Optimal Merge Pattern — Greedy Method

given
2 sorted lists   combined

A	B	C
3	5	3
8	9	5
12	11	8
20	16	11
m	n	12
		16
		20

compared one by one

time $O(m+n)$
to $O(8)$ in this scenario

what about more than 2 lists?

List →	A	B	C	D
size →	6	5	2	3

two way merging (2 lists at time)

```
A    B       C    D
6    5       2    3
 \  /
  (11)
    \
    (13)
       \
       (16)
```
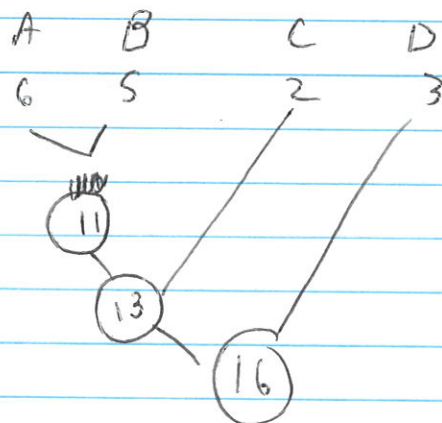
total merging d?

$11 + 13 + 16 = 40$

other way

```
A    B    C    D
6    5    2    3
 \  /      \  /
 (11)      (5)
    \      /
     (16)
```
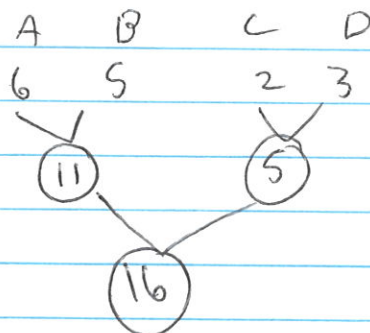
total cost: $11 + 5 + 16 = 32$

many possibilities

```
A    B    C    D
6    5    2    3
            \  /
            (5)
          /
      (10)
     /
  (16)
```

best

$cost = 16 + 10 + 5 = 31$

Merge pairs of smallest size lists.
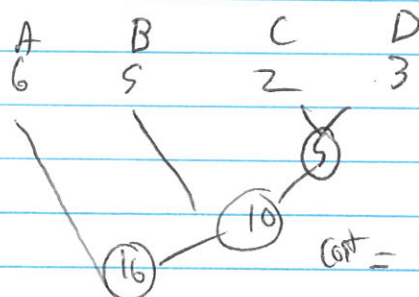
Optimal Merge Pattern

list →	X_1	X_2	X_3	X_4	X_5
sizes →	20	30	10	5	30

```
                          (95)
              (35)                      (60)
       (15)          \            /           \
    /       \         \         [30]          [30]
  (5)      [10]      [20]        X₂            X₅
   X₄       X₃        X₁
```
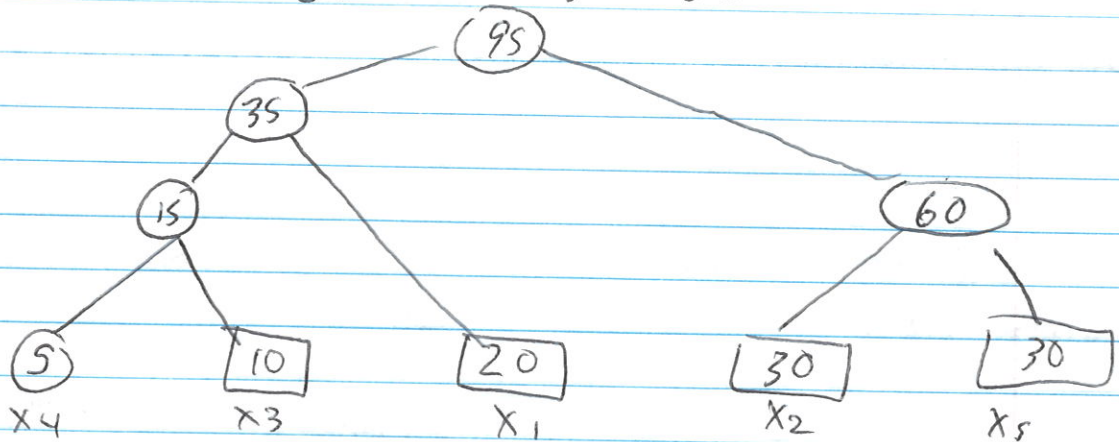
cost: $15 + 35 + 95 + 60 = 205$

distances: $3 \times 5 + 3 \times 10 + 2 \times 20 + 2 \times 30 + 2 \times 30 = 205$

$\sum d_i \times x_i$