

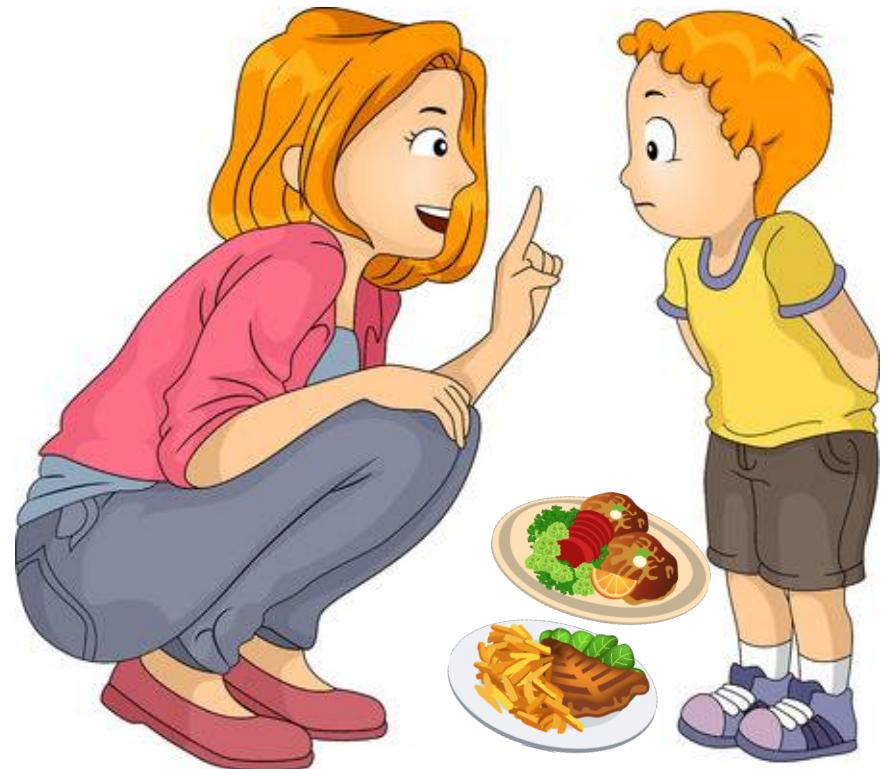
Recipe Recommendation Reasoning on Features: Ensemble Topic Modeling Based Approach

Mansura A. Khan, Ellen Rushe, Barry Smyth and David Coyle
University College Dublin

Why food recommendation is interesting ?

Food choice is multifaceted,
multilevel, contextual,
dynamic, integrated and
diverse

-Jeffery Sobal



Core Challenges in Food/Recipe Recommendation Domain

- Capturing user's preference on food related aspects.
 - Identifying coherent content and context information.
 - Getting access to standardized food and nutrition data.
 - Representation of Food Data
 - Mapping health on recommendations.
 - Measuring healthiness of food item.
 - Measure user's nutrient requirement.
 - Diversity
 - Coverage
-
- Pursue user to choose healthier options.
 - Achieve continuous and regular user engagement.

What is a recipe?

Low Carb Scalloped Zucchini



1hr15mins 4 Serving Nutrition

Ingredients

- 1 : 3 medium zucchini: sliced into disks
- 2 : 1 egg
- 3 : 1 cup cottage cheese
- 4 : 1/3 cup red onion
- 5 : 1/4 lb diced ham
- 6 : 2 teaspoons dried parsley
- 7 : 1/2 teaspoon salt
- 8 : 1/4 teaspoon garlic powder
- 9 : 6 slices bacon

Instruction

- Step 1 : Preheat oven to 350°F.
- Step 2 : Boil the zucchini in salted water for 5 minutes and then drain really well and pat dry.
- Step 3 : Mix the egg, cottage cheese, onion, diced ham, parsley, salt and garlic powder together.
- Step 4 : Spray a 2 quart casserole with nonstick cooking spray and then layer 1/3 of the zucchini in the bottom.
- Step 5 : Layer 1/2 of the cheesy ham mixture over the zucchini and continue layering until finished off with a top layer of zucchini.
- Step 6 : Spread the uncooked bacon out over the top and bake for 1 hour at 350°F.

Nutrition

Calorie : 299.9
Calories from Fat : 187
Total Fat: 20.8g
Saturated Fat : 7.6g
Total Carbohydrate : 8.2g
Sugars : 3.4g
Dietary Fiber: 1.9g
Protein: 20.4g
Cholesterol: 98.6mg
Sodium: 1249.6mg

Recipe is a Story : Document

Title: Yummy mashed potatoes

Ingredients: butter, cream, potatoes, salt and pepper

Instruction : cook potatoes in bowling water until tender but still firm, In a small saucepan heat butter and cream at low heat. Using a potato masher slowly blend cream mixture into potatoes. Season with salt and pepper to taste.

How RS reads a recipe?

Frequency Count :

Occurrence of terms in each document

Terms	Frequency
Potatoes	4
saucepan	1
heat	2
title	1
.....	
in	2
salt	2
tender	1
a	2

Recipe 1

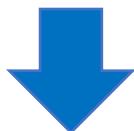
Title: Yummy mashed potatoes

Ingredients: potatoes, butter, cream, salt and pepper

Instruction : cook potatoes in bowling water until tender but still firm, In a small saucepan heat butter and cream at low heat. Using a potato masher slowly blend cream mixture into potatoes. Season with salt and pepper to taste.



Bag of word representation



a	in	potatoes	salt	low	Sauce pane	but				masher			blend
2	2	4	2	1	1	1				1			1

Hundreds of thousands of Documents : Recipe Corpus

Title: Irish stew

Ingredients: chuck lamb stew meat parsnips broth russet potatoes Instruction

Title: Gunnies beef pie

Ingredients: flour beef gunnies butter salt celery beef stock carrot

Title: Yummy mashed potatoes

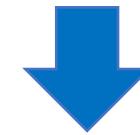
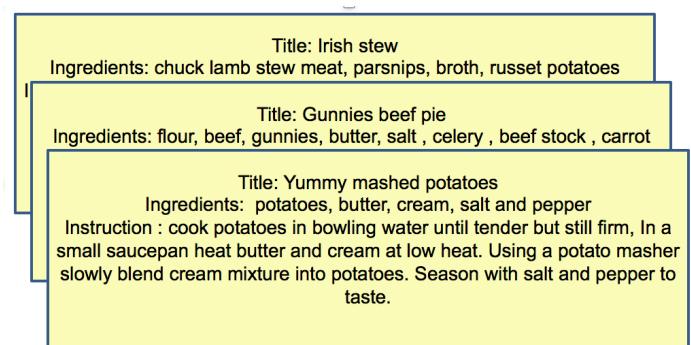
Ingredients: butter, cream, potatoes salt and pepper

Instruction : cook potatoes in bowling water until tender but still firm, In a small saucepan heat butter and cream at low heat. Using a potato masher slowly blend cream mixture into potatoes. Season with salt and pepper to taste.

Recipe 1, 2, 3



Bag of word representation



	a	in	potatoes	salt	low	saucepan	but			beef			lamb
R1	2	2	4	2	1	1	1			0			0
R2	9	5	0	4	0	4	0			2			0
R3	6	4	3	3	0	2	0			0			3

Recommending recipes

beef recipes

	a	in	potatoes	salt	low	saucepans	but			beef			lamb
R1	2	2	4	2	1	1	1			0			0
R2	9	5	0	4	0	4	0			2			0
R3	6	4	3	3	0	2	0			0			3



Understanding the relevance weight

	a	in	potatoes	salt	low	saucepan	but			beef			lamb
R1	2	2	4	2	1	1	1			0			0
R2	9	5	0	4	0	4	0			2			0
R3	6	4	3	3	0	2	0			0			3



Document Frequency: Occurrence of terms over entire corpus

Title: Irish stew
Ingredients: chuck lamb stew meat, parsnips, broth, russet potatoes

Title: Gunnies beef pie
Ingredients: flour, beef, gunnies, butter, salt , celery , beef stock , carrot

Title: Yummy mashed potatoes
Ingredients: potatoes, butter, cream, salt and pepper
Instruction : cook potatoes in bowling water until tender but still firm, In a small saucepan heat butter and cream at low heat. Using a potato masher slowly blend cream mixture into potatoes. Season with salt and pepper to taste.

Terms	Frequency
Potatoes	7
saucepan	7
heat	9
Title	3
.....	
in	11
salt	9
tender	1
a	17

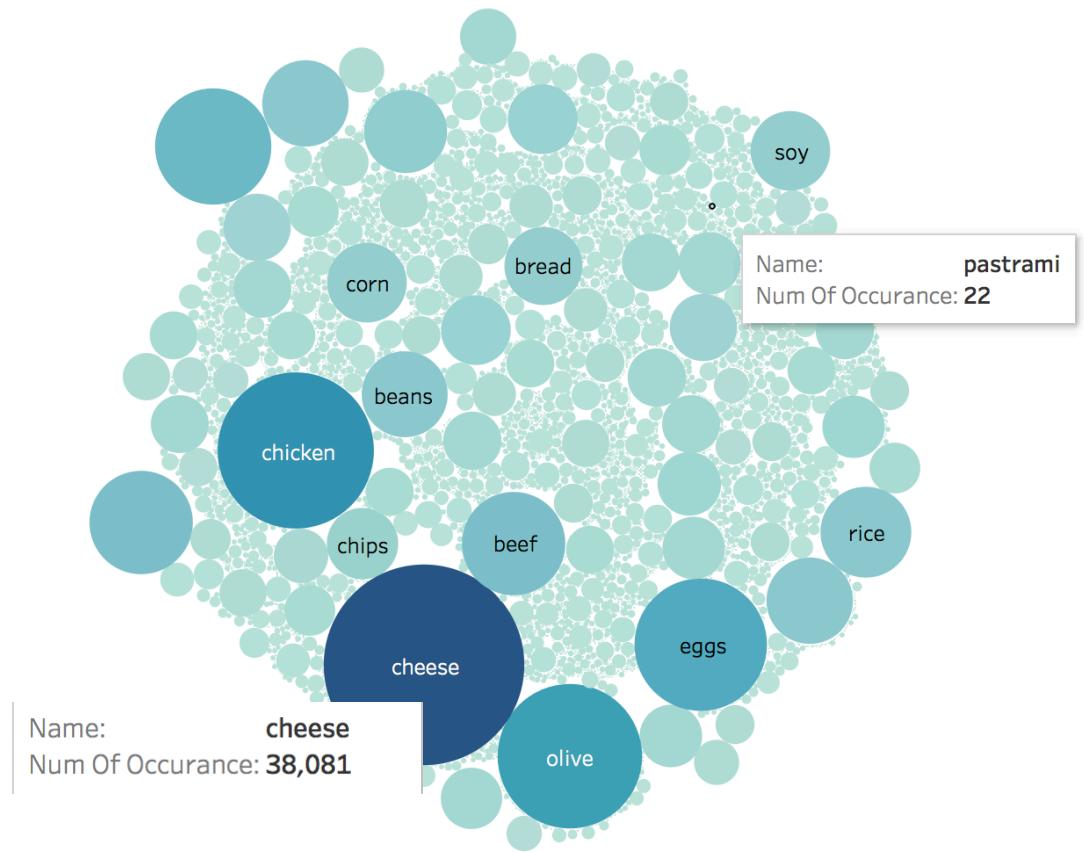
Frequency Matrix

	a	in	potatoes	salt	low	saucepan	but			beef			lamb
R1	2	2	4	2	1	1	1			0			0
R2	9	5	0	4	0	4	0			2			0
R3	6	4	3	3	0	2	0			0			3

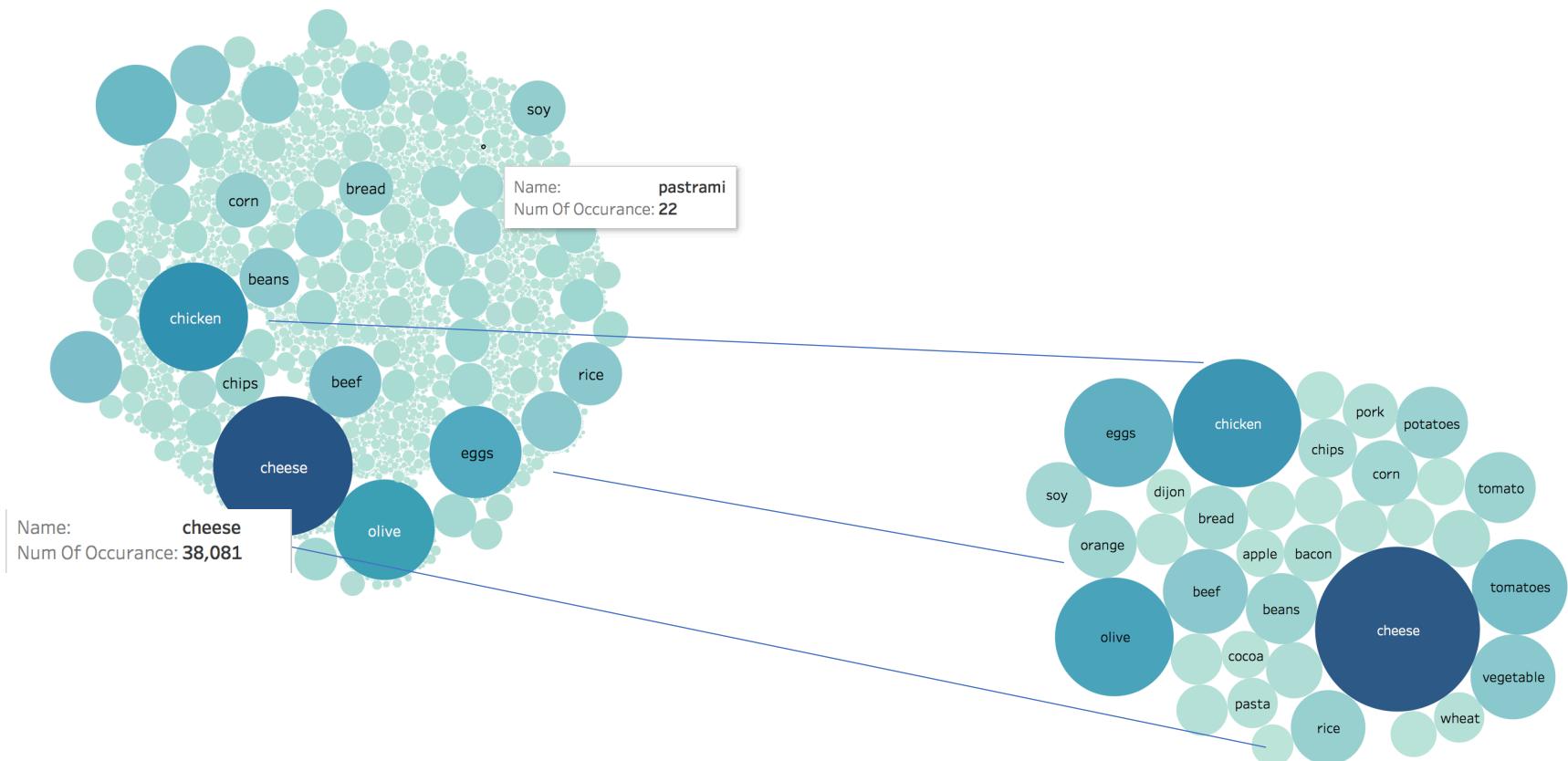
Tf-Idf Matrix

	a	in	potatoes	salt	low	saucepan	but			beef			lamb
R1	0.493	0.871	2.296	1.045	1.477	0.632	1.477	0	0	0	0	0	0
R2	2.220	2.178	0.574	2.091	0	2.528	0	0	0	2.352	0	0	0
R3	1.480	1.742	1.722	1.568	0	1.264	0	0	0	0	0	0	3

- 10,661 ingredients
 - 230,872 recipes



Considering only highly frequent ingredients ?



What information are relevant to Food Recommender?

Topic Modeling

Topic models aim to discover the latent semantic structure or themes within a corpus of documents, which can be derived from co-occurrences of words across the documents.

-Mark Belford

Topic Model

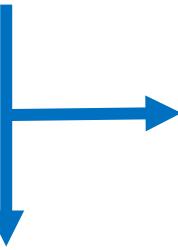
A topic model typically consists of k topics, each represented by a ranked list of strongly-associated terms (often referred to as a “topic descriptor”).

	a	in	potatoes	salt	low	saucepan	but	beef	lamb
R1	2	2	4	2	1	1	1	0	0
R2	9	5	0	4	0	4	0	2	0
R3	6	4	3	3	0	2	0	0	3
R4	2	2	4	2	1	1	1	0	0
R5	9	5	0	4	0	4	0	2	0
R6	6	4	3	3	0	2	0	0	3



Topic Modeling

Recipe-Topic Matrix



Topic -Term Matrix

	potatoes	saucepan	coco	beef	lamb
Topic ₁	6	.07	0	7	0
Topic ₂	6	1	0	0	4
Topic ₃	0	1	2	0	0

	Topic ₁	Topic ₂	Topic ₃
R ₁	.5	0	0
R ₂	0	0	0
R ₃	.7	0	0.002
R ₄	0	0	0
R ₅	0	0.3	0.9
R ₆	0	0	0

Each document/recipe in the corpus can be associated with one or more topics.

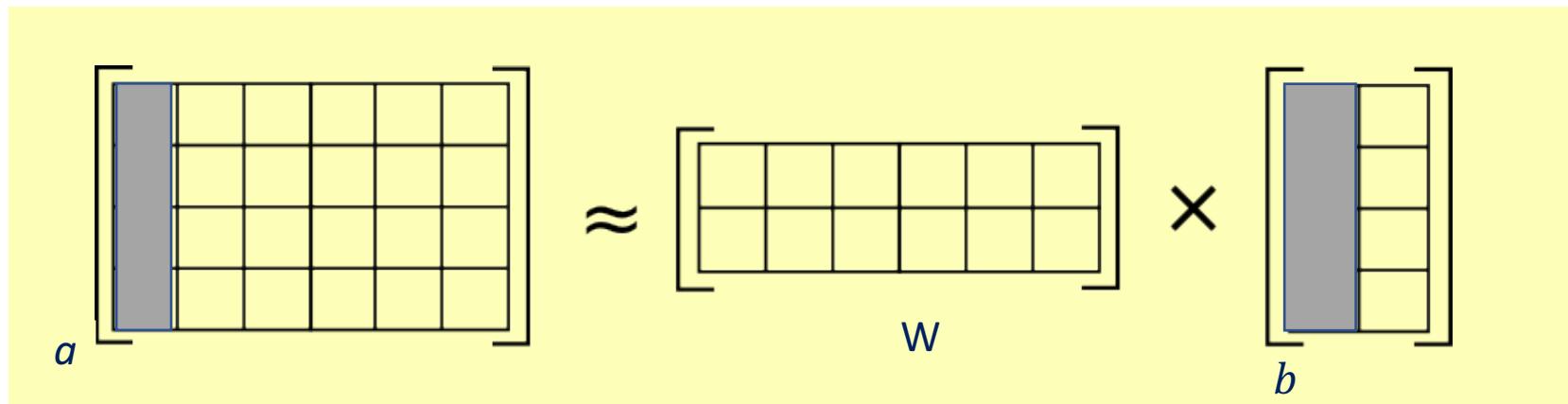
Non-negative matrix factorization

$$\begin{bmatrix} n \times m \\ V \end{bmatrix} \approx \begin{bmatrix} n \times r \\ W \end{bmatrix} \times \begin{bmatrix} r \times m \\ H \end{bmatrix}$$

$$V \approx W \times H$$

It can be rewritten column by column as,

$$a \sim W \times b$$

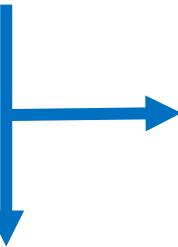


	a	in	potatoes	salt	low	saucepan	but	beef	lamb
R1	2	2	4	2	1	1	1	0	0
R2	9	5	0	4	0	4	0	2	0
R3	6	4	3	3	0	2	0	0	3
R4	2	2	4	2	1	1	1	0	0
R5	9	5	0	4	0	4	0	2	0
R6	6	4	3	3	0	2	0	0	3



Topic Modeling

Recipe-Topic Matrix



Topic -Term Matrix

	potatoes	saucepan	coco	beef	lamb
Topic ₁	6	.07	0	7	0
Topic ₂	6	1	0	0	4
Topic ₃	0	1	2	0	0

	Topic ₁	Topic ₂	Topic ₃
R ₁	.5	0	0
R ₂	0	0	0
R ₃	.7	0	0.002
R ₄	0	0	0
R ₅	0	0.3	0.9
R ₆	0	0	0

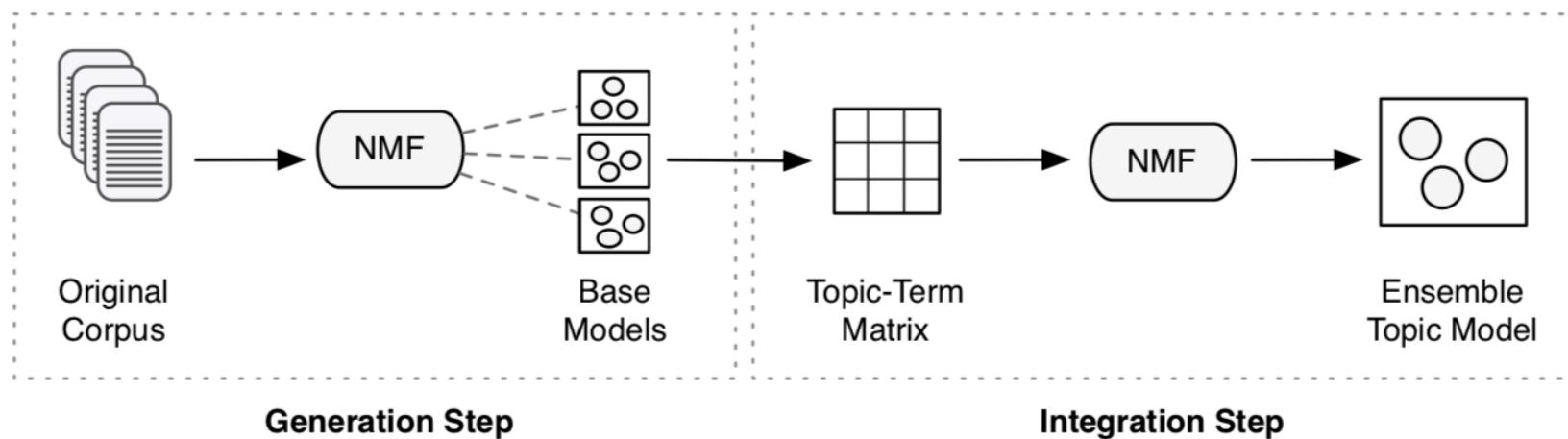
Outcome of different topic modeling session is only approximately equal

Topic	Terms
Topic 0	beginner-cook, easy, inexpensive, kid-friendly, appetizer, eggs-dairy, holiday-event, snack, toddler-friendly, technique, served-cold, potluck, egg-free, finger-food, european
Topic 1	cheese, eggs-dairy, cheddar, parmesan, appetizer, mozzarella, tortilla, high-calcium, low-carb, cheesecake, macaroni, mayonnaise, feta, goat, lasagna
Topic 2	spinach, olive, feta, artichoke, vegetable, strawberry, parmesan, low-carb, pine, main-dish, salad-dressings, lasagna, tofu, vinaigrette, phyllo
Topic 3	casserole, one-dish-meal, main-dish, sausage, cheddar, noodle, tuna, side-dishes, macaroni, potluck, bubbly, cheese, weeknight, ritz, less-than-half-hour
Topic 4	apple, dessert, low-protein, tart, cranberry, pies-and-tarts, walnut, oat, caramel, applesauce, pecan, maple, pear, batter, salad
Topic 5	dessert, cookies-and-brownies, for-large-groups, cocoa, holiday-event, pecan, almond, bar-cookies, pudding, drop-cookies, christmas, pies-and-tarts, pumpkin, savoury, mixer
Topic 6	vegetable, carrot, side-dishes, zucchini, soups-stews, celery, cabbage, stove-top, asparagus, carrots, cauliflower, pea, pumpkin, mushrooms, green-yellow-beans
Topic 7	corn, tortilla, cornstarch, cornmeal, salsa, cilantro, chowder, cornbread, jalapeno, chilies, cob, ear, popcorn, soups-stews, pecan
Topic 8	rice, side-dishes, soy, white-rice, brown-rice, chinese, basmati, long-grain, pea, one-dish-meal, risotto, pilaf, stove-top, stir-fry, celery
Topic 9	low-cholesterol, low-protein, low-calorie, low-carb, easy, side-dishes, soups-stews, appetizer, strawberry, smoothy, peach, cucumber, technique, savory-sauces, salsa
Topic 10	broccoli, floret, cauliflower, vegetable, mayonnaise, soy, cornstarch, stir-fry, cheddar, chinese, side-dishes, bisques-cream-soups, florets, low-carb, sunflower

Topic	Terms
Topic 0	vegetable, side-dishes, broccoli, spinach, zucchini, asparagus, stove-top, cauliflower, olive, mushrooms, green-yellow-beans, served-hot, soy, beans, cucumber
Topic 1	dessert, cookies-and-brownies, for-large-groups, cocoa, pecan, bar-cookies, holiday-event, drop-cookies, pudding, cooky, walnut, pies-and-tarts, mixer, christmas, hand-formed-cookies
Topic 2	bread, quick-breads, loaf, wheat, rolls-biscuits, low-cholesterol, muffins, small-appliance, for-large-groups, cornmeal, batter, weeknight, high-calcium, coffee-cakes, easy
Topic 3	dessert, apple, low-protein, tart, cranberry, pies-and-tarts, walnut, saur, caramel, applesauce, pecan, maple, pear, batter, salad
Topic 4	chicken, poultry, meat, chicken-breasts, main-dish, low-carb, one-dish-meal, high-protein, chicken-thighs-legs, olive, soy, wing, whole-chicken, easy, weeknight
Topic 5	low-cholesterol, low-protein, low-calorie, low-carb, easy, side-dishes, soups-stews, appetizer, strawberry, smoothy, peach, cucumber, technique, savory-sauces, salsa
Topic 6	beginner-cook, easy, inexpensive, kid-friendly, eggs-dairy, holiday-event, toddler-friendly, snack, technique, served-cold, potluck, egg-free, european, served-hot, south-west-pacific
Topic 7	orange, citrus, cranberry, marmalade, mandarin, holiday-event, tea, oranges, easy, christmas, served-cold, olive, apricot, eel, grapefruit
Topic 8	banana, tropical-fruit, bananas, quick-breads, smoothy, yogurt, muffins, smoothie, walnut, pudding, kid-friendly, wheat, oat, blueberry, batter
Topic 9	almond, blueberry, cherry, raspberry, almonds, peach, coffee, pitted-fruit, yogurt, batter, apricot, yolk, cranberry, european, maraschino
Topic 10	tortilla, appetizer, salsa, cilantro, avocado, jalapeno, mayonnaise, for-large-groups, lettuce, chilies, finger-food, snack, easy, olive, chips

Ensemble Topic Modeling

Ensemble procedures seek to encourage diversity with a view to improving the quality of the information available in the integration phase
- Alexander Topchy



Recipe Recommendation Reasoning on Features : Ensemble Topic Modeling Based Approach

Extracting significant Features(words) using Ensemble
Topic modeling

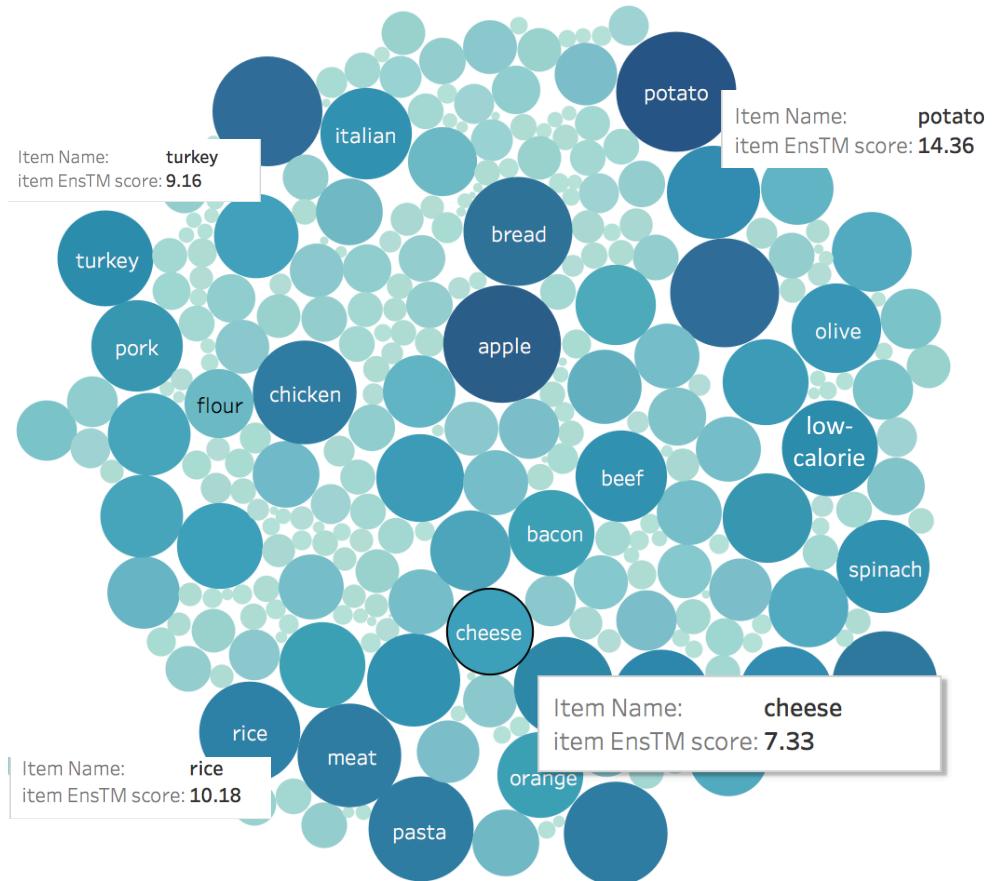
- Tokenize , Lemmatize, Stem , customWord
- Domain and corpus specific Stopwords generation
- Ensemble Topic modeling
- Selecting first 15 words from top 30 topics
- Calculating the weight for the Unique 288 words from the previous step

Example of identified topics

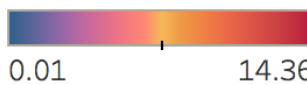
Topics descriptor	List of 15 features within each topic
Roman	italian, beef-sausage, european, olive, parmesan, mozzarella, pork-sausage, spaghetti, chorizo, pepperoni, lasagna, german, marinara, eggplant, romantic
Banana based dessert and drinks	banana, tropical-fruit, frozen-desserts, quick-breads, smoothie, yogurt, muffins, thermomix, walnut, blueberry, pudding, krispies, wheat, bran, batter
Easy and quick snacks	beginner-cook, easy, inexpensive, kid-friendly, appetizer, eggs-dairy, holiday-food, pretzel, toddler-friendly, few-ingredients-recipe, served-cold, potluck, egg-free, finger-food, served-hot
Easy fish mains	salmon, fish, saltwater-fish, seafood, main-dish, high-protein, spinach, low-carb, vinaigrette, cream-cheese, halibut, dijon, asparagus, chickpeas, beginner-cook
Corn based maxican	tortilla, cornstarch, cornmeal, casserole, salsa, chowder, cornbread, cilantro, jalapeno, chilies, cob, sweet-corn, popcorn, soups-stews, roma-tomato
Rice dishes	rice, side-dishes, white-rice, soy, casserole, brown-rice, chinese, one-dish-meal, basmati, long-grain, pea, risotto, pilaf, stir-fry, stove-top
Tropical juice and desserts	pineapple, tropical-fruit, cherry, hawaiian, mango, maraschino, carrot, low-protein, cornstarch, dessert, soy, pudding, marshmallow, easy, caribbean
Beef based mains	beef, meat, ground-beef, main-dish, one-dish-meal, roast-beef, sirloin, crock-pot-slow-cooker, meatloaf, casserole, meatball, scallion, noodle, breadcrumb, easy
Vegetable dishes	vegetable, carrot, saucepan, zucchini, spinach, soups-stews, tofu, cabbage, sunflower-oil, asparagus, week-night, chickpeas, cauliflower, hard-boiled-egg, mushroom
Seafood mains	seafood, soy-sauce, shellfish, tuna, appetizer, main-dish, wok, low-carb, leek, crabmeat, olive, cod,high-protein, easy, cream-style
Turkey mains	turkey, meat, cooking-wine, main-dish, couscous, thanksgiving, turkey-breasts, tortilla, sausage, lettuce, cranberry, one-dish-meal, burger, gravy, casserole
Health conscious	low-cholesterol, low-protein, low-calorie, low-carb, easy, side-dishes, soups-stews, appetizer, smoothie, few-steps-recipe, cucumber, egg-free, savory-appliance, salsa

The final 288 Food Features

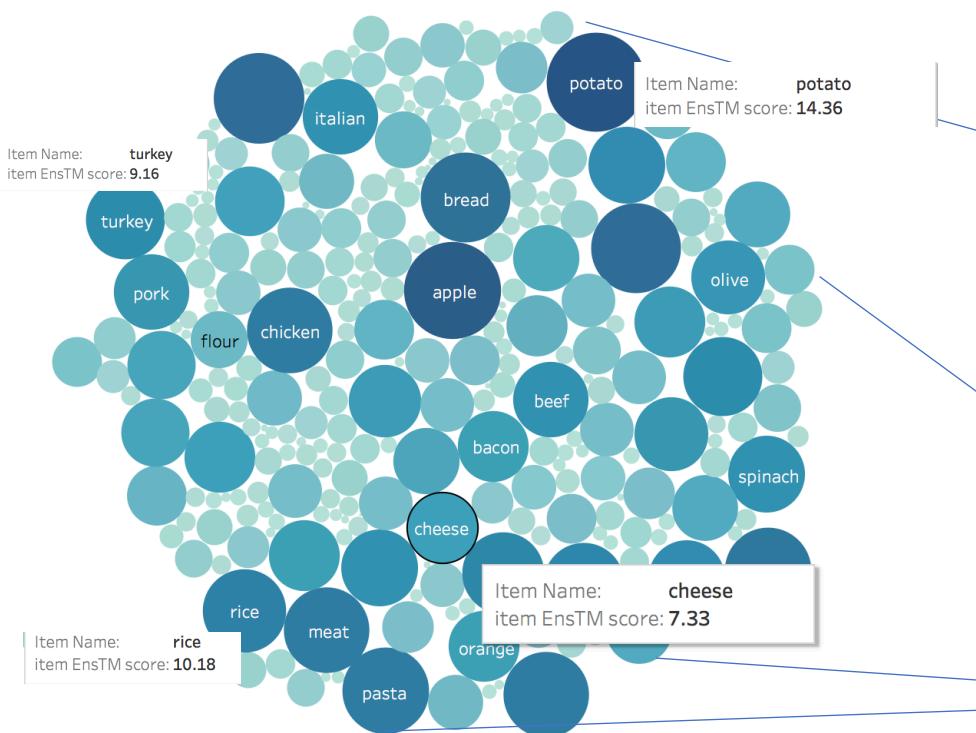
Which we later considered the basis of new data representation format and thereby recommendation algorithms



The final 288 Food Features

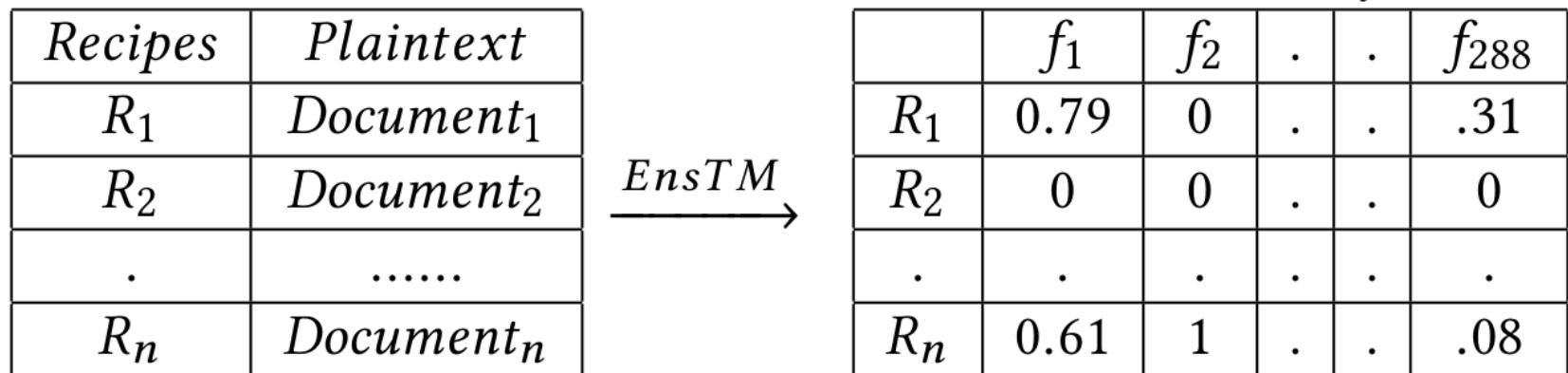


The final 288 Food Features



	%	Features
context	4.2	holiday-food, beginner-cook, week-night, inexpensive , 6-people-or-more, potluck
cuisine	6.7	italian, hawaiian, tex-mex, chinese, cajun
equipment	2.4	saucepans, thermomix, wok, dutch-oven
cooking process	3.12	few-steps-recipe, less-than-one-hour, fried, slow-cooked, marinated, 4-hours-or-more
ingredient	61.15	poultry, feta, spaghetti, shredded-meal
category	15.2	risotto, lasagna, stew, appetizer, pot-roast
nutrition	3.01	high-calcium, low-cholesterol, egg-free

Our proposed n-by-288 data representation format



Recommendation approaches

Food Features based Recommendation (FFbR)

- u_a is an user
- r_n is a new recipe
- i is each feature in r_n $i=0,1,2,\dots,m$
- $f_{i,ua}$ is u_a 's rating on i

$$P(u_a, r_n) = \left(\sum_{i=0}^m f_{i, u_a} \right)^{(0,5)}$$

Recommendation approaches

Weighted Food Features based
Recommendation (WFFbR)

- u_a is an user
- r_n is a new recipe
- i is each ingredient in r_n $i=0,1,2,\dots,m$
- $f_{i,ua}$ is u_a 's rating on i
- w_i is significance score of each feature

$$P(u_a, r_n) = \left(\sum_{i=0}^m f_{i, u_a} \times w_i \right)^{(0,5)}$$

Recommendation approaches

Food Features based Collaborative Filtering (FFbCF)

- u_a is an user
- i is each neighbor of u_a $i=0,1,2....n$
- $f_{b,i}$ is neighbor i 's rating on a feature f_b
- We calculate $f_{r,ua}$ using FFbR after learning u_a 's rating on all unknown feature f_b using FFbCF

$$P(f_{b,u_a}) = \frac{\sum_{i=0}^n f_{b,i}}{n}$$

Recommendation approaches

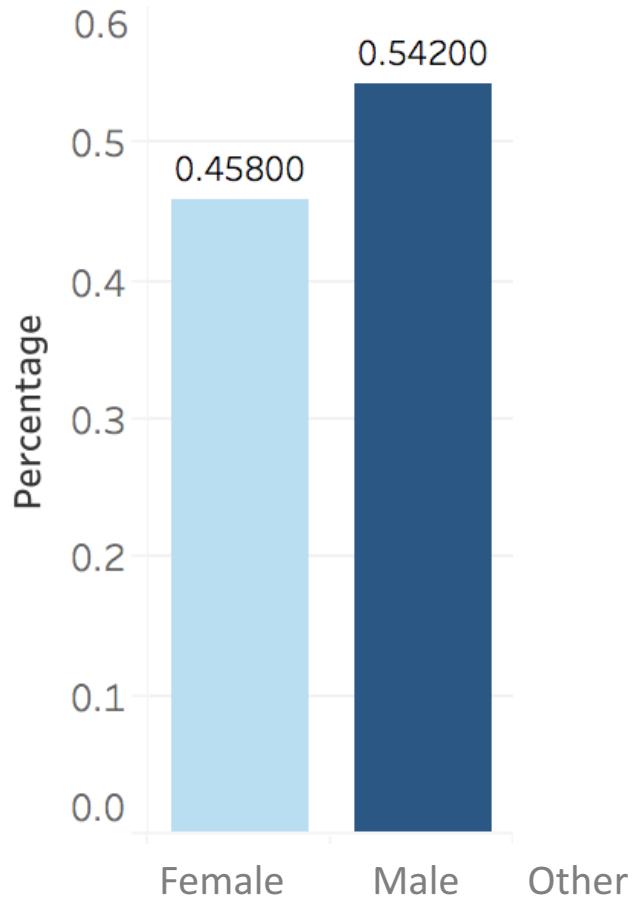
Content Based(CB)

$$P(u_a, r_n) = \frac{\sum_{i=0}^m Ing_{i,u_a}}{m}$$

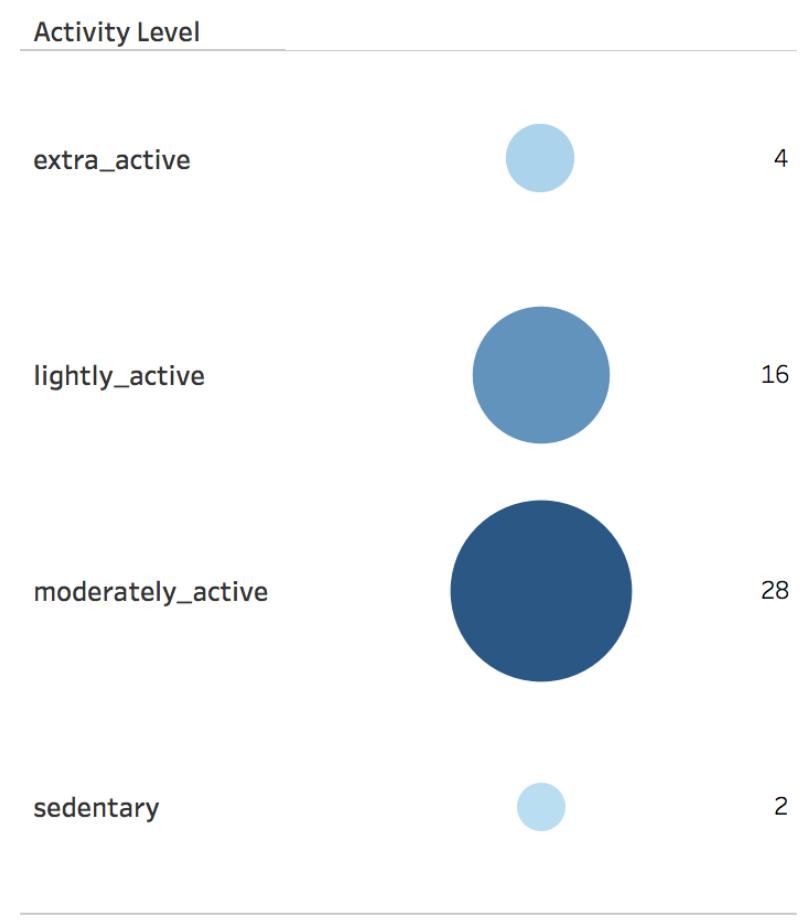
- u_a is an user
- r_n is a new recipe
- i is each ingredient in r_n $i=0,1,2,\dots,m$
- $Ing_{i,ua}$ is u_a 's rating on i

User modeling and
testing the recommendation algorithms

User Study : 4 recommenders and 48 user

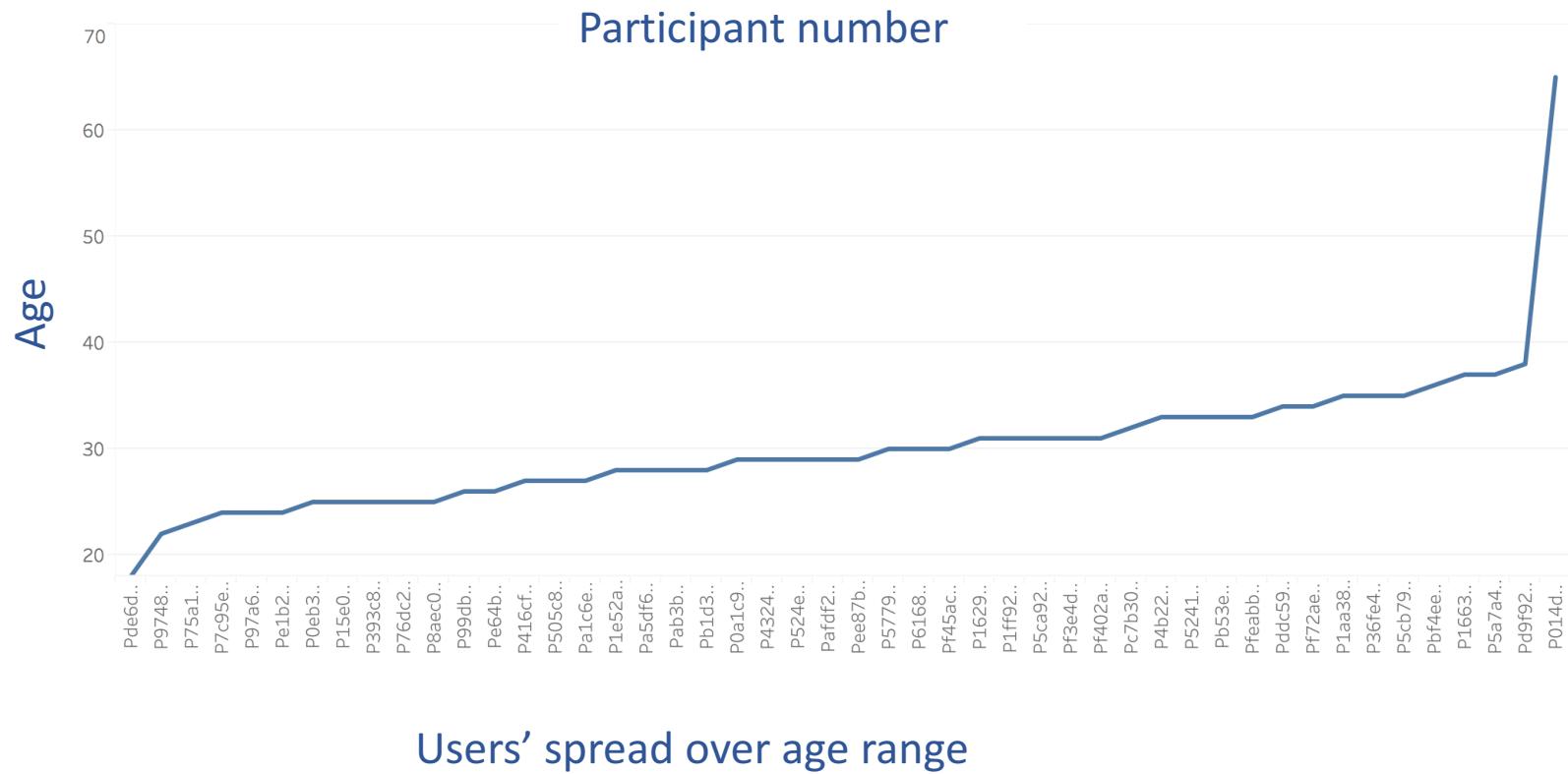


Users' spread over gender category



Users' spread over activity category

User Study : 4 recommenders and 48 user



User Study : 4 recommenders and 48 user

Please insert the following infomation

Age 18 34

Weight (in kg) 01 150 80

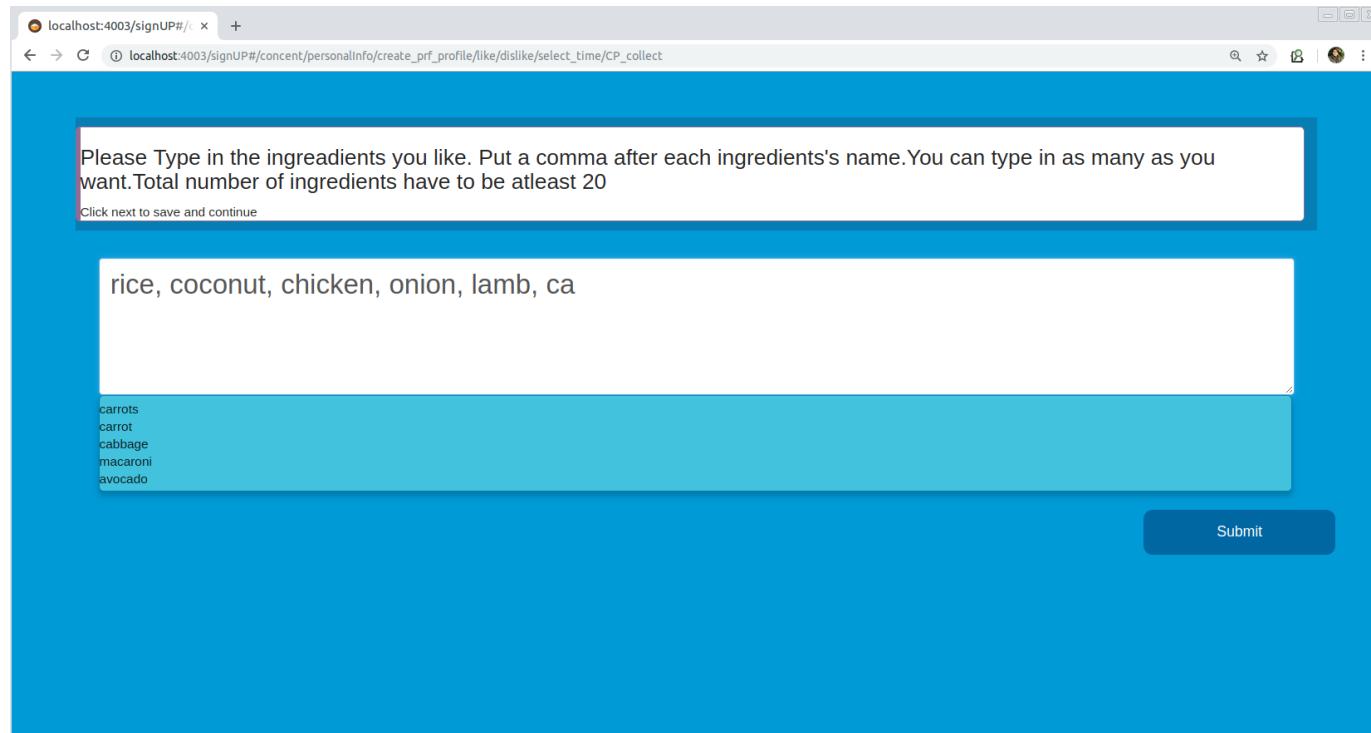
height (in cm) 31 224 174

Gender Male Female Other

How would you describe your everyday activity level ?

Sedentary Lightly Active Moderately Active Very Active

User Study : 4 recommenders and 48 user



User Study : 4 recommenders and 48 user

localhost:4003/signUP#/ < +

localhost:4003/signUP#/concent/personalInfo/create_prf_profile/like

Please select the options you like. Your choices would be used to make your taste profile , **you have to select atleast 20 options**
Please select the options you actually like or consume.
Do not select options which , you think you should like or consume.

21 selected

Dessert	Easy recipes / Few steps recipe	Olive	Main-dish	Soy	Cornstarch
One-dish-meal	Low-carb	European Cuisine	Celery	Pudding	Festival Holiday Food
Walnut	Casserole	Appetizer	Mayonnaise	Side-dishes	Oat
Meat	Breadcrumb	Vegetable	Beignets/Beignets	Cilantro	Pecan

User Study : 4 recommenders and 48 user

localhost:4003/signUP#/

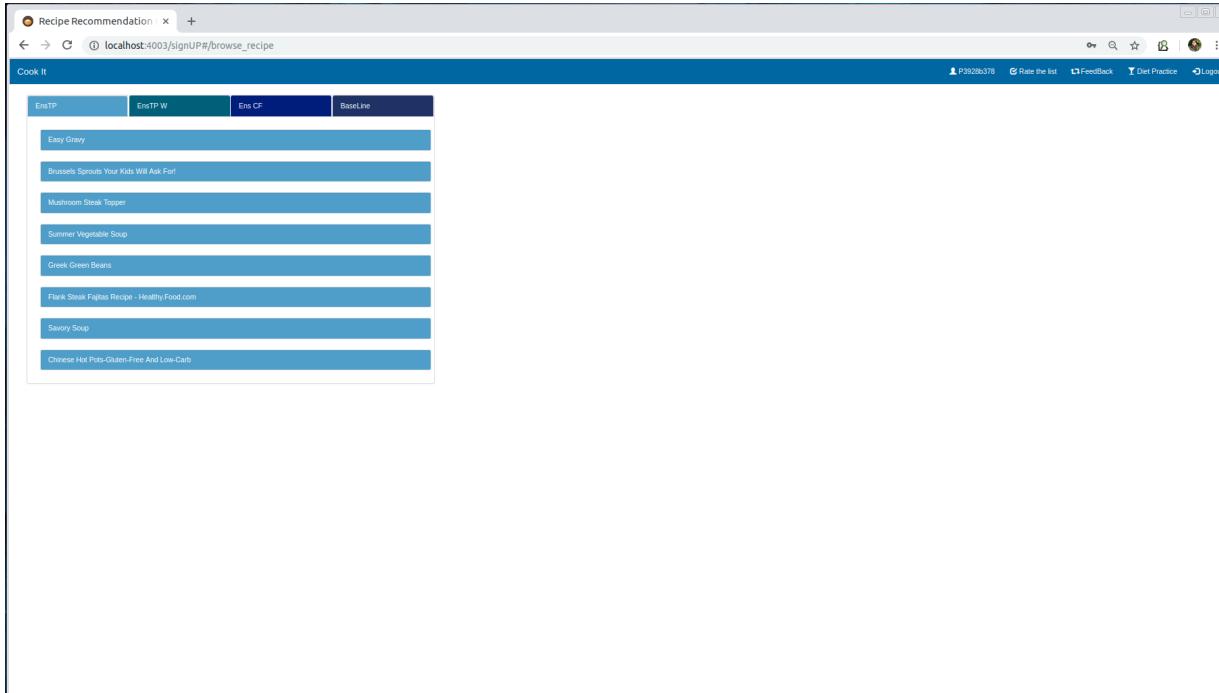
Please select the options you **Do not like**. Your choices would be used to make your taste profile . **you have to select atleast 20 options**

Please select the options you **do not** like or consume in practice.
Do not select options which , you think you **should not** like or consume.

5 selected

Dessert	Easy recipes / Few steps recipe	Olive	Main-dish	Soy	Cornstarch
One-dish-meal	Low-carb	European Cuisine	Celery	Pudding	Festival/ Holiday Food
Walnut	Casserole	Appetizer	Mayonnaise	Side-dishes	Oat
Meat	Breadcrumb	Vegetable	Soups/stews	Cilantro	Pecan

User Study : 4 recommenders and 48 user



User Study : 4 recommenders and 48 user

Recipe Recommendation

localhost:4003/signUp#/browse_recipe

Cook It

EriSTP EriSTP W Eri CF Baseline

Garlic Soup

A Quick And Easy White Cake

Chilled Herbless Tomatoes With Fresh Herbs

Mushroom Vegetable Soup

Brussels Sprouts Soup

Stir-Fried Peppers With Thyme

Ginger Soup

Creamy Cheesy Vegetable Soup

Stir-Fried Peppers With Thyme

★★★★★

20mins 3-4 Serving Nutrition

Ingredients

- 1 : 2 tablespoons olive oil
- 2 : 2 medium bell peppers, of any color cut in 1 1/2 x 1/4 inch strips
- 3 : 1 1/2 teaspoons chopped fresh thyme leaves or 1/2 teaspoon dried thyme
- 4 : salt and pepper, to taste

Instruction

- Step 1 : Heat oil in large skillet or small wok over moderately high heat.
- Step 2 : Add peppers and thyme, stirring frequently, until peppers are tender-crisp.
- Step 3 : Add salt and pepper to taste.
- Step 4 : Serve hot, warm or at room temperature.

User Study : 4 recommenders and 48 user

Recipe Recommendation x +

localhost:4003/signUp#/Rate_D_List

Cook It

P3928578 Rate the list Feedback Diet Practice Logout

Please rate the following each list in a scale of 0 to 5 based on how much you like the list.
Click submit to save your Ratings

Easy Gravy	Garlic Soup	Crock Pot - Best Chuck Roast	Lazy Stuffed Cabbage Casserole
Brussels Sprouts Your Kids Will Ask For!	A Quick And Easy White Cake	Red Root Soup	Chicken Cabbage Stir Fry
Mushroom Steak Topper	Chilled Herbion Tomatoes With Fresh Herbs	Easy Chicken Noodle Casserole	Lemon And Oregano Lamb Chops Recipe - AustralianFood.com
Summer Vegetable Soup	Mushroom Vegetable Soup	Dees Shepherds Pie	Lamb, Aspicoke And Tomato Stew
Greek Green Beans	Brussels Sprouts Soup	Brussels Sprouts Your Kids Will Ask For!	Lamb Tagine
Flank Steak Fajitas Recipe - HealthyFood.com	Stir-Fried Peppers With Thyme	Deluxe Pinto Beans	Algerian Lamb And Lentil Soup
Savory Soup	Ginger Soup	Peking Pork Spare Ribs	Lamb Shanks On Cannellini Beans
Chinese Hot Pots-Gluten-Free And Low-Carb	Creamy Cheesy Vegetable Soup	Dirty Rice - Vegetarian Style	Gluten Free Triple Coconut Muffins Delicious And Healthy

★★★★★ ★★★★★ ★★★★★ ★★★★★

Submit

User Study : 4 recommenders and 48 user

Recipe Recommendation x +

localhost:4003/signUp#/YourFoodPractice

Cook It

P39286378 Rate the list FeedBack Diet Practice Logout

Please select your food practice and rate the recommendation lists in a scale of 0 to 5 based on, how much it was addressing your food practice.

Your Food Practice

<input type="radio"/> Meat Eater	eats all kind of meat and dairy products
<input type="radio"/> Flexitarian	no red meat
<input type="radio"/> Pescatarian	Vegetarian + Fish
<input type="radio"/> VEGETARIAN	Vegetables + Egg + Dairy
<input type="radio"/> Pollo Vegetarian	Vegetarian + occasionally chicken
<input type="radio"/> Ovo Vegetarian	Vegetarian + egg + no dairy
<input type="radio"/> Macrobiotic	Vegetarian + seafood - Egg - Dairy
<input type="radio"/> Vegan	Vegetarian - Egg - Dairy
<input type="radio"/> No pork + No alcohol	Islamic Diet
<input type="radio"/> No beef	Diet followed in Hinduism
<input checked="" type="radio"/> Any nutrient restriction	If you the individual is prescribed to take/evadent food item

Did the EnsTP Reclists addressed your food practice ?

Did the EnsTP_W Reclists addressed your food practice ?

Did the EnsTP_CF Reclists addressed your food practice ?

Did the Baseline Reclists addressed your food practice ?

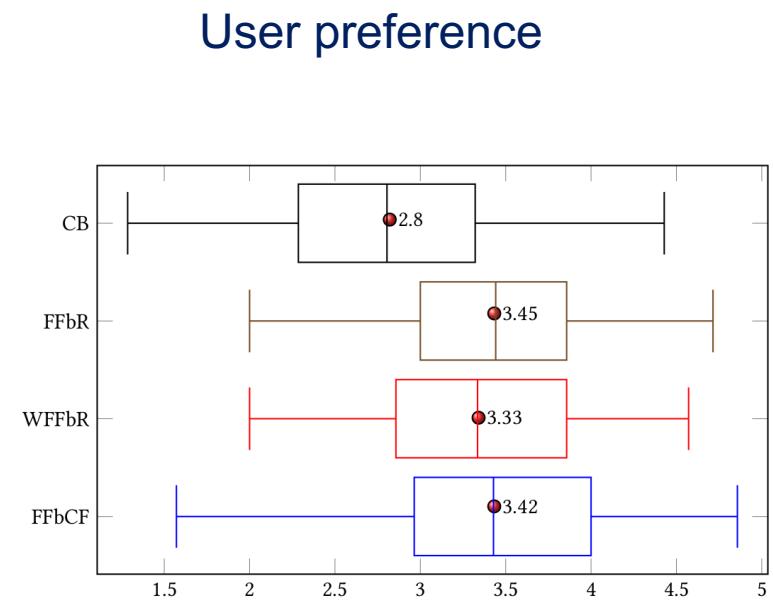
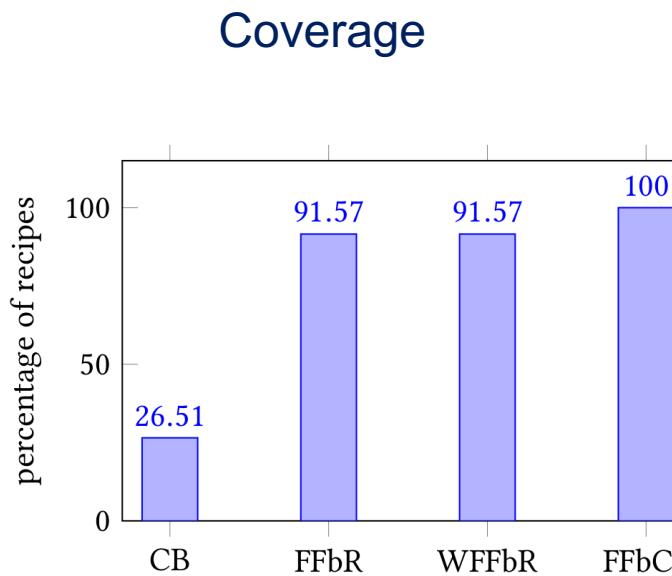
Submit choice

User Study : 4 recommenders and 48 user

Demo on our developed system could be found on

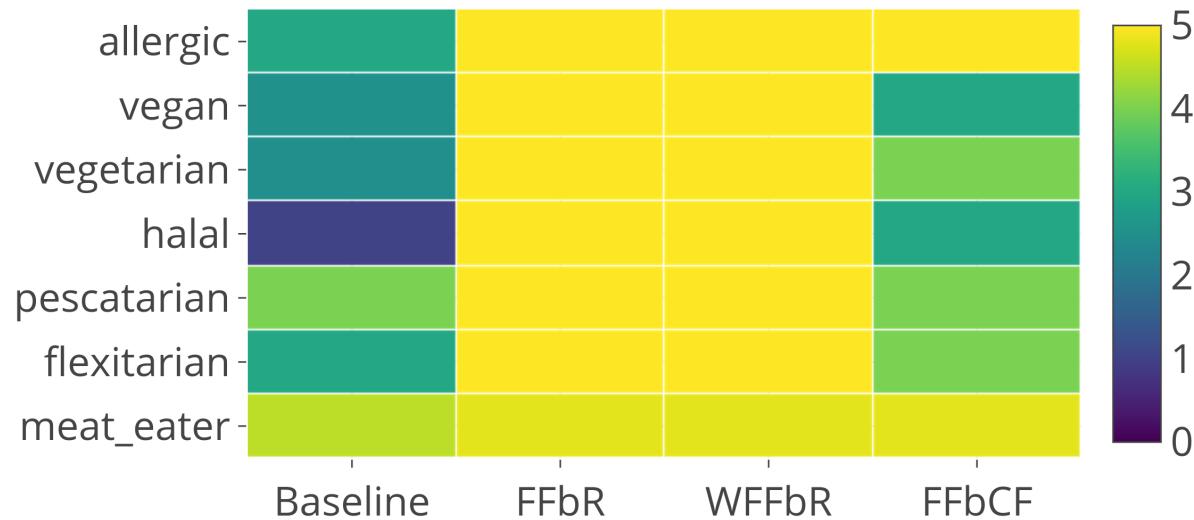
<https://www.youtube.com/watch?v=ujaB0FiqRwk>

Results



Results

Identifying user's food requirement and restriction



Recommending Healthy Recipe ??

Distributions of items(recipes)in my data-set over WHO and FSA Health Scales.

WHO score	Total (percentage)		FSA score	Total (percentage)	
	Recipes n =230872	Recipes n =230872		Recipes n =230872	Recipes n =230872
0	88(0.04)		4	40877(17.71)	
1	2732(1.18)		5	32227(13.96)	
2	15603(6.76)		6	44807(19.41)	
3	63969(27.71)		7	40647(17.61)	
4	123453(53.47)		8	30754(13.32)	
5	22395(9.7)		9	24249(10.5)	
6	2533(1.1)		10	13002(5.63)	
7	99(0.04)		11	4009(1.74)	
8	0(0)		12	300(0.13)	

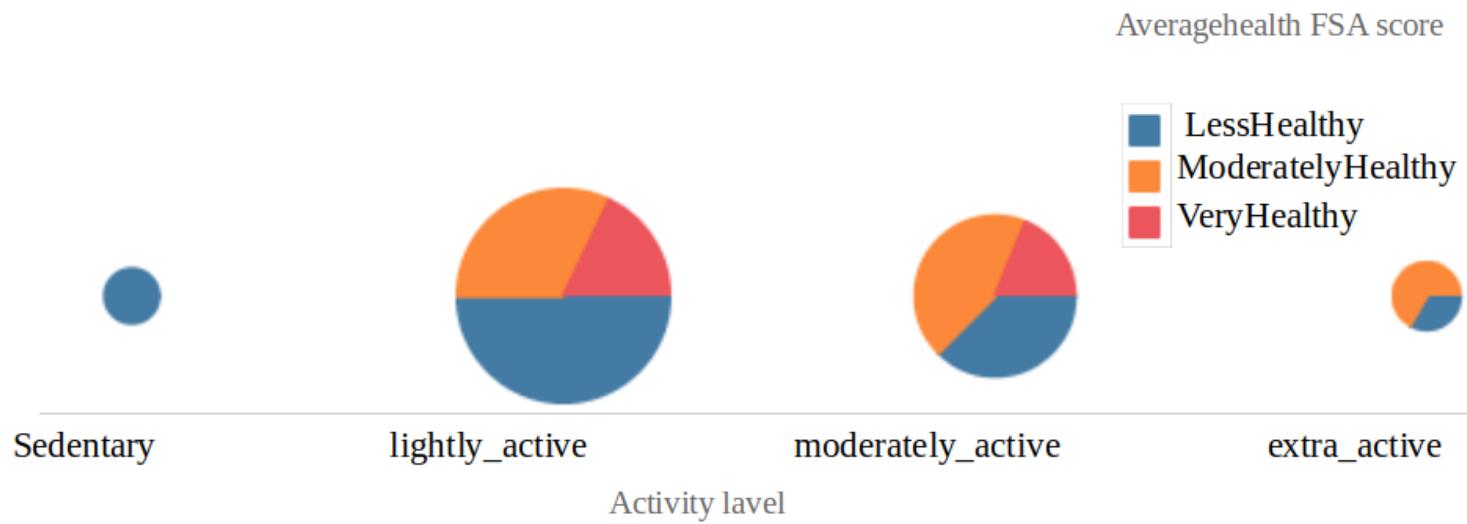
Recommending Healthy Recipe ??

	%	Features
context	4.2	holiday-food, beginner-cook, week-night, inexpensive , 6-people-or-more, potluck
cuisine	6.7	italian, hawaiian, tex-mex, chinese, cajun
equipment	2.4	saucepan, thermomix, wok, dutch-oven
cooking process	3.12	few-steps-recipe, less-than-one-hour, fried, slow-cooked, marinated, 4-hours-or-more
ingredient	61.15	poultry, feta, spaghetti, shredded-meal
category	15.2	risotto, lasagna, stew, appetizer, pot-roast
nutrition	3.01	high-calcium, low-cholesterol, egg-free

Looking for user group with healthier life style??

Scale	Guideline	User Group
Activity Level	FAO: activity level	sedentary, lightly_active, moderately_active, extra_active
BMI	WHO:BMI	underweight, normal_weight , pre_obesity, obesityclass_1
Food Choices	FSA: nutrient intake guideline	less_healthy, moderately_healthy, very_healthy

Looking for user group with healthier life style??



Users' spread over different Healthiness scale

Positively correlated features to healthier user groups

Average Food HealthScore		Activity Level	
Feature	r	Feature	r
peanut-butter	0.447989	wing	0.441152
granola	0.365171	tuna	0.430467
lentil	0.360767	tilapia	0.363502
indian	0.356347	salmon	0.359852
cauliflower	0.352353	hawaiian	0.346401
low-cholesterol	0.350818	canadian	0.322470
maple	0.321131	smoothy	0.314174
vegetable	0.307459	chicken-thighs-legs	0.314059
wheat	0.303326	halibut	0.310990
carrot	0.303052	main-dish	0.303345

Negatively correlated features to healthier user groups

Average Food HealthScore		Activity Level	
	r		r
roast-beef	-0.564273476	hard-boiled	-0.345550067
lasagna	-0.464811126	chicken-breasts	-0.329366275
sausage	-0.389612531	white-rice	-0.32198579
wing	-0.364559511	rice	-0.32198579
thanksgiving	-0.350745293	ham	-0.289471946
chicken-breast	-0.329366275	pear	-0.292700772

Limitation

Feature work



Thank You