CDS130 Final exam (PART I)

The final exam consists of two sections. The first section is a closed-book paper exam (60 minutes); and the second section involves use of Matlab on the computer (90 minutes). The following part is the first section of the exam.

- Be sure your exam booklet has 7 pages for this section.
- Write your name at the top of each page.
- This is a closed book exam, but you are permitted to read your study guide.
- All computational commands and statements appearing in this exam are specifically referring to the Matlab programming language taught in class.
- You may not use Matlab on the computer during this section.
- Absolutely no interaction between students is allowed.
- You are not allowed to search the internet.
- Each question is worth 5 points. Partial credit may be awarded ONLY if work is shown.
- Duration for this section: 60 minutes (1:30am – 2:30am).

(If you are done with this section, you may proceed to work on the second section of the exam).

Q1. Colors can be specified by RGB triples in Matlab. For example, the red, green, yellow colors
can be represented by

```
Red = [1, 0, 0];
Green = [0,1,0];
Yellow = [1, 0, 1];

NewColor = Red | Green  &  Yellow
```

What is the color of the combination of the Red, Green, Yellow colors specified above? i.e., what is the color of NewColor?

(A) Black
(B) Red
(C) Green
(D) Yellow
(E) None of the above

Q2. What is the output of executing the following Matlab code?

```
clear all; clc;
A(3)=3;
for i=3:6
  A(i)=A(i-1)+ A(i-2) +7;
end
A
```

Q3. Identify the parts of this program that are repeated. Write a shorter version of the program to the left using a for-loop.

```
a = 0;
z = a+1;
a = z+1;
q = a+z;
z = a+1;
a = z+1;
q = a+z;
z = a+1;
a = z+1;
q = a +z;
q = q*q;
```

Answer:

Q4. Write some lines of code that use nested for loops to produce a 5 by 5 (square) matrix A .

The matrix should look like this:

```
0     1     2     3     4
2     3     4     5     6
4     5     6     7     8
6     7     8     9     10
8     9     10    11    12
```

Q5. What is the result of running the following Matlab code:

```
clear all; clc;
M = [ 1  2  -3  0  4  5  0  -7 ;
      -3  4  -1  7  3  2  9   5 ;
       0  0   0 -1  1 -2  2  -3 ];

counter = 0;
for i = 1:3
  for j = 1:8
    if  M(i,j) > 0
        counter = counter + 1;
    elseif M(i,j) == 0
         counter = counter -1 ;
    end
  end
end
counter
```

Answer____

Q6. Given the following Matlab code,

```
k= 0;
n = 0;
while  2*k +1 > k^2
      n = n +1;
      if  mod (n,2)
            k = k + 1;
      end
end
k
n
```

What are the values of k and n after executing the code ?

Q7. A matrix was generated using

M = rand(5);

Which of the following statements is **not** valid in Matlab? (list all correct answers)
(A) M^2
(B) M(:, 1)'
(C) sin(M)
(D) exp(M)
(E) M(1:3 , :)^2
(F) M(6)
(G) M .* M / 2

Q8.What is the result of running the matlab code?

```
clear all;
a = 1:0.5:2;
b = 2:-0.5 :1;
c = a > b > 0.5;
sum (c )
```

Q9. Images in Matlab are represented by matrices. In order to properly display the image with desired colors, a color map is needed (for indexed images). Given a matrix

$M = \begin{pmatrix} 1 & 5 & 7 \\ 9 & 3 & 6 \\ 5 & 8 & 2 \end{pmatrix}$ with the following Matlab code:

```
clear all;  clc;
M=[1, 5, 7; 9, 3, 6; 5, 8, 2];
image(M);
A=[M/10; M/10];
colormap(A);
axis square off
```

Which of the following statements is most likely correct?

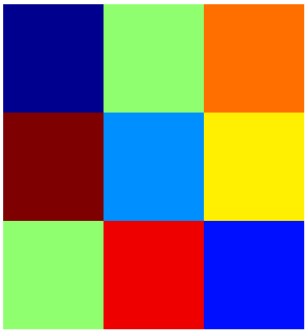
(A) No image will be produced, because the colormap is not properly assigned.

(B) The following image will be produced:

(C) The following 3-color image will be produced:

(D)The following 9-color image will be produced:

((E) The following image will be produced:

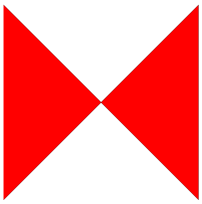


Answer: _____

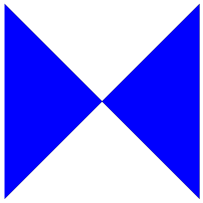
Q10. The 'fill' command can be used to plot polygons with filled colors. Which plot will be generated by executing the following command lines?

```
clear;
fill([0, 0, 1, 1], [0,1, 1, 0], [0,0,1]);
axis square off;
```

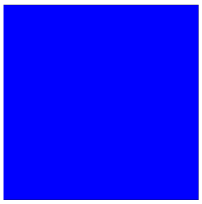
(A)



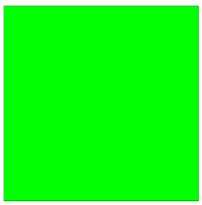
(B)



(C)



(D)



Answer:

Sample: CDS130 Final exam (PART II)

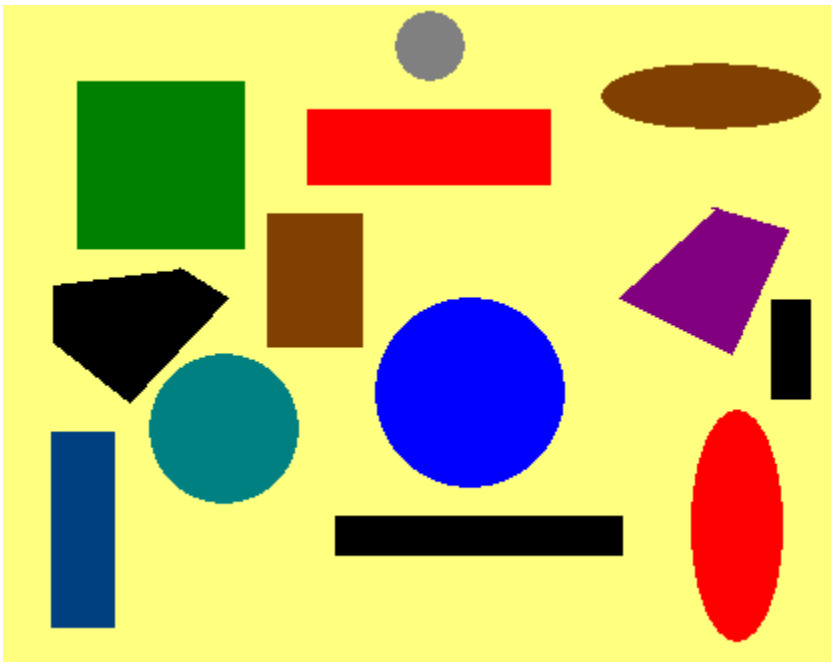
The final exam consists of two sections. The first section is a close-book paper exam (60 minutes); and the second section involves use of Matlab on the computer (90 minutes). The following part is the second section of the exam.

- You are required to use Matlab to solve the problems.
- Absolutely no interaction between students is allowed.
- Partial credit may be awarded ONLY if work is shown.
- Turn in your Matlab code and final answer to each question on scracth paper
- Duration for this section: 90 minutes (2:30am – 4:00 am).

Q1. (10 points) Run the following matlab code, and you will obtain an image as follows.
(1) Write a matlab to calcualte the ratio of the areas covered by the red color and the black color.

(2) Change the color of the yellow area to white, and display the image. Provide your matlab code to do so.

```
clear all, clc;
M = imread('http://cds130.org/wiki/images/exam.png');
[A,map] = rgb2ind(M,10)
image(A);
colormap(map);
colorbar;
[m, n] =size(A); % m and n correspond to the size of the image matrix.
```



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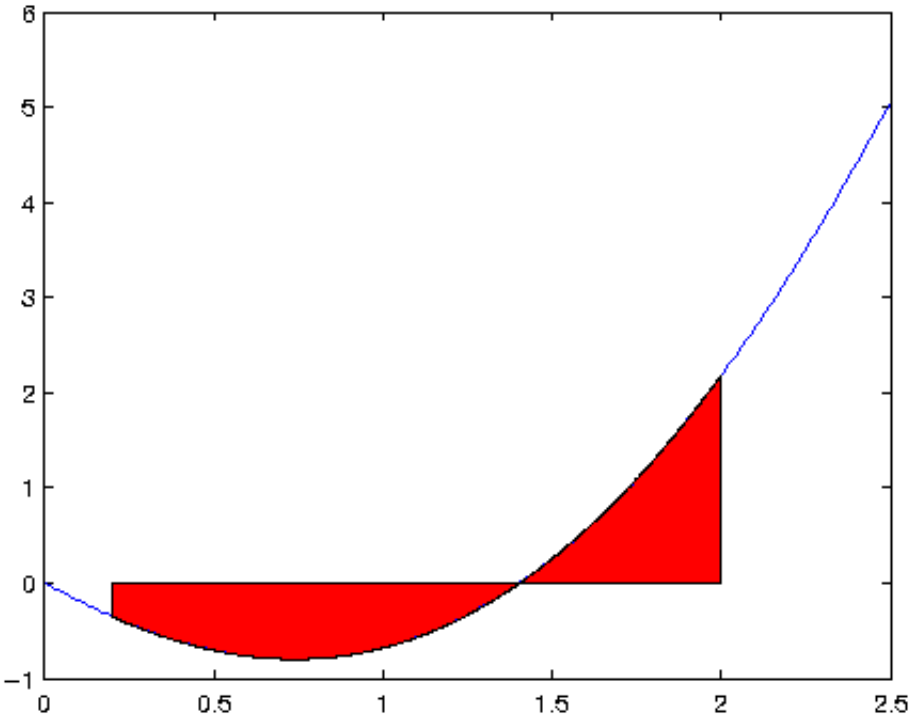
Q2. (10 points) Write a MATLAB code that draws a 32-by-32 checkerboard with red and green tiles (Provide your matlab code).

Q3. (10 points) Write a Matlab computational code to compute the result of the following formula. You need to provide the matlab code and the final answer of s using x = 5.

$$s=\frac{1}{x}+\frac{1}{x^2}+\frac{1}{x^3}+\frac{1}{x^4}+\ldots+\frac{1}{x^{100}}$$

Q4. (10 points) Given a mathematical function $f(x)=x^2-2\sin(x)$, write matlab codes to:
(1) plot the shaded area (as shown in the following figure) from x=0.2 to x = 2.0

(2) calculate the red area underneath the curve from x=0.2 to x = 2.0



Answer:

Q5 (10 points) Suppose a colony of 500 bacteria is multiplying at the rate of r = 0.8 per hour per individual (i.e., an individual produces an average of 0.8 offspring every hour). After 10 hours (i.e, at the beginning of the 11^{th} hour), bacteria run out of nutrient and begin to die. Assuming the bacterial death rate at this stage is 1.2 (and the multiplication process continues),

(1) predict the number of bacteria at different hours, and report the number of bacteria at 15^{th} hour.

(2) plot the predicted number of bacteria as a fuction of time (hour).