

# Prime Generation

Primality Testing  $\rightarrow O(\sqrt{N})$

$$1 \leq N \leq 10^6$$

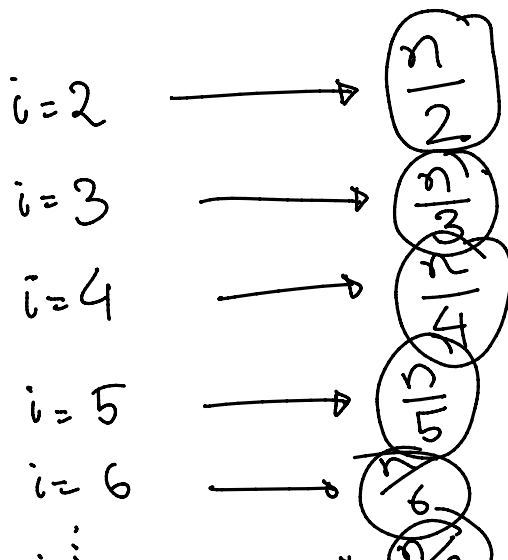
$$1 \leq N \leq 10^{16}$$

$[1, N] \rightarrow$  generate all primes within this range

i) With primality testing  $\rightarrow O(N\sqrt{N})$

↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
x	✓	✓	x	✓	x	✓	x	x	x	✓	x	✓	x	x	x	

↓	↓	↓	↓	↓	↓											
1	2	3	4	5	6	7	8	9	10							
x	✓	✓	x	✓	x	✓	x	x	x							
11	12	13	14	15	16	17	18	19	20							
✓	x	✓	x	x	x	✓	x	✓	x							
21	22	23	24	25	26	27	28	29	30							
x	x	✓	x	x	x	x	x	✓	x							
31	32	33	34	35	36											
✓	x	x	x	x	x											



$$\begin{aligned}
 & \frac{n}{1} + \frac{n}{2} + \frac{n}{3} + \frac{n}{4} + \frac{n}{5} + \dots + \frac{n}{n} \\
 &= n \left( 1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \dots + \frac{1}{n} \right) \\
 &= n \cdot \log_2 n
 \end{aligned}$$

$i = 6 \rightarrow \text{circle with } 6 \text{ and } \frac{1}{6}$   
 $i = n \rightarrow \text{circle with } n \text{ and } \frac{1}{n}$

$O^2$

$$P < n \log_2 n$$

$$P = n \log_2 n - n - X \rightarrow$$

$$\frac{n}{2} + \frac{n}{3} + \frac{n}{5} + \frac{n}{7} + \dots$$

$$\approx O(N \log_2(\log_2(n))) \approx O(N)$$

