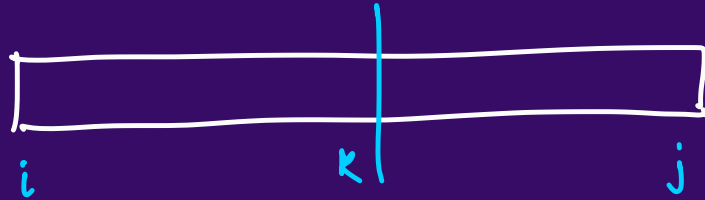


Ques: Partition DP / MCN

Q: Matrix Chain Multiplication



$$\begin{matrix} \begin{bmatrix} a & b \end{bmatrix} \\ 1 \times 2 \end{matrix} \times \begin{matrix} \begin{bmatrix} c & f & g \\ h & i & j \end{bmatrix} \\ 2 \times 3 \end{matrix} = \begin{bmatrix} \end{bmatrix}_{1 \times 3}$$

$$A \times B \neq B \times A$$

Ques:

Q : Matrix Chain Multiplication

$$\begin{array}{ccc} A \times B \times C & \Rightarrow & (A \times B) \times C \\ & \searrow & \\ & & A \times (B \times C) \end{array}$$

$$\begin{aligned} A \times B \times C \times D &= A (B (C D)) \\ &A ((BC) D) \\ &(AB)(CD) \\ &((AB)C) D \\ &(A (BC)) D \end{aligned}$$

Ques:

Q: Matrix Chain Multiplication

$$\begin{bmatrix} \end{bmatrix}_{10 \times 20} \times \begin{bmatrix} \end{bmatrix}_{20 \times 25} = \begin{bmatrix} \end{bmatrix}_{10 \times 25}$$

$$\text{cost} = 10 \times 20 \times 25$$

$$A_1 \cdot A_2 \cdot A_3 \cdot A_4 \cdot A_5 = \begin{bmatrix} \end{bmatrix}_{m_1 \times n_5}$$

Ques:

Q: Matrix Chain Multiplication

$$\begin{bmatrix} A \end{bmatrix}_{1 \times 2} \times \begin{bmatrix} B \end{bmatrix}_{2 \times 3} \times \begin{bmatrix} C \end{bmatrix}_{3 \times 4} = \begin{bmatrix} AB \end{bmatrix}_{1 \times 3} \times \begin{bmatrix} C \end{bmatrix}_{3 \times 4} \quad \boxed{6 + 12 = 18}$$

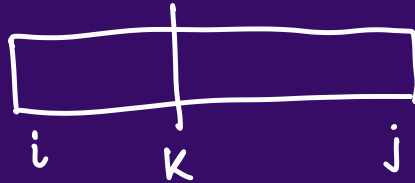
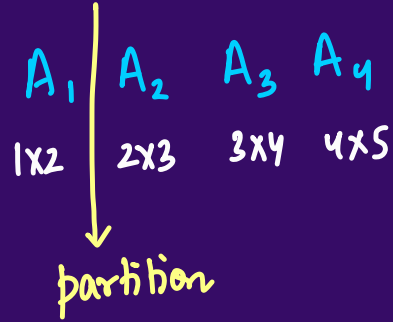
\Rightarrow

$$\begin{bmatrix} A \end{bmatrix}_{1 \times 2} \times \begin{bmatrix} BC \end{bmatrix}_{2 \times 4} \quad \boxed{24 + 8 = 32}$$

$$A_1 A_2 A_3 \dots A_n$$

Ques:

Q : Matrix Chain Multiplication \rightarrow All possible combinations \rightarrow Recursion



$$\text{cost}(i, j) = \text{cost}(i, k) + \text{cost}(k+1, j) + C$$

Ques:

Q : Matrix Chain Multiplication

input
format :

arr

1	2	3	4
2	3	4	2

i k k+1 j

$$[(1 \times 2)(2 \times 3)] \times [(3 \times 4)(4 \times 2)]$$

$$[1 \times 3] \times [3 \times 2]$$

$$1 \times 3 \times 2 = 6$$



arr

1	2	3	4	2
---	---	---	---	---

i k k+1 j

4 matrices

$$n = \underset{\substack{\downarrow \\ \text{arr}[i]}}{1} \times \underset{\substack{\uparrow \\ \text{arr}[k+1]}}{3} \times \underset{\substack{\downarrow \\ \text{arr}[j+1]}}{2}$$

arr

		i		j	
		0	1	2	3
arr	1	1	2	3	4
	2	2	3	4	2
		A_1	A_2	A_3	A_4

partition $\rightarrow k$

```

int cost(int i, int j, arr){
    if(i==j) return 0;
    minCost =  $\infty$ ;
    for(int k=i; k<j; k++){
        x = arr[i][0] * arr[j][1] * arr[k][1];
        tc = cost(i, k) + cost(k+1, j) + x;
        minCost = min(minCost, tc);
    }
    return minCost;
}
    
```

	i			j	
	0	1	2	3	4
arr	1	2	3	4	2
	A_1	A_2	A_3	A_4	

partition $\rightarrow K$

```

int cost (int i, int j, arr) {
    if (i == j) return 0;
    minCost = ∞;
    for (int k = i; k < j; k++) {
        x = arr[i] * arr[k+1] * arr[j+1];
        tc = cost(i, k) + cost(k+1, j) + x;
        minCost = min(minCost, tc);
    }
    return minCost;
}
    
```


Memoization : $\begin{matrix} i \rightarrow n \rightarrow 0 \\ j \rightarrow m \rightarrow 0 \end{matrix} \} \rightarrow \text{Tabulation} \rightarrow \begin{matrix} i \Rightarrow 0 \text{ to } n \\ j \Rightarrow 0 \text{ to } m \end{matrix}$

$\begin{matrix} i \rightarrow 0 \text{ to } n \\ j \rightarrow n \text{ to } 0 \end{matrix} \} \rightarrow \text{tabul} \rightarrow \begin{matrix} i = n \rightarrow 0 \\ j \rightarrow 0 \text{ to } n \end{matrix}$

Ques:

Q : Matrix Chain Multiplication

Ques:

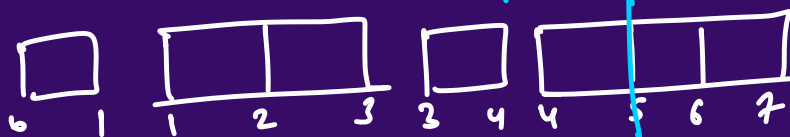
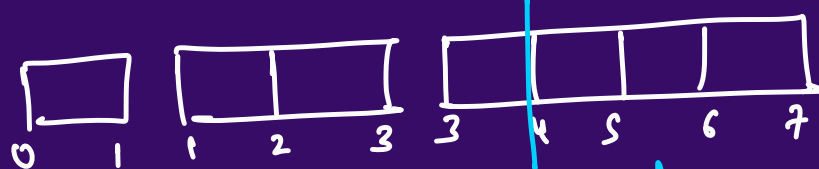
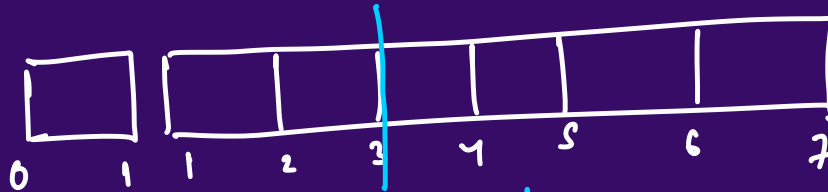
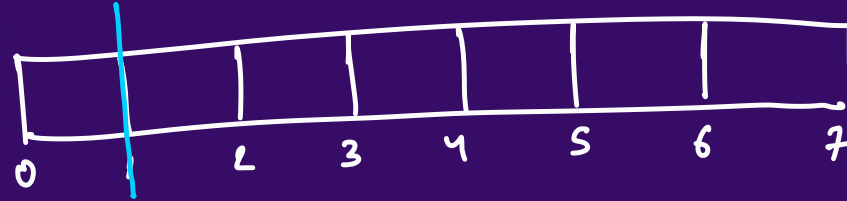
minimize



1, 3, 4, 5

Q: Minimum cost to cut a stick

$n=7$



$$\text{cuts} = \{1, 3, 4, 5\}$$

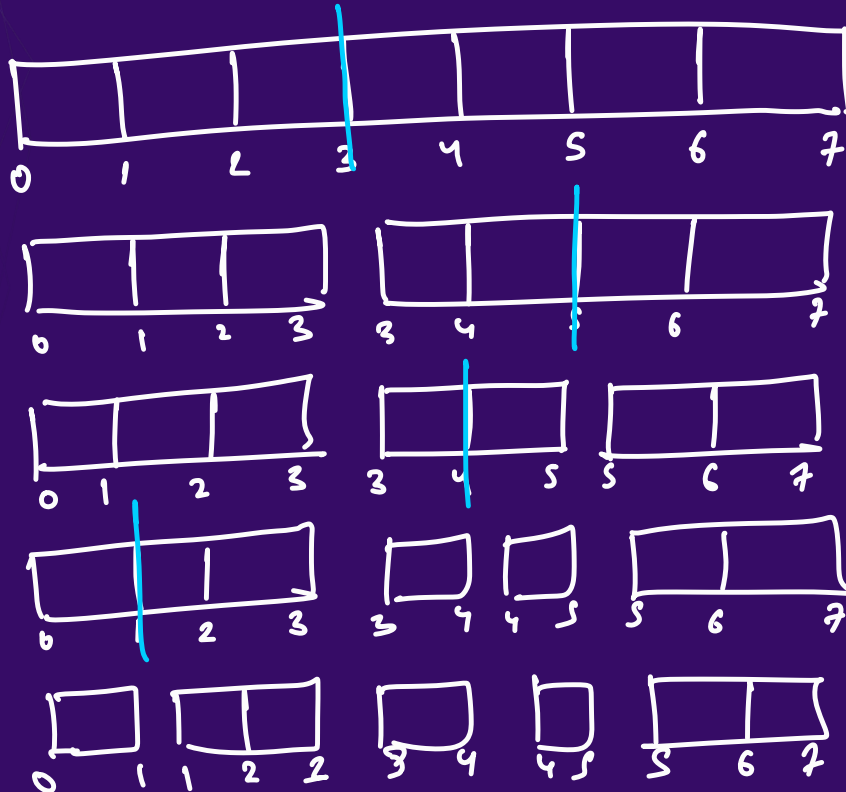
$$\text{cost} = 7 + 6 + 4 + 3 = 22$$

[Leetcode 1547]

Ques:

Q : Minimum cost to cut a stick

$n=7$



$$\text{cuts} = \{1, 3, 4, 5\}$$
$$3, 5, 4, 1$$

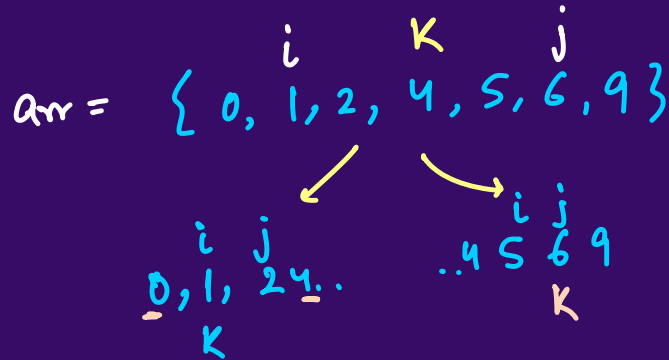
$$\text{Cost} = 7 + 4 + 2 + 3$$
$$= 16$$

[Leetcode 1547]

Ques: cuts \rightarrow sort
cuts \rightarrow front $\rightarrow 0$, end = n \rightarrow Partition DP

Q: Minimum cost to cut a stick

n=9, cuts = {5, 6, 1, 4, 2} \rightarrow

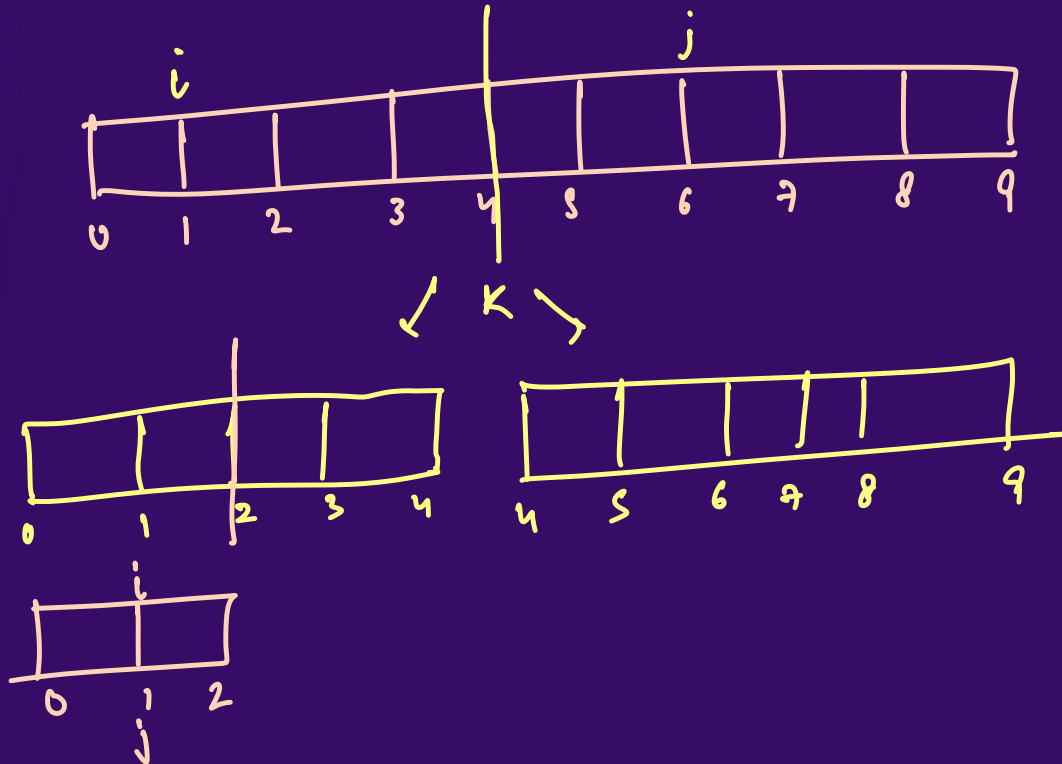


$$\text{cost}(i, j) = \text{cost}(i, k-1) + \text{cost}(k+1, j) + \underset{\substack{\downarrow \\ \text{arr}[j+1] - \text{arr}[i-1]}}{\text{len}}$$

[Leetcode 1547]

Ques:

Q : Minimum cost to cut a stick



[Leetcode 1547]

◀ **THANK YOU** ▶