

For each of the following SQL statements, give an equivalent relational algebra expression, if possible.

- a. `select distinct B.age, B.rank
from employee A, employee B
where A.enum > B.enum`

- b. `select max(salary)
from employee
where rank = manager`

- c. `select deptnum, max(salary)
from employee
where rank = manager group by deptnum`

- d. `select distinct enum
from employee
where not exists
 (select *
 from projects
 where not exists
 (select *
 from works
 where employee.enum = works.enum and works.pnum = projects.pnum))`

Sample answers:

a. $\pi_{B.age, B.rank}(\sigma_{A.enum > B.enum}(\rho_A(\text{employee}) \times \rho_B(\text{employee})))$

b. $\pi_{salary}(\sigma_{rank=manager}(\text{employee})) - \pi_{employee.salary}(\sigma_{employee.salary < E.salary}(\sigma_{rank=manager}(\text{employee}) \times \sigma_{rank=manager}(\rho_E(\text{employee}))))$

c. Not possible in RA because of the specific groupings here.

d. $\pi_{employee.enum, works.pnum}(\sigma_{employee.enum = works.enum}(\text{employee} \times \text{works})) / \pi_{pnum}(\text{projects})$