

Series 2: Relational Algebra

Consider the relational database, PUF, with the schema:

- **U** (NU, NameU, City)
- **P** (NP, NameP, Color, Weight)
- **F** (NF, NameF, Status, City)
- **PUF** (NP, NU, NF, Quantity)

Where:

- **NP** references **P.NP**
- **NU** references **U.NU**
- **NF** references **F.NF**

This database describes the following:

- **U**: A factory is identified by its number (**NU**), its name (**NameU**), and the city (**City**) where it is located.
- **P**: A product is identified by its number (**NP**), its name (**NameP**), its color (**Color**), and its weight (**Weight**).
- **F**: A supplier is identified by its number (**NF**), its name (**NameF**), its status (**Status**) (such as subcontractor, client-supplier, etc.), and the city (**City**) where it is located.
- **PUF**: The product with number (**NP**) was delivered to the factory with number (**NU**) by the supplier with number (**NF**) in a given quantity (**Quantity**).

Express the following queries in relational algebra:

1. Retrieve the number, name, and city of all factories.
2. Retrieve the number, name, and city of all factories located in London.
3. Retrieve the numbers of suppliers who supply factory No. 1 with product No. 1.
4. Retrieve the name and color of products delivered by supplier No. 1.
5. Retrieve the numbers of suppliers who supply factory No. 1 with a red product.
6. Retrieve the names of suppliers who supply a factory in London or Paris with a red product.
7. Retrieve the numbers of products delivered to a factory by a supplier from the same city.
8. Retrieve the numbers of products delivered to a factory in London by a supplier from London.
9. Retrieve the numbers of factories that have at least one supplier from a different city.
10. Retrieve the numbers of suppliers who supply both factories No. 1 and No. 2.
11. Retrieve the numbers of factories that use at least one product available from supplier No. 3 (i.e., a product they deliver, but not necessarily to that factory).
12. Retrieve the numbers of products that are delivered to all factories in Annaba.
13. Retrieve the numbers of factories that source exclusively from supplier No. 3