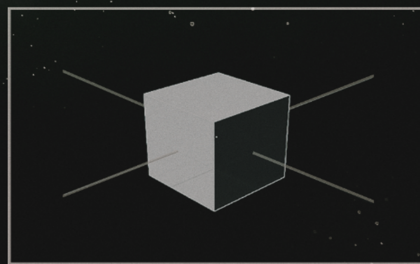
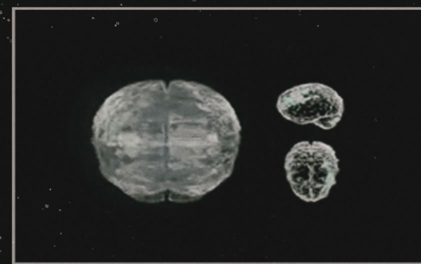
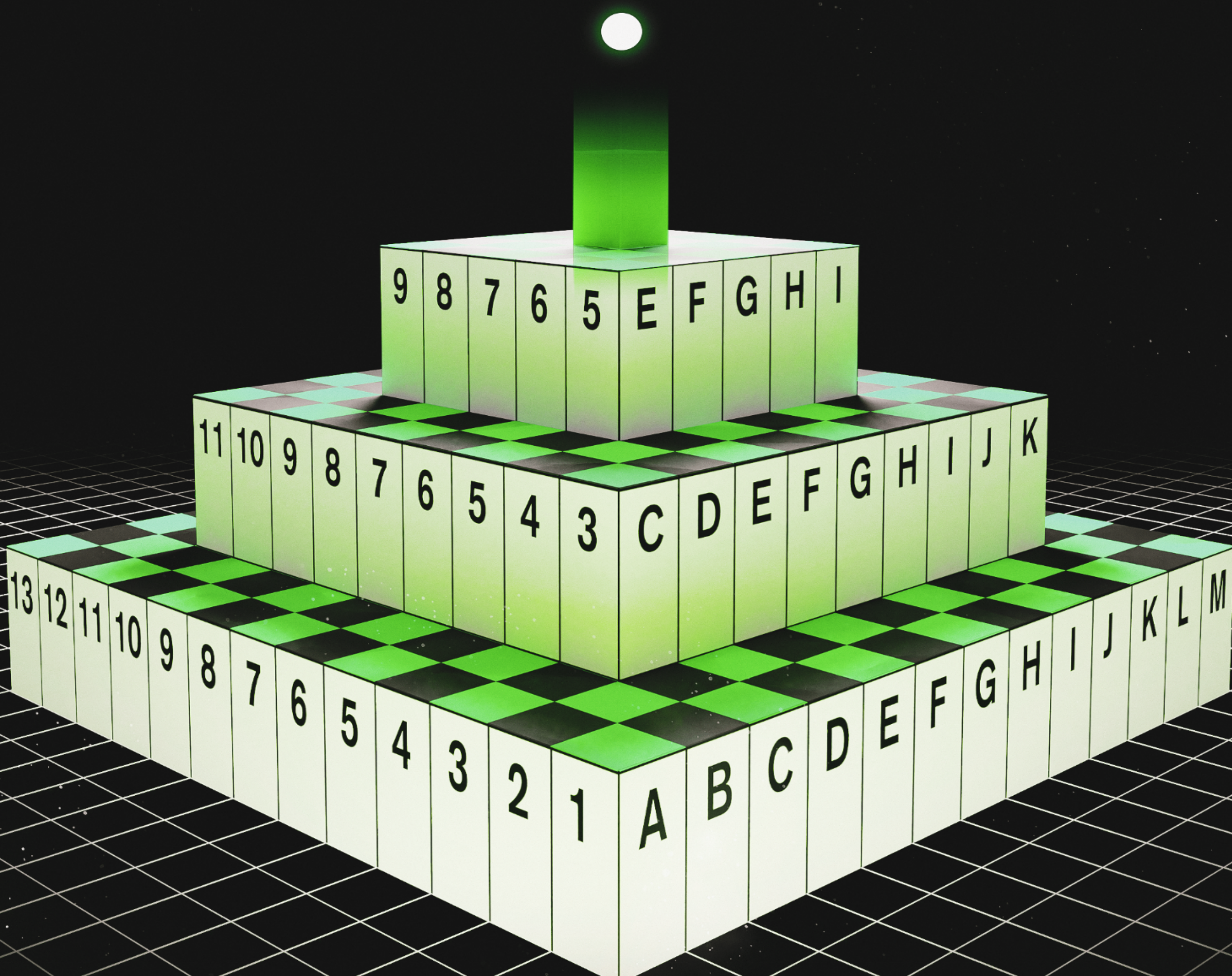
SCIENTIFIC XIMA

IMPROVE YOUR LOGICAL THINKING AND THREE-DIMENSIONAL ANALYSIS



A.W. Romero Jorge

Scientific Xima

Improve your logical thinking and three-dimensional analysis

Author: Adrian William Romero Jorge
Translated by: Giselle Borrero Blanco

email: adrianwilliam1998@gmail.com

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1. Summary

Xima is a new three-dimensional science game of Cuban origin, designed to allow more than two players to compete simultaneously. It can be played either in a competitive mode or incorporating elements of chance. Furthermore, it introduces a new classification genre for board games, known as Scienluck, which uniquely allows players to engage with or without randomness within the same match. Xima is a game of personal growth that is very easy to learn. It helps develop various skills such as observation, logic, spatial memory, and creativity.

The goal of this book is to introduce a new system of magnitudes to describe the dynamics experienced in board games, specifically applied to Xima. Concepts such as force, power, and level of play are introduced. Additionally, a formula is presented that allows the calculation of a player's relative skill, called CIMAX, which is based not only on scores achieved in previous games but also on the actual development of ongoing matches.

The book provides detailed steps to calculate each of these magnitudes, explains what they represent, how they are interpreted, and why they are useful. The incorporation of these measurements makes Xima particularly exciting for spectators, as comparing scores becomes much easier for both new players and the general public to understand.

Several sample games are also included for strategic analysis, and they are used to calculate Xima's magnitudes. In addition, the book explores the history of board games and presents a fairly accurate quantitative comparison of the number of possible combinations in various board games, comparing Xima to Chess, Go, and Checkers.

2. What is new in XIMA

1. **Easy-to-learn three-dimensional science game**, allowing two, three, four, or more players to play at the same time, even in pairs. The board's dimensions and the number of possible combinations make it possible for several players to play in the same match, ideal for playing in pairs, with family, and friends.

2. **The world's first hybrid board game** that can be played with or without luck. It introduces a new genre in board games called *Scienluck*. XIMA can be played in sports mode, in luck mode with dice, and also in a combined mode during the same match, known as *Scienluck*. This new mode allows one player to use dice while the other does not, blending luck with strategic skill, making it very fun and entertaining.

3. **Features a new system for measuring and calculating the force, level, power, and excitement** during gameplay. XIMA introduces a new scoring system called *CIMAX*, a mathematical method that incorporates variables such as the player's movement and performance during the match to calculate the relative skill of the players. It also includes dynamic magnitudes calculated each turn, such as gameplay force, power, and playing level, making it highly entertaining from a spectator's point of view.

4. **Develops cognitive skills through three-dimensional analysis and calculation abilities.** It contributes to mental and intellectual development for those who play it. It helps to cultivate clear, logical, and combinatorial thinking. With more than 1.7 trillion possible combinations just by the second turn in a two-player game, it boosts memory and creativity. During gameplay, the frontal lobe and both hemispheres of the brain are engaged to forecast future moves, create ideas, and calculate the general situation of the match. It plays an important role in brain development, especially in children and growing students. It is also suitable for teaching concentration and integral judgment.

5. **It is a game without draws; there is always a winner who reaches the top (Xima) first.** At

a professional level, many competitive board games face the problem of frequent draws, such as chess, where many grandmaster matches end in ties, making it less exciting for spectators. XIMA solves this issue: draws do not exist, as completely dominating all enemy blocks and leaving the opponent without moves results in defeat. If players lack resources to reach the top, a rule provides both players with new blocks to keep the game flowing.

6. **A healthy game with a noble and peaceful objective,** where winning is about building your own path to the top rather than destroying or killing opponents. It does not promote racism; its blocks and squares are vibrant colors like yellow, blue, orange, and green. The board inspires spiritual harmony; all blocks are identical, avoiding social class distinctions, racism, and slavery. The core teaching of the game is personal growth.

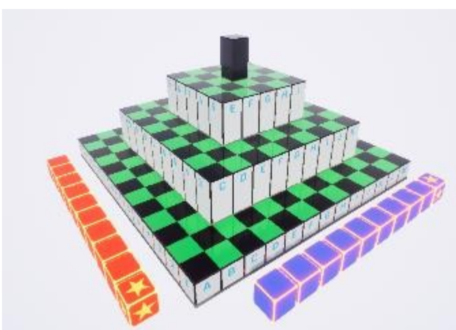
7. **It includes a very simplified algebraic notation system,** easy to write and read. Despite being a three-dimensional game, the notation system is simplified to a two-dimensional 13x13 board, which is easy to learn.

8. **The first board game in human history with a sporting nature created by known authors.** XIMA was created in Cuba in 2010 by Physical Culture graduate Yosdel Vicente Muiño Acevedo and Doctor Liz Power Suarez. Although Chess and Go are also sports-like board games, their original creators are unknown, with only myths and unproven theories about their origins.

9. **The law of gravity is evidenced as part of the game's dynamics.** The XIMA blocks experience gravitational phenomena, especially during the capture of blocks, helping players understand the concept of gravity.

3. Rules and Objectives of the XIMA Game

1. At the beginning of the game, all the blocks (10), including the special one, will be off the board.

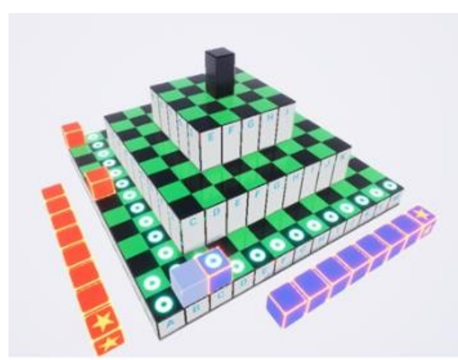


2. Each player will move once per turn. They can either add or move a block up any of the pyramid faces.

3. On their turn, the player can choose to add a new block or move one of the blocks they already have on the board.

4. Blocks move in a straight line in all directions, whether vertical, horizontal, or diagonal, for as many steps as desired, or in the case of playing in chance mode, the number of steps indicated by the dice.

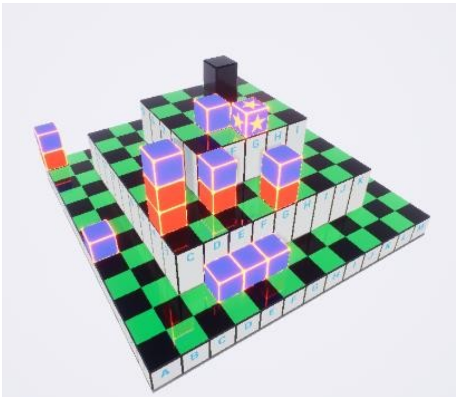
5. When adding a block, it must always be placed on the board.



6. Blocks cannot move off the board once they are in play.

7. If a player on their turn has all their blocks immobilized, they will be declared drowned and will be the winner. Completely immobilizing the opponent is not allowed and will result in a defeat.

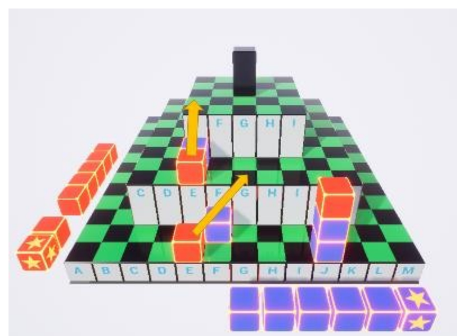
8. To move up from one level to another, blocks must do so by passing over another block, moving in a proportional staircase. No conditions are required to move down.



9. If a player moves a block on the board and in its last step it lands on top of one or more blocks, it immobilizes all the blocks beneath it.
10. If a special block is captured, the affected player can bring a common block to the top of the board and in exchange can rescue the special block, which can be reintroduced into play at any desired moment as if for the first time.

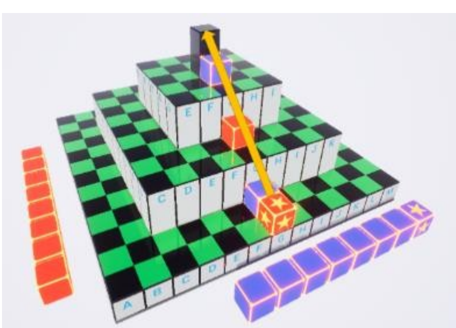
11. When a block moves on top of another block(s) and in that column has a majority color, it will eliminate from the game all those that are in the minority in that same column.

12. A player who loses all their blocks will lose the game.



13. If both players have insufficient material to win the game, 3 blocks will be added to each player, which they can incorporate into the game whenever they wish.

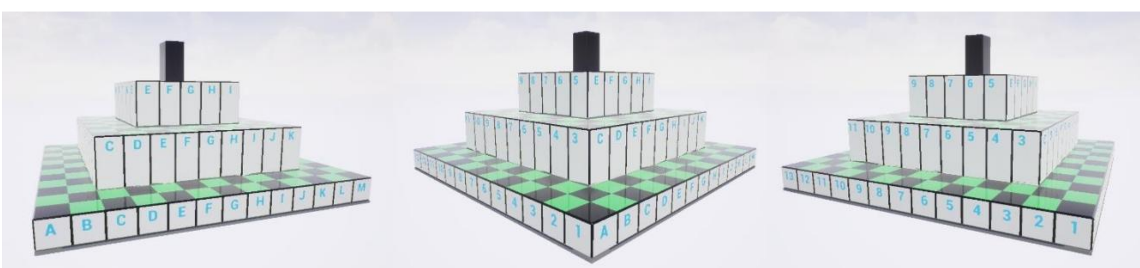
14. If, despite having sufficient material to reach the peak, the game level does not progress in 20 turns, 3 blocks will be added to each player.



15. The same position cannot be repeated three consecutive times in a game.

4. XIMA Game Board

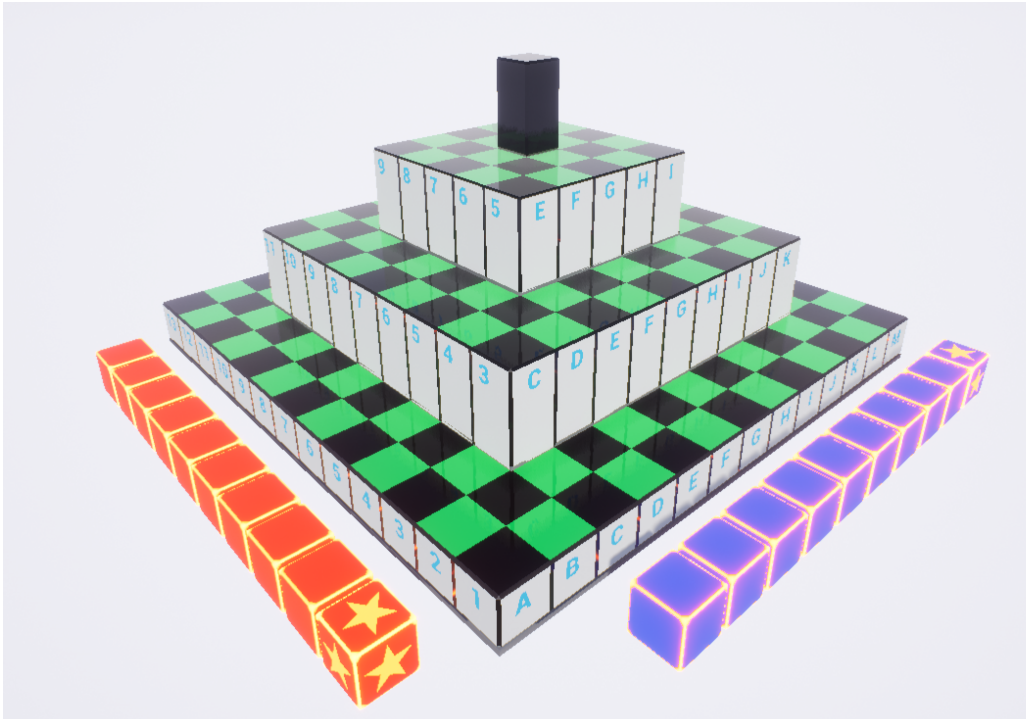
The **XIMA board** consists of four levels, forming a discrete pyramid shape. From a two-dimensional view, it would be a 13x13 square board, a total of 169 accessible squares, compared to chess which has an 8x8 two-dimensional board with 64 accessible squares. This is just from a two-dimensional perspective, but in reality, each block moves in a three-dimensional space with access to a 13x13x13 board, a total of 2197 accessible squares, a very large number compared to the 64 in chess and the 361 of a 19x19 Go board. This number of possible positions in XIMA gives it a wide range of combinations, strategies, openings, and endgames, making it difficult for one game to resemble another. Each game is unique, and you always learn something new.



The first floor has 88 squares, the second has 56 squares, the third has 24 squares, and the last and fourth floor has a single square, the summit square, which can only be reached by the special block. The sum of all the squares per floor gives a total of 169, which is as if the board were viewed from a top-down perspective.

The XIMA board has several symmetries:

- **Rotational symmetry** about the Z-axis when rotated by 90, 180, 270, or 360 degrees around a central axis passing through the center of the board (Z-axis).
- **Bilateral symmetry** with respect to the XZ and YZ planes. Additionally, there are two more



planes of bilateral symmetry, the planes formed along the diagonals that pass through the Z-axis.

If we simplify the symmetry, we are left with one-eighth of the board. This is important because when studying XIMA openings, all openings made in this section of the board are repeated in other parts of the board since it is symmetrical, thus defining them as unique and independent openings from the rest of the board.

5. Notation System in XIMA

Although there are 3 directions of movement on the Xima board, the notation system for Xima games is two-dimensional.

The notation system used in Xima is derived from an adaptation of the system used in Chess, which is called simplified algebraic. However, in Xima, we call it very simplified algebraic. This is because Xima has only one type of block, whereas Chess uses 6 pieces, which makes it unnecessary to highlight the name of the blocks unless referring to the special block, which will be denoted by an equal sign (=).

Another difference is that the boards, instead of having lowercase letters, in Xima the horizontals and verticals are defined with uppercase letters, as they will not interfere with the name of any block.

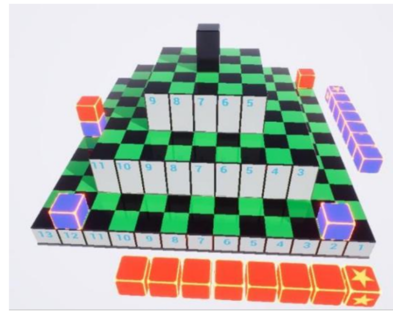
The very simplified algebraic notation system has two modes: the long or complete mode, which is easier for beginners to learn, where you only need to write the name of the square the block comes from, followed by the name of the square the block reaches. However, once players acquire skills in Xima, it is more practical and simplified to learn the short or abbreviated mode, which is less tedious to write and is also easy to understand. Below, we will provide an example of both modes. Unlike the long mode, the short mode is characterized by mentioning only the square where the block arrives, without having to specify from which square it leaves most of the time. Below are the steps for recording the moves in both cases.

- a) The move number followed by a period.
- b) The name of the destination square of the block being moved.(In the long mode, the starting square is noted first, followed by the destination square).

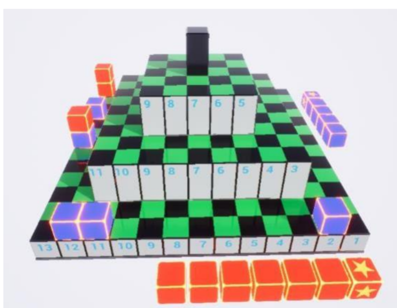
Note: If a new block is added to the board, a dash or minus sign (-) should be placed before the move, and if it is the special block, an equal sign (=) should be used to differentiate it.

Next, an example game is shown to compare the long and short notation systems.

	Short Mode		Long Mode	
#	Player A (Red)	Player B (Blue)	Player A (Red)	Player B (Blue)
1	-M1	-A2	-M1	-A2
2	-M13	-G13	-M13	-G13
3	G13	-A12	A13G13	-A12

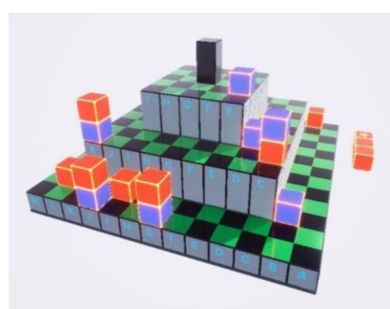


Notice how there is no need to put a minus sign in move 3 for the blue blocks because it moved one of the blocks already on the board, and also how in the long system, although it is very similar to the short one, it starts to become more extended in its writing from this point onward.

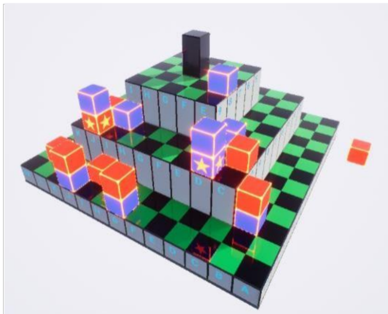


	Short Mode		Long Mode	
#	Player A (Red)	Player B (Blue)	Player A (Red)	Player B (Blue)
4	-M13	-J13	-M13	-J13
5	-MM13	-A11	-M1M13	-A11

	Short Mode		Long Mode	
#	Player A (Red)	Player B (Blue)	Player A (Red)	Player B (Blue)
6	-M12	-B11	-M12	-B11
7	-B1	2A12	-B1	A2A12
8	-I12	D9	-I12	A12D9
9	J10	K11	M13J10	A11K11
10	K11	-C11	J10K11	-C11
11	MJ13	E8	M13J13	A12E8
12	-C10	CC10	-C10	C11C10



Pay attention to how in move 5 for the red blocks, there are two blocks that can move to the same square, M13, so you have to specify the column where the moving block is located, followed by the destination square. Now, if by chance there were two blocks from the same column moving

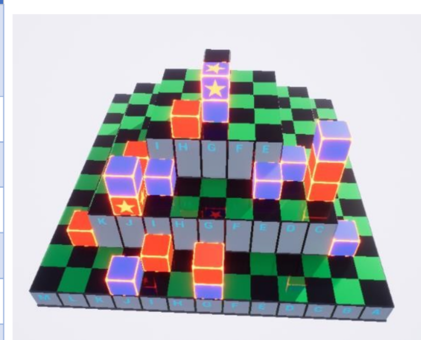


#	Short Mode		Long Mode	
	Player A (Red)	Player B (Blue)	Player A (Red)	Player B (Blue)
13	=J11	=D11	=J11	=D11
14	D11	J11	K11D11	K11J11
15	-J10	-I9	-J10	-I9
16	BB11	CxD	B1B11	C10xD10

to the same square, then the row should be specified, and if by some coincidence, there are two blocks in the same column and two in the same row, then it should be written just like the long mode, specifying both the starting and destination squares, and that's it. But be careful, this is not very common and are just sporadic situations that can arise, and I explain them here to clear up any future doubts.

As you can see, an (x) can be used to highlight a capture if desired, and it is very useful when evaluating the game.

#	Short Mode		Long Mode	
	Player A (Red)	Player B (Blue)	Player A (Red)	Player B (Blue)
17	C10	EC10	J10C10	E8C10
18	LL11	-I6	L12L11	-I6
19	JL11	DE10	J13L11	D11E10
20	D11	IxD	B11D11	I6xD11
21	J9	G8	L11J9	D11G8
22	-I8	=G8	-I8	=G8
23	H9	CIMA	I8H9	CIMA



As you can see, the short mode remains the same as the game develops, which is why it is recommended for professionals, tournaments, and competitions. In contrast, the long mode requires more writing to convey the same thing, but its advantage is that it is easier to understand, which is why it is recommended for beginners.

6. History of the Xima Game

Xima was created in Cuba in 2010 by Yosdel Vicente Muiño Acevedo and Liz Power Suarez. It arose from a promise of love made by the game's creator to his girlfriend, the co-author of the game. Its goal was to gift her a new noble and completely peaceful game-science, different from the ones known until then. After several designs that ended in failure and others still under development, such as: El Ajetreo, 360 Grados, and 3Dmino, which were the predecessors, the foundations of Xima were developed.

Initially, the game was played at the authors' house with family and some local friends, and in a short time, it gained great acceptance. The same players recommended expanding it to another social sphere, so the decision was made to bring it to universities. At that time, Xima was played recreationally, with luck involved through a die, and it was not until 2018 that it took on a sporting character by eliminating the element of chance, turning it into a mental sport with equal conditions for all players.

In October 2016, the first official Xima tournament was held in its recreational mode at the Faculty of Electrical Engineering at the José Antonio Echeverría Technological University of Havana, CUJAE. In March 2017, as part of the "March 13" university games, about 400 students participated at the main venue. In 2019, the first community project of Xima was created in the Párraga locality, in the municipality of Arroyo Naranjo, Havana, Cuba.

The presentation of the game-science Xima participated and won its first Significant Award at the Ramal Sports Forum in Havana in June 2019. The first official public exhibition of Xima was in July during the Havana Fair 2019 at Expocuba, alongside the Provincial Directorate of Sports. It was repeated in October at the same venue, but this time at the Havana International Fair (FIHAV). In this event, Xima was recognized by the invited entrepreneurs as the game representing Havana in its 500th anniversary. In September 2019, a technical and methodological decree was approved, endorsed by the National Institute of Sports, Physical Education, and Recreation (INDER), the Ministry of Education (MINED), and the Institute of Science, Technology, and the Environment

(CITMA), recognizing it as a game-science.

In 2020, Xima is undergoing a process of expansion and development. Currently, it is part of the teaching process at the A+ Adolescents Spaces Center of the Havana Historian's Office, in collaboration with UNICEF, as one of the workshops constituting its educational plan. Furthermore, as a demonstration of its ability to interrelate with other science games, Xima participates in the "Ajedrez Habana" project, a chess academy guided by three Cuban grandmasters.

7. Board Games

A board game is one that, as its name suggests, is played on a board or flat surface. The rules of the game depend on the type of game, and it can be played by one or more players. Some games require manual dexterity or logical reasoning, while others are based on chance. Throughout history, board games have represented one of humanity's oldest recreational activities, being used in various cultures as a means of education, entertainment, and, in some cases, conflict resolution or strategic training.

Board games come in a wide variety of types and can be classified according to their gameplay mechanics. Some of the most common types include:

- **Strategy games**: These games require a high degree of logical reasoning and planning. Players must make strategic decisions throughout the game. Examples of this type include:
  - *Xima*: Three-Dimensional Science Game. Each player starts with 10 blocks, one of which is the special block. The objective of the game is to move the special block to the top. The player who accomplishes this first wins the game. Number of players: 2 to 4.
  - *Chess*: A classic two-player game where the objective is to checkmate the opponent's king.
  - *Go*: An ancient Chinese game that involves surrounding the opponent's stones with one's own to gain territory.
  - *Checkers*: Similar to chess, but with simpler piece movements. The goal is to capture the opponent's pieces.
- **Games of chance**: In these games, luck plays a predominant role. Examples of this type include:
  - *Monopoly*: An economic game where players buy properties and try to earn the most

profit.
  - *Parcheesi*: A board game that involves rolling dice and moving pieces to advance on the board.
  - *Lottery*: A game of chance where players hope that their numbers are randomly selected to win.

- **Card games**: These are games played with a deck of cards. They may involve elements of both chance and strategy. Examples include:

  - *Poker*: A card game involving betting and played mainly with card combinations.
  - *Solitaire*: A card game played alone, where the player organizes the cards according to a set of rules.
  - *Uno*: A card game where players must match colors or numbers and use special cards to change the game.

- **Family or recreational board games**: These games are designed to be played by large groups of people and are focused on social entertainment. Examples include:

  - *Scrabble*: A word game in which players form words using letter tiles.
  - *Catan*: A strategy game where players colonize an island by collecting resources and trading with other players.
  - *Clue (or Cluedo)*: A mystery game where players must deduce who committed a crime, with what weapon, and in which room.

Throughout the centuries, board games have evolved, adapting to new generations and technologies, but they continue to be a popular form of recreation and socialization today. In addition to being an educational tool, board games foster skills such as critical thinking, decision-making, and problem-solving.

8. History of Board Games

The history of board games stretches back thousands of years, reflecting the diverse cultures, traditions, and innovations of human civilization. The earliest board games were not just forms of entertainment but also served as vehicles for teaching strategy, culture, and life lessons. Evidence suggests that the first known board games were played in the ancient civilizations of Mesopotamia, Egypt, and the Indus Valley.

8.1 Early Origins

The earliest known board game is believed to be the Royal Game of Ur, which dates back to around 2600 BCE in Mesopotamia. This game, found in the Royal Tombs of Ur, involved a form of racing game played with dice and pieces moving across a board. Other ancient games, like *Senet*, were discovered in Egypt, with some scholars suggesting that *Senet* had ritualistic and symbolic meanings tied to life after death. It is believed that this game was played by the elite and could have been used for divination or to symbolize the journey through the afterlife.

In India, the game of *Chaturanga* (circa 600 CE), a precursor to chess, was played on a board that resembled a modern chessboard. It is from this game that chess and other strategy games would evolve, influencing global game culture for centuries. The concept of *Chaturanga* was introduced to Persia, where it became *Shatranj*, and eventually, it spread to Europe via the Islamic world.

8.2 Games in the Classical World

The Greeks and Romans made significant contributions to the development of board games. The Greeks created games like *Petteia* and *Kottabos*, which involved strategic movement of pieces on boards. The Romans, for instance, played a game called *Latrunculi*, which involved strategy and tactics similar to modern-day chess. These games were often used to train soldiers in strategic thinking, emphasizing planning and foresight. Other games, like *Tabula* (a predecessor of backgammon), were enjoyed by both the elite and common people alike, and were played in the public baths and other social spaces.

8.3 Medieval and Renaissance Games

During the Medieval period, board games began to appear in Europe. One of the most well-known games, chess, evolved from *Chaturanga* and gained popularity in the Islamic world before being introduced to Europe by the Moors in the 9th century. Chess became a game for the noble classes and was also used as a training tool for strategic warfare. The game underwent significant changes in its rules in Europe, with the modern version of chess solidifying in the 15th century.

The game of backgammon, with its roots in ancient Mesopotamian games, also became widely popular across Europe during this period. It was often played in taverns and royal courts, symbolizing both chance and skill. Another medieval game, *The Game of the Goose*, a race-type board game, originated in Italy and became a popular pastime across Europe.

In the Renaissance, there was a resurgence of interest in games as a form of intellectual and social entertainment. The development of card games, such as tarot and playing cards, also began during this time. These games evolved into an important part of European culture, and many medieval and Renaissance games are still played today, albeit with modern variations.

8.4 Modern Board Games

The 19th century saw the industrial revolution play a pivotal role in the mass production of board games, making them accessible to a broader public. The creation of games like Monopoly in the early 20th century marked the beginning of modern board gaming. These games introduced new themes and mechanics, such as property trading and economic simulation, which are still prevalent in today's games. Monopoly, for example, was invented in 1903 by Elizabeth Magie as a way to demonstrate the negative aspects of monopolies and capitalistic greed, though it later evolved into a game of capitalist competition.

During the early 20th century, the development of abstract strategy games, such as Go, checkers, and various variations of chess, flourished. These games were widely popular in both Europe and Asia, with Go gaining particular importance in China, Japan, and Korea. The game of Go, originating from ancient China, is one of the oldest board games still played today and has a rich history of philosophical and strategic significance.

In the 1960s and 1970s, the emergence of the board game hobbyist movement led to the creation of modern board games like Risk, Clue, and Settlers of Catan. These games introduced more complex rules, social interaction, and player-driven strategies. The rise of modern board role-playing games (RPGs), such as Dungeons Dragons, also expanded the boundaries of board gaming, incorporating elements of storytelling, fantasy, and imagination.

8.5 Digitalization and Modern Developments

The digital age has had a profound impact on the world of board games. The advent of video games, computer simulations, and online gaming platforms has led to the digital adaptation of traditional board games. Many classic games, like chess, backgammon, and Monopoly, now have digital versions that can be played on various devices.

In recent years, hybrid board games have emerged, blending physical board play with digital technology. These games often use apps or interactive features to enhance gameplay, making them more immersive and engaging. The rise of crowdfunding platforms like Kickstarter has also democratized the development of new games, allowing independent creators to produce innovative games that might otherwise have been overlooked by traditional publishers.

The board game industry has also seen a rise in niche games, with genres like strategy, deck-building, cooperative, and legacy games becoming increasingly popular. These games offer more complex mechanics, deeper themes, and a greater variety of player experiences, attracting a diverse and passionate community of gamers.

The history of board games reveals how they have been woven into the cultural fabric of societies around the world, often carrying meaning beyond just play. From the ancient games of strategy to modern recreational games, board games continue to evolve and inspire new generations of players. The development of these games has mirrored human progress, reflecting shifts in technology, culture, and the way we view competition and cooperation. Board games will undoubtedly continue to evolve, shaping and reflecting the cultures of future generations.

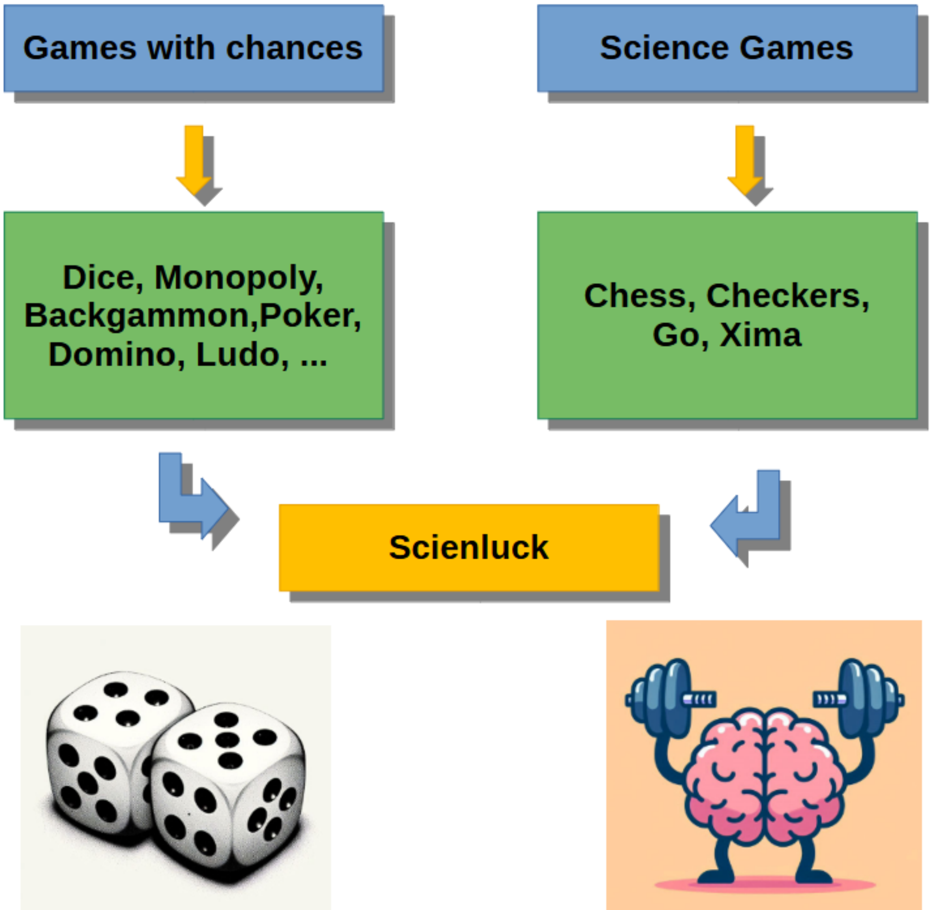
For further readings on the history and evolution of board games, refer to the works of Bell [**Bell1979**], Stern [**Stern2014**], Parlett [**Parlett1999**], and Zimmerman [**Zimmerman2015**], who provide in-depth discussions on the origins, development, and impact of these games on societies.

9. Classification of Board Games

Board games are commonly grouped into categories, each with particular features that differentiate them. Some of these are:

- **Dice Games:** These games use dice. Examples: Ludo, Backgammon, among others.
- **Token Games:** These involve the use of marked tokens. Examples: Dominoes, Mahjong.
- **Card Games:** Cards made from cardboard are decorated and printed with various designs, shapes, colors, and numbers. They have been used since ancient times for games and are called cards, decks, or playing cards. There are several types of playing cards or board games, with the most common being Spanish, French, or the unique Egyptian cards. Nowadays, card games are very popular as games of chance, with many varieties and countless ways to play them, such as Poker, Canasta, or Truco.
- **Role-Playing Games:** These are considered an experience with tools for imaginative development, skill development, and a wealth of supporting materials. They increase socialization between different people, genders, and ages, and they offer an active learning experience. Role-playing games involve trial and error, and players learn experientially. The themes of role-playing games vary, including medieval, warriors, pirates, gladiators, extraterrestrials, vikings, independence wars, fantasy, zombie horror, futuristic, and others, where costumes and weapons play an important role.
- **Science Games:** These are games understood as art, where winning depends not on luck, but on the player's skill and creativity. These games are considered sports. Examples: Chess, Checkers, Go, Xima, etc.

All existing board games can be classified in two ways: as games of chance and games that do not depend on chance to win. Games of chance rely on luck for victory, and are typically played for



fun, with predicting exact results being impossible. On the other hand, games that do not involve chance can be considered sports because their outcome depends entirely on the player's skill and creativity.

The game **Xima**, however, cannot be classified into either of these two categories. Xima can be played with or without luck, and even with a combination of both in a single game. The first mode, with luck, involves dice. Both players roll a die to determine the number of available moves for their blocks. The second mode, without luck, is played in turns, with no movement limits for a block in a turn, and this is the competitive version that fits into science games.

In the third mode, one player uses two dice while the other plays in the competitive mode. The player who rolls the dice has the option to move two different blocks during their turn, while the other player can only move one block per turn, but with no movement limits for that block. This is a new mode called *Scienluck*, and it is unique to board games.

This new mode allows one player to use dice while the other does not, combining luck with strategic skill, making it both fun and engaging.

10. Number of Combinations

In this section, a summary of the number of possible combinations generated in the first turns of the games Checkers, Chess, Go, and Xima will be presented, along with a comparison between them.

First, let's define what we mean by the number of possible combinations. Suppose we have a 6-sided die and roll it. How many different possible outcomes do we have? The answer is evident: there are 6 possible combinations, as the die has 6 sides.

Now, suppose we have two 6-sided dice. How many possible combinations can occur? We would need to list the results: 1-1, 1-2, 1-3, 1-4, 1-5, 1-6, 2-1, 2-2, ..., 6-4, 6-5, and 6-6, totaling 36. However, some combinations are the same, such as 1-2 and 2-1, 3-4 and 4-3, and so on. Thus, while there are 36 possible combinations, there are only 18 unique combinations.

Applying this to board games for two players, let turn 1 of player 1 be denoted as T_1^1 and turn 1 of player 2 as T_1^2, turn 2 of player 1 as T_2^1, and so on. Let C_{cp} represent the number of possible unique combinations at turn T_n. The number of possible combinations C_{cp} of a game can be calculated using the expression:

$$C_{cp} = (T_1^1)(T_1^2)(T_2^1)(T_2^2)\dots(T_n) \tag{10.1}$$

where T is the number of turns up to which the number of combinations is to be calculated.

10.1 Combinations in the Game of Checkers

Let's calculate the number of combinations up to turn 2 for the game of Checkers.

In the first turn of the white player, T_1^1, the number of possible combinations is 7. The 3 white checkers on the left can move to two squares on their diagonals, but the checker on H3 can only move to its left diagonal. Similarly, for the black player, there are 7 combinations regardless of what the white player does on their turn.

$$N_1^1 = N_1^2 = 7 \tag{10.2}$$

Suppose the white player moves D3E4 and the black player moves E6D5; then, on the second turn of the white player, due to the obstructions, 7 possible moves are available. The 5 checkers in front can only make one move, except for the checker on B3, which can make two moves.

$$N_2^1 = 7 \tag{10.3}$$

Suppose the white player moves H3G4; now, let's look at the second turn of the black player and their possible moves. 5 checkers can move to one square, and one checker can move two squares, resulting in 7 possible moves in total.

$$N_2^2 = 7 \tag{10.4}$$

Now we can calculate the number of possible combinations up to the second turn in the game of Checkers using the equation:

$$C_{cp} = (N_1^1 N_1^2)(N_2^1 N_2^2) = 7 \times 7 \times 7 \times 7 = 2401 \tag{10.5}$$

In the game of Checkers, by the second turn, there can be up to 2400 possible combinations.

10.2 Combinations in Chess

Let's calculate the number of combinations up to turn 2 for the game of Chess.

In the first turn, the white player can choose from 20 possible moves for the opening:

- 16 moves with the pawns (8 on the third row of the board and 8 on the fourth row).
- 4 moves with the knights (on squares A3, C3 with the queen's knight, and F3, H3 with the king's knight).

Additionally, the possibility of resigning should be considered, but it is only added in the turn where the calculation is made, as there is no point in counting the possibility of resigning and continuing the calculation. So, in the first turn of the chess game, the number of possible different moves is:

$$N_1^1 = 20 \tag{10.6}$$

Suppose the white player moved a pawn to e4, as this position, along with e3, d3, and d4, are the moves that generate the most possible combinations in the next turn. What we want to calculate is an estimate of the number of possible moves, so we will maximize the moves that generate the maximum number of possible combinations.

Next, the black player, in the first turn, has the same number of possible moves since the board is symmetric:

$$N_1^2 = 20 \tag{10.7}$$

And assuming the black player moved to e6. Now, for the second turn of the game, let's see what moves the white player can make:

- 14 moves from the 7 remaining pawns on the third row.
- 1 move from the pawn on e4.
- 4 moves from the knights.
- 1 move of the king to e2.
- 4 moves of the queen on the right diagonal (e2, f3, g4, and h5).
- 5 moves of the bishop on the left diagonal (e2, d3, c4, b5, and a6).

$$N_2^1 = 14 + 1 + 4 + 1 + 4 + 5 = 29 \tag{10.8}$$

For the black player on their second turn, they will also have the same number of combinations as the white player, with the addition of the possibility of resigning.

$$N_2^2 = 29 + 1 = 30 \tag{10.9}$$

Now we can calculate the number of combinations for turn 2 in the game of Chess:

$$C_{cp} = N_1^1 N_1^2 N_2^1 N_2^2 = 20 \times 20 \times 29 \times 30 = 348000 \tag{10.10}$$

This gives a total of more than 300 000 possible moves by the second turn.

10.3 Combinations in Go

Now let's calculate the number of combinations up to turn 2 for the game of Go on a board of dimensions $D \times D$ (with $D = 13$). This calculation is simple with a basic analysis. In the first turns, both players can only place one stone, and there is a possibility of capture on the second turn of player B if player A places a stone in one of the four corners of the board and player B manages to surround it. However, this situation rarely occurs, although it cannot be completely ruled out.

Assuming that the game progresses without captures until turn T, the number of possible combinations decreases by one each time as the board spaces are occupied. Player A, on their first turn, can place a stone in any of the $D \times D = 169$ available spaces. Once player A places a stone, only 168 spaces remain for player B on their first turn, and after player B places their stone, player A has 167 spaces available to place a stone, and so on. This sequence continues until a capture occurs, freeing up spaces.

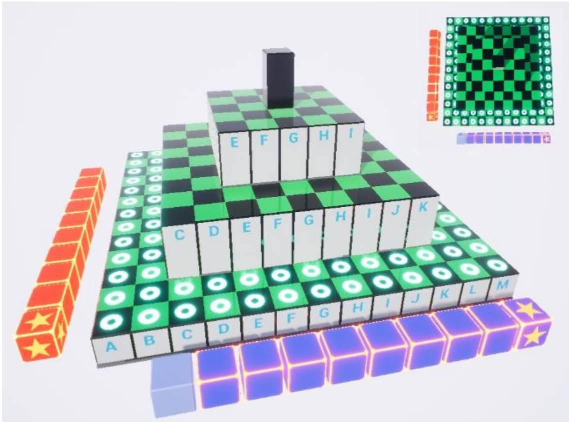
Taking this analysis into account, we can calculate the number of possible combinations up to the second turn:

$$C_{cp} = N_1^1 N_1^2 N_2^1 N_2^2 = 169 \times 168 \times 167 \times 166 = 787083024 \tag{10.11}$$

With a total of over 700 million possible combinations just by the second turn, this is a massive number compared to the games of Chess and Checkers, mainly due to the large size of the board.

10.4 Combinations in the Game of XIMA

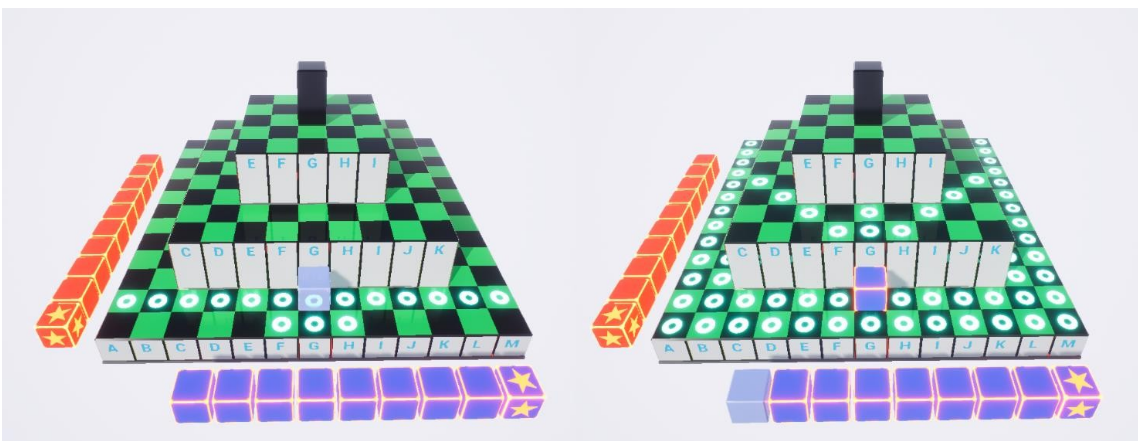
Let's consider the case of XIMA. There are 88 possible moves on the first floor for placing a common block and 88 for the special block. In the case of chess, there are 20 possible moves (16 with pawns and 4 with knights). Additionally, we must account for the possibility of resignation, but this is only added on the turn up to which the calculation is to be made, as it does not make sense to include the possibility of resignation and continue the calculation. For the first turn of the game, XIMA has a total of 176 possible move combinations, while chess has 20.



$$N_1^1 = 176 \tag{10.12}$$

Now, assuming that player 1 made a move from the 176 possible ones (and did not resign), let's assume that they placed a common block at position G2, as this position, along with B7, L7, and G11, are the ones that generate the most possible combinations. The goal here is to estimate the number of possible combinations in the game of XIMA, so we will maximize the moves that generate the most combinations.

Player 2 (red) on their first turn has access to the second floor and can also place a common or special block in 87 positions on the second floor, as one space is occupied by the blue common block at G7. On the second floor, player 2 can place a block in 10 more positions, but they can do so with either a common or special block, so there are 20 possible combinations. Adding these 174 placements on the first floor, the total number of possible combinations for player 2's first turn is 194.



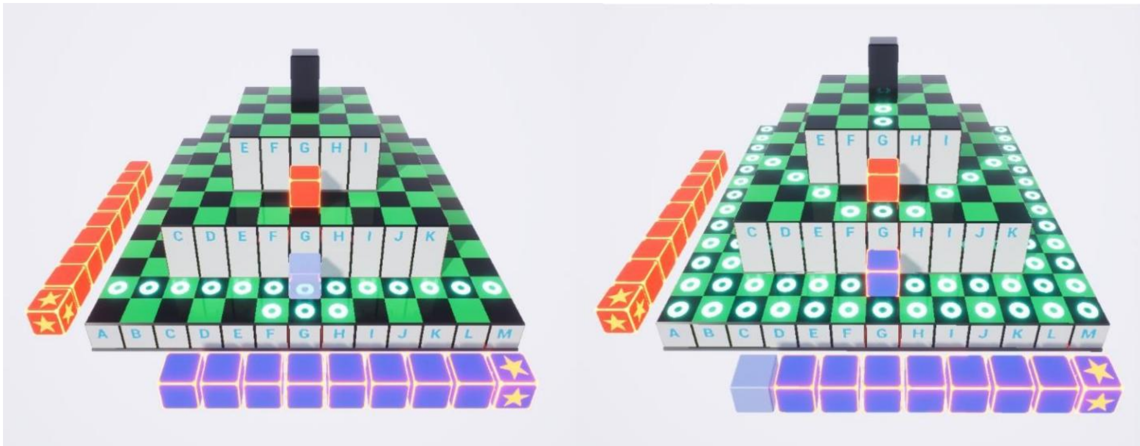
$$N_1^2 = 194 \tag{10.13}$$

Now, multiplying the number of combinations for the blue player's first turn by the number of combinations for the red player's first turn gives the total number of possible combinations for the first turn.

$$C_{cp} = N_1^1 \cdot N_1^2 = 177 \times 195 = 34144 \tag{10.14}$$

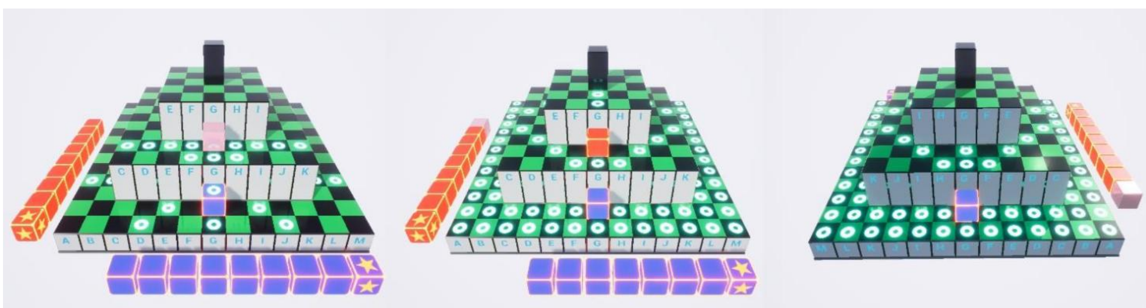
Thus, there are 34,144 possible combinations for the first turn in the game of XIMA, while in chess, there are only 400 possible combinations on the first turn. This is not an exact calculation, as if the blue player were to play in the outer ring of the first floor, the red player would not be able to move to the second floor, reducing the number of combinations. However, this calculation provides a sense of the order of magnitude.

Let's now analyze the second turn of the game. Suppose player 2 (red) places a common block at G4. On the second turn, the blue player moves first. As we can see in the image:



The blue player can move the block from G2 to 15 positions. They can place a common or special block in 87 positions on the first floor, in 9 positions on the second floor, and in 2 positions on the third floor. This results in a total of:

$$N_2^1 = 15+87+87+9+9+2+2 = 211 \text{ possible combinations.} \tag{10.15}$$



Now, assuming the blue player places a common block at G11 (other possible moves could be placing it at G6, L7, or B7, but G11 generates the most combinations). Now, it is red player's turn, and they can move their common block from G4 to 21 positions. For placements on the first floor, there are 86 spaces for a common block and 86 for a special block. On the second floor, there are 9 for the step at G7 and 10 for the step at G11. On the third floor, there are only 2 positions, in addition to the possibility of resignation, as this is the point at which we want to end the calculation. The total number of possible combinations for player 2's second turn is:

$$N_2^2 = 21+86+86+9+9+10+10+2+2 = 235 \tag{10.16}$$

Now we can calculate the total number of combinations for the second turn in the XIMA game approximately:

$$C_{cp} = N_1^1 \cdot N_1^2 \cdot N_2^1 \cdot N_2^2 = 177 \times 195 \times 211 \times 235 = 1711426275 \tag{10.17}$$

Thus, the game of XIMA generates more than 1.7 billion combinations by the second turn, while chess has 348,000 possible combinations in its second turn, just half a million. Note that the 19x19

	Number of possible combinations (millions of combinations)	
Board Game	***1st turn***	***2nd turn***
XIMA (13x13) 4 Players	1711	2.5×10^{12}
Go (19x19)	0.12	16 702
XIMA (13x13) 2 Players	0.034	1711
Go (13x13)	0.028	787
Chess (8x8)	0.00040	0.34
Checkers (8x8)	0.000014	0.0024

Go game has more combinations than the Xima game with 2 players, both on the first turn and starting from the second turn. This is only for the case of 2 players, but Xima can be played with 3, 4, or even more players. In the case of the Xima game with 4 players, the combinations just on its first turn exceed those of 19x19 Go by 4 orders of magnitude, and for the second turn, the number of combinations is enormous, surpassing any existing board game, with more than two and a half quintillion combinations.

11. Magnitudes Describing the XIMA Game

11.1 Importance of Magnitudes in Board Games. The ELO Problem.

The habit of quantifying everything has been a necessity since the appearance of humans, leading to the origin of numbers. Even primitive humans could distinguish between two or more groups of objects without knowing how to count, because their instinct told them that it was better to accumulate a greater amount of food for the winter rather than a small amount. Although they couldn't count, they knew how much food they consumed daily and could differentiate between groups of elements. Numbers and arithmetic emerged as an evolutionary consequence for humans.

Today, everything is built on the basis of numbers and the magnitudes they describe. For any social, sports, political, economic, leisure, and many other activities, magnitudes are needed to describe the environment in which they are involved. To build a bridge, for instance, it is necessary to calculate the forces on the columns, tensions in the cables, the resistance of the beams, and other necessary magnitudes to ensure the structure is stable. The tendency to quantify things and describe them with magnitudes makes the world easier to understand.

The case of board games is no exception. Whether it's counting the points won or the number of steps to advance, numbers are used as a means of expression. Let's consider a game like chess, where draws are possible. It's very common to see a chess match end in a draw. If one were to ask, "Which player played better?" The answer would be that it was a draw, because it was a game that ended in a draw.

Let's look at this example. Suppose we have 4 non-professional chess players (their ELO is unknown), and a tournament is organized with these 4 players in an elimination format. Player A plays against C, and B plays against D. As a result, players C and B win their respective matches. Now, if one were to ask, "Which player played better?" Both had different matches, but both won.

Does this mean they are at the same level? No, assuming they made no rookie mistakes during their games, one could not precisely know which player between B and C played better. This would also happen if the game were checkers, backgammon, Go, etc. There is no magnitude that qualifies the player based on their performance in the game. The way to measure if one player is better than another is by using their ranking (in the case of chess, this would be the ELO). There is no magnitude that characterizes chess players by their actions in the game, but rather a ranking that depends mainly on whether they win, draw, or lose the game, regardless of whether a game was good, average, poor, or spectacular.

ELO depends only on whether a player wins (1 point), draws (0.5 points), or loses (0 points), and on the previous ELO of the players. After the game, their ELO is adjusted using a logistic function based on each player's expected values. The ELO equation does not consider what happened in the game, just the results. Therefore, it is incapable of measuring the "force" of a player in the game, but instead relies on accumulating points from past victories.

Let's look at the following example. Suppose a grandmaster with an ELO of 2560 points has 8 months to prepare for an important international tournament, but during that time, the grandmaster spends the time vacationing, relaxing, and doing everything except studying chess. Then, on the day of the tournament, the grandmaster plays his first match with an ELO of 2560 against another player with an ELO of 2127 (who studied chess every day without rest, preparing intensively for the tournament) and is easily defeated by his opponent.

So, which player is better? In terms of ELO, the player who went on vacation is still considered better, but the reality is different. The game showed that their skills did not match their current ranking, as they were defeated by a player with a much lower ranking. Does this mean the other player who defeated them is better? One cannot say just because they won a game. There is no additional information that can be measured to draw further conclusions. This is why board games (mainly scientific games) need new magnitudes that measure a player's skill level, their relative force, statistics, and more. New magnitudes are needed to describe other parameters, such as a player's experience, the force or emotion of a game, which are new alternatives to describe board games and make them more entertaining and understandable to an amateur audience.

This is where XIMA comes in as a scientific game with a revolutionary magnitude system capable of measuring a player's game force, power, emotion, and gaming experience.

Xima has a new scoring system called CIMAX, a mathematical method that incorporates variables accounting for the player's progress and performance during the game, allowing the calculation of the relative skill of Xima players. In addition, there are dynamic magnitudes that are calculated during each turn, such as game force, power, and skill level, making the game very entertaining for the audience. CIMAX is to XIMA what ELO is to chess, but with the difference that it takes the player's performance in the match into account to calculate their new ranking scores. In other words, it does not only consider the match result but also what was done during the match. These new magnitudes help better understand scientific games, especially when dealing with draws. Interesting conclusions can be drawn.

Returning to the previous example, where players B and C won a match against players D and A respectively, we can now know with some probability which player is better: B or C. If the tournament were XIMA, even without knowing the players' rankings, the magnitudes describing the game would help answer which player is better. In the game between player A and C, player A had a game force of 34 points, while player B had a game force of 56.5 points against D. It can be concluded that player B is likely better than C, even without knowing their rankings (in this case, referring to CIMAX), as the game force developed by player B in the first match is 1.6 times greater than that of player C, and it is highly probable that if players B and C play against each other, B will win.

But what exactly is game force, and how is it calculated? The following describes each of the magnitudes that define the XIMA game.

11.2 Game Force

The *Game Force* is a dynamic, measurable scalar quantity in the game *Xima* that provides the positional value of blocks, captured blocks, the potential of blocks outside the game, and other factors. A higher game force relative to the opposing player generally indicates better control over the board and a better position compared to the opponent. Game force is directly proportional to having greater control over the third level, dominating blocks, capturing blocks, having blocks outside the board to incorporate, and, of course, winning the game. The unit of measurement for game force is the Xima [Xima].

The game force F_G of a player is calculated as:

$$F_G = V_{BB} + V_{OB} + V_{CB} + V_R + V_W, \tag{11.1}$$

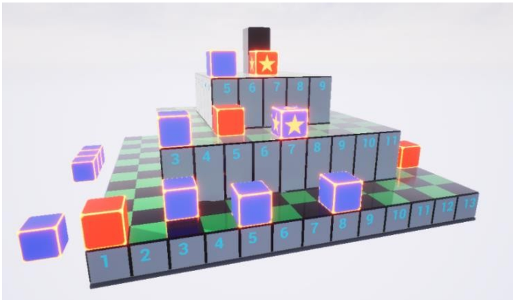
where:

- V_{BB} (Value of the blocks on the board): We explained how to calculate it in the next section.
- V_{OB} (Value of the blocks off the board): Once the first block is incorporated, the value of each block off the board equals the average value of the blocks on the board.
- V_{CB} (Value of the captured blocks): Before a block is captured, it always has a value in that position. When captured, it retains that last value, which is added as force points to the player who captured it.
- V_R (Resignation value): The player who resigns will give the opposing player half of their game force. If a player runs out of time, it is also considered a resignation.
- V_W (Win value): When the special block is positioned at the top, the game is automatically won, and a value of 16 XIMAs is added to the game force. Normally, a common block would generate 8 XIMAs, but remember that this one is special.

11.3 Value of the blocks on the board

A *XIMA* board has three floors where common blocks can be positioned. The value of a common block is $2n$, where $n = 1, 2, 3$ depending on the floor where the block is located, except for the special block, which is worth two blocks and can be positioned on the 4th floor if it reaches the top. The value of the special block is $4n$, where $n = 1, 2, 3, 4$.

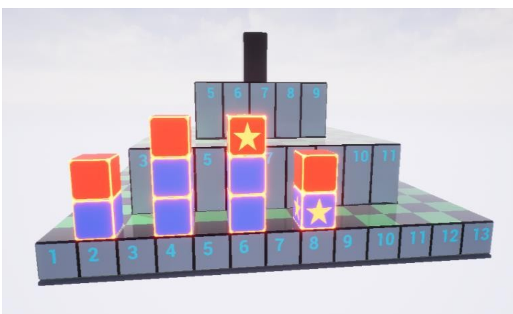
11.3.1 Block Value on the Board for Different Positions



The common red block in position A1 is worth 2 points, being on the first floor. The common blue block in position C3 is worth 4 points, being on the second floor. The special blue block in C7 is worth 8 points as it is worth two common blocks on the second floor, and the special red block in F7 is worth 12 points on the third floor.

If a block is dominating another, its value on the board changes. The dominating block acquires half the points of the blocks it is dominating, and the dominated block is worth half its points. Example 1: Consider a common blue block dominated by a common red block on floor n. The value of the dominating red block is $2n+n=3n$, and the value of the dominated blue block is $2n-n=n$. Let p be the number of common blocks dominated by a common dominating block, then the value of the dominating block is $2n+pn=(2+p)n$.

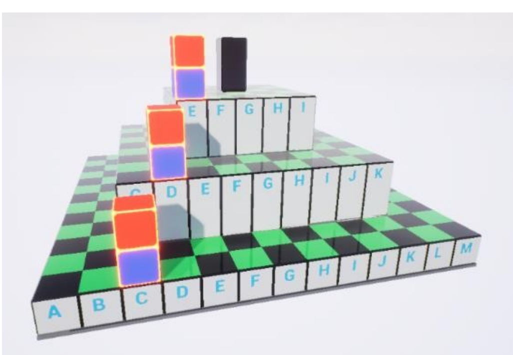
11.3.2 Value of Dominated and Dominant Blocks



The red block 21 on A2 is worth 3 points, acquiring half the points from the blue block, which is worth 1 point when dominated. Note that the total value of the two blocks together is 4. The total value of the blocks is conserved but redistributed. In the case of the red block on A4, it is worth 4 points while dominating two blocks, and the dominated blocks are worth 1 point each.

If the special block is the dominating block on A6, its value is 6 points. Lastly, if the special block is the dominated block, as in A8, its value is 2 points because it loses half of its points.

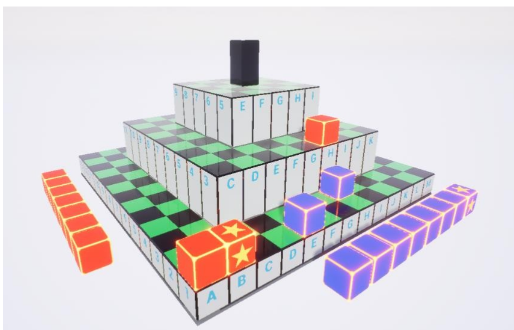
11.3.3 Value of Dominated and Dominant Blocks on Different Levels



For the first level, we had already seen that the red block on C1 is worth 3 points, and the blue block is worth 1 point. On the second level, the red block on D3 is worth 6 points, and the blue block is worth 2 points. On the third level, in E5, the red block is worth 9 points, and the blue block is worth 3 points. As you move to a higher level, the dominating block gains 3 points, and the dominated block gains 1 point.

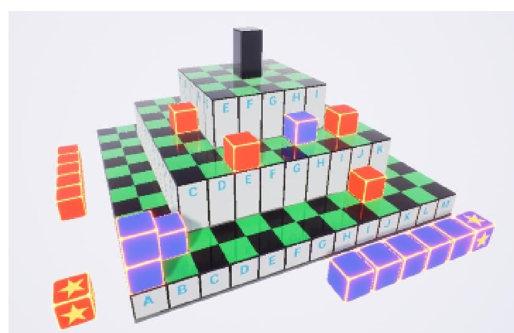
The value of the blocks that are associated with it is relative, as there are situations where different blocks may have the same positional value on the board but not the same functional value. This is evident since, while all blocks on the first floor, for example, have the same value of 2 points, they do not serve the same functions. Some blocks are more important because they may be threatening an important position or serving another function. This functional value is not considered when calculating the game force, as game force is calculated at the end of the game. Once the game ends, blocks no longer have a function. However, if the game force were to be calculated at each player's turn, the functional value of the blocks would not be taken into account. This is a topic that remains open for discussion in order to improve the scoring system.

11.3.4 Importance of Functional Value of the Blocks



In this situation, it can be observed that the two blue blocks on E1 and H2 have the same positional value of 2 points because they are on the first level. However, they serve different functions. The blue block on E1 can capture the enemy special block on its turn, making it much more important than the blue block on H2, which does not have a direct attacking function but serves as a stepping stone for the third floor. When comparing the importance of their functions, it is clear that capturing the enemy's special block forces the opponent to use more blocks to free it, while the blue blocks can use those turns to reach higher levels.

In this case, let's analyze the functional value of the three red blocks on the second floor. The red block on E3 is about to block the advancement of the blue blocks if it moves to position C3, as the blue blocks would no longer be able to rise to the second floor. The red block on J4 can dominate the blue block on H4, and in its next turn, it will rise to the third floor, which increases the chances for the red blocks to reach the top. Meanwhile, the red block on D7 does not seem to serve any apparent function.



These three red blocks on the second floor have the same positional value but serve different functions. This is just a simple analysis of how complicated it can be in other cases, leading to the question: What is the best move? For which, there is no answer for now, as *XIMA*, like chess and other board games, is a sport that does not depend on chance. If the question could be answered in any of these games, they would no longer be sports games because it would not make sense to play something where knowing the best move would always guarantee a win or a draw, as in chess, because in *XIMA*, there are no draws.

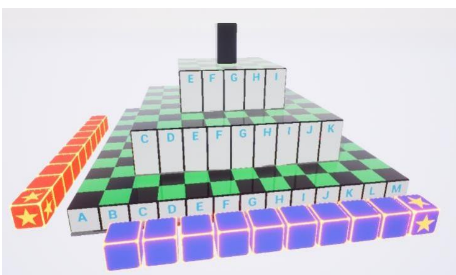
11.3.5 Value of Blocks Outside the Board

Each block outside has a potential to act, a game force that has not been incorporated, a reserve of important material, and has its value and importance in the game. At the start of the *XIMA* game, when no blocks have been incorporated into the board, each block outside is worth 1 point. Once the first block is incorporated, the value of each block outside becomes a function of the value of the blocks on the board divided by the number of blocks on the board.

$$V_{OB} = \frac{V_{BB}}{N_B} N_{OB}, \tag{11.2}$$

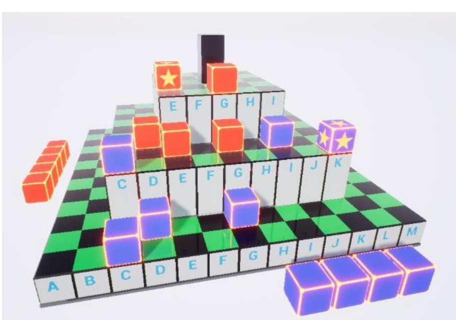
where N_T is the number of blocks inside the game board. It holds that $N_T = N_B + N_{OB}$, where N_{OB} is the number of blocks outside the game board, and N_T is the total number of blocks for the player, which is not necessarily 10. If the blocks inside the board are captured, this number decreases. Additionally, if $N = 0$, the player automatically loses the game because they have no blocks inside or outside the board. The value of each block outside the board V_{BB}/N_B is the same for all blocks, as it is indistinguishable which block to use when incorporating it, whether it is a common block or the special block.

11.3.6 Value of Blocks Outside the Board at the Start of the Game



At the beginning of the game, each player has 9 common blocks and 1 special block. On turn zero, these blocks outside the board have a value of 1 point, including the special block. Since there are no blocks on the board, the blocks outside cannot be combined with the blocks on the board. They only serve the function of being incorporated, but this is only valid on turn zero. Once a block is incorporated on turn one, these blocks serve a more complex function and are no longer worth 1 point. The following illustration explains this.

11.3.7 Value of Blocks Outside the Board in Midgame

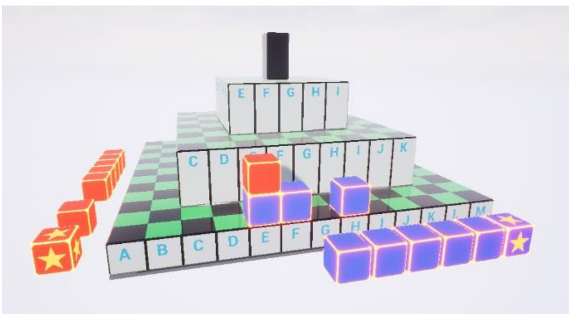


Let's calculate the value of a block outside the board. First, the value of the red blocks inside the board is 30 points, and the value of the blue blocks is 22. The number of red blocks inside the board is 5, and the number of blue blocks is 6. We can see that the red blocks, despite having one less block than the blues, have more points, thus more game force. Calculating the value of a block outside the board, for the reds, it is $\frac{30}{5} = 6$ points, while for the blues, it is $\frac{22}{6} = 3.66$ points. A red block outside the board is worth more than a blue one because the red player has more control over the board with fewer blocks inside the board. In conclusion, the red player has a total value of blocks outside the board equal to 30 points, and the blue player has 14.66 points.

11.3.8 Value of Captured Blocks (V_{CB})

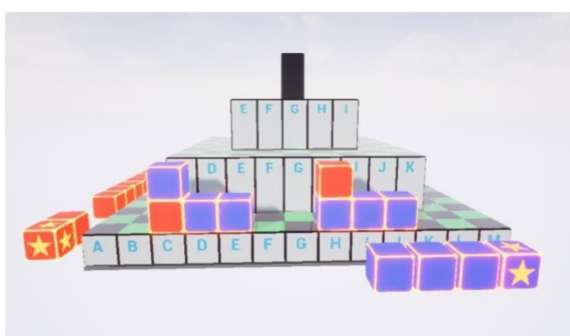
The process of capturing an enemy block requires the use of blocks and expenditure of turns. Once the block is captured, it is removed from the game with no possibility of returning (except in the case of the special block, see: rescue of the special). Its value on the board is transferred to the game force of the opponent as a reward for spending blocks and turns to capture that block. The value of the captured block varies depending on the floor it is on, the blocks it is dominating, and its positional value in the game. However, its value is only taken into account at the moment it is captured.

11.3.9 Block Capture Process

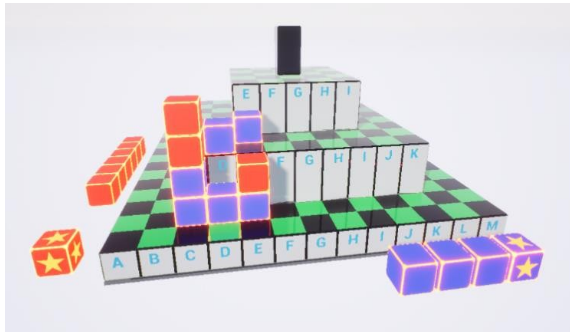


A block is captured when there is a majority of blocks of one color in a column relative to the other color, and the block at the top of the tower in that column is of the color that captures. For example, in square E1, the red block dominates the blue block, but it does not capture it because there is no majority of red blocks in that case. However, if the block in H1 moves to E1, the red block would be captured, as there is a majority of blue blocks in that column, and a blue block dominates the rest. This capture situation should not be confused with the case where a red block dominates two blue blocks, in which there is a majority of blue blocks, but the red block dominates at the top of the column, so there is no capture. The capture process has a value. In the case that the block in H1 captures the block in E1, it would gain 3 points, as the red block before the capture was worth 3 points for dominating a blue block.

11.3.10 Capture Value of Blocks



Let's look at the following situation. Both are capture situations, but the point gain is different. In the first case, the blue block on E1 can capture at C1, and the red block is worth 1 point, which is the gain from the capture. In the second case, the blue block on J1 captures at H1 and absorbs 3 points, which is the value of the red block dominating the blue block in that case. Both are capture processes, but the gain is different, as the captured red blocks do not have the same positional or functional value. The red block at C1 is dominated by a blue block and is completely immobilized and without apparent functional value. The red block at H1, on the other hand, is the dominating block and can move freely to another position, so it remains a threat.



Let's calculate the gain from capturing in the following case: the blue block at E4 can capture at C2 and E2. If the blue block captures at C1, it would eliminate two red blocks from the game. So, the smartest option, when capturing in that position, would absorb 6 points, as the red block on top is worth 4 points, and the red block beneath it is worth 2 points. In the case of capturing at E2, only 3 points would be gained, as the red block is worth 3 points. Clearly, the capture is an important transformation that must be done carefully, as sometimes the capture that generates more points may not be the most appropriate.

11.3.11 Resignation Value (V_R)

The player has the right to surrender, or if the time runs out on the clock, it will also be considered a surrender. Surrendering directly affects the game force of the opponent, whether for strategic reasons or external causes. When a player surrenders, it prevents the opponent from increasing their game force. Therefore, the player who surrenders is penalized by distributing their game force equally among the other players.

$$V_R = \frac{F_{G,O}}{N_P}, \tag{11.3}$$

where $F_{G,O}$ is thr opponent's game force at the moment of surrender and N_P is the number of players.

In the case of two players, it is as follows:

$$V_R = \frac{F_{G,O}}{2}. \tag{11.4}$$

11.3.12 Value for Reaching the Top

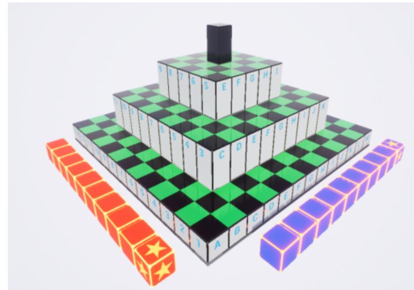
When the special block reaches the top, the game is automatically won, and a game force value of 16 ximas is acquired (the value of a common block on the 4th floor is 8 ximas, but since the special block is worth two common blocks, its value on the 4th floor is 16 ximas). Although this value should be infinite since reaching the top represents the highest achievement in life.

11.4 Calculation of Game Force

Once the Xima game ends, the game force value of both players is calculated. Let's look at an example of how to calculate this for a game.

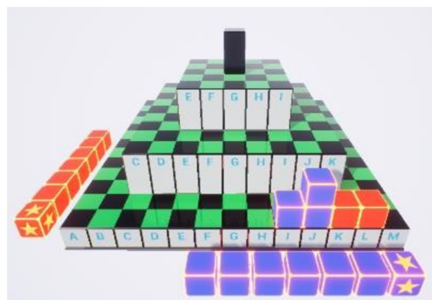
Example Game:

#	Player A (Red)	Player B (Blue)
1	-B1	-J1
2	J1	-B1
3	-K1	-I1
4	-L1	BxJ



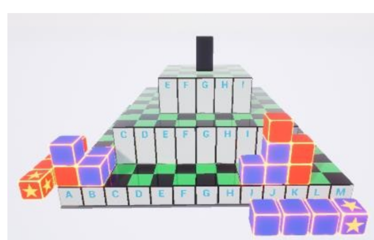
J1: Dominates from the beginning, although ideally, blocks should keep being incorporated, and not repeat moves with the same block.

#	Player A (Red)	Player B (Blue)
5	J1	-H1
6	-A1	HA1
7	-L1	-B2
8	LK1	-B1



BxJ: Captures a red block in exchange for the blue blocks dominating J1 in the next turn. The red player loses a block and is forced to dominate at J1 to balance the lost block. The blue player now has two blocks captured, and the red player has one dominant block and one removed, a seemingly balanced situation, but the blue player may recover their blocks from J1 in the future.

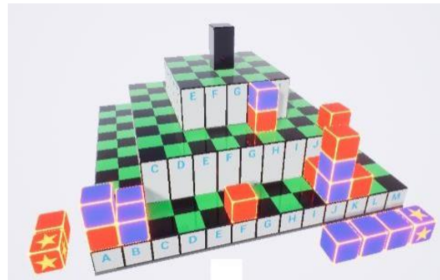
#	Player A (Red)	Player B (Blue)
9	-F1	IF1
10	-J2	k3
11	H4	I3
12	-K3	H4



HA1: Dominates at A1 with the goal of placing a step block at B2 and moving to the second floor. It's a bad move for the red player to incorporate at A1.

LK1: Doubles their blocks at K1, places a step, and moves quickly to the second floor, as the blue player is already entering it.

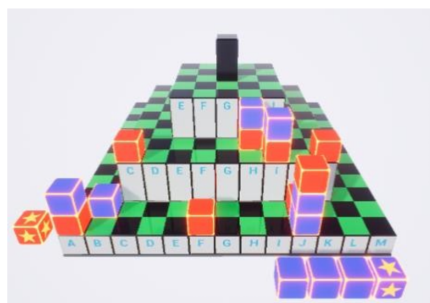
#	Player A (Red)	Player B (Blue)
13	KI3	BB2
14	-K1	BD4
15	IC3	C3
16	KI3	CI3



K3: Incorporates at K3 due to the red step block, leaving an opening to move to the 2nd floor.

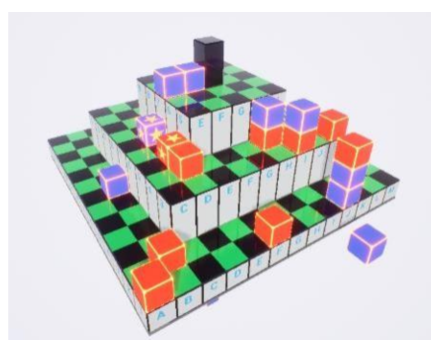
-K3: The red player prefers to let the blue block access the 3rd floor to continue incorporating blocks to the 2nd floor and maintain a better position.

#	Player A (Red)	Player B (Blue)
17	xA1	B7
18	JB2	=D7
19	=D5	-F7
20	AD4	-E7



IC3: The red block at I3 is forced to block the blue ascent to the 2nd floor from A1.

#	Player A (Red)	Player B (Blue)
21	=D4	ID8
22	I3	HI3
23	=F6	7F6
24	AE5	=D8

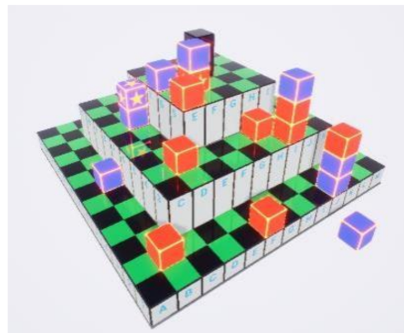


CI3: The blue block dominating at C3 takes over the other block at I3, preventing communication between the red blocks at C3 and K3 and gaining access to the 3rd floor. However, they neglect the block at A1, which can now be captured by the red block at C3. If the red player captures at A1, they would just delay their blocks back to the 1st floor, while the blue player can remove their step at B2

to prevent it from returning to the 2nd level.

=D7: The incorporation of the special block at D7 as a step is a very good move because the red player has no blocks left on the board, allowing the blue player to easily move their reserve blocks to the 3rd floor.

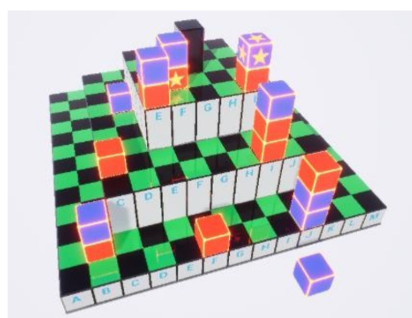
#	Player A (Red)	Player B (Blue)
25	H4	7E5
26	H5	7B2
27	C4	=I8
28	I5	=I5



=F6: The red special block moves to a square where it can be dominated, as the blue player has complete control of the 3rd floor, and the red player sacrifices their special block in exchange for gaining time.

=I8: The blue special block moves to the 3rd floor.

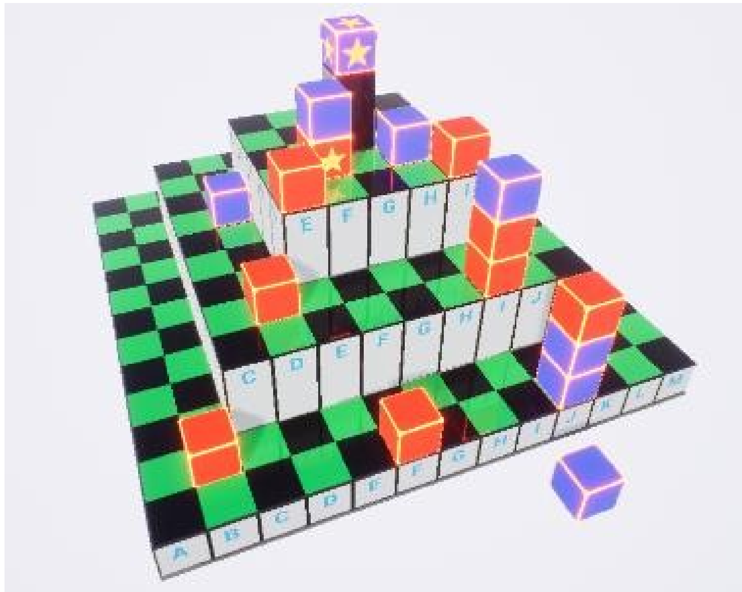
#	Player A (Red)	Player B (Blue)
29	C3	EH8
30	CxB2	8H6
31	BD4	TOP



I5: The red player sacrifices their red block at I5 to be captured by the special block, as they have no better move. The blue blocks dominate all blocks on the 3rd floor, and the red player has no more material to incorporate nor any possibility to move blocks to the 3rd floor. The red player is losing the game

EH8: The blue block moves to H8 to then move to H6, allowing the special block to reach the top. The red player cannot stop this.

TOP: The blue special block reaches the top and wins the game.



11.4.1 Steps to Calculate the Game Force of a Player

Now let's calculate the game force. To do this, we present a series of steps to follow:

1. Sum the value of all the blocks on the board for the player. This starts by counting the value of the blocks on the third floor down to the first floor. The sum of all these values gives the value of the blocks on the board .

2. Count the number of blocks outside the board at the end of the game and the number of blocks inside the board for the player. Divide the value of the blocks on the board by the number of blocks inside the board and multiply it by the number of blocks outside the board, giving the result as the value of the blocks outside the board (V_{OB}).

3. Count the value of the blocks captured during the game. This value should be noted at the time of capture or checked in the game notes as it is often forgotten. The sum of the points for capturing blocks is the value of the captured blocks (V_{CB}).

4. In the case of a player's surrender (or if the clock runs out, which is also considered a surrender), the player who surrenders transfers half of the points from their blocks on the board to the winning player. The winning player must add half of the points from the surrendered player's blocks on the board. This value is called the surrender value (V_R).

5. The winning player gains 16 points for winning; this value is called the winning value (V_W).

6. Finally, sum all the accumulated points, which gives the value of the player's game force. The game force equation can be used, which contains the sum of each term.

$$F_G = V_{BB} + V_{OB} + V_{CB} + V_R + V_W . \tag{11.5}$$

Let’s Apply These Steps to Calculate the Game Force of Each Player.

For the red player:

1. Summing the points from all the red blocks gives a total of 34 ximas ($V_{BB} = 34$).
2. The red player incorporated all their blocks onto the board, so they have no blocks outside the board $V_{OB} = 0$.
3. Two blue blocks were captured, one on the first floor worth 3 points and another on the first floor also worth 3 points, so $V_{CB} = 6$.
4. No player surrendered.
5. The red player lost, so $V_W = 0$.
6. Summing all the points gives a total of $F_G = 40$ ximas for the red player.

For the winning blue player:

1. Summing the points from all the blue blocks gives a total of 27 ximas ($V_{BB} = 27$).
2. The blue player has one block outside the board $N_{OB} = 1$ and has 6 blocks inside the board ($N_B = 6$), dividing V_{BB} by gives the value of the block outside $V_{OB} = 4.5$.
3. One red block was captured, one on the first floor worth 3 points ($V_{CB} = 3$).
4. No player surrendered.
5. The blue player won, so $V_W = 16$ ximas.
6. Summing all the points gives a total of $F_G = 50.5$, a game force of 10 points more compared to the red player.

$$F_G(A) = 40, \tag{11.6}$$

$$F_G(B) = 50.5. \tag{11.7}$$

This game forces information tells us which player achieved greater domination on the board. A player with a high game force is likely to win the game since they have one or more blocks on the third floor, dominate more enemy blocks, and have had one or more captures. On the other hand, a player with a low game force means they have incorporated few blocks, had one or more blocks captured, and have few or no blocks on the third floor.

Game force is used to calculate the game power and, with this value, the CIMAX of each player, a concept that will be explained in the following chapters.

11.5 Game Power

Game Power: A dynamic quantitative scalar magnitude measurable in the Xima game that gives us an average of the game force per turns used. A higher game power compared to the opponent generally indicates that more game force was generated per turn and less time was used on the clock. Game power is directly proportional to game force, using less time on the clock, and winning the game in the fewest turns possible. The unit of measurement for game power is Xima per turn [Xima per turn].

The game power P of a player is calculated as:

$$P_G = \frac{F_G}{2^{te} \cdot T}, \tag{11.8}$$

where:

- T (turns taken by the player in the game): The average number of turns in a game is 30 turns, 10 turns for short games, and 50 turns for long games. There is no limit on the number of turns per player as long as the clock does not reach zero.
- t_e (Effective time): The effective time is the ratio of the time the player used to the total agreed time. For example, if both players agree to 10 minutes each, this would be the agreed time, and the time used until the game ends is the employed time, which is usually different for each player. In formula form, it would look like this:

$$t_e = \frac{t_{\text{used}}}{t_{\text{pactado}}} = \frac{t_{\text{agreed time}} - t_{\text{clock}}}{t_{\text{agreed time}}} = 1 - \frac{t_{\text{clock}}}{t_{\text{agreed time}}} \tag{11.9}$$

This effective time gives us an idea of the time spent by the player. If $t_e = 1$, the player loses the game because their time has run out.

Game power is directly proportional to game force and inversely proportional to the time on the clock and the number of turns taken by the player.

Let's analyze the limit cases of the game power equation. First, assuming an effective time factor of $t_e = 0.1$, which means the player used 10% of the total agreed time, the player's power can be approximated as:

$$P_G = \frac{F_G}{2^{te} \cdot T}, \tag{11.10}$$

This indicates that "playing fast" (using the least possible time on the clock) increases the player's power. Now, secondly, if we assume an effective time factor of $t_e = 0.9$, meaning the player used 90% of the total agreed time, the player's power can be approximated as:

$$P_G = \frac{F_G}{2 \cdot T}, \tag{11.11}$$

This means that using most of the clock time is penalized with half the game force.

For an average XIMA game, an average player consumes 50% of the total agreed time ($t_e = 0.5$), uses about 30 turns ($T = 30$), and has a game force of 80 Ximas ($F = 85\,\text{Ximas}$); their game power will be 2 Ximas per turn ($P = 2\,\text{Ximas/turn}$), which means that on average, after the time penalty, an average player develops a game force of 2 Ximas per turn.

Having a higher game power induces a greater game force and increases the chances of victory. Let P_1 be the game power of player 1 and P_2 the game power of player 2. The condition $P_1 < P_2$ does not guarantee victory for player 2 due to possible errors that player may make ("bad moves"), even having better control of the board, domination, availability of blocks, and therefore game force. Having greater game power than the opponent does not guarantee reaching the top, as game power is a measure of the average game force per turn that the player develops in a game of XIMA.

11.5.1 Steps to Calculate the Game Power of a Player

1. Calculate the Game Force F_G previously, a value that is calculated using the steps indicated in the previous section.

2. Note the time spent on the clock t_{used}[1] and the number of turns taken T by the player.
3. Calculate the effective time t_e, as the division of the time used t_{used} by the total agreed time t_{agreed}.
4. For the calculation of game power, use the equation above 11.5. First, divide the game force F_G by the number of turns T. Second, calculate the power of 2 raised to the effective time, 2^{t_e} (this calculation requires a scientific calculator). Third, divide the first term calculated by the second, giving the game power.

With the game data presented in the previous section, let's calculate the game power of each player. We know that the time spent is $t_{used}(A) = 24.5$ minutes and $t_{used}(B) = 16.1$ minutes out of a total agreed time of 60 minutes, and the number of turns is $T = 31$ for both players.

For player A (Red):

1. The previously calculated game force for player A is $F_G(A) = 40$.
2. The time spent is $t_{used}(A) = 24.5$ minutes, and the number of turns used is $T = 31$.
3. The division between the time spent and the total time gives the effective time $t_e(A) = 0.40$.
4. The Game Force divided by the number of turns gives 1.29, and the power of 2 raised to the effective time gives 2^{t_e}. Dividing 1.29 by the power of 2^{t_e} gives the game power $P_G(A) = 0.98$.

For player B (Blue):

1. The previously calculated game force for player B is $F_G(B) = 50.5$.
2. The time spent is $t_{used}(B) = 16.1$ minutes, and the number of turns used is $T = 31$.
3. The division between the time spent and the total time gives the effective time $t_e(B) = 0.26$.
4. The Game Force divided by the number of turns gives 1.62, and the power of 2 raised to the effective time gives 2^{t_e}. Dividing 1.62 by the power of 2^{t_e} gives the game power $P_G(B) = 1.36$.

Thus, the game powers are:

$$P_G(A) = 0.98, \qquad P_G(B) = 1.36 \tag{11.12}$$

Game power is a more comprehensive magnitude than game force, as it includes other factors such as the number of turns and the time spent in the game. Game power is linearly proportional to game force, so it shares the same properties. A game power lower than one indicates that the player consumed most of their clock time or used too many turns in the game, in addition to having low game force. Meanwhile, a game power greater than one implies speed in the moves and greater game force. This magnitude is used to calculate the CIMAX of each player, a concept that will be explained in the following chapters.

11.6 Game Level

The game level of a Xima match is the sum of the game forces developed by the number of players. This measures the level and creativity with which the match was played. A XIMA game with a low game level could mean that players have played using little of their clock time, a player has reached the top with little difficulty (either due to the opponent's mistake or inexperience), there are very few

[1] The time used is not the time shown on the clock; that is the elapsed time. To calculate the time used, subtract the elapsed time on the clock from the agreed total time.

dominations and captures, and the game tends to have few blocks on the board, etc. A XIMA game with a high game level might mean that the players are very experienced, there are many dominations and captures, the games tend to be long with all blocks used, and sometimes additional material is needed to reach the top, etc. The unit of measurement for the game level is the Xima [Xima].

The game level or level of play (L_G) of a XIMA match is calculated as:

$$L_G = \sum_{i=1}^{n} F_G(i) \tag{11.13}$$

where n is the number of players and $F_G(i)$ is the game force of each player.

For a two-player game, the game level is calculated as the sum of the game forces of each player:

$$L_G = F_G(A) + F_G(B) \tag{11.14}$$

For this example we are analyzing, the game level is easily calculated, and there is no need to write the necessary steps:

$$L_G = 40 + 50.5 = 90.5 \tag{11.15}$$

The game level is a measure of how effective the Xima match was. A game level between 80 and 100 means it was a match with players of medium skill, while a game level below 80 means it was a match between novices or a novice and a medium-skilled player. Game levels above 120 are generally games between high-level players in Xima.

11.7 CIMAX Equation

CIMAX: A scalar quantitative magnitude assigned to each Xima player to measure relative skill. It depends not only on the match result but also on new magnitudes like game power and game level to give a more accurate description of Xima games. Each Xima player is initially granted a CIMAX of 1000 points, which increases or decreases depending on the games won or lost. CIMAX is a conservative magnitude, as the points lost by a player are transferred to the winner.

In a XIMA match where the players have CIMAX values of $C_x(1)$ and $C_x(2)$ and develop game powers of $P_G(1)$ and $P_G(2)$, assuming player 1 wins the match, the new CIMAX values for both players will be corrected. The winner will absorb certain points from the loser's CIMAX as a reward for reaching the top. This corrective term, which we will call Δ (Delta), is proportional to the game force, game power, using little clock time, playing against rivals with a higher CIMAX, etc.

$$C_x^{final}(1) = C_x^{initial}(1) + \Delta \tag{11.16}$$

$$C_x^{final}(2) = C_x^{initial}(2) - \Delta \tag{11.17}$$

We can analyze how CIMAX values change in the case of a two-player XIMA match for different cases of CIMAX and game power:

- Case $P_G(1) \sim P_G(2), C_x(1) \sim C_x(2)$: Players with equal CIMAX who developed similar game power in their match. Suppose player 1 wins. The CIMAX gain or loss for the player is given by the game level developed in their match, and the CIMAX correction factor is $\Delta = L_G$.

- Case $P_G(1) \sim P_G(2), C_x(1) \neq C_x(2)$: Players with different CIMAX values who developed a similar game power during their match. Suppose that player 2 has a higher CIMAX, $C_X(1) < C_X(2)$, and that player 2 wins, which is the most likely outcome because they have a higher CIMAX. Then, player 2's gain will be determined by the game level but reduced by the relation between both players' CIMAX values, $\Delta = \alpha L_G$, where $\alpha = \frac{C_X(1)}{C_X(2)}, \alpha < 1$. It is more remarkable if a player with a lower CIMAX defeats one with a higher CIMAX. In the case that player 1 wins, where $\alpha > 1$, the CIMAX gain is greater for player 1, and player 2 suffers a greater loss. Conclusion: the CIMAX correction factor is $\Delta = \alpha L_G$, where the multiplicative factor $\alpha = \frac{C_X^{\text{loser}}}{C_X^{\text{winner}}}$ represents how many times the winner's CIMAX is relative to the loser's.

- Case $P_G(1) \neq P_G(2), C_x(1) \sim C_x(2)$: Players with similar CIMAX values who developed different game powers during their match. Suppose that player 2 developed a higher game power, $P_G(1) < P_G(2)$, and that player 2 wins, which is the most likely outcome because they have a higher game power. Then, player 2's gain will be determined by the game level but reduced by the relation between both players' game powers, $\Delta = \beta L_G$, where $\beta = \frac{P_G(2)+1}{P_G(1)+1}, \beta > 1$. The factor β was defined this way by adding 1 to the game powers to avoid complications caused by divergences that could affect the meaning of the magnitudes. Now, let us analyze the case where player 1 wins the match. In that case, even though player 2 had greater game power, they were unable to win, and player 1, with lower game power, managed to win, or it could be the case that player 2 made a mistake, giving the victory to player 1. On the contrary, the point is that player 1 absorbs more points from player 2's CIMAX than if player 2 had won. Now, if the factor $\beta = \frac{P_G(1)+1}{P_G(2)+1}$ is in this form, player 1 would not have the gain they deserve since $\beta < 1$. Therefore, the game power that should be in the denominator is the higher game power, $\beta = \frac{P_G^{\text{Max}}+1}{P_G^{\text{Min}}+1}$. This form of β fits well in different situations. Conclusion: The CIMAX correction factor is $\Delta = \beta L_G$, where the multiplicative factor $\beta = \frac{P_G^{\text{Max}}+1}{P_G^{\text{Min}}+1}$ represents a gain ratio for the player who wins the match, either having a lower game power or having a higher game power than the opponent.

- $C_x(1) \neq C_x(2)$ and $P_G(1) \neq P_G(2)$: Players with different CIMAX and game power values. This case combines the two previous cases. The CIMAX correction factor is $\Delta = \alpha \times \beta \times L_G$, where $\alpha = \frac{C_X^{\text{loser}}}{C_X^{\text{winner}}}$ and $\beta = \frac{P_G^{\text{Max}}+1}{P_G^{\text{Min}}+1}$.

In conclusion, for a XIMA match where the players have CIMAX values of $C_x(1)$ and $C_x(2)$ and develop game powers of $P_G(1)$ and $P_G(2)$, the adjustment of their new CIMAX values, depending on the winner or loser, is given by the correction:

For a three-player XIMA match where player 1 wins:

$$\Delta = \alpha \times \beta \times L_G = \frac{C_X^{\text{loser}}}{C_X^{\text{winner}}} \left(\frac{P_G^{\text{Max}} + 1}{P_G^{\text{Min}} + 1} \right) (F_G(1) + F_G(2)). \tag{11.18}$$

In the case of a XIMA match with more than two players, a similar analysis can be performed, leading to an extension of the CIMAX correction equation.

For a match with n players where the winner is player i, the correction can be extended similarly.

$$\Delta = \frac{C_X^P(2)}{C_X^G(1)} \frac{C_X^P(3)}{C_X^G(1)} \left(\frac{P_G^{\text{Max}}(1,2)+1}{P_G^{\text{Min}}(1,2)+1} \right) \left(\frac{P_G^{\text{Max}}(1,3)+1}{P_G^{\text{Min}}(1,3)+1} \right) (F_G(1)+F_G(2)+F_G(3)), \tag{11.19}$$

and in the case of a match with n players where the winner is player i.

$$\Delta = \prod_{i=1, i\neq j}^{n} \alpha_{ij} \beta_{ij} L_G, \tag{11.20}$$

$$\Delta = \prod_{i=1, i\neq j}^{n} \frac{C_X^P(i)}{C_X^G(j)} \left(\frac{P_G^{\text{Max}}(i,j)+1}{P_G^{\text{Min}}(i,j)+1} \right) \sum_{j=1}^{n} F_G(j). \tag{11.21}$$

The CIMAX depends on what is done in the game, the number of turns, the dominated and captured blocks, the time spent on the clock, etc. Let's look at an example to calculate the CIMAX of two players in a match. For this, let's take the example match we are using, knowing that player A (red) has a CIMAX of $C_X(A) = 1240.11$ ximas and player B (blue) has a CIMAX of $C_X(B) = 1322.81$ ximas.

11.8 Steps to calculate a player's CIMAX

To calculate a player's new CIMAX after a match, the Delta Δ must be calculated and added to the player's CIMAX if they win, or subtracted if they lose. Delta is calculated by multiplying the alpha factor by the beta factor by the level of the game.

$$\Delta = \alpha \times \beta \times L_G. \tag{11.22}$$

1. Calculate the game force of each player, the game power, and the game level. The steps to calculate each of these magnitudes have already been explained earlier.
2. Calculate the alpha factor, for this, divide the CIMAX of the loser by the CIMAX of the winner $\alpha = \frac{C_X^{\text{loser}}}{C_X^{\text{winner}}}$.
3. Calculate the beta β factor, for this, divide the maximum game power by the minimum game power. Before dividing, add 1 to the game power of each player. Add 1 to each power and then divide the results, always dividing the larger result by the smaller one, $\beta = \frac{P_G^{\text{Max}}+1}{P_G^{\text{Min}}+1}$.
4. Calculate Delta Δ, it is calculated by multiplying the alpha factor by the beta factor, and then multiplying the result by the level of the game.

$$\Delta = \alpha \times \beta \times L_G = \frac{C_X^{\text{loser}}}{C_X^{\text{winner}}} \left(\frac{P_G^{\text{Max}}+1}{P_G^{\text{Min}}+1} \right) (F_G(1)+F_G(2)). \tag{11.23}$$

5. The Delta factor Δ is then added (if the player won) or subtracted (if the player lost) from the player's CIMAX to obtain the new CIMAX.

Now let us apply these steps to the example game:

11.9 CIMAX Calculation Example

1. Calculate the game force for each player ($F_G(A) = 40$, $F_G(B) = 50.5$), game power ($P_G(A) = 0.98$, $P_G(B) - 1.36$), and game level ($L_G = 90.6$).
2. Calculate the factor α by dividing the loser's CIMAX by the winner's CIMAX: $\alpha = \frac{C_x(A)}{C_x(B)} = 1240.11/1322.81 = 0.93$.
3. Calculate the factor β by dividing the higher game power by the lower, adding 1 to both powers before division: $\beta = \frac{P_G(B)+1}{P_G(A)+1} = \frac{1.36+1}{0.98+1} = 1.19$.
4. Calculate Delta $\Delta = \alpha \times \beta \times L_G = 0.93 \times 1.19 \times 90.5 = 100.15$.

Then the CIMAX of the winning player B is increased by Δ because they won, and the CIMAX of player A is decreased by Δ. The new CIMAX of both players would be:

$$C_x(A) = 1240 - 100 = 1140, \quad (11.24)$$

$$C_x(B) = 1322 + 100 = 1423. \quad (11.25)$$

As a result of the match, a certain amount of points, calculated using the CIMAX equation, was transferred to the CIMAX of the winning player. The value of this point transfer varies depending on the magnitudes of the match and does not solely depend on a simple outcome such as whether a player wins or loses. The calculated magnitudes for the example game are summarized in the following table.

Players	Force	Power	Starting CIMAX	Outcome	Final CIMAX
Play. Red (A)	40	0.98	1240 (-100.15)	Lose	1140
Play. Blue (B)	50.5	1.36	1322 (+100.15)	Win	1423

11.10 Game Experience

Xima incorporates a simple quantitative system to calculate the experience gained by players, a novel parameter that allows us to distinguish between two players who will face each other in a match. We can define experience as the knowledge or skill acquired by having done, lived, felt, or suffered something one or more times.

Let player 1 have a Cimax $C_x(1)$ and experience ε_1, and player 2 have $C_x(2)$ and ε_2, who face each other in a match. Player 1 emerges victorious, gaining Δ in their Cimax, while the losing player incurs a loss of Δ. Then, the new experience ε' for each player in this game is:

$$\varepsilon'_{winner} = \varepsilon_{winner} + \frac{\Delta}{2}, \quad \varepsilon'_{loser} = \varepsilon_{loser} + \Delta, \quad (11.26)$$

where the winning player gains half the experience of the losing player. This is because we associate that the losing player has learned more from the defeat and can reflect on their mistakes, while the winning player also gains experience by refining their technique, avoiding errors, and applying the knowledge they possess.

Experience is a monotonically increasing quantity and is always positive. This quantity serves as a statistic when two rivals face off. For example, consider a game between two players whose

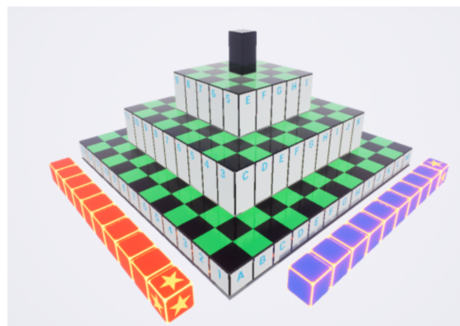
CIMAX values are 1229 and 1250, seemingly players of similar levels, but their experience tells a different story: one player has 2230 experience, while the other only has 625. The conclusion is clear: despite having a similar ranking, one player has much more experience than the other, as they have played more games, lost more, while the other player has fewer games, but won most of them.

11.11 Game Analysis. Calculation of CIMAX

The next chapter aims to show, comment on, and explain some example games to calculate the relevant data such as force, power, and the new CIMAX of the players.

Game 1

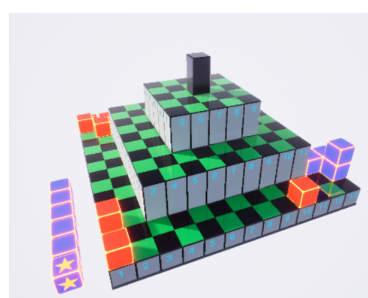
#	Player A (Red)	Player B (Blue)
1	-A1	-B13
2	-M1	-L13
3	-K1	-K13
4	-M10	B13L
5	-B2	-K12



B13L. The blue player creates a double defense to move to the second level by dominating the squares K11 and J11. **B2**. The red player has some poorly coordinated blocks but aims to move to the second level with a simple defense (which is faster) targeting square C3.

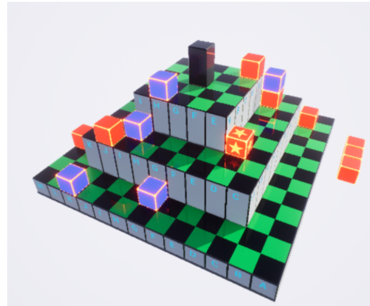
J11. Incorporates by using the opponent's step block to block the entrance and prevent the opponent from adding blocks to the second level.

#	Player A (Red)	Player B (Blue)
6	MA1	J10
7	D4	H9
8	-J11	KG12
9	E5	-C3
10	=D9	D4



KG12. Moves their step block to G12 to create more routes to the second level, but this is a very good play because the red player uses it to position themselves as well.
10A. Moves the special block to the second level to combine it with the block at D4 to try to bring it to the third level, but risks it being dominated by the blue block at H9.

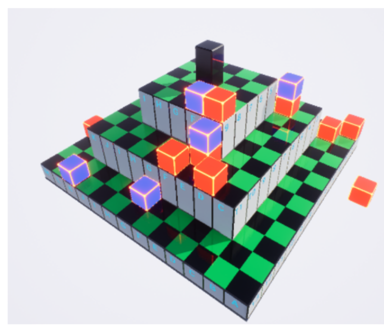
#	Player A (Red)	Player B (Blue)
11	-E10	4D9
12	-F11	IE10
13	JD11	HxD9
14	KA1	DF9
15	E9	D4



10B. Dominates the block at D4 with the goal of having the opponent capture it and lose time, exchanging material for time. Additionally, if the opponent doesn't capture it, the red player is threatening the enemy's special block.

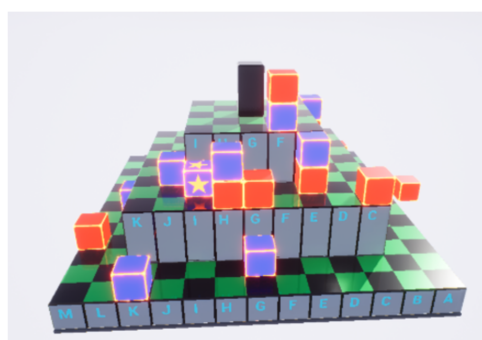
4D9. The opponent makes an error by incorporating at E10 instead of moving their special block or capturing the block at D4, as their special block has been dominated by the blue block at D4.

#	Player A (Red)	Player B (Blue)
16	F9	-J9
17	DH11	H11
18	C3	-L7
19	3C11	-J9
20	FG11	=I10



HxD9. Captures the red special block, forcing the red player to rescue it in the future if they wish to recover it.

#	Player A (Red)	Player B (Blue)
21	M6	7M6
22	-C3	=J9
23	xH11	E6
24	GH10	G6
25	J9	FxJ9

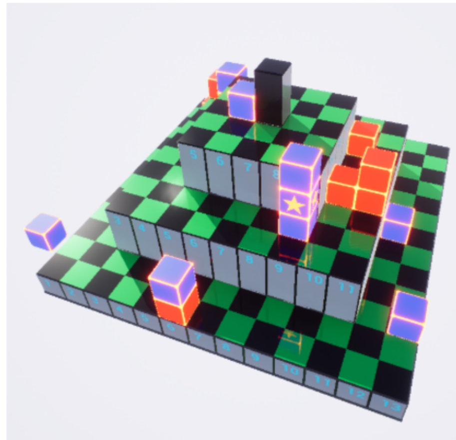


L7. Incorporates a block as a step to create an entry to move the special block up.

FG11. Moves the block to G11 to be able to capture the enemy block at H11.

=I10. Excellent move by incorporating the special block at I10, threatening the H11 square and preventing the red block at C11 from capturing at H11.

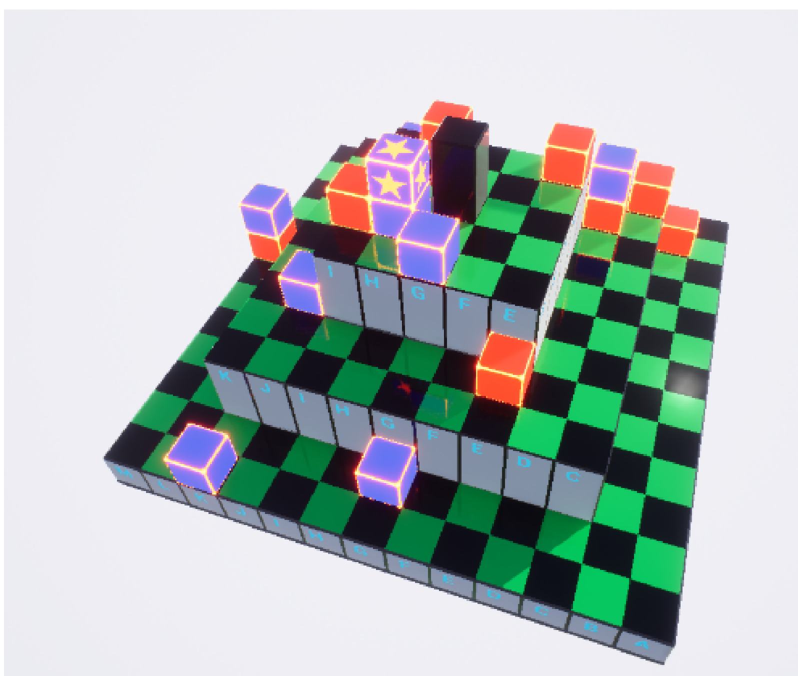
#	Player A (Red)	Player B (Blue)
26	H5	H5
27	H7	G9
28	I8	=G9
29	E10	5H8
30	10E5	=H8
31	xD4	TOP



M6. The red block attempts to ascend through the step at L7 but is dominated by the same block.

=J9. Moves the special block to J9 to access the third level. The red block at C11 can now freely capture the blue block at H11. At this point, it is evident that the blue player has a considerable advantage.

E6. Moves the block to E6 to position it at G6, allowing the special block to reach the top.



GH10. The step allows access to the third level and blocks the special block's path to G6.

J9. Dominates J9 to force the blue player to capture it and gain a turn.

=G9. The special block moves to G9, reaching a height above all blocks on the third level. Only one step block is needed to reach the top.
xD4. The red player resigns upon seeing the game is lost and captures the blue block at D4.

Now we will calculate the force and power of each player using the steps explained in previous chapters. Additionally, let's calculate how the new CIMAX values change.

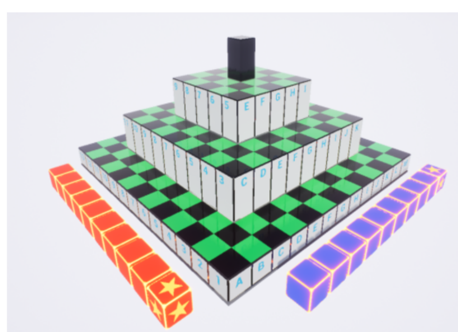
Players	Force	Power	Level of Play	Turns	Effective time	CIMAX Variations	Outcome
Play. Red A	39	1.08	95.57	31	0.21	-107.5	Lose
Play. Blue B	56.57	1.34			0.44	+107.5	Win

Here we can notice that the winner spent more time on the clock compared to the other player. Furthermore, it is evident that the winner has greater force and power, as expected for the player who reaches the top. The game level does not reach 100 ximas, so it can be considered a medium-level game.

Game 2

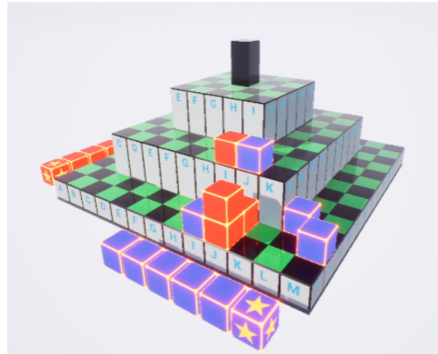
J2. The red player places a step block at J2 to, along with the tower at J1, reach the second level. However, the position is not advantageous because it leaves the diagonals open for the opponent to also place their blocks.

#	Player A (Red)	Player B (Blue)
1	-B1	-M2
2	-J1	-M3
3	J1	-I1
4	-J2	-L3
5	-I3	J3



J3. The blue player moves to J3 to block the red blocks' path, although leaving an opening at K3 for the opponent to add a block to the second level.

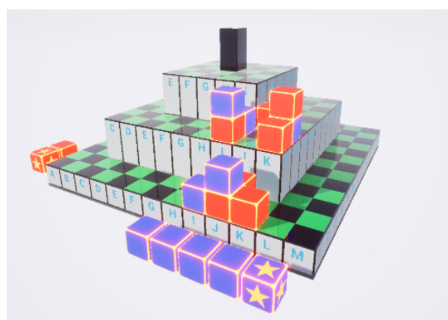
#	Player A (Red)	Player B (Blue)
6	-K3	MK4
7	K4	-K3
8	-K1	KI3
9	-K3	JI4
10	1J5	LJ1



JI4. Dominates the block at I4, but leaves an opening through which the red blocks can access the second level.

LJ1. Dominates the block at J1 to force the opponent to retreat and capture it to gain a turn.

#	Player A (Red)	Player B (Blue)
11	5xJ1	I5
12	1J5	LJ1
13	xJ1	J3
14	IJ3	-G12
15	-F11	-I10

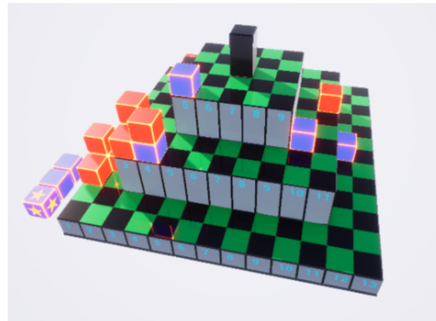


I5. The blue player reaches the third level first, which, in some cases, is associated with a higher probability of winning.

LJ1. Offers a block again for the opponent to capture and retreat.

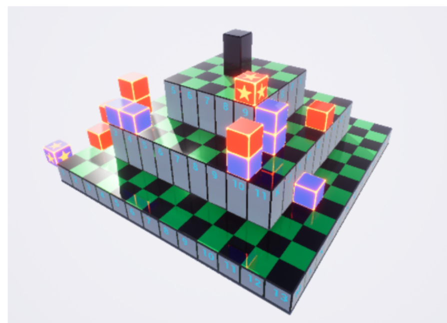
J3. Now, the blue player removes their step block from the second level and blocks the path to the second level, leaving the red block structure as it was at the beginning of the game. Now, the blue player has an advantage by having a block at the third level.

#	Player A (Red)	Player B (Blue)
16	-H11	GI12
17	=I9	I9
18	xJ4	-K10
19	3K10	-K3
20	HI10	xI10



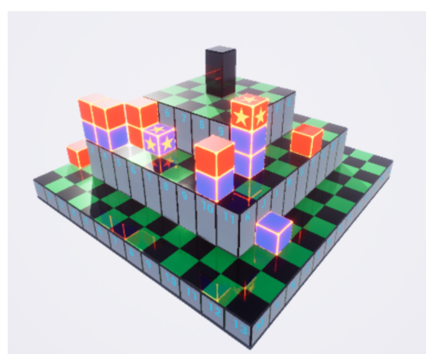
G12. Opens a new entry on the other side of the board to combine with the block at I5.

#	Player A (Red)	Player B (Blue)
21	=I10	4K9
22	JK3	9K4
23	JK4	=J13
24	1J5	IJ12
25	1J5	=J6



GI12. Moves the step block to I12, leaving a direct entry to the third level, since the opponent only has one block outside, their special. This move aims to capture the enemy special, which is forced to rise. If not, the blue player would add another block to the third level, giving them more advantage.

#	Player A (Red)	Player B (Blue)
26	JG8	L12
27	=G8	H9
28	TOP	-

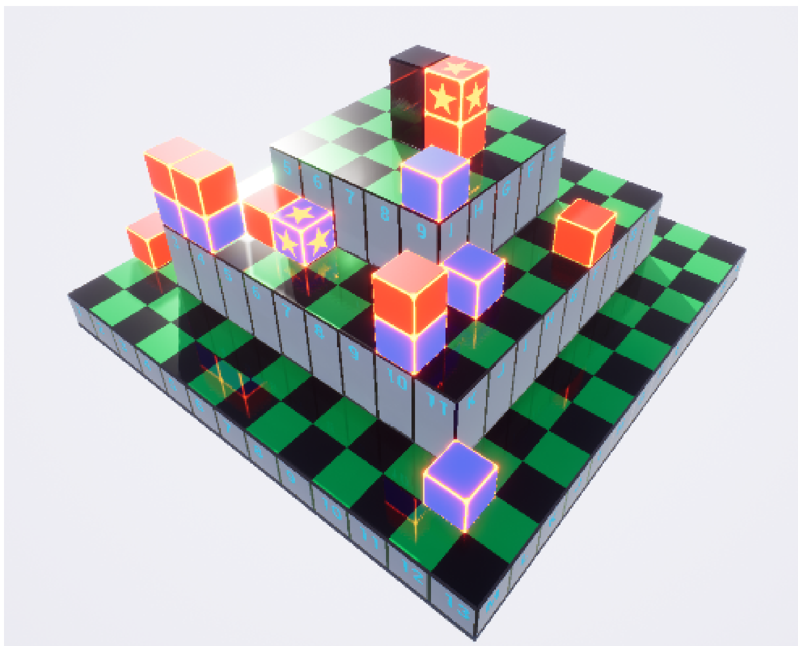


xI10. Captures the red block that was going to the third level at I10, freeing the enemy special. This is a poor move by the blue player that may cost them the game, as keeping control of the special would delay the opponent and force them to have at least two red blocks at the third level to release it.

=J13. Incorporates the special at the first level, a poor move since the red player can dominate it with the red blocks in the same row.

1J5. Prepares the block to position at G8 so that the special can reach the top. There's no need to dominate the enemy special, as the blue player already has the game won. The blue player has lost all their advantage at the third level and has no way to defend.

=G8. At this point, the red player can either choose to win or start capturing and dominating the blue player to gain game force. This would cost a few turns and slightly decrease game power. It's a personal decision: finish the game here or completely defeat the opponent, which is also a valid option. In fact, the opponent may surrender to avoid giving the red player points for game force or face them and gain points as well.



Now, let's calculate the force and power of each player using the steps explained in previous chapters. Additionally, let's calculate how the new CIMAX values change. All is summarized in the following table:

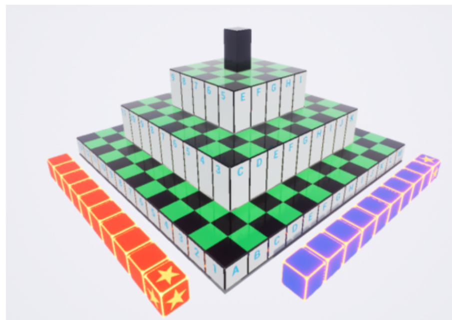
Players	Force	Power	Level of Play	Turns	Effective Time	CIMAX Variation	Outcome
Play. Red A	62	1.55	94	28	0.51	+136.9	Win
Play. Blue B	32	0.75		27	0.65	-136.9	Lose

We notice that the winning player nearly doubled the game force of the loser, as they dominated most of the opponent's blocks and controlled the third level. Additionally, the victorious player developed a much higher game power compared to the blue player, whose game power is below

1. Although the skill level exceeds 100 ximas, this is considered a medium-level game where both players made mistakes.

Game 3

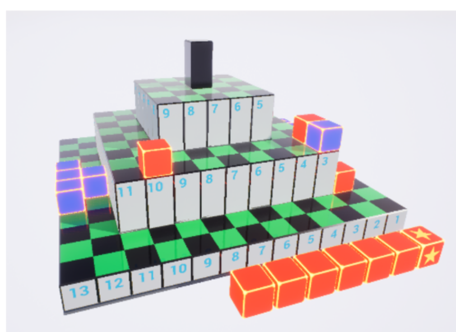
#	Player A (Red)	Player B (Blue)
1	-B1	-F13
2	-C1	-E13
3	-C2	-G13
4	D3	-F12
5	C10	-C3



C3. The blue player opts for a triple defense, which is slower to build but more effective when moving blocks to the second level.

C10. The red player moves to C10 to dominate a future step block at row 10, but leaves an opening in their own step block through which the opponent can rise.

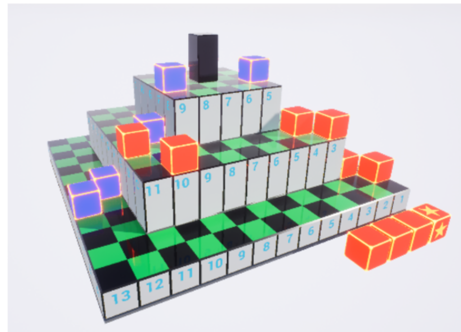
#	Player A (Red)	Player B (Blue)
6	-B1	E11
7	E4	D3
8	-C3	F5
9	ED4	E11F10
10	-E11	13F9



D3. Moves to block the red blocks' path to the third level, but leaves an entry open for the red player to incorporate a block.

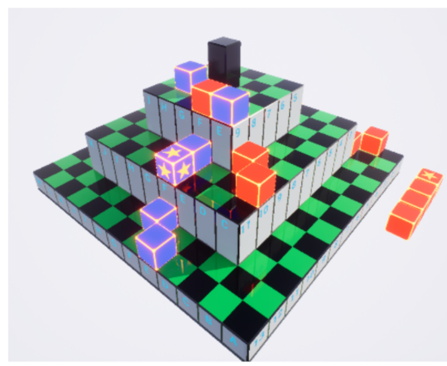
-C3. Incorporates using the opponent's step block to block the entry and prevent further block incorporation to the second level. Does not dominate at D3, leaving the access to the third level open for the blue block, doing so to add more blocks to the second level.

#	Player A (Red)	Player B (Blue)
11	EG9	=F11
12	GF10	9xF10
13	CF6	5F6
14	4D9	F6H8
15	F9	E9



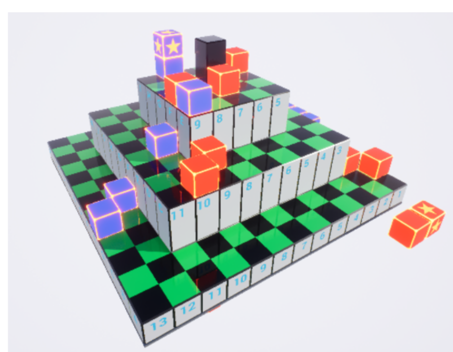
E11F10. Acts as a step block to let the F13 block rise to the third level. The red block can dominate it, but won't since the F5 block can capture it. It's a good move, sacrificing the force of the triple defense by leaving openings for the red player to rise to the second level, but gaining speed by moving another block to the third level.

#	Player A (Red)	Player B (Blue)
16	H5	I8
17	-C10	=F10
18	CF7	=I7
19	-C10	=I8

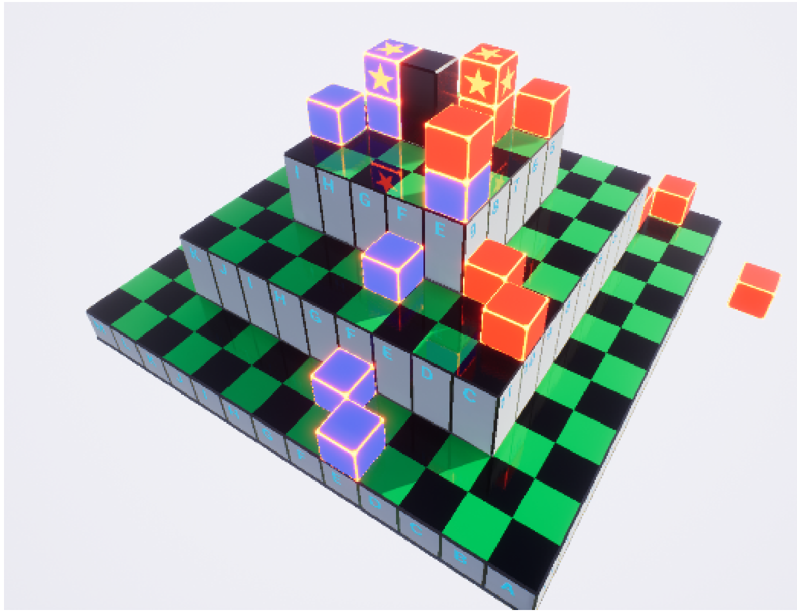


4D9. Moves to D9 so the red block can rise, but this is a bad move since the enemy special can dominate it.

#	Player A (Red)	Player B (Blue)
20	E9	-E10
21	F6	H8
22	HE5	H7
23	=F7	=H7
24	=F6	TOP



F6H8. Observe how the player leaves the red block free and provokes it to dominate at F10. However, it cannot, as the blue block from H8 protects that position. In case of domination, the red block would be captured.



-C10. Now it's the red player's turn to use a block to rise to the third level with protection at D9.

=I8. The special rises over their own block to have the necessary height to pass over any block that might interfere. It's a very strong position; only a step block is needed to reach the top.

-E10. Incorporates to later move it to H8 as a step and let the special reach the top.

HE5. With this move, the player threatens H8, and the enemy special can't move because it might be dominated. In the end, it only delays the inevitable; just move the step block to H7.

Players	Force	Power	Level of Play	Turns	Effective Time	CIMAX Variation	Outcome
Play. Red A	50.62	1.48	105.47	24	0.36	-118.2	Lose
Play. Blue B	54.85	1.78			0.51	+118.2	Win

We note that, despite the blue player always having the advantage on the board, the red player ended up dominating the special to the third level, adding some points to the red side. Thus, game forces are almost equal. It was a close game in terms of incorporations and dominations.

The following games are provided for the reader to review and complete the table of magnitudes.

12. EXERCICES

12.1 Exercise 1

#	Player A (Red)	Player B (Blue)	#	Player A (Red)	Player B (Blue)	#	Player A (Red)	Player B (Blue)
1	-D1	-M2	13	I5	-I7	25	DD8	6J5
2	-D2	D2	14	E5	-K5	26	DE7	MK4
3	-D13	-M4	15	3D11	D3M	27	GF7	+7
4	-D12	-L4	16	-K3	K3	28	-D7	D8
5	DxD	-D3	17	L4	JxL4	29	6xD8	KI6
6	-D11	-K5	18	4D8	C3	30	DF8	IH6
7	D3	=M3	19	1D8	LJ6	31	6F8	-K5
8	-D4	J6	20	G8	MJ6	32	DD7	HI6
9	2C3	=I7	21	KD3	JF6	33	EF6	KI5
10	3D4	-D11	22	3D8	F5	34	DF7	5I7
11	=C3	=G5	23	DF6	F6	35	8E7	5J4
12	-I7	=E5	24	xF6	=I5	36	FF6	I6H7

Players	Force	Power	Level of Play	Turns	Effective Time	CIMAX Variation	Outcome
Play. Red A				36	0.44		
Play. Blue B					0.42		

12.2 Exercise 2

#	Player A (Red)	Player B (Blue)	#	Player A (Red)	Player B (Blue)
1	-A4	-B1	13	I10	D3
2	-B4	-C5	14	=I4	I3
3	-C3	-A3	15	FD9	-G10
4	AC4	D6	16	-G8	F9
5	BA3	-C2	17	F9	G11
6	3C2	-G12	18	CD9	H11
7	-C8	-J9	19	DF7	J11
8	-H11	H11	20	=F7	J3
9	-F11	-L7	21	TOP	-
10	-I4	-I10			
11	I4	=J9			
12	=J5	=I10			

Players	Force	Power	Level of Play	Turns	Effective Time	CIMAX Variation	Outcome
Play. Red A				21	0.31		
Play. Blue B					0.22		

12.3 Exercise 3

#	Player A (Red)	Player B (Blue)	#	Player A (Red)	Player B (Blue)
1	-A4	-B1	13	BE4	-F3
2	-B4	B4	14	-C3	3F4
3	-M4	-G2	15	3C5	xD5
4	-C6	-D5	16	H7	J5
5	D5	-E4	17	DE4	G8
6	-J5	-H3	18	H7	=G8
7	-L4	E4	19	FE4	TOP
8	=K5	xE4			
9	=E4	J5			
10	=xJ5	J5			
11	ME4	-C5			
12	ED5	-K3			

Players	Force	Power	Level of Play	Turns	Effective Time	CIMAX Variation	Outcome
Play. Red A				19	0.19		
Play. Blue B					0.12		

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THE END

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