

COMP 3004

Assignment 1

Team 11

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Functional Requirements

ID	Description	Traceability
FR01	There must be a main menu which will display the four potential players each with 3 available options: User, AI, or Off. There must also be an option to choose between professional and non-professional rules at this menu. There will also be a start button to launch the game.	There are 2 different rule sets from the Lotus rules, so we are giving the user the option between choosing to play one of these 2 rule sets and the number/type of players. The most logical place for this is a main menu.
FR02	The Ravensburg dragon must be correctly displayed.	The actual board game displays the dragon, so this game application should replicate that.
FR03	Each space on the game board must correctly display its symbol, including the spring board space.	Each space on the game board has a symbol, so it should be replicated in this game application.
FR04	The game must correctly display stacks in terms of height and color.	It is very important to know what color of each piece in a stack, and the number of pieces in a stack, so we must display this accordingly.
FR05	In a two player game, each player starts with 10 pieces divided into stacks of 4, 3, 2, and 1 respectively. These must use the black and white colors.	In the actual game, only the black and white colors have 10 pieces, so it makes sense that in a 2 player game each player must be black or white. Stack sizes are based on the rules
FR06	In a 3 or 4 player game, each player starts with 6 pieces divided into stacks of 3, 2 and 1 respectively.	Based on the rules, these are the required stack size for 3-4 players.
FR07	On each turn, the game must display which player is currently moving by highlighting the corner pertinent to that player (see AS03).	With multiple players, it can get complicated to remember whose turn it currently is. To rectify this, the game will display it for you!
FR08	When moving a piece onto the board from its start position, either of the two start paths can be chosen to move onto.	Based on the Lotus rules, this is allowed.
FR09	When a user is making their move, clicking on a valid stack (anywhere on the stack itself) will highlight the top piece of that stack as well as the destination space (or spaces if they are about to move the piece onto the board) which the top piece would reach if moved. Clicking the stack again will deselect it. Clicking the highlighted destination space will confirm the move and make the action.	Because each stack only has a limited (1 or 2) amount of destinations to travel to, we want to simplify moving pieces. This is to make the game interface less confusing

FR10	When a user is selecting a stack from which to move the top piece, the stack can only be selected if it is a valid move for that user to move the top piece.	A player isn't allowed to move other players pieces (except under no possible moves) so they aren't allowed to select any invalid stacks
FR11	Under the professional rule set with two players, the player to make the first move has the choice to move one piece and then move another.	The Lotus rules state this option can be made under 2 player professional rule set.
FR12	On each turn a player must make exactly one move unless either adhering to the 2 player professional starting rule or skipping a turn due to having no available moves.	This is simply from the Lotus rules, a person can only make 1 move per turn with the one mentioned exception.
FR13	On each move a piece must only be able to move forward in the number of spaces equivalent to the height of the stack (no more, no less and no moving backwards).	Basic Lotus rules
FR14	Under regular rules, when a player has no possible moves, they have the choice to skip their turn or to make a single play as any other player would be able to.	Under the “No Possible Moves” section of the Lotus rules
FR15	Under professional rules when a player has no possible moves they must skip their turn.	Under the “Professional Rules” section of the Lotus rules
FR16	When a piece lands on the spring board it automatically advances another number of spaces equivalent to the number that was just traveled in that turn to reach the spring board.	Under the “Trampoline Square” section of the Lotus rules, basic functionality of this space.
FR17	There is no limit to stack heights.	Basic Lotus rules
FR18	The game must have at least 2 players and at most 4 players, any number of these can be AI or human.	Under “Before You Begin” of the Lotus rules, basic functionality
FR19	There are no restrictions to a destination. It may be an empty space, on top of another piece of any color or off the game board if the player passes the finish space.	Basic Lotus rules regarding movement, and under the “Finish” section states such rules.
FR20	Once a piece moves past the final space, it is considered off the board. There is no need for an exact number of movements to get off the board.	Under the “Finish” section of the Lotus rules
FR21	The game must end once a player gets all their pieces past the finish point, and then give the option to continue playing if there are two or more players remaining.	Under the “End of the Game” section of the Lotus rules

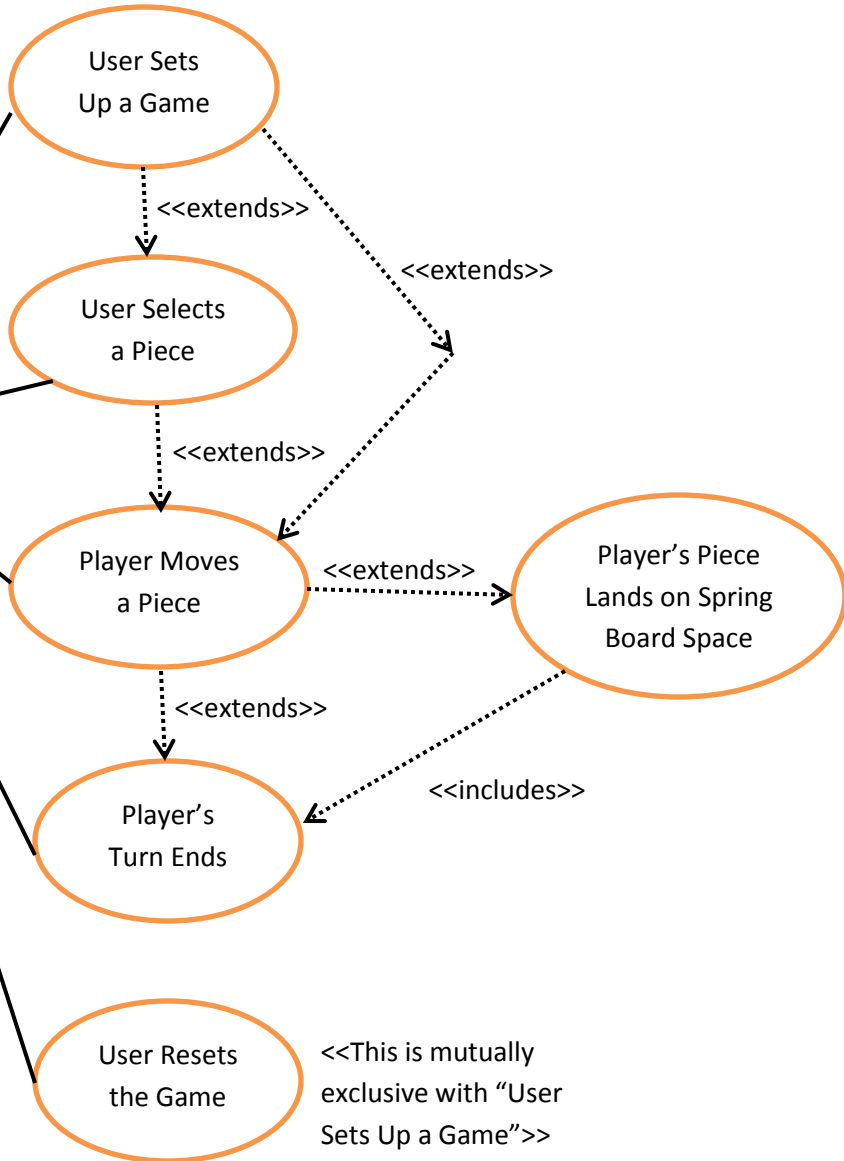
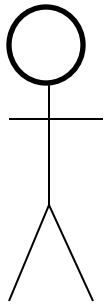
Non-Functional Requirements

ID	Description	Traceability
NFR01	The game should not exceed the usage of 1GB of memory.	Reasonable application usage, so it isn't a memory hog.
NFR02	The game should not crash.	Reasonable restriction so the game actually runs properly
NFR03	The game can support 2-4 players any number of which can be human or AI. This means that a game of all AI is allowed.	“Before you Begin” section of the Lotus rules states 2-4 players. Because this game can involve AI, having 4 AI play against each other should be reasonable
NFR04	There must be two rule sets to dictate game play (professional and non-professional) that can be applied depending on the which is chosen by the user.	Under the “Professional Rules” section of the Lotus rules because 2 different rule sets are allowed.
NFR05	The game must be able to distinguish between 2 player, 3 player or 4 player scenarios.	Basic functionality of the game, the game plays differently with 2, 3, or 4 players.
NFR06	The game must be able to distinguish between professional and non-professional rules scenarios.	Basic functionality of the game, the game plays differently depending on the rule set.
NFR07	The game must maintain stack height in order to calculate the destination space of any given move.	Basic functionality of the game, a piece will move a different amount of space depending on it's stack height.
NFR08	Each piece has a “movable” attribute to represent if it can be moved by the current player at that time. This will be used for both regular turns as well as for the professional two player starting rule and for instances when a player may move another players pieces.	This is so no illegal moves are allowed within the game, based on the Lotus rules.
NFR09	The game must recognize when the very first move is being made.	The first move may be done differently, based on the rule sets from the Lotus rules. (2 player professional rules)
NFR10	When the user makes a move, the game must respond instantly (less than 1 second) and do the appropriate computations and animations.	Reasonable restriction of the game, so the user does not lose interest from excess time elapse
NFR11	On the turn of the AI, it must look at it each move available to it, weigh the benefits vs the drawbacks of making that move in some way as to assign an integer value of usefulness with that move and then select the one with the highest value and make that move.	This is to make a reasonably challenging AI, that makes moves for a reason and not just randomly.

NFR12	The game must recognize when a player has no available moves.	A player is given different options from the “No Possible Moves” section of the Lotus rules, so the game needs to recognize this.
NFR13	When a player is allowed to make a move using any player's pieces, the game must give them permission to select and move any top piece of any stack (under non-professional rules).	When a player has no possible moves, the valid moves change, so the game must work with this properly.
NFR14	Each space will be an object which maintains attributes regarding that space and the stack on it.	This is to keep track of each players' pieces, and a stack's movement
NFR15	The spring board piece must have an attribute to distinguish it as such. When a piece lands on a space, that space will be checked for whether it is the spring board piece and appropriate action will be taken.	The spring board piece acts differently based on the “Trampoline Square” section of the Lotus rules, so the game must work with this properly.
NFR16	Each stack must have an appropriate area calculated which will form the click box over that stack so that when clicking a stack to view their potential move, the user can click anywhere on the stack. This will be calculated with regard to the height of the stack.	To simplify clicking on the correct piece, it is reasonable that the whole stack the piece is resting on can be selected, since only the 1 piece is movable.
NFR17	Each time a move is made, all appropriate object attributes must be updated.	Basic game functionality, attributes such as stack height must be constantly kept track of.
NFR18	Certain game attributes will be set based off of menu items selected.	# of players and which rule set changes how the game is played.
NFR19	When the restart button is clicked, all attributes are reset (see AS09).	A reset button is reasonable so a player can easily start a new game.
NFR20	The game will have an attribute to represent the player who is currently moving.	With multiple players, it can get complicated to remember whose turn it is, so the game keeps track
NFR21	The game will be designed for Windows based PCs.	All of our group member use Windows based PCs, so its much easier to work with
NFR22	The game will be written in C++ and OpenGL.	This is how the legacy code is written, so it's easier to work with
NFR23	Traceability must be tracked.	This makes going back and changing things in the code or documentation easier
NFR24	Delivery date will be specified by the assignment 3 due date.	We have to adhere to due dates!

Assumptions

ID	Description	Motivation
AS01	We have made the assumption that when landing on the spring board, the piece must be advanced as the spring board bounce dictates.	Though this is likely a set rule, we are listing under assumptions as the rules provided explain the bounce using the word “can” making it seem as though the user has a choice to simply sit on the spring board.
AS02	Unless the player has no valid moves, they must make a move.	This is not stated explicitly but given that it is only stated that a player may skip a turn when they have no valid moves, we assume that on a normal turn they have no choice but to move.
AS03	Each corner of the board will be given a color (from white, black, red and blue) to represent the player using that color.	This is done to help visualize the concept of clockwise rotation for turns.
AS04	When starting the game, the first player will be randomly selected. Subsequent turns will be made in a clockwise rotation.	Some mechanism to determine the first player was required so we chose to do it in this fashion.
AS05	Graphically, the game will be displayed in a 2D format made to look as though you are looking downwards at an angle onto the board.	This is done so as to be able to see all pieces in a stack.
AS06	The game must be drawn in colour.	This is done so that players can distinguish which piece belongs to which player.
AS07	The image of the dragon/board provided from the course web page should be rendered underneath all other graphical representations to act as the game board.	This is done to facilitate the graphical setup.
AS08	The game must check upon each move made for a condition to represent that the game has ended. If two or more players remain, it must be able to continue for the remaining players if desired.	Assumption made in order to allow for the players to choose whether the game should end after the first player finishes or wait until only one player remains.
AS09	We will choose to add in a restart button which returns to the main menu and scraps the current game.	This is to give to extra functionality to the game and to facilitate testing.



UC-1	User Sets Up a Game	Traceability
Description	Upon starting the program the player is given the options of how the game is to be played, this consists of setting the rules, whether additional players should be added to the game, and whether those players are human or AI.	
Actors	User, System	
Triggering Event	User launches the game, or chooses to play again after a game is finished or the game has reset	
Pre-Condition	A game is not being played, or a game has just ended.	
Main Sequence	<ol style="list-style-type: none"> 1) Optionally, user selects either Regular or Professional rule set. 2) Optionally, user selects whether Player 1 is Human or AI. 3) Optionally, user selects whether Player 2 is Human or AI. 4) Optionally, user selects whether Player 3 is Human, AI, or not playing. 5) Optionally, user selects whether Player 4 is Human, AI, or not playing. 6) Steps 1 to 5 can be repeated 0 or more times. 7) User starts the game. 8) A player is randomly selected to go first and their turn starts. 	FR-1 FR-18 NFR-3 NFR-4 AS-4
Resulting Event	The game is now ready to play	UC-2 or UC-3
Post-Condition	The game starts	UC-2 or UC-3
Alternative Scenario		
Comments	<p>Player 1 is defaulted as Human, player 2 is defaulted as AI, and player 3 and 4 are defaulted off. Regular rule set is defaulted.</p> <p>When the first turn starts, if there are 2 players, each player gets 1 stack of each denomination of 4, 3, 2, and 1 pieces. If there are 3 or 4 players, each player gets 1 stack of each denomination of 3, 2, and 1 pieces.</p>	

UC-2	User Selects a Piece	Traceability
Description	<p>Upon the start of an active user's turn, that user gets to select a piece of his from either: the top of a stack located off the board, the top of a stack located on the board.(a 1 piece is considered a stack....)</p> <p>If the active user has no pieces on top of a stack, and regular rule set is in play, he may choose to select another player's piece from the top of a stack. Otherwise, their turn is ended.</p>	
Actors	User	
Triggering Event	User's turn has started, or, under professional rules and 2 players, the user chooses to move a 2 nd piece on the first turn.	FR-11 NFR-5 NFR-6 NFR-8 NFR-9 NFR-20
Pre-Condition	The user is active and a game is being played.	
Main Sequence	<ol style="list-style-type: none"> 1) The user selects a piece of his from the top of a stack. 2) Available destination space(s) are calculated 3) Optionally, the user may select the same piece again in order to deselect it. 	FR-8 FR-10 FR-13

	4) If user does step 3, repeat all previous steps	FR-19 NFR-7 NFR-8 NFR-14 NFR-16 AS-2
Resulting Event	The selected piece can now be advanced.	UC-3
Post-Condition	Piece is selected and user is ready to make move.	UC-3
Alternative Scenario	<p>UC-2-ALT01</p> <p>The user has no pieces which are on top of a stack and the game is under regular rule set. Step 1 from the Main Sequence is changed to the following:</p> <p>1) Optionally, the user selects a piece from the top of a stack.</p> <p>And the following step is added before step 1:</p> <p>0) Optionally, the user chooses to end turn</p> <p>UC-2-ALT02</p> <p>The user has no pieces which are on top of a stack and the game is under professional rule set. The main sequence is changed to:</p> <p>1) The user's turn is ended.</p>	<p>FR-14 FR-15 NFR-6 NFR-8 NFR-12 NFR-13</p> <p>Moves to UC-3 or UC-4</p>
Comments	If the destination space is off the board, regardless of how many spaces it would travel off the board, it will go to a single destination space off the board.	FR-20

UC-3	Player Moves a Piece	Traceability
Description	Upon the determination of a selected piece, the player moves the selected piece. The amount of spaces the player's piece moves is equivalent to the height of the stack that the piece is initially on.	
Actors	Player	
Triggering Event	The piece which will be moved has been decided upon by the player.	AS-2
Pre-Condition	The piece which will be moved has been decided upon by the player.	AS-2
Main Sequence	<p>1) The player selects a valid destination to move the currently selected piece to</p> <p>2) The currently selected piece now moves to the destination</p> <p>3) If the destination is off the board, the piece is removed from the game</p> <p>4) The player's turn is ended.</p>	<p>FR-8 FR-12 FR-13 NFR-7 NFR-8 NFR-10 NFR-11 NFR-13 NFR-17 NFR-19 NFR-20 AS-2</p>
Resulting Event	Player ends his turn.	UC-4 or UC-5
Post-Condition	Player has moved a piece.	UC-4 or UC-5
Alternative Scenario	<p>UC-3-ALT01</p> <p>It's the players first turn under professional rules with exactly 2 players. Step 4 is changed to:</p>	<p>FR-11 FR-12 NFR-5</p>

	4) Optionally, the player chooses to end their turn 5) If step 4 was not chosen, the player cannot reselect the previously moved piece for the duration of this turn.	NFR-6 NFR-8 NFR-9 NFR-10 NFR-17 AS-2
Comments	If the player is an AI, the player's selected piece refers to the piece it has decided to move. If the player is a user, the selected piece is the piece selected from UC-2	

UC-4	Player's Turn Ends	Traceability
Description	A player has ended his turn and the system checks for an end game condition and cycles player rotation if required.	
Actors	System, Player	
Triggering Event	A player has moved a piece and their turn has ended	
Pre-Condition	A player's turn has ended	
Main Sequence	1) Amount of pieces left on board for that player is calculated. 2) If this amount is greater than 0, the next player in queue is chosen to start his turn.	NFR-17 NFR-20
Resulting Event	Next active player is chosen to start their turn or game has ended.	UC-2, UC-3 or UC-1
Post-Condition	Current active player has ended his turn.	UC-2, UC-3 or UC-1
Alternative Scenario	UC-4-ALT01 If the amount of pieces left on the board for that player is exactly 0 and there only remains 1 other active player, these following steps are done instead of the main sequence. 1) The player is now inactive. 2) The game is now over and displays an end screen, asking whether to play again or quit 3) If play again is chosen, game returns to menu 4) If quit is chosen, the game closes UC-4-ALT02 If the amount of pieces left on the board for that player is exactly 0 and there remains at least 2 active players, these following steps are done instead of the main sequence. 1) The player is now inactive. 2) A message box will appear asking whether to play again, quit, or continue playing 3) If play again is chosen, game returns to menu 4) If quit is chosen, the game closes 5) If continue playing is chosen, the next active player in queue is chosen to start his turn.	FR-21 NFR-17 NFR-20 AS-8
Comments		

UC-5	Player's Piece Lands on Spring Board Space	Traceability
Description	A player decides to move a piece which lands upon the spring board space thereby doubling the distance the piece will travel.	
Actors	System, Player	
Triggering Event	Player moves a piece to spring board space	
Pre-Condition	Player is active and it's his turn.	
Main Sequence	<ol style="list-style-type: none"> 1) Player's piece moves to the spring board space as its destination 2) Piece is automatically moved an extra n-spaces; where n is the number of spaces it has travelled on that turn to reach the spring board space 3) Piece reaches its new destination 	FR-16 FR-19 NFR-14 NFR-15 NFR-17 AS-1
Resulting Event	Player's turn has ended	UC-4
Post-Condition	Player's piece has reached its new destination	UC-4
Alternative Scenario	UC-0-ALT01 The new destination space does not exist as it would be past the finish space. Step 3 is replaced with: 3) Piece is removed from the game.	FR-19 FR-20
Comments	Spring board space is equivalent trampoline space	

UC-6	User Resets Game	Traceability
Description	At any time during a game in progress, the user chooses to reset the game thereby returning to the main menu.	
Actors	User	
Triggering Event	User selects to reset game.	
Pre-Condition	A game is being played	
Main Sequence	<ol style="list-style-type: none"> 1) User selects to reset game. 2) Game is now returned to main menu 	FR-1 NFR-19 AS-9
Resulting Event	Game is returned to main menu	UC-1
Post-Condition	Player can set up a new game.	UC-1
Alternative Scenario		
Comments		

Glossary:

Player: An initially active player of the game, whether it is human or AI controlled

User: A human who is using the game (may or may not be a player)

Active player: A player that has pieces currently on the board

Inactive player: A player that was initially active, and has since removed all of his pieces from the game board

Shortcomings

ID	Description	Requirements Failed	Test Instructions
PR-01	There is no ability to select the rule set from the menu.	FR01 FR11 FR12 FR14 FR15 NFR04 NFR06 NFR13 NFR18	-Run game -Observe menu screen -Choose players -Observe options screen -Begin game
PR-02	The dragon displayed isn't the proper Ravensburg dragon.	FR02	-Run game -Select menu options -Begin game -Observe the dragon
PR-03	The tiles of the game board have no symbol displayed (this includes the lotus tile).	FR03	-Run game -Select menu options -Begin game -Observe the tiles
PR-04	The game does not display anywhere which player's move it currently is.	FR07	-Run game -Select menu options -Begin game -Observe the board/interface
PR-05	During a 2 player game, the first player does not have the option to move 2 pieces (lack of rule set makes it unclear how this should have been handled).	FR11 FR12 NFR09	-Run game -Select menu options -Begin game -Move a piece -Turn has ended
PR-06	The stacks display the number of pieces in the pile, but they do not visually show each piece, nor the color of each piece on the stack.	FR04	-Run game -Select menu options -Begin game -Observe the board
PR-07	After clicking on a piece, there is no indication that the piece is selected, or what destination that the piece can move to. We are solving this by highlighting the selected piece and the destination space(s).	FR09	-Run game -Select menu options -Begin game -Select a piece
PR-08	When resizing the window, player pieces are drawn in incorrect positions and click locations are also in incorrect positions.	NFR16	-Run game -Select menu options -Begin game -Resize the window
PR-09	When a player has no available moves, there is not an option for that player to skip their turn (lack of rule set makes it	FR12 FR14 FR15	-Run game -Select menu options -Begin game

	unclear how this should have been handled).		-Attain a scenario with all pieces of a human player covered by different coloured pieces -Observe no skip turn option
PR-10	The game crashes under a variety of circumstances for undiscernable reasons.	NFR02	-Run game -Select menu options -Begin game -Play until crash
PR-11	Once one player has won, if 2 or more players remain, they are not given the option to continue.	FR21	-Run game -Select menu options (requires 3 or 4 players) -Begin game -Remove all pieces from one player -Observe that the game ends
PR-12	The State AI is not implemented		-Run game -Select menu options (at least one player must be State AI) -Begin game -Observe that the State AI does nothing