The Usage of Combinatorials to Calculate Different Super Attack Scenarios of Ultimate Red Zone Bosses in Dragon Ball Z: Dokkan Battle

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Abstract—**Dragon Ball Z: Dokkan Battle is a game that has been widely popular in multiple different countries such as the United States and France. The gameplay structure of this game requires players to be strategic with their moves while also having an element of luck within the fights themselves. The element of luck within this game creates different numbers of possibilities that could happen within a fight. It is possible to calculate the different possibilities using combinatorial. This paper researches the usage of combinatorial to count the possibilities that could happen in every boss in the final stages of Ultimate Red Zone editions, as the results can help mathematically show the difficulty of each stage that is researched in this paper.**

Keywords—**Combinatorial, Combinations, Different possibilities, Ultimate Red Zone**

I. INTRODUCTION

Dragon Ball Z: Dokkan Battle is a free-to-play mobile game that is based on the Dragon Ball franchise. It is developed by Akatsuki and published by Bandai Namco Entertainment on 30 January 2015, in Japan for Android and 15 February 2015 for IOS. The worldwide release for this game came several months after the release in Japan, specifically on 16 July 2015 for both Android and IOS.

Ever since its release, Dragon Ball Z: Dokkan Battle has been providing players with new content which includes different game modes as well as different events with varied amounts of difficulty. One of those events is called the Ultimate Red Zone. Ultimate Red Zone is an event in Dragon Ball Z: Dokkan Battle that has players fight against bosses that have high amounts of stats which includes attack stat, defense stat, health stat, damage reduction percentage, amount of attacks, as well as other gimmicks such as multiple super attacks and chances to dodge players' attacks. Ultimate Red Zone is notorious among players as being difficult to defeat relative to every edition's release dates.

Due to the different stats of bosses in every edition of Ultimate Red Zone, the difficulty between those editions may also vary. One way to mathematically understand the difference in difficulty between every edition of Ultimate Red Zone is with the usage of combinatorial and applying them to the stats of the bosses in every edition of Ultimate Red Zone, specifically stats which concerns the super attack percentages the bosses have as well as the number of attacks the bosses do.

II. DRAGON BALL Z: DOKKAN BATTLE

Before delving into the more mathematical side of this research, the subject of this research must first be understood. As explained previously, Dragon Ball Z: Dokkan Battle is a free-to-play mobile game based on the Dragon Ball franchise that is developed by Akatsuki and published by Bandai Namco Entertainment.

Dragon Ball Z: Dokkan Battle has lasted for over 8 years, still getting high amounts of support even in December of 2023. Throughout the years, the game has introduced multiple different game modes. Such game modes include events, World Tournament, Virtual Dokkan Ultimate Clash, etc. Throughout these multiple game modes, the gameplay stays mostly the same with mostly some minor changes and tweaks.

The gameplay of Dragon Ball Z: Dokkan Battle can be seen not as an action based gameplay, but rather a mesh of different gameplay elements from board games, puzzle games, and collectible card games. The gameplay requires the player to bring a team of 7 collectible characters and go on stages that bear a similarity to board games. The board game aspect of Dragon Ball Z: Dokkan Battle can be seen in the image below.

Fig 2.2 The board game aspect of Dragon Ball Z: Dokkan Battle

There are different tiles in the board section of the game such as item tiles, power-up tiles, trap tiles, mystery tiles as well as enemy tiles. Item tiles are identified with a symbol of a capsule with different colors. Meanwhile, power-up tiles are identified by a silhouette of a person as well as a yellow aura surrounding the silhouette. Then, trap tiles are identified with a target symbol as well as the red color in those tiles themselves. Next up are mystery tiles which can be identified with a question mark symbol. Finally, there are enemy tiles which are identified by a symbol of an actual character. If a player lands on an enemy tile, the game will take the player to the fight section of the game.

The fight section of the game has 3 different characters on the field with 4 other characters that will be on the field in the following turns, an enemy with a certain amount of health, as well as colored orbs known as Ki spheres. To fight an enemy, a player has to collect Ki spheres in order to defeat the enemy while surviving the enemy's attacks that will reduce your health. The following image is a screenshot of the gameplay.

Fig 2.2 The gameplay of Dragon Ball Z: Dokkan Battle

As seen in the image, there are 23 Ki spheres with multiple different colors that are spread randomly across the field. Those colors being blue, red, yellow, purple, green, and rainbow. The game requires players to get enough Ki spheres to do attacks, preferrably a super attack if the Ki meter in the characters have reached a certain point. There are also 3 different character slots with 4 enemy slots. The 4 enemy slots being before the first character slot, after the first character slot, after the second character slot, and after the third character slot. This coupled with the stats of the enemies players face can provide the data needed to make calculations for the super attack scenarios for different bosses using combinatorial or combinatorics.

III. COMBINATORIAL

Combinatorial, also known as combinatorics, is the basis used in this report. Combinatorial in definition is a field of mathematics that concerns problems regarding selection, arrangement, and operation within the finite and discrete system. As formally said in the definition, it revolves within the finite and discrete system which means that it concerns systems that only have a countable or limited number of states.

As stated in the definition, combinatorial is a field of mathematics which means it encompasses multiple different subjects. The following are the subjects that are under combinatorial.

A. Rule of Product and Sum

Rule of product and sum is the most basic set of rules in regard to how things are arranged. The set of rules within the rule of product and sum are tied with multiplication and addition with multiplication being under the rule of product and addition being under the rule of sum. The rule of product and sum concerns 2 different things or subjects which have their own number of ways to arrange. With subject 1 having a p number of ways to arrange things and subject 2 having a q number of ways to arrange things, the rule of product and sum can be defined by the following equations.

$$Subject\ 1\ and\ 2 = p\,.\,q$$
$$Subject\ 1\ or\ 2 = p + q$$

In these equations, it is stated that subject 1 and 2 equates to p times q. That means if there is a p amount of ways to arrange subject 1 and q amount of times to arrange subject 2, p times q can be used to define the amount of ways to arrange both subjects at once. A similar case can also be seen in the last equation which states that subject 1 or subject 2 equates to p plus q. That means there is a p amount of ways to arrange subject 1 and q amount of times to arrange subject 2, p plus q can be used to define the amount of ways to arrange either subject.

B. Principle of Inclusion and Exclusion

Principle of inclusion and exclusion is a principle which concerns the ways to organize different things by using the number of elements in sets as well as intersections and unions between sets. This principle can be used when dealing with different sets by arranging things through the uses of intesections and unions to achieve the desired results. For example, there are 2 sets which have the name of set A and set B. Both sets intersect in a manner that is shown in the image below.
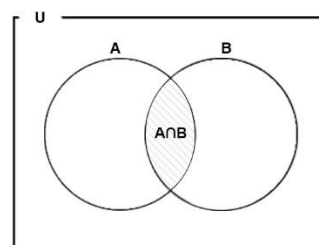

Fig 3.1 Two sets intersecting with one another
(Taken from Mathstopia)

This image shows the two different sets and how they intersect with each other. By using the principle of inclusion and exclusion, it becomes possible to find a solution to a problem using the sets themselves as well as intersections and unions. To get the union of 2 sets, the following equation can be used.

$$|A \cup B| = |A| + |B| - |A \cap B|$$

This equation means that to acquire the union between set A and set B, it is possible to add set A and B and subtract it with the intersection between set A and B.

C. Permutation

The definition of permutation when applied to a set is the different ways to arrange the set in different orders. Permutation in mathematical terms is similar to factorials, multiplying the amount of things in a set to the same amount subtracted by 1 and multiplied again by the same amount subtracted by the previous subtraction added by 1. The same process goes on until it multiplies by 1 and it can no longer be subtracted. The only difference being that permutation can stop before reaching 1 depending on the circumstances while factorials will always keep going until it reaches 1. The following is the normal equation for permutation.

$$|P| = n(n-1)(n-2) \ldots (2)(1) = n!$$

In this case, the result of a permutation can be defined by using a factorial on the number that represents the amount of things in a set in which in this case, that number is n. Not every case can be represented with only a single factorial as some cases may ask for the subset of n instead of n itself. The following is an equation to do a permutation on the subset of n.

$$|P| = \frac{n!}{(n-k)!}$$

In this case, the result of a permutation can be defined by using a factorial on n which represents the amount of things in a set and dividing it with the factorial of n subtracted by k in which k represents the result of n subtracted by subset of n.

D. Combination

Combination in definition is a form of permutation that does not pay attention to the order of how a set is ordered. For instance, if there are 2 yellow balls and 3 cups, the normal equation for permutation does not apply. Instead, the following equation applies.

$$|C| = \frac{n!}{r!\,(n-r)!} = C(n,r)$$

In this equation, n represents the amount of things in a single set while r represents the subset of n. This equation can be used to calculate the total number of different ways to arrange a set without factoring in different orders.

IV. CALCULATIONS

A. Method of Research

To begin with the calculations, the problem that is being researched must first be made clearer. This is a research of the different super attack scenarios between different bosses in every edition of Ultimate Red Zone using combinatorial. The

results of this research come in the form of calculation which shows the different scenarios that could happen in every Ultimate Red Zone edition. The results of this research can be used to mathematically determine the difficult nature of each boss. Due to the number of factors that may affect this research as well as the number of bosses in every Ultimate Red Zone edition, certain limitations must be implemented. The following are the limitations used in this research.

1. The bosses that will be used for the purpose of this research are only the final bosses of each Ultimate Red Zone edition. Such a limitation is due to the difficult nature of the final bosses in each Ultimate Red Zone edition which works well for the purpose of this research.
2. This research will not account for different characters and items that can be used against the different bosses. This is due to the fact this research only involves the bosses themselves and not the character and item options that can be used even though they can affect how bosses do super attacks.

Finding the different super attack scenarios can be done by applying combinations using the possible amount of super attacks attacks done by bosses in a turn to the number of attacks bosses will always do in a turn. Due to the nature of the gameplay, calculations will include the super attack scenarios in every possible slot as well as every possible attack that can be done in multiple different slots. This allows for the results to show all possible scenarios that can happen in a single turn, no matter how low or high the chances are.

B. Calculations for Ultimate Red Zone [GT Edition]

The final boss for Ultimate Red Zone [GT Edition] is a character whose name is Syn Shenron. Syn Shenron's boss fight has 3 different phases. According to dataminers, his first phase is able to attack 9 times in a single turn with each attack having a 14% chance to be a super attack with a 9-attack cooldown after doing a super attack. Syn Shenron's second phase is also able to attack 9 times in a single turn with each attack also having a 14% chance to be a super attack. The 9-attack cooldown after performing a super attack is also the same. Syn Shenron's third phase however does 10 attacks in a single turn with a 0% chance to be a super attack. Although he may not do a super attack in his third phase, he does a countdown which will allow him to do a very powerful attack once the countdown has reached 0.

Based on the data above, we can apply combinations to calculate the different super attack scenarios in each phase. The following are the calculations for Syn Shenron's first phase.

$$C(9,4)\,.\,2 = \frac{9!}{4!\,(5)!}\,.\,2 = 252$$

According to these calculations, the first phase of the Syn Shenron's boss fight has 252 different possible attack scenarios in a single turn. $C(9, 4)$ is used since Syn Shenron is able to do 9 attacks in 4 different slots. The result of that combination is then multiplied by 2 since Syn Shenron has the chance to either do 0 or 1 super attack.

For Syn Shenron's second phase, the calculations are as

follows.

$$C(9, 4) \cdot 2 = \frac{9!}{4! \, (5)!} \cdot 2 = 252$$

Due to the same number of attacks and attack cooldown, Syn Shenron's second phase has the same number of possible attack scenarios as his first phase.

For Syn Shenron's third phase, the calculations are as follows.

$$C(10, 4) = \frac{10!}{4! \, (6)!} = 210$$

According to these calculations, the third phase of Syn Shenron's boss fight has 210 different possible attack scenarios. C(10, 4) is used since Syn Shenron is able to do 10 attacks in 4 different slots. The result of the combination does not have any added multiplication due to Syn Shenron's third phase not being able to do a super attack.

C. Calculations for Ultimate Red Zone [Movie Edition]

The final boss for Ultimate Red Zone [Movie Edition] is a character whose name is Broly. Broly's boss fight has 4 different phases. According to dataminers, Broly's first phase is able to attack 8 times in a single turn with each attack having a 17% chance to be a super attack with an 8-attack cooldown after doing a super attack. Broly's second phase meanwhile is able to attack 9 times in a single turn with each attack also having a 14% chance to be a super attack. He also has a 9-attack cooldown after performing a super attack. Broly's third phase does the same number of attacks as well as super attack chance and attack cooldown as his second phase. Broly's fourth phase is a little bit different in which he does 11 attacks in a single turn with a 20% chance to do a super attack. He also only has a 5-attack cooldown after performing a super attack hence allowing him to do 2 super attacks in 1 turn.

Based on the data above, we can apply combinations to calculate the different super attack scenarios in each phase. The following are the calculations for Broly's first phase.

$$C(8, 4) \cdot 2 = \frac{8!}{4! \, (4)!} \cdot 2 = 140$$

According to these calculations, the first phase of the Broly's boss fight has 140 different possible attack scenarios in a single turn. C(8, 4) is used to show all the possible attack scenarios in a single turn since Broly is able to do 8 attacks in 4 different slots. The result of that combination is then multiplied by 2 since Broly has the chance to either do 0 or 1 super attack.

For Broly's second phase, the calculations are as follows.

$$C(9, 4) \cdot 2 = \frac{9!}{4! \, (5)!} \cdot 2 = 252$$

According to these calculations, the second phase of Broly's boss fight has 252 different possible attack scenarios. C(9, 4) is used since Broly is able to do 9 attacks in 4 different slots. The result of that combination is then multiplied by 2 since Syn

Shenron has the chance to either do 0 or 1 super attack.

For Broly's third phase, the calculations are as follows.

$$C(9, 4) \cdot 2 = \frac{9!}{4! \, (5)!} \cdot 2 = 252$$

Due to the same number of attacks and attack cooldown, Broly's third phase has the same number of possible attack scenarios as his second phase.

For Broly's fourth phase, the calculations are as follows.

$$C(11, 4) \cdot 3 = \frac{11!}{4! \, (7)!} \cdot 3 = 990$$

According to these calculations, the fourth phase of Broly's boss fight has 990 different possible attack scenarios. C(11, 4) is used since Broly is able to do 11 attacks in 4 different slots. The result of that combination is then multiplied by 3 since Broly has the chance to either do 0,1, or 2 super attacks.

D. Calculations for Ultimate Red Zone [Wicked Bloodline Edition]

The final boss for Ultimate Red Zone [Wicked Bloodline Edition] is a character whose name is Metal Cooler Core. Metal Cooler Core's boss fight has 2 different phases. According to dataminers, Metal Cooler Core's first phase is able to attack 11 times in a single turn with each attack having a 20% chance to be a super attack with a 5-attack cooldown after doing a super attack. This allows his first phase to super attack twice in a single turn. After 3 turns however, the boss fight transitions to its second phase that is able to attack 8 times in a single turn with each attack having a 17% chance to be a super attack. Although not doing as many attacks as he does during his first phase, Metal Cooler Core has a massive increase in stats during his second phase.

Based on the data above, we can apply combinations to calculate the different super attack scenarios in each phase. The following are the calculations for Metal Cooler Core's first phase.

$$C(11, 4) \cdot 3 = \frac{11!}{4! \, (7)!} \cdot 3 = 990$$

According to these calculations, the first phase of Metal Cooler Core's boss fight has 990 different possible attack scenarios. C(11, 4) is used since Metal Cooler Core is able to do 11 attacks in 4 different slots. The result of that combination is then multiplied by 3 since Metal Cooler Core has the chance to either do 0,1, or 2 super attacks.

For Metal Cooler Core's second phase, the calculations are as follows.

$$C(8, 4) \cdot 2 = \frac{8!}{4! \, (4)!} \cdot 2 = 140$$

According to these calculations, the second phase of the Metal Cooler Core's boss fight has 140 different possible attack

scenarios in a single turn. C(8, 4) is used to show all the possible attack scenarios in a single turn since Metal Cooler Core is able to do 8 attacks in 4 different slots. The result of that combination is then multiplied by 2 since Metal Cooler Core has the chance to either do 0 or 1 super attack.

E. Calculations for Ultimate Red Zone [Red Ribbon Army Edition]

The final boss for Ultimate Red Zone [Red Ribbon Army Edition] is a character whose name is Cell Max. Unlike most other difficult bosses in the game, Cell Max only has one phase. According to dataminers, he is able to attack 10 times in 1 turn with each attack having a 25% chance to be a super attack. However, he only has a 2-attack cooldown which means he is able to do multiple super attacks in rapid succession. The total amount of super attacks he can do in 1 turn is limited to 3 times.

Based on the data above, we can apply combinations to calculate the different super attack scenarios in each phase. The following are the calculations for Cell Max's boss fight.

$$C(10,4) \cdot 4 = \frac{10!}{4!\,(6)!} \cdot 4 = 840$$

According to these calculations, the Cell Max boss fight have 840 different possible attack scenarios. C(10, 4) is used since Cell Max is able to do 10 attacks in 4 different slots. The result of that combination is then multiplied by 4 since Cell Max has the chance to either do 0, 1, 2, or 3 super attacks.

F. Calculations for Ultimate Red Zone [Dismal Future Edition]

The final boss for Ultimate Red Zone [Dismal Future Edition] is a character whose name is Fusion Zamasu. Fusion Zamasu has 2 different phases. According to dataminers, his first phase is able to attack 10 times in 1 turn with each attack having a 15% chance to be a super attack and one of those attacks having an effect to hit all enemies. He has no attack cooldown although the total amount of super attacks he can do in 1 turn is limited to only once each turn. His second phase, however, is able to do 8 attacks in 1 turn with a 17% chance to do a super attack. He has an 8-attack cooldown after doing a super attack which makes him only capable of doing 1 super attack each turn.

Based on the data above, we can apply combinations to calculate the different super attack scenarios in each phase. The following are the calculations for Fusion Zamasu's boss fight.

$$C(10,4) \cdot 2 \cdot 2 = \frac{10!}{4!\,(6)!} \cdot 2 \cdot 2 = 840$$

According to these calculations, the first phase of Fusion Zamasu's boss fight has 840 different possible attack scenarios. C(10, 4) is used since Fusion Zamasu is able to do 10 attacks in 4 different slots. The result of that combination is then multiplied by 2 since Metal Cooler Core has the chance to either perform 0 or 1 super attack. The result of that is then multiplied again by 2 due to the fact Fusion Zamasu can either do 0 or 1 attack that attacks all of the player's characters that are in the field.

For Fusion Zamasu's second phase, the calculations are as follows.

$$C(8,4) \cdot 2 = \frac{8!}{4!\,(4)!} \cdot 2 = 140$$

According to these calculations, the second phase of Fusion Zamasu's boss fight has 140 different possible attack scenarios in a single turn. C(8, 4) is used to show all the possible attack scenarios in a single turn since Fusion Zamasu is able to do 8 attacks in 4 different slots. The result of that combination is then multiplied by 2 since Fusion Zamasu has the chance to either do 0 or 1 super attack.

G. Calculations for Ultimate Red Zone [SDBH Edition]

The final boss for Ultimate Red Zone [SDBH Edition] is a character whose name is Hearts. Hearts has 2 different phases. According to dataminers, his first phase is able to attack 7 times in 1 turn with each attack having a 17% chance to be a super attack. He has a 7-attack cooldown after performing a super attack which allows him to do 1 super attack at most each turn. His second phase, however, is able to do 8 attacks in 1 turn without a chance of it being a super attack. Instead of a super attack, he does a countdown similar to Syn Shenron's third phase which allows him to do a very powerful attack once the countdown reaches 0.

Based on the data above, we can apply combinations to calculate the different super attack scenarios in each phase. The following are the calculations for Hearts' boss fight.

$$C(7,4) \cdot 2 = \frac{7!}{4!\,(3)!} \cdot 2 = 70$$

According to these calculations, the first phase of Heart's boss fight has 70 different possible attack scenarios. C(7, 4) is used since Hearts is only able to do 7 attacks in 4 different slots. The result of that combination is then multiplied by 2 since Hearts has the chance to either perform 0 or 1 super attack.

For Metal Cooler Core's second phase, the calculations are as follows.

$$C(8,4) = \frac{8!}{4!\,(4)!} = 70$$

According to these calculations, the second phase of Heart's boss fight also has 70 different possible attack scenarios due to different reasons. C(8, 4) is used since Hearts is able to do 8 attacks in 4 different slots. The result of the combination does not have any added multiplication due to Heart's third phase not being able to do a super attack. His super attack mechanic is replaced by a countdown mechanic that allows him to perform a powerful attack once the countdown reaches 0.

V. RESULTS

The results gained from this research is that the final bosses of all Ultimate Red Zone editions tend to have different super

attack scenarios that go up to hundreds of different possibilities.

Ultimate Red Zone [GT Edition] has Syn Shenron as the boss for the final stage. Syn Shenron has an average amount of attacks. However, Syn Shenron still boasts a respectable amount of damage output. Couple that with the rest of his stats and he is able to pose a good challenge for newer accounts even to this day. That said, there are not a lot of scenarios that can really show how dangerous Syn Shenron can be. That can be attributed to the unit releases that have become more powerful as time passes. However, a super attack in the first slot can happen with multiple different scenarios showing attacks in the first slot as well as a decent amount of chance to do a super attack.

Ultimate Red Zone [Movie Edition] has Broly as the boss for the final stage. Although released at the same time as the Syn Shenron stage, Broly has the capability to do more attacks than most other Ultimate Red Zone final bosses as well as a damage output that is still respectable even to this day. According to the calculations that have been previously done, there are a bunch of scenarios that can be dangerous during the fight against Broly as he has a chance to perform a super attack early in a turn. Couple that with Broly's third phase having the capability to damage every one of the player's characters on the field with 1 super attack, it certainly can be dangerous. During Broly's fourth phase, he is able to do 2 super attacks with one turn, each having a 20% chance to activate. This coupled with the number of attacks Broly does allows for multiple different dangerous scenarios for players to be in.

Ultimate Red Zone [Wicked Bloodline Edition] has Metal Cooler Core as the boss for the final stage. Metal Cooler Core does multiple different attacks early in the boss fight only to trade it with a high increase in stats in his second phase. There are scenarios that can be dangerous when facing Metal Cooler Core. Similar to Broly's fourth phase, Metal Cooler Core's first phase allows for multiple different scenarios where he does 2 super attacks in 1 turn, hence dealing high amounts of damage. Meanwhile, Metal Cooler Core's second phase might not have the same amount of dangerous scenarios. However, there are certain dangerous scenarios where Metal Cooler Core performs a super attack in the first slot. His high damage output in his second phase makes such a scenario harder to deal with as well.

Ultimate Red Zone [Red Ribbon Army Edition] has Cell Max as the boss for the final stage. Cell Max is by far the only boss in the game to be able to perform 3 super attacks in 1 turn. This affects the amount of dangerous scenarios that can happen when facing Cell Max as Cell Max has multiple different scenarios that can happen during a single fight. Considering the high amount of attacks, the amount of super attacks Cell Max can do in a turn, and his 25% chance of performing a super attack, the amount of dangerous scenarios that is possible against Cell Max are high.

Ultimate Red Zone [Dismal Future Edition] has Fusion Zamasu as the boss for the final stage. Fusion Zamasu is known to be the most notorious Dokkan boss as of December 2023 due to his damage output and one of his attacks that can hit every character on the field. This makes Fusion Zamasu have the most amount of dangerous scenarios. Fusion Zamasu's first phase has a multitude of dangerous scenarios where he can do a super attack as well as an attack that hits every character on the field

in the first or second slot. Fusion Zamasu's second phase however has a smaller number of dangerous scenarios though his damage output is enough to make most scenarios into a dangerous one.

Ultimate Red Zone [SDBH Edition] has Hearts as the boss for the final stage. Unlike other final bosses of Ultimate Red Zone editions, Hearts has a lower attack count as well as a lower damage output compared to most other final bosses in every other Ultimate Red Zone edition. Due to these factors, Hearts does not have a lot of dangerous scenarios.

VI. CONCLUSION

In conclusion, combinatorial can be used to calculate the different super attack scenarios in Ultimate Red Zone stages in Dragon Ball Z: Dokkan Battle. Although the results help to mathematically show the difficulty behind the Ultimate Red Zone stages that are viewed in this paper, the results do not stand on their own. Instead, the results work to complement different aspects of each bosses' stats to determine the difficulty of different bosses.
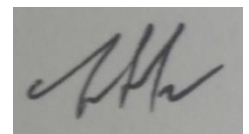
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PERNYATAAN

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