南 开 大 学

JAVA 语 言 与 应 用 实 验 报 告

中文题目： **控制台版五子棋游戏实验报告**

外文题目： Experiment Report: Console-Based Gomoku Game

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年　　级： 2023 级

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完成日期： 2024 年 11 月

摘 要

本实验设计并实现了一个基于控制台的五子棋游戏，采用 MVC 模式（Model-View-Controller）来组织代码。通过 Model 模块负责棋盘数据存储和逻辑运算，View 模块负责用户界面显示，Control 模块管理游戏流程。此外，加入了输入错误处理和棋子覆盖检查，确保用户输入的行列坐标合法且目标位置为空，从而提升了程序的健壮性和用户体验。本实验进一步巩固了面向对象设计和单例模式的应用，提高了代码的可读性、可维护性和扩展性。

关键词：五子棋；MVC 模式；单例模式

Abstract

This experiment involves designing and implementing a console-based Gomoku (Five-in-a-Row) game, using the MVC (Model-View-Controller) pattern for code organization. The Model module is responsible for storing board data and game logic, the View module manages the user interface, and the Control module orchestrates game flow. Additional improvements include input error handling and piece placement validation to ensure valid coordinates and prevent piece overlap, enhancing program robustness and user experience. This experiment reinforces object-oriented design and Singleton pattern usage, improving code readability, maintainability, and scalability.

Key Words: Gomoku; MVC pattern; Singleton pattern

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第一章　实验目的

本实验的目标是开发一个简易的控制台版五子棋游戏，允许两位玩家轮流下棋并判断胜负。通过该实验，加深对 Java 编程、控制台交互以及面向对象设计思想的理解，同时学习 MVC 设计模式和单例模式的实际应用。具体目标包括：

1. 掌握面向对象编程的基本概念，熟悉 MVC 模式的结构与应用。
2. 设计一个控制台交互式应用，学习基本的输入输出处理。
3. 实现五子棋游戏的规则逻辑，包括棋盘状态管理、棋子放置和胜负判断。

第二章　需求分析

在设计五子棋控制台游戏时，需要满足以下功能需求：

1. **用户输入**：允许用户输入棋子的坐标，以控制棋子的落子位置。
2. **棋盘显示**：游戏需要在每次落子后刷新棋盘，并在控制台中显示当前棋盘的状态。
3. **胜负判断**：程序应能自动判断是否有玩家在横、竖、对角线上形成五子连珠。库存的功能，以保证有足够的库存满足租赁和销售需求。
4. **黑白棋交替下棋**：在游戏过程中，黑白棋应按照规则轮流进行落子。
5. **输入错误处理和棋子覆盖检查**：在用户输入无效的行或列坐标、或者选择已被占用的位置时，程序应给予友好的提示并允许用户重新输入，以提升程序的健壮性。

第三章　功能设计

本实验采用 MVC 模式，将程序结构划分为以下三个模块：

1. **Model 模块**：负责棋盘状态的数据存储和更新，提供棋子落子接口及胜负判断方法。
2. **View 模块**：负责游戏界面展示，包括棋盘绘制和用户输入处理
3. **Control 模块**：负责游戏逻辑控制，包括管理玩家轮流落子、调用胜负判断等。

每个模块通过单例模式管理唯一实例，避免模块实例的重复创建，提高了系统资源的利用效率。

第四章　代码实现

第一节　Model 类

Model 类是五子棋游戏的核心逻辑部分，负责存储棋盘数据和实现棋子的放置和胜负判断。以下是对主要代码的详细描述：

1. 类变量
    - WIDTH：定义棋盘的大小为 19x19 格。
    - BLACK , WHITE , SPACE : 常量值分别代表黑棋、白棋和空位置。
    - data：二维数组存储棋盘状态，元素值为 BLACK , WHITE 或 SPACE 。
    - lastRow , lastCol : 记录最后一个落子的行列位置，用于判断连珠。
2. 方法说明
    - putChess(int row, int col, int color)：该方法接收行、列及颜色参数，判断是否可以在指定位置落子。若位置有效，则更新棋盘数据并记录最新位置，否则抛出参数异常。
    - getchess(int row, int col)：返回指定位置的棋子状态。
    - whoWin()：遍历棋盘，判断是否有五子连珠的胜利条件。通过四种方向（水平、垂直、正对角、反对角）的连续检查，判断是否有五个连续同色棋子。

第二节　View 类

View 类用于在控制台中显示当前棋盘状态和接受用户输入。主要方法包括：

1. repaint：遍历棋盘 data 数组，将其显示在控制台。棋盘中的空位显示为 +，黑棋显示为 *，白棋显示为 O 。
2. input：通过 BufferedReader 从控制台获取用户输入的行列坐标。程序提示用户输入，并将读取的坐标传递给 Control 类进行处理。为提高用户体验，增加了输入错误处理功能。当用户输入非数字、超出范围或选择已被占用的位置时，程序会提示用户重新输入有效坐标。

第三节 Control 类

Control 类用于管理游戏的主要流程，包括切换玩家、调用 View 刷新棋盘、调用 Model 判断胜负等。具体描述如下：

1. **类变量**
    - color：用于记录当前棋子的颜色，初始值为黑棋（Model.BLACK），在每次落子后切换。
2. **方法说明**
    - report(int row, int col)：接收用户输入的棋子位置。调用 Model.putChess 方法进行落子，若成功，则切换当前棋子颜色，并通过 whoWin 检查是否产生胜负。
    - main：程序的入口。初始化棋盘，通过循环调用 View.input 不断接受用户输入，直到某一方获胜。

第五章　Maven 项目构建

在项目构建中使用 Maven 作为依赖管理工具，主要优势包括：

- **模块化管理**：通过 Maven 定义项目的依赖项，便于后期的依赖扩展和管理。
- **自动化构建**：Maven 能够自动下载和管理依赖的库，简化项目的配置过程。
- **统一结构**：Maven 项目结构清晰，有利于代码的管理和共享。

第六章　代码特点

1. **单例模式：** `Model`、`View`和`Control`均通过单例模式实现，确保每个类在系统中仅有一个实例。这样设计不仅减少了内存消耗，还避免了多实例带来的资源竞争问题。
2. **MVC 设计模式：**通过将游戏的核心逻辑、界面和控制逻辑分开，使得代码更加模块化，便于后期的扩展和维护。
3. **输入错误处理和棋子覆盖检查：**在`View`类的`input`方法中增加了错误处理和棋子覆盖检查。当用户输入非数字、超出棋盘范围或选择已被占用的坐标时，程序会提示错误信息并要求重新输入，以确保程序的健壮性和用户体验。

第七章　实验结果

1. 在控制台能够显示 19x19 的棋盘，并支持用户输入坐标落子。
2. 程序在黑白棋轮流落子的基础上，能够正确判断横、竖、对角线的五子连珠胜利条件。
3. 当任意一方达成胜利条件时，系统会在控制台输出获胜方的颜色并结束程序。
4. 当用户输入的坐标无效（非数字、超出范围、已有棋子的位置）时，程序会提示错误信息并要求重新输入，避免了程序崩溃的情况，提升了用户体验

实验运行结果如下：

```
java.exe' '-XX:+ShowCodeDetailsInExceptionMessage
ol'
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
Please enter the row number (0-18):
1
Please enter the column number (0-18):
1
++++++++++++++++++++
+*++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
```

图 7.1 程序运行截图 1

```
Please enter the row number (0-18):
0
Please enter the column number (0-18):
x
Invalid input. Please enter a valid integer.
Please enter the row number (0-18):
1
Please enter the column number (0-18):
1
This position is already occupied. Please choose another position
Please enter the row number (0-18):
0
Please enter the column number (0-18):
0
O++++++++++++++++++
+*++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
Please enter the row number (0-18):
2
Please enter the column number (0-18):
2
```

图 7.2 程序运行截图 2

```
O+++++++++++++++++++
+*+++++++++++++++++++
++*++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
Please enter the row number (0-18):
2
Please enter the column number (0-18):
1
O+++++++++++++++++++
+*+++++++++++++++++++
+O*++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
```

图 7.3 程序运行截图 3

```
Please enter the row number (0-18):
3
Please enter the column number (0-18):
3
O++++++++++++++++++
+*++++++++++++++++++
+O*+++++++++++++++++
+++*++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
Please enter the row number (0-18):
3
Please enter the column number (0-18):
1
O++++++++++++++++++
+*++++++++++++++++++
+O*+++++++++++++++++
+O+*++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
```

图 7.4 程序运行截图 4

```
Please enter the row number (0-18):
4
Please enter the column number (0-18):
4
O++++++++++++++++++
+*++++++++++++++++++
+O*+++++++++++++++++
+O+*++++++++++++++++
++++*++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
Please enter the row number (0-18):
5
Please enter the column number (0-18):
5
O++++++++++++++++++
+*++++++++++++++++++
+O*+++++++++++++++++
+O+*++++++++++++++++
++++*++++++++++++++
+++++O++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
```

图 7.5 程序运行截图 5

```
Please enter the row number (0-18):
4
Please enter the column number (0-18):
3
O+++++++++++++++++
+*+++++++++++++++++
+O*++++++++++++++++
+O+*+++++++++++++++
+++**+++++++++++++++
+++++O+++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
Please enter the row number (0-18):
4
Please enter the column number (0-18):
1
O+++++++++++++++++
+*+++++++++++++++++
+O*++++++++++++++++
+O+*+++++++++++++++
+O+**+++++++++++++++
+++++O+++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
++++++++++++++++++++
```

图 7.6 程序运行截图 6

```
Please enter the row number (0-18):
5
Please enter the column number (0-18):
3
O+++++++++++++++++
+*+++++++++++++++++
+O*++++++++++++++++
+O+*+++++++++++++++
+O+**++++++++++++++
+++*+O++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
Please enter the row number (0-18):
5
Please enter the column number (0-18):
1
O+++++++++++++++++
+*+++++++++++++++++
+O*++++++++++++++++
+O+*+++++++++++++++
+O+**++++++++++++++
+O+*+O++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
```

图 7.7 程序运行截图 7

```
Please enter the row number (0-18):
6
Please enter the column number (0-18):
1
O+++++++++++++++++
+*+++++++++++++++++
+O*++++++++++++++++
+O+*+++++++++++++++
+O+**++++++++++++++
+O+*+O++++++++++++
+*+++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
Please enter the row number (0-18):
5
Please enter the column number (0-18):
0
O+++++++++++++++++
+*+++++++++++++++++
+O*++++++++++++++++
+O+*+++++++++++++++
+O+**++++++++++++++
OO+*+O++++++++++++
+*+++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
```

图 7.8 程序运行截图 8

```
Please enter the row number (0-18):
6
Please enter the column number (0-18):
2
O+++++++++++++++++
+*+++++++++++++++++
+O*++++++++++++++++
+O+*+++++++++++++++
+O+**++++++++++++++
OO+*+O++++++++++++
+**++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
Please enter the row number (0-18):
6
Please enter the column number (0-18):
3
O+++++++++++++++++
+*+++++++++++++++++
+O*++++++++++++++++
+O+*+++++++++++++++
+O+**++++++++++++++
OO+*+O++++++++++++
+**O++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
```

图 7.9 程序运行截图 9

```
Please enter the row number (0-18):
7
Please enter the column number (0-18):
1
O+++++++++++++++++
+*+++++++++++++++++
+O*++++++++++++++++
+O+*+++++++++++++++
+O+**++++++++++++++
OO+*+O++++++++++++
+**O+++++++++++++++
+*+++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
Please enter the row number (0-18):
8
Please enter the column number (0-18):
0
O+++++++++++++++++
+*+++++++++++++++++
+O*++++++++++++++++
+O+*+++++++++++++++
+O+**++++++++++++++
OO+*+O++++++++++++
+**O+++++++++++++++
+*+++++++++++++++++
O+++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
++++++++++++++++++
```

图 7.10 程序运行截图 10

```
Please enter the row number (0-18):
3
Please enter the column number (0-18):
5
O+++++++++++++++++
+*+++++++++++++++++
+O*++++++++++++++++
+O+*+*++++++++++++++
+O+**++++++++++++++
OO+*+O++++++++++++++
+**O++++++++++++++++
+*+++++++++++++++++
O+++++++++++++++++
+++++++++++++++++++
+++++++++++++++++++
+++++++++++++++++++
+++++++++++++++++++
+++++++++++++++++++
+++++++++++++++++++
+++++++++++++++++++
+++++++++++++++++++
+++++++++++++++++++
black win
```

图 7.11 程序运行截图 11

第八章　心得体会

通过本次实验，我对 MVC 设计模式的结构和作用有了更深的理解，尤其是在控制台应用程序中如何实现模块化设计。同时，单例模式的应用也让我意识到资源控制和代码重用的重要性。此外，本实验还让我更加熟悉了 Java 的控制台输入输出操作，增进了对基本数据处理的理解。加入输入错误处理和棋子覆盖检查后，程序更加健壮，用户体验得到了显著提升。未来的改进方向包括优化胜负判断算法、添加更多异常处理以及在控制台中提供更友好的用户交互体验。