Tech ABC Corp - HR Database

Janis Puris, 2021-06-23

Business Scenario

Business requirement

Tech ABC Corp saw explosive growth with a sudden appearance onto the gaming scene with their new AI-powered video game console. As a result, they have gone from a small 10 person operation to 200 employees and 5 locations in under a year. HR is having trouble keeping up with the growth, since they are still maintaining employee information in a spreadsheet. While that worked for ten employees, it has becoming increasingly cumbersome to manage as the company expands.

As such, the HR department has tasked you, as the new data architect, to design and build a database capable of managing their employee information.

Dataset

The HR dataset you will be working with is an Excel workbook which consists of 206 records, with eleven columns. The data is in human readable format, and has not been normalized at all. The data lists the names of employees at Tech ABC Corp as well as information such as job title, department, manager's name, hire date, start date, end date, work location, and salary.

IT Department Best Practices

The IT Department has certain Best Practices policies for databases you should follow, as detailed in the Best Practices document.

Step 1

Data Architecture Foundations

Step 1: Data Architecture Foundations

Hi,

Welcome to Tech ABC Corp. We are excited to have some new talent onboard. As you may already know, Tech ABC Corp has recently experienced a lot of growth. Our AI powered video game console WOPR has been hugely successful and as a result, our company has grown from 10 employees to 200 in only 6 months (and we are projecting a 20% growth a year for the next 5 years). We have also grown from our Dallas, Texas office, to 4 other locations nationwide: New York City, NY, San Francisco, CA, Minneapolis, MN, and Nashville, TN.

While this growth is great, it is really starting to put a strain on our record keeping in HR. We currently maintain all employee information on a shared spreadsheet. When HR consisted of only myself, managing everyone on an Excel spreadsheet was simple, but now that it is a shared document I am having serious reservations about data integrity and data security. If the wrong person got their hands on the HR file, they would see the salaries of every employee in the company, all the way up to the president.

After speaking with Jacob Lauber, the manager of IT, he suggested I put in a request to have my HR Excel file converted into a database. He suggested I reach out to you as I am told you have experience in designing and building databases. When you are building this, please keep in mind that I want any employee with a domain login to be have read only access the database. I just don't want them having access to salary information. That needs to be restricted to HR and management level employees only. Management and HR employees should also be the only ones with write access. By our current estimates, 90% of users will be read only.

I also want to make sure you know that am looking to turn my spreadsheet into a live database, one I can input and edit information into. I am not really concerned with reporting capabilities at the moment. Since we are working with employee data we are required by federal regulations to maintain this data for at least 7 years; additionally, since this is considered business critical data, we need to make sure it gets backed up properly.

As a final consideration. We would like to be able to connect with the payroll department's system in the future. They maintain employee attendance and paid time off information. It would be nice if the two systems could interface in the future

I am looking forward to working with you and seeing what kind of database you design for us.

Thanks,
Sarah Collins
Head of HR

Data Architect Business Requirement

- **Purpose of the new database:**

  Online transactional processing datastore for Human Resources management (HRM).

- **Describe current data management solution:**

  Currently the data is managed in a single, shared excel spreadsheet.

- **Describe current data available:**

  Currently available data consists of flat structured data. The data includes employee and department metadata.

- **Additional data requests:**

  Strict data governance enforcement via access policies. See access to database section below for more information.

- **Who will own/manage data**

  Human resource.

- **Who will have access to database**
  Only management and human resources personnel is allowed to access employee salary data as well as have read and write access. Everyone else would have read only access (except for salary data).

Data Architect Business Requirement

- **Estimated size of database**

  Data size currently estimated to be around 200 rows.

- **Estimated annual growth**

  Expected yearly growth is 20%.

- **Is any of the data sensitive/restricted**

  Salary data is restricted to be accessed only by top management and human resources personnel.

Data Architect Technical Requirement

- **Justification for the new database**

  Scalability - The current data store does not support rapid growth of the data. **Data governance** - The way the data is currently stored, there is no way to enforce any restrictions as to who can access and/or edit the data.

- **Database objects**

  Stage - intended for migration purposes only (stage table).
  Staff - contains information about a person part of staff
  Employment - employee and role/position description entities.
  Department - holds department data as well as it's manager's ID
  Department Manager - a mapping table that establishes relationship between department and staff (manager)
  Staff Education - holds staff education level metadata.
  Salary - restricted entity, accessible only by top management and human resources personnel.
  Position - holds employment position's metadata.
  Location, Address, City, State - location related dimension entities.

- **Data ingestion**

  Data will be ingested with ETL approach. First the data will be loaded in landing (stage) table and then via SQL queries moved into the snowflake schema, that will be used for production once migration is complete.

Data Architect Technical Requirement

- **Data governance (Ownership and User access)**

  Ownership: Human resources department

  User Access: Every employee will have read-only access (except salary entity). Human resources as well as top management will have read and write access.

- **Scalability**

  Replication may be required as organisation grows, but is not an immediate concern. *Sharding will not be used due to its eventual consistency properties.*

- **Flexibility**

  No additional measures are required.

- **Storage & retention**

  Storage (disk or in-memory): 1 GB of space for data storage partition is sufficient.

  Retention: Data needs to be kept for at least 7 years due to legal considerations.

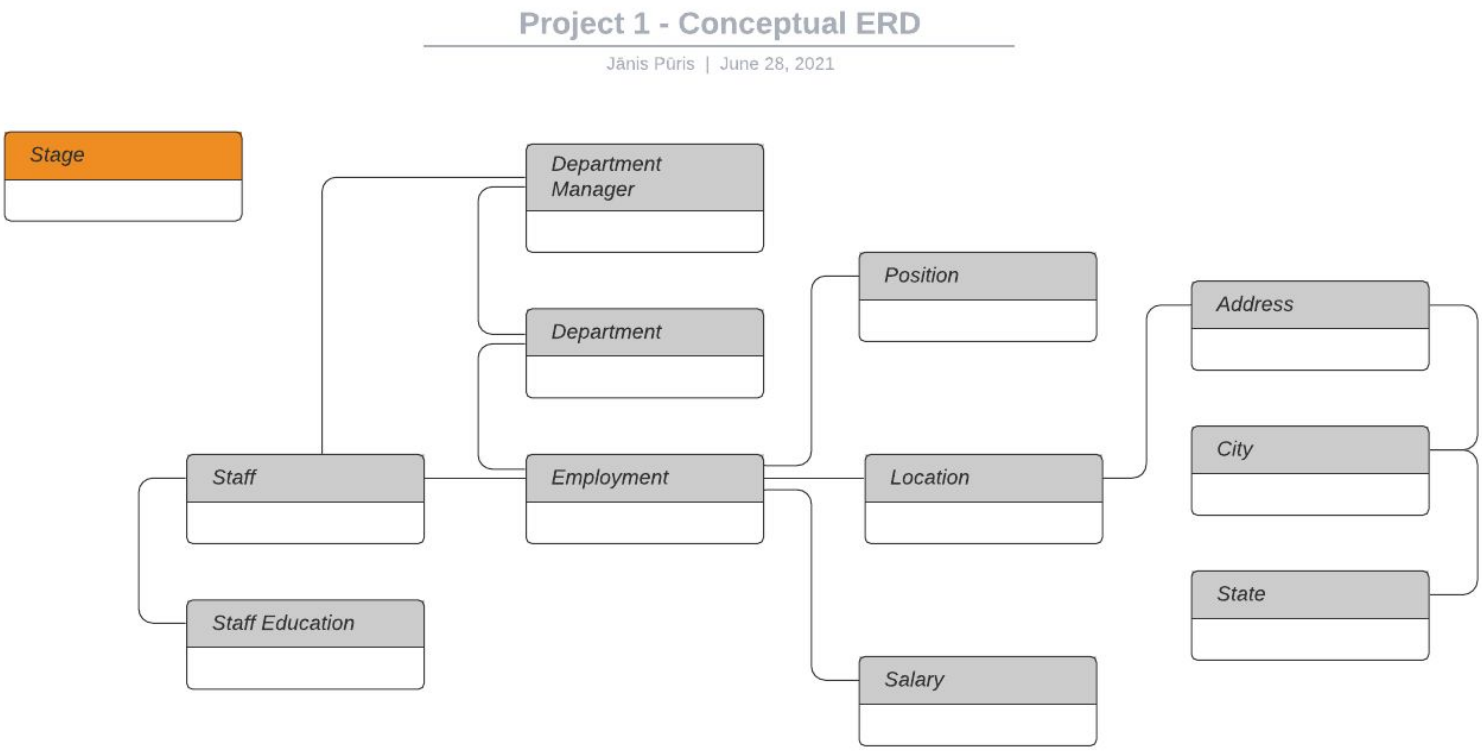
- **Backup**

  Daily incremental and weekly full backups.

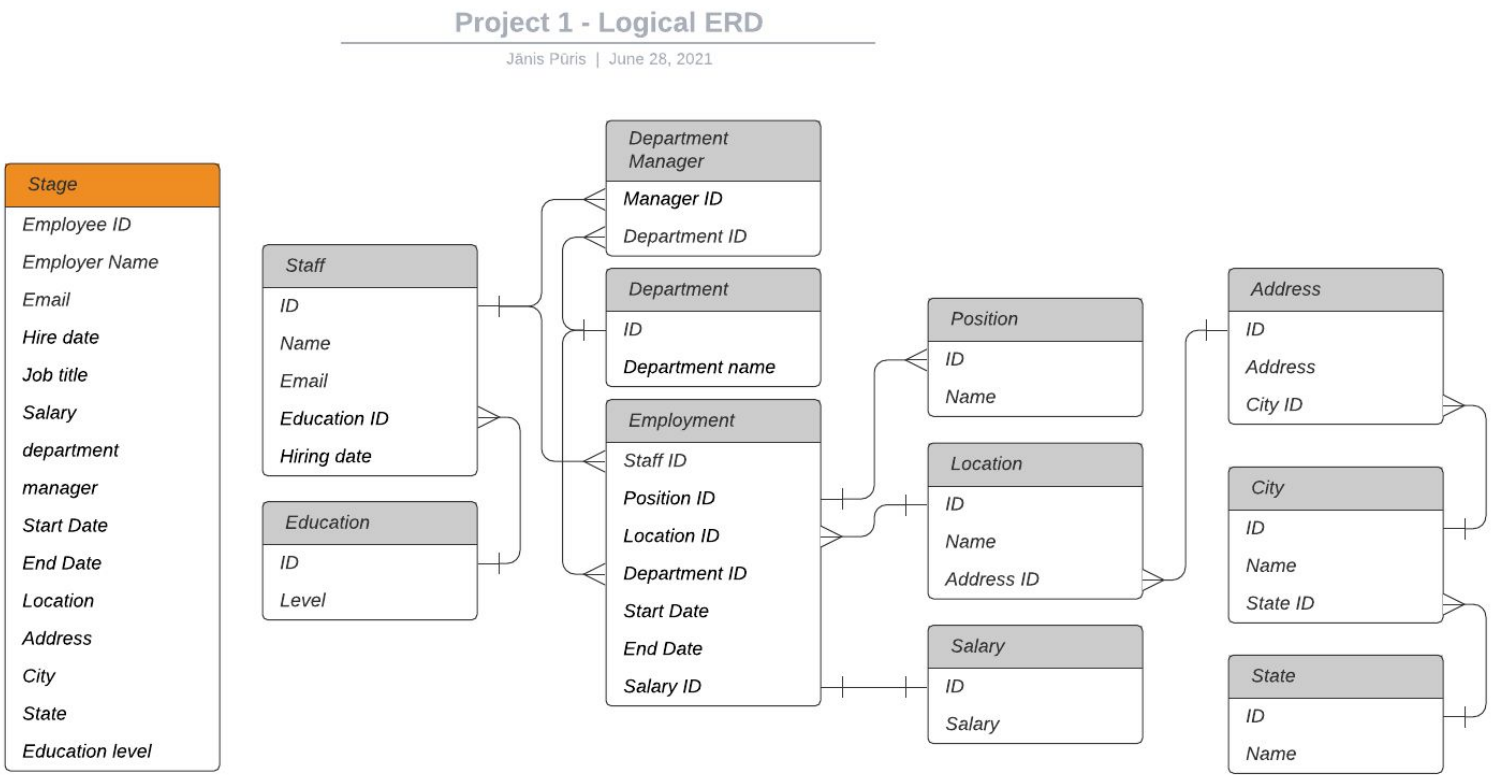
Step 2

Relational Database Design

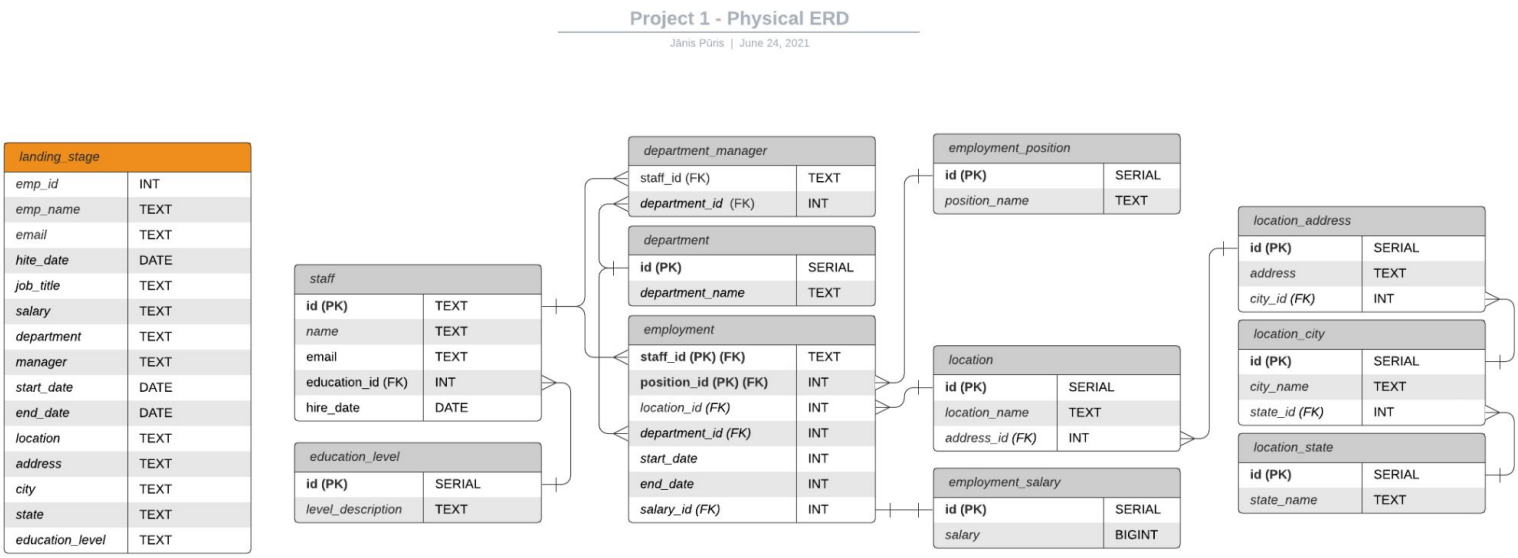
Conceptual ERD



Logical ERD


Project 1 - Logical ERD
Jānis Pūris | June 28, 2021
Stage
Employee ID
Employer Name
Email
Hire date
Job title
Salary
department
manager
Start Date
End Date
Location
Address
City
State
Education level
Staff
ID
Name
Email
Education ID
Hiring date
Education
ID
Level
Department Manager
Manager ID
Department ID
Department
ID
Department name
Employment
Staff ID
Position ID
Location ID
Department ID
Start Date
End Date
Salary ID
Position
ID
Name
Location
ID
Name
Address ID
Salary
ID
Salary
Address
ID
Address
City ID
City
ID
Name
State ID
State
ID
Name

Physical ERD



Step 3

Create A Physical Database

CRUD

- **Question 1: Return a list of employees with Job Titles and Department Names**

```
postgres=# \pset pager 0
Pager usage is off.
postgres=# SET search_path = human_resources;
SET
postgres=# SELECT
    s.id,
    s.name,
    ep.position_name,
    d.department_name
FROM employment e
    JOIN employment_position ep ON e.position_id = ep.id
    JOIN department d ON e.department_id = d.id
    JOIN staff s ON e.staff_id = s.id;
   id    |        name          |      position_name        |   department_name
--------+----------------------+---------------------------+---------------------
 E53895 | Kumar Durairaj       | Shipping and Receiving    | Distribution
 E15292 | Melinda Fisher       | Software Engineer         | IT
 E34816 | Roseann Martineeti   | Sales Rep                 | Product Development
 E81369 | Kevin Soltis         | Network Engineer          | IT
 E16995 | Wilson Martinez      | Sales Rep                 | Product Development
 E33486 | Stephen Colluci      | Legal Counsel             | HQ
 E60929 | Tanya Maheshwari     | Legal Counsel             | Product Development
 E47655 | Cody Holland         | Legal Counsel             | IT
 E87822 | Anil Padala          | Software Engineer         | Product Development
 E93734 | Melissa DeMaio       | Sales Rep                 | Product Development
 E31931 | Leo Manhanga         | Shipping and Receiving    | Distribution
 E56444 | Curtis Steward       | Sales Rep                 | Sales
 E39652 | Kyle Guilmartin      | Sales Rep                 | Product Development
 E82137 | Arup Das             | Software Engineer         | IT
 E95199 | Carlos Fernandes     | Sales Rep                 | Product Development
 E47926 | Janice Canterbury    | Network Engineer          | Product Development
 E20848 | Edward Eslser        | Shipping and Receiving    | Distribution
 E10407 | Darshan Rathod       | Sales Rep                 | Product Development
 E32359 | Jen Frangias         | Sales Rep                 | Sales
 E20848 | Edward Eslser        | Software Engineer         | IT
 E48637 | Joey Fulkerson       | Design Engineer           | Product Development
 E49459 | Courtney Newman      | Shipping and Receiving    | Distribution
 E10033 | Jermaine Massey      | Software Engineer         | Product Development
 E37389 | Becky Weaver         | Sales Rep                 | Sales
 E96856 | Tom Wilson           | Legal Counsel             | HQ
 E67793 | Fausto Recalde       | Network Engineer          | IT
 E38997 | Roseann Clemente     | Sales Rep                 | Sales
 E91075 | Micah Vass           | Network Engineer          | IT
 E98891 | Doris Venama         | Database Administrator    | IT
 E75344 | Michael Kapper       | Software Engineer         | IT
 E76053 | Darryl Reamer        | Legal Counsel             | Product Development
 E34496 | Tony Hughes          | Administrative Assistant  | Sales
 E62527 | Barry Walsh          | Network Engineer          | IT
 E67190 | Nathan Hile          | Sales Rep                 | Product Development
 E22785 | Tami Smith           | Sales Rep                 | Sales
 E56459 | Raven Landis         | Administrative Assistant  | HQ
 E87230 | Sara Erwin           | Sales Rep                 | Sales
 E55855 | Parker Williams      | Sales Rep                 | Sales
 E35053 | Ashley Bergman       | Administrative Assistant  | Distribution
 E35075 | John Certa           | Administrative Assistant  | HQ
 E94387 | Erica Davis          | Sales Rep                 | Product Development
 E95214 | Faheem Ahmed         | Legal Counsel             | IT
 E77884 | Conner Kinch         | Manager                   | Product Development
 E54196 | Phil Wisneski        | Sales Rep                 | Product Development
 E87219 | Jorge Moscoso        | Administrative Assistant  | Sales
 E18697 | Anita Deluise        | Administrative Assistant  | HQ
 E79464 | Anu Patel            | Legal Counsel             | HQ
 E36988 | Michelle Zietz       | Shipping and Receiving    | Distribution
 E37246 | Paulius Mikalainis   | Database Administrator    | IT
 E26322 | Raisa Paulson        | Software Engineer         | Product Development
 E29652 | Jennifer Westin      | Software Engineer         | Product Development
 E84122 | Congkhanh Nguyen     | Software Engineer         | IT
 E93871 | Travis Black         | Sales Rep                 | Product Development
 E63041 | Allison Gentle       | Manager                   | Distribution
 E69297 | Nilden Tutalar       | Shipping and Receiving    | Distribution
 E93715 | Charles Barker       | Sales Rep                 | Sales
 E99949 | William Graf         | Administrative Assistant  | IT
 E68807 | Wes Tappan           | Sales Rep                 | Sales
 E41712 | Elaine Podwika       | Design Engineer           | Product Development
 E22197 | Oliver Jia           | Network Engineer          | IT
 E52489 | Kelly Price          | Shipping and Receiving    | Distribution
 E76443 | Thanuja Polani       | Database Administrator    | IT
 E65052 | Leobrian Mason       | Sales Rep                 | Sales
 E96966 | Lu Huang             | Software Engineer         | IT
 E49025 | Mark Fiore           | Database Administrator    | IT
 E51619 | Tom Meola            | Design Engineer           | IT
 E53406 | Janice Mayzlik       | Legal Counsel             | HQ
 E48884 | Stacey Lewis         | Network Engineer          | IT
 E16346 | Jill Fram            | Administrative Assistant  | Product Development
 E55880 | Alex Warring         | Shipping and Receiving    | Distribution
 E91182 | Nick Gowen           | Sales Rep                 | Product Development
```

CRUD

- **Question 2: Insert Web Programmer as a new job title**

```
postgres=# INSERT INTO employment_position (position_name)
VALUES
    ('Web Programmer');

SELECT *
FROM employment_position
WHERE position_name ILIKE 'web%';
INSERT 0 1
 id | position_name
----+---------------
 12 | Web Programmer
(1 row)
```

CRUD

- **Question 3: Correct the job title from web programmer to web developer**

```
postgres=# UPDATE employment_position
SET
    position_name = 'Web Developer'
WHERE position_name = 'Web Programmer';
UPDATE 1
postgres=# SELECT *
FROM employment_position
WHERE position_name ILIKE 'web%';
 id | position_name
----+---------------
 12 | Web Developer
(1 row)
```

CRUD

- **Question 4: Delete the job title Web Developer from the database**

```
postgres=# DELETE
FROM employment_position
WHERE position_name = 'Web Developer';
DELETE 1
postgres=# SELECT *
FROM employment_position
WHERE position_name ILIKE 'web%';
 id | position_name
----+---------------
(0 rows)
```

CRUD

- **Question 5: How many employees are in each department?**

```
postgres=# SELECT
    d.department_name,
    COUNT(DISTINCT staff_id) AS employee_count
FROM employment e
    JOIN department d ON e.department_id = d.id
GROUP BY d.id;
   department_name    | employee_count
----------------------+----------------
 Product Development  |             70
 HQ                   |             13
 Distribution         |             27
 Sales                |             41
 IT                   |             52
(5 rows)
```

CRUD

- **Question 6: Write a query that returns current and past jobs (include employee name, job title, department, manager name, start and end date for position) for employee Toni Lembeck.**

```
postgres=# SELECT
    s.name AS employee_name,
    ep.position_name AS job_title,
    d.department_name AS department,
    m.name AS manager_name,
    e.start_date AS position_start_date,
    e.end_date AS position_end_date
FROM employment e
    JOIN staff s ON e.staff_id = s.id
    JOIN employment_position ep ON e.position_id = ep.id
    JOIN department d ON e.department_id = d.id
    LEFT JOIN staff m ON e.manager_id = m.id
WHERE s.name = 'Toni Lembeck';
 employee_name |        job_title        | department | manager_name | position_start_date | position_end_date
---------------+-------------------------+------------+--------------+---------------------+-------------------
 Toni Lembeck  | Database Administrator | IT         | Jacob Lauber | 2001-07-18          |
 Toni Lembeck  | Network Engineer       | IT         | Jacob Lauber | 1995-03-12          | 2001-07-17
(2 rows)
```

CRUD

- **Question 7: Describe how you would apply table security to restrict access to employee salaries using an SQL server.**

  Create different roles and segment users into those roles. One role would have read and write access (NO DDL's) to all tables in human_resources schema, while the other would have read only access to the schema's tables, except with no access to salary entity.

Step 4

Above and Beyond

(optional)

Step 4: Above and Beyond

This last step is called Above and Beyond. In this step, I have proposed 3 challenges for you to complete, which are above and beyond the scope of the project. This is a chance to flex your coding muscles and show everyone how good you really are.

These challenge steps will bring your project even more in line with a real-world project, as these are the kind of "finishing touches" that will make your database more usable. Imagine building a car without air conditioning or turn signals. Sure, it will work, but who would want to drive it.

I encourage you to take on these challenges in this course and any future courses you take. I designed these challenges to be a challenge to your current abilities, but I ensured they are not an unattainable challenge. Remember, these challenges are completely optional - you can pass the project by doing none of them, or just some of them, but I encourage you to at least attempt them!

Standout Suggestion 1

Create a view that returns all employee attributes; results should resemble initial Excel file

```
postgres=# CREATE OR REPLACE VIEW all_employee_data AS
SELECT
    e.staff_id AS "EMP_ID",
    s.name AS "NAME",
    s.email AS "EMAIL",
    s.hire_date AS "HIRE_DT",
    ep.position_name AS "JOB_TITLE",
    es.salary AS "SALARY",
    d.department_name AS "DEPARTMENT",
    m.name AS "MANAGER",
    e.start_date AS "START_DT",
    e.end_date AS "END_DT",
    l.location_name AS "LOCATION",
    la.address AS "ADDRESS",
    lc.city_name AS "CITY",
    ls.state_name AS "STATE",
    el.level_description AS "EDUCATION LEVEL"
FROM employment e
    JOIN staff s ON e.staff_id = s.id
    LEFT JOIN staff m ON e.manager_id = m.id
    JOIN employment_position ep ON e.position_id = ep.id
    JOIN employment_salary es ON e.salary_id = es.id
    JOIN department d ON e.department_id = d.id
    JOIN location l ON e.location_id = l.id
    JOIN location_address la ON l.address_id = la.id
    JOIN location_city lc ON la.city_id = lc.id
    JOIN location_state ls ON lc.state_id = ls.id
    JOIN education_level el ON s.education_id = el.id;

SELECT * FROM all_employee_data;
CREATE VIEW
 EMP_ID |        NAME        |          EMAIL          | HIRE_DT  |      JOB_TITLE      | SALARY |     DEPARTMENT     |      MANAGER      | START_DT  | END_DT | LOCATION |      ADDRESS      |     CITY     | STATE |        EDUCATION LEVEL
--------+--------------------+-------------------------+----------+---------------------+--------+--------------------+-------------------+-----------+--------+----------+-------------------+--------------+-------+-----------------------------------
 E53895 | Kumar Durairaj     | kumar.durairaj@techcorp.com | 2014-10-27 | Shipping and Receiving |  28700 | Distribution       | Allison Gentle    | 2014-10-27 |        | West Coast | 705 James Way     | San Francisco | CA    | No College
 E15292 | Melinda Fisher     | melinda.fisher@techcorp.com | 2011-02-06 | Software Engineer   | 117958 | IT                 | Jacob Lauber      | 2011-02-06 |        | HQ       | 1 Tech ABC Corp Way | Dallas       | TX    | Bachelors Degree
 E34816 | Roseann Martineeti | roseann.martineeti@techcorp.com | 2000-08-01 | Sales Rep           |  82192 | Product Development | Conner Kinch      | 2000-08-01 |        | East Coast | 165 Broadway      | New York City | NY    | Bachelors Degree
 E81369 | Kevin Soltis       | kevin.soltis@techcorp.com | 2019-05-29 | Network Engineer    |  93362 | IT                 | Jacob Lauber      | 2019-05-29 |        | East Coast | 165 Broadway      | New York City | NY    | Bachelors Degree
 E16995 | Wilson Martinez    | wilson.martinez@techcorp.com | 2001-02-28 | Sales Rep           | 130161 | Product Development | Conner Kinch      | 2001-02-28 |        | HQ       | 1 Tech ABC Corp Way | Dallas       | TX    | Bachelors Degree
 E33486 | Stephen Colluci    | stephen.colluci@techcorp.com | 2000-08-02 | Legal Counsel       | 153296 | HQ                 | Tyrone Hutchison  | 2000-08-02 |        | HQ       | 1 Tech ABC Corp Way | Dallas       | TX    | Doctorate
 E60929 | Tanya Maheshwari   | tanya.maheshwari@techcorp.com | 2013-07-03 | Legal Counsel       | 195992 | Product Development | Conner Kinch      | 2013-07-03 |        | Midwest  | 1300 Nicollet Mall | Minnapolis   | MN    | Masters Degree
 E47655 | Cody Holland       | cody.holland@techcorp.com | 1997-11-27 | Legal Counsel       | 207651 | IT                 | Jacob Lauber      | 1997-11-27 |        | East Coast | 165 Broadway      | New York City | NY    | Doctorate
 E87822 | Anil Padala        | anil.padala@techcorp.com | 2014-04-02 | Software Engineer   |  90884 | Product Development | Conner Kinch      | 2014-04-02 |        | East Coast | 165 Broadway      | New York City | NY    | Bachelors Degree
 E93734 | Melissa DeMalo     | melissa.demalo@techcorp.com | 2005-06-21 | Sales Rep           | 111114 | Product Development | Conner Kinch      | 2005-06-21 |        | East Coast | 165 Broadway      | New York City | NY    | Bachelors Degree
 E31931 | Leo Manhanga       | leo.manhanga@techcorp.com | 2013-09-26 | Shipping and Receiving |  38206 | Distribution       | Allison Gentle    | 2013-09-26 |        | Midwest  | 1300 Nicollet Mall | Minnapolis   | MN    | Some College
 E56444 | Curtis Steward     | curtis.steward@techcorp.com | 1999-06-10 | Sales Rep           |  87817 | Sales              | Jennifer De La Garza | 1999-06-10 |        | East Coast | 165 Broadway      | New York City | NY    | Masters Degree
 E39652 | Kyle Guilmartin    | kyle.guilmartin@techcorp.com | 2012-08-11 | Sales Rep           |  71867 | Product Development | Conner Kinch      | 2012-08-11 |        | East Coast | 165 Broadway      | New York City | NY    | Bachelors Degree
 E82137 | Arup Das           | arup.das@techcorp.com   | 2006-10-04 | Software Engineer   |  97040 | IT                 | Jacob Lauber      | 2006-10-04 |        | East Coast | 165 Broadway      | New York City | NY    | Masters of Business Administration
 E95199 | Carlos Fernandes   | carlos.fernandes@techcorp.com | 2017-01-09 | Sales Rep           | 153889 | Product Development | Conner Kinch      | 2017-01-09 |        | HQ       | 1 Tech ABC Corp Way | Dallas       | TX    | Masters Degree
 E47926 | Janice Canterbury  | janice.canterbury@techcorp.com | 2008-05-31 | Network Engineer    |  85880 | Product Development | Conner Kinch      | 2008-05-31 |        | East Coast | 165 Broadway      | New York City | NY    | Bachelors Degree
```

Standout Suggestion 2

Create a stored procedure with parameters that returns current and past jobs (include employee name, job title, department, manager name, start and end date for position) when given an employee name.

```
postgres=# DROP FUNCTION IF EXISTS employment_history;
CREATE FUNCTION employment_history(staff_name TEXT)
    RETURNS TABLE
            (
                employee_name       TEXT,
                job_title           TEXT,
                department          TEXT,
                manager_name        TEXT,
                position_start_date DATE,
                position_end_date   DATE
            )
AS
$$
BEGIN
    RETURN QUERY
        SELECT
            s.name,
            ep.position_name,
            d.department_name,
            m.name,
            e.start_date,
            e.end_date
        FROM employment e
            JOIN staff s ON e.staff_id = s.id
            JOIN employment_position ep ON e.position_id = ep.id
            JOIN department d ON e.department_id = d.id
            LEFT JOIN staff m ON e.manager_id = m.id
        WHERE s.name = staff_name;
END;
$$
    LANGUAGE plpgsql;
DROP FUNCTION
CREATE FUNCTION
postgres=# SELECT * FROM employment_history('Toni Lembeck');
 employee_name |        job_title        | department | manager_name | position_start_date | position_end_date
---------------+-------------------------+------------+--------------+---------------------+------------------
 Toni Lembeck  | Database Administrator | IT         | Jacob Lauber | 2001-07-18          |
 Toni Lembeck  | Network Engineer       | IT         | Jacob Lauber | 1995-03-12          | 2001-07-17
(2 rows)
```

Standout Suggestion 3

Implement user security on the restricted salary attribute.

```
postgres=# CREATE ROLE management_role;
GRANT USAGE ON SCHEMA human_resources TO management_role;
GRANT USAGE, SELECT ON ALL SEQUENCES IN SCHEMA human_resources TO management_role;
GRANT SELECT, UPDATE, INSERT, DELETE ON ALL TABLES IN SCHEMA human_resources TO management_role;

CREATE ROLE employee_role;
GRANT USAGE ON SCHEMA human_resources TO employee_role;
GRANT SELECT ON ALL TABLES IN SCHEMA human_resources TO employee_role;
REVOKE SELECT ON TABLE employment_salary FROM employee_role;

CREATE USER employee_user WITH PASSWORD 'employee_user';
CREATE USER management_user WITH PASSWORD 'management_user';

GRANT management_role TO management_user;
GRANT employee_role TO employee_user;
```

Appendix

Additional Info

Please see following files on github repository

https://github.com/jpuris/udacity-da-nand-projects/tree/main/project_1

Step	Filename
DDL	1_create_schema.sql
ETL (staging)	2_load_stage.sql
ETL (load schema)	3_sql_etl.sql
CRUD	4_crud.sql
Challenges	5_challanges.sql