

# Sieve of Eratosthenes

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Given a number  $n$ , print all primes smaller than or equal to  $n$ . It is also given that  $n$  is a small number.

## Example:

**Input :**  $n = 10$

**Output :** 2 3 5 7

**Input :**  $n = 20$

**Output:** 2 3 5 7 11 13 17 19

The sieve of Eratosthenes is one of the most efficient ways to find all primes smaller than  $n$  when  $n$  is smaller than 10 million or so

Following is the algorithm to find all the prime numbers less than or equal to a given integer  $n$  by the Eratosthene's method:

When the algorithm terminates, all the numbers in the list that are not marked are prime.

## Explanation with Example:

Let us take an example when  $n = 50$ . So we need to print all prime numbers smaller than or equal to 50.

We create a list of all numbers from 2 to 50.

	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50

According to the algorithm we will mark all the numbers which are divisible by 2 and are greater than or equal to the square of it.

	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50

Now we move to our next unmarked number 3 and mark all the numbers which are multiples of 3 and are greater than or equal to the square of it.

	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50

We move to our next unmarked number 5 and mark all multiples of 5 and are greater than or equal to the square of it.

	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50

We continue this process and our final table will look like below:

	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50

So the prime numbers are the unmarked ones: 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47.

```
def seiveOfEratosthenes(n):
    isPrime = [True for i in range(n+1)]

    p = 2
    for i in range(2, int(n**0.5)+1):
        if isPrime[i] == True:
            j = i+i
            while j<=n:
                isPrime[j] = False
                j = j+i
```

```
print(isPrime)
```

```
seiveOfEratosthenes(10)
```