Generic Interface for Developing Abstract Strategy Games

Ivo Paz dos Reis

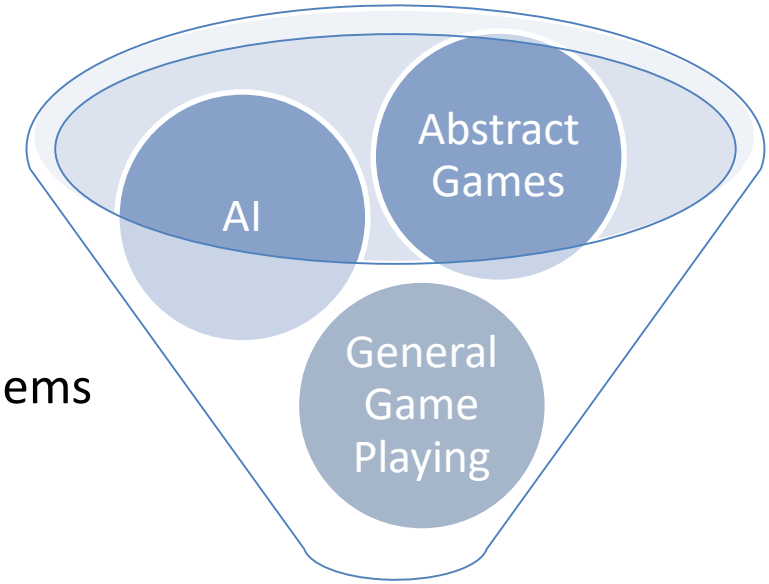
Supervisor: Luís Paulo Reis (PhD)

Presentation Outline

- Introduction
  - Motivation
  - Objectives
- State of the Art
  - Abstract Strategy Games
  - Artificial Intelligence Approaches
  - General Game Playing Systems
- Generic Interface
  - System Architecture
  - Abstract Game Components
  - Examples
- Results
- Conclusions and Future Work

Motivation

- **Artificial Intelligence** applied to Board Games allows for:
  - The study of advanced **problem-solving** methodologies
  - Finding **generic solutions** for similar problems
- The **videogame** industry:
  - Is growing exponentially
  - Has an enourmous potential for **scientific study**
- There are no software applications that allow users to **generically create** board games



Generic Interface for Developing Abstract Strategy Games

Objectives

- Research on abstract game characteristics:
  - classification methods
  - comparative analysis of game mechanics
- Development of a platform with a simple graphical user interface:
  - which allows users to create their own games
  - capable of generating games in a general game playing format

Abstract Strategy Games

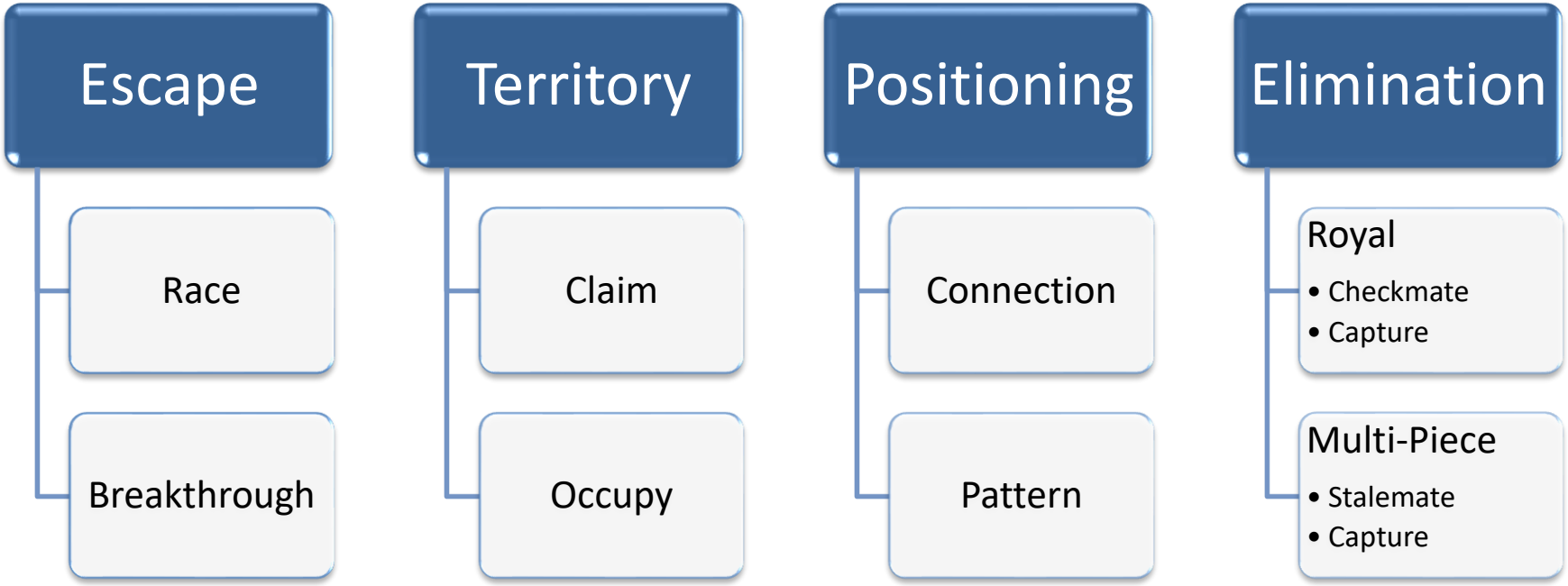
Perfect Information

Abstract Theme

Simple Mechanics

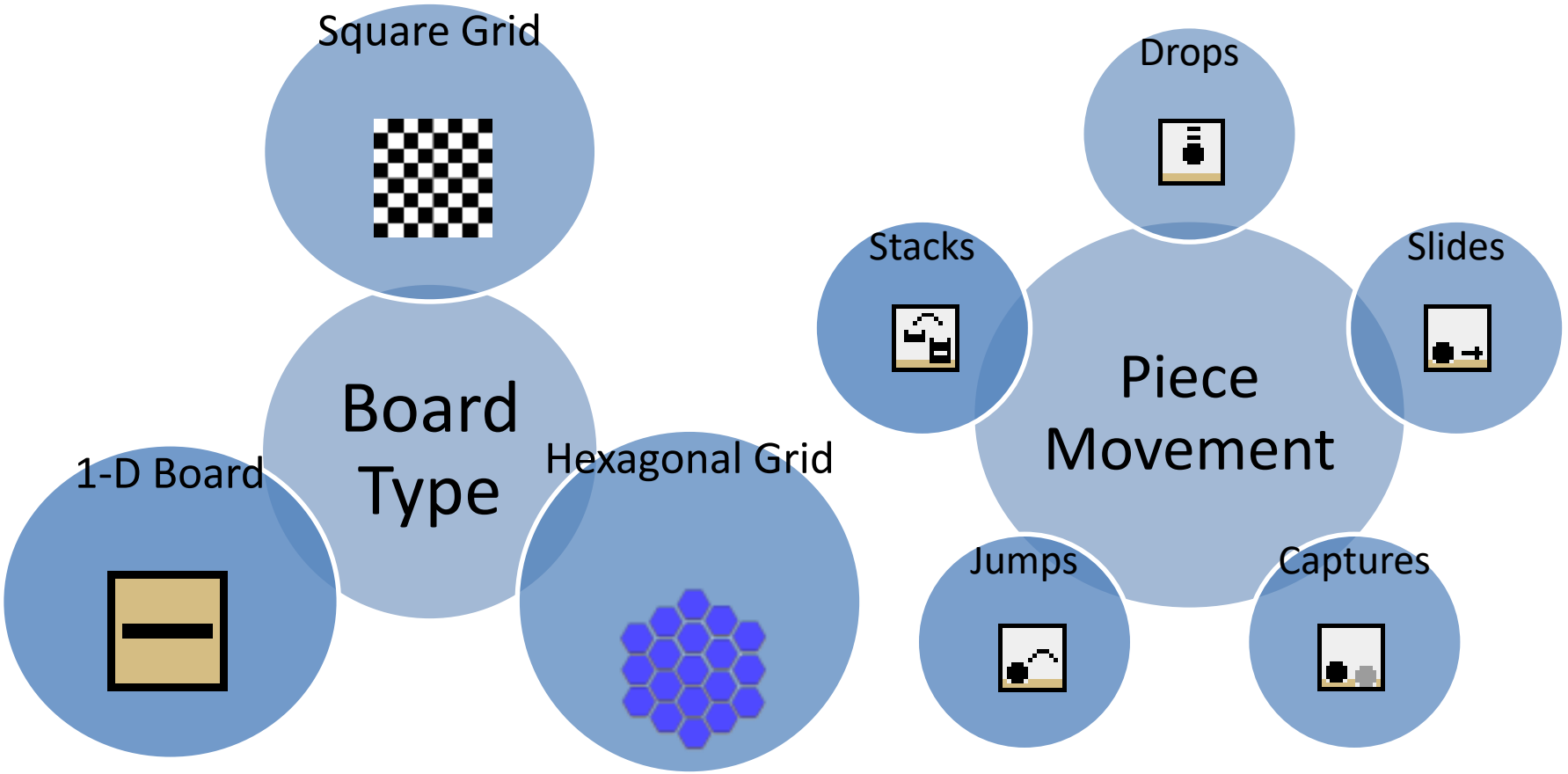
Tactics & Strategy

Goal-Oriented Classification



(IAGO, 2008)

Feature-Oriented Classification



(World of Abstract Games, 2010)

Artificial Intelligence Approaches

- Expert Systems
- Machine Learning
- Intelligent Search Algorithms
- Optimization Algorithms

Kasparov vs. Deep Blue *(1997)*

General Game Playing Systems

- The LUDÆ Project
  - Investigation project with learning AI agents focusing on abstract games
- Zillions of Game
  - Extensive board game collection
  - Powerful rule-analysing AI engine
  - Allows for the creation of new games by programming in the ZRF language

Zillions of Games
Zillions Development Corporation
(1998-2009)

Research Overview

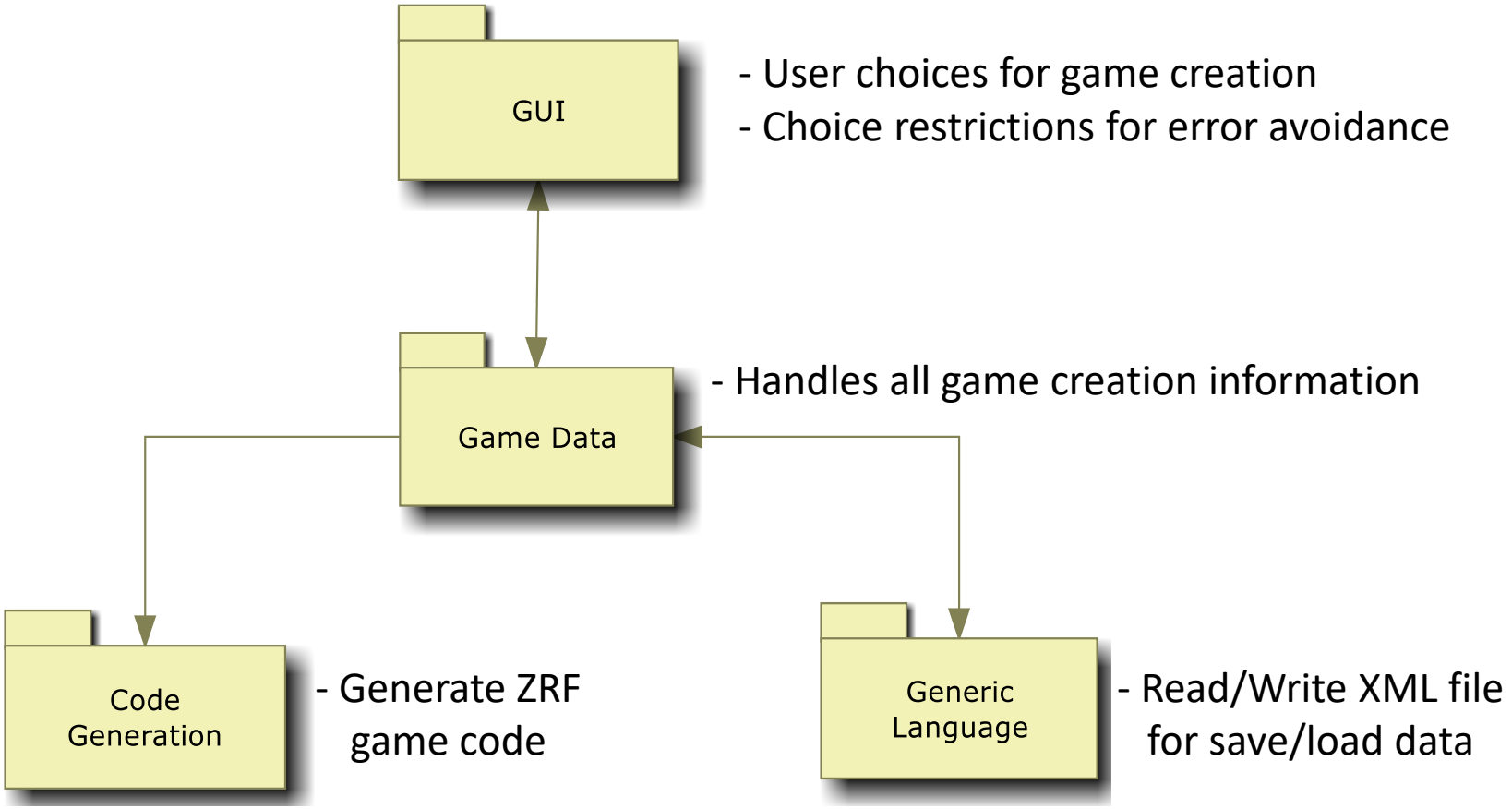
- There is **no easy way** to create Abstract Games
  - Programming required
  - Extensive game mechanics knowledge
- Different groups classify Abstract Games differently
- Zillions of Games is a good starting point:
  - ✓ versatility and rule analysing AI engine
  - ✗ programming language and static AI capabilities

Problem Statement

Is it possible to create abstract games by a set of user choices?

- How to translate game rules into option sets?
- To what degree can specificity be defined without sacrificing generalization?

System Architecture



Abstract Game Components

Board	Movements	Pieces	Goals	Rules
Dimensions	Type	Positions	Type	Turn Order
Regularity	Motion	Movements	End Game Result	Turn Passing
Directions	Effect	Attributes	Conditions	Game Specific Rules
Positions	Restrictions		Players Affected	
Zones				

Tic-Tac-Toe Components

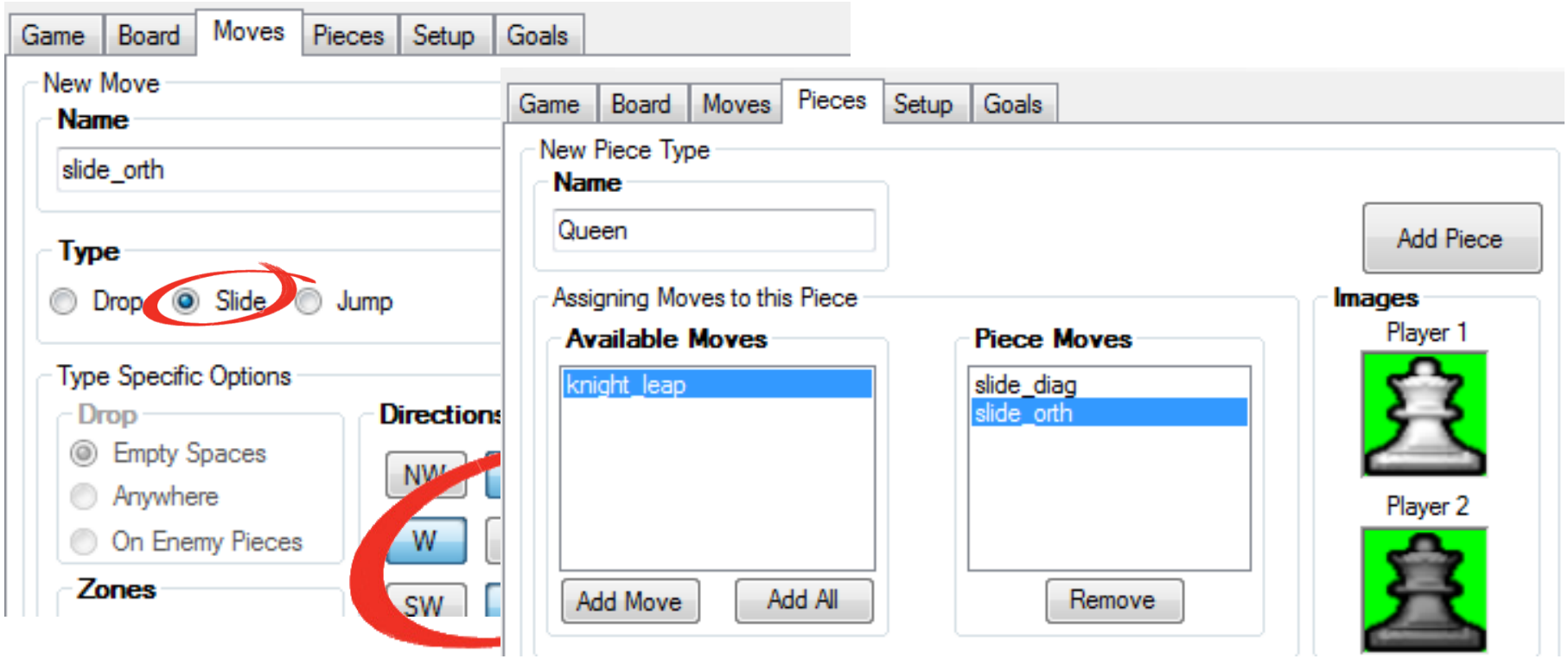
- **Board** — 3x3
- **Movements** — Pieces are dropped
- **Pieces** — X, O
- **Goals** — Pattern: a line of 3 pieces in any direction
- **Rules**

Chess Components

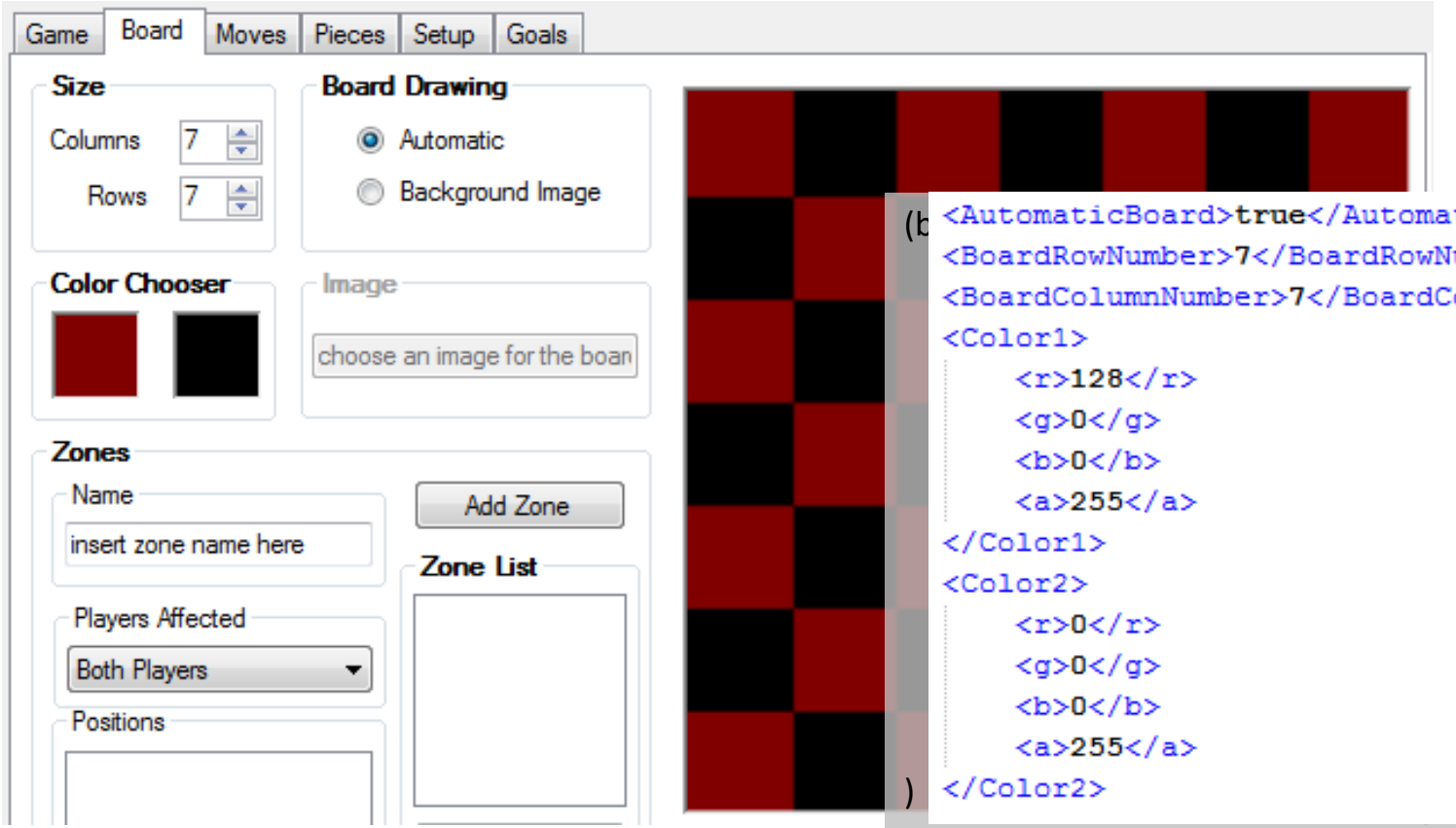
Board	Movements	Pieces	Goals	Rules
8x8 Zones: Promotion Pawn Move	Knight Leap Orthogonal Slide Diagonal Slide Pawn Capture Pawn 1st Move ...	Pawn King Queen Rook Knight Bishop	Checkmate: King	Pawn Promotion Castling En Passant

Creating Tic-Tac-Toe

Piece Creation Example



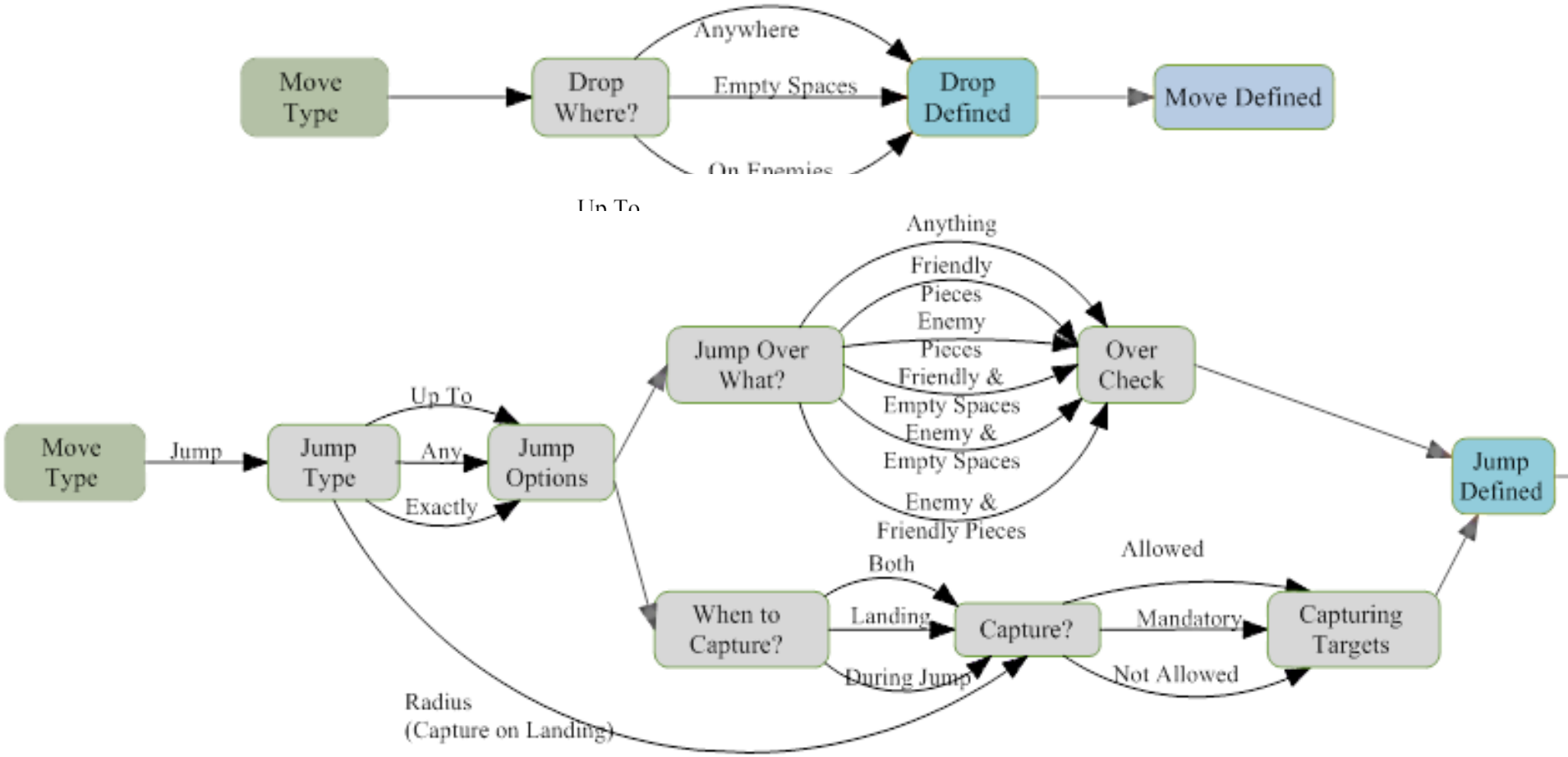
Board Creation Example



Generated XML Code

```
<AutomaticBoard>true</AutomaticBoard>
<BoardRowNumber>7</BoardRowNumber>
<BoardColumnNumber>7</BoardColumnNumber>
<Color1>
    <r>128</r>
    <g>0</g>
    <b>0</b>
    <a>255</a>
</Color1>
<Color2>
    <r>0</r>
    <g>0</g>
    <b>0</b>
    <a>255</a>
</Color2>
```

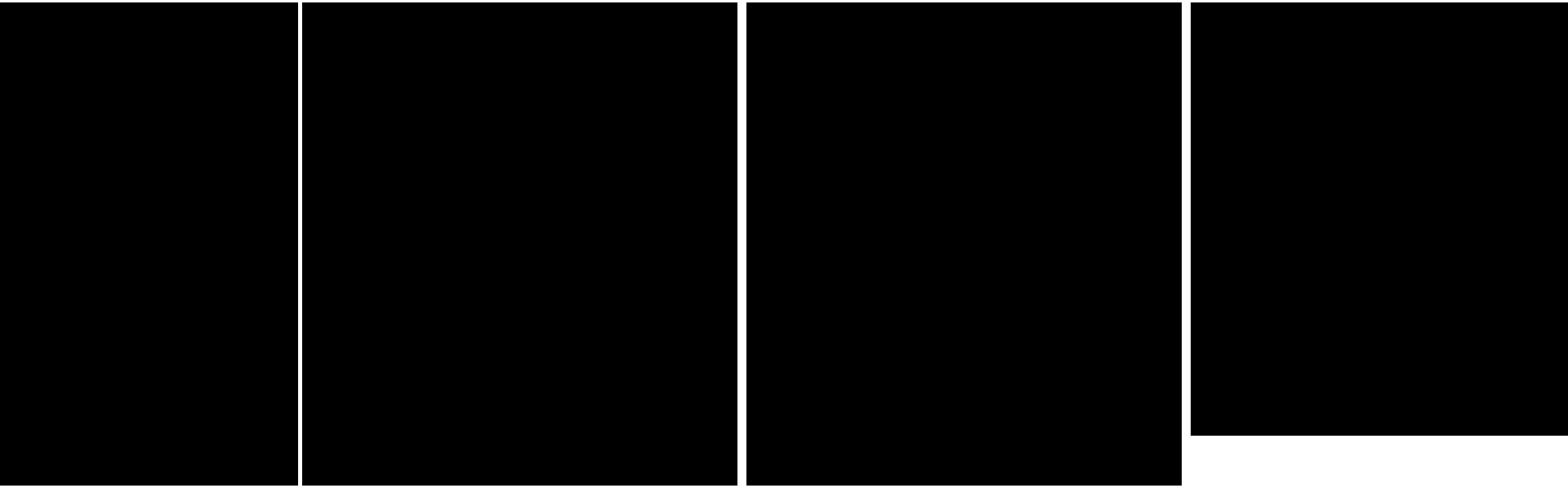
Movement Construction



Movement Permutations

	Type	Zones	Capturing	Direction	Method	Jump Over	Total
Drop	3	3	1	1	1	1	9
Slide	4	3	3	8	1	1	288
Jump	3	3	3	8	3	6	3888
Radius Jump	1	3	3	1	1	1	9
Total	11	12	10	18	6	9	**4194**

Examples of Created Games



Examples of Created Games

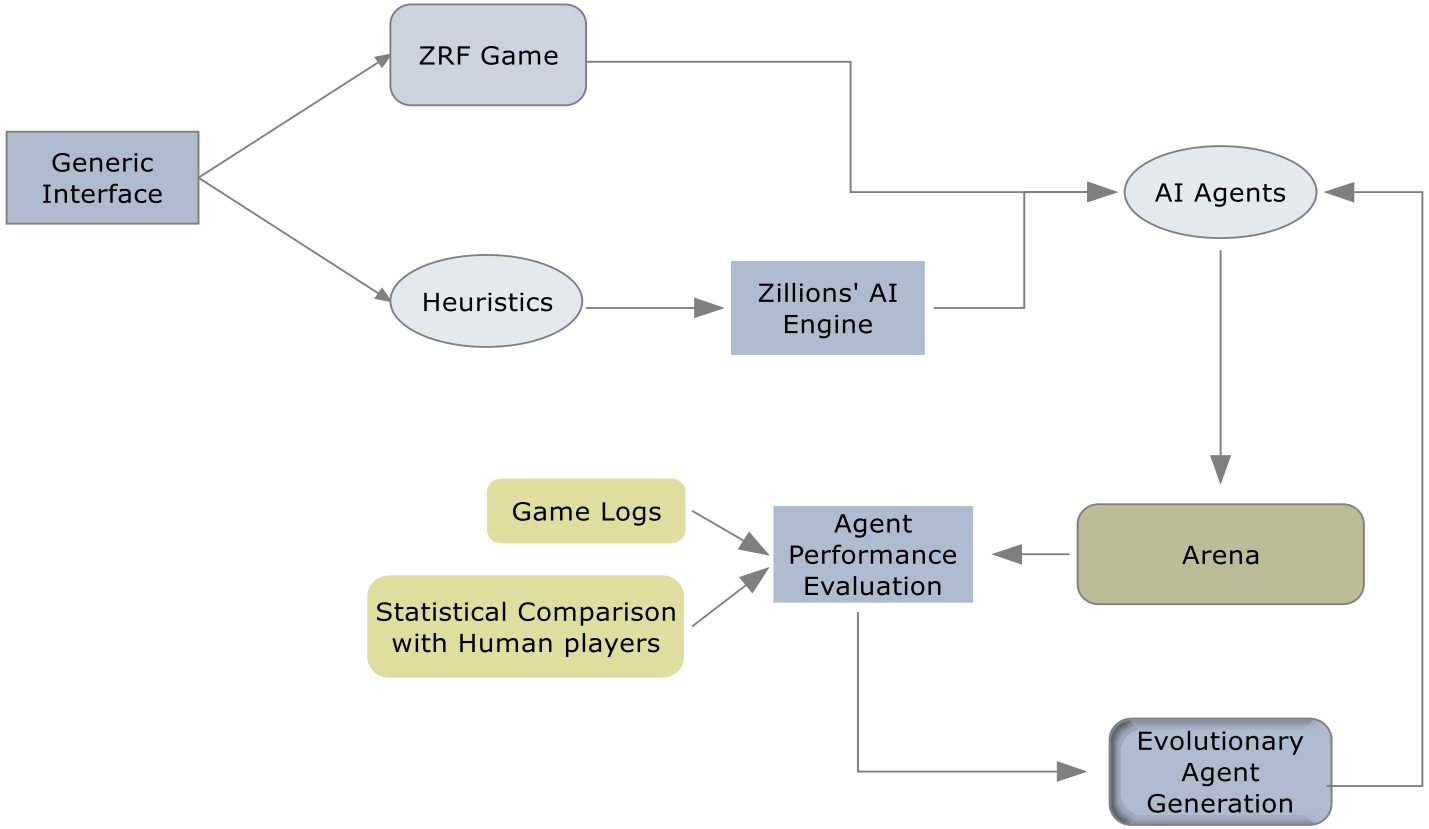
	Option No.	ZRF Code Metrics (LOC)	XML Code Metrics (LOC)	Creation Time (Min)
TicTacToe	7	45	83	1
Maze	6	64	151	3
Alquerque	9	56	112	3
Connect 4	12	78	170	4
Grand Chess	20	193	320	6

Conclusions

- This project presents an innovative application that allows the creation of some abstract strategy games:
  - Through a simple and intuitive graphical user interface
  - Without knowledge of programming skills
  - Allows for the rapid testing of new game concepts
  - Playable in the Zillions of Games platform

Future Work

- Develop a general game playing platform with AI capabilities



Publication

prisma.com

Questions?

Ivo Paz dos Reis

ivopazdosreis-thesis.weebly.com

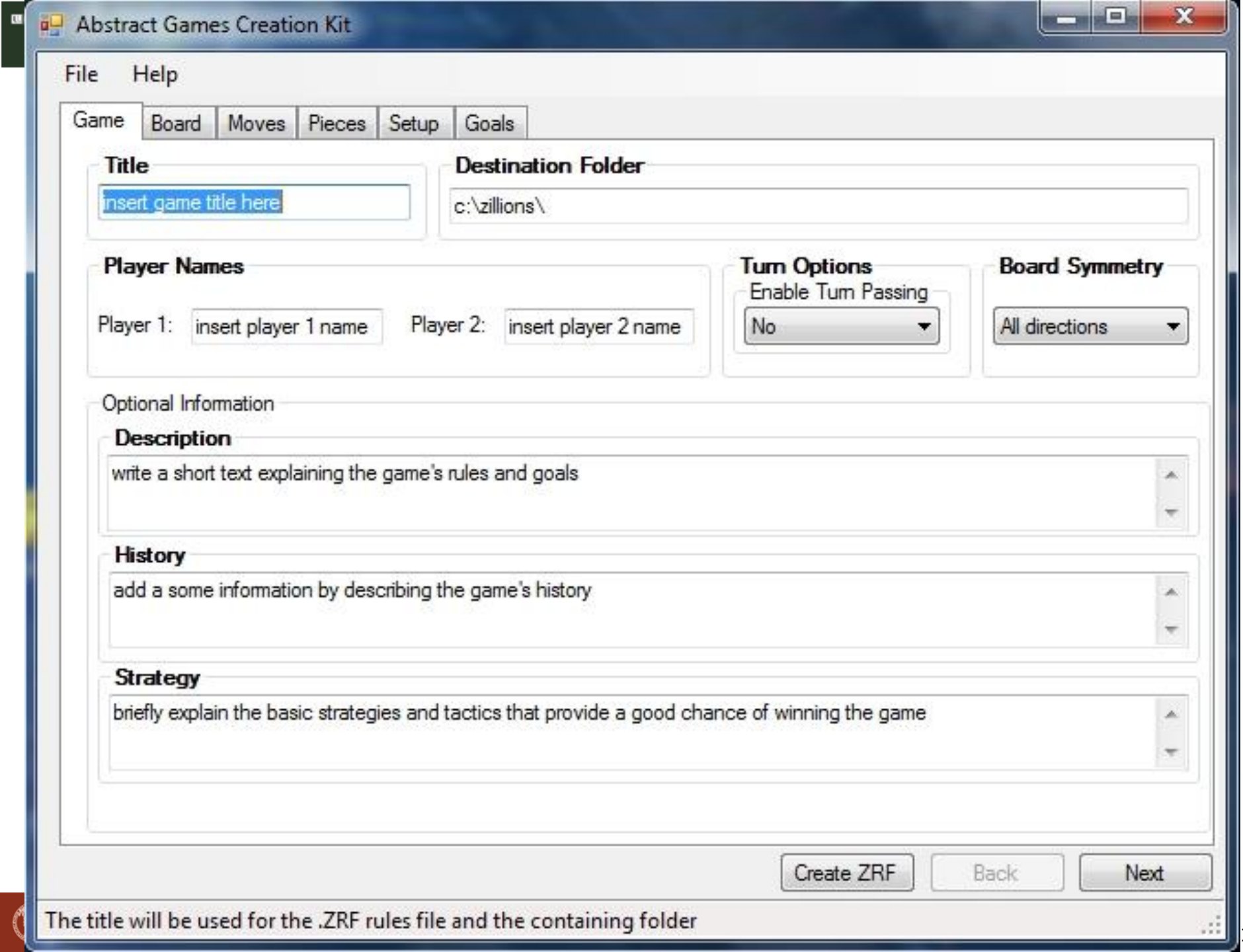
Referências

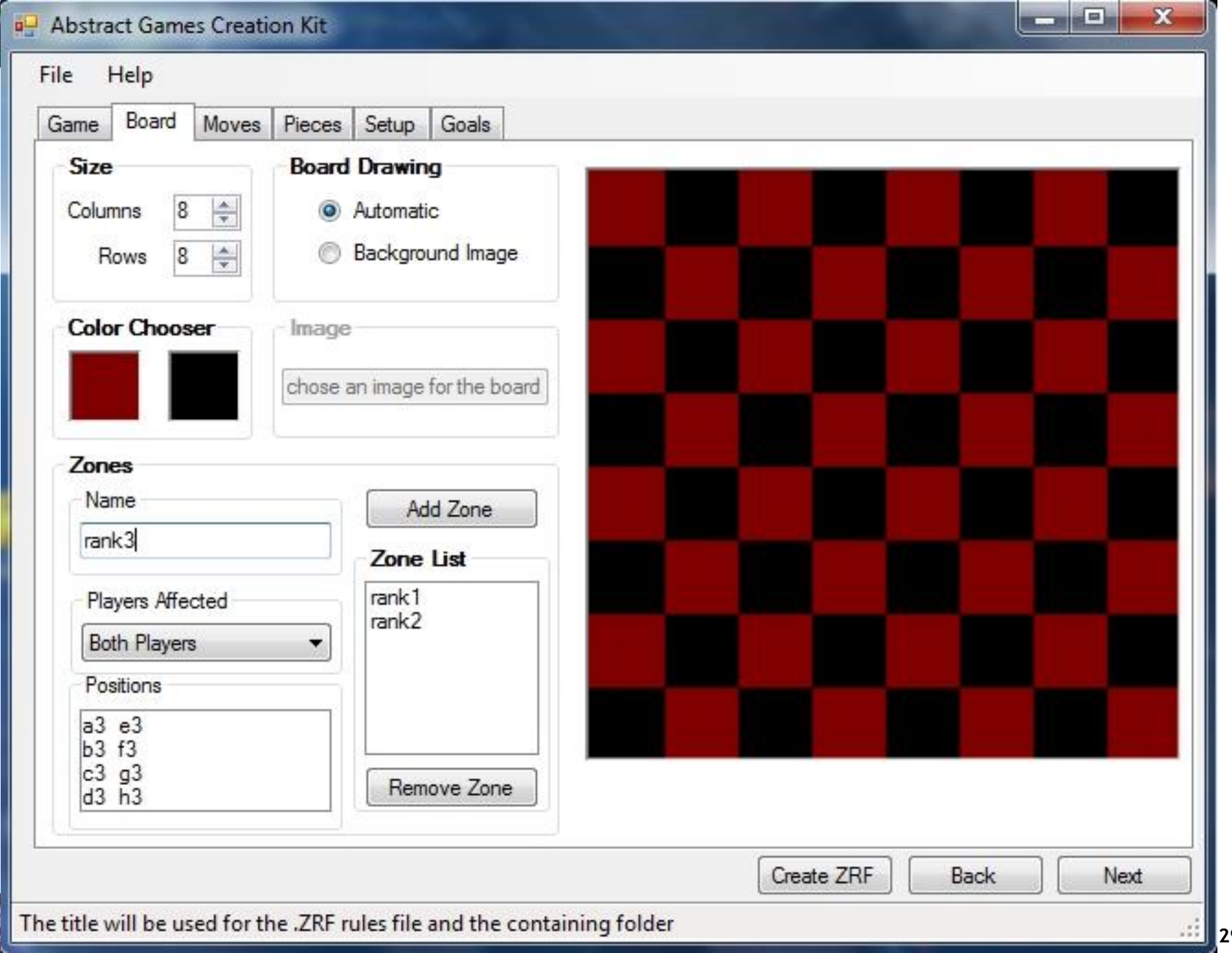
IAGO – International Board Games Organization (2010)
iagoweb.com

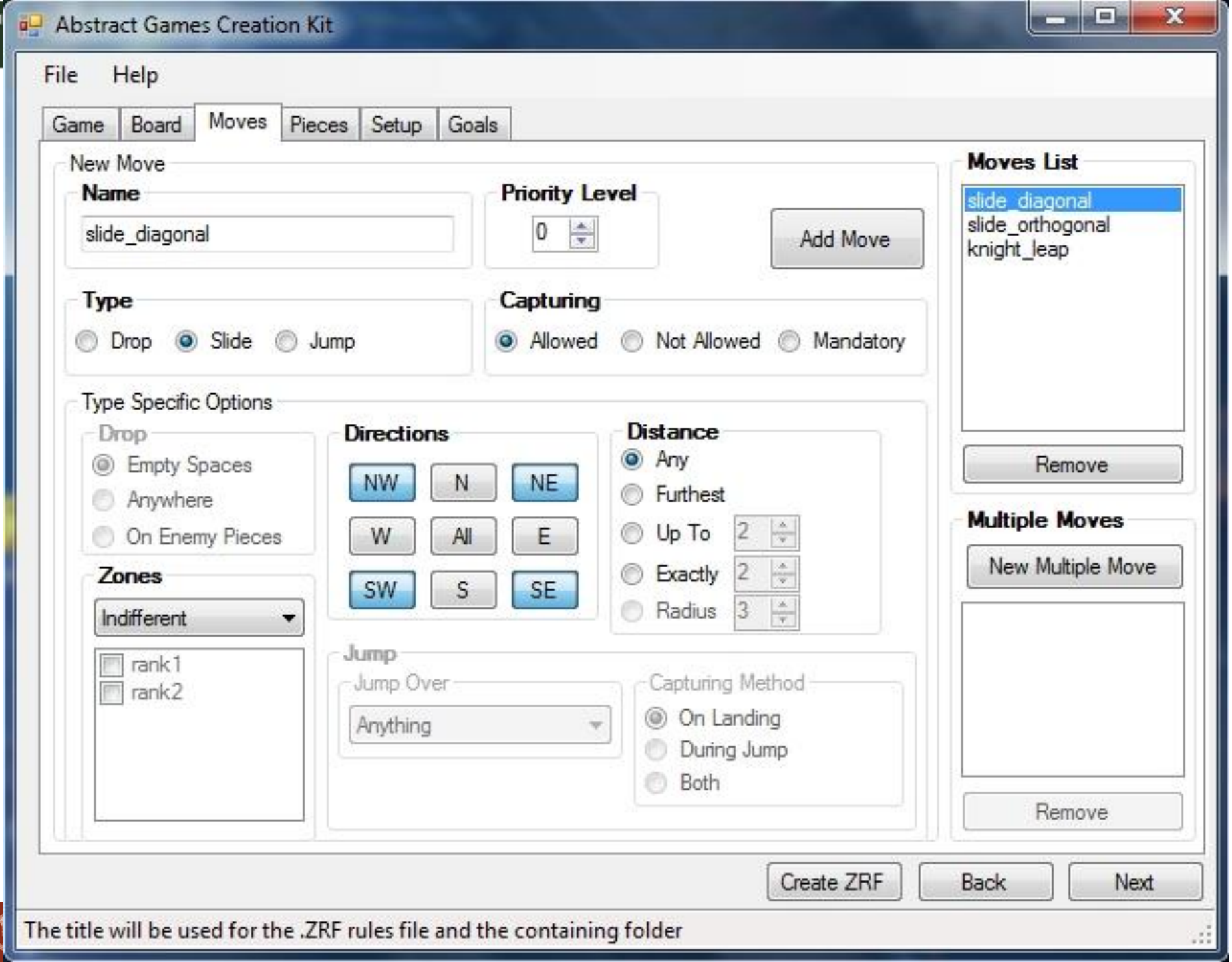
The LUDÆ Project (2003)
The World of Abstract Games (2011)

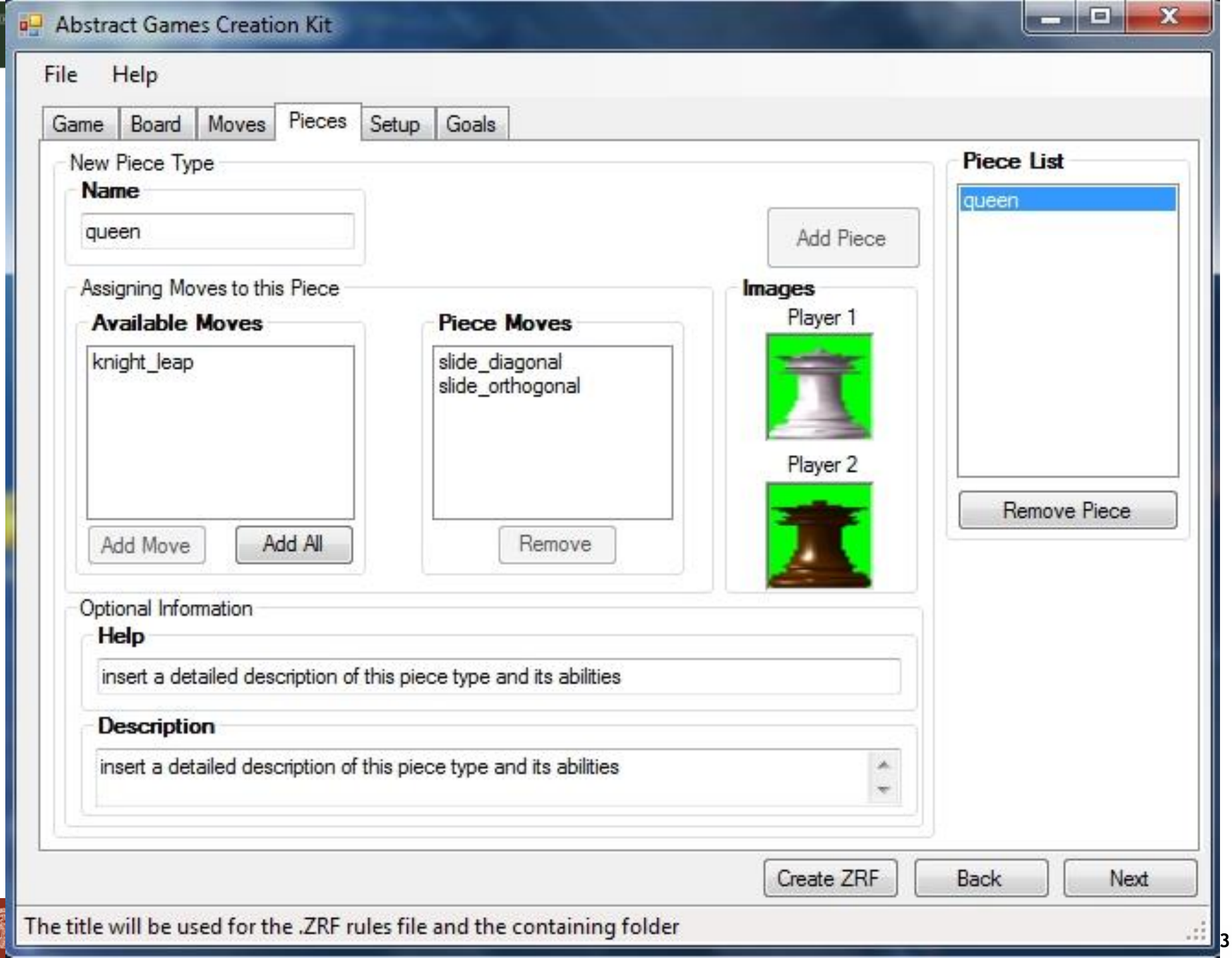
João Neto
Faculdade de Ciências
Universidade de Lisboa

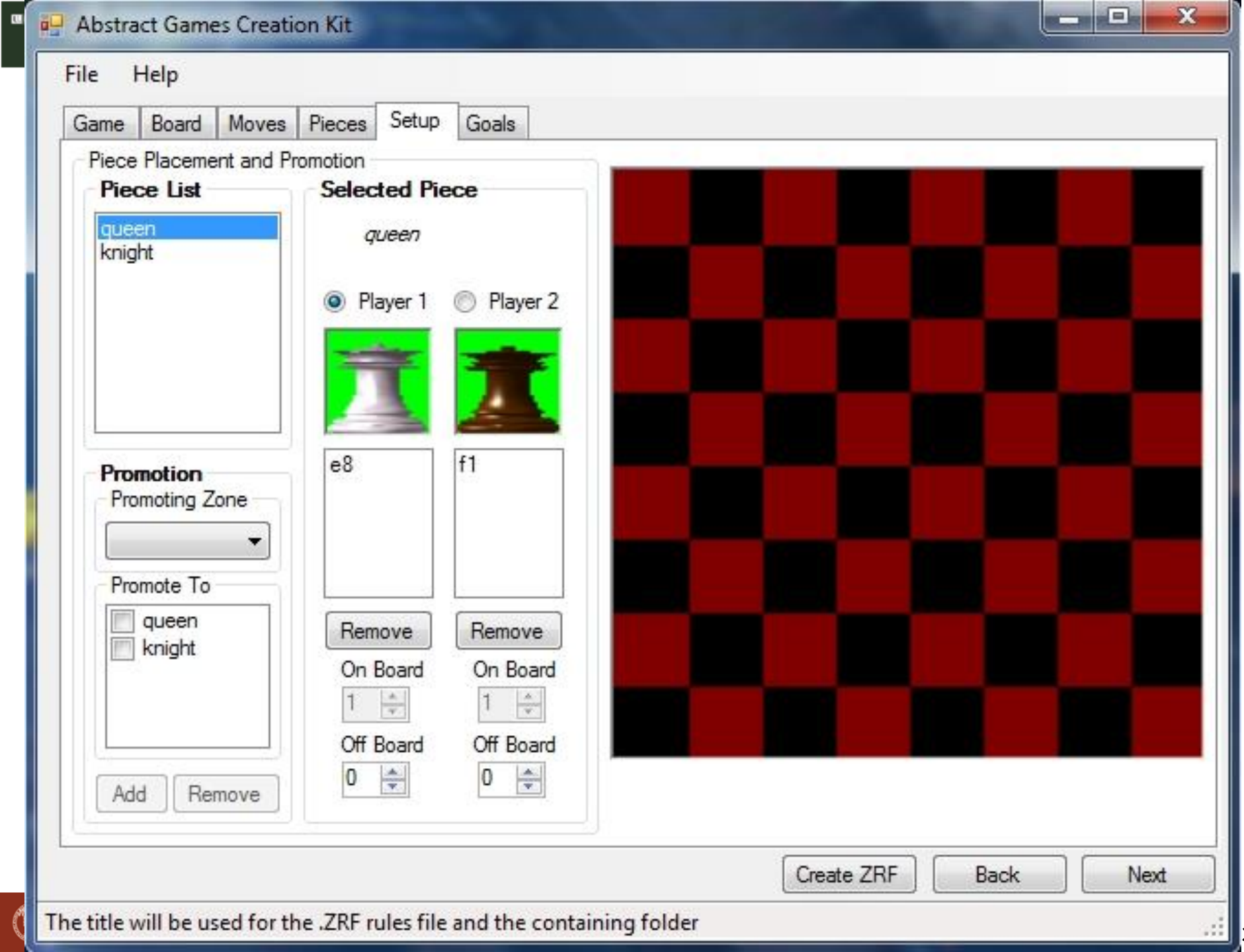
Zillions of Games
Zillions Development Corporation
(1998-2009)
www.zillionsofgames.com

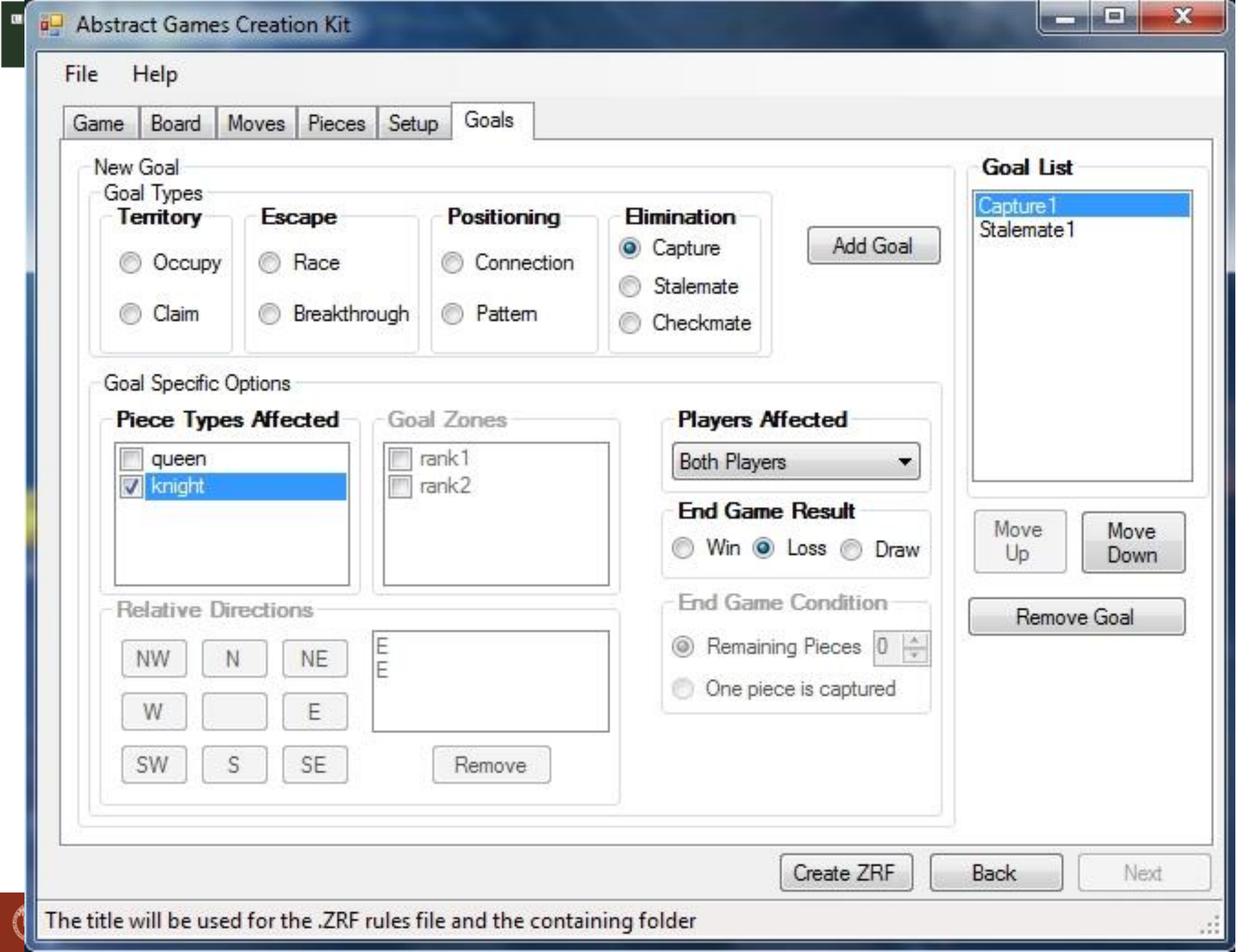

Abstract Games Creation Kit
File
Help
Game
Board
Moves
Pieces
Setup
Goals
Title
insert game title here
Destination Folder
c:\zillions\
Player Names
Player 1:
insert player 1 name
Player 2:
insert player 2 name
Turn Options
Enable Turn Passing
No
Board Symmetry
All directions
Optional Information
Description
write a short text explaining the game's rules and goals
History
add a some information by describing the game's history
Strategy
briefly explain the basic strategies and tactics that provide a good chance of winning the game
Create ZRF
Back
Next
The title will be used for the .ZRF rules file and the containing folder


Abstract Games Creation Kit
File
Help
Game
Board
Moves
Pieces
Setup
Goals
Size
Columns
8
Rows
8
Board Drawing
Automatic
Background Image
Color Chooser
Image
chose an image for the board
Zones
Name
rank3
Add Zone
Zone List
rank1
rank2
Players Affected
Both Players
Positions
a3 e3
b3 f3
c3 g3
d3 h3
Remove Zone
Create ZRF
Back
Next
The title will be used for the .ZRF rules file and the containing folder


Abstract Games Creation Kit
File
Help
Game
Board
Moves
Pieces
Setup
Goals
New Move
Name
slide_diagonal
Priority Level
0
Add Move
Moves List
slide_diagonal
slide_orthogonal
knight_leap
Remove
Type
Drop
Slide
Jump
Capturing
Allowed
Not Allowed
Mandatory
Type Specific Options
Drop
Empty Spaces
Anywhere
On Enemy Pieces
Directions
NW
N
NE
W
All
E
SW
S
SE
Distance
Any
Furthest
Up To
2
Exactly
2
Radius
3
Zones
Indifferent
rank1
rank2
Jump
Jump Over
Anything
Capturing Method
On Landing
During Jump
Both
Multiple Moves
New Multiple Move
Remove
Create ZRF
Back
Next
The title will be used for the .ZRF rules file and the containing folder


Abstract Games Creation Kit
File
Help
Game
Board
Moves
Pieces
Setup
Goals
New Piece Type
Name
queen
Add Piece
Assigning Moves to this Piece
Available Moves
knight_leap
Add Move
Add All
Piece Moves
slide_diagonal
slide_orthogonal
Remove
Images
Player 1
Player 2
Piece List
queen
Remove Piece
Optional Information
Help
insert a detailed description of this piece type and its abilities
Description
insert a detailed description of this piece type and its abilities
Create ZRF
Back
Next
The title will be used for the .ZRF rules file and the containing folder


Abstract Games Creation Kit
File
Help
Game
Board
Moves
Pieces
Setup
Goals
Piece Placement and Promotion
Piece List
queen
knight
Selected Piece
queen
Player 1
Player 2
e8
f1
Promotion
Promoting Zone
Promote To
queen
knight
Add
Remove
Remove
Remove
On Board
On Board
1
1
Off Board
Off Board
0
0
Create ZRF
Back
Next
The title will be used for the .ZRF rules file and the containing folder


Abstract Games Creation Kit
File
Help
Game
Board
Moves
Pieces
Setup
Goals
New Goal
Goal Types
Territory
Occupy
Claim
Escape
Race
Breakthrough
Positioning
Connection
Pattern
Elimination
Capture
Stalemate
Checkmate
Add Goal
Goal List
Capture1
Stalemate1
Goal Specific Options
Piece Types Affected
queen
knight
Goal Zones
rank1
rank2
Players Affected
Both Players
End Game Result
Win
Loss
Draw
Move Up
Move Down
Remove Goal
Relative Directions
NW
N
NE
W
E
SW
S
SE
E
E
Remove
End Game Condition
Remaining Pieces
0
One piece is captured
Create ZRF
Back
Next
The title will be used for the .ZRF rules file and the containing folder