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- 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:

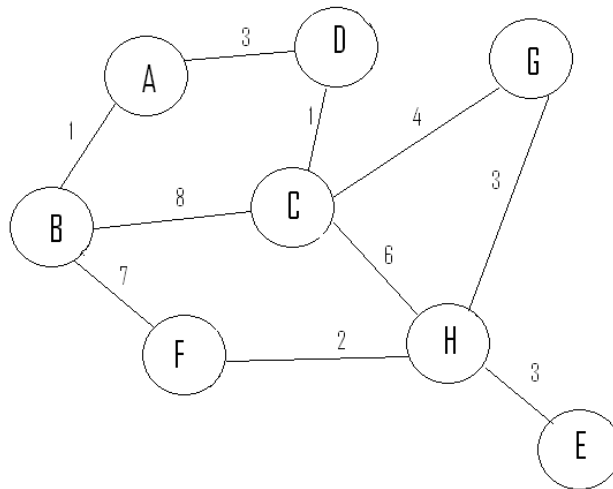
- a. Insertion Sort: _____
- b. Merge Sort: _____
- c. Quick Sort: _____
- d. Bubble Sort: _____

II. Sort the following vector using Merge Sort:

[9 1 18 20 5 8 2]

Problem 3 – Graphs [20 Points]

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



2. Use Dijkstra's algorithm to find the quickest path between A and G in the tree above.

Priority Queue	Dequeued Paths

Problem 4 – 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 $y = -x^3 + 5x^2 - 21x + 43$ 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? _____

```
xx = vv;  
rr = -xx.^3 + 5*xx.^2 - 21*xx + 43;  
yy = rr.*cos(tth);  
zz = rr.*sin(tth);  
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 5 – Images/Sounds[20 Points]

1. 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

2. Given the file *soundtest.wav*, the following commands are executed:

```
[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. $fs * L / (fs + 1)$

3. 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.

4. 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 6 – Vector Manipulations/Matrices [20 Points]

1. Consider the following code:

```
earth = linspace(10,20,10)
earth_age = length(earth)
water = floor(earth)
fire = abs(water.*length(earth))
air = sum(find(earth==19))
heart = islogical(isnumeric(air, 'double'))
```

What are the values of the following variables:

(If you think that the expression will give an error, write 'error' as the answer)

earth_age: _____

water: _____

fire: _____

air: _____

heart: _____

2. Given:

$$3x + 4y + 3z = 10$$

$$2x + 5y + z = 12$$

$$x + y + z = 5$$

Write the code to solve the above system of equations.

Problem 7 – Miscellaneous [20 Points]

1. List the three conditions required for a function be recursive:

- 1.
- 2.
- 3.

2. Which one(s) evaluate to a logical(boolean) 'true' ?

- I. $(5 > 4) \& ((8 + 4) < 11)$
- II. $\sim((6 + 4 * 3) > 20)$
- III. $\sim((4 \sim= 4) | (\sim(6 < (4 * 2 / 8 + 4))))$

- A. I only
- B. II only
- C. III only
- D. I and III
- E. II and III

3. If the following command is typed in the Matlab command window, what is returned?

`>> 4%2`

- A. error
- B. 2
- C. 4
- D. 0

4. You have x-data and y-data points which best fit a 4th order polynomial. You now want to evaluate the same polynomial at different x-data points. Which function(s) will you need to obtain the above?

Problem 8 – Cell Arrays/Recursion [20 Points]

Given the following two functions:

```
function y = cellfunc_1(x, d)

if d == 0
    y = x;
else
    y = cellfunc_1( {x}, d-1 );
end

-----
function y = cellfunc_2( x )

if ~iscell(x)
    y = x;
else
    y = cellfunc_2( x{1} );
end
```

What are the results of the following function calls?

```
A = [1,5,7];
B = cellfunc_1(A,0);
C = cellfunc_1(B,3);
D = cellfunc_2(C);
E = cellfunc_2(D);
```

B = _____

C = _____

D = _____

E = _____

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