

The background features abstract, overlapping green geometric shapes, primarily triangles and polygons, in various shades of green, creating a modern, layered effect. The shapes are concentrated on the left and right sides of the frame, leaving a large white central area.

Count prime

# Count prime

- Given an integer  $n$ , return the number of prime numbers that are strictly less than  $n$ .
- Input:  $n = 10$
- Output: 4
- Explanation: There are 4 prime numbers less than 10, they are 2, 3, 5, 7.

# 10 points out of a total 25 points that your program can run $n < 10^4$

- iterated from  $i = 2$  to  $i < n$ 
  - iterated from  $j = 2$  to  $j < i$ , check that whether  $i$  is perfectly divisible by  $j$ 
    - If  $i$  is perfectly divisible by  $j$ ,  $i$  is not a prime number, then terminated the loop
  - Otherwise,  $i$  is a prime number.

15 points out of a total 25 points that your program can run  $10^5 \leq n < 2.5 \cdot 10^6$  in one second.

- iterated from  $i = 2$  to  $i < n$ 
  - iterated from  $j = 2$  to  $j * j \leq i$ , check that whether  $n$  is perfectly divisible by  $j$ 
    - If  $i$  is perfectly divisible by  $j$ ,  $i$  is not a prime number, then terminated the loop
  - Otherwise,  $i$  is a prime number.

若 $N$ 為合數，且有 $r$ 個因數( $r \geq 2$ )

反證明  $P_1, P_2, \dots, P_r > \sqrt{N}$

$$N = P_1 \times P_2 \times \dots \times P_r > N^{\frac{r}{2}}$$

$$N^{\frac{r}{2}} \geq N \quad (\because \frac{r}{2} \geq 1)$$

$\therefore N > N^{\frac{r}{2}}$  和  $N^{\frac{r}{2}} \geq N$  矛盾

$\therefore$  反證成立

If it is a composite number,  
it must have at least one  
factor  $\leq \sqrt{n}$

25 points out of a total 25 points that your program can run  $3.3 \cdot 10^6 \leq n \leq 5 \cdot 10^6$  in one second.

## Sieve of Eratosthenes

algorithm Sieve of Eratosthenes is

input: an integer  $n > 1$ .

output: all prime numbers count from 2 through  $n-1$ .

let A be an array of Boolean values, indexed by integers 2 to  $n-1$ , initially all set to true.

for  $i = 2, 3, 4, \dots$ , not exceeding  $\sqrt{n}$  do

if A[i] is true

for  $j = i^2, i^2 + i, i^2 + 2i, i^2 + 3i, \dots$ , not exceeding  $n$  do

A[j] := false

return all  $i$  such that A[i] is true.

	2	3	4	5	6	7	8	9	10	Prime numbers
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	
51	52	53	54	55	56	57	58	59	60	
61	62	63	64	65	66	67	68	69	70	
71	72	73	74	75	76	77	78	79	80	
81	82	83	84	85	86	87	88	89	90	
91	92	93	94	95	96	97	98	99	100	
101	102	103	104	105	106	107	108	109	110	
111	112	113	114	115	116	117	118	119	120	

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Questions?