**Assignment Number**

1

**Problem Statement**

Program in C to print the prime factors of a number in descending order

**Theory**

Factors of a number are the integers smaller or equal to the number itself, by which the number is completely divisible. A number may have any number of factors, but there is a certain range all of its factors must lie within. All integers are divisible by 1, so the least divisor of a number except for 1 should be 2. Let us consider a number N, which is divisible by 2. i.e.

N = 2 \* M

Now since the result of multiplication (2 \* M) is constant, if we increase 2, M will decrease. Hence the largest factor of the number except the number number itself is M. So the factors of any number except for 1 and the number itself will lie within the range [2, N/2]. A number which does not have any factors in the said range is called a prime number. Consequently, the factors of a number which themselves are prime numbers, are said to be the prime factors of the given number.

Example : 15 has 4 factors – 1, 3, 5, 15 – out of which 3 and 5 are only divisble by 1 and the number itself. Hence, they are prime factors of 15.

**Algorithm**

Input : The number to search prime factors of, say N.

Output : The prime factors of the number in descending order, if any.

Steps :

Step 1 : Print “Prime factors of “ N “ are : “

Step 2 : Repeat through step 4 to step 13 for i = N/2 to 2

Step 3 : If(N mod i = 0)

Then

Step 4 : Set temp = i

Step 5 : Set isprime = 1 // The prime flag

Step 6 : Repeat through step 8 to step 10 for j = 2 to temp/2

Step 7 : If(temp mod j = 0)

Then

Step 8 : Set isprime = 0

Step 9 : Goto step 11

[End of inner if structure]

Step 10 : Set j = j + 1

[End of inner for loop]

Step 11 : If(isprime = 1)

Then

Step 12 : Print temp

[End of inner if structure]

[End of outer if structure]

Step 13 : Set i = i - 1

[End of outer for loop]

Step 14 : End

**Source Code**

#include <stdio.h>

int main(){

int a, i, j, temp, isprime;

printf("\nEnter the number : ");

scanf("%d", &a); // Input the number

printf("\nThe prime factors of %d are :", a);

for(i = a/2; i >= 2; i--){ // Search for factors of `a`

if(a % i == 0){ // `i` is a factor of `a`

temp = i; // Store it to a temporary variable

isprime = 1; // prime flag

for(j = 2; j <= temp/2; j++){ // Search for factors of // `temp`

if(temp % j == 0){ // Factor of `temp` is found

isprime = 0; // `temp` is not prime

break;

}

}

if(isprime) // `temp` is prime

printf(" %d", i);

}

}

return 0;

}

**Input and Output**

Set 1 :

Enter the number : 12345

The prime factors of 12345 are : 823 5 3

Set 2 :

Enter the number : 500000

The prime factors of 500000 are : 5 2

**Discussion**

This program demonstrates a very basic approach towards the finding of prime factors of a given number, but it performs very poorly for large numbers. For example, this program makes a total of (N/2 – 2)\*(P/2 – 2) iterations for a number N with P factors in the worst case. So for a sufficiently large number with a handful of factors can make this program run for quite a while. It can also be shown that if a number is constituted by multiplying two sufficiently large, random prime numbers, factorizing the resultant number is computationally infeasible with the resource presently we have at hand – which serves the basis of all cryptographic security services at present.