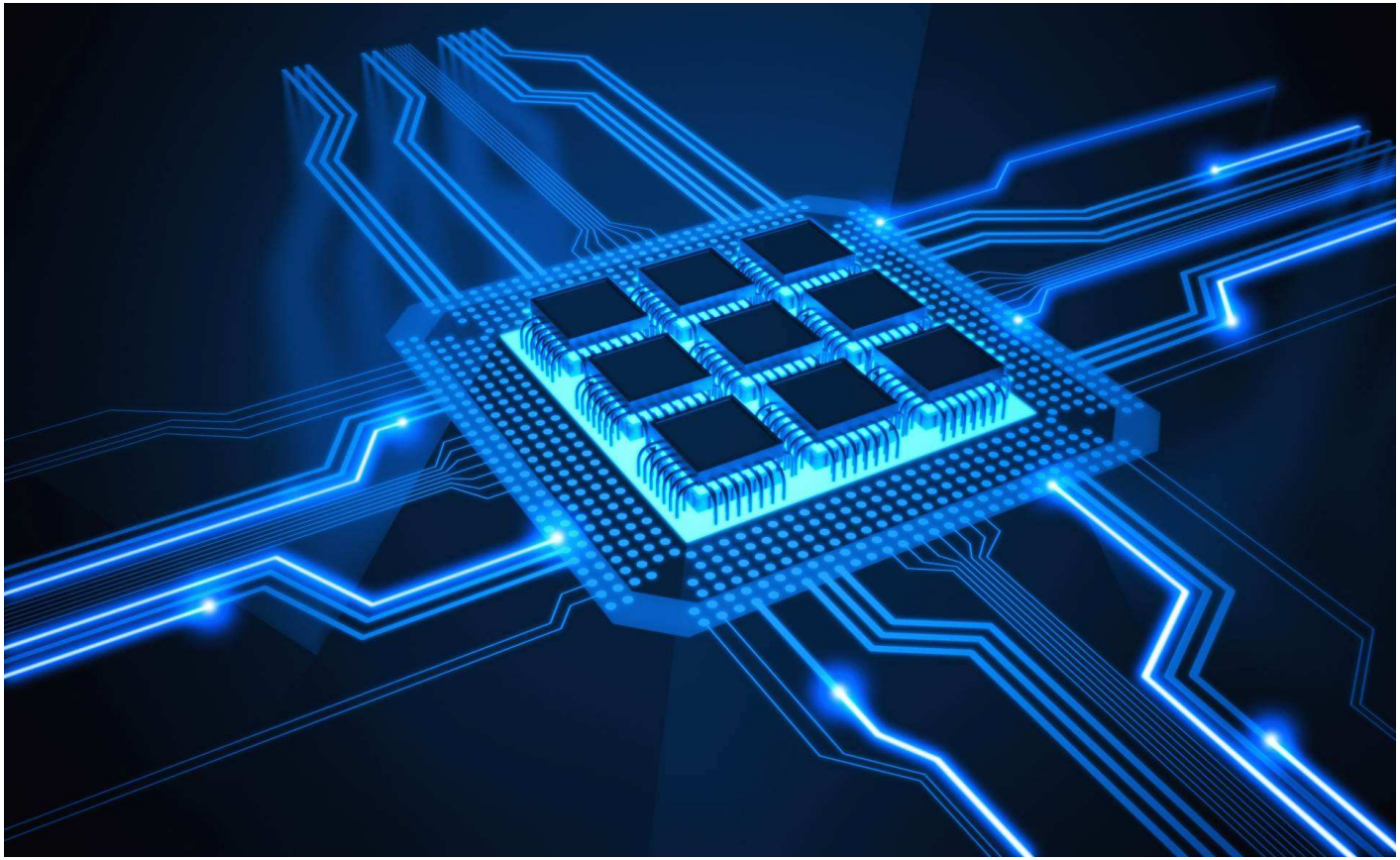
中山大學
SUN YAT-SEN UNIVERSITY



# 2021级《数据库原理与应用》第8周

2023.4.18

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# 开窗短语：range

```
select empno,ename,deptno,hiredate,sal,
sum(sal) over (partition by deptno order by hiredate
range between unbounded preceding and 365 following) sum_sal
from emp;
```

**从本分区最开始的行一直累加到hiredate+365（值范围）的行**

# 结果

```
SQL> select empno,ename,deptno,hiredate,sal,
  2  sum(sal) over (partition by deptno order by hiredate
  3  range between unbounded preceding and 365 following) sum_sal
  4  from emp;
```

| EMPNO | ENAME | DEPTNO | HIREDATE | SAL | SUM_SAL |
|---|---|---|---|---|---|
| 7782 | CLARK | 10 | 09-6月 -81 | 2450 | 10800 |
| 4682 | MAY | 10 | 19-10月-81 | 2050 | 10800 |
| 7839 | KING | 10 | 17-11月-81 | 5000 | 12150 |
| 7934 | MILLER | 10 | 23-1月 -82 | 1300 | 12150 |
| 4921 | ROSE | 10 | 03-11月-82 | 1350 | 12150 |
| 7369 | SMITH | 20 | 17-12月-80 | 800 | 9675 |
| 7566 | JONES | 20 | 02-4月 -81 | 2975 | 9675 |
| 4932 | IRENE | 20 | 04-10月-81 | 2900 | 9675 |
| 7902 | FORD | 20 | 03-12月-81 | 3000 | 9675 |
| 4566 | JOHN | 20 | 23-4月 -83 | 3500 | 13175 |
| 4877 | CASSANDRA | 20 | 13-12月-85 | 1000 | 14175 |
| 7499 | ALLEN | 30 | 20-2月 -81 | 1600 | 11350 |
| 7521 | WARD | 30 | 22-2月 -81 | 1250 | 11350 |
| 7698 | BLAKE | 30 | 01-5月 -81 | 2850 | 11350 |
| 7844 | TURNER | 30 | 08-9月 -81 | 1500 | 11350 |
| 7654 | MARTIN | 30 | 28-9月 -81 | 1250 | 12700 |

# 测试

- 注意JOHN这行

```
SQL> select empno,ename,deptno,hiredate,sal,
  2  sum(sal) over (partition by deptno order by hiredate
  3  range between 365 preceding and 365 following) sum_sal
  4  from emp;
```

| EMPNO | ENAME | DEPTNO | HIREDATE | SAL | SUM_SAL |
|---|---|---|---|---|---|
| 7782 | CLARK | 10 | 09-6月 -81 | 2450 | 10800 |
| 4682 | MAY | 10 | 19-10月-81 | 2050 | 10800 |
| 7839 | KING | 10 | 17-11月-81 | 5000 | 12150 |
| 7934 | MILLER | 10 | 23-1月 -82 | 1300 | 12150 |
| 4921 | ROSE | 10 | 03-11月-82 | 1350 | 7650 |
| 7369 | SMITH | 20 | 17-12月-80 | 800 | 9675 |
| 7566 | JONES | 20 | 02-4月 -81 | 2975 | 9675 |
| 4932 | IRENE | 20 | 04-10月-81 | 2900 | 9675 |
| 7902 | FORD | 20 | 03-12月-81 | 3000 | 9675 |
| 4566 | JOHN | 20 | 23-4月 -83 | 3500 | 3500 |
| 4877 | CASSANDRA | 20 | 13-12月-85 | 1000 | 1000 |
| 7499 | ALLEN | 30 | 20-2月 -81 | 1600 | 11350 |
| 7521 | WARD | 30 | 22-2月 -81 | 1250 | 11350 |
| 7698 | BLAKE | 30 | 01-5月 -81 | 2850 | 11350 |
| 7844 | TURNER | 30 | 08-9月 -81 | 1500 | 11350 |
| 7654 | MARTIN | 30 | 28-9月 -81 | 1250 | 12700 |
| 4903 | JADE | 30 | 03-11月-81 | 1950 | 12700 |
| 7900 | JAMES | 30 | 03-12月-81 | 950 | 12700 |
| 4854 | LARRY | 30 | 25-9月 -82 | 1350 | 8550 |

# 常用分析函数

- 统计函数
- 排序函数
- 数据分布函数
- 统计分析函数

# 统计函数

- AVG（）
- MAX（）
- MIN（）
- SUM（）
- COUNT（）

# 排序函数

- RANK（）
- DENSE_RANK（）
- FIRST
- FIRST_VALUE（）
- LAST
- LAST_VALUE（）
- LAG（）
- LEAD（）
- ROW_NUMBER（）

# RANK()

select empno,ename,deptno,hiredate,sal,

rank() over (partition by deptno order by sal) rank_sal

from emp;

```
SQL> select empno,ename,deptno,hiredate,sal,
  2  rank() over (partition by deptno order by sal) rank_sal
  3  from emp;

     EMPNO ENAME          DEPTNO HIREDATE              SAL   RANK_SAL
---------- ---------- ---------- -------------- ---------- ----------
      7934 MILLER             10 23-1月 -82           1300          1
      4921 ROSE               10 03-11月-82           1350          2
      4682 MAY                10 19-10月-81           2050          3
      7782 CLARK              10 09-6月 -81           2450          4
      7839 KING               10 17-11月-81           5000          5
      7369 SMITH              20 17-12月-80            800          1
      4877 CASSANDRA          20 13-12月-85           1000          2
      4932 IRENE              20 04-10月-81           2900          3
      7566 JONES              20 02-4月 -81           2975          4
      7902 FORD               20 03-12月-81           3000          5
      4566 JOHN               20 23-4月 -83           3500          6
      7900 JAMES              30 03-12月-81            950          1
      7521 WARD               30 22-2月 -81           1250          2
      7654 MARTIN             30 28-9月 -81           1250          2
      4854 LARRY              30 25-9月 -82           1350          4
      4421 WATSON             30 25-8月 -84           1350          4
      7844 TURNER             30 08-9月 -81           1500          6
```

# 特点

- 有并列自动顺延
- 可以看做row_number伪列函数的大号升级版

# 混合多个rank

```
SQL> select empno,ename,deptno,hiredate,sal,
  2  rank() over (partition by deptno order by sal) rank_sal,
  3  rank() over (partition by deptno order by hiredate) rank_hiredate
  4  from emp;
```

| EMPNO | ENAME | DEPTNO | HIREDATE | SAL | RANK_SAL | RANK_HIREDATE |
|---|---|---|---|---|---|---|
| 7934 | MILLER | 10 | 23-1月 -82 | 1300 | 1 | 4 |
| 4921 | ROSE | 10 | 03-11月-82 | 1350 | 2 | 5 |
| 4682 | MAY | 10 | 19-10月-81 | 2050 | 3 | 2 |
| 7782 | CLARK | 10 | 09-6月 -81 | 2450 | 4 | 1 |
| 7839 | KING | 10 | 17-11月-81 | 5000 | 5 | 3 |
| 7369 | SMITH | 20 | 17-12月-80 | 800 | 1 | 1 |
| 4877 | CASSANDRA | 20 | 13-12月-85 | 1000 | 2 | 6 |
| 4932 | IRENE | 20 | 04-10月-81 | 2900 | 3 | 3 |
| 7566 | JONES | 20 | 02-4月 -81 | 2975 | 4 | 2 |
| 7902 | FORD | 20 | 03-12月-81 | 3000 | 5 | 4 |
| 4566 | JOHN | 20 | 23-4月 -83 | 3500 | 6 | 5 |
| 7900 | JAMES | 30 | 03-12月-81 | 950 | 1 | 7 |
| 7521 | WARD | 30 | 22-2月 -81 | 1250 | 2 | 2 |
| 7654 | MARTIN | 30 | 28-9月 -81 | 1250 | 2 | 5 |
| 4421 | WATSON | 30 | 25-8月 -84 | 1350 | 4 | 11 |
| 4854 | LARRY | 30 | 25-9月 -82 | 1350 | 4 | 8 |
| 7844 | TURNER | 30 | 08-9月 -81 | 1500 | 6 | 4 |
| 4499 | ALEXANDER | 30 | 20-12月-83 | 1500 | 6 | 10 |
| 7499 | ALLEN | 30 | 20-2月 -81 | 1600 | 8 | 1 |
| 4845 | PETER | 30 | 10-9月 -85 | 1600 | 8 | 12 |
| 4903 | JADE | 30 | 03-11月-81 | 1950 | 10 | 6 |

# Dense_rank(): 处理并列的方式有差异

| EMPNO | ENAME | DEPTNO | HIREDATE | SAL | RANK_SAL | DENSERANK_SAL |
|---|---|---|---|---|---|---|
| 7934 | MILLER | 10 | 23-1月 -82 | 1300 | 1 | 1 |
| 4921 | ROSE | 10 | 03-11月-82 | 1350 | 2 | 2 |
| 4682 | MAY | 10 | 19-10月-81 | 2050 | 3 | 3 |
| 7782 | CLARK | 10 | 09-6月 -81 | 2450 | 4 | 4 |
| 7839 | KING | 10 | 17-11月-81 | 5000 | 5 | 5 |
| 7369 | SMITH | 20 | 17-12月-80 | 800 | 1 | 1 |
| 4877 | CASSANDRA | 20 | 13-12月-85 | 1000 | 2 | 2 |
| 4932 | IRENE | 20 | 04-10月-81 | 2900 | 3 | 3 |
| 7566 | JONES | 20 | 02-4月 -81 | 2975 | 4 | 4 |
| 7902 | FORD | 20 | 03-12月-81 | 3000 | 5 | 5 |
| 4566 | JOHN | 20 | 23-4月 -83 | 3500 | 6 | 6 |
| 7900 | JAMES | 30 | 03-12月-81 | 950 | 1 | 1 |
| 7521 | WARD | 30 | 22-2月 -81 | 1250 | 2 | 2 |
| 7654 | MARTIN | 30 | 28-9月 -81 | 1250 | 2 | 2 |
| 4854 | LARRY | 30 | 25-9月 -82 | 1350 | 4 | 3 |
| 4421 | WATSON | 30 | 25-8月 -84 | 1350 | 4 | 3 |
| 7844 | TURNER | 30 | 08-9月 -81 | 1500 | 6 | 4 |
| 4499 | ALEXANDER | 30 | 20-12月-83 | 1500 | 6 | 4 |
| 4845 | PETER | 30 | 10-9月 -85 | 1600 | 8 | 5 |
| 7499 | ALLEN | 30 | 20-2月 -81 | 1600 | 8 | 5 |
| 4903 | JADE | 30 | 03-11月-81 | 1950 | 10 | 6 |
| 7698 | BLAKE | 30 | 01-5月 -81 | 2850 | 11 | 7 |
| 4695 | BOB | 30 | 01-9月 -83 | 3050 | 12 | 8 |

# First和keep

```
SQL> select empno,ename,deptno,hiredate,sal,
  2  dense_rank() over (partition by deptno order by sal) denserank_sal,
  3  min(ename) keep (dense_rank first order by sal) over (partition by deptno) min_first
  4  from emp;
```

| EMPNO | ENAME | DEPTNO | HIREDATE | SAL | DENSERANK_SAL | MIN_FIRST |
|---|---|---|---|---|---|---|
| 7934 | MILLER | 10 | 23-1月 -82 | 1300 | 1 | MILLER |
| 4921 | ROSE | 10 | 03-11月-82 | 1350 | 2 | MILLER |
| 4682 | MAY | 10 | 19-10月-81 | 2050 | 3 | MILLER |
| 7782 | CLARK | 10 | 09-6月 -81 | 2450 | 4 | MILLER |
| 7839 | KING | 10 | 17-11月-81 | 5000 | 5 | MILLER |
| 7369 | SMITH | 20 | 17-12月-80 | 800 | 1 | SMITH |
| 4877 | CASSANDRA | 20 | 13-12月-85 | 1000 | 2 | SMITH |
| 4932 | IRENE | 20 | 04-10月-81 | 2900 | 3 | SMITH |
| 7566 | JONES | 20 | 02-4月 -81 | 2975 | 4 | SMITH |
| 7902 | FORD | 20 | 03-12月-81 | 3000 | 5 | SMITH |
| 4566 | JOHN | 20 | 23-4月 -83 | 3500 | 6 | SMITH |
| 7900 | JAMES | 30 | 03-12月-81 | 950 | 1 | JAMES |
| 7521 | WARD | 30 | 22-2月 -81 | 1250 | 2 | JAMES |
| 7654 | MARTIN | 30 | 28-9月 -81 | 1250 | 2 | JAMES |
| 4854 | LARRY | 30 | 25-9月 -82 | 1350 | 3 | JAMES |
| 4421 | WATSON | 30 | 25-8月 -84 | 1350 | 3 | JAMES |
| 7844 | TURNER | 30 | 08-9月 -81 | 1500 | 4 | JAMES |
| 4499 | ALEXANDER | 30 | 20-12月-83 | 1500 | 4 | JAMES |
| 4845 | PETER | 30 | 10-9月 -85 | 1600 | 5 | JAMES |
| 7499 | ALLEN | 30 | 20-2月 -81 | 1600 | 5 | JAMES |
| 4903 | JADE | 30 | 03-11月-81 | 1950 | 6 | JAMES |

# 札记

- 之前“求每个部门工资最高的员工名字”用了内部视图嵌套，分析函数减少了内部视图使用
- 有并列会显示什么？注意使用了“min”保证返回一个值而不是多个值

# last

```
select empno,ename,deptno,hiredate,sal,
dense_rank() over (partition by deptno order by sal)
denserank_sal,
min(ename) keep (dense_rank first order by sal) over
(partition by deptno) min_first,
min(ename) keep (dense_rank last order by sal) over
(partition by deptno) min_last
from emp;
```

# last

| EMPNO | ENAME | DEPTNO | HIREDATE | SAL | DENSERANK_SAL | MIN_FIRST | MIN_LAST |
|---|---|---|---|---|---|---|---|
| 7934 | MILLER | 10 | 23-1月 -82 | 1300 | 1 | MILLER | KING |
| 4921 | ROSE | 10 | 03-11月-82 | 1350 | 2 | MILLER | KING |
| 4682 | MAY | 10 | 19-10月-81 | 2050 | 3 | MILLER | KING |
| 7782 | CLARK | 10 | 09-6月 -81 | 2450 | 4 | MILLER | KING |
| 7839 | KING | 10 | 17-11月-81 | 5000 | 5 | MILLER | KING |
| 7369 | SMITH | 20 | 17-12月-80 | 800 | 1 | SMITH | JOHN |
| 4877 | CASSANDRA | 20 | 13-12月-85 | 1000 | 2 | SMITH | JOHN |
| 4932 | IRENE | 20 | 04-10月-81 | 2900 | 3 | SMITH | JOHN |
| 7566 | JONES | 20 | 02-4月 -81 | 2975 | 4 | SMITH | JOHN |
| 7902 | FORD | 20 | 03-12月-81 | 3000 | 5 | SMITH | JOHN |
| 4566 | JOHN | 20 | 23-4月 -83 | 3500 | 6 | SMITH | JOHN |
| 7900 | JAMES | 30 | 03-12月-81 | 950 | 1 | JAMES | BOB |
| 7521 | WARD | 30 | 22-2月 -81 | 1250 | 2 | JAMES | BOB |
| 7654 | MARTIN | 30 | 28-9月 -81 | 1250 | 2 | JAMES | BOB |
| 4854 | LARRY | 30 | 25-9月 -82 | 1350 | 3 | JAMES | BOB |
| 4421 | WATSON | 30 | 25-8月 -84 | 1350 | 3 | JAMES | BOB |
| 7844 | TURNER | 30 | 08-9月 -81 | 1500 | 4 | JAMES | BOB |
| 4499 | ALEXANDER | 30 | 20-12月-83 | 1500 | 4 | JAMES | BOB |
| 4845 | PETER | 30 | 10-9月 -85 | 1600 | 5 | JAMES | BOB |
| 7499 | ALLEN | 30 | 20-2月 -81 | 1600 | 5 | JAMES | BOB |
| 4903 | JADE | 30 | 03-11月-81 | 1950 | 6 | JAMES | BOB |
| 7698 | BLAKE | 30 | 01-5月 -81 | 2850 | 7 | JAMES | BOB |
| 4695 | BOB | 30 | 01-9月 -83 | 3050 | 8 | JAMES | BOB |
| 5521 | ZEN | 40 | 22-12月-83 | 1250 | 1 | ZEN | SNOW |
| 5599 | ATARI | 40 | 21-6月 -81 | 1650 | 2 | ZEN | SNOW |

# Firs_value

```
select empno,ename,deptno,hiredate,sal,
dense_rank() over (partition by deptno order by sal) denserank_sal,
max(ename) keep (dense_rank first order by sal) over (partition by deptno)
min_first,
first_value(ename) over (partition by deptno order by sal) firstvalue
from emp;
```

与前面的first+keep有什么不同？处理并列的方式不同（删除7900员工实验）

# First_value

```
SQL> select empno,ename,deptno,hiredate,sal,
  2  dense_rank() over (partition by deptno order by sal) denserank_sal,
  3  min(ename) keep (dense_rank first order by sal) over (partition by deptno) min_first,
  4  first_value(ename) over (partition by deptno order by sal) firstvalue
  5  from emp;
```

| EMPNO | ENAME | DEPTNO | HIREDATE | SAL | DENSERANK_SAL | MIN_FIRST | FIRSTVALUE |
|---|---|---|---|---|---|---|---|
| 7934 | MILLER | 10 | 23-1月 -82 | 1300 | 1 | MILLER | MILLER |
| 4921 | ROSE | 10 | 03-11月-82 | 1350 | 2 | MILLER | MILLER |
| 4682 | MAY | 10 | 19-10月-81 | 2050 | 3 | MILLER | MILLER |
| 7782 | CLARK | 10 | 09-6月 -81 | 2450 | 4 | MILLER | MILLER |
| 7839 | KING | 10 | 17-11月-81 | 5000 | 5 | MILLER | MILLER |
| 7369 | SMITH | 20 | 17-12月-80 | 800 | 1 | SMITH | SMITH |
| 4877 | CASSANDRA | 20 | 13-12月-85 | 1000 | 2 | SMITH | SMITH |
| 4932 | IRENE | 20 | 04-10月-81 | 2900 | 3 | SMITH | SMITH |
| 7566 | JONES | 20 | 02-4月 -81 | 2975 | 4 | SMITH | SMITH |
| 7902 | FORD | 20 | 03-12月-81 | 3000 | 5 | SMITH | SMITH |
| 4566 | JOHN | 20 | 23-4月 -83 | 3500 | 6 | SMITH | SMITH |
| 7900 | JAMES | 30 | 03-12月-81 | 950 | 1 | JAMES | JAMES |
| 7654 | MARTIN | 30 | 28-9月 -81 | 1250 | 2 | JAMES | JAMES |
| 7521 | WARD | 30 | 22-2月 -81 | 1250 | 2 | JAMES | JAMES |
| 4854 | LARRY | 30 | 25-9月 -82 | 1350 | 3 | JAMES | JAMES |
| 4421 | WATSON | 30 | 25-8月 -84 | 1350 | 3 | JAMES | JAMES |
| 4499 | ALEXANDER | 30 | 20-12月-83 | 1500 | 4 | JAMES | JAMES |
| 7844 | TURNER | 30 | 08-9月 -81 | 1500 | 4 | JAMES | JAMES |
| 7499 | ALLEN | 30 | 20-2月 -81 | 1600 | 5 | JAMES | JAMES |
| 4845 | PETER | 30 | 10-9月 -85 | 1600 | 5 | JAMES | JAMES |
| 4903 | JADE | 30 | 03-11月-81 | 1950 | 6 | JAMES | JAMES |
| 7698 | BLAKE | 30 | 01-5月 -81 | 2850 | 7 | JAMES | JAMES |
| 4695 | BOB | 30 | 01-9月 -83 | 3050 | 8 | JAMES | JAMES |

# First_value

| EMPNO | ENAME | DEPTNO | HIREDATE | SAL | DENSERANK_SAL | MIN_FIRST | FIRSTVALUE |
|---|---|---|---|---|---|---|---|
| 7934 | MILLER | 10 | 23-1月 -82 | 1300 | 1 | MILLER | MILLER |
| 4921 | ROSE | 10 | 03-11月-82 | 1350 | 2 | MILLER | MILLER |
| 4682 | MAY | 10 | 19-10月-81 | 2050 | 3 | MILLER | MILLER |
| 7782 | CLARK | 10 | 09-6月 -81 | 2450 | 4 | MILLER | MILLER |
| 7839 | KING | 10 | 17-11月-81 | 5000 | 5 | MILLER | MILLER |
| 7369 | SMITH | 20 | 17-12月-80 | 800 | 1 | SMITH | SMITH |
| 4877 | CASSANDRA | 20 | 13-12月-85 | 1000 | 2 | SMITH | SMITH |
| 4932 | IRENE | 20 | 04-10月-81 | 2900 | 3 | SMITH | SMITH |
| 7566 | JONES | 20 | 02-4月 -81 | 2975 | 4 | SMITH | SMITH |
| 7902 | FORD | 20 | 03-12月-81 | 3000 | 5 | SMITH | SMITH |
| 4566 | JOHN | 20 | 23-4月 -83 | 3500 | 6 | SMITH | SMITH |
| 7654 | MARTIN | 30 | 28-9月 -81 | 1250 | 1 | WARD | MARTIN |
| 7521 | WARD | 30 | 22-2月 -81 | 1250 | 1 | WARD | MARTIN |
| 4854 | LARRY | 30 | 25-9月 -82 | 1350 | 2 | WARD | MARTIN |
| 4421 | WATSON | 30 | 25-8月 -84 | 1350 | 2 | WARD | MARTIN |
| 4499 | ALEXANDER | 30 | 20-12月-83 | 1500 | 3 | WARD | MARTIN |
| 7844 | TURNER | 30 | 08-9月 -81 | 1500 | 3 | WARD | MARTIN |
| 7499 | ALLEN | 30 | 20-2月 -81 | 1600 | 4 | WARD | MARTIN |
| 4845 | PETER | 30 | 10-9月 -85 | 1600 | 4 | WARD | MARTIN |
| 4903 | JADE | 30 | 03-11月-81 | 1950 | 5 | WARD | MARTIN |
| 7698 | BLAKE | 30 | 01-5月 -81 | 2850 | 6 | WARD | MARTIN |
| 4695 | BOB | 30 | 01-9月 -83 | 3050 | 7 | WARD | MARTIN |
| 5521 | ZEN | 40 | 22-12月-83 | 1250 | 1 | ZEN | ZEN |
| 5599 | ATARI | 40 | 21-6月 -81 | 1650 | 2 | ZEN | ZEN |
| 5559 | NED | 40 | 11-12月-81 | 2800 | 3 | ZEN | ZEN |
| 5566 | SNOW | 40 | 22-4月 -82 | 2975 | 4 | ZEN | ZEN |

已选择26行。

# Lag()和lead()

```
select empno,ename,deptno,hiredate,sal,
lag(sal) over (partition by deptno order by sal) lag_sal,
lead(sal) over (partition by deptno order by sal) lead_sal
from emp;
```

# 结果

| EMPNO | ENAME | DEPTNO | HIREDATE | SAL | LAG_SAL | LEAD_SAL |
|---|---|---|---|---|---|---|
| 7934 | MILLER | 10 | 23-1月 -82 | 1300 | | 1350 |
| 4921 | ROSE | 10 | 03-11月-82 | 1350 | 1300 | 2050 |
| 4682 | MAY | 10 | 19-10月-81 | 2050 | 1350 | 2450 |
| 7782 | CLARK | 10 | 09-6月 -81 | 2450 | 2050 | 5000 |
| 7839 | KING | 10 | 17-11月-81 | 5000 | 2450 | |
| 7369 | SMITH | 20 | 17-12月-80 | 800 | | 1000 |
| 4877 | CASSANDRA | 20 | 13-12月-85 | 1000 | 800 | 2900 |
| 4932 | IRENE | 20 | 04-10月-81 | 2900 | 1000 | 2975 |
| 7566 | JONES | 20 | 02-4月 -81 | 2975 | 2900 | 3000 |
| 7902 | FORD | 20 | 03-12月-81 | 3000 | 2975 | 3500 |
| 4566 | JOHN | 20 | 23-4月 -83 | 3500 | 3000 | |
| 7521 | WARD | 30 | 22-2月 -81 | 1250 | | 1250 |
| 7654 | MARTIN | 30 | 28-9月 -81 | 1250 | 1250 | 1350 |
| 4421 | WATSON | 30 | 25-8月 -84 | 1350 | 1250 | 1350 |
| 4854 | LARRY | 30 | 25-9月 -82 | 1350 | 1350 | 1500 |
| 7844 | TURNER | 30 | 08-9月 -81 | 1500 | 1350 | 1500 |
| 4499 | ALEXANDER | 30 | 20-12月-83 | 1500 | 1500 | 1600 |
| 4845 | PETER | 30 | 10-9月 -85 | 1600 | 1500 | 1600 |
| 7499 | ALLEN | 30 | 20-2月 -81 | 1600 | 1600 | 1950 |
| 4903 | JADE | 30 | 03-11月-81 | 1950 | 1600 | 2850 |
| 7698 | BLAKE | 30 | 01-5月 -81 | 2850 | 1950 | 3050 |

# 测试

```
SQL> select empno,ename,deptno,hiredate,sal,
  2  lag(ename) over (partition by deptno order by sal) lag_sal,
  3  lead(ename) over (partition by deptno order by sal) lead_sal
  4  from emp;
```

| EMPNO | ENAME | DEPTNO | HIREDATE | SAL | LAG_SAL | LEAD_SAL |
|---|---|---|---|---|---|---|
| 7934 | MILLER | 10 | 23-1月 -82 | 1300 | | ROSE |
| 4921 | ROSE | 10 | 03-11月-82 | 1350 | MILLER | MAY |
| 4682 | MAY | 10 | 19-10月-81 | 2050 | ROSE | CLARK |
| 7782 | CLARK | 10 | 09-6月 -81 | 2450 | MAY | KING |
| 7839 | KING | 10 | 17-11月-81 | 5000 | CLARK | |
| 7369 | SMITH | 20 | 17-12月-80 | 800 | | CASSANDRA |
| 4877 | CASSANDRA | 20 | 13-12月-85 | 1000 | SMITH | IRENE |
| 4932 | IRENE | 20 | 04-10月-81 | 2900 | CASSANDRA | JONES |
| 7566 | JONES | 20 | 02-4月 -81 | 2975 | IRENE | FORD |
| 7902 | FORD | 20 | 03-12月-81 | 3000 | JONES | JOHN |
| 4566 | JOHN | 20 | 23-4月 -83 | 3500 | FORD | |
| 7521 | WARD | 30 | 22-2月 -81 | 1250 | | MARTIN |
| 7654 | MARTIN | 30 | 28-9月 -81 | 1250 | WARD | WATSON |
| 4421 | WATSON | 30 | 25-8月 -84 | 1350 | MARTIN | LARRY |
| 4854 | LARRY | 30 | 25-9月 -82 | 1350 | WATSON | TURNER |
| 7844 | TURNER | 30 | 08-9月 -81 | 1500 | LARRY | ALEXANDER |
| 4499 | ALEXANDER | 30 | 20-12月-83 | 1500 | TURNER | PETER |
| 4845 | PETER | 30 | 10-9月 -85 | 1600 | ALEXANDER | ALLEN |
| 7499 | ALLEN | 30 | 20-2月 -81 | 1600 | PETER | JADE |
| 4903 | JADE | 30 | 03-11月-81 | 1950 | ALLEN | BLAKE |
| 7698 | BLAKE | 30 | 01-5月 -81 | 2850 | JADE | BOB |
| 4695 | BOB | 30 | 01-9月 -83 | 3050 | BLAKE | |

# 更复杂的用法

```
select empno,ename,deptno,hiredate,sal,
lag(ename,2,'NA') over (partition by deptno order by sal) lag_sal
from emp;
```

# 测试结果

```
SQL> select empno,ename,deptno,hiredate,sal,
  2  lag(ename,2,'NA') over (partition by deptno order by sal) lag_sal
  3  from emp;

     EMPNO ENAME          DEPTNO HIREDATE              SAL LAG_SAL
---------- ---------- ---------- -------------- ---------- ----------
      7934 MILLER             10 23-1月 -82           1300 NA
      4921 ROSE               10 03-11月-82           1350 NA
      4682 MAY                10 19-10月-81           2050 MILLER
      7782 CLARK              10 09-6月 -81           2450 ROSE
      7839 KING               10 17-11月-81           5000 MAY
      7369 SMITH              20 17-12月-80            800 NA
      4877 CASSANDRA          20 13-12月-85           1000 NA
      4932 IRENE              20 04-10月-81           2900 SMITH
      7566 JONES              20 02-4月 -81           2975 CASSANDRA
      7902 FORD               20 03-12月-81           3000 IRENE
      4566 JOHN               20 23-4月 -83           3500 JONES
      7521 WARD               30 22-2月 -81           1250 NA
      7654 MARTIN             30 28-9月 -81           1250 NA
      4421 WATSON             30 25-8月 -84           1350 WARD
      4854 LARRY              30 25-9月 -82           1350 MARTIN
      7844 TURNER             30 08-9月 -81           1500 WATSON
      4499 ALEXANDER          30 20-12月-83           1500 LARRY
      4845 PETER              30 10-9月 -85           1600 TURNER
      7499 ALLEN              30 20-2月 -81           1600 ALEXANDER
      4903 JADE               30 03-11月-81           1950 PETER
      7698 BLAKE              30 01-5月 -81           2850 ALLEN
```

# Row_number（）

```
select empno,ename,deptno,hiredate,sal,
rank() over (partition by deptno order by sal) rank_sal,
rank() over (partition by deptno order by hiredate) rank_hiredate,
row_number() over (partition by deptno order by sal) rank_sal_rownumber
from emp;
```

按输出顺序rank，没有并列

# 结果

| EMPNO | ENAME | DEPTNO | HIREDATE | SAL | RANK_SAL | RANK_HIREDATE | RANK_SAL_ROWNUMBER |
|---|---|---|---|---|---|---|---|
| 7934 | MILLER | 10 | 23-1月 -82 | 1300 | 1 | 4 | 1 |
| 4921 | ROSE | 10 | 03-11月-82 | 1350 | 2 | 5 | 2 |
| 4682 | MAY | 10 | 19-10月-81 | 2050 | 3 | 2 | 3 |
| 7782 | CLARK | 10 | 09-6月 -81 | 2450 | 4 | 1 | 4 |
| 7839 | KING | 10 | 17-11月-81 | 5000 | 5 | 3 | 5 |
| 7369 | SMITH | 20 | 17-12月-80 | 800 | 1 | 1 | 1 |
| 4877 | CASSANDRA | 20 | 13-12月-85 | 1000 | 2 | 6 | 2 |
| 4932 | IRENE | 20 | 04-10月-81 | 2900 | 3 | 3 | 3 |
| 7566 | JONES | 20 | 02-4月 -81 | 2975 | 4 | 2 | 4 |
| 7902 | FORD | 20 | 03-12月-81 | 3000 | 5 | 4 | 5 |
| 4566 | JOHN | 20 | 23-4月 -83 | 3500 | 6 | 5 | 6 |
| 7521 | WARD | 30 | 22-2月 -81 | 1250 | 1 | 2 | 1 |
| 7654 | MARTIN | 30 | 28-9月 -81 | 1250 | 1 | 5 | 2 |
| 4854 | LARRY | 30 | 25-9月 -82 | 1350 | 3 | 7 | 3 |
| 4421 | WATSON | 30 | 25-8月 -84 | 1350 | 3 | 10 | 4 |
| 7844 | TURNER | 30 | 08-9月 -81 | 1500 | 5 | 4 | 5 |
| 4499 | ALEXANDER | 30 | 20-12月-83 | 1500 | 5 | 9 | 6 |
| 4845 | PETER | 30 | 10-9月 -85 | 1600 | 7 | 11 | 7 |
| 7499 | ALLEN | 30 | 20-2月 -81 | 1600 | 7 | 1 | 8 |
| 4903 | JADE | 30 | 03-11月-81 | 1950 | 9 | 6 | 9 |
| 7698 | BLAKE | 30 | 01-5月 -81 | 2850 | 10 | 3 | 10 |
| 4695 | BOB | 30 | 01-9月 -83 | 3050 | 11 | 8 | 11 |
| 5521 | ZEN | 40 | 22-12月-83 | 1250 | 1 | 4 | 1 |
| 5599 | ATARI | 40 | 21-6月 -81 | 1650 | 2 | 1 | 2 |
| 5559 | NED | 40 | 11-12月-81 | 2800 | 3 | 2 | 3 |
| 5566 | SNOW | 40 | 22-4月 -82 | 2975 | 4 | 3 | 4 |

# Cume_dist ()

```
SQL> select empno,ename,deptno,hiredate,sal,
  2  rank() over (partition by deptno order by sal) rank_sal,
  3  rank() over (partition by deptno order by hiredate) rank_hd,
  4  cume_dist() over (partition by deptno order by sal) cumedist_sal
  5  from emp;
```

| EMPNO | ENAME | DEPTNO | HIREDATE | SAL | RANK_SAL | RANK_HD | CUMEDIST_SAL |
|---|---|---|---|---|---|---|---|
| 7934 | MILLER | 10 | 23-1月 -82 | 1300 | 1 | 4 | .2 |
| 4921 | ROSE | 10 | 03-11月-82 | 1350 | 2 | 5 | .4 |
| 4682 | MAY | 10 | 19-10月-81 | 2050 | 3 | 2 | .6 |
| 7782 | CLARK | 10 | 09-6月 -81 | 2450 | 4 | 1 | .8 |
| 7839 | KING | 10 | 17-11月-81 | 5000 | 5 | 3 | 1 |
| 7369 | SMITH | 20 | 17-12月-80 | 800 | 1 | 1 | .166666667 |
| 4877 | CASSANDRA | 20 | 13-12月-85 | 1000 | 2 | 6 | .333333333 |
| 4932 | IRENE | 20 | 04-10月-81 | 2900 | 3 | 3 | .5 |
| 7566 | JONES | 20 | 02-4月 -81 | 2975 | 4 | 2 | .666666667 |
| 7902 | FORD | 20 | 03-12月-81 | 3000 | 5 | 4 | .833333333 |
| 4566 | JOHN | 20 | 23-4月 -83 | 3500 | 6 | 5 | 1 |
| 7521 | WARD | 30 | 22-2月 -81 | 1250 | 1 | 2 | .181818182 |
| 7654 | MARTIN | 30 | 28-9月 -81 | 1250 | 1 | 5 | .181818182 |
| 4854 | LARRY | 30 | 25-9月 -82 | 1350 | 3 | 7 | .363636364 |
| 4421 | WATSON | 30 | 25-8月 -84 | 1350 | 3 | 10 | .363636364 |
| 7844 | TURNER | 30 | 08-9月 -81 | 1500 | 5 | 4 | .545454545 |
| 4499 | ALEXANDER | 30 | 20-12月-83 | 1500 | 5 | 9 | .545454545 |
| 4845 | PETER | 30 | 10-9月 -85 | 1600 | 7 | 11 | .727272727 |
| 7499 | ALLEN | 30 | 20-2月 -81 | 1600 | 7 | 1 | .727272727 |
| 4903 | JADE | 30 | 03-11月-81 | 1950 | 9 | 6 | .818181818 |
| 7698 | BLAKE | 30 | 01-5月 -81 | 2850 | 10 | 3 | .909090909 |
| 4695 | BOB | 30 | 01-9月 -83 | 3050 | 11 | 8 | 1 |

# Percent_rank()

```
SQL> select empno,ename,deptno,hiredate,sal,
  2  rank() over (partition by deptno order by sal) rank_sal,
  3  cume_dist() over (partition by deptno order by sal) cumedist_sal,
  4  percent_rank() over (partition by deptno order by sal) pcrank_sal
  5  from emp;
```

| EMPNO | ENAME | DEPTNO | HIREDATE | SAL | RANK_SAL | CUMEDIST_SAL | PCRANK_SAL |
|---|---|---|---|---|---|---|---|
| 7934 | MILLER | 10 | 23-1月 -82 | 1300 | 1 | .2 | 0 |
| 4921 | ROSE | 10 | 03-11月-82 | 1350 | 2 | .4 | .25 |
| 4682 | MAY | 10 | 19-10月-81 | 2050 | 3 | .6 | .5 |
| 7782 | CLARK | 10 | 09-6月 -81 | 2450 | 4 | .8 | .75 |
| 7839 | KING | 10 | 17-11月-81 | 5000 | 5 | 1 | 1 |
| 7369 | SMITH | 20 | 17-12月-80 | 800 | 1 | .166666667 | 0 |
| 4877 | CASSANDRA | 20 | 13-12月-85 | 1000 | 2 | .333333333 | .2 |
| 4932 | IRENE | 20 | 04-10月-81 | 2900 | 3 | .5 | .4 |
| 7566 | JONES | 20 | 02-4月 -81 | 2975 | 4 | .666666667 | .6 |
| 7902 | FORD | 20 | 03-12月-81 | 3000 | 5 | .833333333 | .8 |
| 4566 | JOHN | 20 | 23-4月 -83 | 3500 | 6 | 1 | 1 |
| 7521 | WARD | 30 | 22-2月 -81 | 1250 | 1 | .181818182 | 0 |
| 7654 | MARTIN | 30 | 28-9月 -81 | 1250 | 1 | .181818182 | 0 |
| 4421 | WATSON | 30 | 25-8月 -84 | 1350 | 3 | .363636364 | .2 |
| 4854 | LARRY | 30 | 25-9月 -82 | 1350 | 3 | .363636364 | .2 |
| 7844 | TURNER | 30 | 08-9月 -81 | 1500 | 5 | .545454545 | .4 |
| 4499 | ALEXANDER | 30 | 20-12月-83 | 1500 | 5 | .545454545 | .4 |
| 4845 | PETER | 30 | 10-9月 -85 | 1600 | 7 | .727272727 | .6 |
| 7499 | ALLEN | 30 | 20-2月 -81 | 1600 | 7 | .727272727 | .6 |
| 4903 | JADE | 30 | 03-11月-81 | 1950 | 9 | .818181818 | .8 |
| 7698 | BLAKE | 30 | 01-5月 -81 | 2850 | 10 | .909090909 | .9 |
| 4695 | BOB | 30 | 01-9月 -83 | 3050 | 11 | 1 | 1 |
| 5521 | ZEN | 40 | 22-12月-83 | 1250 | 1 | .25 | 0 |

# 索引（index)

- 大部分数据库缺省使用B+树索引（另有专题阐述索引原理）
- 用于提高查询性能，但同时又会影响DML性能（因为需要维护索引）
- 索引自动维护，自动使用
- 主键，候选键对应的列会自动建立索引
- 一张表不适合建立太多索引，可以建在大表常用的查询条件上
- 11g以后的版本由于大量使用内存缓冲数据，索引的效果对于不太大的表不是很明显（做实验时表的大小应超过内存数）
- 索引技术是数据库产品最重要的核心技术之一

# 测试

```
SQL> truncate table test_table;

表被截断。

已用时间:  00: 00: 00.04
SQL> declare
  2  max_record constant int:=10000000;
  3  i int:=1;
  4  begintime date;
  5  endtime date;
  6  runtime number;
  7  begin
  8  begintime:=sysdate;
  9  for i in 1..max_record loop
 10  if mod(i,2)=1 then
 11  insert into test_table values (i,sysdate);
 12  else
 13  insert into test_table values (i,sysdate+1);
 14  end if;
 15  end loop;
 16  commit;
 17  endtime:=sysdate;
 18  runtime:=(endtime-begintime)*86400;
 19  dbms_output.enable;
 20  dbms_output.put_line(runtime);
 21  end;
```

# 测试

```
SQL> select * from test_table where record_number=6789000;

RECORD_NUMBER CURRENT_DATE
------------- -------------
      6789000 15-5月 -22

已用时间:  00: 00: 00.13
SQL> create index xxxyyy on test_table(record_number);

索引已创建。

已用时间:  00: 00: 15.89
SQL> select * from test_table where record_number=6789000;

RECORD_NUMBER CURRENT_DATE
------------- -------------
      6789000 15-5月 -22

已用时间:  00: 00: 00.00
SQL>
```

# 序列（sequence）

```
SQL> create sequence abcd start with 1 increment by 10;

序列已创建。

已用时间:  00: 00: 00.00
SQL> select scott.abcd.nextval from dual;

   NEXTVAL
----------
         1

已用时间:  00: 00: 00.00
SQL> /

   NEXTVAL
----------
        11

已用时间:  00: 00: 00.00
SQL>
```

# 序列

- 可以指定首项和公差的等差数列，开始时指针指向数列首部，每访问一次指针往前移动一项。
- 序列不可以回滚，指针永远前进不可回退，故每次访问序列（即使是不同的会话）均获得不同的返回值
- 用途：产生唯一的编号，例如学号，会员号，商品号，机票号等等
- 把现实信息融入标识中是不良设计（隐私泄露，编号容易被推测）

# 测试

```
SQL> alter table emp add (clubid number(4));

表已更改。

已用时间:  00: 00: 00.01
SQL> update emp set clubid=scott.abcd.nextval;

已更新27行。

已用时间:  00: 00: 00.00
SQL> select * from emp;
```

| EMPNO | ENAME | JOB | MGR | HIREDATE | SAL | COMM | DEPTNO | CLUBID |
|---|---|---|---|---|---|---|---|---|
| 7369 | SMITH | CLERK | 7902 | 17-12月-80 | 800 | | 20 | 311 |
| 7499 | ALLEN | SALESMAN | 7698 | 20-2月 -81 | 1600 | 300 | 30 | 321 |
| 7521 | WARD | SALESMAN | 7698 | 22-2月 -81 | 1250 | 500 | 30 | 331 |
| 7566 | JONES | MANAGER | 7839 | 02-4月 -81 | 2975 | | 20 | 341 |
| 7654 | MARTIN | SALESMAN | 7698 | 28-9月 -81 | 1250 | 1400 | 30 | 351 |
| 7698 | BLAKE | MANAGER | 7839 | 01-5月 -81 | 2850 | | 30 | 361 |
| 7782 | CLARK | MANAGER | 7839 | 09-6月 -81 | 2450 | | 10 | 371 |
| 7839 | KING | PRESIDENT | | 17-11月-81 | 5000 | | 10 | 381 |
| 7844 | TURNER | SALESMAN | 7698 | 08-9月 -81 | 1500 | 0 | 30 | 391 |
| 7900 | JAMES | CLERK | 7698 | 03-12月-81 | 950 | | 30 | 401 |
| 7902 | FORD | ANALYST | 7566 | 03-12月-81 | 3000 | | 20 | 411 |
| 7934 | MILLER | CLERK | 7782 | 23-1月 -82 | 1300 | | 10 | 421 |

# 测试：序列不能出现在子查询中

```
SQL> update emp set clubid=(select scott.abcd.nextval from dual);
update emp set clubid=(select scott.abcd.nextval from dual)
                                                *
第 1 行出现错误:
ORA-02287: 此处不允许序号


已用时间:  00: 00: 00.01
```

```
SQL> select empno,ename,(select scott.abcd.nextval from dual) from emp;
select empno,ename,(select scott.abcd.nextval from dual) from emp
                                                *
第 1 行出现错误:
ORA-02287: 此处不允许序号


已用时间:  00: 00: 00.01
```

# 同义词（synonym）

```
SQL> connect system/manager
已连接。
SQL> select * from scott.emp where ename='KING';

     EMPNO ENAME      JOB              MGR HIREDATE          SAL       COMM     DEPTNO     CLUBID
---------- ---------- --------- ---------- -------------- ---------- ---------- ---------- ----------
      7839 KING       PRESIDENT            17-11月-81          5000                    10        381

已用时间:  00: 00: 00.00
SQL> create synonym e for scott.emp;

同义词已创建。

已用时间:  00: 00: 00.01
SQL> select * from e where ename='KING';

     EMPNO ENAME      JOB              MGR HIREDATE          SAL       COMM     DEPTNO     CLUBID
---------- ---------- --------- ---------- -------------- ---------- ---------- ---------- ----------
      7839 KING       PRESIDENT            17-11月-81          5000                    10        381

已用时间:  00: 00: 00.00
SQL>
```

# 同义词

- 用户只能使用自己创建的同义词
- 使用他人创建的同义词需要经过授权（与表类似）
- 同义词并不能绕过权限系统，相当于别名而已

# 创建用户

```
SQL> connect system/manager
已连接。
SQL> create user y1 identified by abc;

用户已创建。

已用时间:  00: 00: 00.05
SQL> create user y2 identified by 123;

用户已创建。

已用时间:  00: 00: 00.01
SQL> connect y1/abc
ERROR:
ORA-01045: user Y1 lacks CREATE SESSION privilege; logon denied


警告: 您不再连接到 ORACLE。
SQL>
```

# 使用户能登录会话

```
SQL> connect system/manager
已连接。
SQL> grant connect to y1
  2  ;

授权成功。

已用时间:  00: 00: 00.01
SQL> grant connect to y2;

授权成功。

已用时间:  00: 00: 00.00
SQL> connect y1/abc
已连接。
```

# 修改用户口令

```
SQL> connect system/manager
已连接。
SQL> alter user y1 identified by xyz;

用户已更改。

SQL> connect y1/xyz
已连接。
```

# 删除用户

```
SQL> connect system/manager
已连接。
SQL> drop user y3;

用户已删除。

SQL> grant resource to y1;

授权成功。

SQL> connect y1/xyz
已连接。
SQL> create table xxxxx (c1 char(1));

表已创建。
```

# 级联删除用户

```
SQL> connect system/manager
已连接。
SQL> drop user y1;
drop user y1
*
第 1 行出现错误:
ORA-01922: 必须指定 CASCADE 以删除 'Y1'


SQL> drop user y1 cascade;

用户已删除。
```

# 用户权限

- 系统特权：支配系统中一般性资源的能力，一般由DBA授予
- 对象特权：支配某一具体数据库对象的能力，一般由对象拥有者授予

# 列出所有系统特权

```
SQL> desc dba_sys_privs
 名称                                                                    是否为空? 类型
 ----------------------------------------------------------------------- -------- ------------------
-------
 GRANTEE                                                                 NOT NULL VARCHAR2(30)
 PRIVILEGE                                                               NOT NULL VARCHAR2(40)
 ADMIN_OPTION                                                                     VARCHAR2(3)

SQL> select privilege from dba_sys_privs;

PRIVILEGE
----------------------------------------
UPDATE ANY CUBE BUILD PROCESS
CREATE MINING MODEL
DROP ANY ASSEMBLY
DROP ANY EDITION
CREATE EXTERNAL JOB
MANAGE FILE GROUP
ADMINISTER SQL TUNING SET
MANAGE SCHEDULER
CREATE ANY RULE
CREATE ANY EVALUATION CONTEXT
CREATE ANY CONTEXT
```

# 几个有趣的系统特权

- SELECT ANY TABLE
- DROP USER，CREATE USER
- CREATE SESSION
- UNLIMITED TABLESPACE

# 授予系统特权

```
SQL> connect system/manager
已连接。
SQL> grant create user to scott;

授权成功。

SQL> connect scott/tiger
已连接。
SQL> create user z1 identified by xyz;

用户已创建。

SQL> _
```

# 撤销系统特权

```
SQL> connect system/manager
已连接。
SQL> revoke create user from scott;

撤销成功。

SQL> connect scott/tiger
已连接。
SQL> create user z1 identified by xyz;
create user z1 identified by xyz
                             *
第 1 行出现错误:
ORA-01031: 权限不足
```

# 带“with admin option”授权

```
SQL> connect system/manager
已连接。
SQL> grant create user to scott with admin option;

授权成功。

SQL> connect scott/tiger
已连接。
SQL> grant create user to z1;

授权成功。
```

# 对象特权?

- 针对特定数据库对象（表，视图，索引，同义词，序列，存储过程，存储函数等等）
- Select
- Update
- Insert
- Delete
- Alter
- Index
- Execute

# 授予对象特权

- Dba或对象owner可以进行授权

```
SQL> connect system/manager
已连接。
SQL> grant connect to z1;

授权成功。

SQL> grant select on scott.emp to z1;

授权成功。

SQL> connect scott/tiger
已连接。
SQL> grant select on emp to z1;

授权成功。
```

# 测试

```
SQL> connect z1/xyz
已连接。
SQL> set linesize 120
SQL> select * from emp;
select * from emp
              *
第 1 行出现错误:
ORA-00942: 表或视图不存在


SQL> select * from scott.emp;
```

| EMPNO | ENAME | JOB | MGR | HIREDATE | SAL | COMM | DEPTNO |
|---|---|---|---|---|---|---|---|
| 7369 | SMITH | CLERK | 7902 | 17-12月-80 | 800 | | 20 |
| 7499 | ALLEN | SALESMAN | 7698 | 20-2月 -81 | 1600 | 300 | 30 |
| 7521 | WARD | SALESMAN | 7698 | 22-2月 -81 | 1250 | 500 | 30 |
| 7566 | JONES | MANAGER | 7839 | 02-4月 -81 | 2975 | | 20 |
| 7654 | MARTIN | SALESMAN | 7698 | 28-9月 -81 | 1250 | 1400 | 30 |
| 7698 | BLAKE | MANAGER | 7839 | 01-5月 -81 | 2850 | | 30 |
| 7782 | CLARK | MANAGER | 7839 | 09-6月 -81 | 2450 | | 10 |
| 7839 | KING | PRESIDENT | | 17-11月-81 | 5000 | | 10 |
| 7844 | TURNER | SALESMAN | 7698 | 08-9月 -81 | 1500 | 0 | 30 |
| 7900 | JAMES | CLERK | 7698 | 03-12月-81 | 950 | | 30 |
| 7902 | FORD | ANALYST | 7566 | 03-12月-81 | 3000 | | 20 |
| 7934 | MILLER | CLERK | 7782 | 23-1月 -82 | 1300 | | 10 |

# 撤销对象特权

```
SQL> connect scott/tiger
已连接。
SQL> revoke select on emp from z1;

撤销成功。

SQL> connect z1/xyz
已连接。
SQL> select * from scott.emp;
select * from scott.emp
                    *
第 1 行出现错误:
ORA-00942: 表或视图不存在
```

# With grant option

- 类似with admin option
- With admin option和with grant option的微妙区别?

# 作业答案

- 求底层员工（即没有直属下属）中工资最高的员工名字

```
SQL> select ename from emp
  2  where sal=(select max(sal) from emp where empno in
  3  ((select empno from emp) minus (select mgr from emp)))
  4  and empno in ((select empno from emp) minus (select mgr from emp)) ;

ENAME
----------
ALLEN
```

# 夹带知识点：集合运算

- Minus，intersect，union，union all

```
select ename from emp
where sal=(select max(sal) from emp where empno in
((select empno from emp) minus (select mgr from
emp)));
```

# Union与union all

- Union（去除重复元素），union all（不去除重复元素）

```
SQL> (select empno from emp) union all (select mgr from emp);

     EMPNO
----------
      7369
      7499
      7521
      7566
      7654
      7698
      7782
      7839
      7844
      7900
      7902
      7934
      7902
      7698
      7698
      7839
      7698
      7839
      7839

      7698
      7698
      7566
      7782

已选择24行。
```

# 作业答案

- 用1条SQL语句建立以下统计表格，分别统计每个部门，每个年份进入公司，每个工种的人数

```
SQL> (select deptno,count(*) from emp group by deptno) union all
  2  (select to_char(hiredate,'yyyy'),count(*) from emp group by to_char(hiredate,'yyyy')) union all
  3  (select job,count(*) from emp group by job);
(select deptno,count(*) from emp group by deptno) union all
        *
第 1 行出现错误:
ORA-01790: 表达式必须具有与对应表达式相同的数据类型
```

# 作业答案

```
SQL> (select dname,count(*) from emp, dept  where emp.deptno=dept.deptno group by dname) union all
  2  (select to_char(hiredate,'yyyy'),count(*) from emp group by to_char(hiredate,'yyyy')) union all
  3  (select job,count(*) from emp group by job);

DNAME          COUNT(*)
-------------- ----------
ACCOUNTING              3
RESEARCH                3
SALES                   6
1980                    1
1982                    1
1981                   10
CLERK                   3
SALESMAN                4
PRESIDENT               1
MANAGER                 3
ANALYST                 1

已选择11行。
```

# 作业答案

```
SQL> select dname,to_char(hiredate,'yyyy'),job,count(*),
  2  grouping(dname),grouping(to_char(hiredate,'yyyy')),grouping(job)
  3  from emp,dept
  4  where emp.deptno=dept.deptno
  5  group by rollup (dname,to_char(hiredate,'yyyy'),job);

DNAME          TO_C JOB          COUNT(*) GROUPING(DNAME) GROUPING(TO_CHAR(HIREDATE,'YYYY')) GROUPING(JOB)
-------------- ---- --------- ---------- --------------- ------------------------------------ -------------
SALES          1981 CLERK              1               0                                    0             0
SALES          1981 MANAGER            1               0                                    0             0
SALES          1981 SALESMAN           4               0                                    0             0
SALES          1981                    6               0                                    0             1
SALES                                  6               0                                    1             1
RESEARCH       1980 CLERK              1               0                                    0             0
RESEARCH       1980                    1               0                                    0             1
RESEARCH       1981 ANALYST            1               0                                    0             0
RESEARCH       1981 MANAGER            1               0                                    0             0
RESEARCH       1981                    2               0                                    0             1
RESEARCH                               3               0                                    1             1
ACCOUNTING     1981 MANAGER            1               0                                    0             0
ACCOUNTING     1981 PRESIDENT          1               0                                    0             0
ACCOUNTING     1981                    2               0                                    0             1
ACCOUNTING     1982 CLERK              1               0                                    0             0
ACCOUNTING     1982                    1               0                                    0             1
ACCOUNTING                             3               0                                    1             1
                                      12               1                                    1             1
```

# 作业答案

```
SQL> select dname,to_char(hiredate,'yyyy'),job,count(*) from emp,dept
  2  where emp.deptno=dept.deptno
  3  group by cube (dname,to_char(hiredate,'yyyy'),job)
  4  having grouping(dname)+grouping(to_char(hiredate,'yyyy'))+grouping(job)=2;

DNAME          TO_C JOB          COUNT(*)
-------------- ---- --------- ----------
                    CLERK              3
                    ANALYST            1
                    MANAGER            3
                    SALESMAN           4
                    PRESIDENT          1
               1980                    1
               1981                   10
               1982                    1
SALES                                  6
RESEARCH                               3
ACCOUNTING                             3

已选择11行。
```

# 作业答案

- 在学生选修表SC与课程表C放置一些数据，写一条SQL求出选修了C表所列全部课程的学生名单
- **思路：翻译为not exists算法能解决的形式，找出这样的学生，不存在一门课他是没有选修的**

# 建立数据

```
insert into s values ('s1','X','MA',21);
insert into s values ('s2','Y','PH',20);
insert into s values ('s3','Z','CS',21);
insert into s values ('s4','W','MA',25);

insert into c values ('c1','Algebra',NULL);
insert into c values ('c2','C Language',NULL);
insert into c values ('c3','Analysis',NULL);

insert into sc values ('s1','c1',90);
insert into sc values ('s1','c2',99);
insert into sc values ('s2','c1',70);
insert into sc values ('s2','c2',90);
insert into sc values ('s2','c3',92);
insert into sc values ('s3','c3',60);
```

# 作业答案

```
SQL> select * from s;

S#       SN       SD                    SA
-------- -------- -------------------- ----------
s1       X        MA                   21
s2       Y        PH                   20
s3       Z        CS                   21
s4       W        MA                   25
```

# 作业答案

```
SQL> select * from c;

C#       CN          PC#
-------- ---------- --------
c1       Algebra
c2       C Language
c3       Analysis

SQL> select * from sc;

S#       C#                  G
-------- -------- ----------
s1       c1                 90
s1       c2                 99
s2       c1                 70
s2       c2                 90
s2       c3                 92
s3       c3                 60

已选择6行。
```

# 作业答案

```
select sn from s
where not exists ( select * from c where
                    not exists (select * from sc
                                where s#=s.s# and c#=c.c#)
                  );
```

# 作业答案

```
SQL> select sn from s
  2  where not exists ( select * from c where
  3                        not exists (select * from sc
  4                                    where s#=s.s# and c#=c.c#)
  5                           );

SN
--------
Y

SQL>
SQL>
```

# 参考

- 王珊《数据库系统概论》第5版第110页例3.62
- 这种运算在关系代数中称为“关系（table）的除法”,记为“sc÷c”,这是唯一没有被翻译为SQL基本操作的关系代数运算

# 故事

- N年前一道研究生入学考试题：列出选修了每一门课的同学人数
- 难道不是“select c#,count(*) from sc group by c#”？

# 问题

- 怎样用一条SQL语句判断两个集合（假设都没有重复元素）是否相等或是子集关系?
- 列出选修课程与某位指定同学完全一样的同学
- 列出所有选修课程完全一样的同学名单，以学号对的形式输出结果

# 作业答案

- 有A，B两张表，均有C1，C2两列，C1代表商品名称，C2代表商品价格。B中的商品有些是A中的原有商品，有些是在A中没有的新商品，要求对A表进行更新修改，B中原有商品用B里的新价格覆盖A的原价格，B中的新商品则插入到A中，要求1条SQL语句完成

```
SQL> select * from ta;

C          C2
- ----------
X         100
Y         140
Z          30
W         500
U         160
V         230
P         800
Q         320

已选择8行。
```

```
SQL> select * from tb;

C          C2
- ----------
V        1300
Y        1400
Q        1500
```

# 作业答案

```
SQL> insert into tb values ('A',2400);

已创建 1 行。

SQL> insert into tb values ('B',3400);

已创建 1 行。

SQL> commit;
  2
SQL>
SQL> select * from tb;

C          C2
- ----------
A        2400
B        3400
V        1300
Y        1400
Q        1500
```

# 用两条语句完成的方法

- 用已经学过的语句不大可能一条语句完成，update不能insert，insert不能update
- 先insert A表没有的行
- 化归为上周作业的问题
- 问题：为什么insert进去的行会放在最前面?

```
SQL> insert into ta
  2  select c1,c2 from tb
  3  where not exists(select * from ta where c1=tb.c1);

已创建2行。

SQL> select * from ta;

C          C2
- ----------
A        2400
B        3400
X         100
Y         140
Z          30
W         500
U         160
V         230
P         800
Q         320

已选择10行。
```

# 夹带知识点：MERGE语句

```
SQL> select * from tb;

C          C2
- ----------
A        2400
B        3400
V        1300
Y        1400
Q        1500

SQL> merge into ta using tb on (ta.c1=tb.c1)
  2  when matched then update set ta.c2=tb.c2
  3  when not matched then insert values(tb.c1,tb.c2);

5 行已合并。
```

# 作业答案

```
SQL> select * from ta;

C          C2
- ----------
A        2400
B        3400
X         100
Y        1400
Z          30
W         500
U         160
V        1300
P         800
Q        1500
```

# 作业答案

- 在SC表中加入大量数据，然后用pivot函数将它转为宽表SCwide。再用unpivot函数将SCwide转为窄表

```
SQL> create table scwide as
  2  select * from sc pivot (max (g) for c# in ('c1' c1,'c2' c2,'c3' c3));

表已创建。

SQL> select * from scwide;

S#                  C1          C2          C3
-------- ---------- ---------- ----------
s2                  70          90          92
s1                  90          99
s3                                          60
```

# 作业答案

```
SQL> select * from scwide
  2  unpivot (g for c# in (c1,c2,c3));

S#         C#                    G
---------- -- ----------
s2         C1                   70
s2         C2                   90
s2         C3                   92
s1         C1                   90
s1         C2                   99
s3         C3                   60

已选择6行。
```

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# Thanks

## FAQ时间