

CSE 444: Database Internals

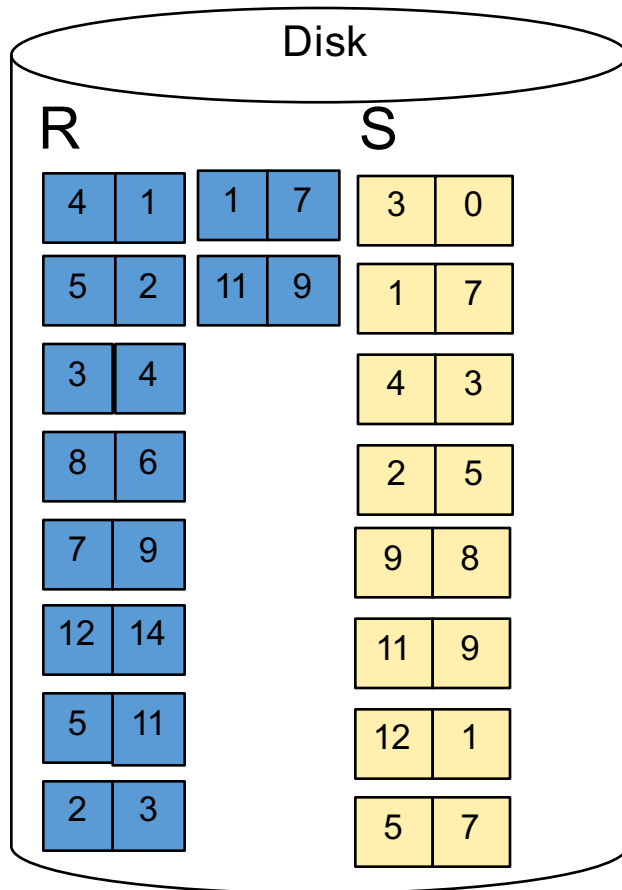
Lecture 8

Operator Algorithms (part 2)

WHITE BOARD EXAMPLE

Relation R: 10 pages
Relation S: 8 pages
Memory: 5 pages

Each page holds 2 tuples
We only show value of join attribute for each tuple

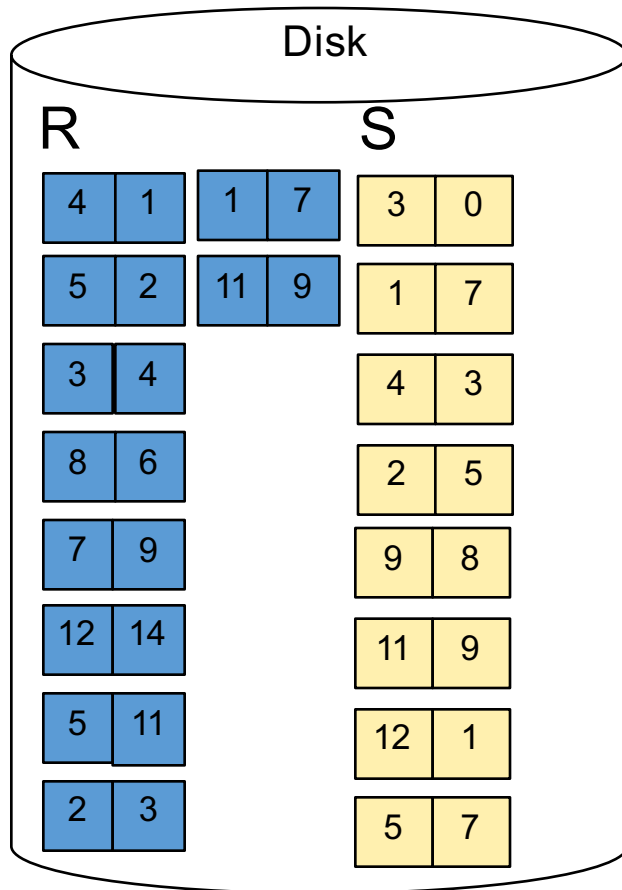


Memory M = 5 pages



Grace Join
Also called
Partitioned Hash-Join Example

Step 1: Read relation S one page at a time and hash into M-1 (=4 buckets)

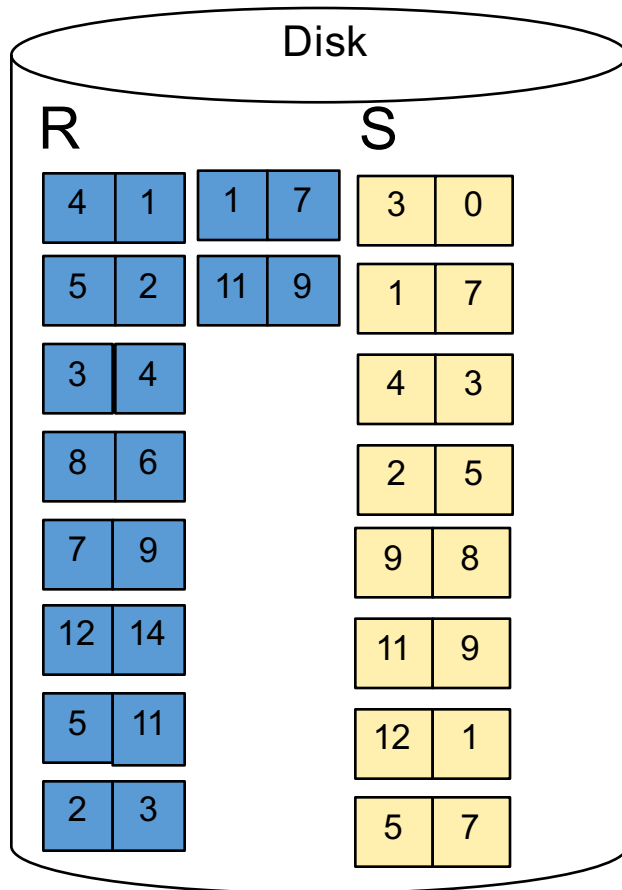


Memory M = 5 pages

Hash h: value % 4

Input buffer	0	
	1	
	2	
	3	

Step 1: Read relation S one page at a time and hash into the 4 buckets

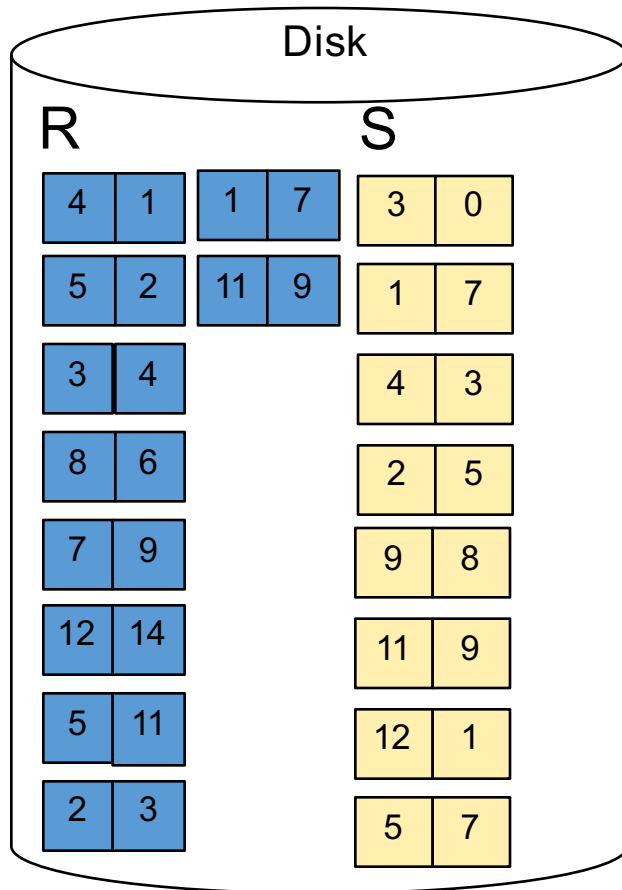


Memory M = 5 pages

Hash h: value % 4

Input buffer	0	0	
	1		
	2		
	3	3	

Step 1: Read relation S one page at a time and hash into the 4 buckets

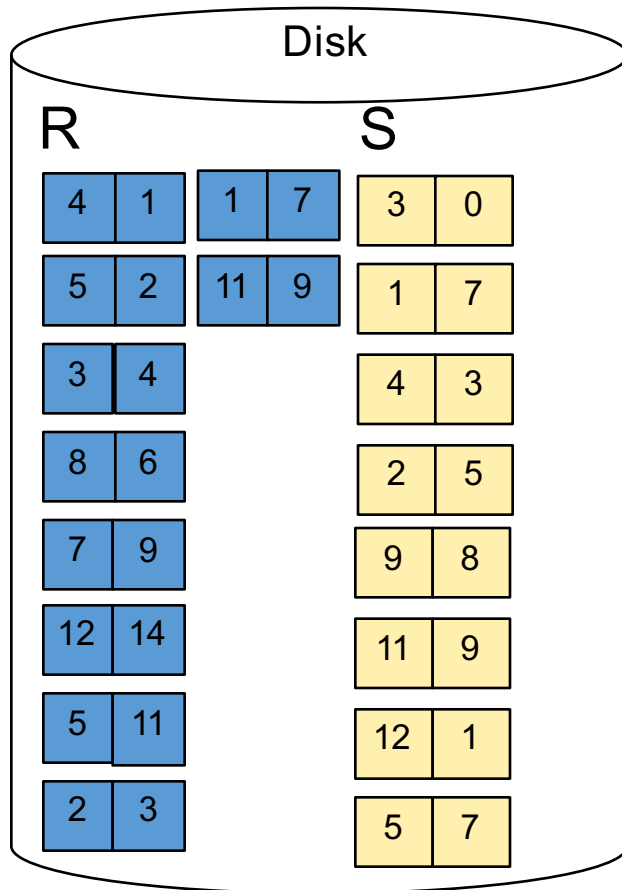


Memory M = 5 pages

Hash h: value % 4

Input buffer	0	0	
	1		
	2		
	3	3	

Step 1: Read relation S one page at a time and hash into the 4 buckets

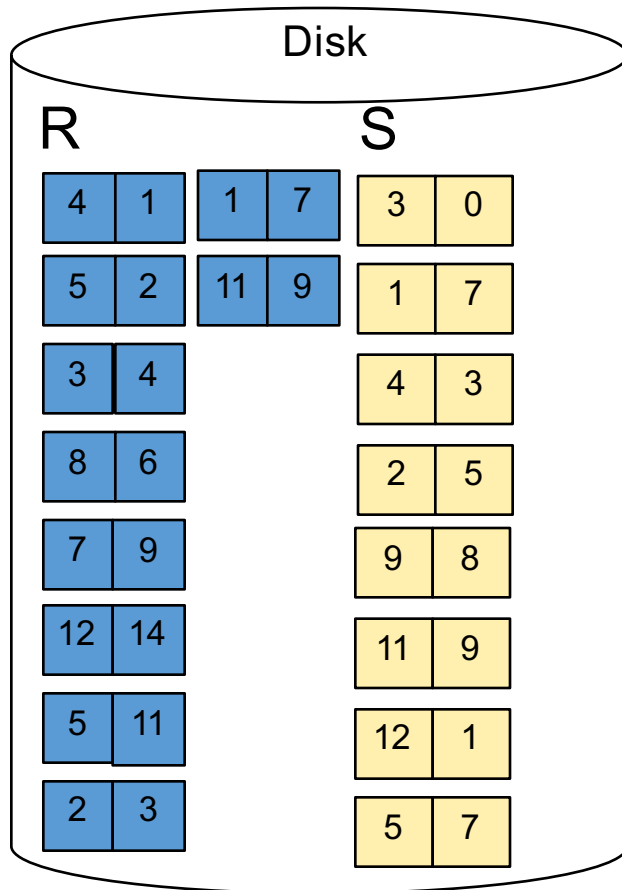


Memory M = 5 pages

Hash h: value % 4

Input buffer	0	0	
	1	1	
	2		
	3	3	7

Step 1: Read relation S one page at a time and hash into the 4 buckets

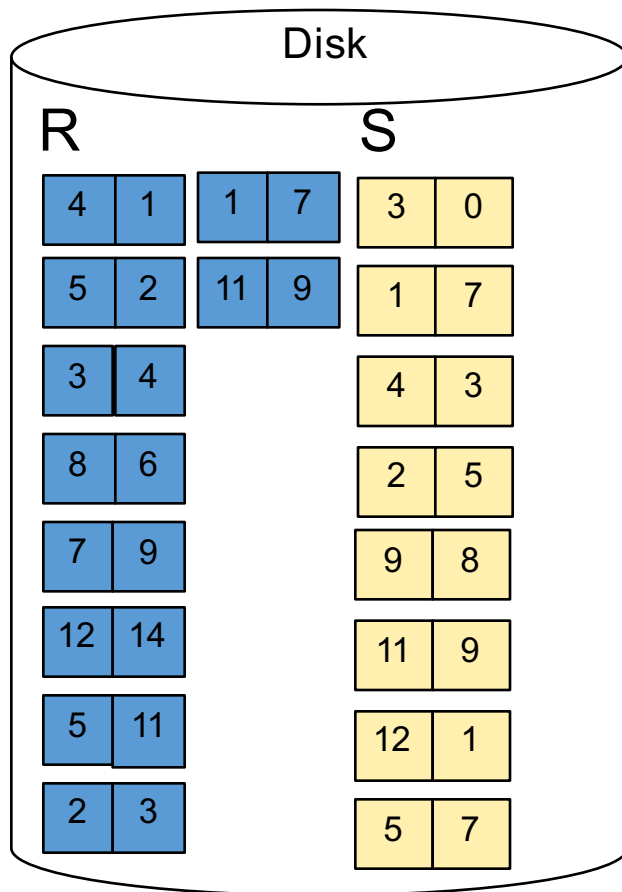


Memory M = 5 pages

Hash h: value % 4

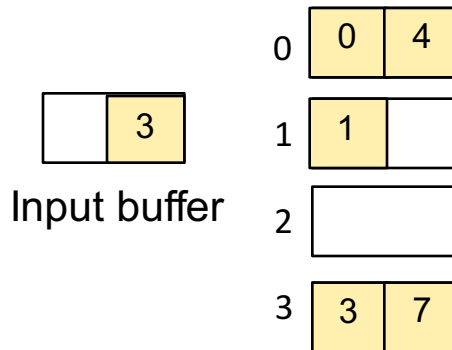
Input buffer	0	0	
	1	1	
	2		
	3	3	7

Step 1: Read relation S one page at a time and hash into the 4 buckets
When a bucket fills up, flush it to disk

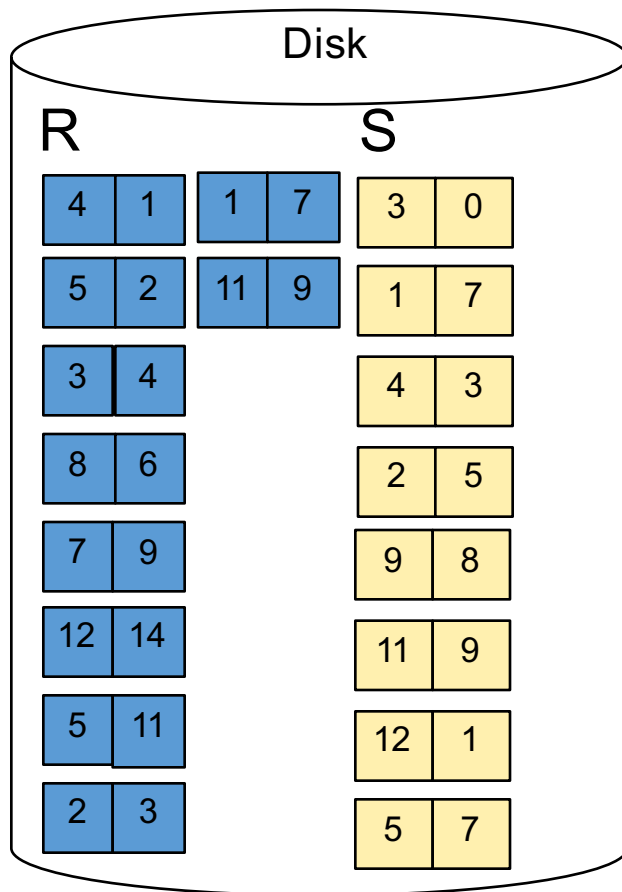


Memory M = 5 pages

Hash h: value % 4

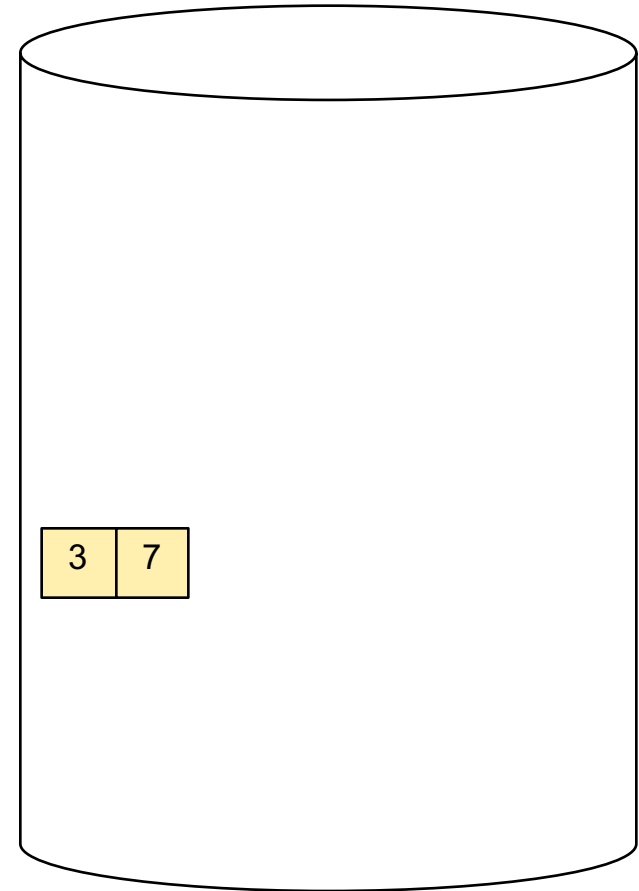
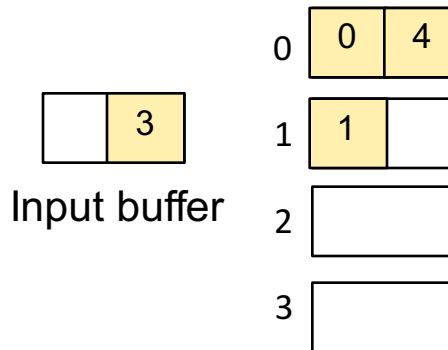


Step 1: Read relation S one page at a time and hash into the 4 buckets
When a bucket fills up, flush it to disk

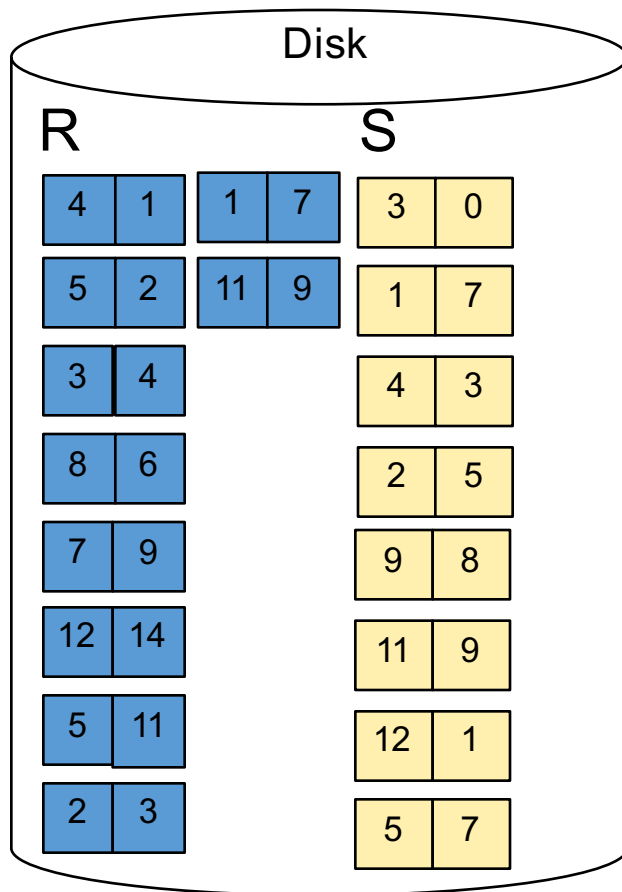


Memory M = 5 pages

Hash h: value % 4



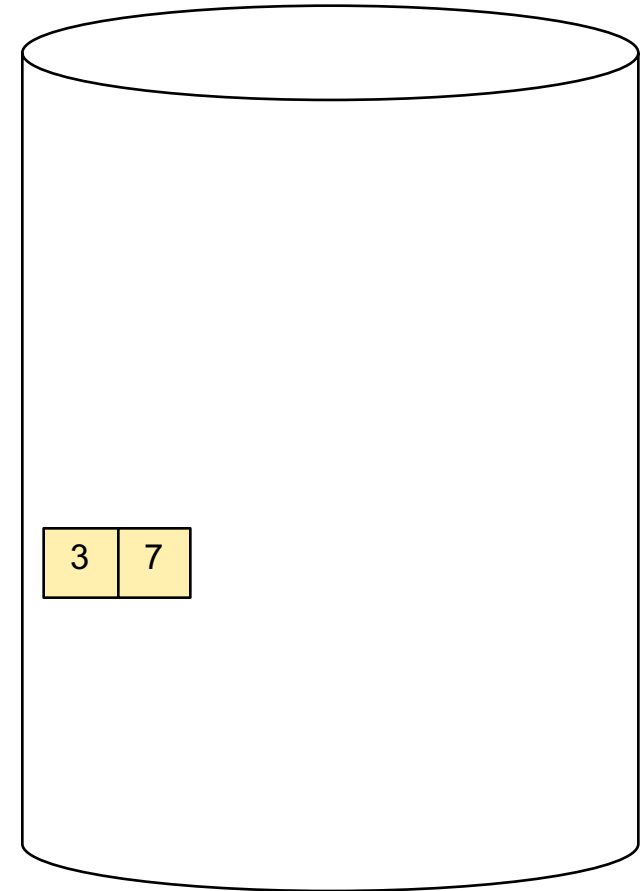
Step 1: Read relation S one page at a time and hash into the 4 buckets
When a bucket fills up, flush it to disk



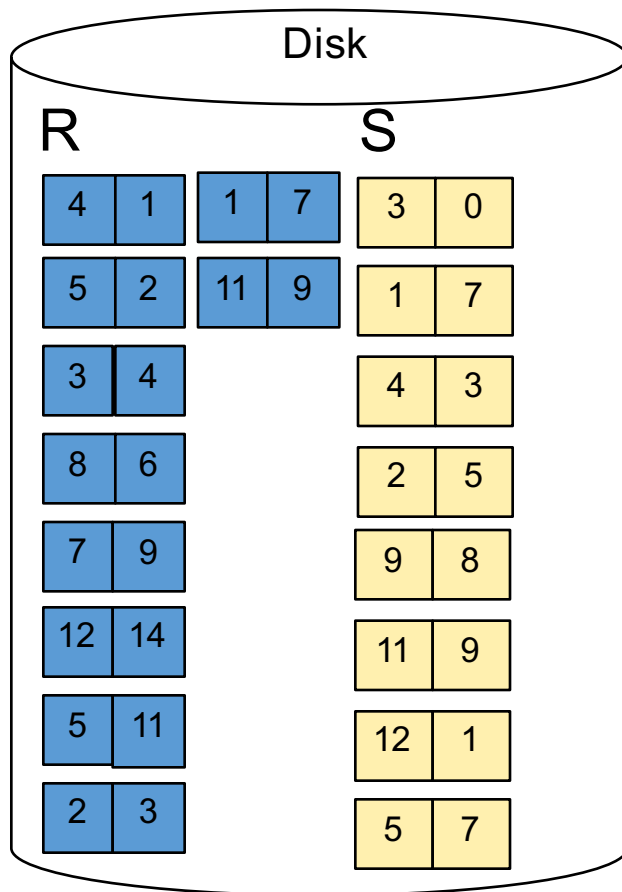
Memory M = 5 pages

Hash h: value % 4

Input buffer	0	0	4
	1	1	
	2		
	3	3	



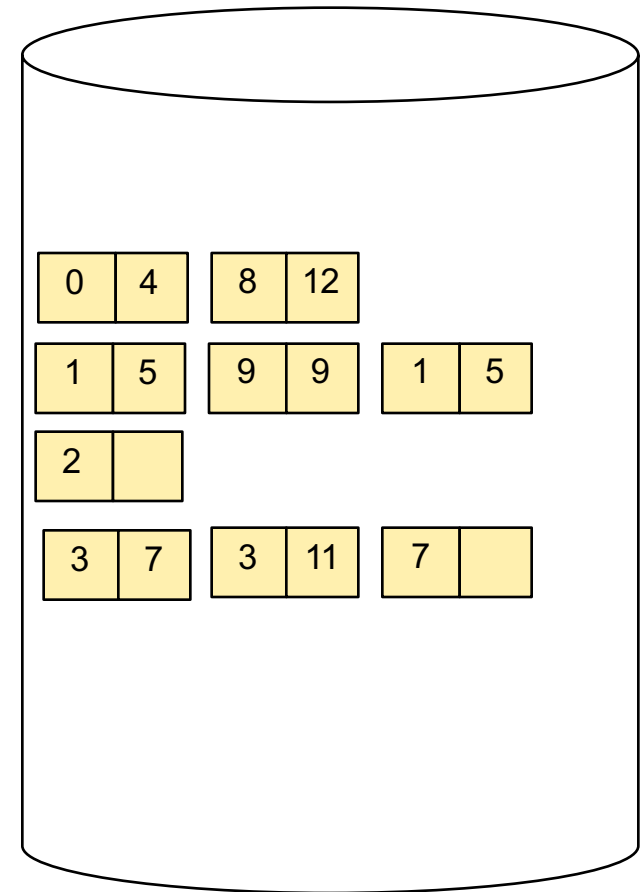
Step 1: Read relation S one page at a time and hash into the 4 buckets
 At the end, we get relation S back on disk split into 4 buckets



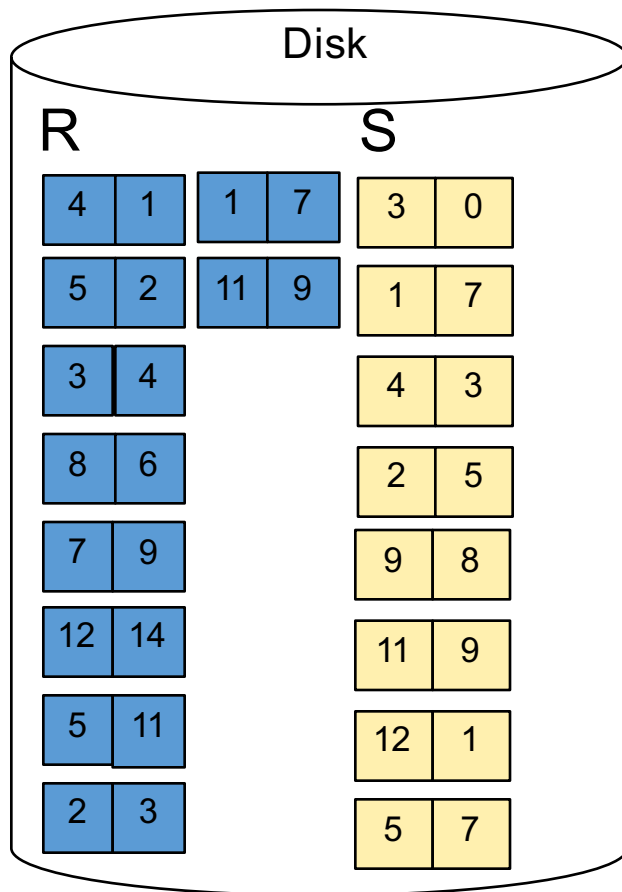
Memory M = 5 pages

Hash h: value % 4

	0	
	1	
Input buffer	2	
	3	



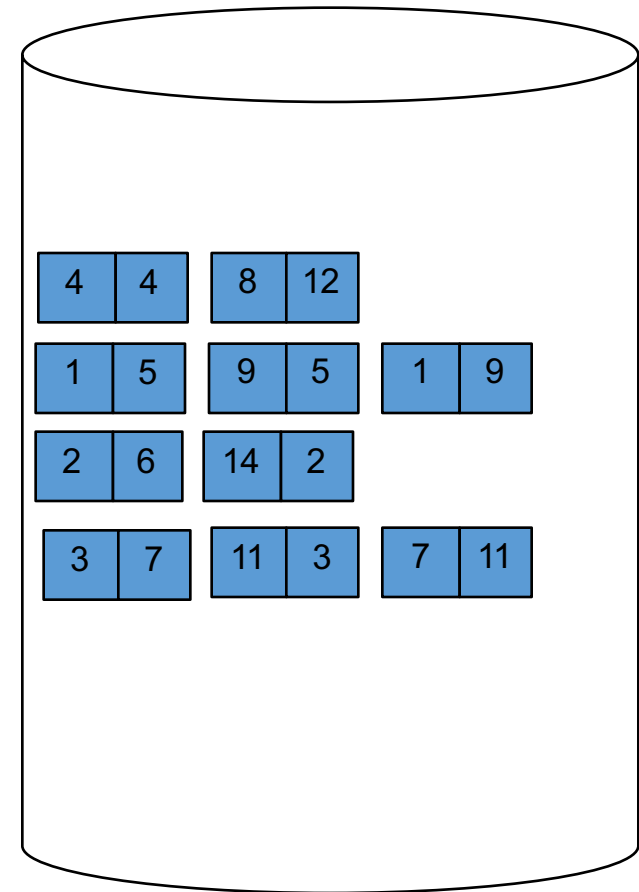
Step 2: Read relation R one page at a time and hash into same 4 buckets



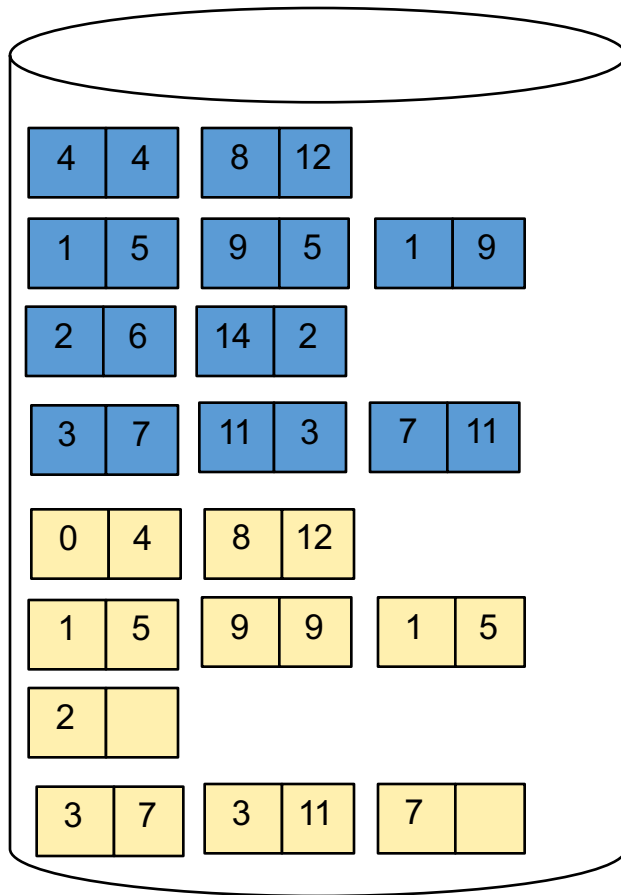
Memory M = 5 pages

Hash h: value % 4

	0	
	1	
Input buffer	2	
	3	

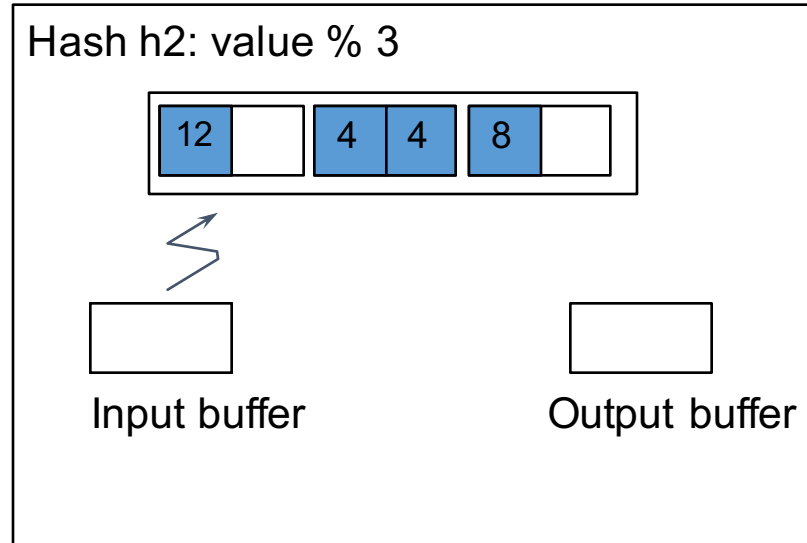


Step 3: Read one partition of R and create hash table in memory using a different hash function



Memory M = 5 pages

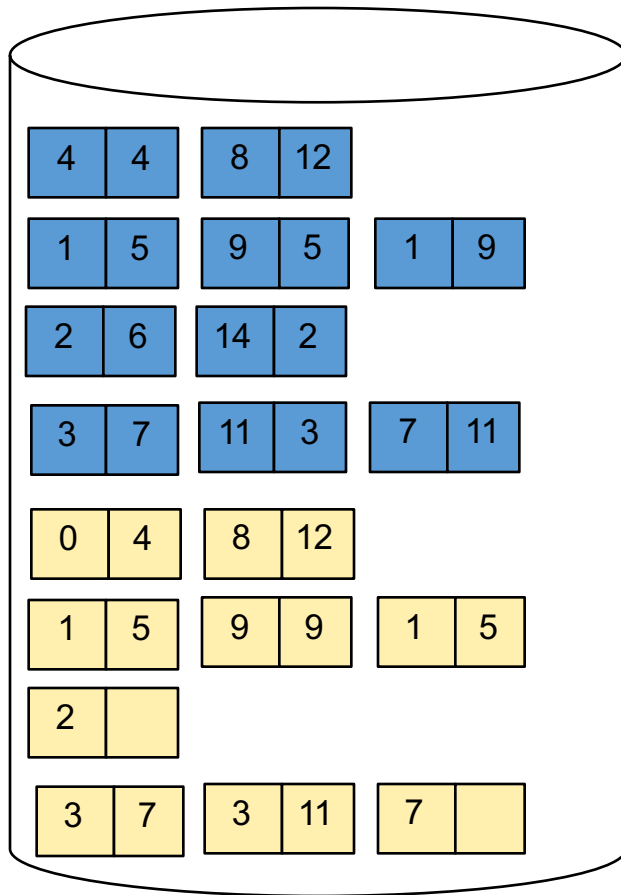
Hash h2: value % 3



Step 4: Scan matching partition of S and probe the hash table

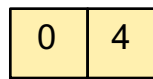
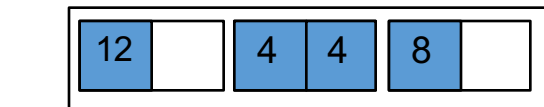
Step 5: Repeat for all the buckets

Total cost: $3B(R) + 3B(S)$

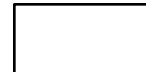


Memory $M = 5$ pages

Hash h_2 : $\text{value} \% 3$



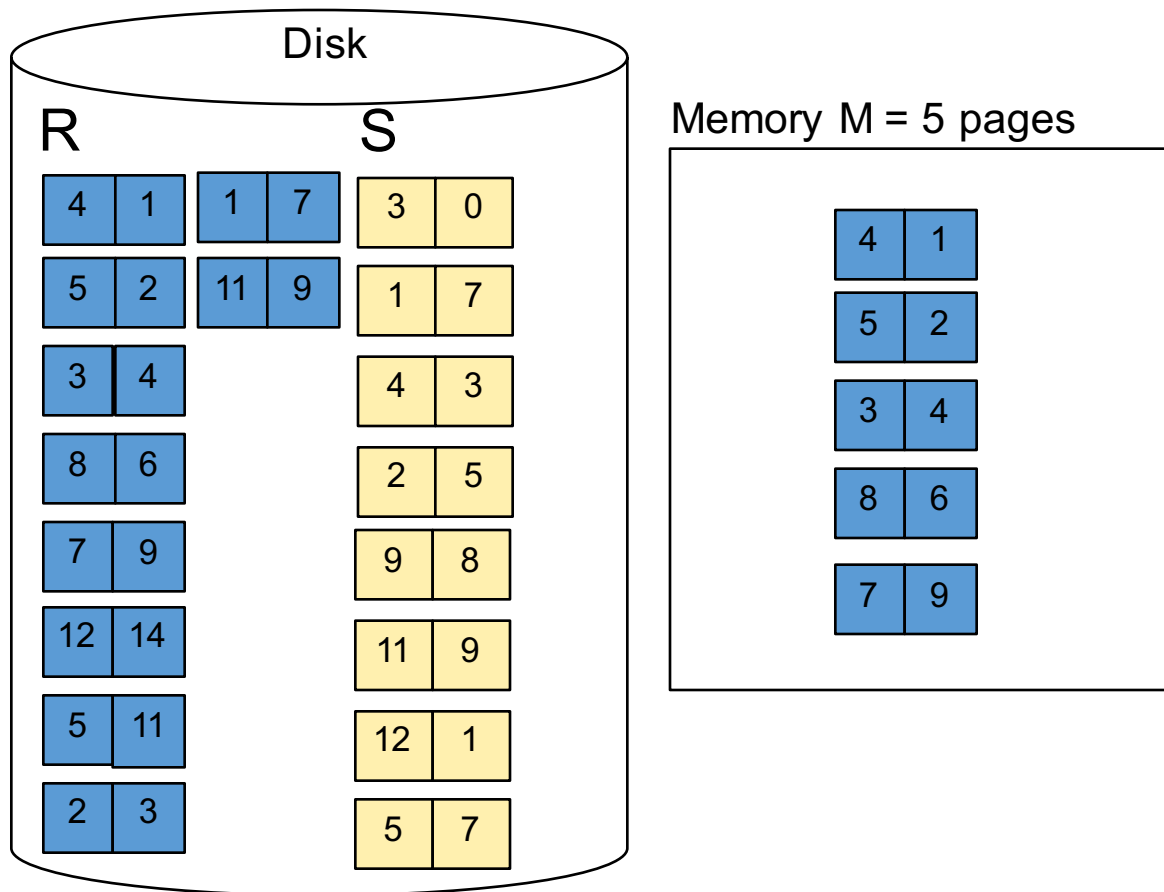
Input buffer



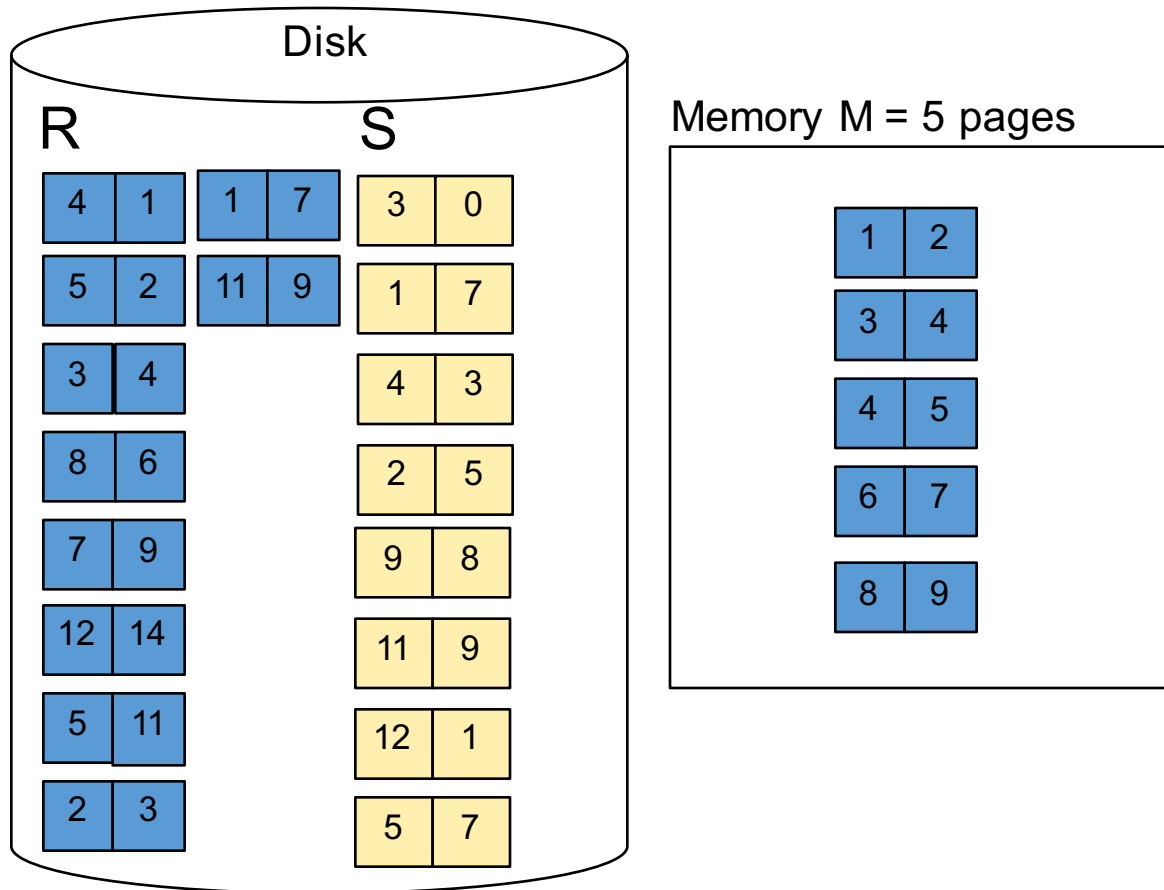
Output buffer

External Merge Join

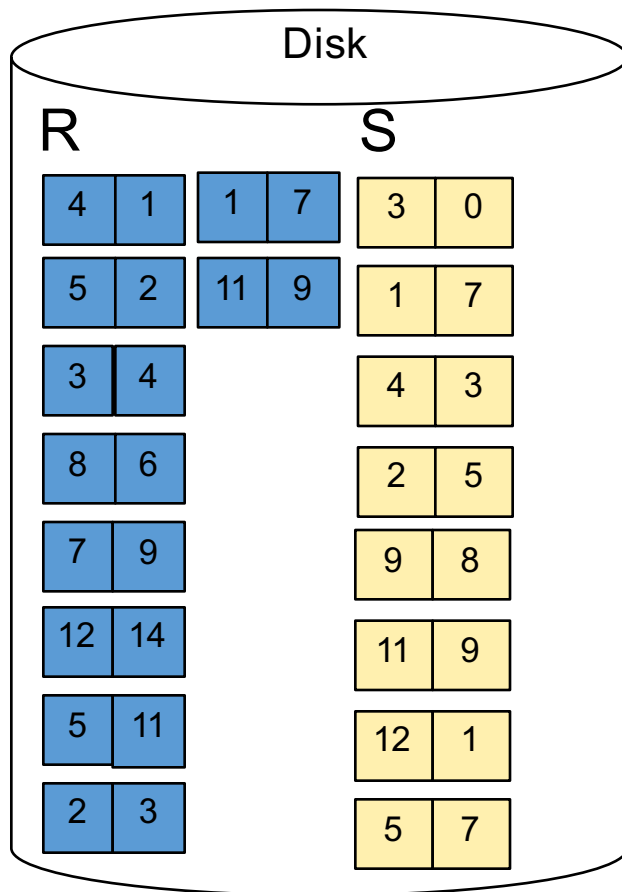
Step 1: Read M pages of R and sort in memory



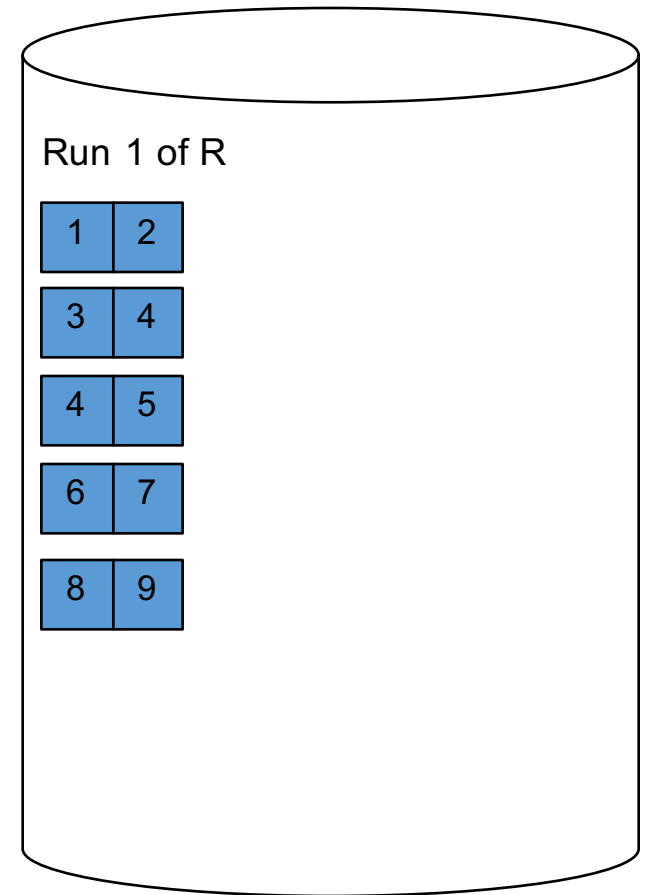
Step 1: Read M pages of R and sort in memory



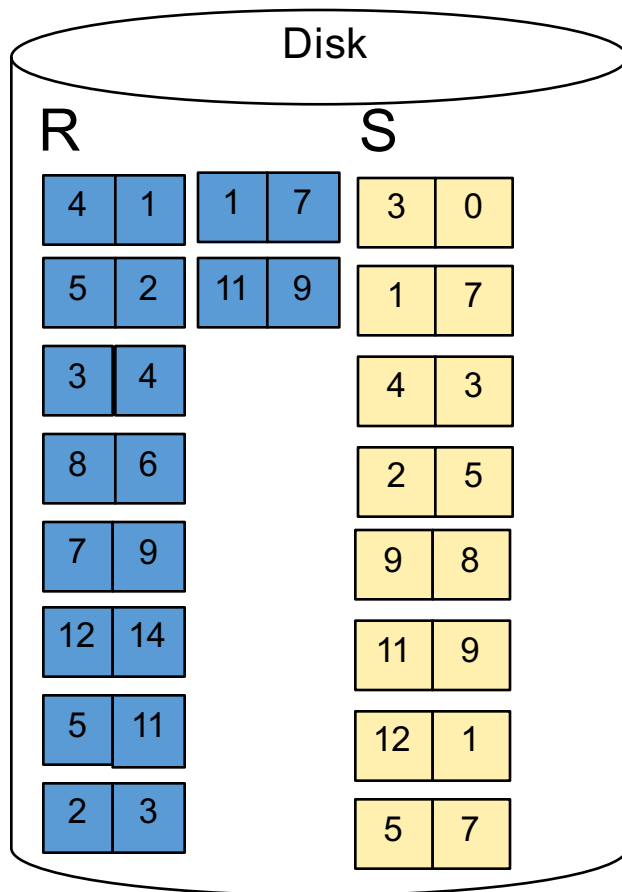
Step 1: Read M pages of R and sort in memory, then write to disk



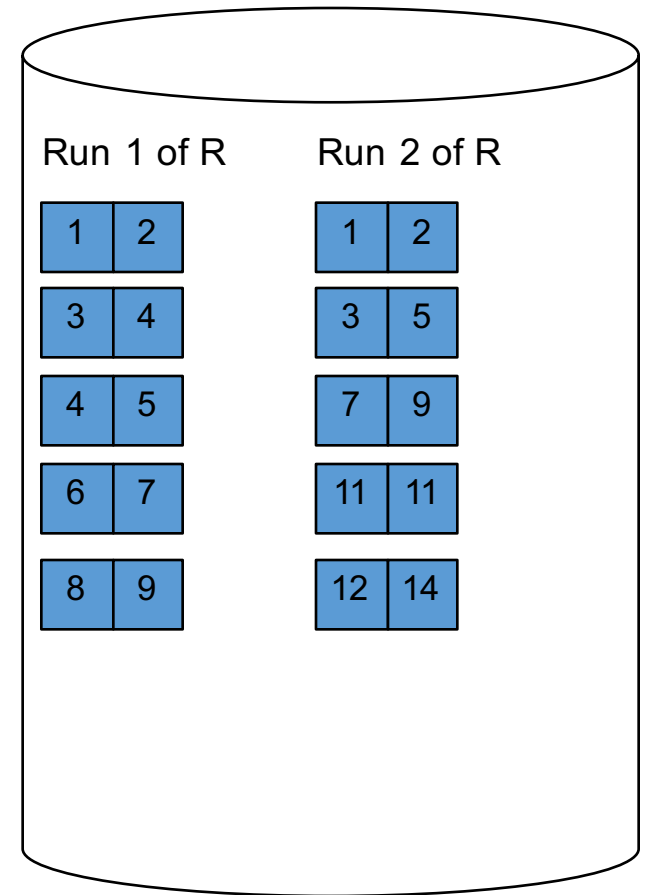
Memory M = 5 pages



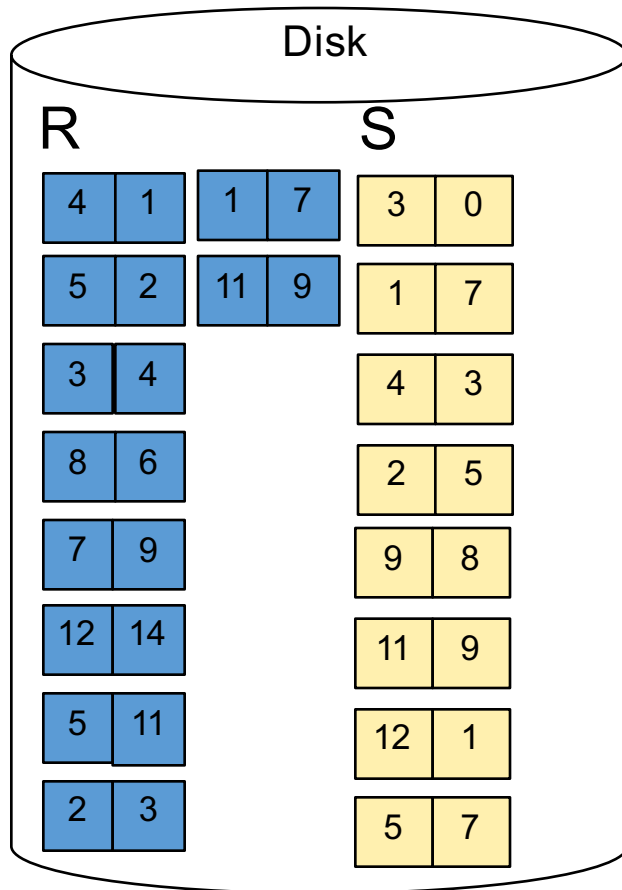
Step 2: Repeat for next M pages until all R is processed



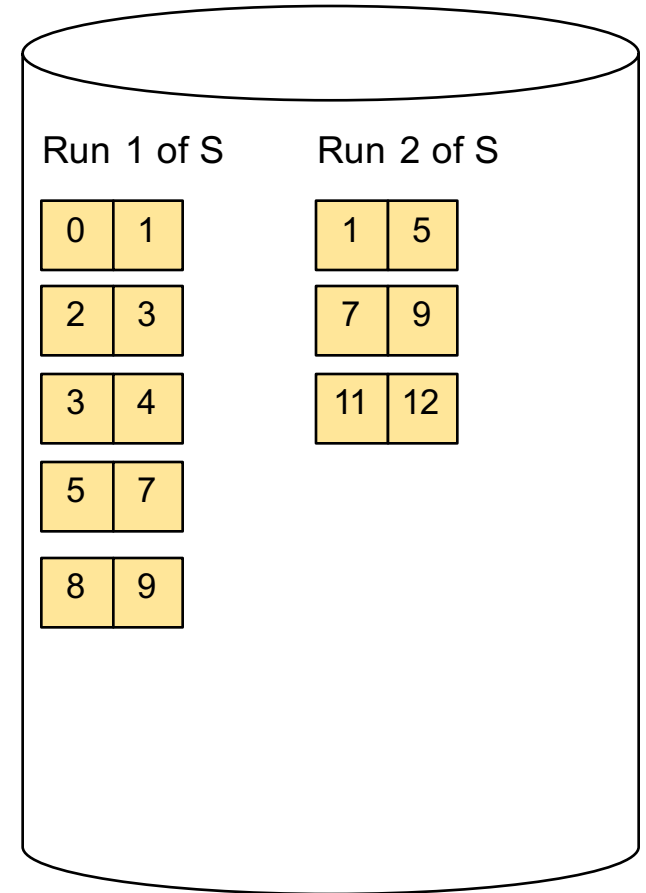
Memory M = 5 pages



Step 3: Do the same with S

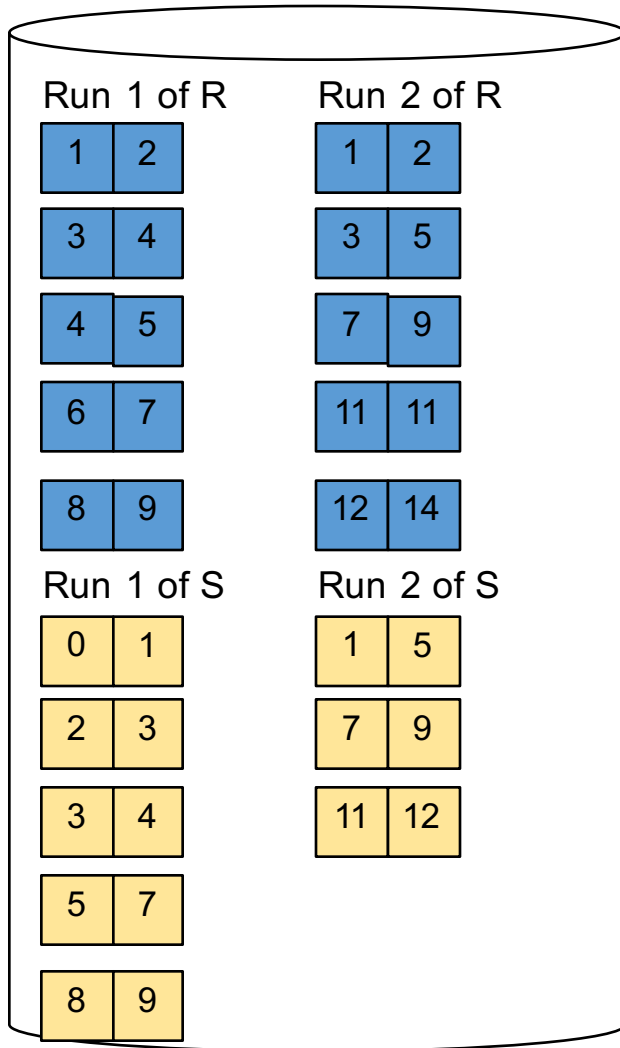


Memory M = 5 pages



Step 4: Join while merging sorted runs

Total cost: $3B(R) + 3B(S)$



Memory M = 5 pages

