Laboratory work 1

1. **Consider the employee database of figure below. Give an expression in the relational algebra to express each of the following queries:**

   employee (*person_name, street, city*)
   works (*person_name, company_name, salary*)
   company (*company_name, city*)

   - Find the ID and name of each employee who works for BigBank:

   $$\prod_{\text{ID, person\_name}} \left(\sigma_{\text{company\_name = "BigBank"}}(\text{works}) \right)$$

   - Find the ID, name, and city of residence of each employee who works for "BigBank":

   $$\prod_{\text{ID, person\_name, city}} \left(\sigma_{\text{company\_name="BigBank"}} \left(\text{employee} \bowtie_{\text{employee.id=works.id}} \text{works} \right) \right)$$

   - Find the ID, name, street, address, and city of residence each employee who works for BigBank and earns more than $10000:

   $$\prod_{\text{ID, person\_name, street, city}} \left(\sigma_{\text{(company\_name, = "BigBank" } \wedge \text{ salary > 10000)}} \left(\text{Works} \bowtie_{\text{employee.id=works.id}} \text{employee} \right) \right)$$

   - Find the ID and name of each employee in this database who lives in the same city as the company for which she or he works:

   $$\prod_{\text{ID, person\_name}} \left(\sigma_{\text{employee.city = company.city}} \left(\text{employee} \bowtie_{\text{employee.ID=works.ID}} \text{works} \bowtie_{\text{works.company\_name=company.company\_name}} \text{company} \right) \right)$$

2. Consider the employee database of figure above. Give an expression in the relational algebra to express each of the following queries:

- Find the ID and name of each employee who does not work for "BigBank".

$$\prod_{\text{ID, person\_name}} \left(\sigma_{\text{company\_name} \neq \text{"BigBank"}} \left(\text{employee} \bowtie_{\text{employee.ID = works.ID}} \text{works} \right) \right)$$

- Find the ID and name of each employee who earns at least as much as every employee in the database.

$$\prod_{\text{ID, person\_name}} \left(\sigma_{\text{salary} \geq \gamma_{\text{avg(salary)}} (\text{works})} (\text{works}) \right)$$

3. Consider the foreign-key constraint from the *dept name* attribute of instructor to the department relation. Give examples of inserts and deletes to these relations that can cause a violation of the foreign-key constraint.

Insert: if we insert a tuple into the "instructor" table with a *dept_name* that does not exist in "department" table, that will be a violation of foreign key constraint.

Delete: if we delete a tuple from the "department" table with a *dept_name* that exists in the "instructor" table, that will be a violation as well.

4. Consider the employee database of figure above. What are the appropriate primary keys?

- Employee : ID (if exists), person_name
- Works: ID (if exists), person_name
- Company: ID (if exists), company_name