CS1112 (CIS 1121) Spring 2009 Prelim 1 Feb 19 7:30–9:00pm

Name: _____
(Legibly print last name, first name, middle name)

NetID: _____

Statement of integrity:
I did not, and will not, violate the rules of academic integrity on this exam.

_____ (Signature)

Q1: (20)	_____	____
Q2: (10)	_____	____
Q3: (20)	_____	____
Q4: (20)	_____	____
Q5: (30)	_____	____
Total: (100)	_____	____

Circle your lecture time: 9:05 or 11:15

Circle your section instructor's name:

	Tuesday	***Wednesday***
10:10		Utkarsh Prateek
11:15		Tim Condon
12:20	Stefan Ragnarsson	Tim Condon
1:25	Stefan Ragnarsson	Myle Ott
2:30	Josef Broder	Myle Ott
3:35	Josef Broder	Myle Ott
7:30		Vivek Maharajh
8:35		Vivek Maharajh

Instructions:

- This is a 90-minute, closed-book exam; no calculators are allowed.
- The exam is worth a total of 100 points, so it's about one point per minute!
- Read each problem completely, including any provided code, before starting it.
- Raise your hand if you have any questions.
- Use the backs of pages or ask for additional sheets of paper as necessary.
- Clarity, conciseness, and good programming style count for credit.
- If you supply multiple answers, we will grade only *one*.
- Use only MATLAB code. No credit for code written in other programming languages.
- Assume there will be no input errors.
- **Do not use arrays. Do not write user-defined functions.**
- Do not use `switch`, `try`, `catch`, or `break` statements.
- You may find the following MATLAB predefined functions useful:
  `abs`, `sqrt`, `rem`, `rand`, `floor`, `ceil`, `input`, `fprintf`, `disp`

Examples:
`rem`(5,2) → 1, the remainder of 5 divided by 2
`rand`(1) → a random real value in the interval (0,1)
`floor`(6.9), `floor`(6) → 6, rounds down to the nearest integer
`ceil`(8.1), `ceil`(9) → 9, rounds up to the nearest integer

Question 1: (20 points)

Part (a): (12 points)

Suppose the following fragment has been executed:

```
% The first interval  [a1,b1] has these endpoints:
a1 = rand(1);  b1 = a1+rand(1);
% The second interval [a2,b2] has these endpoints:
a2 = rand(1);  b2 = a2+rand(1);
% Assume a1, b1, a2, and b2 are unique.
```

(i) Complete the following fragment so that it prints 'Yes' if the second interval is inside the first interval and 'No' otherwise.

```
if ________________________________________________
    disp('Yes')
else
    disp('No')
end
```

(ii) Complete the following fragment so that it prints 'No' if the the intervals fail to intersect and 'Yes' otherwise.

```
if ________________________________________________
    disp('No')
else
    disp('Yes')
end
```

Part (b): (8 points)

Write the loop condition below so that the fragment keeps prompting the user to enter a number until the value entered is positive and is a multiple of 3 or 5.

```
n = input('Enter a number: ');

while  ____________________________________________

   n = input('Enter a number: ');

end
```

Question 2: (10 points)

Part (a): (3 points)

What is the last line of output after executing the following fragment?

```
x = 2;
y = x*3;
while  x<=6 && y<=6
    x = x + 2;
    disp(x)
end
```

Answer:

Part (b): (7 points)

The following fragment calculates and displays the first few Fibonacci numbers. When the fragment finishes execution, which Fibonacci nubmers are stored in variables `f_old`, `f_cur`, and `f_new`? You can, but don't have to, evaluate the Fibonacci numbers. For example, you can write f_4 instead of its value 3.

```
n = 2;
f_old = 1    % f(1)
f_cur = 1    % f(2)
for n = 3:5
    f_new = f_old + f_cur
    f_old = f_cur;
    f_cur = f_new;
end
```

f_old: f_cur: f_new:

Question 3: (20 points)

A certain bacteria has a growth rate that is dependent on the ambient temperature. At or below 32^oF, there is no growth. Above 32^oF the growth rate follows the formula

$$aT^2 + b$$

where T is ambient temperature in ^{o}F, and $a = 0.01$ and $b = -10$ are model parameters. When the temperature is very high, above 90^oF, the rate estimated by the above formula must be corrected by a reduction of 10%.

Complete the frament below to compute and display the growth rate.

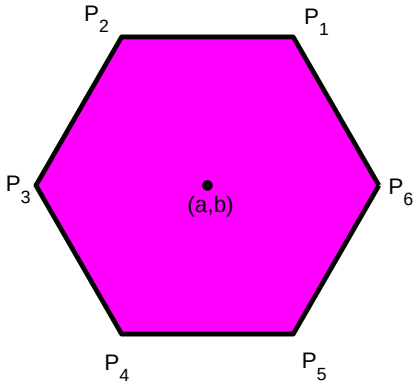
```
T = input('What is the temperature? ');

% Calculate and display the growth rate of the bacteria
```

Question 4: (20 points)

A *unit hexagon* centered at (a, b) has vertices

$$
\begin{array}{rcl}
P_1 & : & (a + \Delta_x, b + \Delta_y) \\
P_2 & : & (a - \Delta_x, b + \Delta_y) \\
P_3 & : & (a - 1, b) \\
P_4 & : & (a - \Delta_x, b - \Delta_y) \\
P_5 & : & (a + \Delta_x, b - \Delta_y) \\
P_6 & : & (a + 1, b)
\end{array}
$$



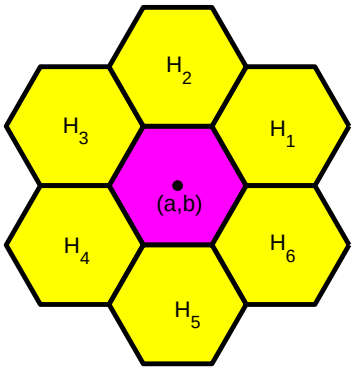
where $\Delta_x = 1/2$ and $\Delta_y = \sqrt{3}/2$. Assume that the function `DrawHex(a,b)` adds to the figure window a unit hexagon with center at (a, b).

We say that a unit hexagon is "good" if it is entirely inside a square with vertices (0,0), (10,0), (10,10), and (0,10). Write a program fragment to randomly choose points from a square with vertices (0,0), (10,0), (10,10), and (0,10)—each coordinate is uniformly random in the interval (0,10). Whenever there is a point that can be the center of a *good* hexagon, draw the hexagon. Your fragment should draw exactly 100 good hexagons. Do not write code to set up the figure window and axes.

Question 5: (30 points)

A unit hexagon has six unit hexagon neighbors with these centers

$$
\begin{array}{rcl}
H_1 & : & (a+3\Delta_x, b+\Delta_y) \\
H_2 & : & (a, b+2\Delta_y) \\
H_3 & : & (a-3\Delta_x, b+\Delta_y) \\
H_4 & : & (a-3\Delta_x, b-\Delta_y) \\
H_5 & : & (a, b-2\Delta_y) \\
H_6 & : & (a+3\Delta_x, b-\Delta_y)
\end{array}
$$



where $\Delta_x = 1/2$ and $\Delta_y = \sqrt{3}/2$. Assume that the function `DrawHex(a,b)` adds to the figure window a unit hexagon with center at (a, b).

Complete the fragment below to draw K columns of a "slanted" bee hive. Each column is made up of n unit hexagons. Center the top left hexagon on the origin (0,0). An example with 5 hexagons in each of 3 columns is shown below. Do not write code to set up the figure window and axes.

```
n = input('How many hexagons in each column? ');
K = input('How many columns? ');

% Draw a slanted bee hive with n hexagons in each
%  of K columns
```