Data Analysis and Integration

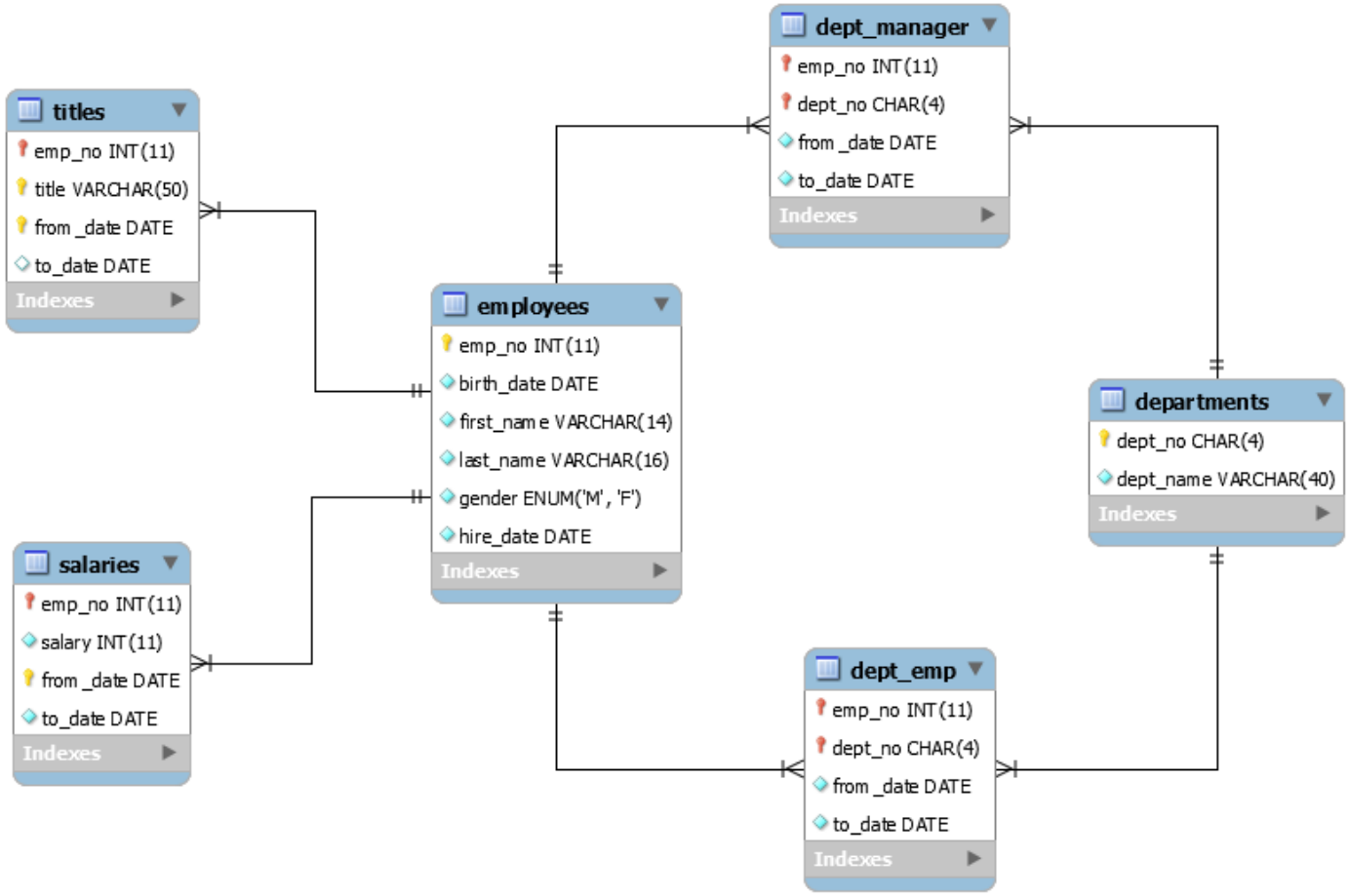
Concepts of data integration

Introduction

- The need for data integration
  - company A merges with company B
  - A is a company with the **employees** database
  - B is a company with the **company** database
  - provide an integrated view of data from both companies
    - e.g. employees, departments, salaries, job titles

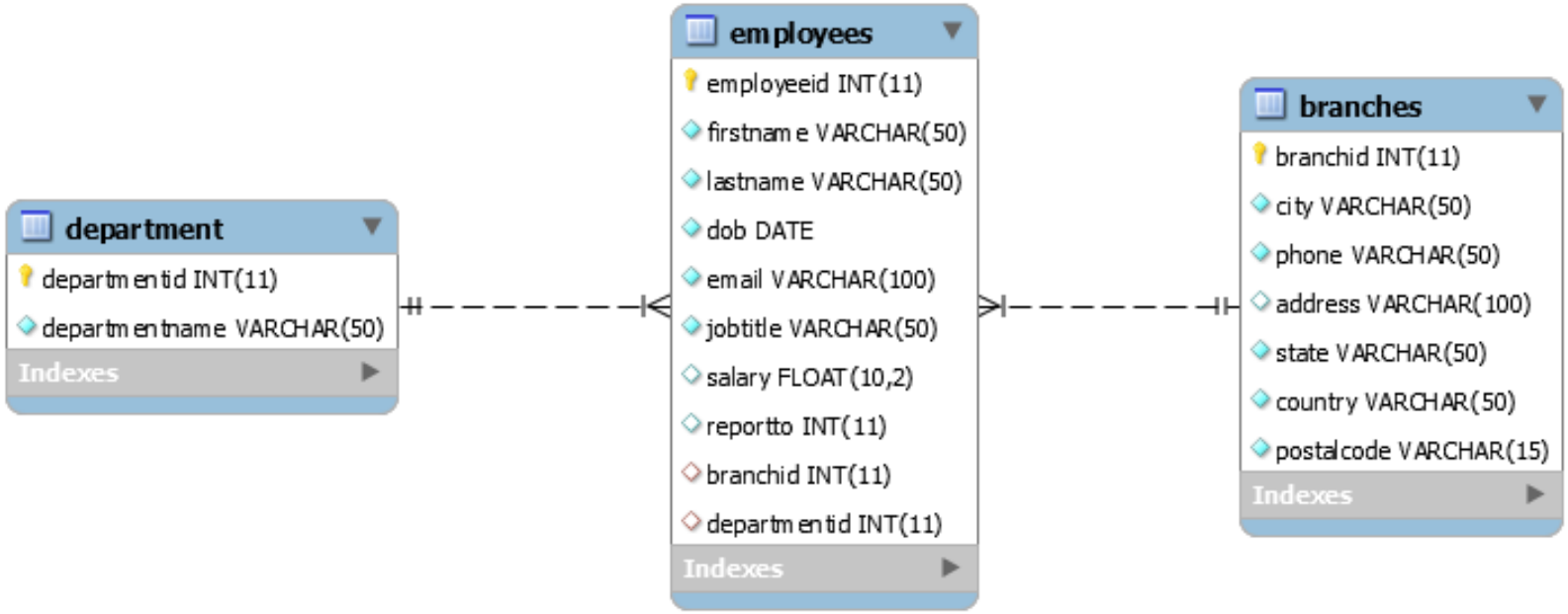
Company A

- The employees database



Company B

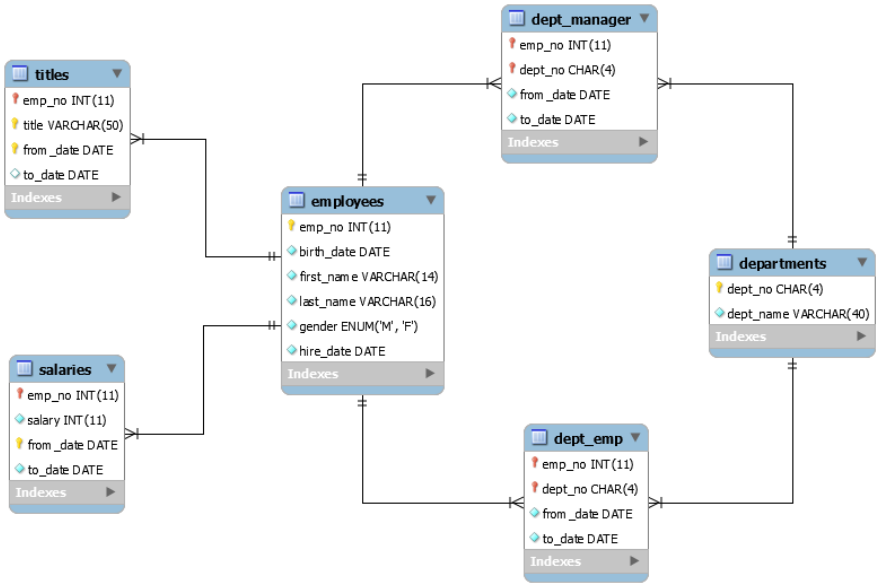
- The company database



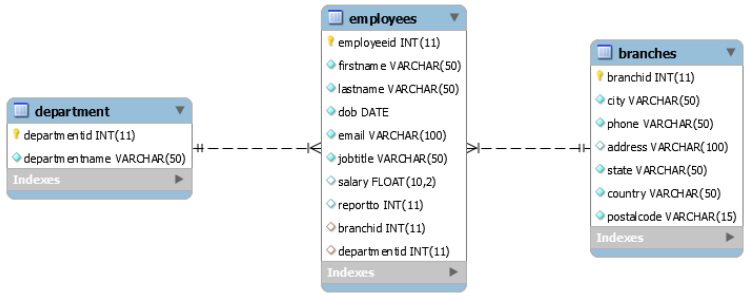
Data sources

- Comparing the two **data sources** (schema)

data source A (**employees** database)

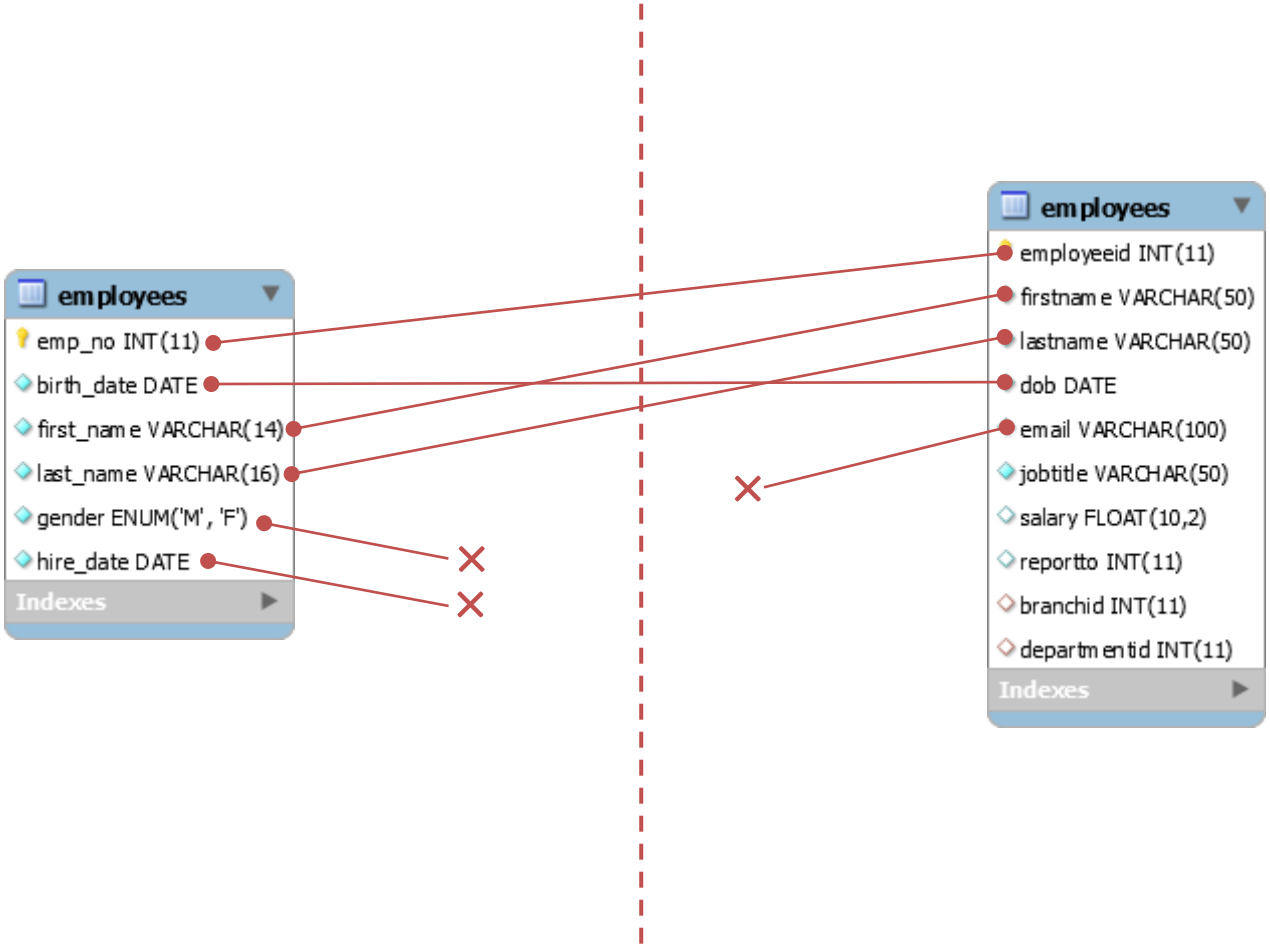


data source B (**company** database)



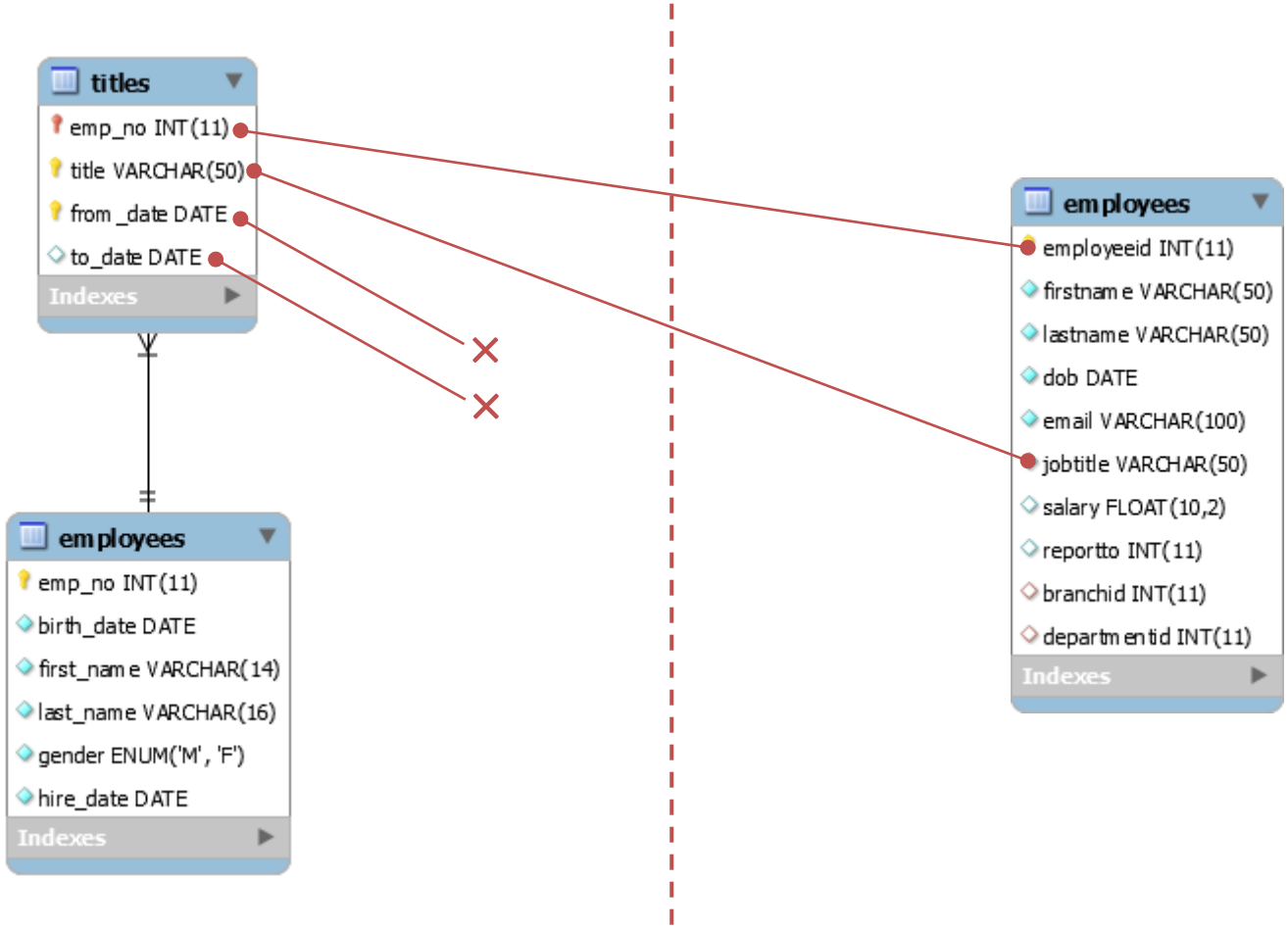
Schema matching (employees)

- Comparing the two data sources (**schema matching**)



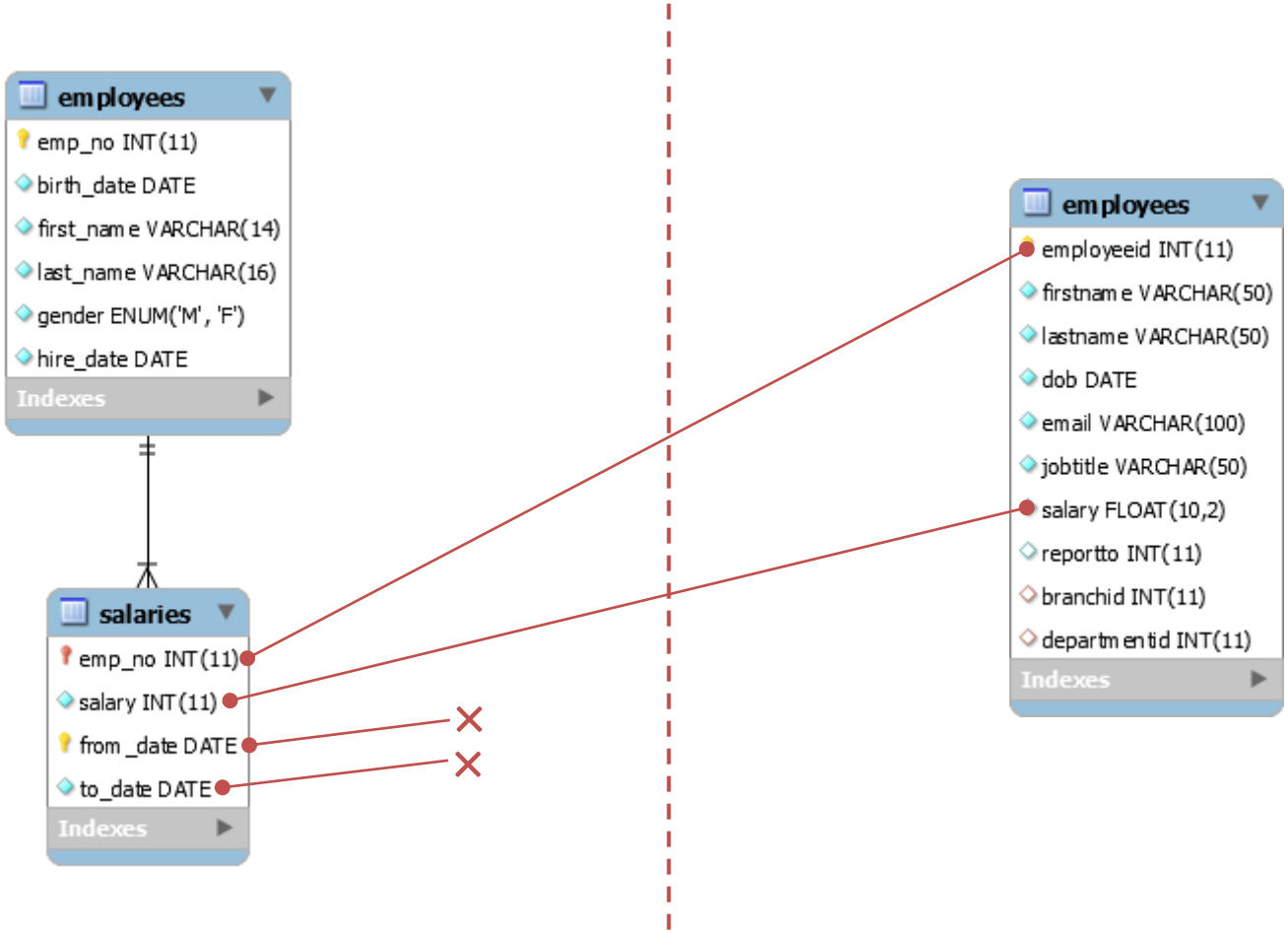
Schema matching (titles)

- Comparing the two data sources (**schema matching**)



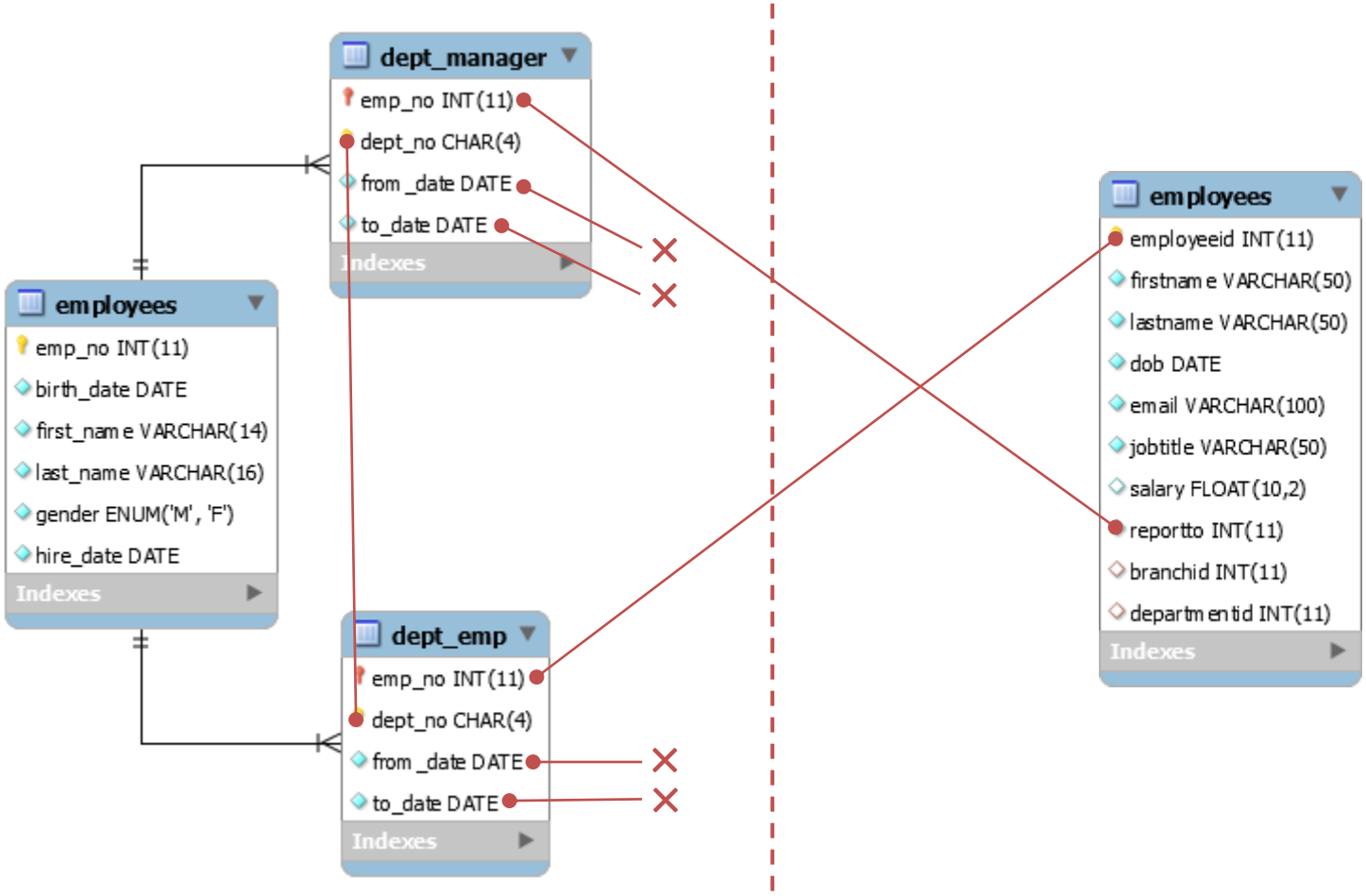
Schema matching (salaries)

- Comparing the two data sources (**schema matching**)



Schema matching (managers)

- Comparing the two data sources (**schema matching**)

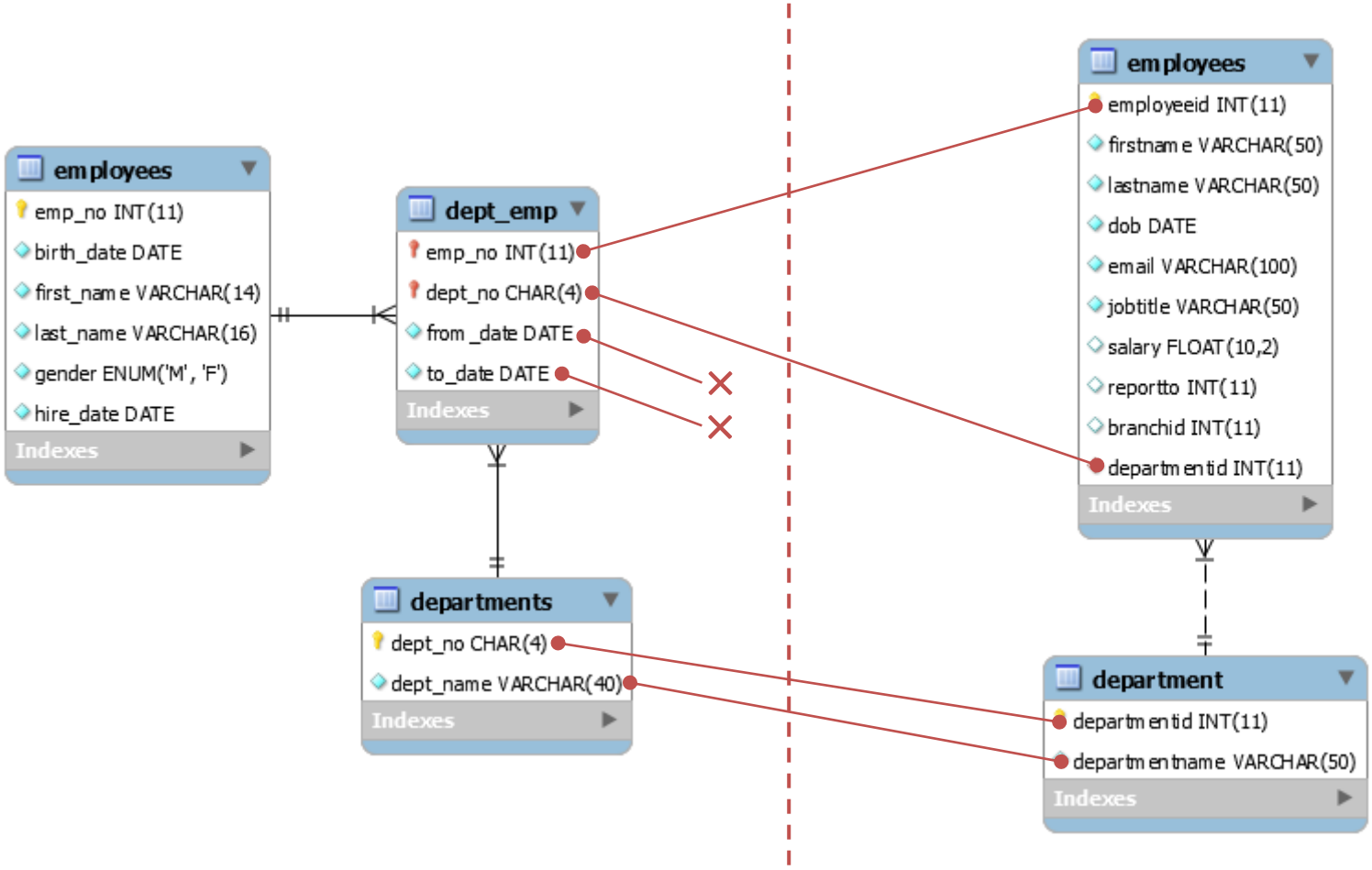


Schema matching (branches)

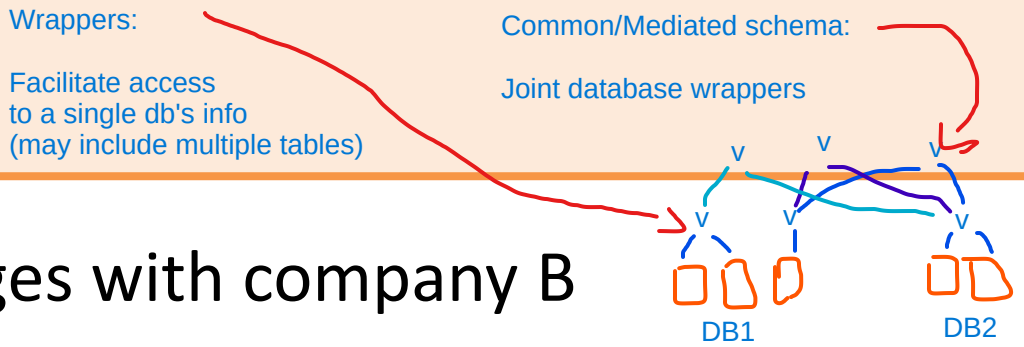
- Comparing the two data sources (**schema matching**)

Schema matching (departments)

- Comparing the two data sources (**schema matching**)



Mediated schema



- Once company A merges with company B
  - we need to access data through a single/uniform access point

- Example of a common schema (**mediated schema**)

  all_employees(emp_no, first_name, last_name, birth_date, report_to)

  all_departments(dept_no, dept_name)

  all_dept_emp(emp_no, dept_no)

  all_salaries(emp_no, salary)

  all_titles(emp_no, title)

Mediated schema

- Common schema (**mediated schema**)

  all_employees(emp_no, first_name, last_name, birth_date, report_to)

  all_departments(dept_no, dept_name)

  all_dept_emp(emp_no, dept_no)

  all_salaries(emp_no, salary)

  all_titles(emp_no, title)

  – absence of **from_date** and **to_date** attributes means that data retrieved from the **employees** database will always refer to current date

Wrappers for data sources

- We have a set of views to retrieve data for the current date

  employees(emp_no, birth_date, first_name, last_name, gender, hire_date)
  departments(dept_no, dept_name)
  curr_dept_emp(emp_no, dept_no)
  curr_dept_manager(emp_no, dept_no)
  curr_salaries(emp_no, salary)
  curr_titles(emp_no, title)

  - we will use these views as a **wrapper** for the employees database
    - i.e. a layer through which we access the employees database

Schema mapping (all_employees)

- Mapping to common schema (**schema mapping**)
  - transformations/queries that populate common schema

all_employees(emp_no, first_name, last_name, birth_date, report_to)

  - from **employees** database

```
select a.emp_no, a.first_name, a.last_name, a.birth_date, c.emp_no
from employees.employees as a,
        employees.curr_dept_emp as b,
        employees.curr_dept_manager as c
where a.emp_no = b.emp_no and b.dept_no = c.dept_no;
```

  - from **company** database

```
select employeeid, firstname, lastname, dob, reportto
from company.employees;
```

Schema mapping (all_employees)

- Mapping to common schema (**schema mapping**)

  all_employees(emp_no, first_name, last_name, birth_date, report_to)

```
(select a.emp_no, a.first_name, a.last_name, a.birth_date, c.emp_no
 from employees.employees as a,
        employees.curr_dept_emp as b,
        employees.curr_dept_manager as c
 where a.emp_no = b.emp_no and b.dept_no = c.dept_no)
union
(select employeeid, firstname, lastname, dob, reportto
 from company.employees);
```

```
+--------+------------+-----------+------------+--------+
| emp_no | first_name | last_name | birth_date | emp_no |
+--------+------------+-----------+------------+--------+
|  21637 | Yefim      | Luby      | 1964-04-28 | 110039 |
|  25949 | Owen       | Matheson  | 1959-08-08 | 110039 |
|    ... | ...        | ...       | ...        |    ... |
|   1001 | Ravi       | Gupta     | 1969-12-03 |   1001 |
|   1002 | Ram        | charan    | 1985-02-20 |   1001 |
|    ... | ...        | ...       | ...        |    ... |
+--------+------------+-----------+------------+--------+
```

Schema mapping (all_employees)

- Mapping to common schema (**schema mapping**)

  all_employees(emp_no, first_name, last_name, birth_date, report_to)

```
create view all_employees(emp_no, first_name, last_name, birth_date, report_to) as
    (select a.emp_no, a.first_name, a.last_name, a.birth_date, c.emp_no
     from employees.employees as a,
          employees.curr_dept_emp as b,
          employees.curr_dept_manager as c
     where a.emp_no = b.emp_no and b.dept_no = c.dept_no)
    union
    (select employeeid, firstname, lastname, dob, reportto
     from company.employees);
```

Schema mapping (all_departments)

- Mapping to common schema (**schema mapping**)

  all_departments(dept_no, dept_name)

  – from **employees** database

  ```
  select dept_no, dept_name
  from employees.departments
  ```

  – from **company** database

  ```
  select departmentid, departmentname
  from company.department
  ```

Schema mapping (all_departments)

- Mapping to common schema (**schema mapping**)

  all_departments(dept_no, dept_name)

```
(select dept_no, dept_name
 from employees.departments)
union
(select departmentid, departmentname
 from company.department);
```

```
+---------+--------------------+
| dept_no | dept_name          |
+---------+--------------------+
| d009    | Customer Service   |
| d005    | Development        |
| d002    | Finance            |
| d003    | Human Resources    |
| d001    | Marketing          |
| d004    | Production         |
| d006    | Quality Management |
| d008    | Research           |
| d007    | Sales              |
| 101     | IT                 |
| 102     | HR                 |
| 103     | Finance            |
| 104     | Sales              |
| 105     | marketing          |
+---------+--------------------+
14 rows in set (0.00 sec)
```

Schema mapping (all_departments)

- Mapping to common schema (**schema mapping**)

  all_departments(dept_no, dept_name)

```
create view all_departments(dept_no, dept_name) as
      (select dept_no, dept_name
       from employees.departments)
      union
      (select departmentid, departmentname
       from company.department);
```

Schema mapping (all_dept_emp)

- Mapping to common schema (**schema mapping**)

  all_dept_emp(emp_no, dept_no)

  – from **employees** database

  ```
  select emp_no, dept_no
  from employees.curr_dept_emp
  ```

  – from **company** database

  ```
  select employeeid, departmentid
  from company.employees
  ```

Schema mapping (all_dept_emp)

- Mapping to common schema (**schema mapping**)

  all_dept_emp(emp_no, dept_no)

```
(select emp_no, dept_no
 from employees.curr_dept_emp)
union
(select employeeid, departmentid
 from company.employees);
```

emp_no	dept_no
10721	d009
11260	d009
...	...
1008	101
1014	101
...	...

Schema mapping (all_dept_emp)

- Mapping to common schema (**schema mapping**)

  all_dept_emp(emp_no, dept_no)

```
create view all_dept_emp(emp_no, dept_no) as
      (select emp_no, dept_no
       from employees.curr_dept_emp)
      union
      (select employeeid, departmentid
       from company.employees);
```

Schema mapping (all_salaries)

- Mapping to common schema (**schema mapping**)

  all_salaries(emp_no, salary)

  – from **employees** database

  ```
  select emp_no, salary
  from employees.curr_salaries
  ```

  – from **company** database

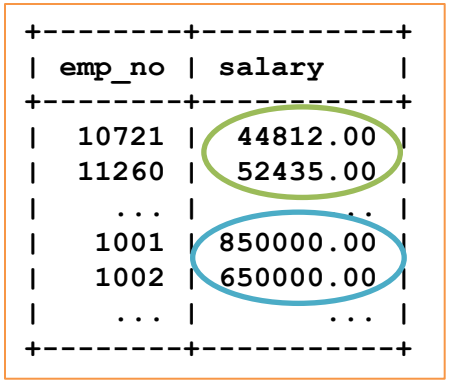
  ```
  select employeeid, salary
  from company.employees
  ```

Schema mapping (all_salaries)

- Mapping to common schema (**schema mapping**)

  all_salaries(emp_no, salary)

```
(select emp_no, salary
from employees.curr_salaries)
union
(select employeeid, salary
from company.employees);
```



emp_no	salary
10721	44812.00
11260	52435.00
...	..
1001	850000.00
1002	650000.00
...	...

Schema mapping (all_salaries)

- Mapping to common schema (**schema mapping**)

  all_salaries(emp_no, salary)

```
create view all_salaries(emp_no, salary) as
    (select emp_no, salary
    from employees.curr_salaries)
    union
    (select employeeid, salary
    from company.employees);
```

Schema mapping (all_titles)

- Mapping to common schema (**schema mapping**)

  all_titles(emp_no, title)

  - from **employees** database

    select emp_no, title
    from employees.curr_titles

  - from **company** database

    select employeeid, jobtitle
    from company.employees

Schema mapping (all_titles)

- Mapping to common schema (**schema mapping**)

  all_titles(emp_no, title)

```
(select emp_no, title
from employees.curr_titles)
union
(select employeeid, jobtitle
 from company.employees);
```

emp_no	title
11371	Senior Engineer
41548	Staff
62635	Engineer
64387	Senior Staff
110039	Manager
204631	Assistant Engineer
207968	Technique Leader
...	...
1001	CEO
1002	Director
1003	President
1004	Vice President
1005	Sr. Manager
1007	Sales Manager
1008	Reporting Manager
1009	Team Leader
1010	Sales Rep
1014	Software Engineer
1023	Admin
1024	Network Engineer
...	...

Schema mapping (all_titles)

- Mapping to common schema (**schema mapping**)

  all_titles(emp_no, title)

```
create view all_titles(emp_no, title) as
    (select emp_no, title
    from employees.curr_titles)
    union
    (select employeeid, jobtitle
     from company.employees);
```

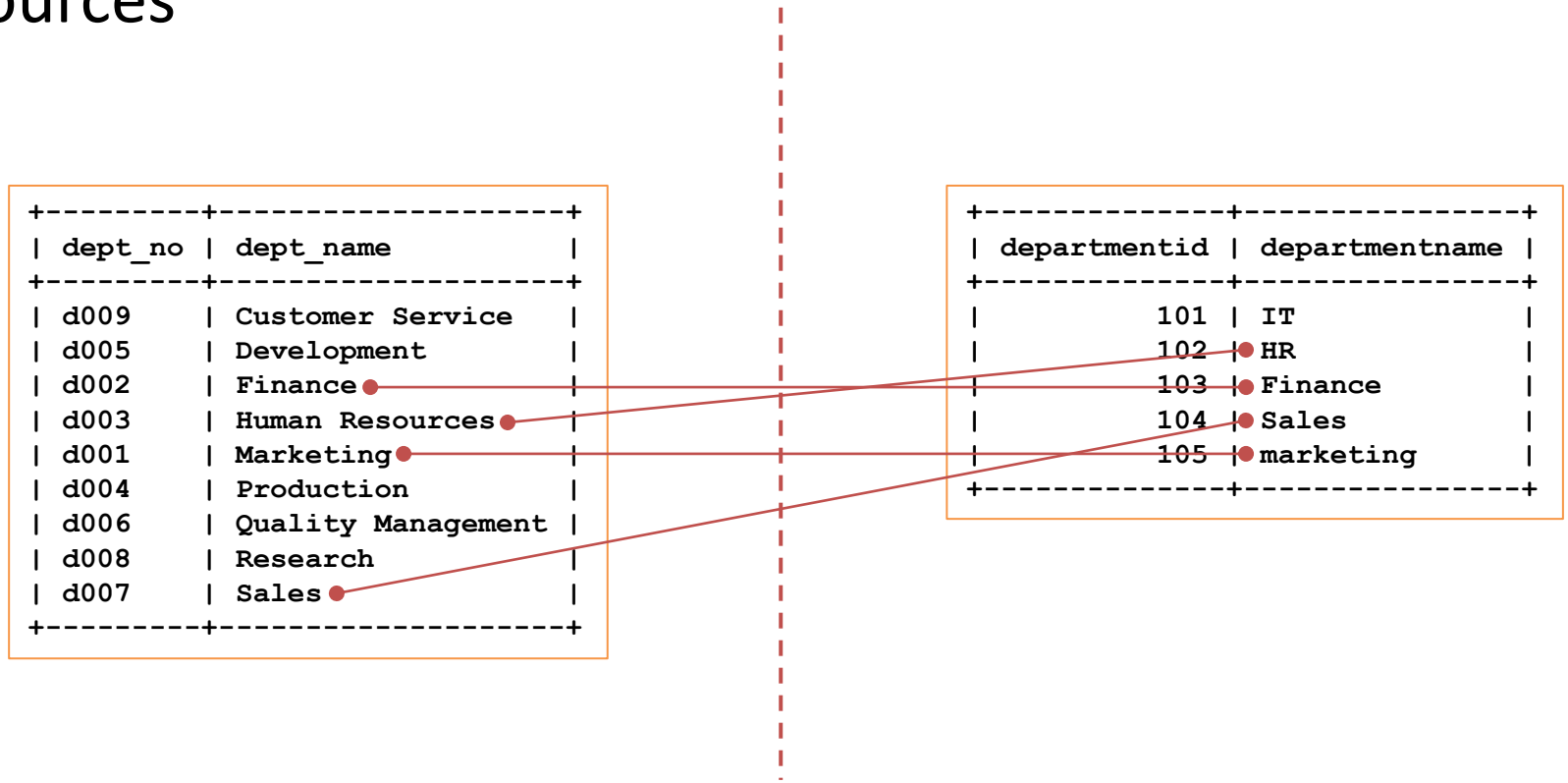
Data matching – duplicates

Schema matching: find correspondence data source shemas

!=

Data matching: find correspondence between values

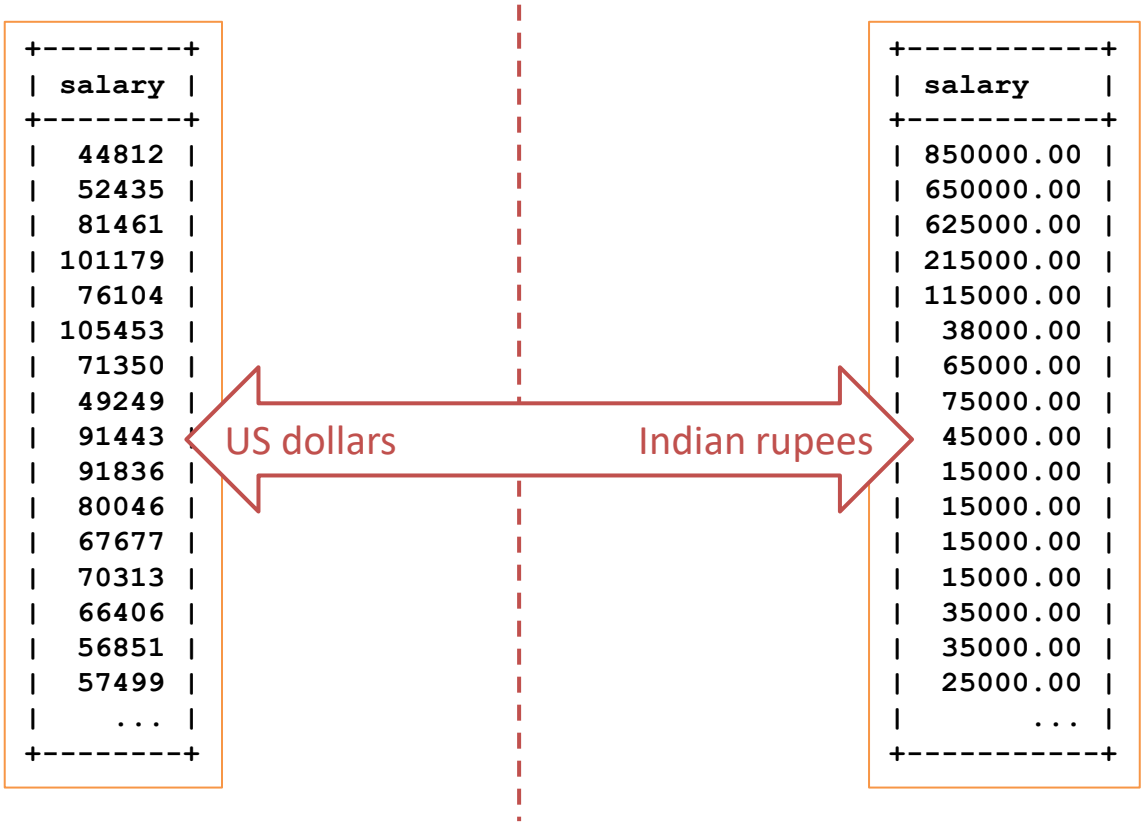
- When comparing data instances from distinct data sources



  - duplicate department names need to be merged

Data matching – conversion

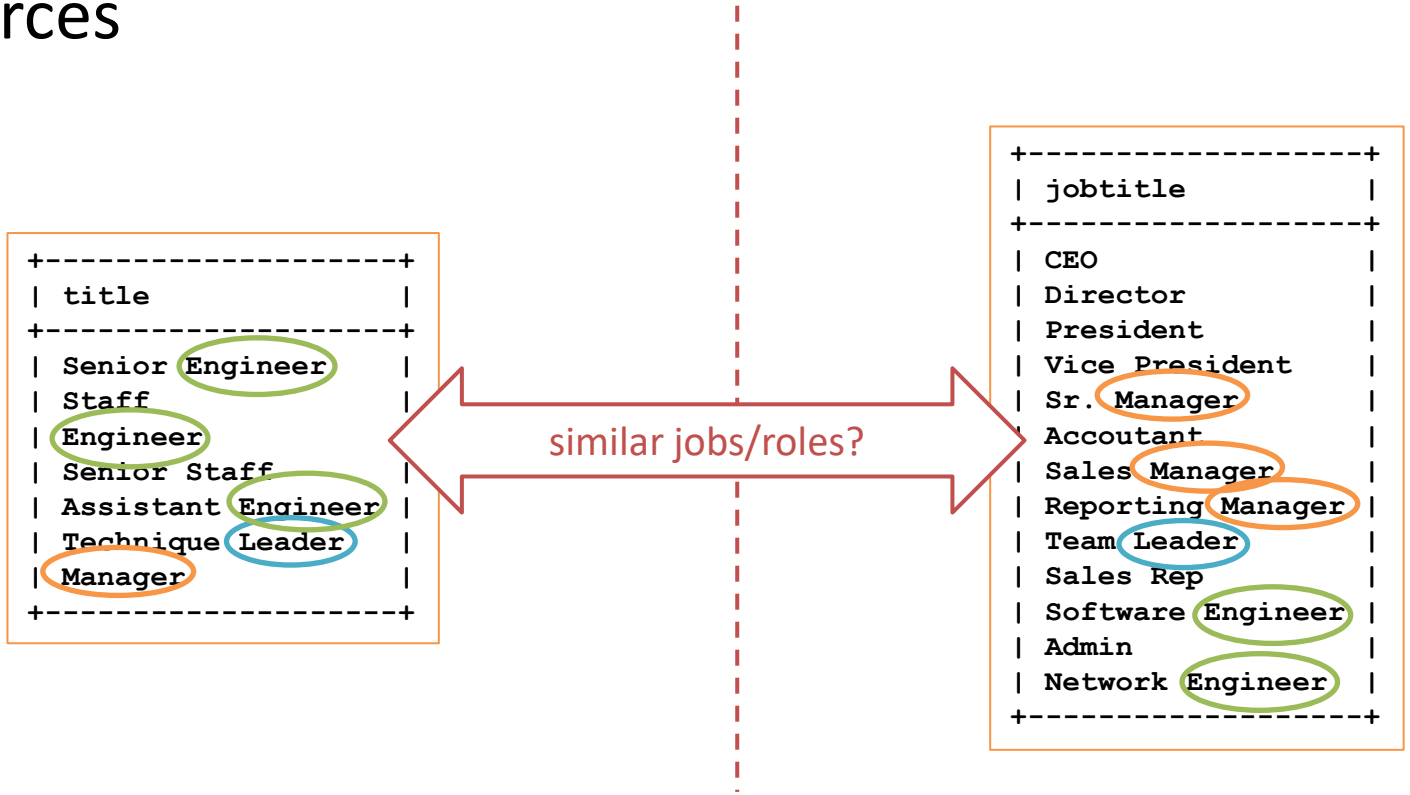
- When comparing data instances from distinct data sources



  - salaries need to be converted

Data matching – approximate duplicates

- When comparing data instances from distinct data sources



  - similar job titles need to be found and merged/consolidated

Summary of concepts

- Multiple **data sources** with different schemas
  - relational databases, but could be other data sources as well
- **Schema matching** between data sources
  - how attributes in one data source correspond to attributes in another data source
- Design of a common **mediated schema**
  - subset of attributes from data source schemas
- **Wrappers** for data sources
  - facilitate and simplify access to data sources
- **Schema mapping** from data sources to mediated schema
  - queries to bring data from local schema to global mediated schema
- **Data matching** between data sources
  - find exact/approximate duplicates from different sources that may need to be merged, converted or consolidated

Identificar que conceitos correspondem a que conceitos

Identificar que valores correspondem a que valores