Creating Cuisine Recipes by Artificial Chef, in 2016

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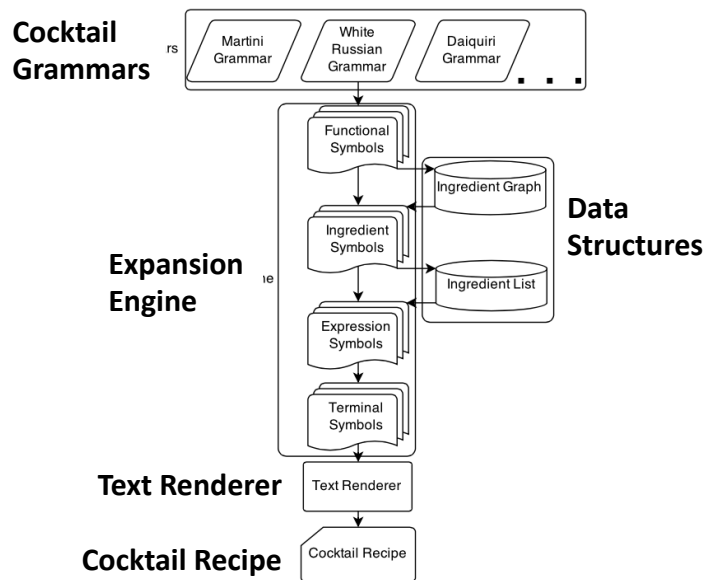
Agenda

- Background

- Related work

- Our system overview

- Evaluation

- Conclusion

Background
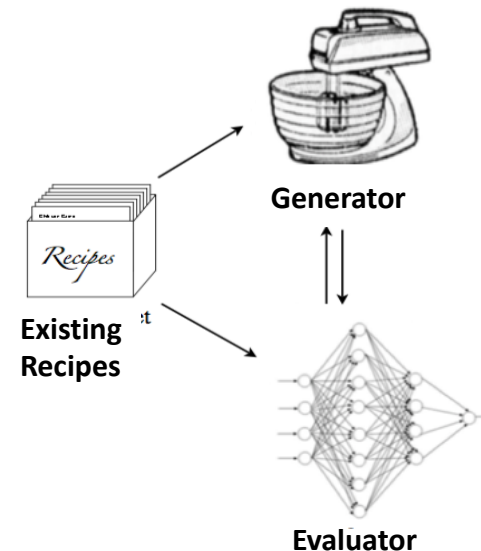
➢ Computational Creativity - Recipe creation studies

■ *Rule-based system*
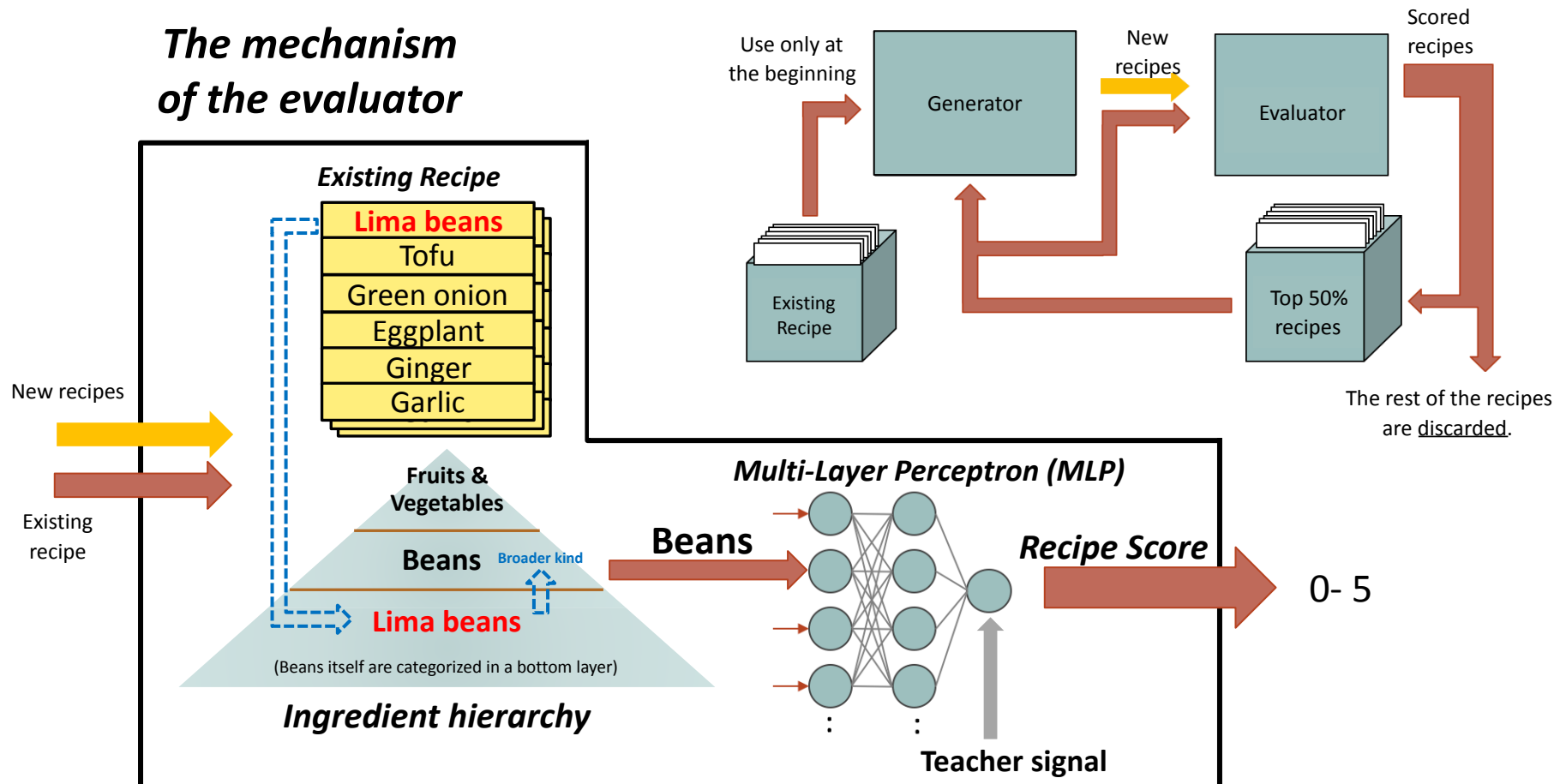(Johnathan Pagnutti, 2015)

■ *Machine learning-based system*
(Richard G. Morris, 2012)

Cocktail Grammars

Martini Grammar | White Russian Grammar | Daiquiri Grammar . . .

Expansion Engine

Functional Symbols

Ingredient Graph

Ingredient Symbols

Ingredient List

Data Structures

Expression Symbols

Terminal Symbols

Text Renderer — Text Renderer

Cocktail Recipe — Cocktail Recipe

Existing Recipes

Generator

Evaluator

Novelty	The same as human creation	✔
Tasty	✔	Tasty and Bad-Tasting

Related work (Richard G. Morris, 2012)

The mechanism of the evaluator

Existing Recipe
- Lima beans
- Tofu
- Green onion
- Eggplant
- Ginger
- Garlic

New recipes

Existing recipe

Fruits & Vegetables

Beans — Broader kind

Lima beans
(Beans itself are categorized in a bottom layer)

Ingredient hierarchy

Multi-Layer Perceptron (MLP)

Beans

Recipe Score → 0- 5

Teacher signal

Use only at the beginning

Generator → New recipes → Evaluator → Scored recipes

Existing Recipe

Top 50% recipes

The rest of the recipes are discarded.

Generator using Genetic Algorithm

Crossover

First sub-list

| Bucket |
| Egg |
| Milk |
| Honey |

| Potato starch |
| Tofu |
| Japanese Lee |
| Eggplant |

A pivot index

Second sub-list

| Ginger |
| Garlic |
| Booze |
| Tonkatsu sauce |

| Maple syrup |
| Cinnamon |
| Coffee |
| Fresh cream |

Mutation

Add

| Fresh cream |

| Macaroni |
| Minced meat |

Replace

| Fresh cream | s |

| Carrot |
| Olive oil |

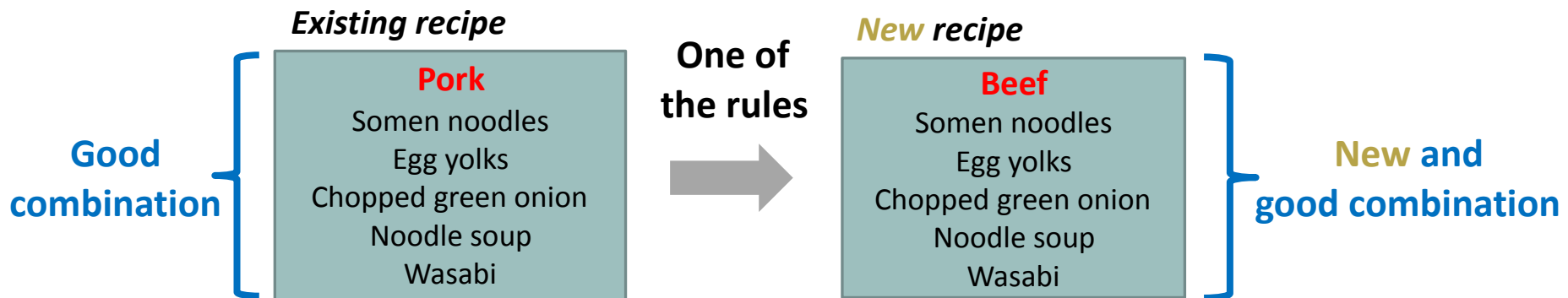**Delete**

| Rosemary |
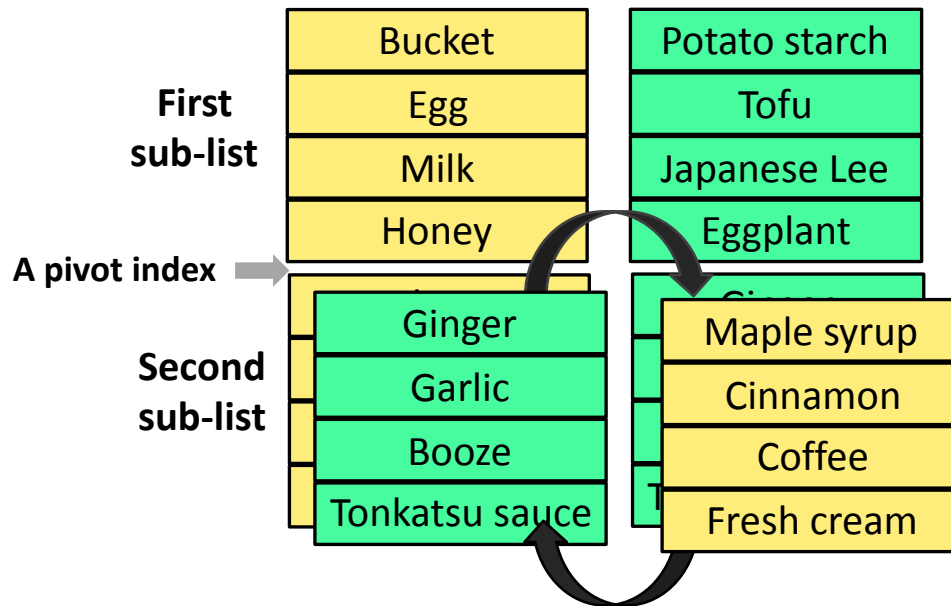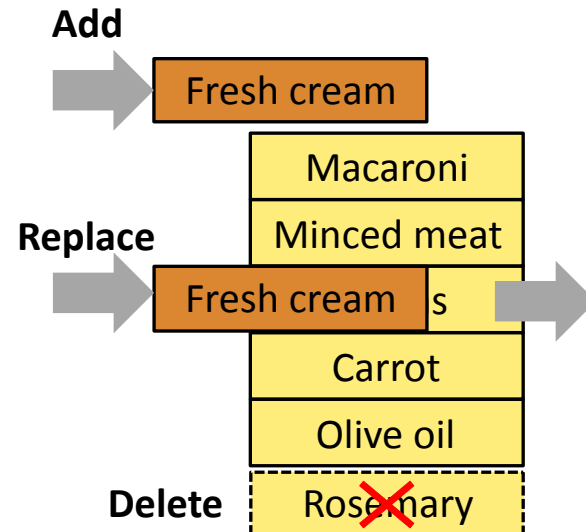
Our Idea

➢ **Morris**

Random Mutation ➡ The cause of creating unpalatable ingredients lists

➢ **Proposal : Rule-based Mutation**

It replaces a ingredient with another one by rule

Existing recipe One of *New recipe*
the rules

Good combination

| **Pork** |
| Somen noodles |
| Egg yolks |
| Chopped green onion |
| Noodle soup |
| Wasabi |

➡

| **Beef** |
| Somen noodles |
| Egg yolks |
| Chopped green onion |
| Noodle soup |
| Wasabi |

New and good combination

What are appropriate rules for recipe generation?

→ **Substitutable Ingredient**

Extracting a rule

Existing Recipe A

> **Pork**
> Japanese Lee
> Chinese cabbage
> soup stock

Existing Recipe B

> **Beef**
> Japanese Lee
> Chinese cabbage
> soup stock

Extract

Pork ⇔ Beef

✓ 212 rules are found

Applying the rule

Existing Recipe C

> **Pork**
> Somen noodles
> egg yolks
> Chopped green onion
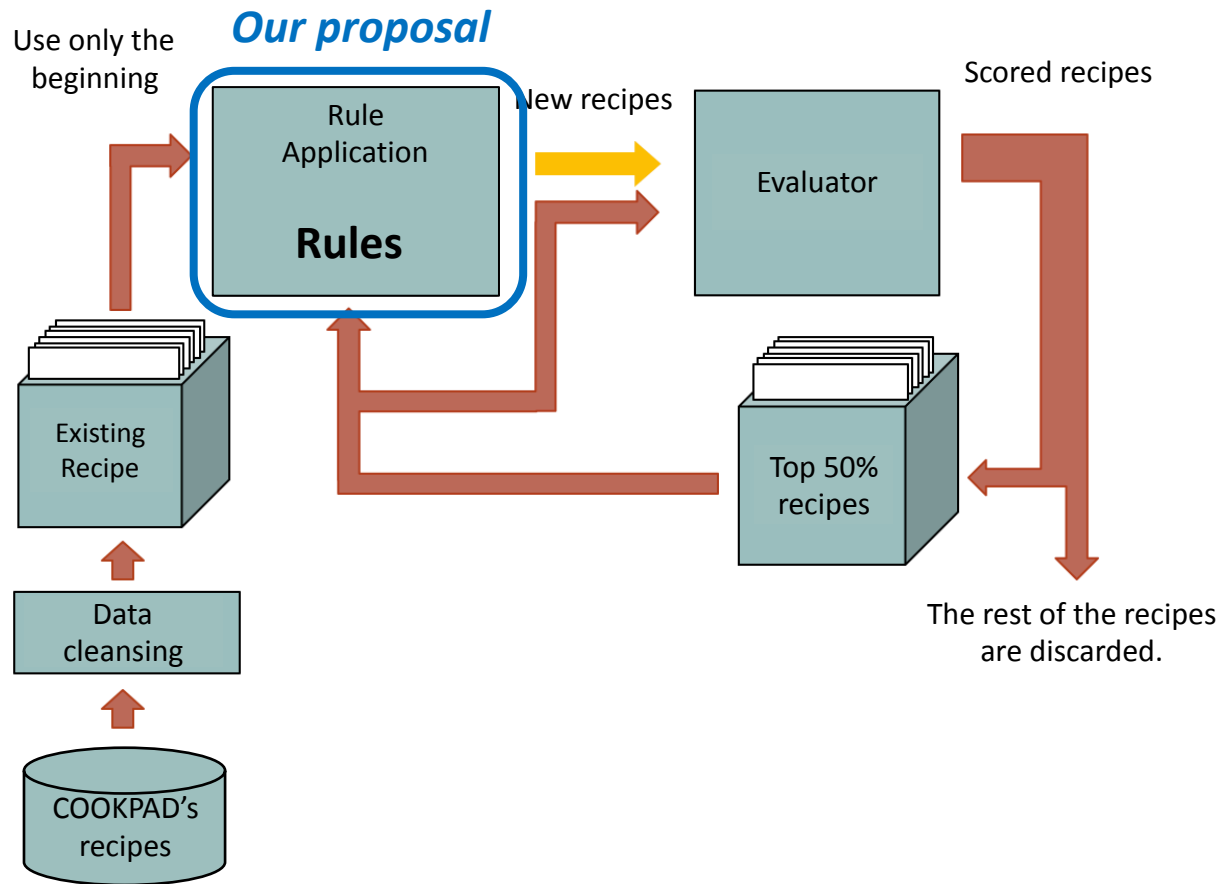> Noodle soup

Apply
Pork ⇔ Beef

New Recipe D

> **Beef**
> Somen noodles
> egg yolks
> Chopped green onion
> Noodle soup

System Overview

Evaluation (1/2)

➢ *Subjective review: **Are the recipes tasty?***

Tasty recipes （2 picks）

- Tofu, Seaweed soup, Radish, Mushroom, Duck, green onion
- Tofu , Seaweed soup, Chinese cabbage , Salt, Pepper, Beef

Bad recipes （2 picks ）

- Tofu, Chinese cabbage , Carrot, Honey, Cinnamon
- Chinese cabbage, Radish, Oil, Raisins

Others （26 picks）

- Turnip, Carro, Radish, Spinach, Salt
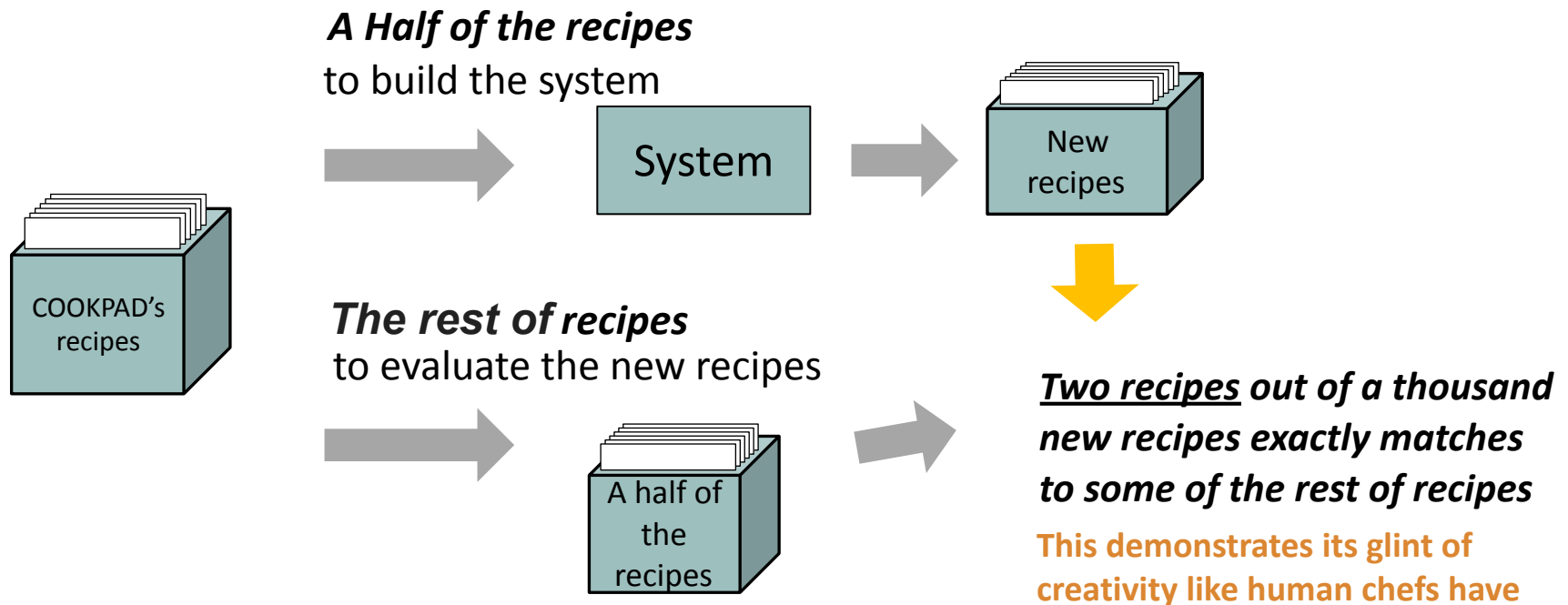- Egg, Bonito, Bamboo shoots, Beef

:

We found the new tasty recipes

Evaluation (2/2)

➢ *Can the system create existing recipes?*

In other words, can the system make as the same recipes as human being makes?

A Half of the recipes
to build the system

COOKPAD's recipes

System

New recipes

The rest of recipes
to evaluate the new recipes

A half of the recipes

<u>*Two recipes*</u> *out of a thousand new recipes exactly matches to some of the rest of recipes*

This demonstrates its glint of creativity like human chefs have

Conclusion

➢ The new recipe creation method was proposed (by substituting ingredients).

➢ The system had builded.

➢ The system showed its capacity to create few new recipes.

Skills in this research

- ***Python, Numba, Numpy, Matplotlib***
- ***AI Algorithms***
    - ・Coding Genetic algorithm and NN(Neural Network)

- ***Database***

    - ・MySQL, MongoDB

- ***Text Handring***

    - ・N-gram, Data Cleansing