Let's start at 9:02 PM

L64

Dynamic Programming : Classical Problems 3

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RECAP

Let’s dive right into it

1. Matrix Chain Multiplication

$$\begin{bmatrix} a & b & c & d \\ e & f & g & h \end{bmatrix}_{2*4} \qquad \begin{bmatrix} \quad & \quad \\ \quad & \quad \end{bmatrix}_{4 \times C}$$

$$\begin{array}{ccccc} A & \times & B & = & C \\ \Downarrow & & \Downarrow & & \Downarrow \\ n_1 * n_2 & & n_2 * n_3 & & n_1 * n_3 \end{array}$$

$n_1 * n_2 * n_3$

$$\begin{array}{c|c} & \begin{array}{cccc} 1 & 2 & \cdots & n_2 \\ \downarrow & \downarrow & & \downarrow \end{array} \\ \begin{array}{c} 1 \rightarrow \\ 2 \rightarrow \\ \vdots \\ n_1 \rightarrow \end{array} & \left[\begin{array}{cccc} & & & \\ \\ \\ \\ \end{array} \right] \end{array} \qquad \begin{array}{c|c} & \begin{array}{cccc} 1 & 2 & \cdots & n_3 \\ \downarrow & \downarrow & & \downarrow \end{array} \\ \begin{array}{c} 1 \rightarrow \\ 2 \rightarrow \\ \vdots \\ n_2 \rightarrow \end{array} & \left[\begin{array}{cccc} & & & \\ \\ \\ \\ \end{array} \right] \end{array}$$

Example:

[40, 20, 30, 10, 30]

$(40 * 20)\ (20 * 30)\ (30 * 10)\ (10 * 30)$

$A \times B \times C \times D$

$$((\underbrace{A \times B}_{40 \times 30}) \times C)^{40 \times 10} \times D \Rightarrow 24000 + 12000 + 12000 = 48000$$

$(A \times B) \times (C \times D)$

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$$(A \times (B \times C)) \times D$$

40×20 $\quad$ 20×30 $\quad$ 10×30

$\underbrace{40 \times 20 \quad 20 \times 10}_{40 \times 10}$

$$6000 + 8000 + 12000 = 26000$$

Intuition

$M_1 \; , \; M_2 \; , \; M_3 \; , \; M_4 , \; M_5$

$M_1 \times M_{2,3,4,5}$

$M_{1,2} \times M_{3,4,5}$

$M_{1,2,3} \times M_{4,5}$

$M_{1,2,3,4} \times M_5$

$dp[i][j]$

The minimum number of multiblication operations required to multibly $[M_i, M_{i+1} \cdots M_j]$

$\Rightarrow dp[1][n]$ // n = no. of matrices

Base Case(s)

$i >= j$

$\hookrightarrow$ ans $\Rightarrow$ 0

Recurrance Relation $\Rightarrow$ How to find $f(i,j)$

$[i,\ i+1,\ i+2\ \cancel{|}\ ----\ j]$

$$f(i,j) = \min_{k=i}^{j-1}\Big(f(i,k) + f(k+1,j) + curCost\Big)$$

$R_i \times C_k$ $\qquad$ $R_{k+1} \times C_j$

$[i\ ----\ k]$ $\qquad$ $[k+1\ ------\ j]$ $\Rightarrow$ $arr[i-1] * arr[k] * arr[j]$

$\Rightarrow\ R_i * (C_k \mid R_{k+1}) * C_j$

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Solution

Let’s implement

3. Palindrome Partitioning

S = "abbabcac"

a | $\underbrace{\text{bbabcac}}_{\Uparrow}$

1 + recurs

abba | $\underbrace{\text{bcac}}_{\Uparrow}$

1 + recur

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Intuition

$s_0\ s_1\ s_2\ s_3\ \text{-----}\ s_{n-1}$

$f(i) \Rightarrow$ Represents the min cuts required for $s[i \text{---} n-1]$.

$ans \Rightarrow f(0)$

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1. $s[i \text{---} n-1]$ pal $\Longrightarrow 0$

2. $k \Rightarrow$ $s[i \text{---} k]$ palindrome.

$1 + f(k+1)$

Solution

s[i------- n-1];

```
f(i) {
  // Base
  // Memo

  for (k = i; k + 1 < n; ++k) {
      if (!pal(i, k))
            continue;

      currAns = 1 + f(k + 1);
      dp[i] = min(dp[i], currAns);
  }
}
```

$$pal(i,j) = s[i] == s[j] \;\&\&\; pal(i+1, j-1);$$

Let’s implement

Thank You!

Reminder: Going to the gym & observing the trainer work out can help you know the right technique, but you'll muscle up only if you lift some weights yourself.

So, PRACTICE, PRACTICE, PRACTICE!