R16
Maths for coding

Basic Concepts of Logs

$\log_a b^m = m \log_a b$

$\log_2 2 = 1$

$\log_a a = 1$

$\log_a m + \log_a n = \log_a (mn)$

204. Count Primes

Medium | Topics | Companies | Hint

Given an integer `n`, return *the number of prime numbers that are strictly less than* `n`.

Example 1:

```
Input: n = 10
Output: 4
Explanation: There are 4 prime numbers less than 10, they are 2, 3, 5, 7.
```

Example 2:

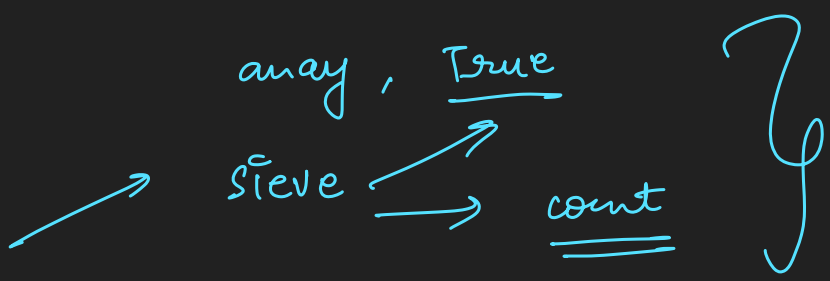
```
Input: n = 0
Output: 0
```

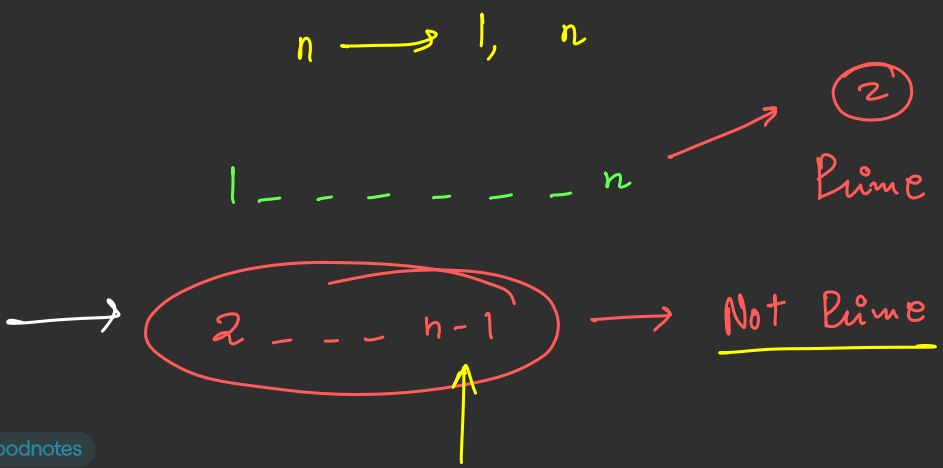
Example 3:

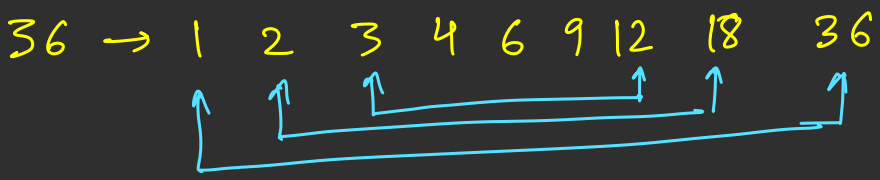
```
Input: n = 1
Output: 0
```

Constraints:

- `0 <= n <= 5 * 10^6`







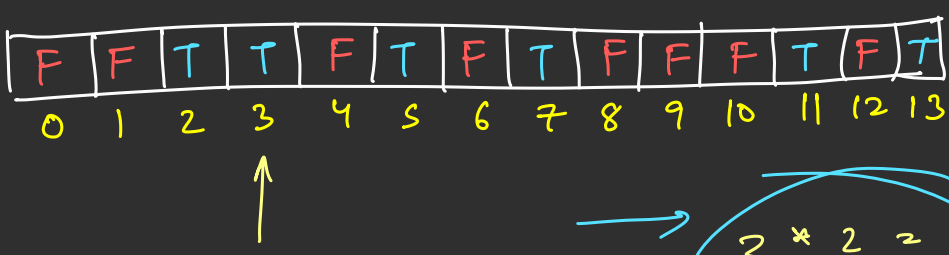
< $\sqrt{36}$ = 6 >

2 ... $\sqrt{n}$

Pairs

Sieve

sqrt(n)



2 * 2 = 4

3 * 3 = 9

2i

5 → 10 → 2 * 5

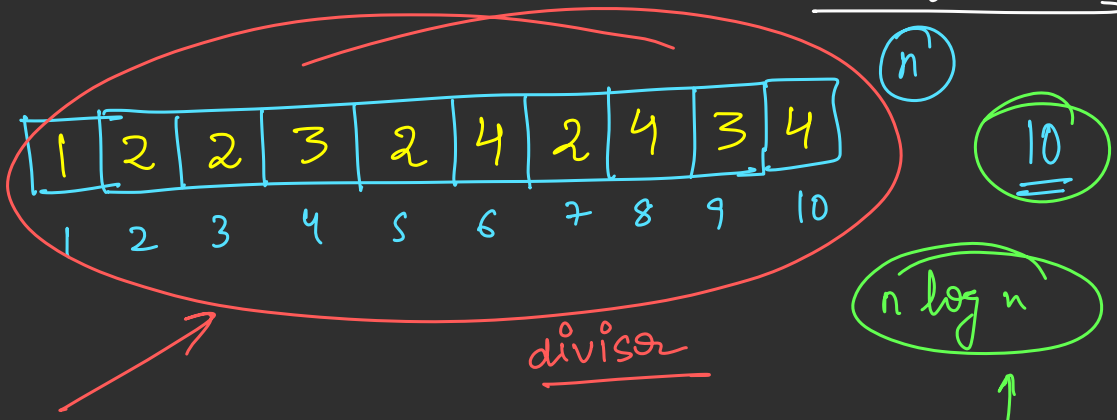
15 → 3 * 5

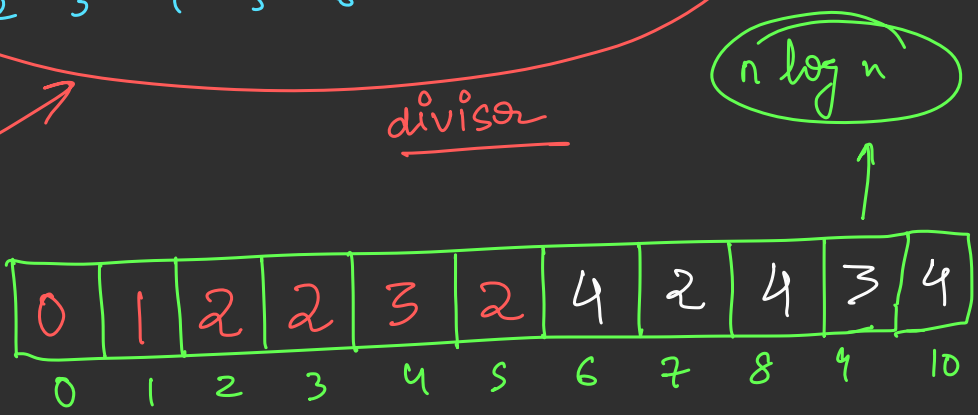
20 → 2 * 2 * 5

5 → 5 * 5 = 25

Different versions of sieve of eranthosis

- Divisor Sieve → count divisors
- Sum of divisor Sieve → sum of divisor

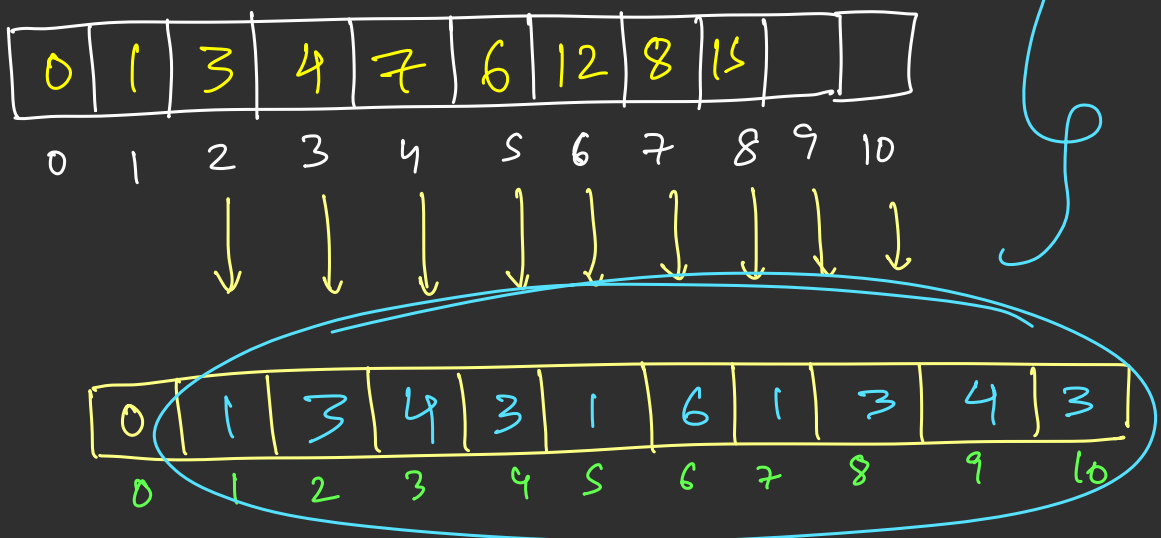





```
for(int i = 1; i <= n; i++)
{
    for(int j = i; j <= n; j = j + i)
    {
        divisor[j]++;
    }
}
```

$n + \frac{n}{2} + \frac{n}{3} + \frac{n}{4} + \frac{n}{5} \cdots \frac{n}{n}$

$n \log n$




```
for(int i=1; i<=n; i++)
{
    for(int j=i; j<=n; j=j+i)
    {
        divisor[j] += i;
    }
}
```

↳ Sum of divisor

divisor sum sieve

DIVSUM - Divisor Summation

#number-theory

Given a natural number n (1 <= n <= 500000), please output the summation of all its proper divisors.

Definition: A proper divisor of a natural number is the divisor that is strictly less than the number.

e.g. number 20 has 5 proper divisors: 1, 2, 4, 5, 10, and the divisor summation is: 1 + 2 + 4 + 5 + 10 = 22.

Input

An integer stating the number of test cases (equal to about 200000), and that many lines follow, each containing one integer between 1 and 500000 inclusive.

Output

One integer each line: the divisor summation of the integer given respectively.

Example

```
Sample Input:
3
2
10
20

Sample Output:
1
8
22
```

T

Precomputation

1 2 3 4 5 6 7 8 9

T

O(1)

n log n

n log n + T

1390. Four Divisors

Medium | Topics | Companies | Hint

Given an integer array `nums`, return *the sum of divisors of the integers in that array that have exactly four divisors*. If there is no such integer in the array, return `0`.

Example 1:

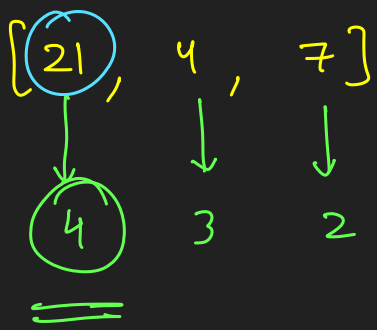
```
Input: nums = [21,4,7]
Output: 32
Explanation:
21 has 4 divisors: 1, 3, 7, 21
4 has 3 divisors: 1, 2, 4
7 has 2 divisors: 1, 7
The answer is the sum of divisors of 21 only.
```

Example 2:

```
Input: nums = [21,21]
Output: 64
```

Example 3:

```
Input: nums = [1,2,3,4,5]
Output: 0
```



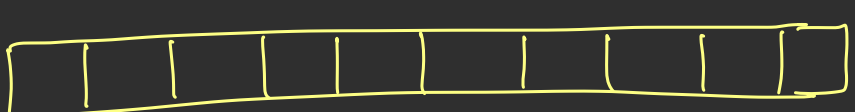
21 → 1, 3, 7, 21

numbers → == 4

n ≥ 10^5 ~ O(1)

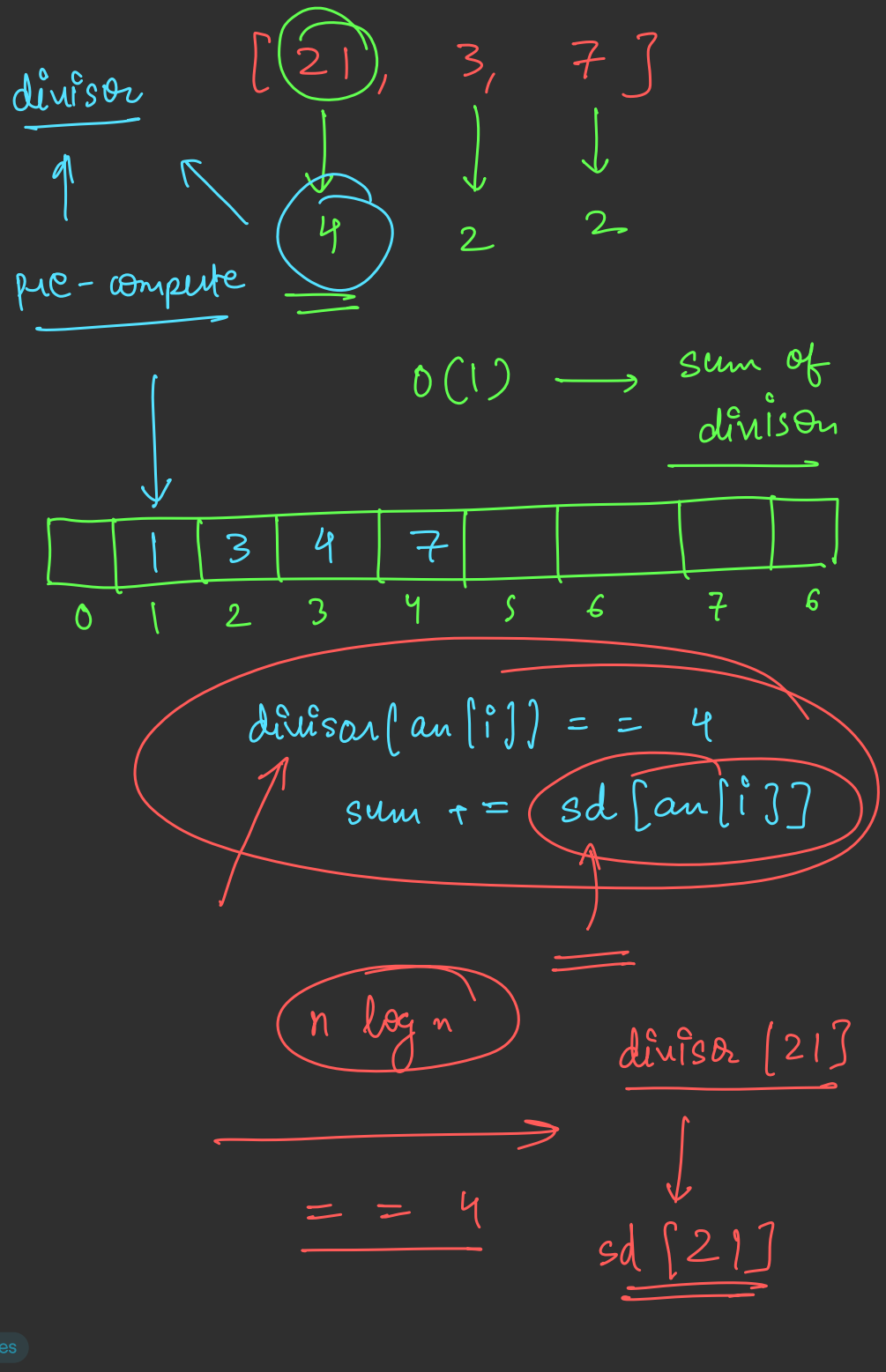
$1 \le a_n[i] \le 10^5$

n log n



== 4

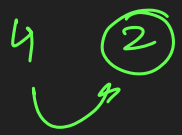
Precompute



1688. Count of Matches in Tournament

Solved

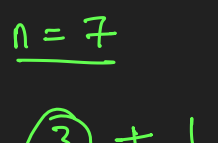
Easy | Topics | Companies | Hint



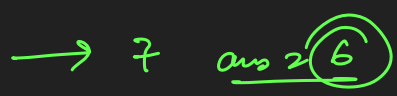
You are given an integer `n`, the number of teams in a tournament that has strange rules:

- If the current number of teams is **even**, each team gets paired with another team. A total of `n / 2` matches are played, and `n / 2` teams advance to the next round.
- If the current number of teams is **odd**, one team randomly advances in the tournament, and the rest gets paired. A total of `(n - 1) / 2` matches are played, and `(n - 1) / 2 + 1` teams advance to the next round.

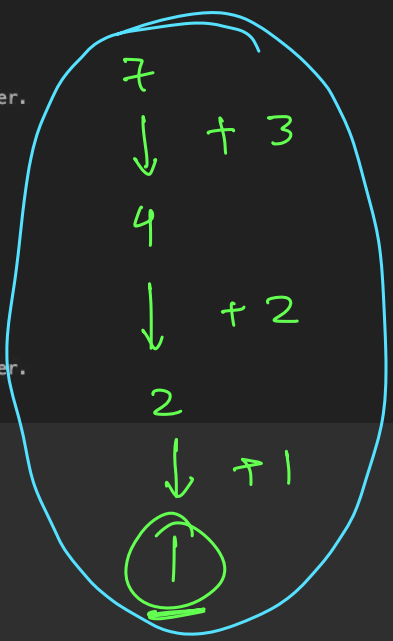
Return *the number of matches played in the tournament until a winner is decided.*



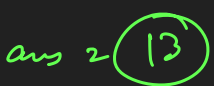
Example 1:



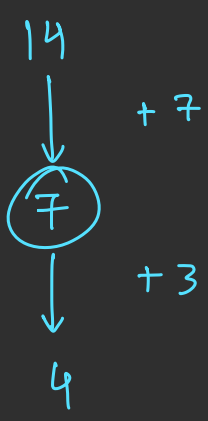
```
Input: n = 7
Output: 6
Explanation: Details of the tournament:
- 1st Round: Teams = 7, Matches = 3, and 4 teams advance.
- 2nd Round: Teams = 4, Matches = 2, and 2 teams advance.
- 3rd Round: Teams = 2, Matches = 1, and 1 team is declared the winner.
Total number of matches = 3 + 2 + 1 = 6.
```

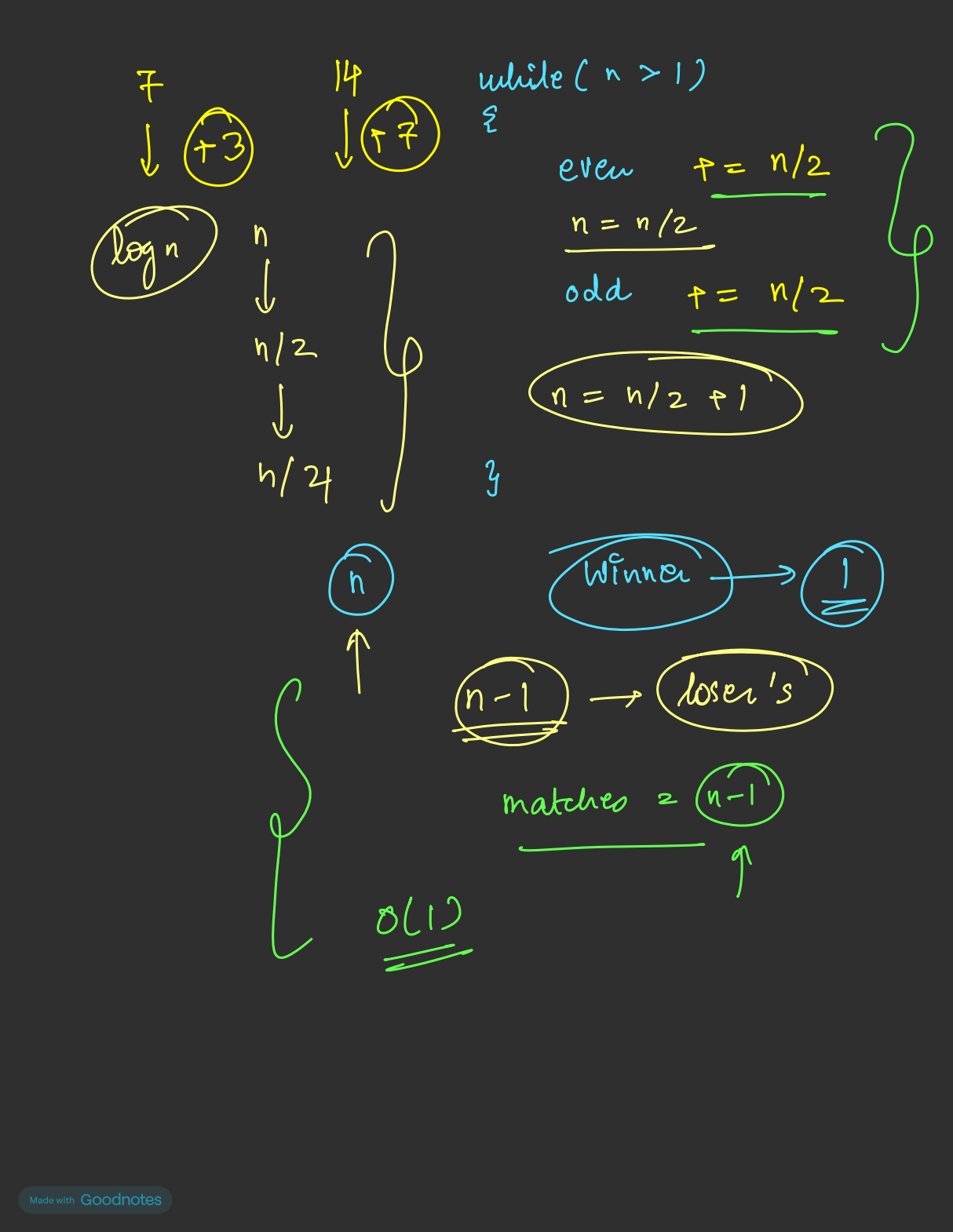


Example 2:



```
Input: n = 14
Output: 13
Explanation: Details of the tournament:
- 1st Round: Teams = 14, Matches = 7, and 7 teams advance.
- 2nd Round: Teams = 7, Matches = 3, and 4 teams advance.
- 3rd Round: Teams = 4, Matches = 2, and 2 teams advance.
- 4th Round: Teams = 2, Matches = 1, and 1 team is declared the winner.
Total number of matches = 7 + 3 + 2 + 1 = 13.
```





Modular arithmetic

$5 \% 4 = 1$

$n \% 4$ → $0, 1, 2, 3$

$10^9 + 7$ ~ Prime

sum $1 ---- N$ $\quad N = 10^8$

$\frac{N * (N+1)}{2} \sim \frac{10^8 * (10^8 + 1)}{2}$

int

$\sim 10^{16} / 10^{15}$

$10^9 + 7$

$a \% M - b \% M$

< 0

Properties

$\rightarrow (a+b) \% M = (a \% M + b \% M) \% M$

$\rightarrow (a-b) \% M = (a \% M - b \% M + M) \% M$

$-5 \% 4 = 3 \% 4$

$-5 + 4 + 4$

$3 \% 4$

$10^9 + 7$

Product %M

$(a * b) \% M$

$\hookrightarrow (a \% M * b \% M) \% M$

$(a/b) \% M =$ Number

$((a \% M) * (b^{-1} \% M)) \% M$