나. 소트를 발생시키는 오퍼레이션

1) Sort Aggregate

전체 로우를 대상으로 집계를 수행할 때 나타남.
실제 소트가 발생하진 않는다.

- SQL Server 실행계획엔 'Stream Aggregate' 라고 표시됨.

```
select sum(sal), max(sal), min(sal) from emp

-------------------------------------------------------------------------------
| Id  | Operation          | Name | Rows  | Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------
|   0 | SELECT STATEMENT   |      |     1 |     4 |     3   (0)| 00:00:01 |
|   1 |  SORT AGGREGATE    |      |     1 |     4 |            |          |
|   2 |   TABLE ACCESS FULL| EMP  |    14 |    56 |     3   (0)| 00:00:01 |
-------------------------------------------------------------------------------
```

2) Sort Order By

- 정렬된 결과집합을 얻고자 할 때 나타남.

```
select * from emp order by sal desc

-------------------------------------------------------------------------------
| Id  | Operation          | Name | Rows  | Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------
|   0 | SELECT STATEMENT   |      |    14 |   518 |     4  (25)| 00:00:01 |
|   1 |  SORT ORDER BY     |      |    14 |   518 |     4  (25)| 00:00:01 |
|   2 |   TABLE ACCESS FULL| EMP  |    14 |   518 |     3   (0)| 00:00:01 |
-------------------------------------------------------------------------------
```

'Sort Group By'나 'Hash Group By' 연산자는 'aggregation'까지 수행함

3) Sort Group By (Sort Group By Aggregation)

- Sorting 알고리즘을 사용해 그룹별 집계를 수행할 때 나타남.
- 오라클은 Hashing 알고리즘으로 그룹별 집계를 수행하기도 함. ← hash group by (hash group by aggregation)

```
select deptno, job, sum(sal), max(sal), min(sal)
from emp
group by deptno, job

-------------------------------------------------------------------------------
| Id  | Operation          | Name | Rows  | Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------
|   0 | SELECT STATEMENT   |      |    11 |   165 |     4  (25)| 00:00:01 |
|   1 |  HASH GROUP BY     |      |    11 |   165 |     4  (25)| 00:00:01 |
|   2 |   TABLE ACCESS FULL| EMP  |    14 |   210 |     3   (0)| 00:00:01 |
-------------------------------------------------------------------------------
```

4) Sort Unique

- 선택된 결과집합에서 중복 레코드를 제거하고자 할 때 나타남.
  Union 연산자나 Distinct 연산자를 사용할 때가 대표적임.

```
select distinct deptno from emp order by deptno

-----------------------------------------------------------------------------
| Id  | Operation          | Name | Rows  | Bytes | Cost (%CPU)| Time     |
-----------------------------------------------------------------------------
|   0 | SELECT STATEMENT   |      |     3 |     9 |     5  (40)| 00:00:01 |
|   1 |  SORT UNIQUE       |      |     3 |     9 |     4  (25)| 00:00:01 |
|   2 |   TABLE ACCESS FULL| EMP  |    14 |    42 |     3   (0)| 00:00:01 |
-----------------------------------------------------------------------------
```

5) Sort Join

- Sort Merge Join을 수행할 때 나타남.

```
select /*+ ordered use_merge(e) */ *
from emp e, dept d
where d. deptno = e. deptno

-------------------------------------------------------------------------------------
| Id  | Operation                    | Name    | Rows  | Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT             |         |    14 |   798 |     6  (17)| 00:00:01 |
|   1 |  MERGE JOIN                  |         |    14 |   798 |     6  (17)| 00:00:01 |
|   2 |   TABLE ACCESS BY INDEX ROWID| EMP     |    14 |   518 |     2   (0)| 00:00:01 |
|   3 |    INDEX FULL SCAN           | EMP_IDX |    14 |       |     1   (0)| 00:00:01 |
|*  4 |   SORT JOIN                  |         |     4 |    80 |     4  (25)| 00:00:01 |
|   5 |    TABLE ACCESS FULL         | DEPT    |     4 |    80 |     3   (0)| 00:00:01 |
-------------------------------------------------------------------------------------
```

6) Window Sort

- 윈도우 함수를 수행할 때 나타남.

```
select empno, ename, job, mgr, sal, row_number() over (order by hiredate)
from emp

-----------------------------------------------------------------------------
| Id  | Operation          | Name | Rows  | Bytes | Cost (%CPU)| Time     |
-----------------------------------------------------------------------------
|   0 | SELECT STATEMENT   |      |    14 |   476 |     4  (25)| 00:00:01 |
|   1 |  WINDOW SORT       |      |    14 |   476 |     4  (25)| 00:00:01 |
|   2 |   TABLE ACCESS FULL| EMP  |    14 |   476 |     3   (0)| 00:00:01 |
-----------------------------------------------------------------------------
```