1. Problem Statement

Design and implement a lightweight, secure, and maintainable desktop **Task Management** application that enables users to create, update, delete, and organize tasks with attributes (title, description, priority, deadline, completion status), supports user accounts and per-user preferences, and persists data reliably on a relational database. The system must be usable offline, easy to install for academic/demo deployment, and designed to allow safe manual control of database schema in production environments. Key functional requirements:

- Create, edit, and delete tasks with title, description, priority, deadline, and completion state.
- User accounts and authentication (email + password).
- User preferences for UI and behavioral choices.
- Task listing and filters (by priority, completion state, deadline sorting).
- Local persistence with transactional guarantees and safe schema management.

Non-functional requirements:

- Cross-platform Java desktop application (Windows, macOS, Linux)
- Simple install (JAR + bundled JRE or run via Maven during development)
- Clean, modern UI implemented with JavaFX and CSS
- Maintainable codebase with separation of concerns (presentation, service, persistence)

Challenges addressed:

- Mapping Java 8+ time types (LocalDate, LocalDateTime) to Oracle TIMESTAMP/DATE types
- Balancing convenience (hibernate auto DDL) and safety (manual DDL for production)

General summary

This Task Management & To-Do desktop application is a lightweight JavaFX application designed for personal productivity. It provides user accounts, task management (CRUD), persistent storage via Hibernate (JPA), and a clean, modern UI. The system is intentionally small but extensible: it demonstrates layered architecture, transaction-safe persistence, and attention to production-ready concerns such as manual DB schema control and secure configuration.

This report documents the problem and solution, provides a complete ER diagram, full DDL, normalization analysis, system requirements, architecture, module descriptions, code snippets, testing plan, and deployment instructions. Appendices contain the full entity source code and helper scripts.

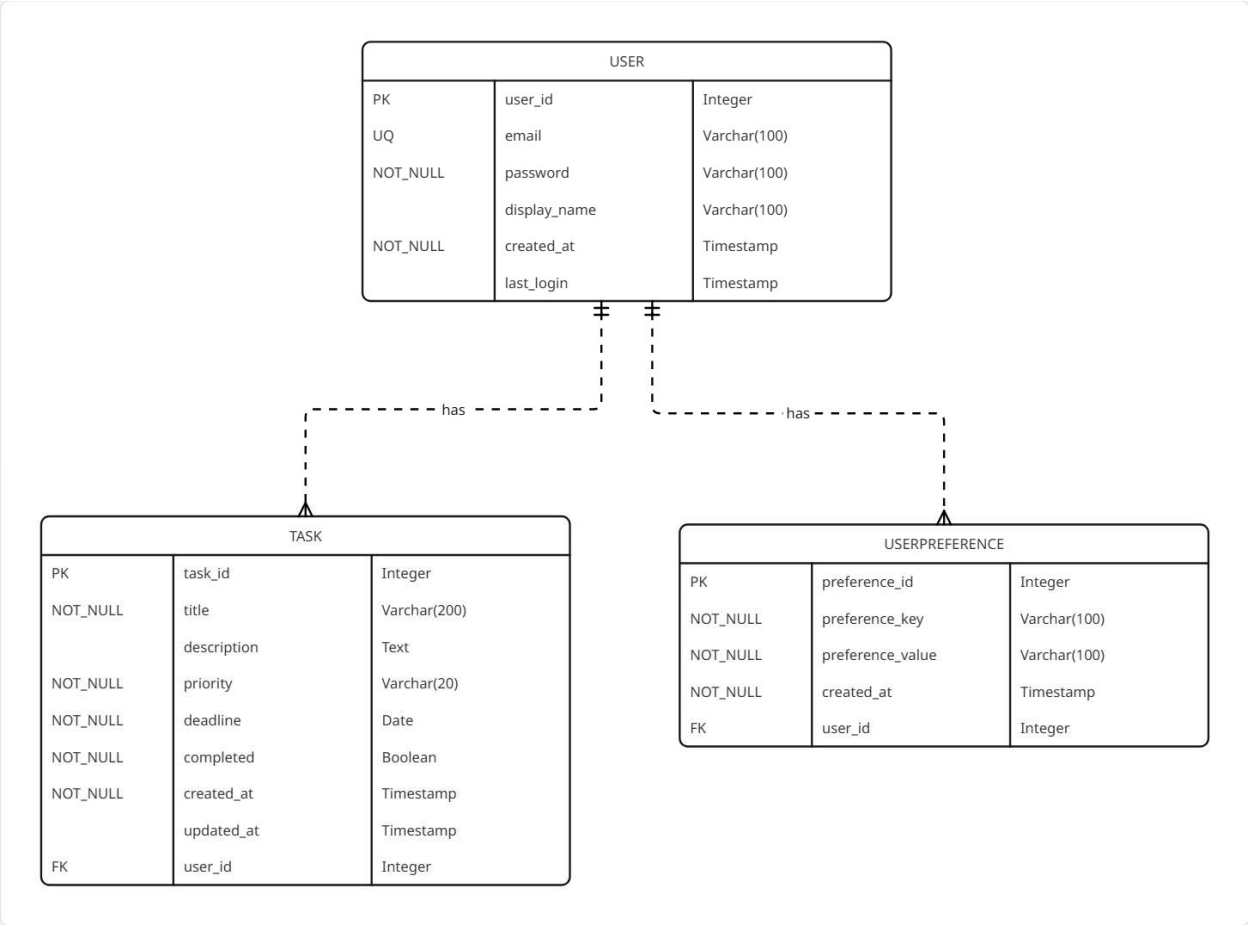
2. ER Diagram

The ER diagram for the application is included in `docs/images/er_diagram.png` and summarized below:

- User (1) — (N) Task
- User (1) — (N) UserPreference

Attributes (selected): -

- User: id (PK), email (unique), password, display_name, created_at, last_login
- Task: id (PK), title, description, priority, deadline, completed, created_at, updated_at, user_id (FK)
- UserPreference: id (PK), preference_key, preference_value, created_at, user_id (FK)



3. Database Schema (complete DDL)

The project includes a full Oracle-compatible DDL script: `src/main/resources/sql/create_schema_oracle.sql`.

For convenience, the script is reproduced here:

```
-- Schema and objects for Task Management app (Oracle)
-- Run as a DBA (SYSTEM) or a user with CREATE USER and GRANT privileges.

-- 1) Create an application schema/user (recommended)
-- Run as SYS or SYSTEM:
-- CREATE USER task_app IDENTIFIED BY "PASSWORD";
-- GRANT CREATE SESSION TO task_app;
-- GRANT CREATE TABLE TO task_app;
-- GRANT CREATE SEQUENCE TO task_app;
-- GRANT CREATE VIEW TO task_app;
-- GRANT CREATE PROCEDURE TO task_app;
-- GRANT UNLIMITED TABLESPACE TO task_app; -- optional, or grant specific quo
tas

-- Alternatively, if you want to create objects in an existing schema, skip u
ser creation

-- 2) Connect as the application user (or run the following as that user)
-- CONNECT task_app/PASSWORD<db_connect_string>

-- 3) Create sequences used by JPA annotations
CREATE SEQUENCE TASK_SEQ START WITH 1 INCREMENT BY 1 NOCACHE NOCYCLE;
CREATE SEQUENCE USER_SEQ START WITH 1 INCREMENT BY 1 NOCACHE NOCYCLE;
CREATE SEQUENCE PREFERENCE_SEQ START WITH 1 INCREMENT BY 1 NOCACHE NOCYCLE;

-- 4) Create tables

-- Users table
CREATE TABLE users (
    id NUMBER(10) PRIMARY KEY,
    email VARCHAR2(255) NOT NULL,
    password VARCHAR2(255) NOT NULL,
    display_name VARCHAR2(255),
    created_at TIMESTAMP,
    last_login TIMESTAMP
);

-- Unique constraint on email
ALTER TABLE users ADD CONSTRAINT uq_users_email UNIQUE (email);
```

```
-- Tasks table
CREATE TABLE tasks (
    id NUMBER(10) PRIMARY KEY,
    title VARCHAR2(400) NOT NULL,
    description CLOB,
    priority VARCHAR2(50),
    deadline DATE,
    completed NUMBER(1) DEFAULT 0 NOT NULL,
    created_at TIMESTAMP,
    updated_at TIMESTAMP,
    user_id NUMBER(10) NOT NULL
);

-- Foreign key to users
ALTER TABLE tasks ADD CONSTRAINT fk_tasks_user FOREIGN KEY (user_id) REFERENC
ES users(id) ON DELETE CASCADE;

-- Index for tasks.user_id
CREATE INDEX idx_tasks_user_id ON tasks(user_id);

-- User preferences table
CREATE TABLE user_preferences (
    id NUMBER(10) PRIMARY KEY,
    preference_key VARCHAR2(255) NOT NULL,
    preference_value VARCHAR2(2000),
    created_at TIMESTAMP,
    user_id NUMBER(10) NOT NULL
);

-- Foreign key to users
ALTER TABLE user_preferences ADD CONSTRAINT fk_prefs_user FOREIGN KEY (user_i
d) REFERENCES users(id) ON DELETE CASCADE;

-- Index for preferences.user_id
CREATE INDEX idx_prefs_user_id ON user_preferences(user_id);

-- 5) Optional: triggers to set id from sequence if inserts originate outside
Hibernate
-- (Hibernate normally fetches NEXTVAL itself; triggers are optional.)

-- Trigger for tasks
CREATE OR REPLACE TRIGGER trg_tasks_before_insert
BEFORE INSERT ON tasks
FOR EACH ROW
BEGIN
  IF :NEW.id IS NULL THEN
    SELECT TASK_SEQ.NEXTVAL INTO :NEW.id FROM DUAL;
  END IF;
END;
```

```
/

-- Trigger for users
CREATE OR REPLACE TRIGGER trg_users_before_insert
BEFORE INSERT ON users
FOR EACH ROW
BEGIN
  IF :NEW.id IS NULL THEN
    SELECT USER_SEQ.NEXTVAL INTO :NEW.id FROM DUAL;
  END IF;
END;
/

-- Trigger for user_preferences
CREATE OR REPLACE TRIGGER trg_prefs_before_insert
BEFORE INSERT ON user_preferences
FOR EACH ROW
BEGIN
  IF :NEW.id IS NULL THEN
    SELECT PREFERENCE_SEQ.NEXTVAL INTO :NEW.id FROM DUAL;
  END IF;
END;
/
-- 6) Optional: enforce boolean semantics for 'completed' column (0/1) via ch
eck constraint
ALTER TABLE tasks ADD CONSTRAINT chk_tasks_completed CHECK (completed IN (0,1
));

-- 7) Verification queries (run as the application user)
-- List tables
-- SELECT table_name FROM user_tables WHERE table_name IN ('USERS','TASKS','U
SER_PREFERENCES');

-- Check sequences
-- SELECT sequence_name, last_number FROM user_sequences WHERE sequence_name
IN ('TASK_SEQ','USER_SEQ','PREFERENCE_SEQ');

-- Basic sample inserts to test sequences and FK constraints
-- INSERT INTO users(email, password, display_name, created_at) VALUES ('alic
e@example.com', 'secret', 'Alice', CURRENT_TIMESTAMP);
-- INSERT INTO tasks(title, description, priority, deadline, completed, creat
ed_at, user_id) VALUES ('Test task', 'desc', 'High', TO_DATE('2025-12-31', 'Y
YYY-MM-DD'), 0, CURRENT_TIMESTAMP, 1);

-- End of script
```

4. Database Normalization (detailed analysis and examples)

Normalization rationale:

- The `users` table contains atomic attributes such as email and password; email is declared UNIQUE to prevent duplicates.
- The `tasks` table uses `user_id` as a foreign key; all task attributes are functionally dependent on the primary key `id` (1NF and 2NF satisfied).
- `user_preferences` stores key-value pairs to avoid schema changes when adding new preference items, improving extensibility.

Example demonstrating avoidance of redundancy:

- If preferences were stored as columns in `users` (e.g., `pref_theme`, `pref_notifications`), adding new preference types would require ALTER TABLE statements and potential data migration. The key/value approach isolates preferences and keeps the main `users` table lean.

Normalization trade-offs:

- The key/value model is flexible but can make queries for multiple preferences slightly more complex (joins or aggregation). For our app scale, the simplicity and flexibility outweigh this cost.

5. System Requirements

Recommended development environment:

- Java 17 (LTS) for modern features and long-term support.
- Maven 3.8+, IntelliJ IDEA Community/Ultimate edition, or Visual Studio Code with the Java extension pack.
- Oracle XE for local testing; alternatively use Postgres for easier CI integration.

Production considerations:

- For single-user desktop installs, an embedded database (H2 with file storage) is acceptable. For multi-user or multi-machine deployments, use a managed RDBMS and create a secure dedicated schema.

6. System Design

Component details:

- MainApp (application entry): initializes `ConfigManager`, sets up the `SceneRouter`, and launches JavaFX.
- SceneRouter: centralizes scene switching and sharing the current user session across controllers.
- DatabaseService: single point of contact for all database operations; uses Hibernate sessions and transactions.
- HibernateUtil: lazily builds a singleton `SessionFactory` using `hibernate.cfg.xml` and ensures clean shutdown.

Threading and UI responsiveness:

- Database operations are executed on background threads to avoid blocking the JavaFX Application Thread. Use `Task/Service` from JavaFX concurrency utilities when performing long-running queries.

7. Core Modules (detailed responsibilities)

- Authentication module: secure password storage is recommended (hashed + salted using BCrypt). Currently the project stores raw passwords — improve by integrating BCrypt (BCrypt library) for production.
- Task management module: provides filtering by priority/completion and ordering by deadline/created date.
- Preferences module: persists user settings; used at startup to apply UI theme and default sort order.

8. Code Snippets (extended)

- HibernateUtil (simplified):

```
public class HibernateUtil {
    private static SessionFactory sessionFactory;
    public static synchronized SessionFactory getSessionFactory() {
        if (sessionFactory == null) {
            Configuration cfg = new Configuration().configure();
            StandardServiceRegistryBuilder builder = new StandardServiceRegis
tryBuilder()
                .applySettings(cfg.getProperties());
            sessionFactory = cfg.buildSessionFactory(builder.build());
        }
        return sessionFactory;
    }
}
```

- DatabaseService: sample query for tasks by priority:

```
public List<Task> getUserTasksByPriority(int userId, String priority) {
    try (Session s = HibernateUtil.getSessionFactory().openSession()) {
        return s.createQuery("from Task t where t.user.id = :uid and t.priori
ty = :p", Task.class)
                .setParameter("uid", userId)
                .setParameter("p", priority)
                .list();
    }
}
```

9. Testing Plan and Sample Test Cases

Testing strategy:

- Unit tests: isolate service-layer logic (mock SessionFactory or use an in-memory DB such as H2 with a Hibernate config profile).
- Integration tests: spin up a transient Oracle/Postgres instance (Docker) and run migrations or manually provision schema before tests.
- Manual acceptance tests: run the application, register user, create tasks, edit tasks, delete tasks; verify referential integrity.

Sample test cases (manual):

1) Register and login
- Steps: Open app -> Register with email/password -> Login
- Expected: user created in `users` table; login succeeds; dashboard loads with empty task list.

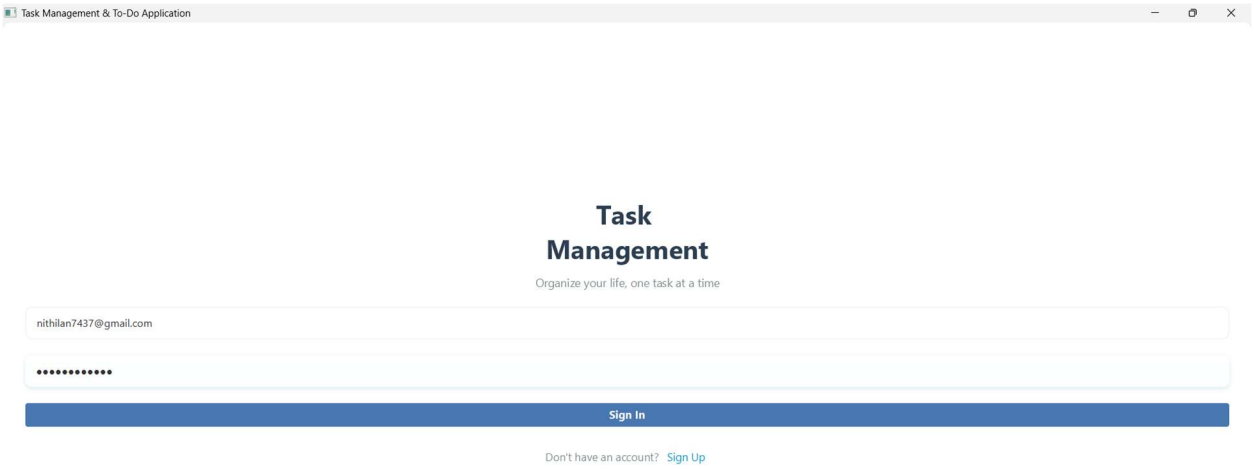
2) Create task and mark complete
- Steps: Add task with title/description/priority/deadline -> Verify in UI and DB -> Mark complete
- Expected: `tasks.completed` toggles from 0 to 1; `updated_at` changes.

3) Cascade delete
- Steps: Create user with tasks -> Delete user via DB -> Expected: tasks deleted by ON DELETE CASCADE constraint.

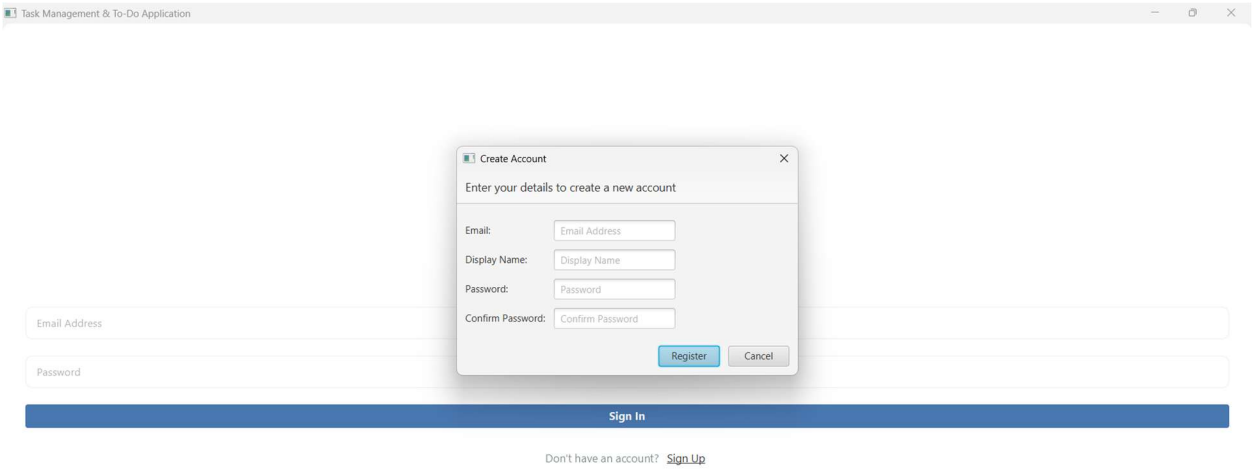
10. Screenshots and GitHub Submission

Screenshots:

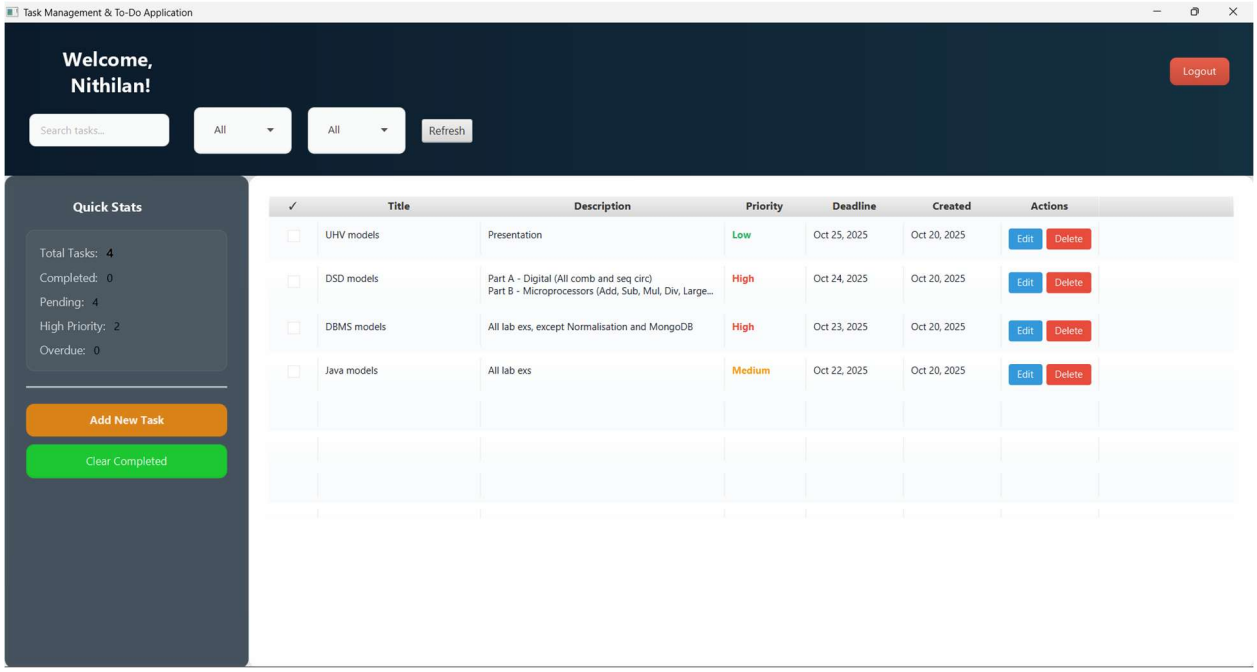
- **Login Page**



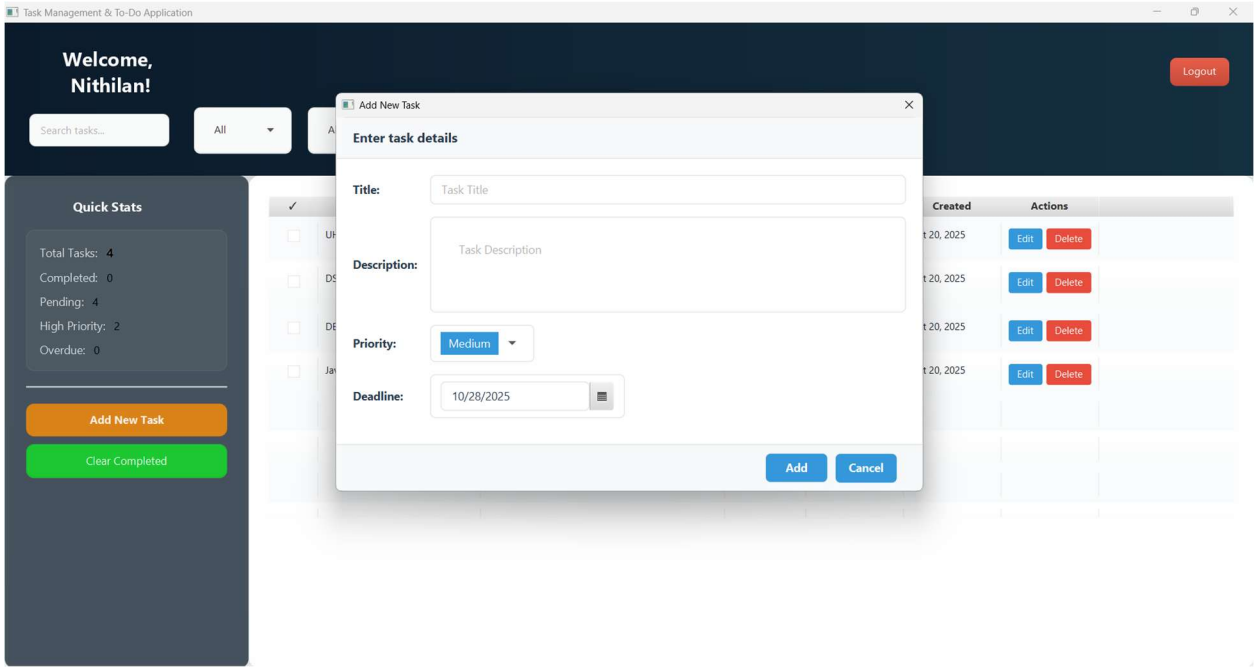
- **Sign Up Page**



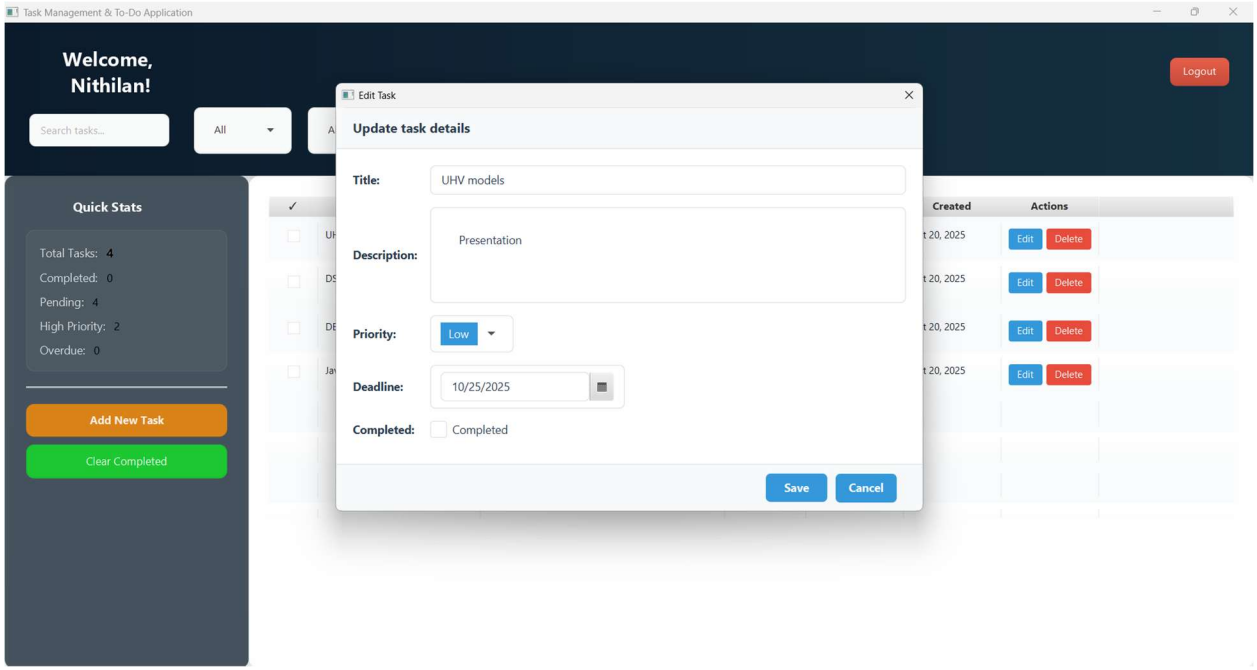
- **Home Page**



- **Add New Task**



- **Edit Task**



Packaging:

- Build a runnable JAR with dependencies using Maven Shade plugin or use a bundled runtime with jlink for smaller size.
- Include the SQL script and report in the repository under `docs/`.

Deployment instructions (developer mode):

```
mvn clean package -DskipTests
mvn javafx:run
```

GitHub Repository Link :
https://github.com/Nithilan77/Task_Management_And_To_Do_Application

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Appendices

Appendix A — Full DDL Script

See `src/main/resources/sql/create_schema_oracle.sql` in the repository.

Appendix B — Hibernate Config Recommendation and XML diff

Current snippet in `src/main/resources/hibernate.cfg.xml`:

```
<property name="hibernate.hbm2ddl.auto">update</property>
```

Recommended change to validate-only mode:

```
<property name="hibernate.hbm2ddl.auto">validate</property>
```

Use `validate` in production to ensure the schema matches the mappings without making changes. Remove the property entirely to fully disable any checks.

Appendix D — Full entity sources (abridged)

The main entity classes are in `src/main/java/com/taskmanager/entity/`.

Task.java (abridged):

```
package com.taskmanager.entity;

import jakarta.persistence.*;
import java.time.LocalDate;
import java.time.LocalDateTime;

@Entity
@Table(name = "tasks")
public class Task {
    @Id
    @GeneratedValue(strategy = GenerationType.SEQUENCE, generator = "task_seq
")
    @SequenceGenerator(name = "task_seq", sequenceName = "TASK_SEQ", allocati
onSize = 1)
    private int id;

    @Column(nullable = false)
    private String title;

    private String description;

    private String priority;

    private LocalDate deadline;

    private boolean completed;
```

```java
    @Column(name = "created_at")
    private LocalDateTime createdAt;

    @Column(name = "updated_at")
    private LocalDateTime updatedAt;

    @ManyToOne(fetch = FetchType.LAZY)
    @JoinColumn(name = "user_id", nullable = false)
    private User user;

    // constructors, getters, setters, @PreUpdate omitted for brevity
}
```

User.java and UserPreference.java are included in the codebase; the full files are included in the repository and this appendix references them by path.