



Modeling Chess with UML

Model the given excerpt from the official FIDE chess specification using UML. The excerpt comprises the first five articles of the international tournament laws of chess. The aim of the model is the development of a chess program, that is able to play against human players and other chess programs.

The text is almost unaltered; we only simplified the language of a few sentences. To restrict the effort for this exercise, we excluded the articles 6 to 14 of the specification. Your task is to model exactly what is in the specification, and not to model what you (think you) know by heart: The goal of this exercise is a most precise translation of the specification into a UML model. Remember to add multiplicities, role and association names, attributes, methods, states, transitions, guards and so on. But keep in mind the aim of the model: Some of the regulations might not apply for the given scenario (chess program) and you may omit them in your model. **If you do omit certain regulations, you have to document your decision in order to score.**

You may use class, activity, sequence, and state transition diagrams, as well as OCL expressions. Expect at least six to eight pages of diagrams for your solution – you cannot expect to obtain full score for only a class model of five classes with three methods each!

Article 1: The nature and objectives of the game of chess

1.1.

The game of chess is played between two opponents. They alternately move their pieces on a square board called a chessboard. The player with the white pieces commences the game. A player has the move, after his opponent made his move.

1.2.

The objective of each player is to place the opponent's king under attack in such a way that the opponent has no legal move. The player who achieves this goal has checkmated the opponent's king and wins the game. Leaving one's own king under attack, exposing one's own king to attack and also capturing the opponent's king are not allowed. The opponent whose king has been checkmated has lost the game.

1.3.

If the position is such that neither player can possibly checkmate, the game is drawn.

Article 2: The initial position of the pieces on the chessboard

2.1.

The chessboard is composed of an 8x8 grid which is composed of 64 equal squares which are alternately light and dark. The chessboard is placed between the players in such a way that the near corner square to the right of the player is white.

2.2.

At the beginning of the game one player has 16 white pieces; the other has 16 black pieces. These pieces are as follows: A white king, a white queen, two white rooks, two white bishops, two white knights, eight white pawns, a black king, a black queen, two black rooks, two black bishops, two black knights and eight black pawns.

2.3.

The initial position of the pieces on the chessboard is as follows: - discarded -

2.4.

The eight vertical columns of squares are called files. The eight horizontal rows of squares are called ranks. A straight line of squares of the same color, touching corner to corner, is called a diagonal.

Article 3: The moves of the pieces

3.1

A piece may not move to a square which is occupied by a piece of the same color. If a piece moves to a square occupied by an opponent's piece, the opponent's piece is captured and removed from the chessboard as part of the same move. A piece attacks an opponent's piece if the piece could make a capture on that square. A piece attacks a square, even if this piece cannot move to that square because it would then leave or place the king of its own color under attack.

3.2.

The bishop may move to any square along a diagonal on which it stands.

3.3.

The rook may move to any square along the file or the rank on which it stands.

3.4.

The queen may move to any square along the file, the rank or a diagonal on which it stands.

3.5.

When making these moves the bishop, rook or queen may not move over any intervening pieces.

3.6.

The knight may move to one of the squares nearest to that on which it stands but not on the same rank, file or diagonal.

3.7.

- a) The pawn may move forward to the unoccupied square immediately in front of it on the same file, or
- b) on its first move the pawn may move one or two squares forward along the same file provided both squares are unoccupied, or
- c) the pawn may move to a square occupied by an opponent's piece, which is diagonally in front of it on an adjacent file, capturing that piece.
- d) A pawn attacking a square crossed by an opponent's pawn which has moved two squares forward in one move from its original square may capture this opponent's pawn in the following move as though the latter had been moved only one square. This capture is called an "en passant" capture.

When a pawn reaches the rank furthest from its original square it must be exchanged as part of the same move for a new queen, rook, bishop or knight of the same color. The player's choice is not restricted to pieces that have been captured previously. This exchange of a pawn for another piece is called promotion and the effect of the new piece is immediate.

3.8.

The king may move to any adjoining square if this square is not attacked by one or more pieces of the opponent. Alternately, the king may castle: This is a move of the king and either rook of the same color on the same rank, counting as a single move of the king and executed as follows: The king is transferred from its original square two squares towards the rook, then that rook is transferred to the square the king has just crossed.

3.8.1

If the king has moved, he may not castle. The king may not castle with a rook that has moved.

3.8.2

If the square on which the king stands, or the square which it must cross, or the square which it is to occupy, is attacked by one or more of the opponent's pieces, the king may not castle. If there is any piece between the king and the rook with which castling is to be effected, the king may not castle.

3.9.

The king is said to be "in check" if it is attacked by one or more of the opponent's pieces, even if such pieces are constrained from moving to that square because they would then leave or place their own

king in check. No piece can be moved that will expose the king of the same color to check. No piece can be moved that will leave the king of the same color in check.

Article 4: The act of moving the pieces

4.1.

Each move must be made with one hand only.

4.2.

Provided that he first expresses his intention, the player having the move may adjust one or more pieces on their squares.

4.3.

Provided that he not expresses his intention to adjust, if the player having the move deliberately touches on the chessboard one or more pieces of his own, he must move the first touched piece that can be moved. Provided that he not expresses his intention to adjust, if the player having the move deliberately touches on the chessboard one or more pieces of his opponent's, he must capture the first touched piece, which can be captured. Provided that he not expresses his intention to adjust, if the player having the move deliberately touches on the chessboard one piece of each color, he must capture the opponent's piece with his piece. Provided that he not expresses his intention to adjust, if the player having the move deliberately touches on the chessboard one piece of each color, and if he may not capture the opponent's piece with his piece, he must move the first touched piece which can be moved or capture the first touched piece that can be captured. If it is unclear, whether the player's own piece or his opponent's was touched first, the player's own piece shall be considered to have been touched before his opponent's.

4.4.

- a) If a player deliberately touches his king and his rook he must castle with this rook if it is legal to do so.
- b) If a player deliberately touches a rook and then deliberately touches his king he may not castle on that side on that move. If a player deliberately touches a rook and then his king, he must move with the first piece touched that can be moved.
- c) If a player intends to castle and the player touches the king or the king and a rook at the same time and castling on that side is illegal, the player must make another legal move with his king which may include castling on the other side. If a player intends to castle and the player touches the king or the king and a rook at the same time and castling on that side is illegal and the king has no legal move, the player may make any legal move.
- d) If a player promotes a pawn and the piece has touched the square of promotion, the choice of the piece is finalized.

4.5.

If the player cannot move any of the touched pieces of his own and if the player cannot capture any of the touched pieces of his opponent's, the player may make any legal move.

4.6.

When, as a part of a legal move, a piece has been released on a square, it cannot then be moved to another square.

- a) If a piece is captured and the captured piece has been removed from the chessboard and the player, having placed his own piece on its new square, has released this capturing piece from his hand, the move has been made.
- b) If the player castles and the player's hand has released the rook on the square previously crossed by the king, the move has been made. If the player castles and the player has released the king from his hand, the move is not yet made, but the player no longer has the right to make any move other than castling on that side, if this is legal.
- c) If a player promotes a pawn, the pawn has been removed from the chessboard, and the player's hand has released the new piece after placing it on the promotion square, the move has been made. If a player promotes a pawn and the player has released from his hand the pawn that has reached the promotion square, the move is not yet made and the player may not play the pawn to another square.

4.7.

A player forfeits his right to a claim against his opponent's violation of Article 4.3 or 4.4, once he deliberately touches a piece.

Article 5: The completion of the game

5.1.

- a) If a player checkmates his opponent's king, he wins the game. If a player checkmates his opponent's king and the move was legal, the game immediately ends.
- b) If a player resigns, his opponent wins the game. If a player resigns, the game immediately ends.

5.2.

- a) If the player having the move cannot make a move and his king is not in check, the game is drawn. If the player having the move cannot make a move and his king is not in check, he game is said to end in stalemate. If the player having the move cannot make a move and his king is not in check and the move producing the stalemate position was legal, the game immediately ends.
- b) If neither player can checkmate the opponent's king with any series of legal moves, the game is drawn. If neither player can checkmate the opponent's king with any series of legal moves and the move producing the position was legal, the game immediately ends.
- c) If the players agree to drawing the game, the game is drawn. If the game is drawn, the game immediately ends.
- d) If any identical position is about to appear on the chessboard at least three times or any identical position has appeared on the chessboard at least three times, the game may be drawn.
- e) The game may be drawn if each player has made at least the last 50 consecutive moves without the movement of any pawn and without any capture.