

DBMS Lab Assignment-3

Database Connectivity

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SQL Program

```
SELECT c.name
FROM citizens AS c
JOIN land_records AS l ON c.citizen_id = l.citizen_id
WHERE l.land_area > 1.00;

SELECT c1.name
FROM citizens AS c1
JOIN households AS h ON c1.household_id = h.household_id
WHERE c1.gender = 'Female'
AND c1.is_student = TRUE
AND
( SELECT SUM(c2.income)
FROM citizens AS c2
WHERE c2.household_id = h.household_id
)
< 100000;

SELECT SUM(land_area)
FROM land_records
WHERE crop_type ILIKE 'rice';

SELECT COUNT(*)
FROM citizens
WHERE dob > '2000-01-01'
AND education ILIKE '10th';

SELECT c.name
FROM citizens AS c
JOIN panchayat_employees AS p ON c.citizen_id = p.citizen_id
JOIN land_records AS l ON p.citizen_id = l.citizen_id
WHERE l.land_area > 1.00;
```

```

SELECT c1.name
FROM citizens AS c1
JOIN households AS h ON h.household_id = c1.household_id
JOIN citizens AS c2 ON c2.household_id = h.household_id
JOIN panchayat_employees AS p ON p.citizen_id = c2.citizen_id
WHERE p.role ILIKE 'Pradhan';

SELECT COUNT(*)
FROM assets
WHERE type ILIKE 'Street Light'
AND location ILIKE 'Phulera'
AND EXTRACT(YEAR FROM installation_date) = 2024;

SELECT COUNT(*)
FROM vaccinations AS v
JOIN citizens as c1 ON v.citizen_id = c1.citizen_id
JOIN citizens AS c2 ON c1.parent_id = c2.citizen_id
WHERE EXTRACT(YEAR FROM v.date_administered) = 2024
AND c2.education ILIKE '10th';

SELECT COUNT(*) from citizens
WHERE gender = 'Male'
AND EXTRACT(YEAR FROM dob) = 2024;
SELECT COUNT(DISTINCT c1.citizen_id)
FROM citizens AS c1
JOIN households AS h ON h.household_id = c1.household_id
JOIN citizens AS c2 ON c2.household_id = h.household_id
JOIN panchayat_employees AS p ON p.citizen_id = c2.citizen_id;

```

High-level language programs

Python (**psycopg2**)

Setup:

Modules:

```
pip install psycopg2-binary python-dotenv
```

Environment variables (.env):

DB_NAME=your_database_name

DB_USER=your_username

DB_PASSWORD=your_password

DB_HOST=your_host

DB_PORT=your_port

Code:

```
import os
import psycopg2
from dotenv import load_dotenv
from datetime import datetime

# Load environment variables
load_dotenv()

# Database connection parameters from environment variables
DB_PARAMS = {
    'dbname': os.getenv('DB_NAME'),
    'user': os.getenv('DB_USER'),
    'password': os.getenv('DB_PASSWORD'),
    'host': os.getenv('DB_HOST', 'localhost'),
    'port': os.getenv('DB_PORT', '5432')
}

def execute_queries():
    # List of queries with descriptive labels
    queries = [
        {
            'label': 'Citizens with land area > 1.00',
            'query': """
                SELECT c.name
            """
        }
    ]
```

```

        FROM citizens AS c
        JOIN land_records AS l ON c.citizen_id = l.citizen_id
        WHERE l.land_area > 1.00;
    """
},
{
    'label': 'Female students from low-income households',
    'query': """
        SELECT c1.name
        FROM citizens AS c1
        JOIN households AS h ON c1.household_id = h.household_id
        WHERE c1.gender = 'Female'
        AND c1.is_student = TRUE
        AND
        ( SELECT SUM(c2.income)
        FROM citizens AS c2
        WHERE c2.household_id = h.household_id
        )
        < 100000;
    """
},
{
    'label': 'Total rice cultivation area',
    'query': """
        SELECT SUM(land_area)
        FROM land_records
        WHERE crop_type ILIKE 'rice';
    """
},
{
    'label': 'Young citizens with 10th education',
    'query': """
        SELECT COUNT(*)
        FROM citizens
        WHERE dob > '2000-01-01'
        AND education ILIKE '10th';
    """
},
{
    'label': 'Panchayat employees with land > 1.00',
    'query': """
        SELECT c.name
        FROM citizens AS c
        JOIN panchayat_employees AS p ON c.citizen_id = p.citizen_id
    """
}

```

```

        JOIN land_records AS l ON p.citizen_id = l.citizen_id
        WHERE l.land_area > 1.00;
    """
},
{
    'label': 'Household members of Pradhans',
    'query': """
        SELECT c1.name
        FROM citizens AS c1
        JOIN households AS h ON h.household_id = c1.household_id
        JOIN citizens AS c2 ON c2.household_id = h.household_id
        JOIN panchayat_employees AS p ON p.citizen_id = c2.citizen_id
        WHERE p.role ILIKE 'Pradhan';
    """
},
{
    'label': 'Street lights in Phulera installed in 2024',
    'query': """
        SELECT COUNT(*)
        FROM assets
        WHERE type ILIKE 'Street Light'
        AND location ILIKE 'Phulera'
        AND EXTRACT(YEAR FROM installation_date) = 2024;
    """
},
{
    'label': 'Vaccinations in 2024 for children of 10th pass parents',
    'query': """
        SELECT COUNT(*)
        FROM vaccinations AS v
        JOIN citizens as c1 ON v.citizen_id = c1.citizen_id
        JOIN citizens AS c2 ON c1.parent_id = c2.citizen_id
        WHERE EXTRACT(YEAR FROM v.date_administered) = 2024
        AND c2.education ILIKE '10th';
    """
},
{
    'label': 'Male births in 2024',
    'query': """
        SELECT COUNT(*) from citizens
        WHERE gender = 'Male'
        AND EXTRACT(YEAR FROM dob) = 2024;
    """
},

```

```

{
    'label': 'Unique citizens in households with panchayat employees',
    'query': """
        SELECT COUNT(DISTINCT c1.citizen_id)
        FROM citizens AS c1
        JOIN households AS h ON h.household_id = c1.household_id
        JOIN citizens AS c2 ON c2.household_id = h.household_id
        JOIN panchayat_employees AS p ON p.citizen_id = c2.citizen_id;
    """
}
]

try:
    # Establish database connection
    conn = psycopg2.connect(**DB_PARAMS)
    cur = conn.cursor()

    # Execute each query and print results
    for query_info in queries:
        print(f"\n=== {query_info['label']} ===")
        cur.execute(query_info['query'])
        results = cur.fetchall()

        # Print results in a formatted way
        if results:
            if len(results[0]) == 1: # Single column result
                if len(results) == 1: # Single row
                    print(f"Result: {results[0][0]}")
                else:
                    for row in results:
                        print(row[0])
            else: # Multiple columns
                for row in results:
                    print(row)
        else:
            print("No results found")

except psycopg2.Error as e:
    print(f"Database error: {e}")
except Exception as e:
    print(f"Error: {e}")
finally:
    if 'cur' in locals():
        cur.close()

```

```
if 'conn' in locals():
    conn.close()

if __name__ == "__main__":
    execute_queries()
```

Run:

```
python3 queries.py
```

C++ (ODBC)

Setup:

Packages:

```
sudo apt-get install unixodbc unixodbc-dev
sudo apt-get install odbc-postgresql
odbcinst -q -d
```

Config file (db_config.txt):

```
# Database configuration
Driver=PostgreSQL Unicode
Server=your_host
Port=5432
Database=your_database
Username=your_username
Password=your_password
```

Code:

```
#include <sql.h>
#include <sqlext.h>
#include <iostream>
#include <string>
#include <vector>
#include <fstream>
#include <sstream>
#include <cstring>

// Function to read connection string from config file
std::string readConnectionString(const std::string& filename) {
    std::ifstream file(filename);
    if (!file.is_open()) {
        throw std::runtime_error("Unable to open config file: " + filename);
    }

    std::stringstream buffer;
    std::string line;
    std::string connStr;

    // Read file and construct connection string
    while (std::getline(file, line)) {
        // Skip empty lines and comments
```



```

    if (line.empty() || line[0] == '#') {
        continue;
    }

    size_t pos = line.find('=');
    if (pos != std::string::npos) {
        std::string key = line.substr(0, pos);
        std::string value = line.substr(pos + 1);

        // Trim whitespace
        key.erase(0, key.find_first_not_of(" \t"));
        key.erase(key.find_last_not_of(" \t") + 1);
        value.erase(0, value.find_first_not_of(" \t"));
        value.erase(value.find_last_not_of(" \t") + 1);

        buffer << key << "=" << value << ";";
    }
}

return buffer.str();
}

struct QueryInfo {
    std::string label;
    std::string query;
};

class DatabaseConnection {
private:
    SQLHENV env;
    SQLHDBC dbc;
    SQLHSTMT stmt;

    void checkError(SQLHANDLE handle, SQLSMALLINT type, RETCODE ret) {
        if (ret == SQL_SUCCESS || ret == SQL_SUCCESS_WITH_INFO)
            return;

        SQLSMALLINT i = 0;
        SQLINTEGER native;
        SQLCHAR state[7];
        SQLCHAR text[256];
        SQLSMALLINT len;

        while (SQLGetDiagRec(type, handle, ++i, state, &native, text,

```

```

        sizeof(text), &len) == SQL_SUCCESS) {
            std::cerr << "ODBC Error: " << text << std::endl;
        }
    }

public:
    DatabaseConnection() : env(NULL), dbc(NULL), stmt(NULL) {}

    bool connect(const std::string& connStr) {
        // Allocate environment handle
        if (SQL_SUCCESS != SQLAllocHandle(SQL_HANDLE_ENV, SQL_NULL_HANDLE, &env)) {
            std::cerr << "Failed to allocate environment handle\n";
            return false;
        }

        // Set ODBC version
        if (SQL_SUCCESS != SQLSetEnvAttr(env, SQL_ATTR_ODBC_VERSION,
(void*)SQL_OV_ODBC3, 0)) {
            std::cerr << "Failed to set ODBC version\n";
            return false;
        }

        // Allocate connection handle
        if (SQL_SUCCESS != SQLAllocHandle(SQL_HANDLE_DBC, env, &dbc)) {
            std::cerr << "Failed to allocate connection handle\n";
            return false;
        }

        // Set connection timeout
        SQLSetConnectAttr(dbc, SQL_ATTR_CONNECTION_TIMEOUT, (SQLPOINTER)5, 0);

        // Connect to database
        SQLCHAR outstr[1024];
        SQLSMALLINT outstrlen;
        RETCODE ret = SQLDriverConnect(dbc, NULL,
                                        (SQLCHAR*)connStr.c_str(), SQL_NTS,
                                        outstr, sizeof(outstr),
                                        &outstrlen, SQL_DRIVER_NOPROMPT);

        if (SQL_SUCCESS != ret && SQL_SUCCESS_WITH_INFO != ret) {
            checkError(dbc, SQL_HANDLE_DBC, ret);
            return false;
        }
    }

```

```

// Allocate statement handle
if (SQL_SUCCESS != SQLAllocHandle(SQL_HANDLE_STMT, dbc, &stmt)) {
    std::cerr << "Failed to allocate statement handle\n";
    return false;
}

return true;
}

void executeQuery(const QueryInfo& queryInfo) {
    std::cout << "\n=== " << queryInfo.label << " ===\n";

    RETCODE ret = SQLExecDirect(stmt, (SQLCHAR*)queryInfo.query.c_str(), SQL_NTS);
    if (SQL_SUCCESS != ret && SQL_SUCCESS_WITH_INFO != ret) {
        checkError(stmt, SQL_HANDLE_STMT, ret);
        return;
    }

    // Get number of columns
    SQLSMALLINT columns;
    SQLNumResultCols(stmt, &columns);

    // Fetch and print results
    while (SQL_SUCCESS == SQLFetch(stmt)) {
        for (SQLSMALLINT i = 1; i <= columns; i++) {
            SQLCHAR buffer[512];
            SQLLEN indicator;

            ret = SQLGetData(stmt, i, SQL_C_CHAR, buffer, sizeof(buffer),
&indicator);
            if (SQL_SUCCESS == ret || SQL_SUCCESS_WITH_INFO == ret) {
                if (indicator != SQL_NULL_DATA)
                    std::cout << (i > 1 ? "\t" : "") << buffer;
                else
                    std::cout << (i > 1 ? "\t" : "") << "NULL";
            }
        }
        std::cout << std::endl;
    }

    // Reset statement
    SQLCloseCursor(stmt);
}

```

```

~DatabaseConnection() {
    if (stmt) SQLFreeHandle(SQL_HANDLE_STMT, stmt);
    if (dbc) {
        SQLDisconnect(dbc);
        SQLFreeHandle(SQL_HANDLE_DBC, dbc);
    }
    if (env) SQLFreeHandle(SQL_HANDLE_ENV, env);
}
};

int main(int argc, char* argv[]) {
    if (argc < 2) {
        std::cerr << "Usage: " << argv[0] << " <config_file_path>\n";
        return 1;
    }

    std::string configFile = argv[1];
    std::string connectionString;

    try {
        connectionString = readConnectionString(configFile);
    } catch (const std::exception& e) {
        std::cerr << "Error reading config file: " << e.what() << std::endl;
        return 1;
    }

    std::vector<QueryInfo> queries = {
        {
            "Citizens with land area > 1.00",
            "SELECT c.name "
            "FROM citizens AS c "
            "JOIN land_records AS l ON c.citizen_id = l.citizen_id "
            "WHERE l.land_area > 1.00;"
        },
        {
            "Female students from low-income households",
            "SELECT c1.name "
            "FROM citizens AS c1 "
            "JOIN households AS h ON c1.household_id = h.household_id "
            "WHERE c1.gender = 'Female' "
            "AND c1.is_student = TRUE "
            "AND (SELECT SUM(c2.income) "
            "      FROM citizens AS c2 "
            "      WHERE c2.household_id = h.household_id) "

```

```

"< 100000;"
},
{
  "Total rice cultivation area",
  "SELECT SUM(land_area) "
  "FROM land_records "
  "WHERE crop_type ILIKE 'rice';"
},
{
  "Young citizens with 10th education",
  "SELECT COUNT(*) "
  "FROM citizens "
  "WHERE dob > '2000-01-01' "
  "AND education ILIKE '10th';"
},
{
  "Panchayat employees with land > 1.00",
  "SELECT c.name "
  "FROM citizens AS c "
  "JOIN panchayat_employees AS p ON c.citizen_id = p.citizen_id "
  "JOIN land_records AS l ON p.citizen_id = l.citizen_id "
  "WHERE l.land_area > 1.00;"
},
{
  "Household members of Pradhans",
  "SELECT c1.name "
  "FROM citizens AS c1 "
  "JOIN households AS h ON h.household_id = c1.household_id "
  "JOIN citizens AS c2 ON c2.household_id = h.household_id "
  "JOIN panchayat_employees AS p ON p.citizen_id = c2.citizen_id "
  "WHERE p.role ILIKE 'Pradhan';"
},
{
  "Street lights in Phulera installed in 2024",
  "SELECT COUNT(*) "
  "FROM assets "
  "WHERE type ILIKE 'Street Light' "
  "AND location ILIKE 'Phulera' "
  "AND EXTRACT(YEAR FROM installation_date) = 2024;"
},
{
  "Vaccinations in 2024 for children of 10th pass parents",
  "SELECT COUNT(*) "
  "FROM vaccinations AS v "

```

```

        "JOIN citizens as c1 ON v.citizen_id = c1.citizen_id "
        "JOIN citizens AS c2 ON c1.parent_id = c2.citizen_id "
        "WHERE EXTRACT(YEAR FROM v.date_administered) = 2024 "
        "AND c2.education ILIKE '10th';"
    },
    {
        "Male births in 2024",
        "SELECT COUNT(*) from citizens "
        "WHERE gender = 'Male' "
        "AND EXTRACT(YEAR FROM dob) = 2024;"
    },
    {
        "Unique citizens in households with panchayat employees",
        "SELECT COUNT(DISTINCT c1.citizen_id) "
        "FROM citizens AS c1 "
        "JOIN households AS h ON h.household_id = c1.household_id "
        "JOIN citizens AS c2 ON c2.household_id = h.household_id "
        "JOIN panchayat_employees AS p ON p.citizen_id = c2.citizen_id;"
    }
};

DatabaseConnection db;
if (!db.connect(connectionString)) {
    std::cerr << "Failed to connect to database\n";
    return 1;
}

for (const auto& query : queries) {
    db.executeQuery(query);
}

return 0;
}

```

Compile and Run:

```

g++ -o db_query queries.cpp -lodbcc
./db_query db_config.txt

```

Java (JDBC)

Setup:

Drivers:

```
wget https://jdbc.postgresql.org/download/postgresql-42.7.2.jar
```

DB properties file (db.properties):

host=your_host

port=5432

database=your_database

username=your_username

password=your_password

Code:

```
import java.io.FileInputStream;
import java.io.IOException;
import java.sql.Connection;
import java.sql.DriverManager;
import java.sql.PreparedStatement;
import java.sql.ResultSet;
import java.sql.ResultSetMetaData;
import java.sql.SQLException;
import java.util.ArrayList;
import java.util.List;
import java.util.Properties;

class QueryInfo {
    String label;
    String query;

    public QueryInfo(String label, String query) {
        this.label = label;
        this.query = query;
    }
}

public class DatabaseQueries {
    private static Properties loadConfig(String filename) throws IOException {
        Properties props = new Properties();
        try (FileInputStream fis = new FileInputStream(filename)) {
            props.load(fis);
        }
    }
}
```

```

    }
    return props;
}

private static String buildConnectionString(Properties props) {
    return String.format("jdbc:postgresql://%s:%s/%s",
        props.getProperty("host", "localhost"),
        props.getProperty("port", "5432"),
        props.getProperty("database")
    );
}

private static void executeQuery(Connection conn, QueryInfo queryInfo) throws
SQLException {
    System.out.println("\n=== " + queryInfo.label + " ===");

    try (PreparedStatement stmt = conn.prepareStatement(queryInfo.query);
        ResultSet rs = stmt.executeQuery()) {

        ResultSetMetaData metaData = rs.getMetaData();
        int columnCount = metaData.getColumnCount();

        while (rs.next()) {
            StringBuilder row = new StringBuilder();
            for (int i = 1; i <= columnCount; i++) {
                if (i > 1) row.append("\t");
                String value = rs.getString(i);
                row.append(value == null ? "NULL" : value);
            }
            System.out.println(row);
        }
    }
}

public static void main(String[] args) {
    if (args.length < 1) {
        System.err.println("Usage: java DatabaseQueries <config_file>");
        System.exit(1);
    }

    List<QueryInfo> queries = new ArrayList<>();
    queries.add(new QueryInfo(
        "Citizens with land area > 1.00",
        "SELECT c.name " +

```



```

        "FROM citizens AS c " +
        "JOIN land_records AS l ON c.citizen_id = l.citizen_id " +
        "WHERE l.land_area > 1.00;"
    ));

queries.add(new QueryInfo(
    "Female students from low-income households",
    "SELECT c1.name " +
    "FROM citizens AS c1 " +
    "JOIN households AS h ON c1.household_id = h.household_id " +
    "WHERE c1.gender = 'Female' " +
    "AND c1.is_student = TRUE " +
    "AND (SELECT SUM(c2.income) " +
    "      FROM citizens AS c2 " +
    "      WHERE c2.household_id = h.household_id) " +
    "< 100000;"
));

queries.add(new QueryInfo(
    "Total rice cultivation area",
    "SELECT SUM(land_area) " +
    "FROM land_records " +
    "WHERE crop_type ILIKE 'rice';"
));

queries.add(new QueryInfo(
    "Young citizens with 10th education",
    "SELECT COUNT(*) " +
    "FROM citizens " +
    "WHERE dob > '2000-01-01' " +
    "AND education ILIKE '10th';"
));

queries.add(new QueryInfo(
    "Panchayat employees with land > 1.00",
    "SELECT c.name " +
    "FROM citizens AS c " +
    "JOIN panchayat_employees AS p ON c.citizen_id = p.citizen_id " +
    "JOIN land_records AS l ON p.citizen_id = l.citizen_id " +
    "WHERE l.land_area > 1.00;"
));

queries.add(new QueryInfo(
    "Household members of Pradhans",

```

```

        "SELECT c1.name " +
        "FROM citizens AS c1 " +
        "JOIN households AS h ON h.household_id = c1.household_id " +
        "JOIN citizens AS c2 ON c2.household_id = h.household_id " +
        "JOIN panchayat_employees AS p ON p.citizen_id = c2.citizen_id " +
        "WHERE p.role ILIKE 'Pradhan';"
    ));

queries.add(new QueryInfo(
    "Street lights in Phulera installed in 2024",
    "SELECT COUNT(*) " +
    "FROM assets " +
    "WHERE type ILIKE 'Street Light' " +
    "AND location ILIKE 'Phulera' " +
    "AND EXTRACT(YEAR FROM installation_date) = 2024;"
));

queries.add(new QueryInfo(
    "Vaccinations in 2024 for children of 10th pass parents",
    "SELECT COUNT(*) " +
    "FROM vaccinations AS v " +
    "JOIN citizens as c1 ON v.citizen_id = c1.citizen_id " +
    "JOIN citizens AS c2 ON c1.parent_id = c2.citizen_id " +
    "WHERE EXTRACT(YEAR FROM v.date_administered) = 2024 " +
    "AND c2.education ILIKE '10th';"
));

queries.add(new QueryInfo(
    "Male births in 2024",
    "SELECT COUNT(*) from citizens " +
    "WHERE gender = 'Male' " +
    "AND EXTRACT(YEAR FROM dob) = 2024;"
));

queries.add(new QueryInfo(
    "Unique citizens in households with panchayat employees",
    "SELECT COUNT(DISTINCT c1.citizen_id) " +
    "FROM citizens AS c1 " +
    "JOIN households AS h ON h.household_id = c1.household_id " +
    "JOIN citizens AS c2 ON c2.household_id = h.household_id " +
    "JOIN panchayat_employees AS p ON p.citizen_id = c2.citizen_id;"
));

try {

```

```

// Load database configuration
Properties config = loadConfig(args[0]);
String url = buildConnectionString(config);

// Connect to database and execute queries
try (Connection conn = DriverManager.getConnection(
    url,
    config.getProperty("username"),
    config.getProperty("password"))) {

    for (QueryInfo query : queries) {
        try {
            executeQuery(conn, query);
        } catch (SQLException e) {
            System.err.println("Error executing query '" + query.label + "':
" + e.getMessage());
        }
    }
} catch (IOException e) {
    System.err.println("Error reading configuration file: " + e.getMessage());
} catch (SQLException e) {
    System.err.println("Database error: " + e.getMessage());
}
}
}

```

Compile and Run:

```

javac -cp postgresql-42.7.2.jar DatabaseQueries.java
java -cp .:postgresql-42.7.2.jar DatabaseQueries db.properties

```