Practical 2 – Animal Chess

Due Friday, week 5 – weighting 35%

In this practical, you will be provided with an object-oriented model, and your task will be to implement it in Java. The model is specified by two things: a UML class diagram showing the required classes, and a suite of tests that define how your program should behave. The details of implementation are up to you: after creating the classes in Java, you will need to fill in their methods yourself, and decide on any additional fields, methods, classes etc. that you might need in order to meet the requirements.

For this practical, you may develop your code in the IDE or text editor of your choice, but you must ensure all your source code is in a folder named **`CS5001-p2-animal-chess/src/animalchess`**, where **`animalchess`** corresponds to the package name required by the specification.

Animal Chess

The game of chess reached Japan from India around one thousand years ago, and over the centuries it developed rather differently in Japan from the rest of the world. The game's focus switched towards pieces that move only one square at a time, and curious innovations arose, including a more complex system of promotions, and the ability to "drop" a captured piece onto the board with its colour changed. The most popular chess variant in Japan today is known as Shogi, or The Game of Generals; it has gained popularity over the years, and now has a significant number of players outside the country.

The subject of this practical is *Goro-Goro Dobutsu Shogi* (or *Purring Animal Chess*), a small Shogi variant designed by professional Shogi player Madoka Kitao, her aim being to introduce children to Shogi. The game is played on a 5×6 board, and features four different animals which all move in different ways, with similarities to pieces found in chess.

The two players sit facing each other, with eight pieces each: a lion, two dogs, two cats and three chicks. Players take turns moving a single piece.

- A chick moves one space forward.
- A dog moves one space forward, backward, left or right, or diagonally forward (6 directions).
- A cat moves one space in any diagonal direction, or directly forward (5 directions).
- A lion moves one space in any direction, either orthogonal or diagonal (8 directions).

These directions are shown on the playing pieces with red dots.

A player cannot move a piece onto one of their own pieces, but they may move onto one of their opponent's pieces, in which case the opponent's piece is **captured**. The capturing player takes the piece into their **hand**, and on a future turn, instead of moving a piece, they may **drop** a captured piece, by placing it onto any empty space on the board as one of their own pieces. A player wins by capturing their opponent's lion.

The chick and cat pieces are **promotable**. If a player moves a chick or a cat into the farthest two rows from them (the two rows closest to their opponent) then it promotes. After promoting, on future turns, it moves like a dog. In a real game, this is shown by flipping the piece over to show the picture on the other side.

The official rules are available on StudRes here, and you should read them carefully before starting. However, note that for this practical you may **ignore** the following rules:

- Two chicks annot normally be dropped on the same rank (don't worry about this).
- A chick drop that causes "checkmate" is normally banned (don't worry about this).
- The same board state occurring 4 times normally results in a draw (don't worry about this).
- When a piece enters the promotion zone, its player normally *chooses* whether to promote (but you should just promote it every time).

More information about the game is here: https://en.wikipedia.org/wiki/D%C5%8Dbutsu_sh%C5%8Dgi#Variation.

System Specification

You are required to implement the classes shown in the following UML class diagram, including all the public methods and attributes shown. Your program should not require any input from the user, nor print any output to the screen. Your code can be tested by running the JUnit tests that are included with this practical. This can be done on the lab machines using *stacscheck*, by navigating into your **`CS5001-p2-animal-chess`** directory and running the following command:

```
stacscheck /cs/studres/CS5001/Practicals/p2-animal-chess/tests
```

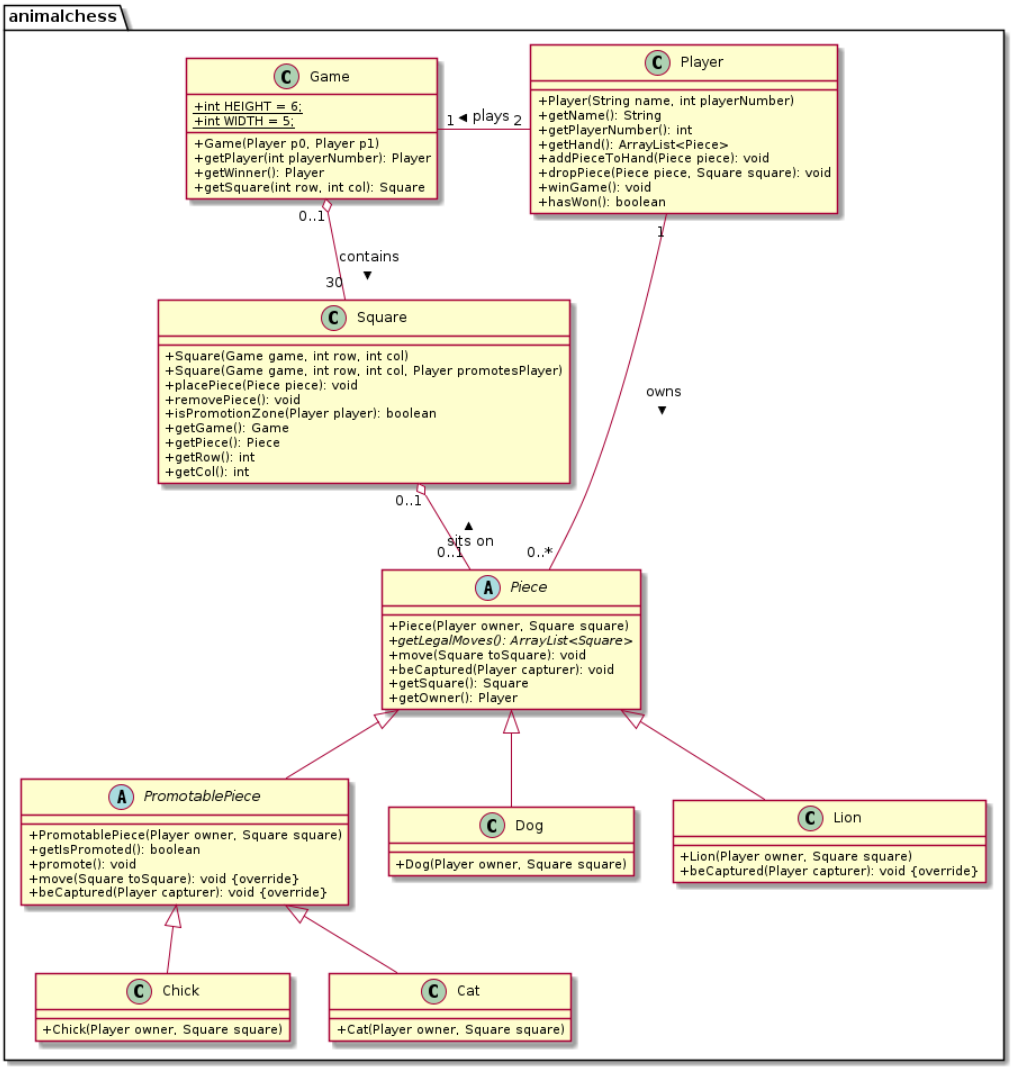
This will compile your classes and run all the provided tests on them. You can access *stacscheck* on the lab machines via SSH, or if you use a Linux or Mac machine, you can install it on your own computer.

Important: The behaviour we want from the system is defined by these tests. If you're not absolutely sure what a class or method is supposed to do, you should look at the tests that correspond to it and examine the examples and assertions there. The relevant unit test files are in subdirectories of the **tests/** directory, and they all have names of the form `<classname>Test.java`

You can add to these by creating your own additional tests if you wish. You can run your own JUnit tests in an IDE, via the command line, or via *stacscheck*. If an aspect of the program's behaviour is not defined by the tests or the UML diagram, you should make your own choice about what the program should do, and document this in your code as a comment.

UML Class Diagram

This is the class structure of the system you should build. You should include every class and every public method on the diagram, but you may implement more classes and methods if you wish, and the choice of private attributes and methods is up to you.



In this diagram, each yellow box is one class. The C symbol in the top part refers to a class, while the A symbol refers to an abstract class. Chick, Dog, Cat and Lion are all special types of Piece, so they inherit its public methods. Chick and Cat also inherit from PromotablePiece, which defines some special functionality for pieces that can promote. PromotablePiece and Lion show some methods marked with {override} – this is a hint that you might want to override these methods in these particular classes. Each Piece is owned by one Player, and may sit on one Square (if it is not in a player's hand). The whole Game has two Players, and 30 Squares (the 5×6 board shown above). When a player moves a piece onto a square, they can use the square's isPromotionZone method to test whether their piece is in the zone where it promotes (the farthest two ranks from the player).

Exception handling

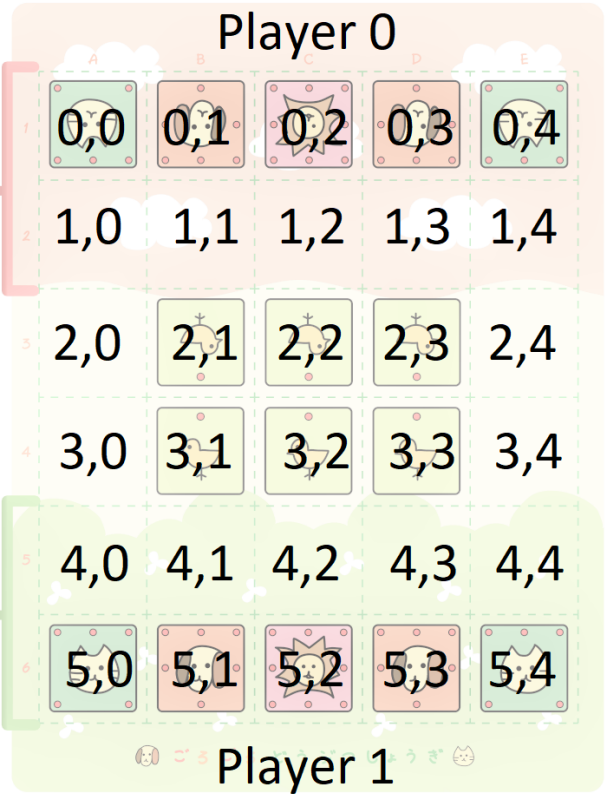
An exception of the class *IllegalArgumentException* should be thrown if a player tries to drop a piece that is not in their hand, or if *placePiece* attempts to place a piece on a square that is already occupied. It may also be used in other situations where an operation cannot be carried out because of an illegal argument. A short message describing what went wrong should be included in the exception. Make sure to catch it and handle it where appropriate!

Packages

Also shown on the UML diagram is the name of the package into which your classes should be placed: **animalchess**. Your .java files should be placed in the corresponding subdirectory inside your **src/** directory. You should make sure to declare this package at the top of each file, with the line `package animalchess;`

Behaviour

A player has an attribute *playerNumber*, which should be either 0 or 1. Player 0 sits at the top of the board, and player 1 sits at the bottom of the board. Each Square has a position on the board defined by its *row* and *col* attributes: these should be numbers between 0 and 5, as shown by the *(row, col)* pairs in the following diagram.



Note that certain events, such as a piece being promoted, or a player winning, are triggered by public methods. These events can be forced by calling the appropriate method – for example, `player.winGame()` – but should also be triggered according to the rules of the game – for example, a player should win when they take their opponent's lion.

Deliverables

A report is not necessary for this project, but if you have strayed from the specification at all, or if you have made any design decisions that you wish to explain, you can include a short readme file in your **CS5001-p2-animal-chess/** folder; this should include any necessary instructions for compiling or running your program. Hand in an archive of your assignment folder, including your **src/** directory and any local test subdirectories, via MMS as usual.

Marking

A submission which does not satisfy all the tests above may still receive a good grade. A submission that implements all classes and methods as shown on the UML diagram, using object-oriented methods, but which does not have the required behaviour in all cases, could receive a grade of up to 15 if it is implemented cleanly and intelligently.

A submission which satisfies all the requirements described, including passing all the tests, can achieve any grade up to 20, with the highest grades awarded to implementations that show clarity of design and implementation, with additional tests that show an insight into the problem.

Any extension activities that show insight into object-oriented design and test-driven development may increase your grade, but a good implementation of the stated requirements should be your priority.

See the standard mark descriptors in the School Student Handbook:

https://info.cs.st-andrews.ac.uk/student-handbook/learning-teaching/feedback.html#Mark_Descriptors

Lateness

The standard penalty for late submission applies (Scheme B: 1 mark per 8-hour period, or part thereof) as shown at:

https://info.cs.st-andrews.ac.uk/student-handbook/learning-teaching/assessment.html#lateness-penalties

Good Academic Practice

The University policy on Good Academic Practice applies:

https://www.st-andrews.ac.uk/students/rules/academicpractice/