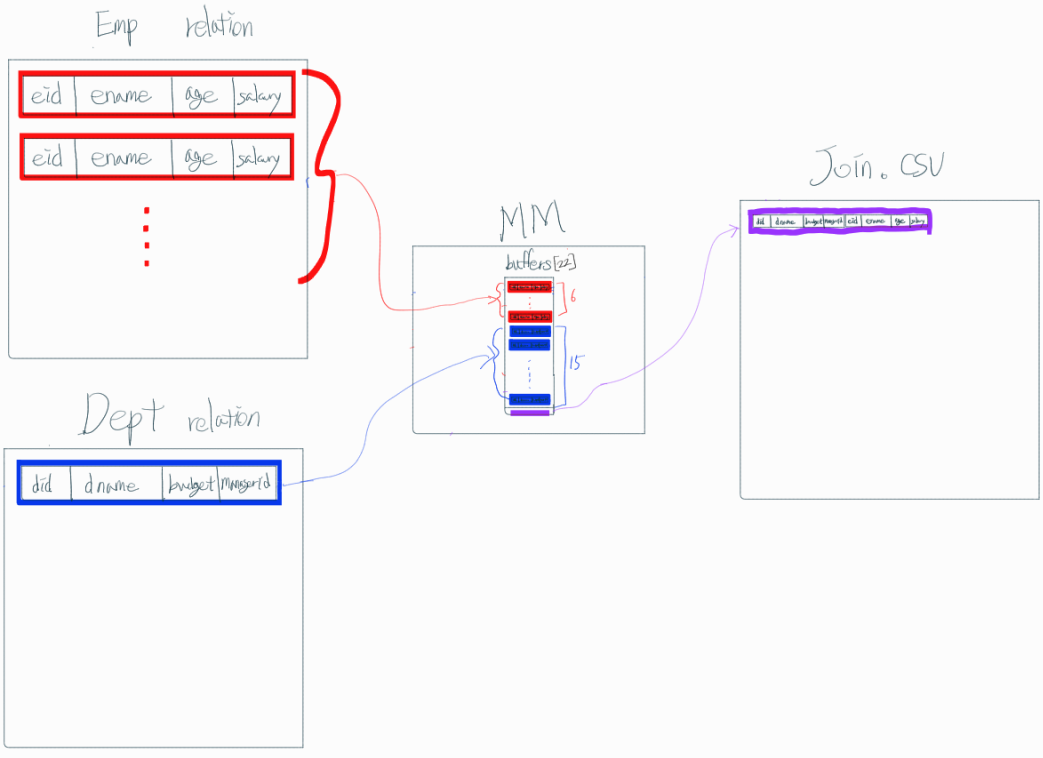
✕ Join two tuple



① 각 Emp, Dept relation sorting [키로]

pass 1

② Sorted_Dept 에서 레코드를 읽어서 buffer에 넣기
15개씩 (Dept)
+
6개씩 (Emp)
+
1개 (output)
=
22개

③ Sorted_Emp에서 튜플 가져오기
6개씩

phase 2

④ Sorting buffer

⑤ buffer 비교

⑥ Natural Join 이므로
- Emp attributes
- Dept attributes

차례대로 Join.csv 에 쓰기

Dept_total record > 0

```
while (Dept_total record > 0) {
  empRecord = buffers[i] → i = 0 ~ 19
  deptRecord = buffers[buffer_size - 2] → 20
  if (empR == deptR)
    joinR (empR + deptR)
    다음 dept 가져오기
    Dept_total recode--;
```

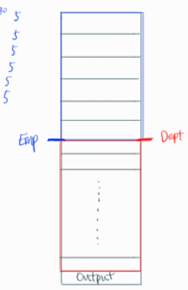
i = 19 까지 갔으면
- flush buffer
- buffers 에 empRecord 20개 채우기
- sort
- Dept 추가.
- i = 0

i++;

60: 10, 10, 10, 10, 10, 10

30: 5, 5, 5, 5, 5, 5

NumPage = 6



empCount = total

35: 6, 6, 6, 6, 6, 5

31: 6, 5, 5, 5, 5, 5

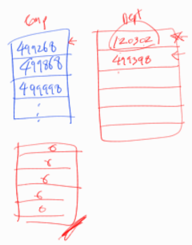
[5, 5, 5, 5, 5, 5]

35 % 6 != 0

remainder = 5

```
for (int i = 0; i < totalpage; i++)
    ep[i] = totalrecords / 6;

if (remainder > 0) {
    ep[0] += 1;
    remainder -= 1;
}
```



$(R \bowtie S) \bowtie U$

ABC　BC.

$5B(R) + 5B(U)$

$500k + 5k = 505k$

$35k + 505k = 540k$

$10k + 5 \times 500$

25k

2　$B(R \bowtie S)$

$(R \bowtie_B S) \Rightarrow$ cost: $5 \times 1000 + 5 \times 750 = 8.75k$ (5000, 3750)

$B(R) = 1000$　output size: $\frac{4000 \times 15}{1} = 60k$

$B(S) = 750$

$B(W) = 500$

$B(U) = 250$.

4000×15: 20000, 4000, 60000

$(R \bowtie_C S) \Rightarrow$ cost: $5 \times 1000 + 5 \times 750 = 8.75k$

output size: $\frac{4000 \times 10}{1} = 40k$

$(R \bowtie_{B,C} S) \Rightarrow$ cost: $5 \times 1000 + 5 \times 750 = 8.75k$

output size: $\frac{20 \times 10}{1} = 200$

ABCD　BC

$(R \bowtie U) \bowtie_B S \Rightarrow$ cost: $6.25k + (5 \times 10k + 5 \times 750) = 60k$ (53.75k; 50k, 3.75k)

output size: $\frac{40k \times 15}{1} = 800k$

$(R \bowtie U) \bowtie_C S \Rightarrow$ cost: 60k

output size: $\frac{40k \times 10}{1} = 400k$

$(R \bowtie U) \bowtie_{B,C} S \Rightarrow$ cost: 60k

output size: $\frac{2 \times 1}{1} = 2k$

ABCD　BD

$((R \bowtie U) \bowtie S) \bowtie_B W \Rightarrow$ cost: $60k + (5 \times 500 + 5 \times 500) = 65k$ (5k)

205k

$(R \bowtie S) \bowtie_B W \Rightarrow$ cost: $8.75k + (5 \times 50 + 5 \times 500) = 11.5k$ (ABC, BD; 250, 2500)

output size: $\frac{200 \times 2000}{200} = 2k$

$((R \bowtie S) \bowtie W) \bowtie U \Rightarrow$ cost: $11.5k + (5 \times 500 + 5 \times 250) = 15.25k$ (3.75k; 2500, 1250)

$(R \bowtie S) \bowtie_A U \Rightarrow$ cost: $8.75k + (5 \times 50 + 5 \times 250) = 10.25k$ (ABC, AD; 1.5k; 250, 1250)

output size: $\frac{200 \times 1000}{100} = 2k$

$((R \bowtie S) \bowtie U) \bowtie W \Rightarrow$ cost: $10.25k + (5 \times 500 + 5 \times 500) = 15.25k$ (ABCD, BD; 5k)

$(W \bowtie_D U) \Rightarrow$ cost: $5 \times 500 + 5 \times 200 = 3.5k$ (2500, 1000)

output size: $\frac{2000 \times 1000}{100} = 20k$

ABD, ABC: $(W \bowtie U) \bowtie_A R \Rightarrow$ cost: $5 \times 20k + 5 \times 1000 = 105k$ (100k, 5k; corrected: 5k, 30k, +3.5k)

output size: $\frac{20k \times 4000}{100} = 800k$

$(W \bowtie U) \bowtie_B R \Rightarrow$ cost: $5 \times 20k + 5 \times 1000 = 105k$ (+3.5k)

output size: $\frac{20k \times 4000}{200} = 400k$

$(W \bowtie U) \bowtie_{AB} R \Rightarrow$ cost: $5 \times 20k + 5 \times 1000 = 105k$ (5k; 5k + 3.5k = 33.5k)

output size: $\frac{20k \times 4000}{100 \times 200} = 4k$

$((W \bowtie U) \bowtie R) \bowtie S \Rightarrow$ cost: $33.5k + (5 \times 1k + 5 \times 750) = 42.25k$ (5000, 3750; 33.5 + 8.75k = 42.25k)

$(S \bowtie_B W) \Rightarrow$ cost: $5 \times 750 + 5 \times 500 = 6.25k$ (3750, 2500)

output size: $\frac{3000 \times 2000}{100} = 60k$

BCD, AD: $(S \bowtie W) \bowtie_D U \Rightarrow$ cost: $6.25k + (5 \times 15k + 5 \times 250) = 82.5k$ (76.25k; 75k, 1.25k)

output size: $\frac{60k \times 1000}{100} = 600k$

$((S \bowtie W) \bowtie U) \bowtie R \Rightarrow$ cost: $82.5k + (5 \times 150k + 5 \times 1000) = 837.5k$ (755k; 755 + 82.5 = 837.5)

BCD, ABC: $(S \bowtie W) \bowtie R \Rightarrow$ cost: $6.25k + (5 \times 15k + 5 \times 1000) = 86.25k$ (80k; BC)

O.S: $\frac{60000 \times 4000}{200 \times 300} = 4k$

$((S \bowtie W) \bowtie R) \bowtie U \Rightarrow$ cost: $86.25k + (5 \times 1k + 5 \times 250)$ (6.25k; 5k + 1.25k)

$= 92.5k$

$(R \bowtie_B W) \Rightarrow$ cost: $5 \times 1000 + 5 \times 500 = 7.5k$ (5000, 2500)

output size: $\frac{4000 \times 2000}{200} = 40k$

ABCD, AD: $(R \bowtie W) \bowtie U \Rightarrow$ cost: $7.5k + (5 \times 10k + 5 \times 250) = 58.75k$ (51.25k; 50k, 1.25k)

O.S: $\frac{40k \times 1000}{100 \times 100} = 4k$

$((R \bowtie W) \bowtie U) \bowtie S \Rightarrow$ cost: $58.75k + (5 \times 1k + 5 \times 750) = 67.5k$ (8.75k; 5k, 3750)

ABCD, BC: $(R \bowtie W) \bowtie S \Rightarrow$ cost: $7.5k + (5 \times 10k + 5 \times 750) = 61.25k$ (53.75k; 50k, 3750)

O.S: $\frac{40000 \times 3000}{200 \times 300} = 2k$

ABCD, AD: $((R \bowtie W) \bowtie S) \bowtie U \Rightarrow$ cost: $61.25k + (5 \times 500 + 5 \times 250) = 65k$ (3.75k)

ABD, BC: $(W \bowtie U) \bowtie_B S \Rightarrow$ cost: $3.5k + (5 \times 5k + 5 \times 750) = 32.25k$ (28.75k; 25k, 3.75k)

output size: $\frac{20k \times 3000}{100} = 600k$

$((W \bowtie U) \bowtie S) \bowtie R \Rightarrow$ cost: $32.25k + (5 \times 150k + 5 \times 1k) = 787.25k$ (755k)

$(R \bowtie_A U) \Rightarrow$ cost: $5 \times 1000 + 5 \times 250 = 6.25k$ (5000, 1250)

output size: $0.01\, T(R) \times T(U) = \frac{4000 \times 1000}{100} = 4k$

ABCD, BD: $(R \bowtie U) \bowtie W \Rightarrow$ cost: $6.25k + (5 \times 10k + 5 \times 500) = 58.75k$ (52.5k; 2500)

O.S: $\frac{40000 \times 2000}{200 \times 100} = 4k$

$((R \bowtie U) \bowtie W) \bowtie S \Rightarrow$ cost: $58.75k + (5 \times 1k + 5 \times 750)$ (8.75k; 5000, 3750)

$= 67.5k$

- R – S
  - W – U ⇒ 15.25k
  - U – W ⇒ 15.25k
- R – W
  - S – U ⇒ 65k
  - U – S ⇒ 67.5k
- R – U
  - W – S ⇒ 67.5k
  - S – W ⇒ 65k
- S – W
  - U – R ⇒ 837.5k
  - R – U ⇒ 93.5k
- W – U
  - R – S ⇒ 42.25k

W–U

└ S–R ⇒ 787,25k