**Five Guys Fun Facts**

By Davis Treybig, Syed Adil,

Lefko Charalambois, Mehul Mehta, and Brian Dorsey

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*To the people and places that brought us together*

**Contents**

[Preface](#Preface)

[The Fun Facts](#TheFunFacts)

[Graham’s Number](#GrahamsNumber)

[Sokaiya](#Sokaiya)

[The Moving Sofa Problem](#TheMovingSofaProblem)

[1936 Berlin Olympics](#BerlinOlympics)

[Women’s Shirt Buttons](#WomensShirtButtons)

[The Arginine Conman](#TheArginineConman)

[Null Island](#NullIsland)

**Preface**

The Fun Facts

**Graham’s Number**

There is a huge number called Graham’s number. Far bigger than googolplex if y’all know of that. Graham’s number is “so large that the observable universe is far too small to contain an ordinary digital representation of Graham’s number, assuming that each digit occupies one Planck volume, possibly the smallest measurable space.”

**Sokaiya**

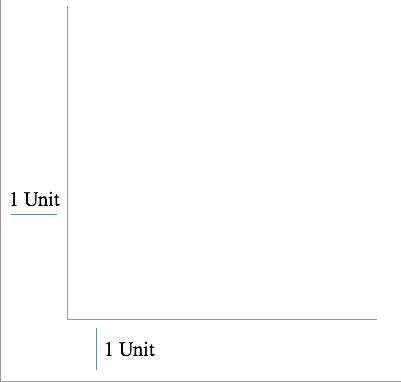
The Yakuza, the most prominent organized crime group in Japan, use a racketeering practice called sokaiya to extort Japanese companies. In Japan, people view shame as the worst possible outcome, sometimes even worse than death. The yakuza prey on this by purchasing the minimum number of shares in a company to be invited to its annual shareholder’s meeting. They then threaten the company’s executive that the Yakuza will come to the meeting and essentially troll them, asking very detailed and pointed questions about small mistakes the company made or making fun of the executives’ wives or mistresses. Unless the company will pay them off (often by purchasing absurdly marked up subscriptions to useless magazines), the yakuza follow through and essentially have ended some executives’ careers.

This is such a big problem that all major corporations will now schedule their meeting on the same day at the same time to limit the number of companies that can be hit by the yakuza in any given year. There is even a specific division of the Tokyo police who only work on preventing sokaiya. In 1984, the law made first steps to reduce the threat from sōkaiya by establishing that you had to own 50,000 yen minimum to be allowed into the shareholder meeting, leading to a slow decline of the number of sōkaiya. In response to this, some sōkaiya would drive what essentially I imagine as ice cream trucks around the building that was holding a meeting, blaring their trolling of the company over the truck’s loudspeakers to try and shame the executives as shareholders walked in and out.

**The Moving Sofa Problem**

When you think of modern problems in mathematics and algorithms, you often think of obscure things, like topology, artificial intelligence, etc. But there are actually a ton of problems that seem SUPER simple, but remain unsolved. For instance, moving furniture.

Consider the following question: What is the largest area of a 2D shape that can be maneuvered through an L shaped planar region with legs of unit width? In other words, if you have the following hallway, what is the maximum area of an object that can be moved through it?

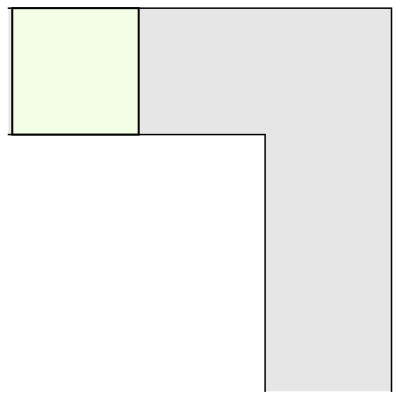


A unit length L-hallway

This problem is known as the “Moving Sofa” problem, and was originally postulated in 1966. The answer to the question (the unknown maximum area A) is known as the sofa constant.

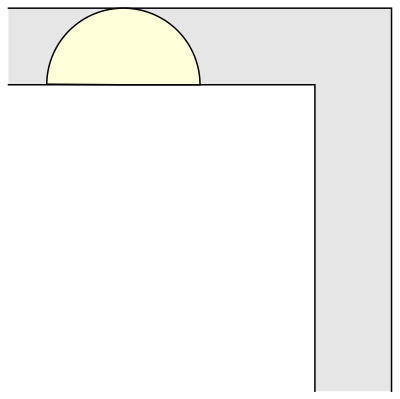
So, what is the elusive sofa constant? Well, we don’t currently know. However, some mathematicians have made some interesting progress on bounding the answer.

The most trivial lower bound is that of a unit square. Below is a gif that demonstrates this behavior. Clearly this lower bounds the sofa constant to 1.



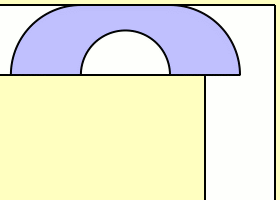
Unit Square Sofa

But, we can do better. Below is another gif, this time demonstrating how a circle of half radius can move through the hallway. This lower bounds the area to π/2.



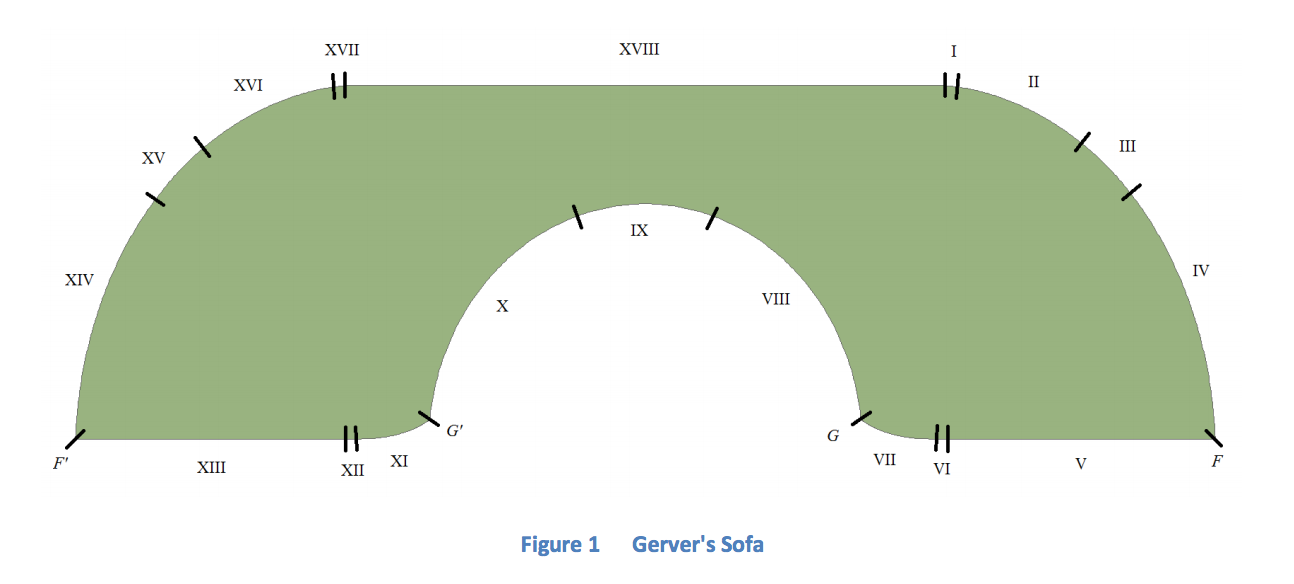
Semicircle Sofa

At this point, though, it gets a bit more interesting. A guy by the name of Jon Hammersley figured out that if you split a semi circle into two quarter circles, and then add a rectangular block in between with a semi circle cut out of it, you get another shape that can move through the hallway! He did all this in a paper called On the enfeeblement of mathematical skills by “Modern Mathematics” and by similar soft intellectual trash in schools and universities. Impressive stuff. Below is a depiction of Hammersley’s sofa:



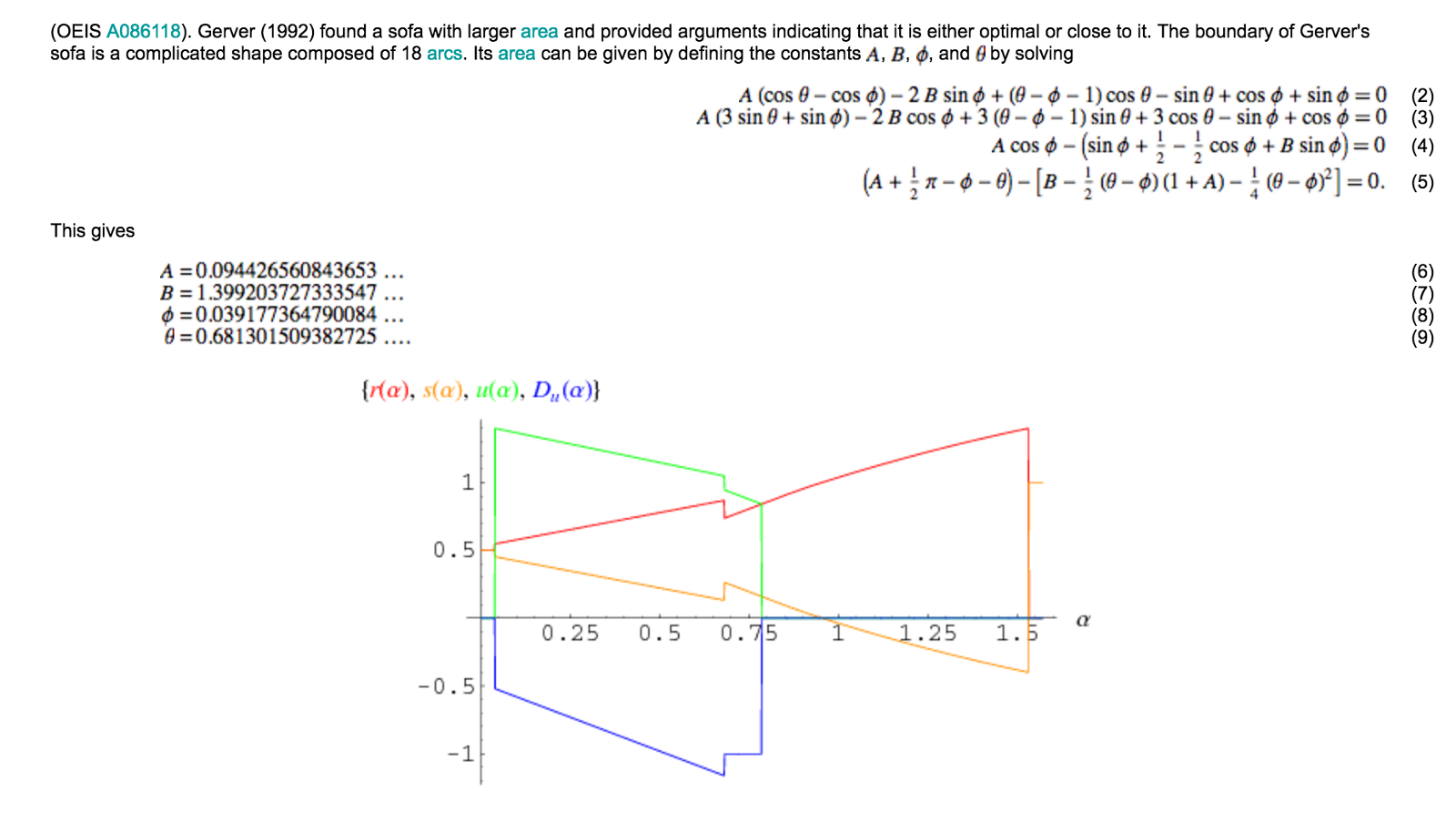
Hammersley’s Sofa

Hammersley’s sofa improved the lower bound of the sofa constant to π/2+2/π. But, this is where it starts to get interesting. A guy named Gerver decided to go full YOLO[[1]](#footnote-1) and compose the shape below, in his very appropriately named paper On moving a sofa around a corner. You’ll note that it looks quite similar to Hammersley’s sofa. However, in fact, it is a shape made of 18 different arcs, each with a distinct formula. (the small demarcations on the shape pinpoint places where different arcs come into play)



Source: Philip Gibbs, “A Computational Study of Sofas and Cars”

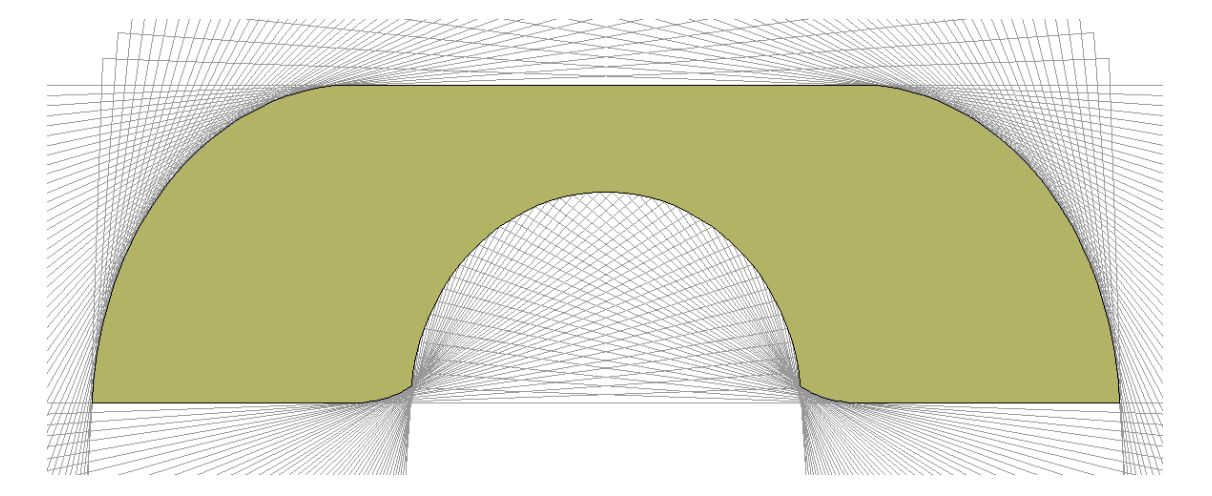
Cool! So what’s the area of Gerver’s fancy 18 arc sofa? Well, that can be answered via some simple math, shown below:



Source: Wolfram Alpha

I don’t understand it either. But, the result is that Gerver’s ridiculously complex sofa has an area of ~2.19…, which is approximately ~.013 higher than Hammersley’s sofa’s area. And as of today, this is the largest sofa proven to go through the unit length hallway.

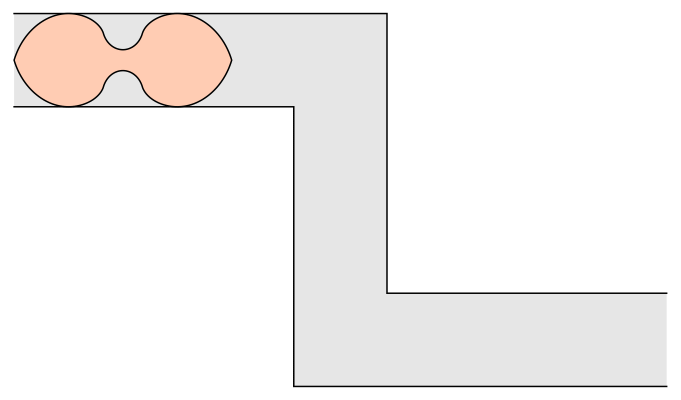
Furthermore, it is believed that this may indeed be the optimal value (the elusive sofa constant). A discretized version of the problem was solved numerically in 2014 by Philip Gibbs. He adopted a somewhat interesting approach in doing this. Instead of constructing different shapes and seeing which could move through the hallway (this is extremely difficult computationally), he considered how a hallway could move around a fixed sofa. In other words, he used a computer to calculate all possible paths a hallway could take around a fixed sofa, in which case the maximum area which fits within the intersection of every hallway path would be the maximum size sofa that can fit in the hallway! (if that doesn’t quite make sense, you can read his paper here) Below is the figure he ended up getting:



Gibbs’ Sofa

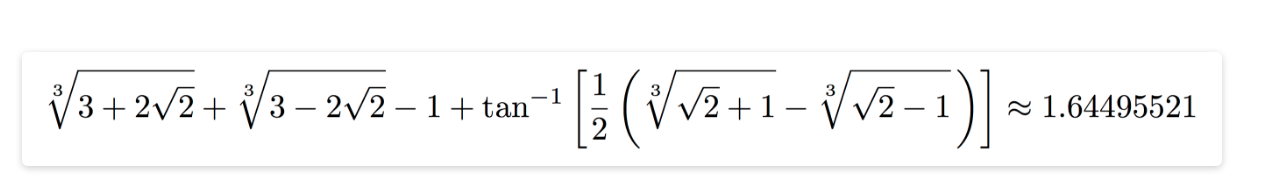
This solution agrees with Gerver’s to 8 significant figures! But, because it is just a discretized version of the problem, we still do not have conclusive proof that this shape is indeed the optimal sofa. :(

There also exist generalizations of this problem that people are still investigating! For instance, what about a hallway that has BOTH a left turn and a right turn? A guy named Dan Romik found the below shape, which is the current best:



Source: Dan Romik

The area of this dumbell looking sofa can be calculated via the following fun formula:



Source: Dan Romik

But, it’s unknown whether this is a truly optimal shape or not. Either way, mathematicians will likely continue to ponder moving sofas through arbitrary spaces, and I can’t wait to see what crazy shapes come next.

**1936 Berlin Olympics**

At the 1936 Berlin Olympics, the US men’s basketball team beat Canada 19–8 to win the gold medal. The game was held outdoors on a dirt court in the pouring rain. The conditions prevented dribbling, which is why the score was so low.

**Women’s Shirt Buttons**

Why do women’s shirts button from the opposite direction? Goes back to the 13th century, when only rich women had shirt buttons. Rich women also had handmaidens dress them, so for their convenience, buttons were placed on the other side. And it stayed like that ever since.

**The Arginine Conman**

Back in the 90’s arginine was all the rage in the Stanford biochemistry department. They had just received a huge grant to study the effects of arginine on blood flow, and there was hope that it could play a key role in unclogging arteries by improving blood flow to poorly supplied areas of the body.

The initial results were a huge success, and so the professor patented the use of arginine as a health supplement and built a small company around it. Tangentially, this is interesting because arginine is a naturally occurring and crucially important amino acid, and so it is a little strange that it can be patented.

Anyways, this professor starts making health bars with arginine in them and markets them. They’re mildly successful and he swears by the stuff. To continue his scholarly pursuit, he gets another federally funded trial for a longitudinal study to prove that on a broad scale these things are good for you. The results come back and it turns out that arginine is actually detrimental to patients with high risk blood flow.

Dr. X was crushed; his life’s work was just proven to be a false lead. Being the good scientist that he was, he admitted defeat and threw in the towel, not wanting to kill people with his business. The patent ends up staying under control of the Stanford patent office for years, until a man named Ron Kramer spotted it. Kramer saw an opportunity and bought the rights to the patent, which Stanford was happy to sell because most university patent offices barely break even.

With the patent, Kramer started a health company called “ThermoLife”. However, the goal of this company wasn’t really to sell useful supplements. Rather, it was a medium by which Kramer could troll the shit out of other supplement companies.

ThermoLife (<http://www.thermolife.com/products/)> has about 9 products listed on their website, and for a long time, 7 of the 9 have been unavailable. What does Kramer do instead of sell products? He finds companies that make legitimate products with arginine, and then sues them for illegal infringement of his patent, using ThermoLife’s few pseudo-supplements as the rationale.

This has pissed off a bunch of people in the industry, who are now teaming up against him and his bullshit. They are calling for the repeal of the laws that allow him to pull off these patent shenanigans, and the movement has even gained the notoriety of president Obama. Their goal is to change the Bayh-Dole act, which allows this to happen.

**Null Island**

There is a fictional island in the South Atlantic, off the west coast of Africa, at latitude/longitude 0,0, called “Null Island.” Although it doesn’t exist in reality, this one-square-meter plot of land helps geographic analysts flag errors in a process called “geocoding.”

Geocoding is the function performed by a geographic information system (GIS) that converts addresses into coordinates which can be easily mapped. This is actually what happens every time you type an address into Google Maps. Due to typos, messy data, or glitches in the geocoder itself, the geocoding process doesn’t always run smoothly. Misspellings and other errors can confuse a geocoder, causing the output to read “0,0”. While this output indicates that an error occurred, since “0,0” is in fact a location on the Earth’s surface according to the coordinate system, the feature will be mapped there, as nonsensical as the location may be. As a result, we end up with an island of misfit data.

Countless GIS professionals and cartographers end up frequently sending data points to Null Island, and this shared experience among map enthusiasts has fed the mystique of Null Island, with GIS enthusiasts creating fantasy maps, a “national” flag, and articles detailing Null Island’s rich history. So not only is Null Island a useful tool to catch errors, but it’s also an elaborate inside joke among cartographers. At “0,0” there is actually a buoy permanently anchored (called “Soul”) to collect data on air temperature, water temperature, wind speed, wind direction and other variables.

After years of geocoder errors, Null Island has hundreds of addresses and places labelled to it that do not, in reality, exist there. This means that it is one of the most interesting, most visited places on Earth, despite the fact that it’s only a data dump that’s been fictionalized by geographers.[[2]](#footnote-2)

**The Maillard Reaction**

The Maillard reaction, as you may know, is what happens when you sear meat. However, this is only one case where the Maillard reaction happens. It’s actually a very common reaction that happens in a lot of different situations, including almost every time we cook food. Searing steaks, browning butter, toasting bread, toasting marshmallows, roasting coffee, baking cookies, and roasting grains are all examples of the Maillard reaction.

In the culinary world, the Maillard reaction is referred to as the “browning reaction”. It starts as a simple chemical reaction between carbonyl groups in sugars and amino groups in amino acids, but ends up being an extremely complicated reaction. This chemical reaction drastically changes the texture and taste of the food involved. And because all different foods have a different combination of sugars and amino acids, the Maillard reaction yields different new flavors for almost every food. Given that, it is hard to say that the Maillard reaction produces this or that taste, but in general it creates a savory or “umami” flavor. Depending on the food, the Maillard reaction can produce a flavor that is especially toasty, nutty, wholesome, or gamey.

The Maillard reaction is drastically accelerated between 284 and 329 Fahrenheit. Above that temperature is

caramelization which is also delicious and above that is pyrolysis (charring) which creates a bitter taste. So a burnt marshmallow isn’t going to just taste a little bit different than a golden brown… it will be completely different. Note — you could have any combination of these reactions in single food item when it is done, but they are distinct chemical reactions with different effects, and will happen at different times and temperatures. Different molecules are present. Keep in mind that this would not happen in a 300-degree oven. It isn’t about the ambient temperature; it has to be the actual temperature of the food. So it happens when the surface of a steak gets to about 300, which requires putting it directly on a very hot surface. In a typical Maillard reaction for a certain food, HUNDREDS of new flavor compounds are created that were not present before the reaction. This is also how artificial flavors are created. Scientists combine different sugars and amino acids, put it through a Maillard reaction, and then taste it and think — hey this almost tastes like peanut butter. Then they tweak the combination of sugars and amino acids until they have the recipe for the artificial flavor for peanut butter. The Maillard reaction also happens in the human eye, and can cause degenerative diseases. Searing before cooking vs searing after cooking will create different tastes, which makes sense. Cooking is always changing the chemical makeup of the food, and searing it first will give food a different initial chemical makeup, so it will react differently and produce a different set of new chemical compounds than if you didn’t sear it. Maillard reactions require high heat and a lack of moisture. So it makes sense that foods cooked with a lot of moisture have a distinctively anti-Maillard taste. Namely, poaching, steaming, boiling, etc. One way to get a Maillard reaction while cooking in water is to use a pressure cooker, because it raises the boiling point of the water and allows the food to reach that ~300 F sweet spot. https://en.m.wikipedia.org/wiki/Maillard\_reaction http://modernistcuisine.com/2013/03/the-maillard-reaction/

1. YOLO means “You Only Live Once” – it is commonly used among today’s youngsters to reference doing something crazy or ridiculous. [↑](#footnote-ref-1)
2. Learn more: https://blogs.loc.gov/maps/2016/04/the-geographical-oddity-of-null-island/ [↑](#footnote-ref-2)