



# SNS COLLEGE OF ENGINEERING

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**AN AUTONOMOUS INSTITUTION**



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Factorization

**Fermat's Factorization method** is based on the representation of an odd integer as the difference of two squares.

For an integer **n**, we want **a** and **b** such as:

$$n = a^2 - b^2 = (a+b)(a-b)$$

where (a+b) and (a-b) are  
the factors of the number n.

**Example:**

## Fermat's Factoring

$$n = t^2 - s^2 \\ (t+s)(t-s)$$

$$n = t^2 - s^2 \\ \underline{s^2 = t^2 - n}$$

$$t = \lfloor \sqrt{n} \rfloor + 1 \quad \text{if } t^2 - n \text{ is a perfect square}$$

Ex: 809009

$$n = 809009$$

$$t = \lfloor \sqrt{n} \rfloor + 1$$

$$t = \lfloor \sqrt{809009} \rfloor + 1$$

$$t = \lfloor 899.44 \rfloor + 1$$

$$t = \lfloor 900.44 \rfloor = 900$$

$$s^2 = t^2 - n$$

$$t^2 = (900)^2 \Rightarrow 810000$$

$$t^2 - n = 810000 - 809009$$

$$s^2 \Rightarrow 991$$

$$s = \sqrt{991} = 31.48 \quad \text{not a perfect square.}$$

next take  $t = \lfloor \sqrt{n} \rfloor + 2$

$$t = \lfloor 900.44 \rfloor + 2$$

$$= 902$$

$$s^2 = t^2 - n$$

$$t^2 = (902)^2 \Rightarrow 813604$$

$$t^2 - n = 813604 - 809009$$

$$s^2 = 4595 \Rightarrow \text{not a perfect square.}$$

$$t = \lfloor \sqrt{n} \rfloor + 3 \Rightarrow 6400 = (80)^2 = \text{perfect square}$$

$$n = (t+s)(t-s)$$

$$= (903+80)(903-80)$$

$$n = 983 \times 823$$

= factorization.

**2. Input:**  $n = 6557$

**Output:** [79,83]

**Explanation:**

For the above value,  
the first try for a is ceil value  
of square root of 6557, which is 81.

Then,

$$b^2 = 81^2 - 6557 = 4,$$

as it is a perfect square.

So,  $b = 2$

So, the factors of 6557 are:

$$(a - b) = 81 - 2 = 79 \text{ \&}$$

$$(a + b) = 81 + 2 = 83.$$