Project Report: Number Guessing Game

1. General Info

Project Title: Number Guessing Game with Performance Analysis
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2. Introduction

This Python-based number guessing game challenges players to guess a secret number within limited attempts. It demonstrates concepts of input validation, control structures, and algorithmic strategies while providing educational feedback on player performance.

3. Problem Statement

Develop an interactive console game that generates a random secret number and limits user guesses. It must validate inputs, offer "higher/lower" hints, and analyze guessing efficiency by estimating winning probability and additional tries needed.

4. Functional Requirements

- Generate random number in range 1 100
- Accept and validate integer inputs
- Prevent duplicate guesses
- Provide hints after each guess
- Limit to 7 attempts
- Analyze probability of winning
- Calculate minimum additional guesses needed
- Display results and exit gracefully

5. Non-functional Requirements

- User-friendly console interface
- Handle invalid inputs gracefully
- Fast response time 1 second)
- Portable across Python 3+ environments
- Use only built-in modules
- Clear error messages

6. System Architecture

Modular design with main controller managing game logic, input validation, feedback, and analysis modules. Built-in modules `random`, `sys`, `time`, and `math` support functionality.

7. Design Diagrams

- **Use Case Diagram:** Player starts game, inputs guesses, receives feedback; system validates input, generates secret, analyzes guesses.
- **Workflow Diagram:** Game start → generate secret → loop guess input and validation → check guess → provide feedback → end game → analysis reported.
- **Sequence Diagram:** Player inputs guess → validated → compared → feedback → tracked → end → analysis displayed.
- **Class/Component Diagram:** Functions for input validation, game logic, analysis; use of built-in modules.
- **ER Diagram:** Not applicable (no persistent storage).

8. Design Decisions & Rationale

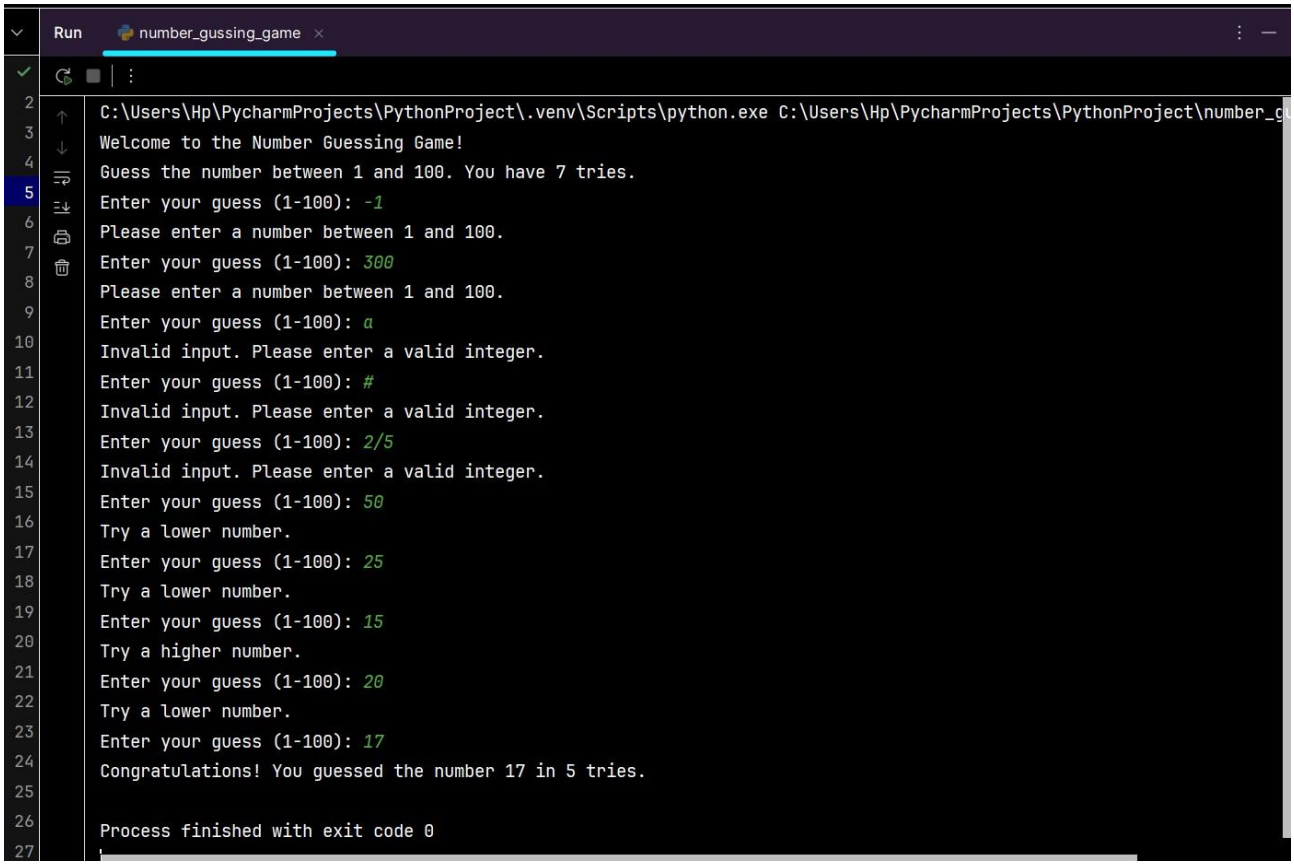
- Console interface chosen for simplicity
- 7 attempts chosen based on optimal binary search limit
- Range of 1 100 balances challenge and accessibility
- Input validation ensures robust, user-friendly gameplay
- Probability analysis educates on success likelihood
- Use of built-in modules avoids external dependencies

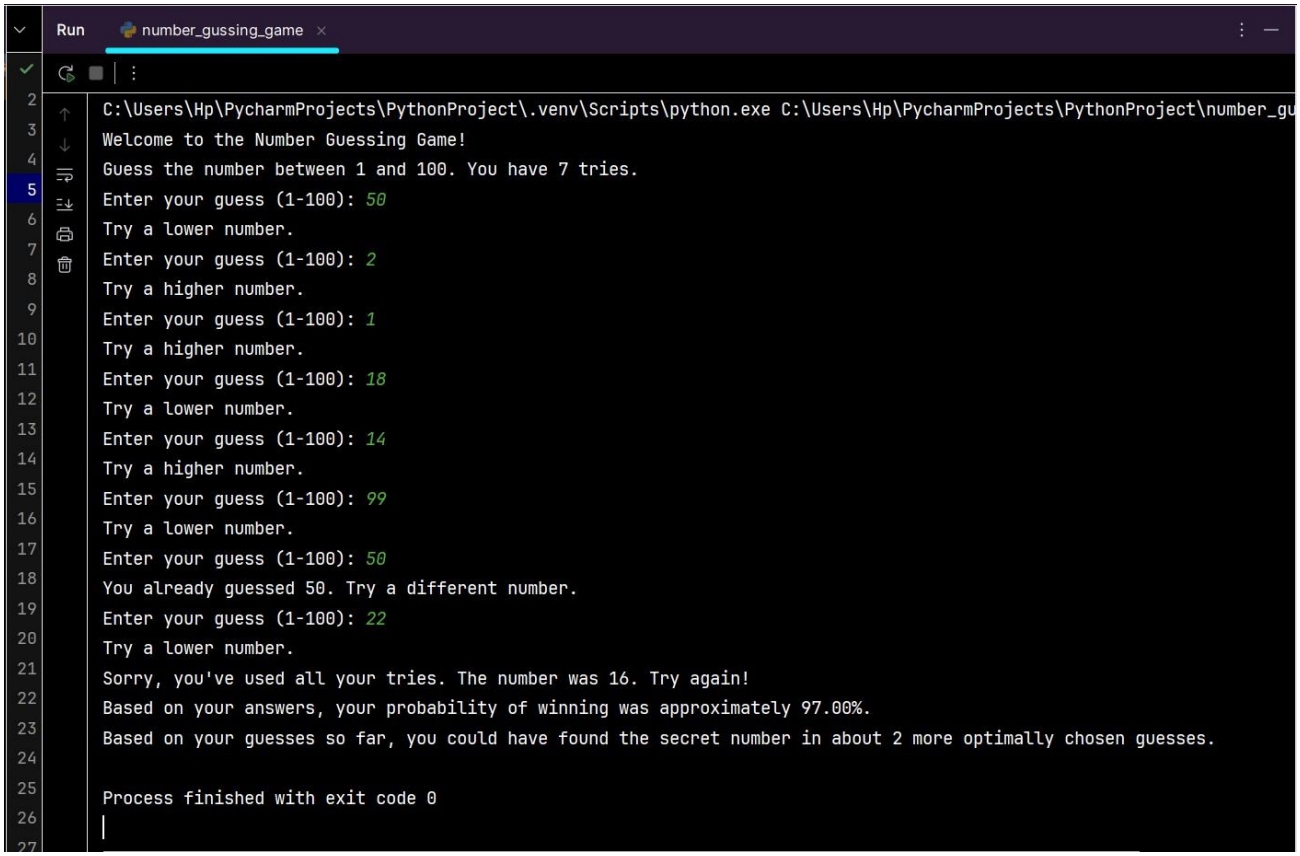
9. Implementation Details

- `get_valid_guess()` validates integer input, range, and duplicates
- `analyze_guesses()` calculates heuristic probability based on eliminated search space
- `min_additional_tries()` estimates further tries using binary search log2 formula
- Main loop gathers guesses and provides feedback after each attempt

10. Screenshots / Results

Sample output demonstrates user guesses, error handling for invalid input, feedback hints, victory or defeat message, and final statistical analysis of performance.





11. Testing Approach

- Unit testing input validation and analysis functions
- Integration testing overall game flow
- Edge cases like repeated inputs, boundary values, and invalid types tested
- Manual playtesting verified correct feedback and results

12. Challenges Faced

- Handling various invalid inputs effectively
- Designing intuitive probability and optimal tries analysis
- Balancing game difficulty with user engagement
- Managing program flow with clean exit and delays

13. Learnings & Key Takeaways

- Mastering input validation and error handling
- Understanding binary search role in efficient guessing
- Applying modular design and clear function responsibilities
- Using built-in Python modules effectively for practical tasks

14. Future Enhancements

- Add GUI for improved user experience
- Introduce difficulty levels and multiplayer support
- Implement data persistence for statistics tracking
- Add hint system and scoring mechanism
- Use unit testing frameworks for automation

15. References

- Python Official Documentation (https://docs.python.org/3/)
- GeeksforGeeks, Number Guessing Game tutorial
- Stack Overflow discussions on guessing game algorithms
- Algorithm textbooks on binary search and probability
- Python built-in module guides

This concise report captures the core elements and structure of the Number Guessing Game project with clarity and precision.