Software Design Specification (SDS)

**Table of Contents**  
1. Introduction  
2. System Architecture  
3. Module Design  
 3.1 User Authentication Module  
 3.2 Game Logic Module  
 3.3 AI Engine Module  
 3.4 Game History & Replay Module  
 3.5 GUI Design Module  
4. Class Diagrams  
5. Data Flow & Flowchart  
6. Database Design  
7. Performance Monitoring  
8. Conclusion

**1. Introduction**  
This Software Design Specification (SDS) provides a detailed design plan for the Advanced Tic Tac Toe Game, a Qt-based desktop application with features including user authentication, AI opponent, game history management, performance tracking, and interactive GUI.

**2. System Architecture**  
The system is organized into a layered architecture:  
- Presentation Layer: Manages user interaction via Qt GUI  
- Application Logic Layer: Manages gameplay, AI, and user flow  
- Data Layer: Handles database operations and storage

**3. Module Design**

3.1 User Authentication Module  
Responsibilities:  
- Handles sign-in/sign-up using GUI  
- Uses SHA-256 with salt for password hashing  
- Supports password reset after 3 failed attempts

Key Classes/Functions:  
- MainWindow::signInButtonClicked()  
- MainWindow::signUpButtonClicked()  
- DatabaseManager:: verifyUser(), saveUser(), updateUserPassword()

3.2 Game Logic Module  
Responsibilities:  
- Manages board state, turn switching, move validity  
- Detects win/draw conditions

Key Class:  
- GameBoard

Important Methods:  
- resetBoard(), enableboard() ,disableboard() , onCellClicked(), UpdatebuttonText  
- makeMove(), checkWinner() ,switchPlayer() TriggerAiMove(),getBooard()isEmpty(),getAvaliableMoves()

3.3 AI Engine Module  
Responsibilities:  
- Implements AI using minimax algorithm  
- Makes optimal moves with slight delay for realism

Key Methods:  
- findBestMove()  
- minimax()  
- triggerAiMove()  
- aiMove()  
- getAvailableMoves()

3.4 Game History & Replay Module  
Responsibilities:  
- Records games with moves, timestamp, mode, and winner  
- Loads past games and replays them step-by-step

Classes:  
- GameDialog, ReplayDialog, HistoryDialog

Important Elements:  
- recordMove()  
- onGameOver()  
- saveGameHistory()  
- loadGameHistory()

3.5 GUI Design Module  
Responsibilities:  
- Provides all visual components (buttons, pages, labels)

- Offers styled UI with stacked pages and buttons Qt Components Used:  
- QPushButton, QStackedWidget, QLineEdit, QDialog, QComboBox, etc.

**4. Class Diagram**



**5. Data Flow & Flowchart**

****

**6. Database Design**  
Tables:  
- users: id, username, password\_hash, salt, created\_at  
- game\_history: id, username, game\_mode, winner, moves, timestamp

**7. Performance Monitoring**  
Tools:  
- PerformanceMonitor class

Tracks:  
- Login speed  
- AI move computation time  
- Database query duration

**8. Conclusion**  
This SDS outlines the internal design of the Advanced Tic Tac Toe Game. It ensures modularity, maintainability, and clarity for all development team members.