

RecipeScape: An Interactive Tool for Analyzing Cooking Instructions at Scale

Minsuk Chang¹, Leonore Guillain², Hyeungshik Jung¹, Vivian Hare^{3,4}
Juho Kim¹, Maneesh Agrawala³



When it comes to cooking,

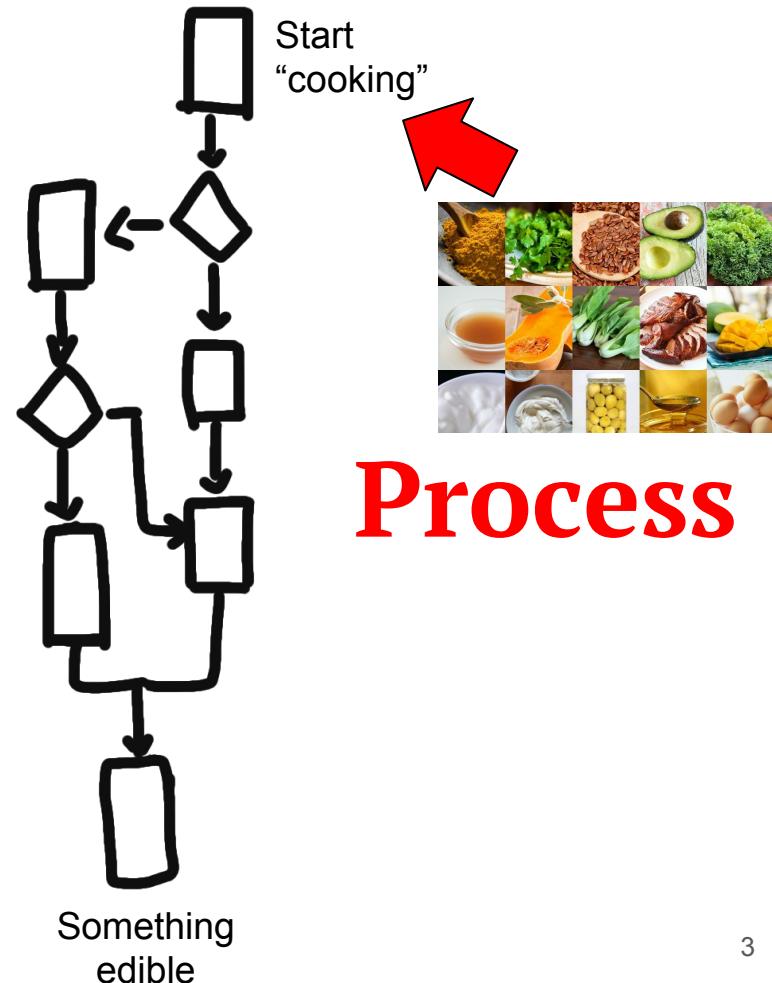
“The proportion of ingredients is important, but the final result is also a matter of **how you put them together.**”

- Alain Ducasse, during an Interview with “the Independent” August 2013

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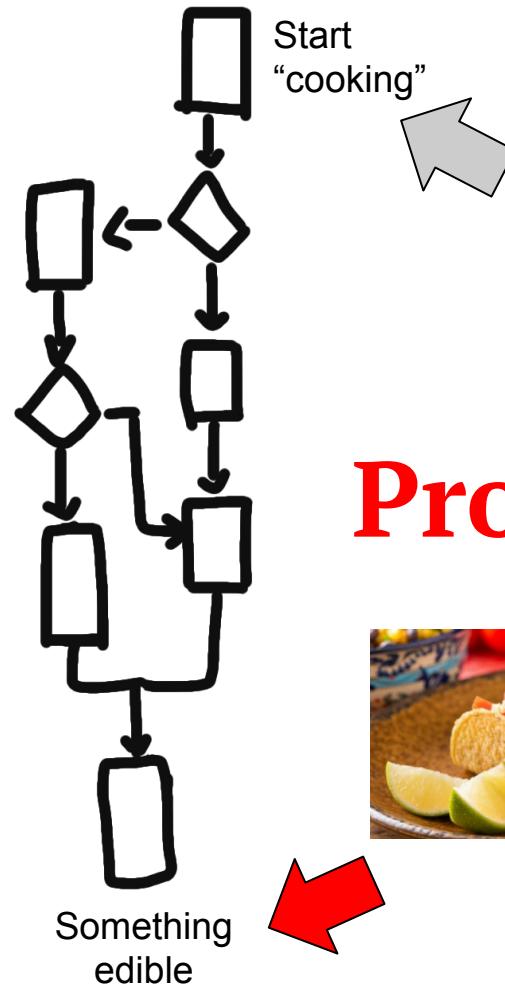
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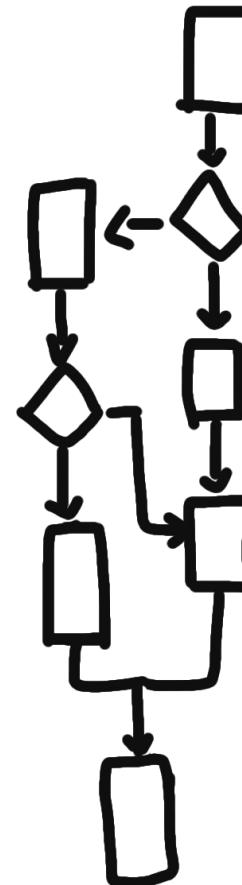


Process

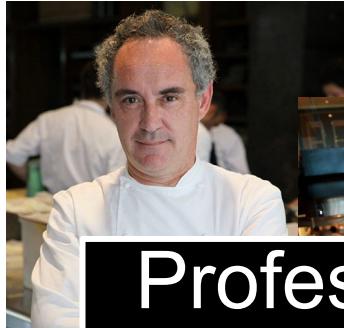
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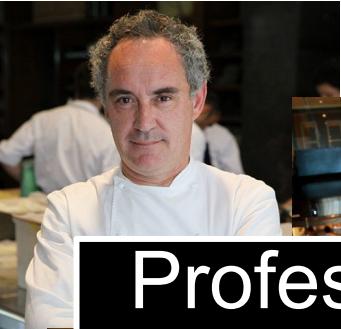


Process
=
**“Cooking
Structure”**



Professional Chefs

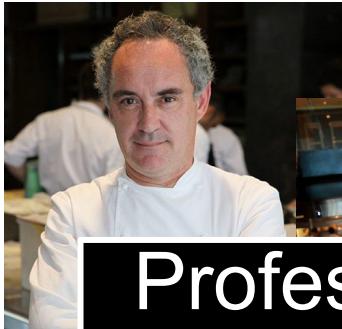




Professional Chefs



Food Journalists



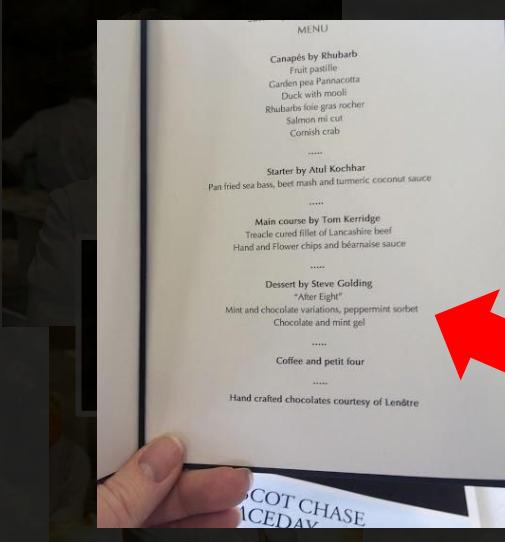
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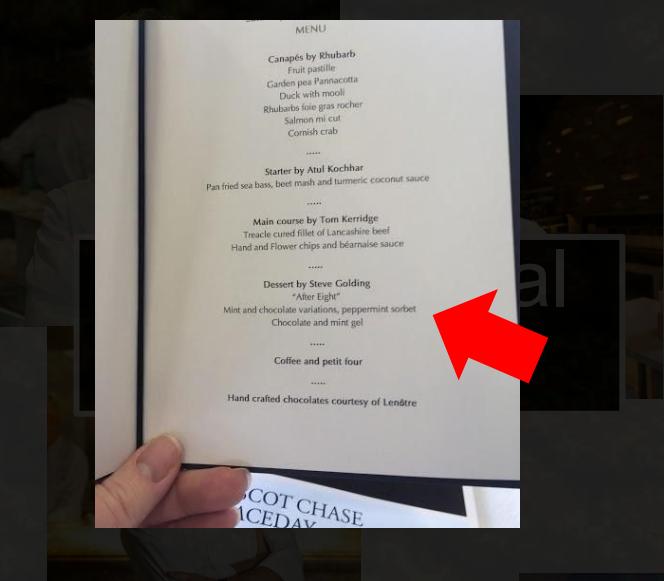


Food Journalists



Culinary Students





New market for Pork Scratches

Once relegated to the confines of dingy pubs in the West Midlands, pork scratchings are breaking into the fine food sector. SF learns more

Pork scratchings may have been traditionally regarded as a 'poor man's delicacy', but the days of eating them with the basic meat and producing them in high street, trolley bars are long gone. Now, they're a sought-after item of the market, inspiring us to open up your snacking selection.

The first reason they've been traditionally regarded as a 'poor man's delicacy' is that they were often the last resort when people had to go without meat. But that's all changed. In the Tid, if you want to buy a bag of pork scratchings, you can buy them in Waitrose or Sainsbury's. They're not the only ones who buy them either. In fact, you can buy them in most supermarkets, and even in some of the more upmarket delis.

The second reason is that the taste of pork scratchings has changed. In the past, they were just a simple bag of crisps. Now, they're more like crisps with added flavor. They're not just plain, they're flavored with things like salt, pepper, and even some herbs and spices. You can even get them with different toppings like cheese or bacon.

The third reason is that the quality of the pork scratchings has improved. In the past, they were just a simple bag of crisps. Now, they're more like crisps with added flavor. They're not just plain, they're flavored with things like salt, pepper, and even some herbs and spices. You can even get them with different toppings like cheese or bacon.

TOP TIPS:

- Looking to make bags of crispy pork scratchings for your shop? Follow these tips to ensure success.
- Front of house information: Make sure your staff know about the high quality of ingredients, presentation and taste of your product. This will give them a bit of confidence.
- Tastings are also effective: Encourage customers to call or visit your shop to taste the product, bringing back fond memories of the past.
- Scratchings from around the world are great: Consider using different seasonings, cooking methods and types of skin. These can appeal to consumers looking for a variety of taste.

Posh Pork

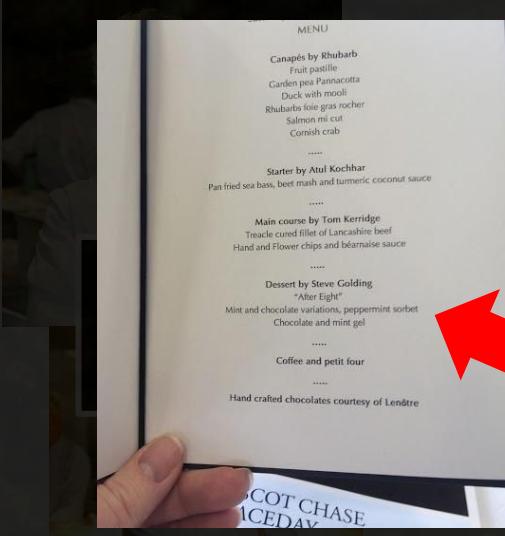
Here are some tips for taking the pork scratchings to the next level:

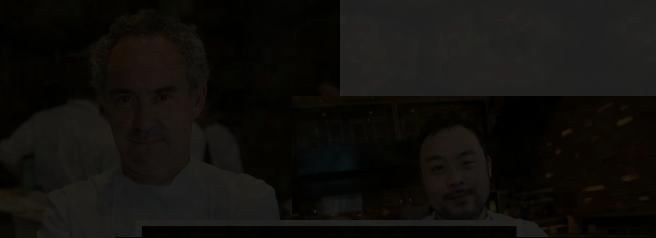
- Front of house: Make sure your staff know about the high quality of ingredients, presentation and taste of your product. This will give them a bit of confidence.
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- Scratchings from around the world are great: Consider using different seasonings, cooking methods and types of skin. These can appeal to consumers looking for a variety of taste.

Changing opinions

One of the main food sectors that have been instrumental in convincing consumers that pork scratchings are a good idea is the food industry. Companies like Nestle, Unilever and Mars have all invested heavily in the production of pork scratchings, looking to the more refined and sophisticated consumer. This has led to a significant increase in the popularity of pork scratchings, highlighting the fact that what was once seen as a simple snack is now a more refined and exciting choice.

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Understanding the cooking processes =
cooking structures is a crucial task



The screenshot shows the Yummly search interface. At the top left is the Yummly logo. A search bar contains the query "chocolate chip cookies". Below the search bar are two small icons: a smiling face and a neutral face. Underneath these icons is the word "INGREDIENTS". At the bottom of the search bar is a red-bordered box containing the text "31,785 RECIPES".

The screenshot shows the allrecipes.com search interface. At the top left is the allrecipes logo. To its right is a "BROWSE" dropdown menu and a search bar containing "chocolate chip cookies". Below the search bar is a red-bordered box containing the text "7878 recipe results for 'chocolate chip cookies'" followed by a "Edit search" link.

The screenshot shows the epicurious search interface. At the top left is the epicurious logo. A search bar contains the query "chocolate chip cookies". Below the search bar are three dropdown menus: "POPULAR", "MEAL & COURSE", and "DISH TYPE". In the center of the page is a red-bordered box containing the text "522 matching results for 'chocolate chip cookies'".

The screenshot shows the foodnetwork.com search interface. At the top left is the food network logo. To its right are links for "Shows", "Chefs", and "Recipes". On the far right, there is a vertical sidebar with options like "Dinner", "FN Dish", and "Health". Below the logo is a "REFINE BY" section with "CHEF" and "SHOW" buttons. Further down is a "FILTERS" section with a "RECIPE" button and a "Clear" link. At the bottom of the page is a red-bordered box containing the text "Showing 1 - 10 of 342 results for chocolate chip cookies".

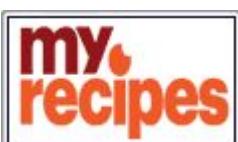
naturally crowdsourced processes toward a shared goal, like “making a chocolate chip cookie”



naturally **co** **rced** processes toward a shared
goal, like “**Using a chocolate chip cookie**”

“No oven”
“Gluten free”
“From scratch”
“Homemade”

exist in diverse context, detail, required skills, writing styles, etc.



naturally cooking processes toward a shared goal, like a late chip cookie”

“No oven”
“Gluten free”
“From scratch”
“Homemade”

“Simple and easy”
“Restaurant style”

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naturally cooking is a shared goal, like baking a cookie”

“No oven”
“Gluten free”
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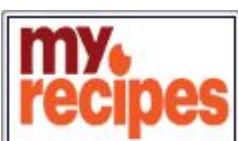
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- “Extreme novice”
- “Learn from the pro”

- “Traditional recipe”
- “Blog”
- “Keywords only like Buzzfeed Tasty”

exist in diverse context, detail, required skills, writing styles, etc.



At-scale browsing &
comparing
is
a challenge.



Recipe sharing
naturally crowded

exist

a shared
“kpie”

writing

How can we support browsing and analysis of hundreds of naturally crowdsourced instructions towards a shared goal?

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1. Understanding the analytic needs of cooking professionals

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How can we support browsing and analysis of hundreds of naturally crowdsourced instructions towards a shared goal?

1. Understanding the analytic needs of cooking professionals
2. Finding a unified framework that captures “cooking structure” for text instructions in diverse contexts and styles
3. Build an interactive system based on 1. and 2.



Interviewed 11 cooking professionals

Professional chefs

(Restaurant Jung/Shinsegae Food, McDonald's)

Patissier

(Dore Dore)

Food business researchers

(SNU Food Business Lab)

Cooking journalists

(LaMain, Hankyoreh)

Recipe website managers

(Naver Food)



**Interviewed
11 cooking
professionals**

**3 Analytics Needs
+
3 Design Goals**

Analytics Needs + Design Goals

N1: **Atomic:** ingredients, cooking actions



Analytics Needs + Design Goals

N1: Atomic:

“What are some unusual ingredients?”

“What are some common cooking actions?”

Analytics Needs + Design Goals

N1: Atomic

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“What are some common cooking actions?”



D1. provide **statistical information** of ingredients, cooking actions, and (ingredient, action) pair

Analytics Needs + Design Goals

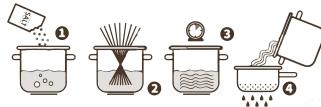
N1: Atomic

“What are some unusual ingredients?”

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D1. provide statistical information of ingredients, cooking actions, and (ingredient, action) pair

N2: Procedural: cooking structure



Analytics Needs + Design Goals

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D1. provide statistical information of ingredients, cooking actions, and (ingredient, action) pair

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“What’s a standard recipe?”

“How is recipe A different from recipe B?”

Analytics Needs + Design Goals

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N3: Aggregate: collection of recipes



Analytics Needs + Design Goals

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N3: Aggregate

“How many different ways can we cook this dish?”

“How standardized is this dish?”

Analytics Needs + Design Goals

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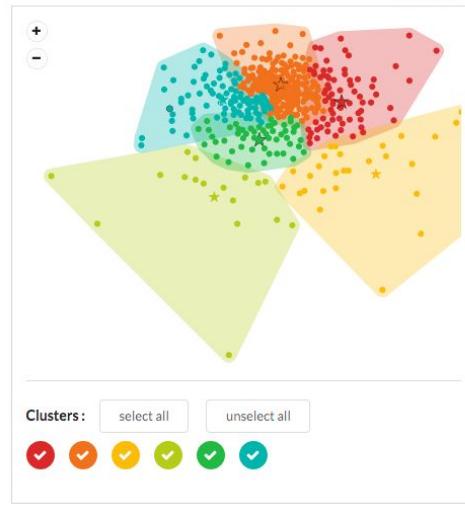
“How standardized is this dish?”

D3. provide (various) clusters of recipes to examine fundamental similarities and differences

RecipeScape

RecipeMap for Chocolate Chip Cookie

Group By



RecipeDeck

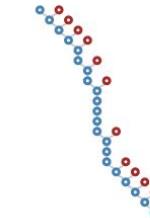
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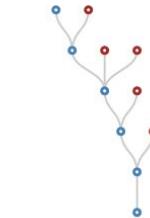
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French Mocha Macaroon Tart



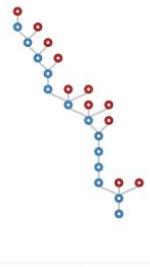
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Double Chocolate Espresso Cookies



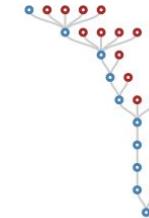
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Crunch Bars



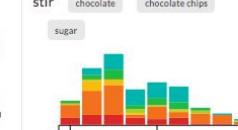
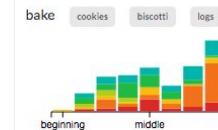
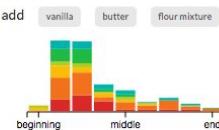
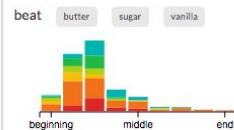
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Salty Chocolate Chunk Cookies

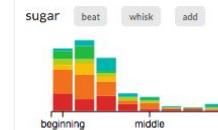
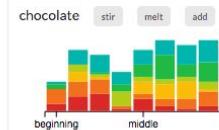
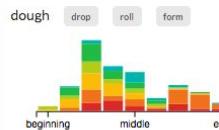
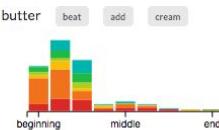
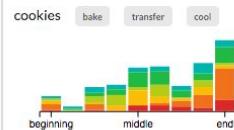


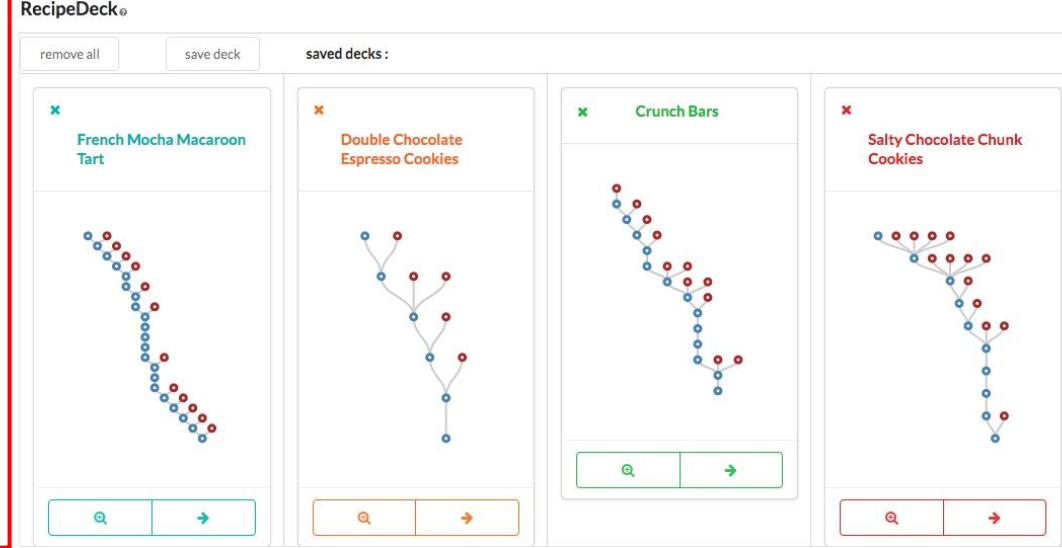
RecipeStat

Actions



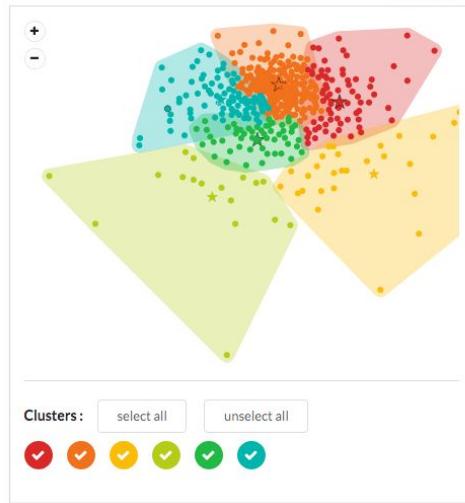
Ingredients





RecipeMap for Chocolate Chip Cookie

Group By



RecipeDeck

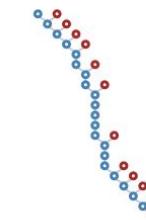
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French Mocha Macaroon Tart



🔍 ➡

x

Double Chocolate Espresso Cookies



🔍 ➡

x

Crunch Bars

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🔍 ➡

x

Salty Chocolate Chunk Cookies

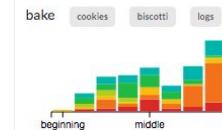
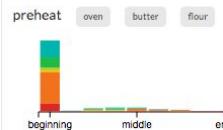
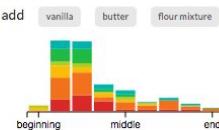
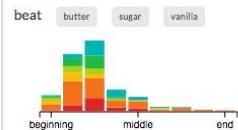


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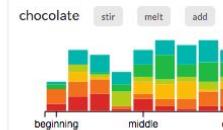
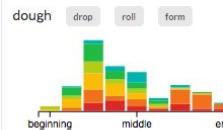
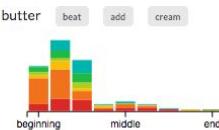
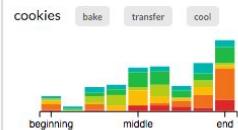
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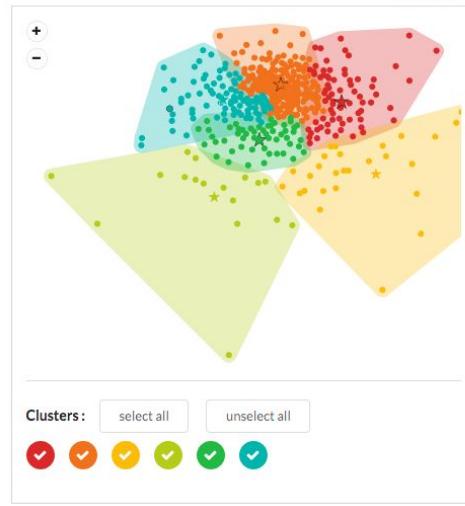


Ingredients



RecipeMap for Chocolate Chip Cookie

Group By



RecipeDeck

remove all

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French Mocha Macaroon Tart

🔍

x

Double Chocolate Espresso Cookies

🔍

x

Crunch Bars

🔍 ➔

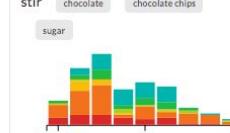
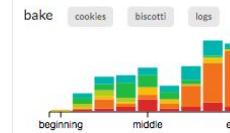
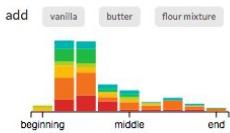
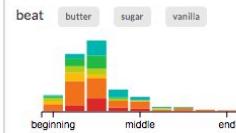
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Salty Chocolate Chunk Cookies

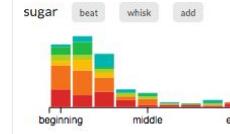
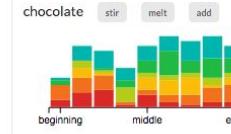
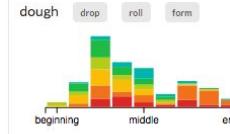
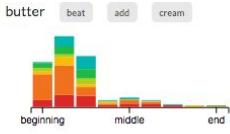
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RecipeStat

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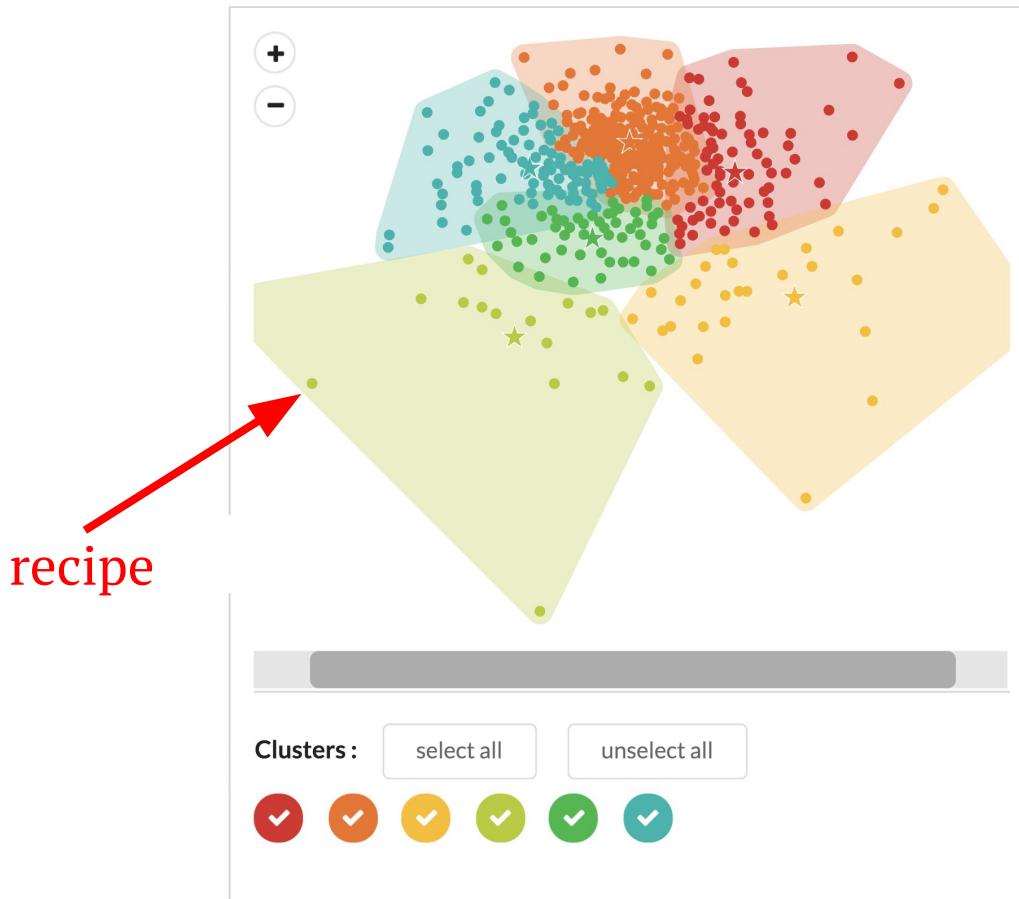
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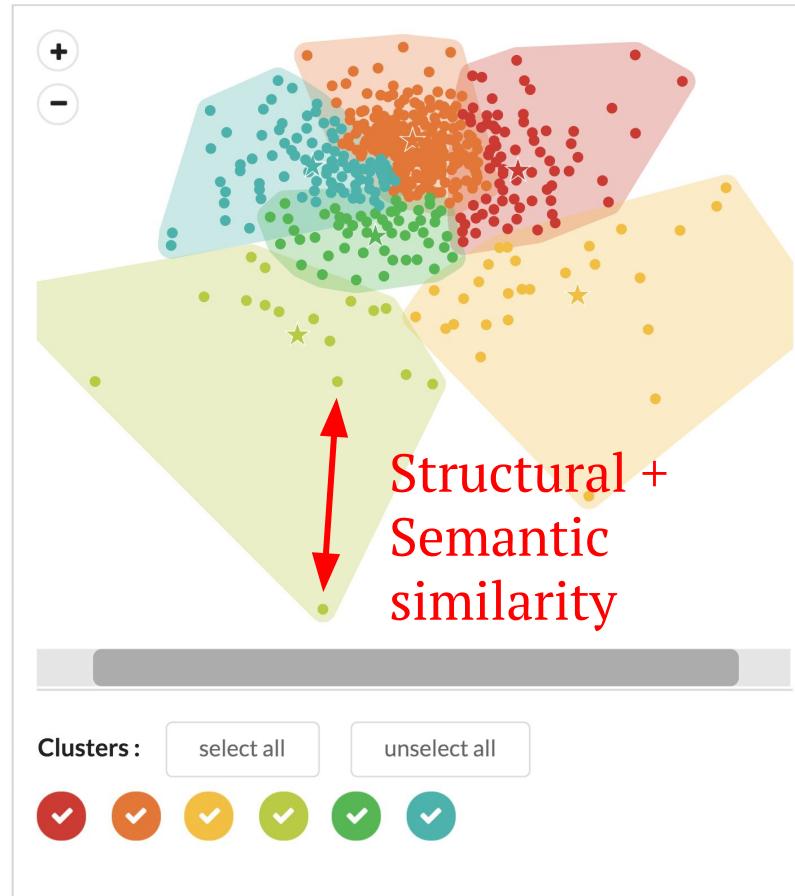
RecipeMap for Chocolate Chip Cookie

Group By ▾



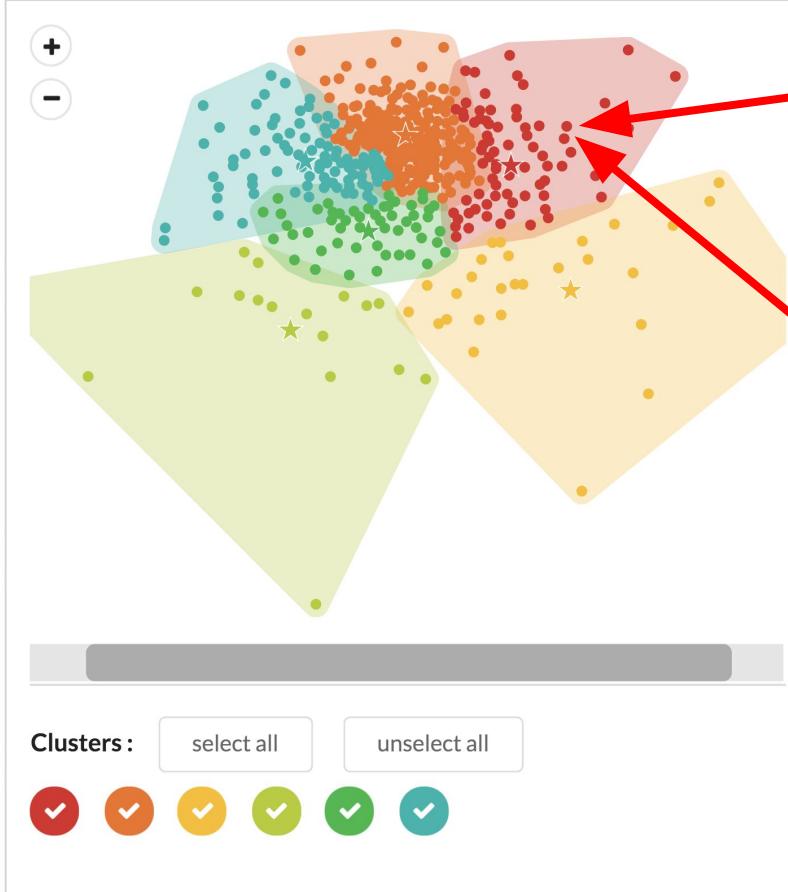
RecipeMap for Chocolate Chip Cookie

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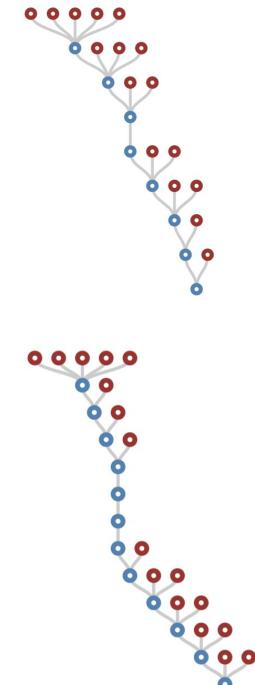


RecipeMap for Chocolate Chip Cookie

Group By ▾



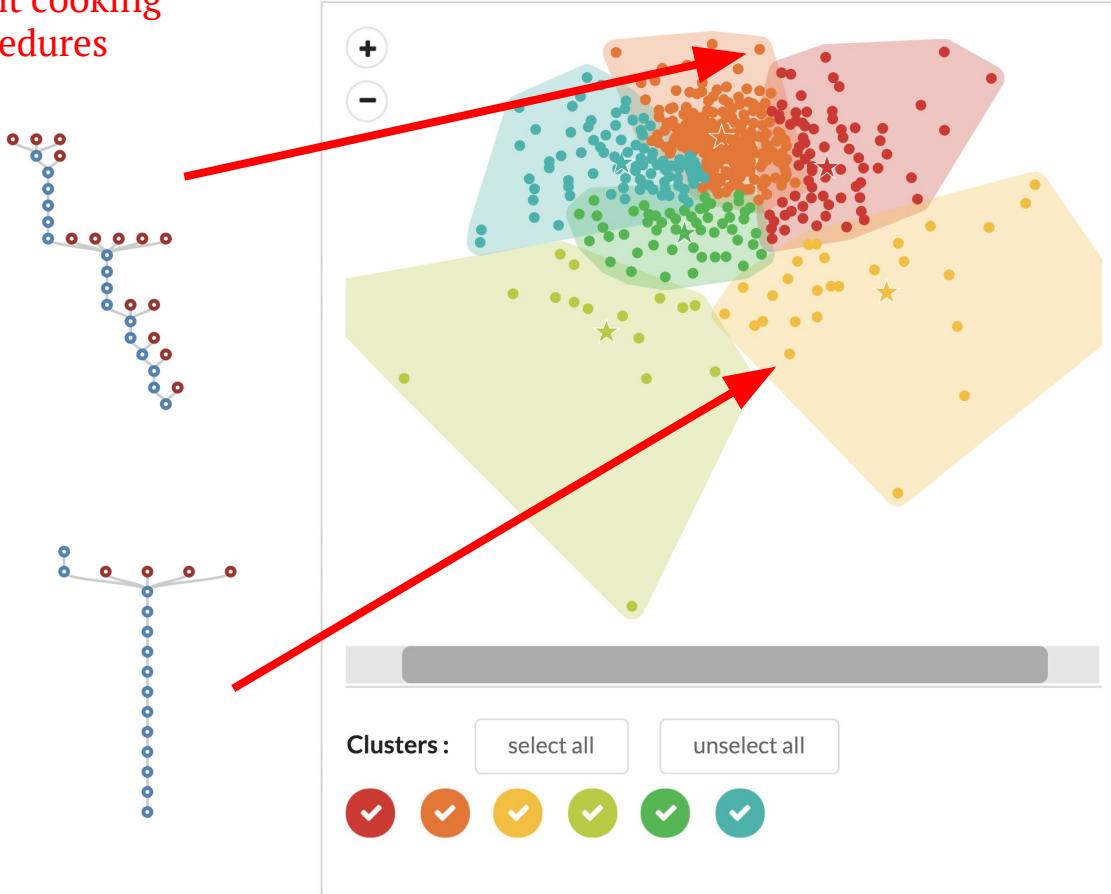
Similar cooking
procedures



RecipeMap for Chocolate Chip Cookie

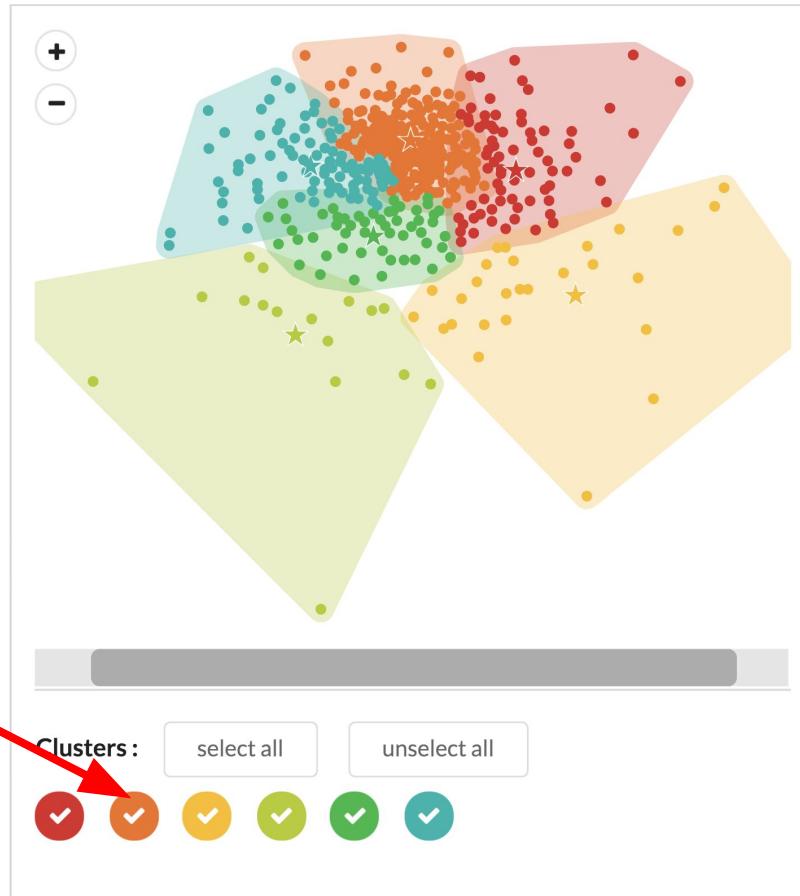
Group By ▾

Different cooking
procedures



RecipeMap for Chocolate Chip Cookie

Group By ▾



Pick which ones
you want to
analyze

RecipeMap for Chocolate Chip Cookie



RecipeDeck

Do you want to compare the two selected recipes?

Compare

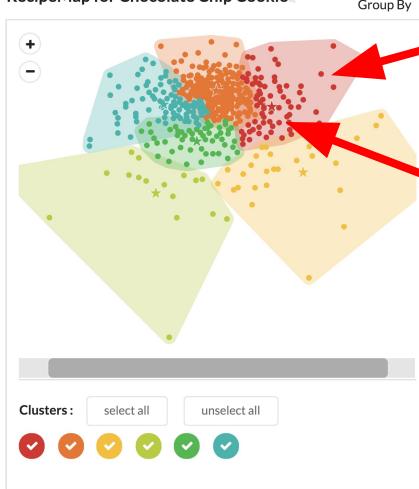
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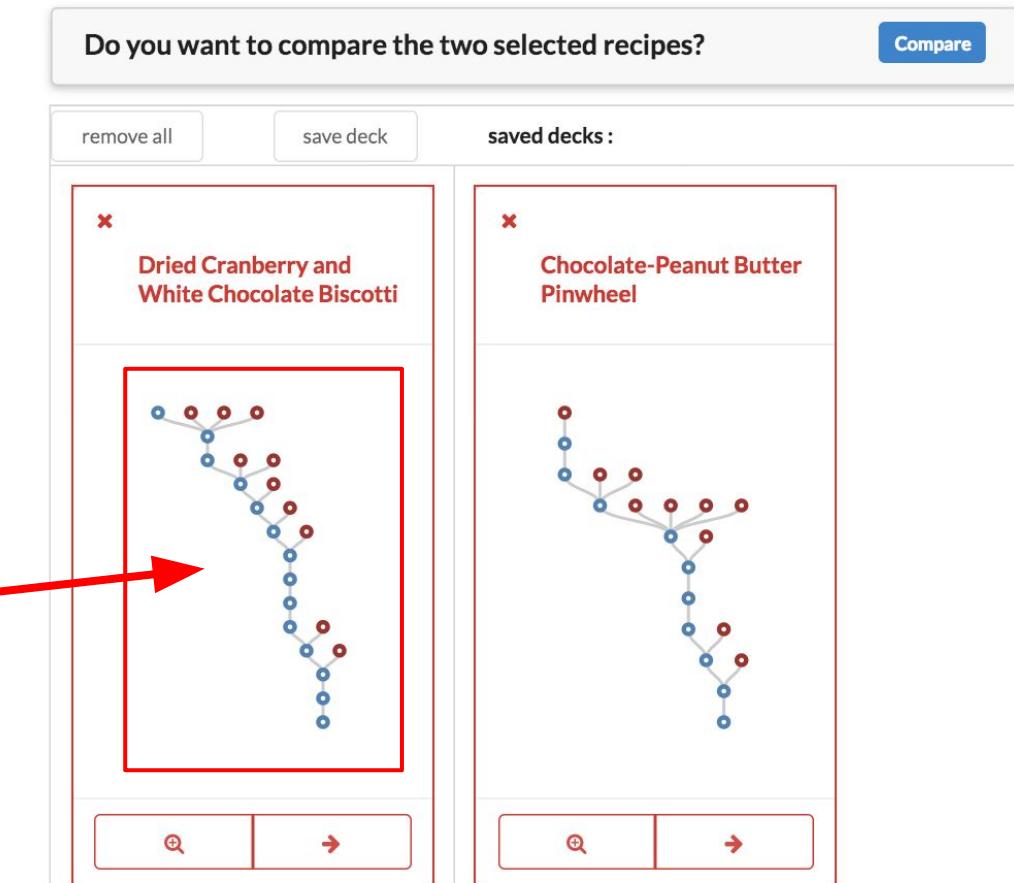
RecipeMap for Chocolate Chip Cookie



click!

click!

RecipeDeck



Cooking
Structure

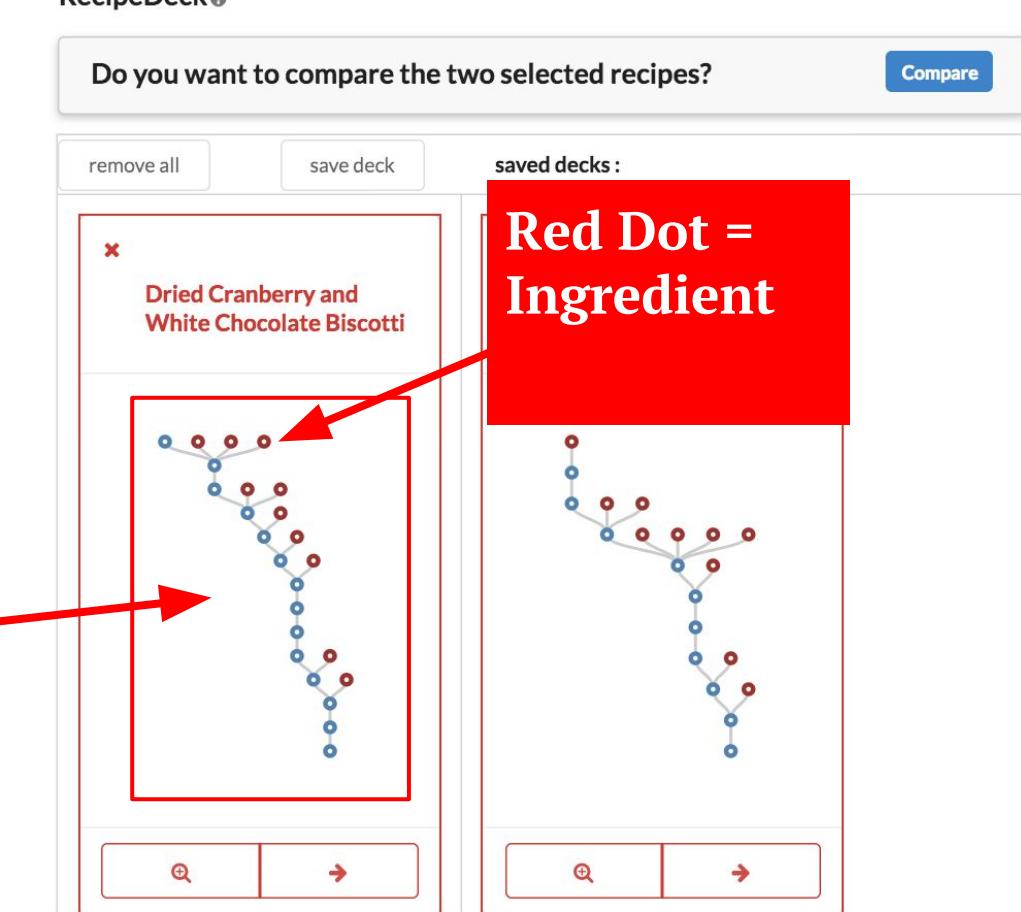
RecipeMap for Chocolate Chip Cookie



click!

click!

RecipeDeck



Cooking
Structure

RecipeMap for Chocolate Chip Cookie



click!
click!

RecipeDeck

Do you want to compare the two selected recipes?

Compare

remove all

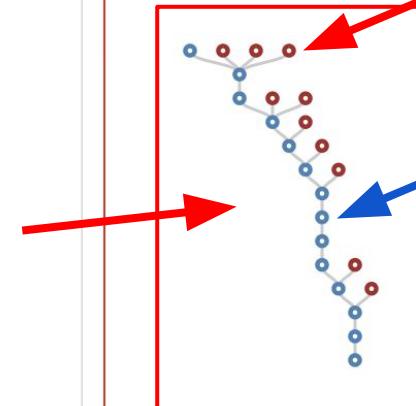
save deck

saved decks :

**Red Dot =
Ingredient**

**Blue Dot =
Cooking
action**

Cooking
Structure



Do you want to compare the two selected?

remove all

save deck

saved de

Dried Cranberry and White Chocolate Biscotti



Dried Cranberry and White Chocolate Biscotti

Recipe View



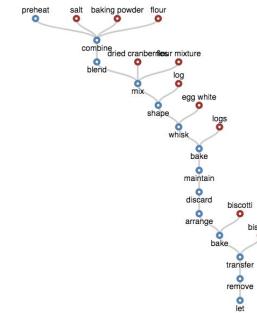
Ingredients

1. 2 1/2 cups all purpose flour
2. 1 teaspoon baking powder
3. 1/2 teaspoon salt
4. 1 1/2 cups sugar
5. 1/2 cup (1 stick) unsalted butter, room temperature
6. 2 large eggs
7. 1/2 teaspoon almond extract
8. 1 1/2 cups dried cranberries (about 6 ounces)
9. 1 egg white
10. 6 ounces good-quality white chocolate (such as Lindt or Baker's), chopped, or white chocolate chips

Instructions

1. Preheat oven to 350°F. Line heavy large baking sheet with parchment paper.
2. Combine 2 1/2 cups flour, 1 teaspoon baking powder and 1/2 teaspoon salt in medium bowl; whisk to blend.
3. Using electric mixer, beat sugar, butter, 2 eggs and almond extract in large bowl until well blended.
4. Mix in flour mixture, then dried cranberries.
5. Divide dough in half.
6. Using floured hands, shape each piece into 2 1/2-inch-wide, 9 1/2-inch-long, 1-inch-high log.

Tree View



Detailed View for individual recipes

Close

Pairwise
comparison

Do you want to compare the two selected recipes?

Compare

remove all save deck saved decks :

Dried Cranberry and White Chocolate Biscotti vs Chocolate-Peanut Butter Pinwheel

Instructions

- preheat
- combine
- blend
- mix
- shape
- whisk
- bake
- maintain
- discard
- arrange
- bake
- transfer
- remove
- let

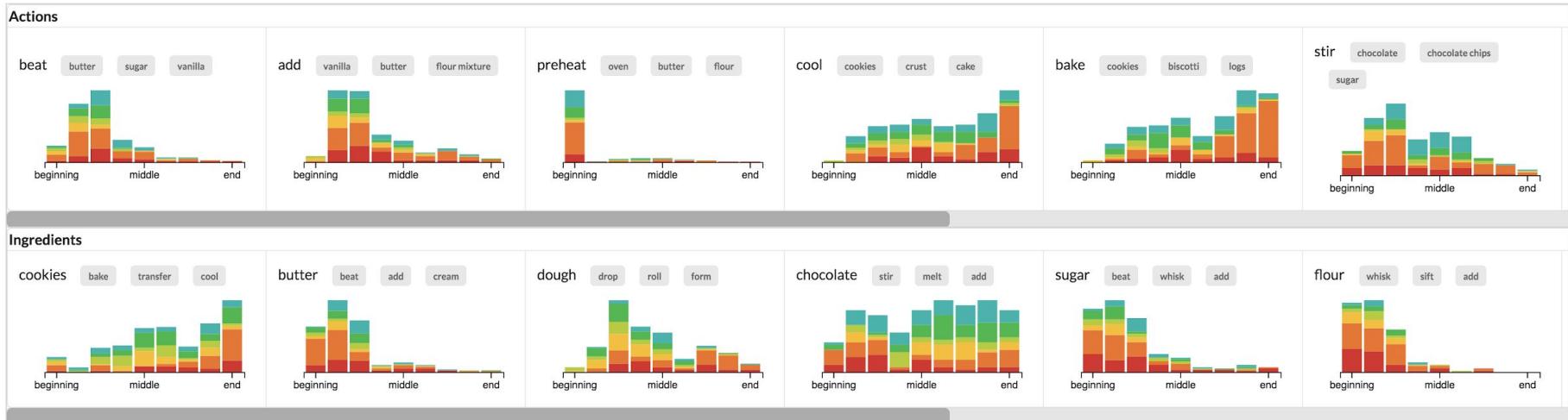
Ingredients

A Venn diagram comparing the ingredients of two recipes. The left circle (red) contains: flour mixture, dried cranberries, log, egg white, logs, and biscotti. The right circle (blue) contains: chocolate, butter, sugar, egg mixture, dough, and rolls. The overlapping area (intersection) contains: flour, baking powder, salt.

🔍 ➡️ 🔍 ➡️

Temporal usages pattern of top 10 cooking ingredients / actions

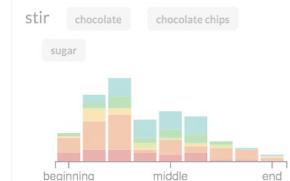
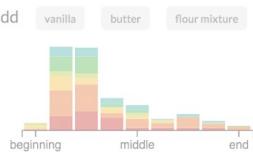
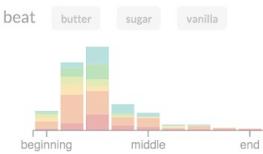
RecipeStat®



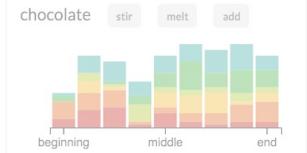
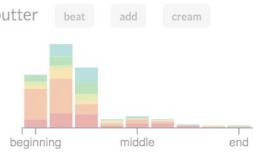
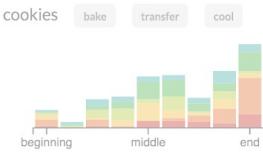
Preheat mostly
in the earlier
stage

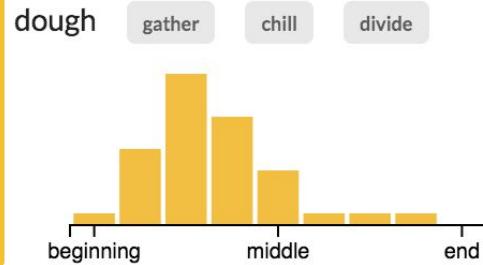
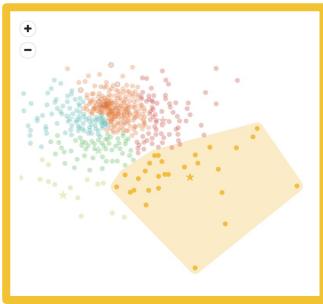
RecipeStat®

Actions

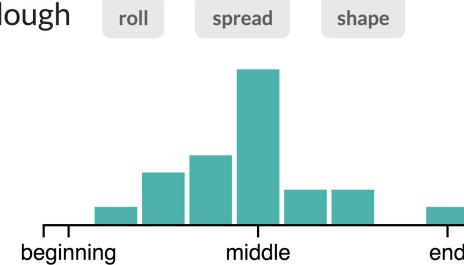
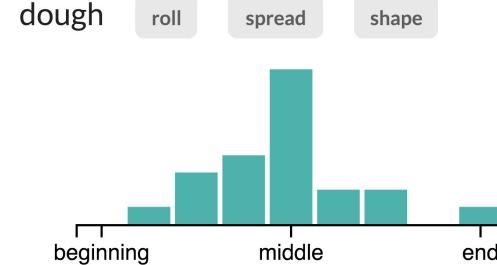


Ingredients



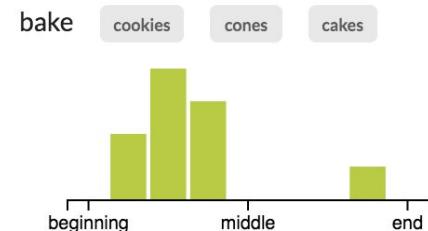
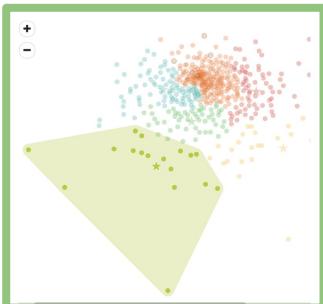


Tends to make dough, and rest

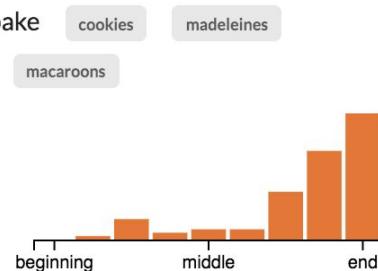
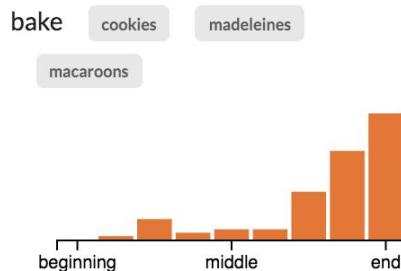


VS

Tends to start from an already prepared dough



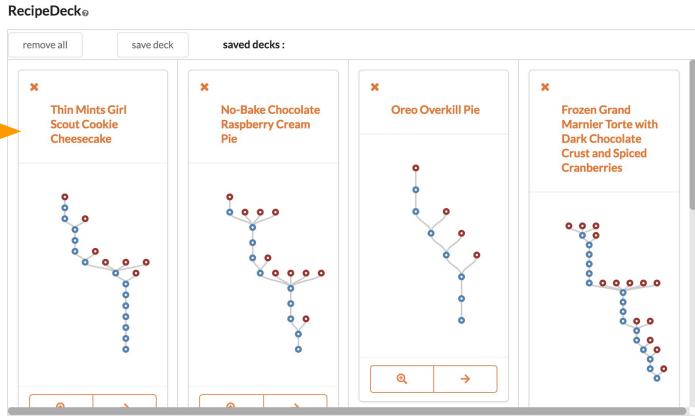
Bake early, decorate, or use cookies in other dishes



Cookies are final results usually

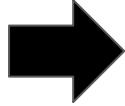
Click on the orange bar!

Corresponding
recipes are added
to RecipeDeck

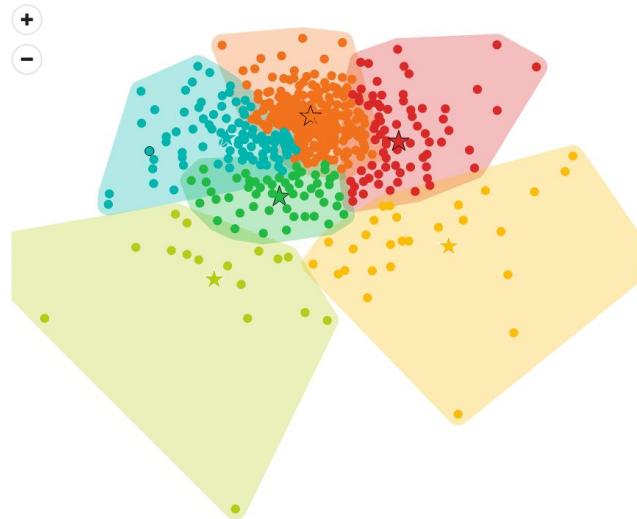


Computational Pipeline

Collected recipe texts



RecipeScape



1)

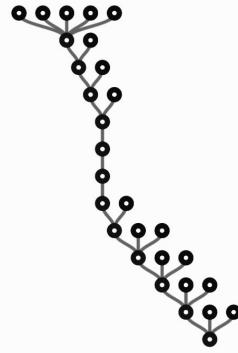
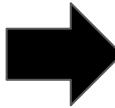
Recipe Text

Ingredients

- + 2 (12 ounce) packages ladyfingers
- + 4 egg whites
- + 1 pint heavy whipping cream
- + 2 eggs
- + 2 cups semisweet chocolate chips
- Add all ingredients to list

Directions

- 1 Line bottom and sides of a 9 inch springform pan with ladyfingers. In the top of a double boiler over hot water, melt the chocolate chips, stirring frequently. When the chocolate has melted, mix in the 2 eggs thoroughly.
- 2 In a large bowl, whip the cream until it is thick. In a separate large bowl, with a clean whisk, whip the whites until stiff but not blothy.
- 3 Add 1/3 of the whipped egg whites to the melted chocolate and fold in. Quickly add this to remaining whites and fold in. Fold in the whipped cream until no streaks remain, being careful not to overmix.
- 4 Pour mousse into the cake-lined pan. Cover with plastic wrap and refrigerate for 4 hours.



1)

Recipe Text

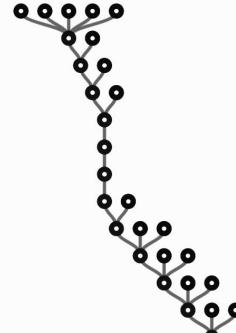
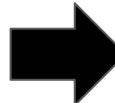
Ingredients

- 2 (12 ounce) packages ladyfingers
- 1 pint heavy whipping cream
- 2 cups semisweet chocolate chips
- 4 egg whites
- 2 eggs

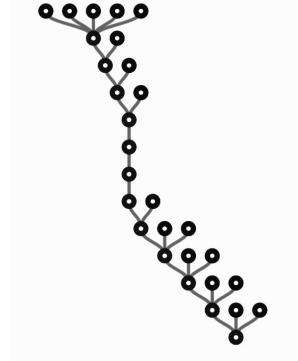
Add all ingredients to list

Directions

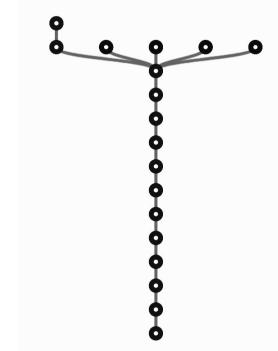
- Line bottom and sides of a 9 inch springform pan with ladyfingers. In the top of a double boiler over hot water, melt the chocolate chips, stirring frequently. When the chocolate has melted, mix in the 2 eggs thoroughly.
- In a large bowl, whip the cream until it is thick. In a separate large bowl, with a clean whisk, whip the whites until stiff but not blothy.
- Add 1/3 of the whipped egg whites to the melted chocolate and fold in. Quickly add this to remaining whites and fold in. Fold in the whipped cream until no streaks remain, being careful not to overmix.
- Pour mousse into the cake-lined pan. Cover with plastic wrap and refrigerate for 4 hours.



2)



VS.



Recipe Text

Stir in remaining 6 tablespoons corn syrup and vanilla.

Recipe Text

Stir in remaining 6 tablespoons corn syrup and vanilla.

Stanford
CoreNLP

Part-Of-Speech Tag

Stir in remaining 6 tablespoons corn syrup and vanilla.
NNP IN JJ CD NN NN NN NN

Verb = cooking action
Noun = ingredient

Stir is not a noun

Recipe Text

Stir in remaining 6 tablespoons corn syrup and vanilla.

Tablespoon is not an ingredient !!

Part-Of-Speech Tag

Stir in remaining 6 **tablespoons** corn syrup and vanilla.

NNP IN

JJ

CD

NN

NN

NN

NN

Stanford
CoreNLP

Should be treated as one entity not two

1 Cooking Action

2 Ingredient

3 Cancel

▷ Press Enter or click submit to proceed

Machine assisted human annotation

Granola and Dried Cranberry Chocolate Chip Cookies

Preheat oven to 350°F.

In a bowl whisk together flour, baking soda, baking powder, and salt.

In another bowl with an electric mixer cream butter and sugar until light and fluffy.

Beat in egg, beating until combined well, and beat in vanilla.

Beat in flour mixture and stir in remaining ingredients.

Drop dough by rounded tablespoons 2 inches apart onto buttered baking sheets and bake in batches in middle of oven 12 to 15 inches or until golden.

Cool cookies on racks.

Already checked

Cookies keep in airtight containers 5 days.

Current sentence

Submit

Recipe Text

Stir in remaining 6 tablespoons corn syrup and vanilla.

Stanford

CoreNLP

Part-Of-Speech Tag

Stir in remaining 6 tablespoons corn syrup and vanilla.

NNP IN JJ CD NN NN NN NN

Human Annotation

fix merge ✓ approve
Stir in remaining 6 tablespoons corn syrup and vanilla.
Cooking Action Ingredients Ingredients

How much did it help? → A LOT

Total 214,109 tokens

- 1) **27,879 verbs** tagged by the Stanford CoreNLP's Part-of-Speech tagger
 - **14,988** were cooking actions confirmed by human annotators
 - **only 54% are relevant to cooking**

- 2) **9,987** cooking actions not captured by Part-of-Speech tagger
 - **40% of total cooking actions**

Recipe Text

Stir in remaining 6 tablespoons corn syrup and vanilla.

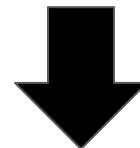
Stanford
CoreNLP

Part-Of-Speech Tag

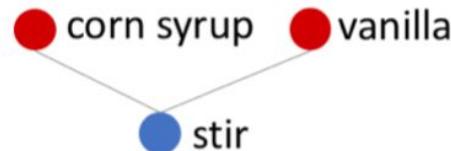
Stir in remaining 6 tablespoons corn syrup and vanilla.
NNP IN JJ CD NN NN NN NN

Human Annotation

fix merge ↓ ↗ ↓ approve
Stir in remaining 6 tablespoons corn syrup and vanilla.
Cooking Action Ingredients Ingredients



Tree Representation

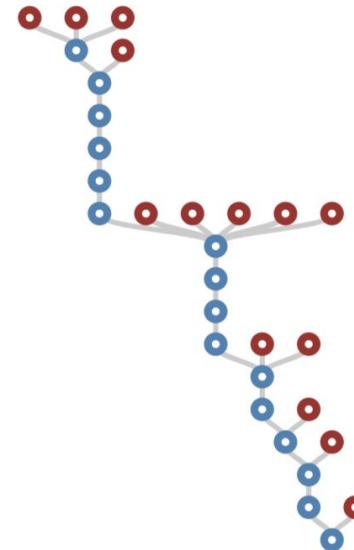


Ingredients

- | | |
|--|--|
| <input type="checkbox"/> 2 (12 ounce) packages ladyfingers | <input type="checkbox"/> 4 egg whites |
| <input type="checkbox"/> 1 pint heavy whipping cream | <input type="checkbox"/> 2 eggs |
| <input type="checkbox"/> 2 cups semisweet chocolate chips | <input type="checkbox"/> Add all ingredients to list |

Directions

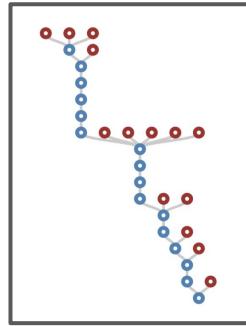
- 1 Line bottom and sides of a 9 inch springform pan with ladyfingers. In the top of a double boiler over hot water, melt the chocolate chips, stirring frequently. When the chocolate has melted, mix in the 2 eggs thoroughly.
- 2 In a large bowl, whip the cream until it is thick. In a separate large bowl, with a clean whisk, whip the whites until stiff but not blocky.
- 3 Add 1/3 of the whipped egg whites to the melted chocolate and fold in. Quickly add this to remaining whites and fold in. Fold in the whipped cream until no streaks remain, being careful not to overmix.
- 4 Pour mousse into the cake-lined pan. Cover with plastic wrap and refrigerate for 4 hours.



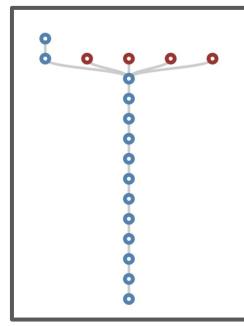
Similarity Comparison → Tree Edit Distance

How many times do I have to either “*add a node*”, “*delete a node*”, or “*replace a node*” to

convert



into

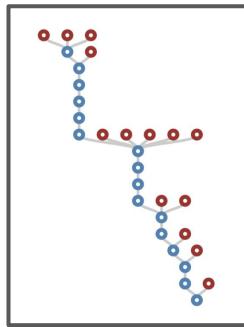


“Structural similarity”

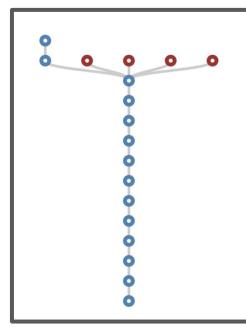
Similarity Comparison → Tree Edit Distance

How many times do I have to either “add a node”, “delete a node”, or “replace a node” to

convert



into



“semantic similarity”

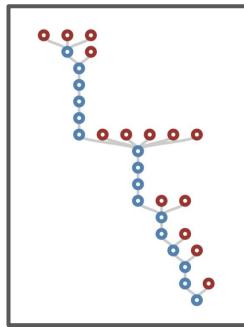
replacing “mix” with “add” vs replacing “fry” with “whisk” should NOT be treated the same!

replacing “sugar” with “corn syrup” vs replacing “flour” with “pepperoni” should NOT be treated the same!

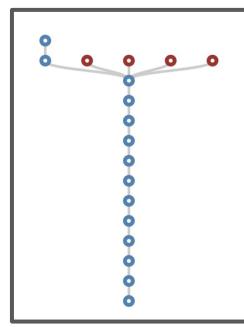
Similarity Comparison → Tree Edit Distance

How many times do I have to either “add a node”, “delete a node”, or “replace a node” to

convert



into



“semantic similarity”

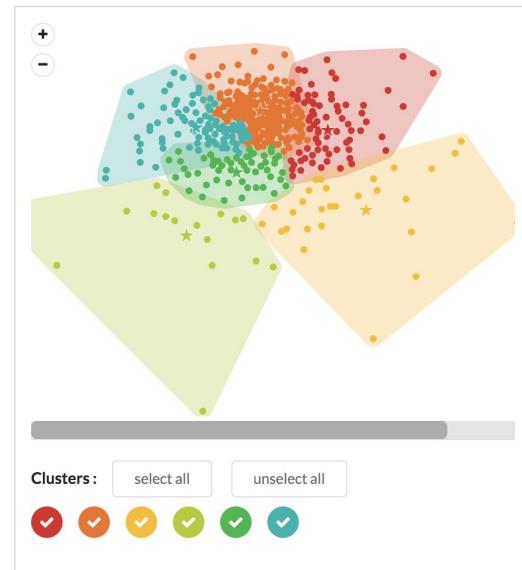
replacing “mix” with “add” vs replacing “fry” with “whisk” should NOT be treated the same!

→ Weigh the replacing operations by the similarities in meaning of words in cooking context (word embedding space of 1M cooking recipes)

Finally,

We calculate both structural + semantic similarities for every pair of recipes
plot them on RecipeMap

use hierarchical clustering to group them



Some Key Findings

How does RecipeScape broaden browsing and analysis capabilities?

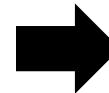
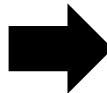
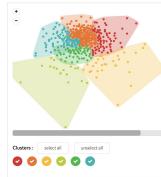


487



510

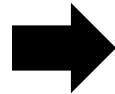
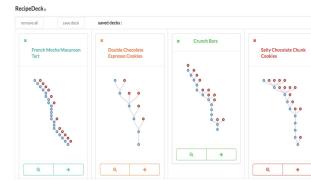
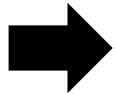
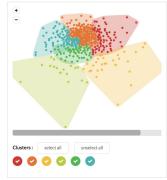




“Recipes in this cluster probably do not use any eggs and probably involve baking in the later stages.”

“These are the recipes for more crispy cookies. You use water so the ingredients don’t stick as much, resulting in crispy cookies.”

“These recipes with adding salt at the last stages are the professional ones. We do that to bring out the sweet taste with your first spoon”

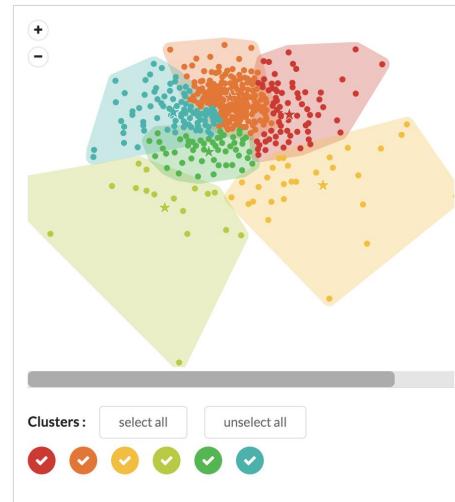


“I find recipes in the usual text format hard to visualize the process ... But this tree diagram summarizes the process very well, I can easily picture the cooking process.”

What's now possible?

Easy at-scale exploration

→ ALL recipes at your fingertips in the context to one another



What's now possible?

Easy at-scale exploration

→ all recipes at your fingertips

User centered queries

→ “what are recipes with more decorations?”

Pick me!



What's now possible?

Easy at-scale exploration

→ all recipes at your fingertips

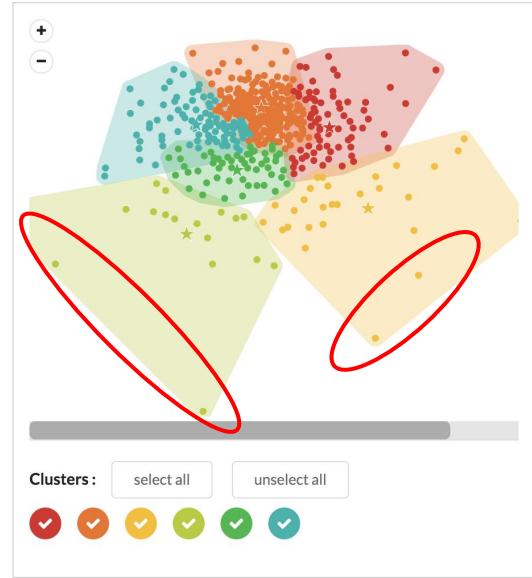
User centered queries

→ “what are recipes with more decorations?”

Support for creativity

→ “where would my recipe stand against the rest?”

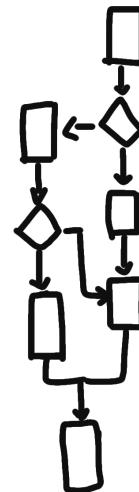
→ easy to spot exotic/creative recipes



Let's put this into perspective.

1)

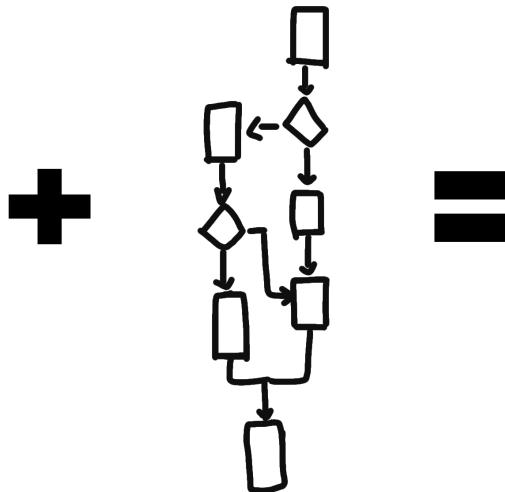
INGREDIENTS Sugar, Peanuts, Corn Syrup, Cocoa Butter, Fractionated Palm Kernel Oil, Chocolate Liquor, Whole Milk Powder, Non Fat Dry Milk, Whey Powder, Soy Lecithin, Cocoa Powder, Buttermilk, Eggwhite Modified Casein Protein



Stronger analytical capabilities

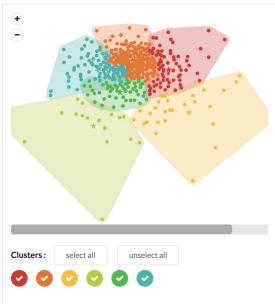
1)

INGREDIENTS Sugar, Peanuts, Corn Syrup, Cocoa Butter, Fractionated Palm Kernel Oil, Chocolate Liquor, Whole Milk Powder, Non Fat Dry Milk, Whey Powder, Soy Lecithin, Cocoa Powder, Buttermilk, Egg Whites, Modified Casein Protein



Stronger analytical capabilities

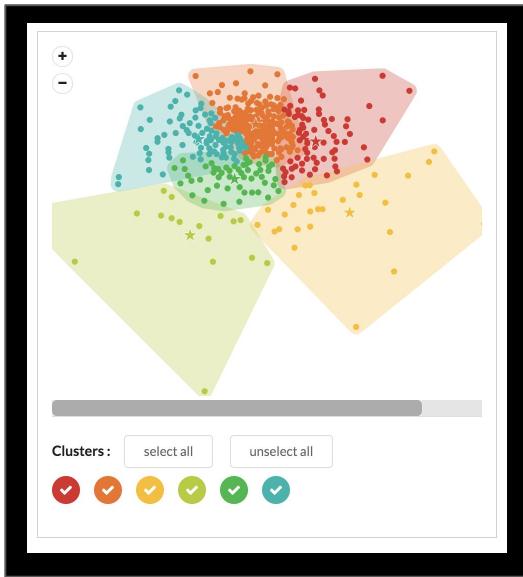
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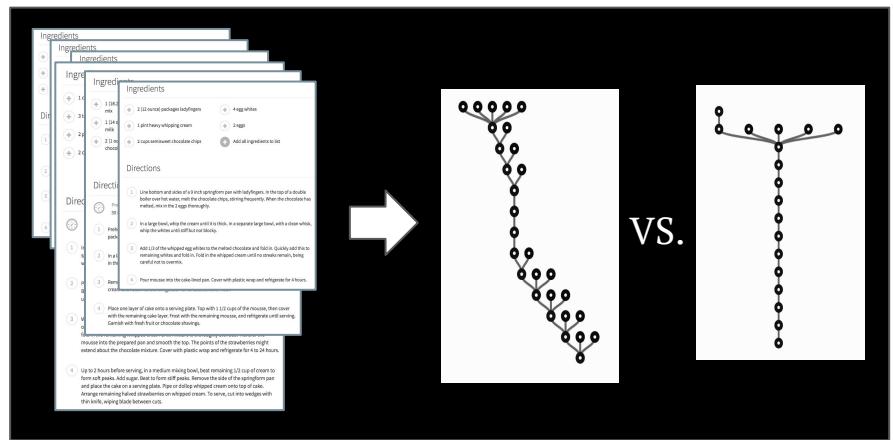
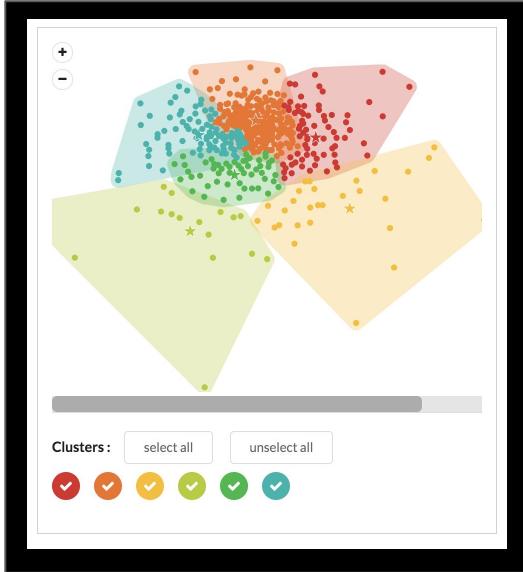


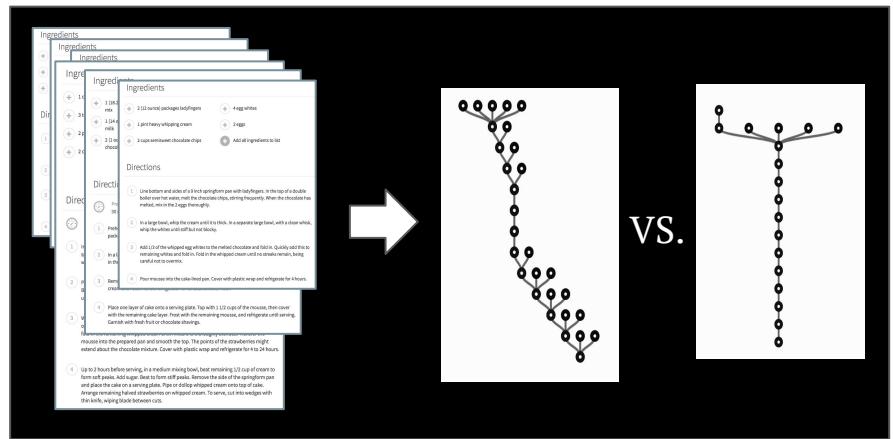
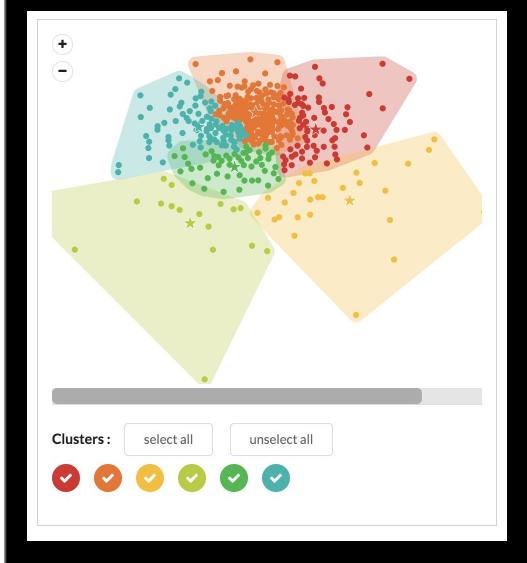
Interpretations
Explanations

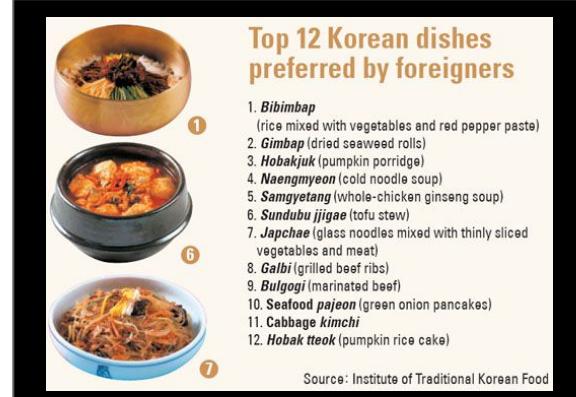
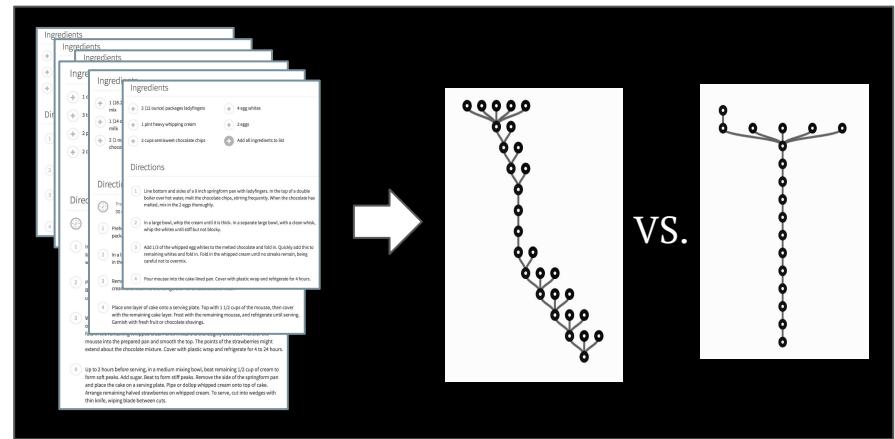
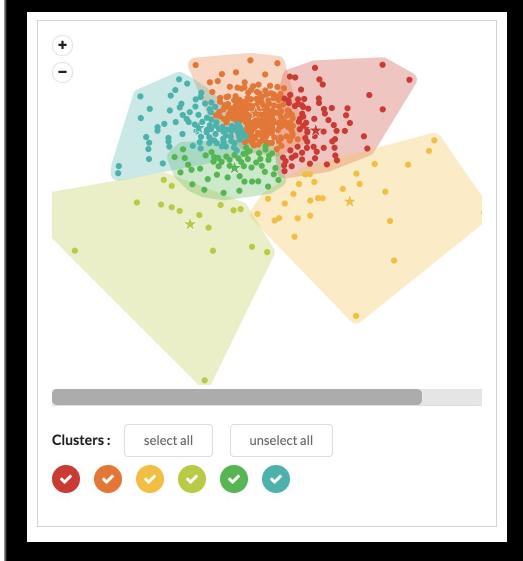
“Sensemaking”

What's next









Acknowledgements

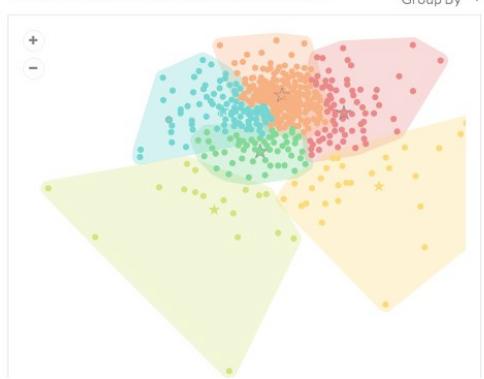


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FOR MEDIA INNOVATION

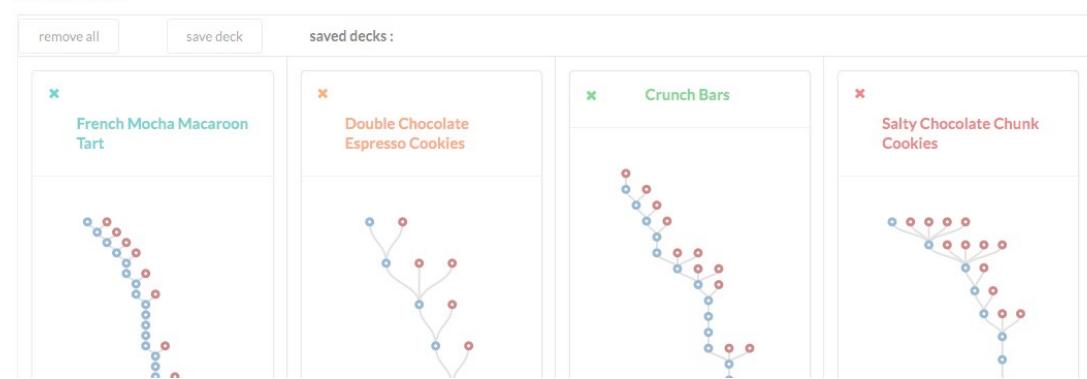


Ministry of Science, ICT

RecipeMap for Chocolate Chip Cookie



RecipeDeck®



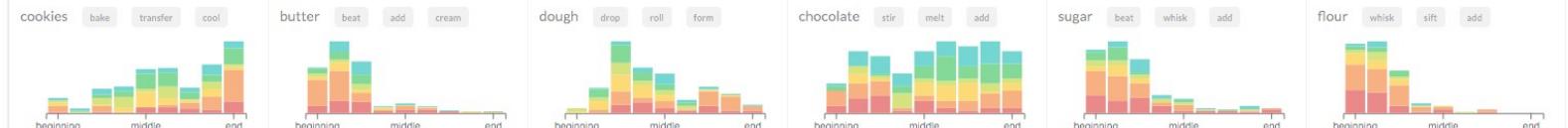
recipescape.kixlab.org

RecipeStat®

Actions



Ingredients



User Evaluation Quotes

D1. Provide statistical information about ingredients and cooking actions

- Expert knowledge
 - (on adding salt at the end of cooking pasta) “This is a professional tip that good restaurants use to make the first spoon of pasta taste extra sweet. If you put salt on tomato, it really brings out the sweetness. I’m surprised this hack is captured.”
- More user-centered queries
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D2. Provide in-depth examination and comparison of individual recipes

- Easy exploration
 - “We (professional chefs) sometimes start from a specific main ingredient and seek creative interpretations. I find these recipes near the edges (of the RecipeMap) are more exotic.”
- Easy imagination/mental simulation
 - “I find recipes in the usual text format hard to visualize the process, because the ingredient sections and the instruction sections are separate. But this tree diagram summarizes the process very well, I can easily picture the cooking process.”
- Subtle substitutes
 - Pairwise comparison of two neighboring recipes to examine subtle differences in ingredients or cooking actions

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D3. Provide analysis for recipes in aggregate

- Fundamental similarities and differences
 - (on a cluster with both baking soda and baking powder in most used ingre.) “Recipes in this cluster probably do not use any eggs, and probably involve baking in the later stages.”
 - (on a cluster with “chill” or “cool”) “These are the recipes for more crispy cookies. You use water so the ingredients don’t stick as much, resulting crispy cookies. These kind of dough tastes better when you cool them.”
 - (on a cluster with “salted water” instead of just water) “I would trust the recipes in this cluster more than the other ones. The fact that people described salted water, not just water, implies the instructions are more friendly and detailed.”

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Contribution

Contribution 1

Clarification of analytics needs and challenges

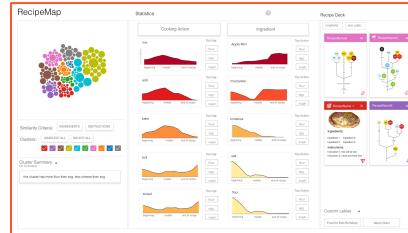
In-depth need analysis with 9 high profile professionals in diverse cooking related fields



Contribution 2

RecipeScape - the analytics interface

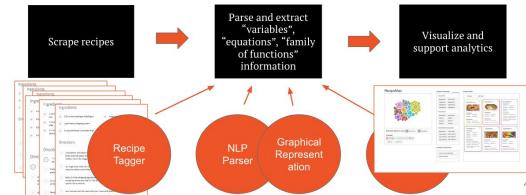
Supports analytic need of diverse professionals in cooking related fields



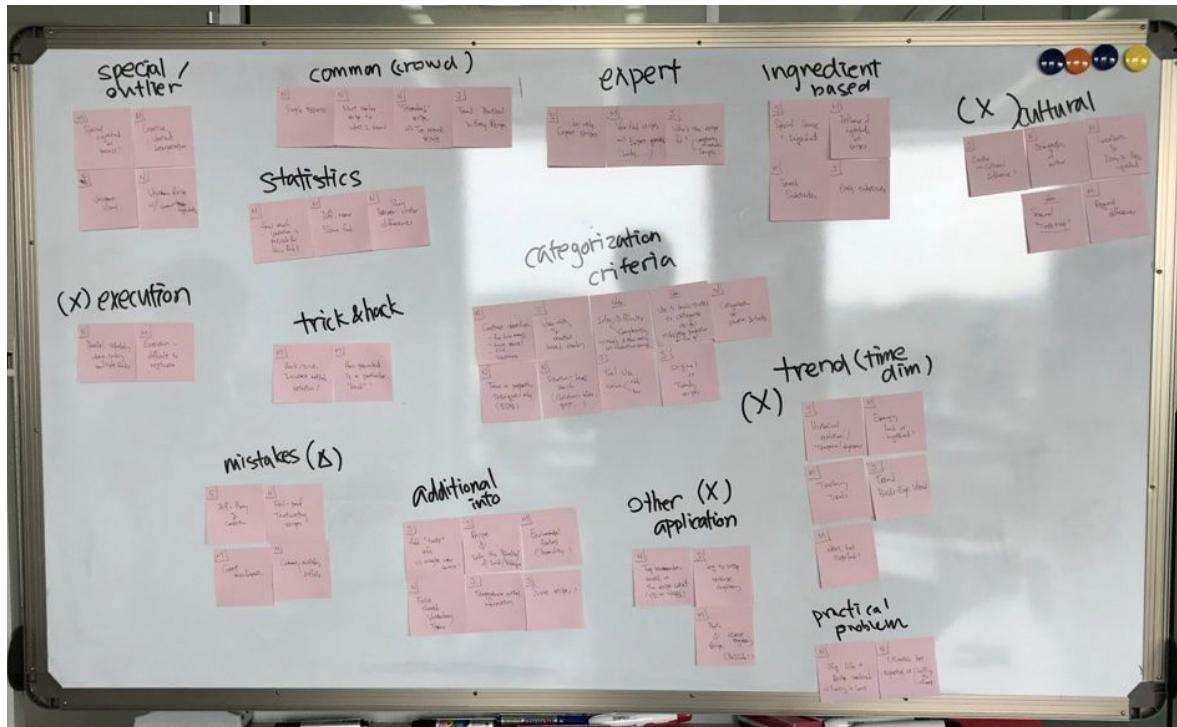
Contribution 3

Computational Pipeline

That converts naturally crowdsourced unstructured text into graphical representation suitable for analytics



Formative Study



Special/Outlier Detection	Common / Crowd-derived info	Expert derived Info	Statistical (distributional) Info	Ingredient based Info
(M) special ingredient	(SE) Simple "golden recipe"	(R) use only "expert" recipes	(M) How much variation is possible for this food	(J) special sauce
(M) special process	(SE) Most similar recipe to what I know	(M) verified recipes, ie. expert generated, cook books. etc.	(M) different names for the same food	(J) special ingredient
(M) creative variant/interpretation	(SE) "standard" recipe	(J) who's this recipe for? complexity of instructions, length	(SE) show between cluster differences	(M) Influence of ingredients on recipes
(SE) uncommon visual	(J) practical & easy recipe			(M) search for substitutes
(SE) uncommon recipe with common ingredients				(J) easy substitutes
trick & hack	Categorization criteria	execution (instruction based)	mistakes	trend (time dimension)
(M) hack, trick, incorrect method detection	(N) constraint identification (for how many people, base sauce, time, substitutes)	(SE) parallel scheduling when cooking multiple food	(R) self fixing & correction	(J) historical evolution / temporal dynamics
(M) how prevalent is a particular "hack"?	(R) user-rating & reaction based ranking	(M) execution is difficult to replicate	(SE) fail-proof trustworthy recipe	(M) emerging food or ingredient
	(SE) categorization per situation & taste	(M) substitute cooking action	(M) correct vs misinformation	(M) tracking trends of the dish
	(J) origial vs trendy recipes		(M) common mistakes & pitfalls	(J) trend, birds-eye-view
	(J) tool use (ie. onion in wok vs pan)			(M) next hot superfood
	(SE) situation based search (christmas, alone, guest)			
	(SE) focus on preparing techniques only			
	(J) inter difficulty, complexity -> simple 5 star rating not enough			
	(J) use 5 basic tastes to categorize recipes, relative proportion of the 5 tastes			
	(J) taste map			
other application	practical problems	cultural info		
(SE) tag recommendation based on recipe content	(SE) blogs: life + recipe combined -> parsing is hard	(J) cluster of cultural influences		
(R) image to recipe, reverse engineering	(R) mismatch between cooking expertise vs willingness to share	(SE) demographics of the author		
(M) photo -> recipe (Pix2Code?)		(M) localization & easy to find ingredient		

CHI 2017 LBW

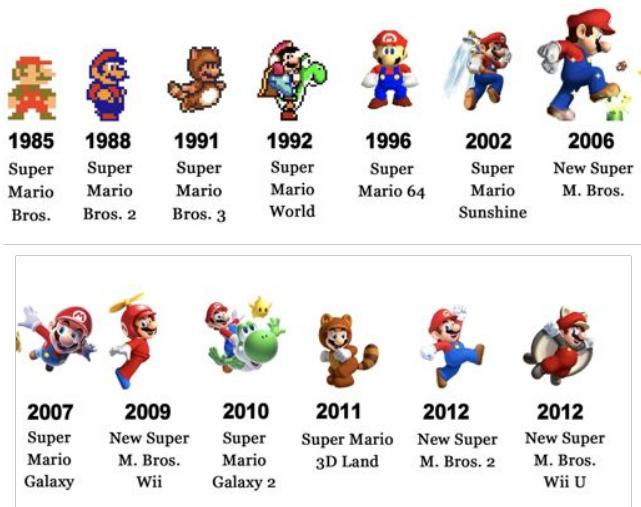
understanding collective human practices

1. Can we find out the most common/uncommon ingredient, cooking action? **YES**
2. Can we find out the “standard” recipe? **YES**
3. Can we find out some outlier recipes? **YES**
4. Can we find out fundamentally different ways of “making a pizza”? **Partly**

Cultural Analytics

Longitudinal Study

how individual entities evolve,
influence with time



“Cross-sectional”

what's the current
state of the world



Let's put this in a perspective,

“procedural structure” is a good metric / protocol for describing instructions on top of “list of features”,
ex) list of ingredients

It expands your ability compare and analyze instructions at large scale

How do we mine implicit “procedural structure”?

- Task specific features, ex) cooking verbs and ingredients

Interface components on the three levels → Clustering around the “structure” , but with other two components (Deck + Stat) gives you more explainability and interpretability, not just from the algorithms, but also from user’s exploration and browsing activities

