

The Quest for the Perfect Weapon

Analyzing Costs, Production, Supply, and Demand



Figure 1. A Red Craven with Perfect Statistics

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Introduction

For my capstone project, I will be analyzing different means to obtain a perfect version of a weapon known as the Red Craven in a game popularly known as Maplestory and evaluating which one of these options is in the best interest of my clientele.

Maplestory is a massively multiplayer online role-playing game (MMORPG) in which you can use certain scrolls obtained from various sources within the game in order to improve your character's equipment which, in turn, improves your character's overall damage per second—one of the main objectives of the game. The equipment we will be focusing on is a weapon for the thief subclass known as Night Lords called the Red Craven—more specifically, what's known as a perfectly scrolled Red Craven, meaning that it has the maximum potential statistics possible within the game. In order to obtain this item, my clientele has two options:

1. Attempt to generate the perfect Red Craven themselves via scrolling

or

2. Wait until another player lists the item for sale and purchase it.

My clientele, late game Night Lords, are the most concerned about the price and supply of these perfect Red Cravens and the production costs and methods associated with generating this legendary item. My business objective is to determine whether it's more feasible for a late game Night Lord to attempt to make this perfect Red Craven through scrolling or purchase it from a different player when one hits the market.

Relation to the Real World

Just as in the real world, when making some product, corporations often analyze whether it is a better business decision to invest resources to create a component of a product required to achieve some greater goal or simply just purchase it from another corporation that already has invested time and money to create the product. For example, Apple Inc.

outsources the majority of its product's screen displays from companies like LG Display and Japan Display Incorporated (Apple, 2023, pp. 9, 11). Outsourcing components of a product, especially in the electronics industry, is a common practice because it allows for a company to focus on its larger business objectives and minimize labor costs while still reaping the benefits of a product developed by top talent (Darwish, 2021).

Background

I. Ability Points (AP)

A. In Maplestory, there are a total of four different abilities—strength (STR), dexterity (DEX), intelligence (INT), and luck (LUK). Each one serves a different purpose, and each job class benefits from a different makeup of abilities.

Typically, a class has one primary statistic which they benefit the most from damage-wise and one secondary statistic.

1. For example, the class that we are interested in is the thief subclass known as the Night Lord whose primary statistic is LUK and secondary statistic is DEX.

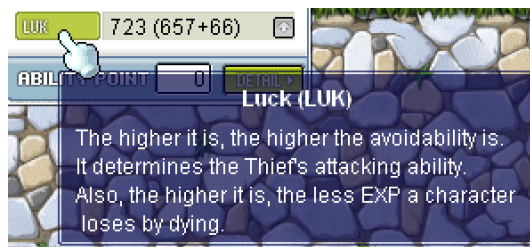


Figure 2. Description of LUK Statistic

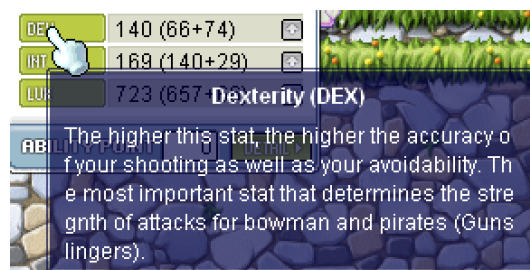


Figure 3. Description of DEX Statistic

- B. At level one, your character starts out with 25 ability points. The distribution of these points are determined on a rolling number game (RNG) basis shown below in figure 4.



Figure 4. Example of Statistics Determined by RNG

- C. Each level, you typically gain a set total of 5 ability points that you can apply to any ability—once you finish the game and reach level 200, the amount of potential AP is static. The only other way to obtain extra statistics to boost your character's damage per second is by supplementing with scrolled equipment.
- D. Relation of LUK to Weapon Attack (W. ATT)
 - 1. This varies depending on what level you are, but for our target audience which are Night Lords that are in the late stage of the game, the ratio is approximately 6-6.5 LUK : 1 Weapon Attack (Selquin, 2021).
 - 2. The relationship between DEX and Weapon Attack isn't well understood. However, we know that for Night Lords, it is nowhere as influential to weapon attack compared to the relation between LUK and weapon attack.

II. Scrolls

- A. In Maplestory, there are several different types of scrolls with varying probabilities with which they will pass that can achieve different desired statistics such as strength (STR), dexterity (DEX), intelligence (INT), luck (LUK), weapon attack (W.ATT), and magic attack (M.ATT) if used on a piece of equipment.

1. Example: The scroll that we are most interested in, Dark Scroll for Claw for ATT, yields 1 LUK and 5 weapon attack in addition to the base statistics of the claw if the scroll passes (*Dark Scroll for Claw for ATT* 30%, n.d.)

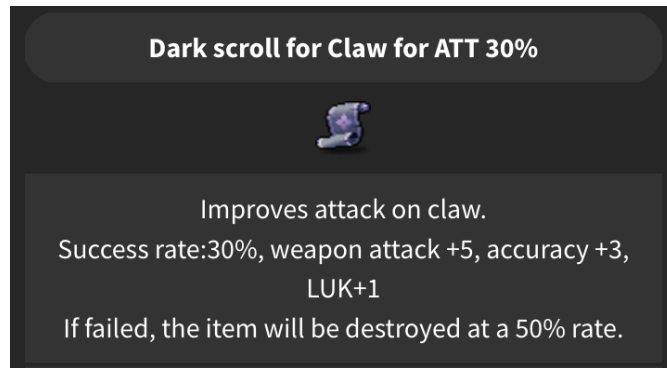


Figure 5. Dark Scroll for Claw for ATT 30%

Dark Scroll for Claw for ATT 30% [Photograph]. Retrieved from <https://maplelegends.com/lib/use?id=2044705>

- B. The most common scrolls are those that have a probability of passing either 10%, 30%, 60%, or 70% of the time. Typically, those that have a probability of passing 10% and 30% of the time are the highest yield of additional statistics whereas 60% and 70% scrolls have a lower yield of additional statistics.
 1. Example: Additional statistics yielded when various scrolls for claw for ATT successfully pass

Probability of Scroll Passing	Additional LUK	Additional W.ATT
10%	1	5
30%	1	5
60%	0	2
70%	0	2

Figure 6. Claw for ATT scrolls with different pass rates and resulting statistics

2. Note: Logically, it seems like the best options are the 30% and the 70% since they yield the exact same results as the 10% and the 70%,

respectively. However, the 30% and the 70% have a conditional destruction feature by which if the scroll fails, then there is a 50% chance of destruction, hence the name, *dark* scroll.

Probability of Scroll Passing	Additional LUK	Additional W.ATT	Chance of Destruction if Scroll Fails
10%	1	5	N/A
30%	1	5	50%
60%	0	2	N/A
70%	0	2	50%

Figure 7. Destruction rates for claw for ATT scrolls

III. In-Game Currencies

- A. The primary currency in this game is called the meso, plural form mesos.
- B. For larger priced items, people tend to use something known as prestigious coins due to the fact that the maximum amount of mesos that a single character can hold is 2,147,483,647 mesos, and therefore, it is also the highest amount you can trade to another character in pure mesos and the highest that you can list an item for in the Free Market (the marketplace where players list their items for sale). In addition, it is a way to evade the 2.5% trade tax that the seller has to pay.
- C. The ratio of a prestigious coin to mesos is 1 prestigious coin : 3,513,962 mesos as of June 28, 2023 (Lin, 2023).

IV. “Perfect” end-game weapon for Night Lords: The Red Craven

- A. A finished “perfect” end-game Red Craven is defined as one with the maximum potential in terms of LUK and Weapon Attack that a Red Craven can possess: +14 LUK and +86 Weapon Attack as shown in Figure 1.
 1. **Pricing:** The pricing of a finished, perfect Red Craven ranges anywhere between 3500-4000 prestigious coins which is approximately 12,298,867,149 mesos - 14,055,848,170 mesos. The reason for this variation is supply and demand. If multiple players are

bidding on one Red Craven, the price will naturally go up and vice versa (Lin, 2023).

- B. A “perfect” Red Craven can also entail that it has the maximum potential but is unfinished, meaning that there are still a number of upgrades available—in game, we call these “slots”. Our desired starting statistics of a Red Craven are LUK: +7 and Weapon Attack: 51 and 7 upgrades available.

Quantity of 30% Scrolls Passed	Remaining Slots	Additional LUK	Additional W. ATT	Final LUK	Final W.ATT
0	7	0	0	7	51
1	6	1	5	8	56
2	5	2	10	9	61
3	4	3	15	10	66
4	3	4	20	11	71
5	2	5	25	12	76
6	1	6	30	13	81
7	0	7	35	14	86

Figure 8. Statistics for unfinished, perfect Red Cravens

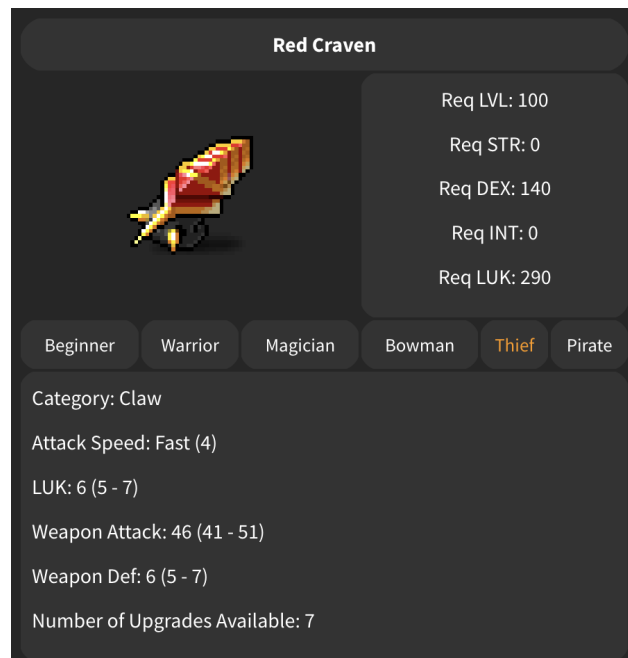


Figure 9. Red Craven



Figure 10. Example of an unfinished, perfect +3 Red Craven (meaning that 3x Dark Scrolls for Claw for ATT 30% passed) with 4 upgrades available

- C. There are multiple other end-game weapon items for Night Lords but Red Cravens are the most popular option due to their accessibility. Other end-game weapons for Night Lords include: Speargrave (Claw), Dragon Green Sleeve, and Dragon Purple Sleeve.

1. Advantages

- a) All of the alternatives have a higher potential weapon attack and overall statistics

Item	Max Weapon ATT (Scrolled)	Max LUK (Scrolled)	Max DEX
Red Craven	86	14	N/A
Speargrave	92	16	N/A
Dragon Green Sleeve	90	15	8
Dragon Purple Sleeve	90	15	8

Figure 11. Alternative late game claw options and their maximum potential

2. Disadvantages

- a) All of the alternatives require more DEX to equip–this is disadvantageous to the character due to the opportunity cost of applying more ability points to the secondary statistic, DEX, rather than the primary statistic, LUK, which therefore also lowers the character’s damage per second.
- b) One work around to this ordeal is to supplement DEX using other equipment, such as eye and face accessories, armor, or a pendant. However, since all of the other attacking characters (all classes except magicians–this includes: other thieves, warriors, archers, and pirates) benefit from DEX, this equipment is very high in demand and is costly.
- c) They are also much more expensive than the Red Craven due to having a lower drop rate and overall lower number of maps that they drop in.

D. Why is it so expensive?

- 1. Night Lords are the most desired bossing class in Maplestory because they ascertain..
 - a) The highest avoidability of all the classes due to LUK being their main statistic. Because of this, Night Lords save a lot of mesos on potions and do not have to worry as much about dying, allowing them to focus more on enjoying the game rather than staying alive.
 - b) Highest damage per second because the weapon type that they use, also known as the claw, has the fastest weapon attack speed.
 - c) Overall ease of play: Due to their primary statistic being LUK, Night Lords have high avoidability so you do not need to

constantly pay attention to re-adjusting the positioning of your character in the map since you often do not get knocked back as a result of mobster attacks. Also, there is really only one main attacking skill whereas many other characters have additional attacks for different circumstances so you can literally just press down one button to cast the skill, triple throw.

2. Status of an end game item

- a) When a character passes a certain threshold for items, upgrades that are only a few statistics greater are exponentially more expensive because it is exponentially harder to obtain the resulting statistics from scrolls.
- b) It is high in demand but low in supply—the only times that a player would sell their perfect item is if they are quitting the game, changing to a different job, or the rare case that they just scroll for fun.

E. Production

1. Materials Required:

- a) Red Craven(s) that are: “clean” in the sense that it has the maximum number of scrolling slots possible: 7 slots and “perfect” in the sense that it has the maximum statistics: +7 LUK and 51 weapon attack.
- b) Dark Scroll(s) for Claw for Attack 30%

2. Average Cost of Materials

- a) **Perfect, Clean Red Craven:** 19,091,893 mesos (Lin, 2023)
- b) **Dark Scroll(s) for Claw for ATT 30%:** 9,639,360 mesos (Lin, 2023)

F. Difficult to produce because..

1. **Financial Constraint:** It is one of the more expensive end-game items to produce out of all the classes within this game.
2. **Limited Supply and High Demand:** The supply of maximum potential “clean” Red Cravens is relatively low while demand is high. The item drops from a few maps and bosses within the game and the statistics are determined by a “rolling number game” (RNG) of a set range. Also, this game has a relatively small player base of about 500-1000 daily players.

Problems

1. Supply
 - a. The supply of all (clean, unfinished, and finished) perfect Red Cravens is relatively low due to low overall player population
 - b. The supply of Dark Scroll(s) for Claw for ATT 30% is also low because there are very few opportunities to obtain it—you can either pull it from..
 - i. Gachapon using gachapon tickets that drop from mobsters
 - ii. Crimsonwood Party Quest
 - iii. Mobsters: Nightghost and Fire Tusk (Dark Scroll for Claw for ATT 30%, n.d.)
2. High up-front cost
 - a. Both the production cost and average cost of a perfect Red Craven are very high. The average casual player usually cannot afford either of these options.

Solutions

1. Supply
 - a. Farm it yourself:
 - i. **Red Cravens:** In addition to dropping from a total of 11 bosses, you can do what's called "farming" which is repeatedly killing mobsters in a map that is known to drop the item. You can also use this as an opportunity to farm gachapon tickets since they drop from all mobs
 1. Pros: You do not have to worry about paying premiums that other players charge. In addition to farming, you can also increase profits by doing what is called selling leech which is a service where a player (usually a magician) kills many mobsters in a short period of time, yielding a significant amount of experience, and selling it to a player in order for them to progress faster within the game.

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2. Cons: Farming is very tedious and time consuming, this may make the game feel like a job rather than a hobby. Also, the chances of a perfect Red Craven dropping is pretty low and is based on RNG.
- ii. **Dark Scroll(s) for Claw for ATT 30%:** In addition to farming, you can join a guild or form a cohort of friends that runs Crimsonwood Party Quests (CWKPQ) often.
 1. Pros: CWKPQ can be fun and is generally very profitable if you run with a small group of people. Many other valuable items, such as prestigious coins, drop from the bonus stage.
 2. Cons: CWKPQ is one of the harder bosses to run because there are so many requirements for party composition and there is something called "signs" which requires two members of each class to be present. It is also a very time consuming party quest, one run usually takes around an hour and it's typically expected that players run it twice. Lastly, the items that drop in the bonus stage are all determined by RNG.
- b. For A Finished Red Craven: Be patient and let it be known through announcements and/or through friends that are of a similar caliber that you are looking to buy a perfect Red Craven.
 - i. Pros: If you buy it instead of attempting to scroll one yourself, you will save a lot in mesos and time that can be invested into another character or better equipment.
 - ii. Cons: This is a waiting game—as I mentioned earlier, there is a very low supply of these perfect, finished Red Cravens. The rare instances in which a player would sell their legendary item is if they are quitting or switching to a different job class.

2. High up-front cost

- a. **Payment Plan/Negotiation:** Sellers understand that the upfront price is high and that most players do not have the full amount of funds to be able to buy the item. Some sellers give the buyer an option to put a down payment and set up a payment plan. In rare cases, other sellers allow the buyer to trade another high priced item and/or top off with mesos/prestigious coins.
 - i. Pros: You have more time to figure out how to make money while still benefiting from having the item (the buyer usually operates on a trust system where they give you the item and just hope that you are a trustworthy individual) and even use it to work towards making the money back.
 - ii. Cons: It can become stressful because the buyer typically has a defined timeline of when to make these payments. If you cannot make these payments on time, this may hurt your reputation as a player and lead to unforeseen repercussions in the future because the community is so small.

- b. **Meso Farming:** The most efficient and secure way to make mesos is by doing what's called "meso farming" in which you find a map with mobs that are known to have high respawn rates and high meso dropping rates.
 - i. Pros: Meso farming can be very profitable if you do it consistently and it can teach you discipline. You are also able to do it on your own schedule since it does not require other players.
 - ii. Cons: The setup of meso farming requires a lot of initial time and money investment. Setups vary but if you want to maximize gain, you need a total of 6 magicians that are level 120 or above and 2 additional characters to pick up the mesos. Similar to other farming methods, this can become very tedious and is very time consuming.

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- c. **Bossing:** Alternatively, a more enjoyable but less efficient way to make mesos is by bossing. Each boss in the game drops a unique subset of items and a mysterious pouch that, if opened, contains a set range of prestigious coins—the alternative currency.
- i. Pros: Compared to item and meso farming, this is a lot more enjoyable because you get to experience the game, play with your friends, and meet new people while also gaining experience to level your character.
 - ii. Cons: Bossing is not as consistent of an income compared to farming because the total value of the bonus/boss drops is highly variable and based on RNG. Also, due to the time consuming nature of bossing content, boss runs are subject to a schedule.
- d. **Merching:** If you already have a lot of mesos and you are patient, you have the option of doing what is known as “merching” which is essentially price gouging. To do this, you buy up most, if not all of the supply of a scroll or other item in the Free Market and as a result, raise the overall average price. This forces players to either wait to buy the scroll or buy it at the price that you set.
- i. Pros: When done strategically, merching can be highly profitable with minimal time investment.
 - ii. Cons: A lot of players question the ethics behind merching because as a mercher, you are contributing to the larger issue of making the game harder (by making things more expensive) which may discourage a lot of players from enjoying the game. In doing so, you compromise your own reputation within the community.

Methods

1. Determining the production cost for a perfect Red Craven (Lin, 2023)
 - a. Average prices of clean, perfect Red Cravens and Dark Scroll for Claw for ATT 30%
 - i. I tracked the prices of perfect, clean Red Cravens and Dark Scrolls for Claw for ATT 30% that were listed in the Free Market for seven different days and recorded them on a spreadsheet.
 - ii. I tested for extreme outliers with the z-test, defining the threshold as data points that fell beyond 2 standard deviations of the mean and excluded them from the analysis.
 - iii. Then, I took the daily averages of those prices and then took the average of the daily prices because there was no feasible way of distinguishing if some listings from different days were merely duplicates.
 - b. Determining the number of materials required to produce perfect Red Cravens (Lin, 2023)
 - i. First, I calculated the probability of achieving our desired results with formula $P(N) = p^N$ where $P(N)$ is the probability of achieving a perfect Red Craven with N scrolls.
 - ii. Then, I used these probabilities to calculate the estimated number of Red Craven's and Dark Scroll(s) for Claw for ATT 30% necessary.
 - iii. To calculate the number of Red Cravens necessary, I used the mean geometric distribution formula, expected value = mean = $1/p$ where p is the probability of N scrolls passing on the first attempt. In the case that the estimated mean number of Red Cravens needed was a decimal, I rounded up because we can only have whole integers of this item.

Quantity of Scrolls	Probability of Scrolls Passing on First Attempt	Estimated Quantity of Red Cravens	Adjusted Quantity of Red Cravens	Cost of Red Cravens
1	0.3	3.333333333	4	76,367,572.00
2	0.09	11.11111111	12	229,102,716.00
3	0.027	37.03703704	38	725,491,934.00
4	0.0081	123.4567901	124	2,367,394,732.00
5	0.00243	411.5226337	412	7,865,859,916.00
6	0.000729	1371.742112	1372	26,194,077,196.00
7	0.0002187	4572.473708	4573	87,307,226,689.00

Figure 12. Calculations for expected quantity of Red Cravens needed to create a perfect with dark scrolls for claw for ATT 30%

- iv. To calculate the number of scrolls necessary, I summed up the number of Red Craven's necessary to achieve a success for that specific slot (e.g., for the 4th slot, we needed 124 Red Cravens) and the number of scrolls we needed for the slots prior (e.g. while calculating the 4th slot, I added the number of scrolls we needed for the 3rd slot).
- v. The calculation for the 1st upgrade was pretty straight forward since we only needed one scroll to pass consecutively—since we needed an estimated value of 4 Red Cravens to pass one scroll, the estimated number of scrolls we needed to successfully pass the scroll on the first slot is 4. For the 2nd slot, I multiplied the probability of a scroll passing by the number of attempts, that is, $(0.3)*12=3.6$. For simplicity's sake, in the case that the product ended in a decimal, I rounded the number up because I needed the final attempt to equal 1, or a probability of 100%.

2. Determining the average price of prestigious coins (Lin, 2023)

- a. I entered all the listings for prestigious coins on 6/28/2023 on a spreadsheet and proceeded with my analysis.
- b. I determined extreme outliers using the z-test, defining the threshold as data points that deviated 2 standard deviations or further from the mean, and excluded them from my analysis.

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- c. According to my research, the average price of one prestigious coin is 3,513,962 mesos as of June 28, 2023.
 - d. Note: I decided to only analyze one day's worth of data because the sample size was much larger than that of the Red Craven's and dark scrolls for claw for ATT 30%. In addition, prestigious coin prices tend to be relatively stable because it is essentially a second currency that the majority of the player base uses in some form.
3. Determining the price of a perfect Red Craven (Lin, 2023)
- I looked at past listings for perfect Red Cravens on the Discord server and confirmed with a few friends that are veteran players and are also late game Night Lord players. I only found a total of four listings but my friends confirmed that the listed price was not far from ordinary. I took the mean and found that the average price was 12,694,187,725 mesos, or 3612.5 prestigious coins.

Conclusion

As a result of conducting this case study, I am reminded of why I am constantly told that buying is always a financially superior option to scrolling. The journey of producing these legendary, end game items through scrolling can become very costly unless you magically beat the law of averages. According to my research, it is far more financially feasible to purchase a perfect Red Craven rather than attempting to scroll one yourself. Based on past listings, the average cost of a perfect, finished Red Craven is 12,694,187,725 mesos whereas the estimated production cost (assuming you purchase all the materials at the average cost) is 150,300,444,289 mesos—nearly twelve times the cost!

Next Steps

The best solution is to save up to buy a perfectly scrolled, finished Red Craven because it is much more affordable than attempting to scroll one yourself. You can finance it primarily through meso farming and some bossing.

Meso farming can become very daunting and requires an extreme amount of discipline since it is such a repetitive task that is typically done for hours on end. People usually do something on the side like watch a show or they take breaks to boss with friends. One popular map for meso farming is Malaysia: Fantasy Theme Park 3 where the mob known as Vikerolas spawn. People usually have a set up in which they have 2 magicians, one that covers each side of the map, and one “sweeper” character that picks up or “sweeps” the drops so that the magicians can stay in place. Aside from meso farming, some bossing would be beneficial to generate some mesos, for a change in environment and gameplay style, and remind you of the reason for your goal—to enjoy the game with your friends.

Some highly profitable bosses that I think you should prioritize running are Horntail and Pink Bean. Some of Horntail's most valuable drops are the Maple Warrior 20 mastery book (up to 3 per run and is valued at about 350m) and mysterious pouch 4 which yields anywhere between 20 to 30 prestigious coins. You can run Horntail up to two times per day

and the drops are typically split between 6-12 people depending on how many people participate. On the other hand, some of Pink Bean's most valuable drops are Facestompers (price is variable depending on statistics, the ones that have the lowest statistic were last sold for 2,450,000,000 mesos), Maple Warrior 30 mastery book (last sold for ~3,000,000,000 mesos), and mysterious coin pouch 5 which yields anywhere between 80 to 100 prestigious coins (HABBYx, n.d., Moon, n.d.). The downsides to Pink Bean is that you can only run it once a week and the drops are typically split anywhere between 18-30 people depending on how many people participate. Good luck on your journey, adventurer!

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