Assignment #4
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Question #1

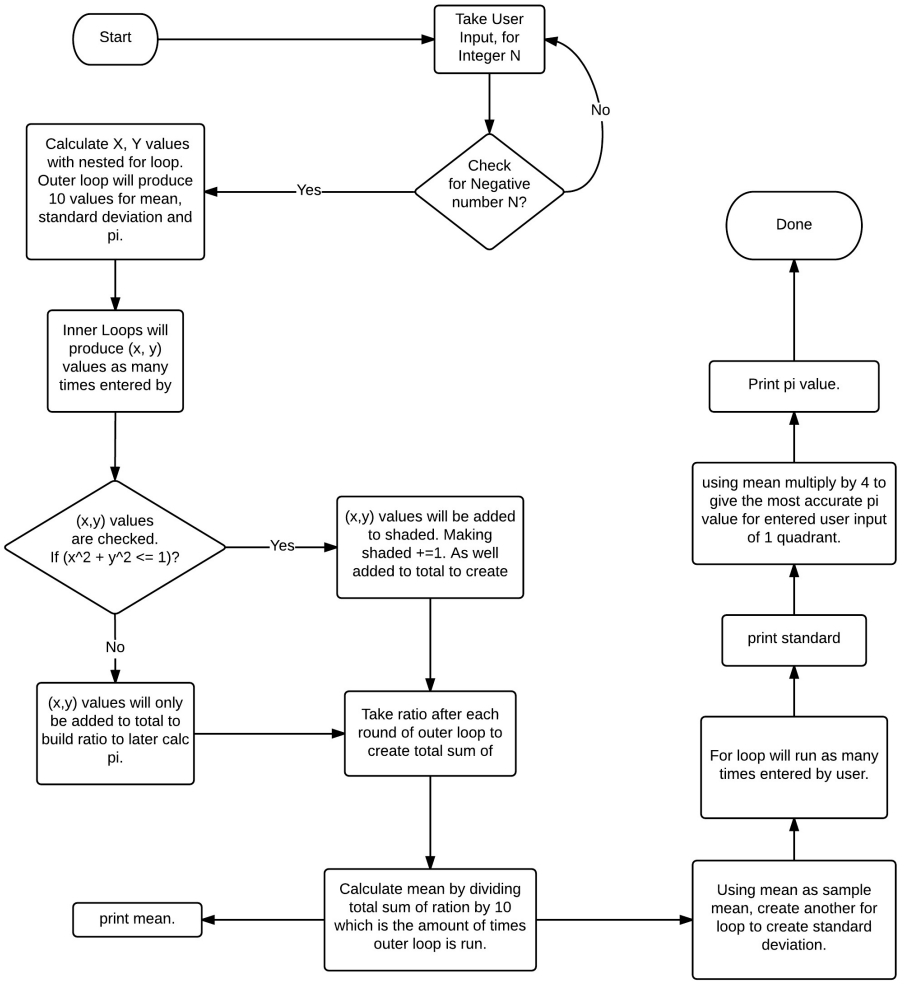
Code:

```
#include <stdio.h>
#include <stdlib.h>
#include <time.h>
#include <math.h>
#define TRUE 0
#define FALSE 1

int main(){
    //declare variables
    int n;
    int flag;
    //total x,y values and amount of x,y values in shaded region
    float total = 0.0;
    float shade = 0.0;

    //do-while statment to check if user input is a positive integer
    do {
        printf("Enter N: \n");
        scanf("%d", &n);
        if (n < 0) {
            printf("Invalid Entry, Try Again..\n");
            flag = 1;
        }else flag = 0;

    } while (flag == 1);

    /*
     using time to create constant to define srand() function which will
     initizialize rand() function and create different numbers each time
     */
    time_t t;
    srand((unsigned) (time(&t)));

    float x = 0.0, y = 0.0;
    float pi = 0.0;
    float ratio = 0.0;
    float mean = 0.0;
    float std_dev = 0.0;
    //X and Y value loop which will calculate ratio and mean 10 times
    for (int i = 0; i < 10; i++) {
        //inner loops will calculate the x and y values based on input from user
        for (int i = 0; i < n; i++) {
            float k = (rand() % 100);
            k = k/100;
            x = k;

            for (int i = 0; i < n; i++) {
```

```
                float k = (rand() % 100);
                k = k/100;
                y = k;
            }
            //if statement to count the valid values in shaded region and total values
            if ((x*x)+(y*y) <= 1) {
                shade++;
                total++;
            }else
                total ++;
        }
        ratio = (shade / total);
        printf("Values: %f\n", ratio);
        mean += ratio;

    }
    //Standard Deviation For-Loop
    for (int i = 1; i <= n; i++) {
        int s = n;
        std_dev = ((i - mean)/s);
    }
    //standard deviation square rooot
    std_dev = sqrtf(std_dev);
    //mean calculation
    mean /= 10;
    //ration calculation
    ratio = (shade / total);
    //most accurate pi calculation within in 1 quadrant
    pi = mean*4.0;

    //printing values for mean, standard dev, and pi
    printf("Mean = %f\n", mean);
    printf("Standard Deviation = %f\n", std_dev);
    printf("Pi = %f\n", pi);

    //printf("Ratio = %f\n", ratio);
}
```

Flow Chart:

Assignment #4 - Question #1



Test Cases:

Test	Input	Output
1	**N = 10**	**Values: 0.90** **Values: 0.80** **Values: 0.77** **Values: 0.75** **Values: 0.76** **Values: 0.80** **Values: 0.83** **Values: 0.80** **Values: 0.82** **Values: 0.82** **Mean = 0.80** **Standard Deviation = 0.44** **Pi = 3.218984**
2	**N = 100**	**Enter N: 100** **Values: 0.83** **Values: 0.83** **Values: 0.82** **Values: 0.82** **Values: 0.83** **Values: 0.82** **Values: 0.82** **Values: 0.81** **Values: 0.80** **Values: 0.80** **Mean = 0.82** **Standard Deviation = 0.96** **Pi = 3.271564**
3	**N = 1000**	**Enter N: 1000** **Values: 0.79** **Values: 0.80** **Values: 0.79** **Values: 0.80** **Values: 0.79** **Values: 0.79** **Values: 0.80** **Values: 0.80** **Values: 0.80** **Values: 0.80** **Mean = 0.79** **Standard Deviation = 1.00** **Pi = 3.178802**
4	**N = 10 000**	**Enter N: 10000** **Values: 0.79** **Values: 0.79** **Values: 0.79** **Values: 0.79** **Values: 0.80** **Values: 0.79** **Values: 0.80** **Values: 0.80**

		Values: 0.80 **Values: 0.80** **Mean = 0.79** **Standard Deviation = 1.00** **Pi = 3.178880**
5	**N = 100 000**	**Enter N:** 100000 **Values: 0.79** **Values: 0.79** **Values: 0.79** **Values: 0.79** **Values: 0.79** **Values: 0.79** **Values: 0.79** **Values: 0.79** **Values: 0.79** **Values: 0.79** **Mean = 0.79** **Standard Deviation = 0.99** **Pi = 3.179937**
6	**N = 1 000 000**	**Enter N:** 1000000 **Values: 0.79** **Values: 0.79** **Values: 0.79** **Values: 0.79** **Values: 0.79** **Values: 0.79** **Values: 0.79** **Values: 0.79** **Values: 0.79** **Values: 0.79** **Mean = 0.79** **Standard Deviation = 1.00** **Pi = 3.166562**
7	**N = 10 000 000**	**Enter N:** 10000000 **Values: 0.80** **Values: 0.80** **Values: 0.80**

		Values: 0.80 **Values: 0.80** **Values: 0.80** **Values: 0.80** **Values: 0.80** **Values: 0.80** **Values: 0.80** **Mean = 0.80** **Standard Deviation = 1.00** **Pi = 3.187313**
8	**N = 100 000 000**	**Enter N: 10000000** **Values: 0.79** **Values: 0.80** **Values: 0.80** **Values: 0.80** **Values: 0.80** **Values: 0.80** **Values: 0.80** **Values: 0.79** **Values: 0.79** **Values: 0.80** **Mean = 0.79** **Standard Deviation = 1.00** **Pi = 3.179758**

Discuss

- It seems the higher the value of N the more consistent the ratio becomes 0.79 making the mean become 0.79. As well the more values of (x, y) the more accurate Pi value becomes. Standard deviation also becomes much closer to 1.00 the more values it has to compute. As we can see for N = 10 where standard deviation is very different compared to N = 100 000.

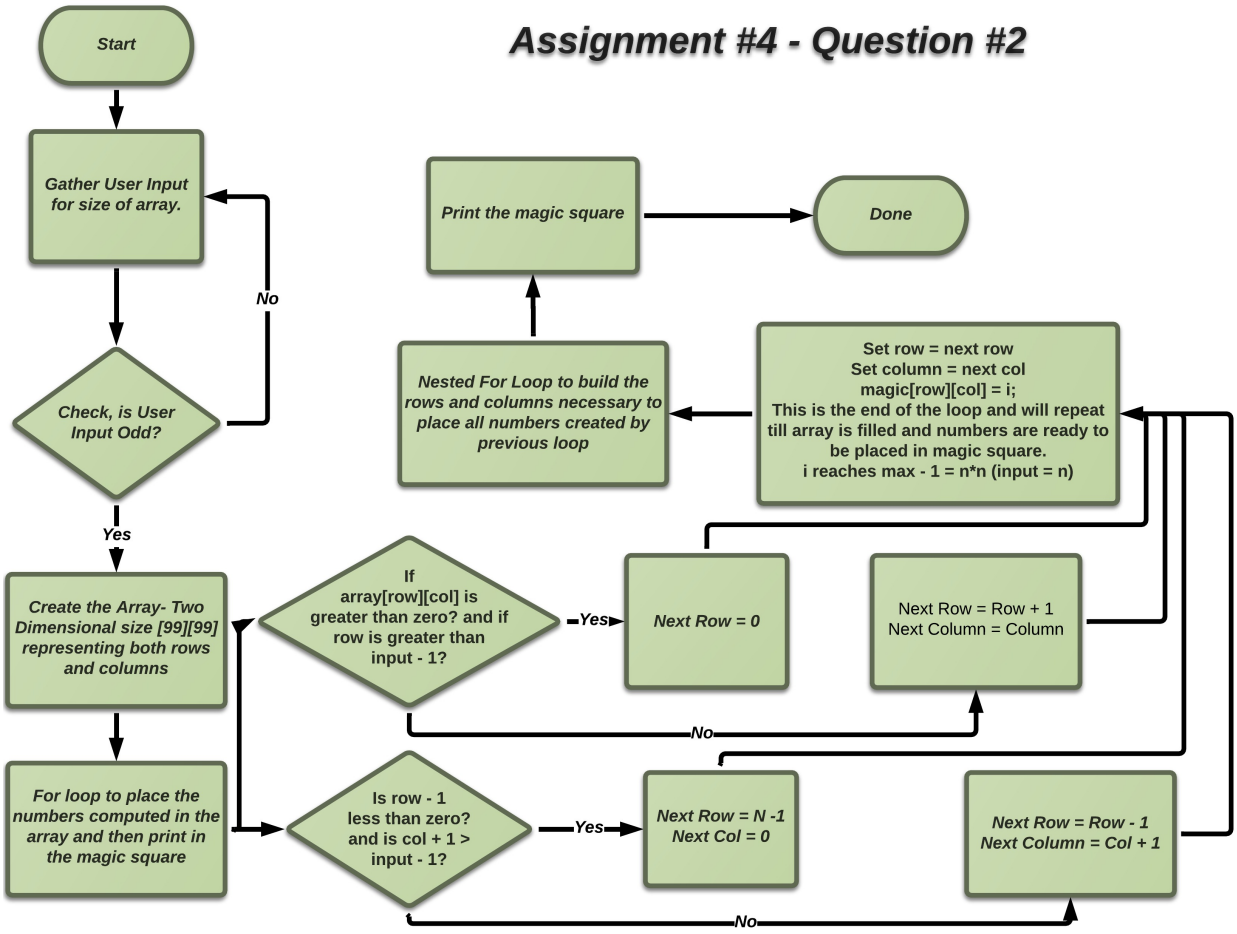
Question 2

Code:

```
#include <stdio.h>
#define FALSE 1
#define TRUE 0

int main() {
    int flag;//for true or false to be checked when number is entered
    int n;
    flag = 1;//setting to false to enter do-while
    do {
        printf("Enter size of magic square: \n");
        scanf("%d", &n);
        //if number is even it will repeat loop else exits
        if (n % 2 == 0) {
            printf("Invalid size, try again...\n");
            flag = 1;
        }else flag = 0;

    } while (flag == 1);
    // Get the users magic number and allocate to int n


    int magic[99][99];// Create the array size of 99 rows and 99 columns

    int start = (n / 2); // The middle column

    int max = n * n; // The final number to be computed

    magic[0][start] = 1; // Place the number one in the middle of row 0

    // Loop to start placing numbers in the magic square
    int row;
    int column;
    int next_row;
    int next_column;
    int i;
    for (i = 2, row = 0, column = start; i < max + 1; i++) {

        if ((row - 1) < 0) { // If going up one will leave the top level of square
            next_row = n - 1; // enter number in bottom row
        }
        else { next_row = row - 1; } //if not go up one row


        if ((column + 1) > (n - 1)) { // If column will leave the farthest side of
square
            next_column = 0; // Wrap back to first column

        }
        else { next_column = column + 1; } // Otherwise go over one column
```

```
        if (magic[next_row][next_column] > 0) { // If next number to be entered's
position is full
            if (row > (n - 1)) { // If going to row below leaves bottom
                next_row = 0; // Go back to the top
            }
            else {
                next_row = row + 1; // allocates number to next row
                next_column = column; // But stay in same column
            }
        }
        row = next_row;
        column = next_column;
        magic[row][column] = i; // Put the current value in that position
        //continue this process tille i reaches max-1 = n*n
        //then exit into next loop where it builds and prints the size of the array
with computed values
    }

    // Now let's print the array
    int j;
    for (i = 0; i < n; i++) {
        for (j = 0; j < n; j++) {
            printf("%4d", magic[i][j]);
        }
        printf("\n");
    }
    return 0;
}
```

Flow Chart:


Assignment #4 - Question #2
Start
Gather User Input for size of array.
Check, is User Input Odd?
No
Yes
Create the Array- Two Dimensional size [99][99] representing both rows and columns
For loop to place the numbers computed in the array and then print in the magic square
If array[row][col] is greater than zero? and if row is greater than input - 1?
Yes
Next Row = 0
Next Row = Row + 1
Next Column = Column
No
Is row - 1 less than zero? and is col + 1 > input - 1?
Yes
Next Row = N -1
Next Col = 0
Next Row = Row - 1
Next Column = Col + 1
No
Set row = next row
Set column = next col
magic[row][col] = i;
This is the end of the loop and will repeat till array is filled and numbers are ready to be placed in magic square.
i reaches max - 1 = n*n (input = n)
Nested For Loop to build the rows and columns necessary to place all numbers created by previous loop
Print the magic square
Done

Test Cases

Test	Input	Output
1	**Enter size of magic square:** 3	**8 1 6** **3 5 7** **4 9 2**
2	**Enter size of magic square:** 5	**17 24 1 8 15** **23 5 7 14 16** **4 6 13 20 22** **10 12 19 21 3** **11 18 25 2 9**
3	**Enter size of magic square:** 4	**Invalid size, try again...** **Enter size of magic square:**
4	**Enter size of magic square:** 9	**47 58 69 80 1 12 23 34 45** **57 68 79 9 11 22 33 44 46** **67 78 8 10 21 32 43 54 56** **77 7 18 20 31 42 53 55 66** **6 17 19 30 41 52 63 65 76** **16 27 29 40 51 62 64 75 5** **26 28 39 50 61 72 74 4 15** **36 38 49 60 71 73 3 14 25** **37 48 59 70 81 2 13 24 35**

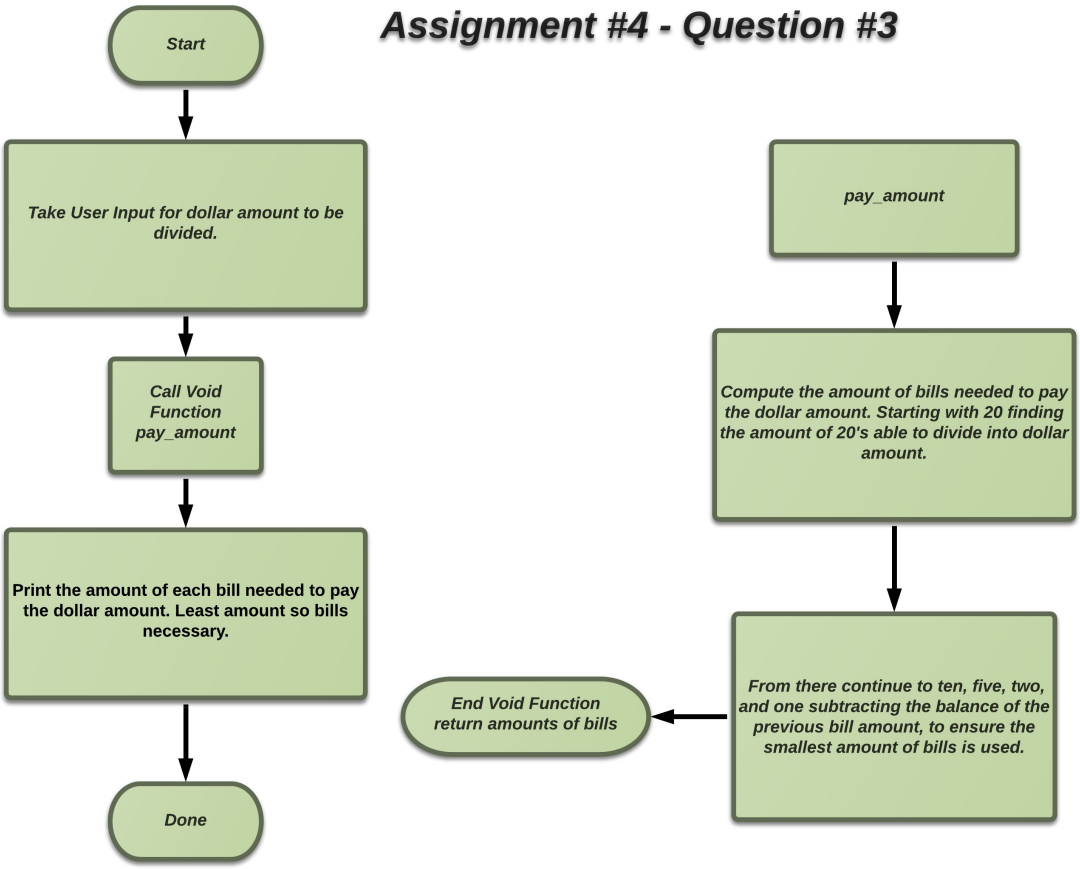
Question 3

Code:

```c
#include <stdio.h>
#define TRUE 0
#define FALSE 1

int dollars;
int twenties;
int tens;
int fives;
int toonies;
int loonies;
int total;

//void function declaration
void pay_amount(int dollars, int *twenties, int *tens, int *fives, int *toonies, int
*loonie);

//pay_amount function
void pay_amount(){

    //computing each variable according amount of bill
    twenties = dollars / 20;
    tens = (dollars - (twenties * 20)) /10;
    fives = (dollars - (twenties*20) - (tens*10)) /5;
    toonies = (dollars - (twenties*20) - (tens*10) - (fives*5)) /2;
    loonies = (dollars - (twenties*20) - (tens*10) - (fives*5) - (toonies*2)) / 1;
    total = twenties + tens + fives + toonies + loonies;
}
//main function
int main(void){
    int flag;
    //printing and scanning dollar amount to be computed from user
    do {
        printf("Enter a Dollar Amount: \n");
        scanf("%d", &dollars);
        if (dollars < 0) {
            printf("Invalid Dollar Amount.. \n");
            flag = 1;

        }else flag = 0;
    } while (flag == 1);

    //calling void function to gain access to computations
    pay_amount(dollars, &twenties, &tens, &fives, &toonies, &loonies);

    //printing out all values
    //total amount enters by user
    printf("Total Dollar Amount is equal to $%d\n", dollars);
    //smallest amount of bills with ability to pay amount
    printf("Smallest amount of bills to pay is %d bill(s).\n", total);
    //total twenty dollar bills needed
```

```
    printf("%d: Twenty Dollar Bill(s)\n", twenties);
    //total ten dollar bills
    printf("%d: Ten Dollar Bill(s)\n", tens);
    //total five dollar bills
    printf("%d: Five Dollar Bill(s)\n", fives);
    //total two dollar bills
    printf("%d: Two Dollar Bill(s)\n", toonies);
    //total one dollar bills
    printf("%d: One Dollar Bill(s) \n", loonies);
}
```

Flow Chart:


Assignment #4 - Question #3
Start
Take User Input for dollar amount to be divided.
Call Void Function pay_amount
Print the amount of each bill needed to pay the dollar amount. Least amount so bills necessary.
Done
pay_amount
Compute the amount of bills needed to pay the dollar amount. Starting with 20 finding the amount of 20's able to divide into dollar amount.
From there continue to ten, five, two, and one subtracting the balance of the previous bill amount, to ensure the smallest amount of bills is used.
End Void Function return amounts of bills

Test Cases:

Test	Input	Output
1	**Enter a Dollar Amount:** 77	**Total Dollar Amount is equal to $77** **Smallest amount of bills to pay is 6 bill(s).** **3: Twenty Dollar Bill(s)** **1: Ten Dollar Bill(s)** **1: Five Dollar Bill(s)** **1: Two Dollar Bill(s)** **0: One Dollar Bill(s)**
2	**Enter a Dollar Amount:** 1	**Total Dollar Amount is equal to $1** **Smallest amount of bills to pay is 1 bill(s).** **0: Twenty Dollar Bill(s)** **0: Ten Dollar Bill(s)** **0: Five Dollar Bill(s)** **0: Two Dollar Bill(s)** **1: One Dollar Bill(s)**
3	**Enter a Dollar Amount:** -123	**Invalid Dollar Amount...** **Enter a Dollar Amount:**
4	**Enter a Dollar Amount:** .60	**Total Dollar Amount is equal to $0** **Smallest amount of bills to pay is 0 bill(s).** **0: Twenty Dollar Bill(s)** **0: Ten Dollar Bill(s)** **0: Five Dollar Bill(s)** **0: Two Dollar Bill(s)** **0: One Dollar Bill(s)**
5	**Enter a Dollar Amount:** 60	**Total Dollar Amount is equal to $60** **Smallest amount of bills to pay is 3 bill(s).** **3: Twenty Dollar Bill(s)** **0: Ten Dollar Bill(s)** **0: Five Dollar Bill(s)** **0: Two Dollar Bill(s)** **0: One Dollar Bill(s)**