COP 3503 4/14

(1) Matrix Chain Mult DP

$A_0 A_1 A_2 \ldots A_{n-1}$

$2\times5, 5\times3, 3\times7, 7\times1, 1\times2$

(a) To mult $r_1 \times c_1$ mat by $r_2 \times c_2$ mat
$c_1 = r_2$.

(b) Amt of work = $r_1 \times c_1 \times c_2$

(c) Result has dimensions $r_1 \times c_2$

(d) Matrix Mult Associative
$(A_1 A_2) A_3 = A_1 (A_2 A_3)$

A_0 A_1 A_2
2×5 5×3 3×7

$(A_0 A_1) A_2$
$30 + 0 = 30$
$2\times3 \times 3\times7 + 42$
72

$A_0 (A_1 A_2)$
$0 + 105 = 105$
$2\times5 \times 5\times7 + 70$
175

How to Solve Recursively

$A_0 A_1 A_2 A_3 A_4$] 1st level split could be anywhere — n-1 options

$A_0 \mid (A_1 A_2 A_3 A_4)$ $(A_0 A_1 A_2) \mid (A_3 A_4)$
$(A_0 A_1) \mid (A_2 A_3 A_4)$ $(A_0 A_1 A_2 A_3) \mid A_4$

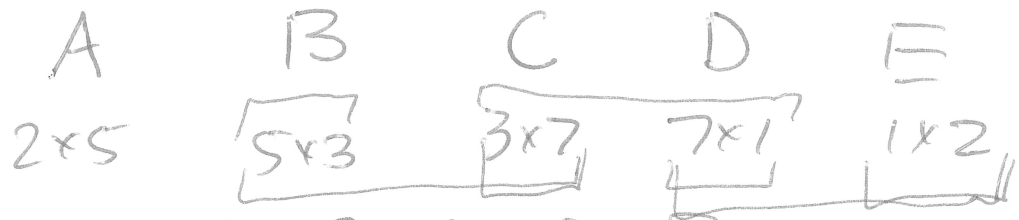
$f(i,j)$ = min mult calculate

$A_i A_{i+1} \cdots A_j$

Pseudocode Idea

```
f(i,j) {
    if (memo[i][j] != -1) return memo[i][j];
    if (i == j) return 0;
    int ans = MAX;
    for (split = i; split < j; split++) {
        int left = f(i, split);
        int right = f(split+1, j);
        int extra = r[i] x c[split] x c[j];
        ans = min(ans, left+right+extra);
    }
    memo[i][j] =
    return ans;
}
```

Add to speed up.



	A	B	C	D	E
A	0	30	72	46	50
B	x	0	105	36	46
C	x	x	0	21	27
D	x	x	x	0	14
E	x	x	x	x	0

A×B $2\times5\times3=30$
B×C $5\times3\times7=105$
C×D $3\times7\times1=21$
D×E $7\times1\times2=14$

ABC = (AB)C → 72
A(BC) → 175

BCD = (BC)D → $105+5\times7\times1 = 140$

B(CD) → $21+5\times3\times1 = 36$

CDE = (CD)E → $21+3\times1\times2 = 27$
C(DE) → $14+3\times7\times2 = 56$

ABCD = (ABC)D → $72+2\times7\times1 = 86$

(AB)(CD) → $30+21+2\times3\times1 = 57$

A(BCD) → $36+2\times5\times1 = 46$

BCDE = (BCD)E → $36+5\times1\times2 = 46$
(BC)(DE) → $105+14 \Rightarrow X$
B(CDE) → $27+5\times3\times2 = 57$

ABCDE: (ABCD)E
$46+2\times1\times2 = 50$
(ABC)(CDE)
→ 72 X
(AB)(CDE)
$30+27 \rightarrow X$
A(BCDE)
$46+2\times5\times2 = 66$

Edit Distance

s → starting string
t → target string
bool: transform s into t via follow steps
(a) add letter (insert)
(b) remove letter
(c) change a letter

ed("house", "mouse") = ed("hous", "mous")
↳ greedy match

ed("house", "paper") = min { ed("hous", "pape") + 1
ed("hous", "paper") + 1
ed("house", "pape") + 1

Similar in Structure to LCS

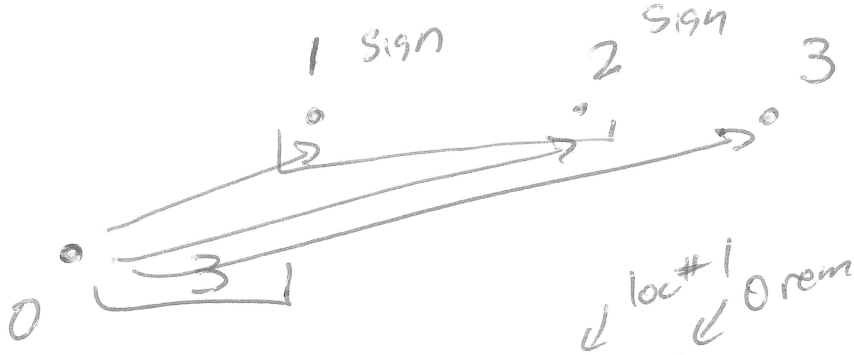
* Note: Add typing distance to extra notes

at ↓ how many removed

$f(\text{location}, \text{numR})$ → how much time to complete the race.

$f(\text{end}, n) = 0$ (already there)

$f(\text{beginning}, 0) = \text{answer}$



$5 \times 3 + f(1, 0)$ ← loc#1, 0 remo

$5 \times 4 + f(2, 1)$ ← 1 rem sign → loc 2

$5 \times 8 + f(3, 2)$