Summation

- **Problem:**

  Write a C program to find the sum of the squares of the integers from 1 to 30. Print the sum of the squares.

  i.e., sum $= 1^2 + 2^2 + 3^2 + \ldots + 29^2 + 30^2$

- **Program:**
```
/* program 4
 * find the sum of the first 30 squares
 */
#include < stdio.h>
void main()
{
    int i,sum;                          // variables

    sum =  0;                           // initialize sum
    /* recursive addition of squares */
    for (i =   1; i < =  30; i+ + )
        sum =  sum +  (i * i);
    printf("%d is the sum of the first 30 squares.\n",sum);
}
```

Defining and Using Constants

- **Defining Constants (The #define Directive):**
  #define *identifier constant_value*

- **Using Constants:**
  ```
  /* program 4
   * find the sum of the first NUMBERTOSUM squares
   */
  #include < stdio.h>
  #define NUMBERTOSUM 30
  void main()
  {
     int i,sum;                     // variables

     sum =  0;                      // initialize sum
     for (i =  1; i < =  NUMBERTOSUM; i+ + )
        sum =  sum +  (i * i);      //recursive addition of squares
     printf("%d is the sum of the first %d squares.\n", sum,
        NUMBERTOSUM);
  }
  ```

- Note: To change the number of integers we wish to sum, we only need to change the value of NUMBERTOSUM at its declaration.

- **Using a Value Entered at the Keyboard:**

```c
/* program 4
 * find the sum of the first 'number_to_sum' squares
 * where number_to_sum is entered at the keyboard
 */
#include < stdio.h>
void main()
{
   int i,sum = 0;                 // variables
   int number_to_sum;

   printf("Enter the number of squares to be summed: ");
   scanf("%d",&number_to_sum);
   for (i = 1; i < = number_to_sum; i+ + )
      sum + = (i * i);
   printf("%d is the sum of the first %d squares.\n", sum,
      number_to_sum);
}
```

Nested for Loops

- **Problem:**
  Write a program to produce a multiplication table that covers the integers 1 through 10.

- **Output:**

X	1	2	3	4	5	6	7	8	9	10
1	1	2	3	4	5	6	7	8	9	10
2	2	4	6	8	10	12	14	16	18	20
3	3	6	9	12	15	18	21	24	27	30
…
10	10	20	30	40	50	60	70	80	90	100

- **Pseudocode:**
  print the headings at the top of the page
  construct each row of the multiplication table
  print the table

- **Pseudocode Refinement:**
  print the headings at the top of the page
  for each multiplicand (m1) from 1 to 10
     print a line of output showing m1 times each multiplier (m2) from 1 to 10.

- **Further Refinement:**
  print a line introducing the table
  print a heading line of multipliers from 1 to 10
  for each multiplicand (m1) from 1 to 10
     start a new line of output by printing m1
     for each multiplier (m2) from 1 to 10
        *print m1 * m2 under the heading for m2*

- **Program:**

```c
/*  program to produce a multiplication table
 *  for the integers 1 to 10
 */
#include < stdio.h>
void main()
{
    int m1,m2;                  //m1= multiplicand, m2= multiplier

    printf("This is a Multiplication Table from 1 to 10\n\n");
    printf(" X");
    /*  loop to print the heading of multipliers */
    for (m2 =  1; m2 < =  10; m2+ + )
        printf("%5d",m2);
    printf("\n");
    /*  nested loop to print the table */
    for (m1 =  1; m1 < =  10; m1+ + ) {
        printf("%2d",m1);               //prints the multiplicand
        for (m2 =  1; m2 < =  10; m2+ + )
            printf("%5d", m1 *  m2);
        printf("\n");
    }
}
```

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