Computational-Creativity Enabled One Pan Seasonings for Retail Sale

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Abstract

Everyone eats. Many people cook. But few are aware of the unique creative challenges facing professional product developers in flavor and food product companies. The *IBM Research AI for Product Composition* is a system to assist product developers with these real-life creativity challenges for which no AI-solution existed. The system for compositional product development is in use at McCormick & Company, a global leader in flavor. We present the first set of products targeted for retail sale that has been enabled by the system. The three seasoning mixes for one dish meals are planned to be on retail shelves mid-2019.

Introduction

McCormick & Company and IBM Research are pioneering the use of computational creativity to aid professional flavor and food product developers. Our multi-year collaboration has produced the first AI-enabled retail products that will be available on grocer's shelves in 2019 (McCormick 2019, Lougee 2019).

Work in computational creativity typically approaches the culinary arts from the perspective of a chef creating a dish represented by recipe (Pinel *et al*. 2015, Anorim *et al*. 2017). We address a different scenario: a professional product developer creating a commercial product represented by a formula. The different objectives, constraints, assumptions and data available for product development require new approaches for creative generation and evaluation.

A product developer may have a target flavor experience objective (e.g., "Tuscan Chicken"). In such a case, the challenge is to create a product formula that will produce an outstanding flavor experience in the final dish prepared by the home cook. It should be highly and consistently liked across the target consumer segment. The product developer must consider a host of constraints (e.g., natural, Halal, nutrition, manufacturability, shelf life, country regulations) which affect the choice and amount of ingredients in the formula.

A product developer iteratively creates trial formulas, compounds samples, and runs a variety of taste and possibly consumer tests on the samples. Feedback on the samples allows the developer to learn what works and suggests how to improve the formula. It is an art and a science. A junior product developer may take three times as many iterations as a senior product developer to create a ready-to-commercialize formula.

Figure 1: Image of a dish being cooked using a new seasoning mix co-designed using computational creativity.

The Seasonings

IBM Research AI for Product Composition is a co-creative system in use at McCormick & Company that applies computational creativity to real-life product development. No such similar system exists today as far as we know. The system incorporates several new technologies including the use of flavor distance for the generation of candidate formulas; user-controlled creativity levels; the ability to learn to predict formula success using direct (e.g., taste tests) and indirect (e.g., sales) success measures. The system does not depend on the flavor-pairing hypothesis (Ahn et. al., 2011) which makes it applicable globally as the flavor-pairing hypothesis is believed not to hold in some cultures. The three flavors that we will present at the conference were developed by product developers at McCormick. The flavors are part of McCormick's new ONE product line which provides seasoning mixes for single pan dishes. The three flavors are "Tuscan Chicken & Vegetables," "Bourbon Pork Tenderloin & Vegetables," and "New Orleans Style Sausage & Vegetables." The product developers who created these dishes report that the AI system made several novel

suggestions that were ultimately included in the final product and helped the products perform well in a consumer panel. These are the first food products developed using computational creativity that are available for retail sale.

Flavor Creation System

IBM Research AI for Product Composition is a data driven machine learning system that helps the developer iterate over designs by suggesting alternative formulations for flavor experiences under development. The system makes suggestions by learning from McCormick's extensive historical repository of formulas and taste tests.

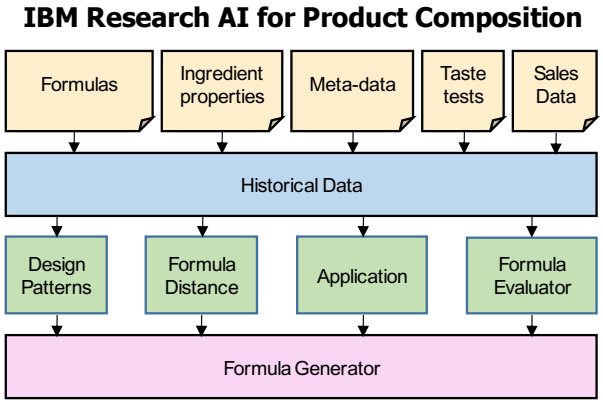

Figure 2: IBM Research AI for Product Composition learns to produce product formulations based on historical product data, ingredient properties, product meta-data, the results of taste tests, and sales information.

The formula generator uses a generate and test methodology in which candidate formulas are created and then evaluated using a success model. The generation process is designed to mimic how product developers usually work. The training data for the system consists of 100,000s of previously created formulas. The data includes not just the final output of the creative process, but all the intermediate product formulations created during a product's development. It mines this data to identify the design patterns that developers typically employ when perfecting a formula. The candidate generation algorithm uses the learned design patterns to search the space of possible formula improvements in a manner similar to how a product developer would search.

The formula evaluator analyzes each proposed candidate and assigns a score that is indicative of how well a formulation is likely to do in the market. Flavor is a very complex human experience. Theoretical constructs such as the flavor pairing hypothesis, olfactory pleasantness (Lapid, Harel, and Sobel, 2008), and Bayesian surprise (Varshney, 2013) try to estimate some dimensions of this experience. But they are approximations. The best indication of how a formula will do in the market is human taste tests and consumer panels. Instead of trying to model human taste, we predict market success based on historical data. The primary source of data for learning the success model is consumer panels and employee taste tests. We also learn from implicit indicators of success, such as sales longevity, to put a greater emphasis on successful formulations.

Conclusion

The first flavor products developed with *IBM Research AI for Product Composition* will be available for retail sale with the new ONE product family launching from McCormick in mid-2019. The computational creativity system helped the ONE product developers explore new creative ideas, accelerating the time to market while achieving high ratings with consumer testers.

Based on the promising results to date, McCormick plans to roll out the system globally to operations in more than 20 labs in 14 countries encompassing over 500 product and flavor developers and their support staff. The underlying technology can be generalized to other products such as cosmetics, fragrances (Goodwin 2017), detergents, adhesives, lubricants and construction materials.

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