield(honda1, 'interior', 'tan');
honda3 = rmfield(honda3, 'spoiler');
honda4 = honda2;

A = isstruct(honda3)

B = honda1.exterior

C = isfield(honda4, 'spoiler')

D = honda2.model

E = getfield(honda1, 'spoiler')
```

What are the values of `A`, `B`, `C`, `D`, and `E`?

A = _____

B = _____

C = _____

D = _____

E = _____