1 ✓
2 ✓
3 ✓

~~low=0~~ $\quad$ mid. $\quad$ $r = 4$

A = [~~2, 5, 7~~, ③ [redacted], | ④ 899]

l = 4

T = 899

(low+high)//2

mid = $\frac{0+4}{2} = 2$

$\left(\frac{low + high}{2}\right)$

i) A[mid] < T

7 < 899

⇒ Neglect left

⇒ Update low

l = mid+1 ✓

ii) A[mid] == T

⇓

✓

iii) A[mid] > T

↓

⇒ Neglect right

⇒ Update r(high)

r = mid−1

7//2

$\frac{3+4}{2} = \frac{7}{2} = 3$

$\frac{4+4}{2} = \frac{8}{2} = 4$

N = 1000

~~1, 2, 3, 4, — — 500~~ | 501 | 750 : 997, 998, 999, 1000

N/4

T = 998

N/2 $\quad$ 500

↓

N/4 $\quad$ 250

↓

N/8

⋮

↓

1

501 − 750

≃ 250 = N/4

$\frac{501+1000}{2}$

= 750

Q) How many times we need to divide N by 2 to make it 1.

$N \to N/2 \to N/4 \to N/8 \to \dots \to 1$ $\log_2 N$

$N = 32 = 2^5$

1
16
2
8
3
4
4
2
5
1

$64 = 2^6$

1
32
2
16
3
8
4
4
5
2
6
1

✓ Beginner : Maths 1

HW2

$\log_2(N)$

$2^x = N$

$\log_2(32) = 5$

$\log_2(64) = 6$

$\log_2(3) = 1.\dots$

3 // 2

$3 \to 1$

Mathematical range

[,] ⇒ included

(,) ⇒ excluded

Q2 [1, 10] $= 10 - 1 + 1 = 10$

included

[3, 10] ⇒ $10 - 3 + 1 = 8$

3, 4, 5, 6, 7, 8, 9, 10

Q3 $\log_a(a^x) = x$ $\quad a^? = a^x \Rightarrow x$

$\log_2(4)$ $\quad 2^{\frac{1}{2}} = 4$ $\quad \log_2(2^2) = 2$

$\log_2(8)$ $\quad 2^3 = 8$ $\quad \log_2(2^3) = 3$

$2^? = 2^3$

correct

Algorithm Analysis

- Time complexity
  - CPU time
  - Computational time
- Space Complexity
  - RAM
  - Memory usage.

$[a, b) \Rightarrow b - a$

excluded

$[1, 100) \Rightarrow 100 - 1 = 99$

$[1, 99]$

Q4)

A)

```
s = 0
for i in range(1, 100):
    s += 1
```

No of iterations to compare

B)

```
s = 0
for i in range(1, 100000000):
    s += 1
```

$(10^8 - 1)$ iterations.

Multiplication Tables

Q5)

```
s = 0
for i in range(0, 101):
    s += i
```

[0, 101)

⇒ 101 − 0 = 101

[0, 100]

⇒ 100 − 0 + 1

= 101

Q6)

```
s = 0
for i in range(1, N+1):
    s += i
```

[1, N+1)

= N+1−1

= N

Q7)

```
i = 1
while (i*i) <= N:
    i += 1
```

What is max value of i^2 allowed

$i^2 = 25$

$i = \sqrt{25} = 5$

$i^2 = N$

$i = \sqrt{N}$

N = 25

i	i^2	$i^2 <= N$
1	1	✓
2	4	✓
3	9	✓
4	16	✓
5	25	✓
6	36	X

$N = 64$

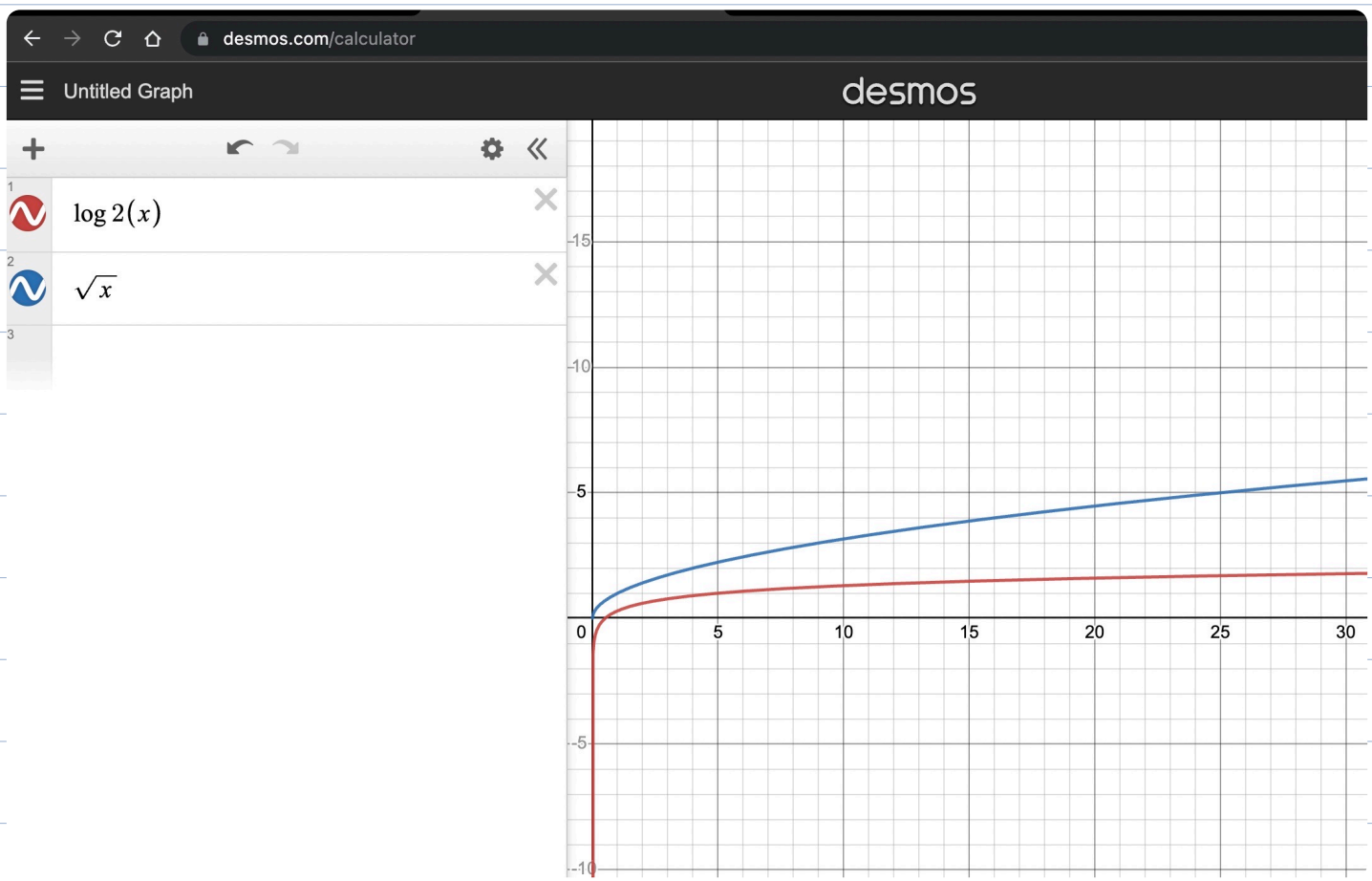
$N = 10000 \longrightarrow 100$

$\sqrt{N}$ → 8 > $\log_2(N)$ → 6

$2^6 = 64$

$\sqrt{N} > \log_2(N)$

Compare 2 functions $\sqrt{N}$ and $\log_2(N)$ } draw a graph for diff. values of N.



Q 8)

```
i = N
while i>1 :
    i = i//2
```

$\Rightarrow$ $\log_2 N$ iterations

$i = 10$

i before	Iterations	i after ($i = i//2$)
10	1	5
5 (+1)	2	2
2 (+1)	3	1
1 (+1)		

$\text{int}(\log_2(10)) \simeq 3.32$

i before	Iterations	i after ($i = i//2$)
100	1	50
50	2	25
25	3	12
12	4	6
6	5	3
3	6	1
1		

$\log_2 100 \simeq 6.$...

$2^6 = 64$ } blw 6 & 7

$2^7 = 128$

Q9)

```
i = 0
while i <= N:
    i *= 2
```

HW
put i=1

$N > 0$

Infinite Loop

i Before	Iterations	i after (i *= 2)
0	1	0
0	2	0
0	3	0
!		
!		
!		

Q10)

N = 5

11 - 1 = 10

1 i → N

10 i → 10N

```
ans = 0
for i in range(1, 11):
    for j in range(1, N+1):
        ans += 1
print(ans)
```

N + 1 - 1 = N

10 * N = 10 * 5 = 50

i	j	Iterations for j loop
1	[1, N+1)	N + 1 - 1 = N
2	[1, N+1)	N + 1 - 1 = N
3	[1, N+1)	N + 1 - 1 = N
⋮		⋮
10	[1, N+1)	N + 1 - 1 = N

10 * N

Q11)

```
ans = 0
for i in range(0, N):
    for j in range(0, N):
        ans += 1
```

$N - 0 = N$

$N - 0 = N$

$N * N = N^2$

N times	i	j	Total iterations of j loop
	0	[0, N)	$N - 0 = N$
	1	[0, N)	$N - 0 = N$
	2	[0, N)	$N - 0 = N$
	⋮		⋮
	N-1	[0, N)	$N - 0 = N$

$N * N = N^2$

Q12)

```
ans = 0
for i in range(0, N):
    for j in range(0, i+1):
        ans += 1
```

HW

Time Complexity to be continued ....

Sorting

Arranging the data in some order based on some parameter

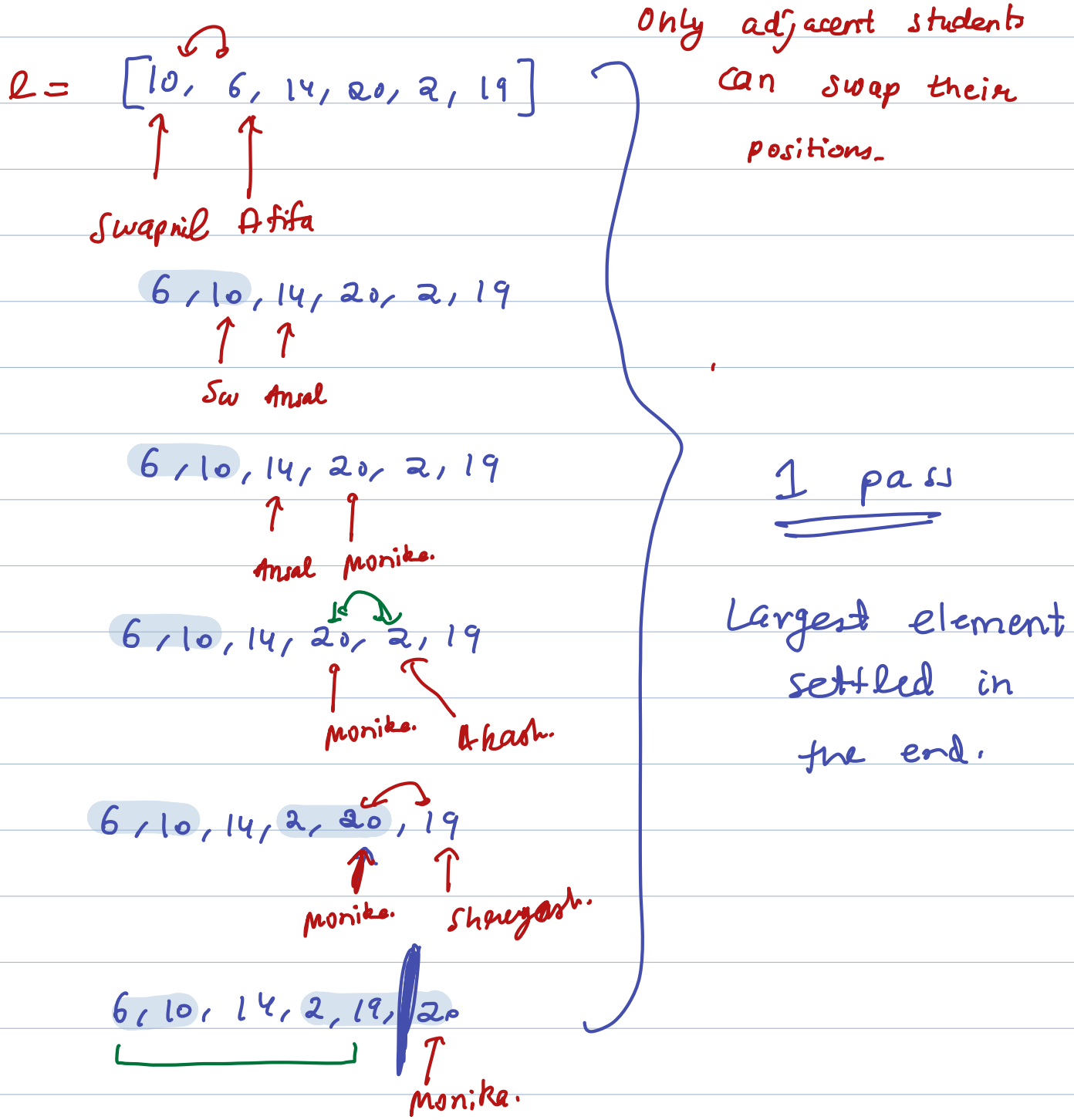
[1, 7, 2, 4, 9, 6] ?

no. of factors	↓ 1	↓ 2	↓ 2	↓ 3	↓ 3	↓ 4

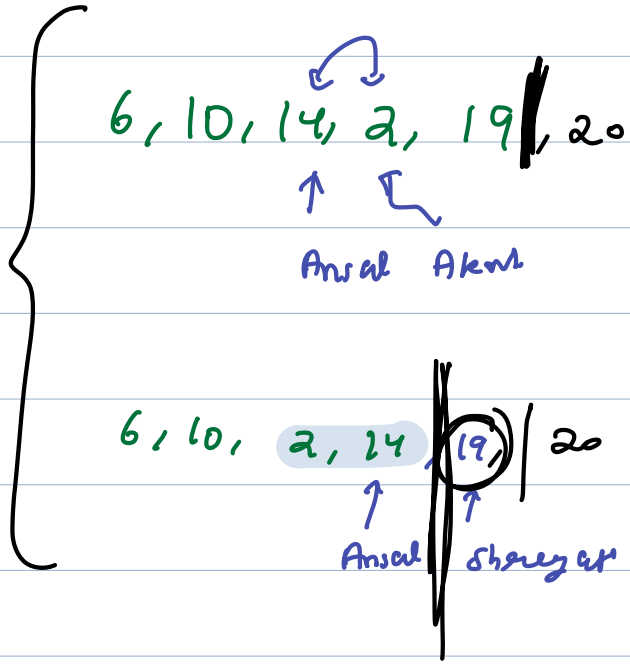
Why Sorting? to make searching easier.

Sorting Algorithms

Q)) Heights of students

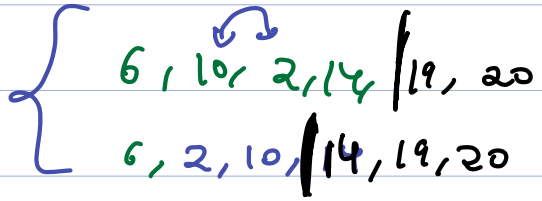


2nd pass

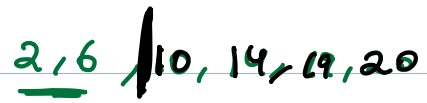


2nd largest element is also settled..

3rd pass

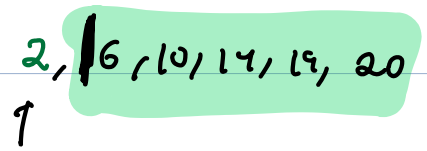


4th pass



5th pass

No swap



$\Rightarrow$ 6 elements