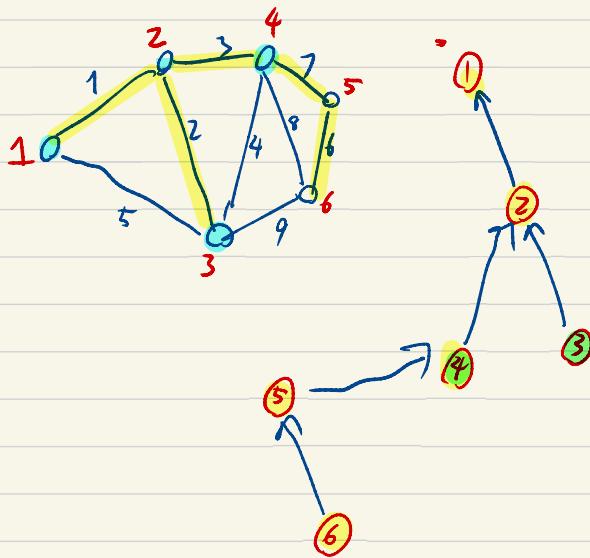




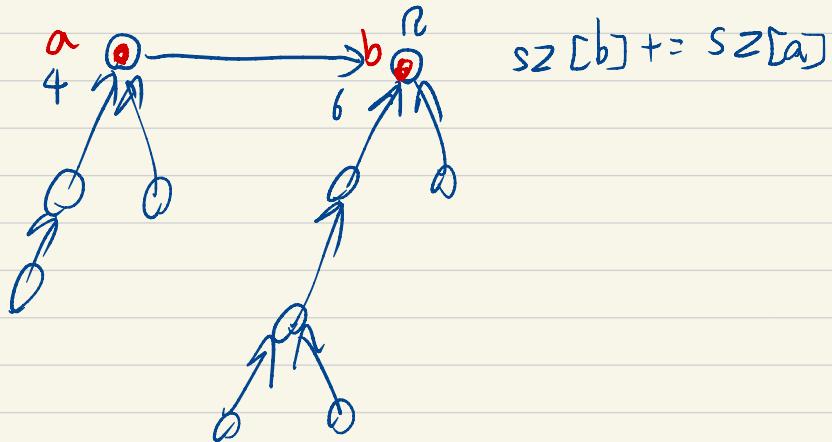
given $G = (V, E)$ $T = (V, E)$ $\sum w \text{ នៅក្នុង}$

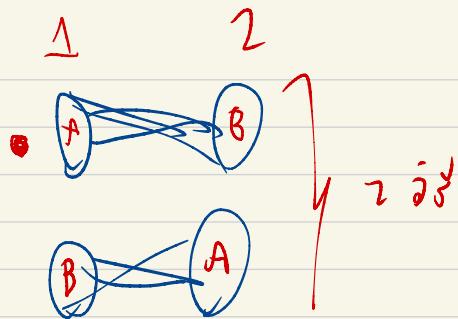


$$E_1 E_2 \dots E_k = W$$

$$\log(E_1 E_2 \dots E_k) = \log(W)$$

$$\log(E_1) + \log(E_2) + \dots + \log(E_k) = \log(W)$$





2
2 component

Dynamic Programming

- optimal sub-structure
- overlapping sub-problem

Quick Sum

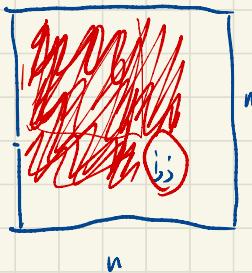
1D: Given $A[1..n]$ at query margin for $[L, R]$ $\sum_{i=L}^R A[i] = ?$

$$dp[i] = \sum_{n=1}^i A[n] = dp[i-1] + A[i] \quad O(n)$$

$$\sum_{i=L}^R A[i] = \sum_{i=1}^R A[i] - \sum_{i=1}^{L-1} A[i] = dp[R] - dp[L-1] \quad O(1)$$

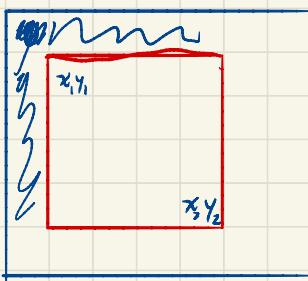


2D:



$$dp[i, j] = \text{maximum value } A[i, j] \text{ in } A[i, j]$$

$$dp[i, j] = dp[i, j-1] + dp[i-1, j] - dp[i-1, j-1] + A[i, j]$$



$$= dp[x_2, y_2] - dp[x_2, y_1-1] - dp[x_1-1, y_2] + dp[x_1-1, y_1-1]$$

Max sum

若有 $A[1 \dots n]$ 为一个整数数组，求其最大子数组和。

$O(n)$

$dp[i]$ 表示以 i 结尾的子数组和。



$$\min = 0$$

for $i=1$ to N

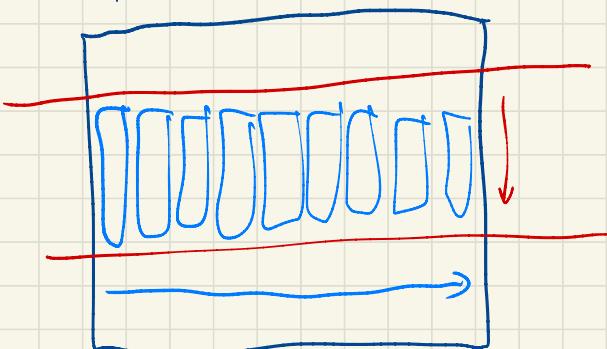
$$dp[i] += dp[i-1] + A[i]$$

$$ans = \max(ans, dp[i] - \min)$$

$$\min = \min(\min, dp[i])$$

$$dp[i] = \max(0, dp[i-1]) + A[i]$$

$$\max_i \{ dp[i] \}$$



$O(n^3)$

Longest Increasing Subsequence (LIS)

$\tilde{w} A[1..n]$

$\rightarrow A[i,j] =$	1	6	2	4	3	1	4	1	5	1
$\rightarrow dp[i,j] =$	1	2	2	2	3	3	1	4	1	5
$i =$	1	2	3	4	5	6	7	8	9	10
$j =$										
$dp[i,j] = LIS \text{ from } i$										

$O(n^2)$

for $i = 1$ to N :

 for $j = 1$ to $i-1$: $dp[i,j] = \max(dp[i,j], dp[j,j]+1)$

 if $A[i,j] < A[i,j]$:

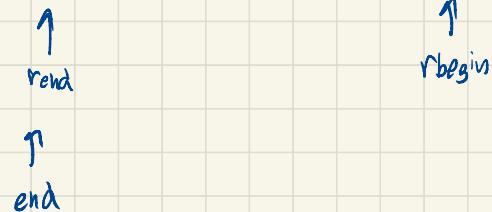
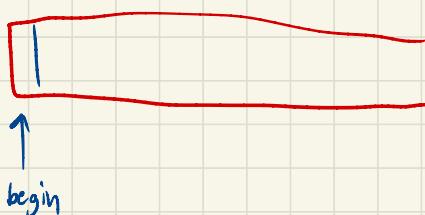
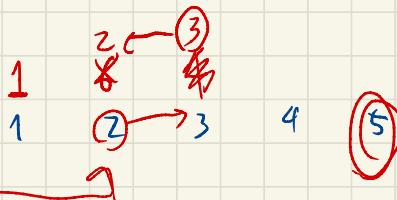
 if $dp[i,j] < dp[i,j]+1$:

$dp[i,j] = dp[i,j]+1$

 prev[i,j] = j

stack S

$dp[i,j] = LIS = i$ និងការ $A[i,j]$ និង $A[i,j]$ $O(n \log n)$



for ($it = \text{vec.begin}(); it != \text{vec.end}(); ++it$)

Longest Common Subsequence (LCS)

$A = \boxed{A \color{green}B A A C}$

$B = \boxed{C B A \color{red}C}$



$dp[i, j] = \text{LCS of } A[1..i], B[1..j]$

$$dp[i, j] = \begin{cases} dp[i-1][j-1]+1 & A[i]=B[j] \\ \max(dp[i-1][j], dp[i][j-1]) & \text{else} \end{cases}$$

DP partition

$$dp[i][j][k] \begin{cases} \text{true} & \text{manejue k en la subsecuencia } [i, j] \\ \text{false} & \text{resto} \end{cases}$$

$dp[i][j][k] \text{ true}$

$$\sqrt{dp[i][z][q_1] / dp[z+1][j][q_2]} \quad i \leq z < j$$

$$q_1 \nabla q_2 = k$$

1, 5, 10, 25, 50

11 \rightarrow $1 \times 11, (10 \times 1) + (1 \times 1), (5 \times 2) + (7 \times 1), (5 \times 1) + (1 \times 6)$
26

dp[i][j] នឹងមែនតុលាករណី នៃការស្ថិតិយវត្ថុ ដែលត្រូវបានដាក់ឡើង

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
dp[i][0]	=	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
dp[i][1]	=	1	1	1	1	2	2	2	2	3	3	3	3	3	4	4	4	4	4	5
dp[i][2]	=	1	1	1	1	2	2	2	2	4	4	4	4	4	6	6	6	6	6	9

$$dp[i][j] = dp[i][j-1] + dp[i][j-W_j]$$

Event point

Q

Query [L, R]

for i=L to R:

AC[i] += K

1	2	2	4	5	6	7	
0	9	0	0	0	0	0	$\sim 10^5$
0	0			0	0		$\sim 10^5$
1	2	2	1	1	2	1	$\sim 10^5$

(1) 1 1 1 (-1)

(1, 1), (3, -1), (3, 1), (4, -1)

1 3 2 4

for j=1 to N

AC[j] = AC[j-1]

Cnt = 1

if Cnt > 2 ans[i]