The Web of Finding Food: Browse, Search, Modify & Eat

Hugo Liu
Counter Intelligence
MIT Media Laboratory
today’s menu

Appetizer
- what’s for dinner? how people forage for food.

Salad
- ways to browse and search for food on the Web

Soup
- gathering “common sense” about foods on the Web

Entrée
- new CI projects: focusing on food foraging

Dessert
- some delicious ideas for food foraging technology
Appetizer

The age old question: What’s for dinner?

How people forage for food.
Finding food. How long is spent?

- **Eating**
  - 90 minutes/day
  - 5 years/lifetime

- **Finding food at a market, Cooking, Finding restaurants, etc.**
  - 50 minutes/day
  - 2 yrs, 9 mos/lifetime

- **How long is spent mentally finding what we want to eat/cook?**

If eating is such a significant part of our lifetime, how do we decide what to eat??
Deciding What’s for Dinner?

- The Bachelor: What am I in the mood for?
- The Mom: What will best fit my family's preferences and my time constraints? How can I spice up my usual dishes?
- The Gourmet: What’s a great restaurant I’ve not tried before? How do I learn more about the culture behind food I’m eating?
- Mr. Practical: What can I make with what’s in my fridge? If I want to cook dish X, what should I buy?

- How can Food Foraging Technology help each of these people find the food they want?
Food Foraging Technology Wish List

- **The Bachelor:** What am I in the mood for?
  - A food database (recipes or menus) browsable by tastes (e.g. spicy, hearty), and ingredients (e.g. chicken, steak) that knows the user’s prefs.
  - A context-aware agent that tracks what the user ate yesterday, and suggests dishes the user might like.
  - A food search engine that takes input like “I’m in the mood for something spicy” and returns recipes, dishes, or restaurants.

- **The Mom:** What will best fit my family's preferences and my time constraints? How can I spice up my usual dishes?
  - A food recommender conscious of preferences of family members, and cooking constraints (nutrition, allergies, time, guests, occasion).
  - Dynamic recipes adjustable to simple and elaborate versions.
Food Foraging Wish List Part II

- **The Gourmet:** What’s a great restaurant I’ve not tried before? How do I learn more about the culture behind food I’m eating?
  - A personalized Web restaurant guide, presents opinions of other restaurant-goers similar to the user.
  - A cultural food browser that teaches how culture influences and describes food.

- **Mr. Practical:** What can I make with what’s in my fridge? If I want to cook dish X, what should I buy?
  - A cook’s oracle that suggests dishes possible using available ingredients
  - Using food commonsense to dynamically modify recipes through substitution and emphasis/de-emphasis of ingredients
  - A smart grocery list that composes itself based on what dishes you are trying to make.
Ways to browse and search for food on the Web.
Why the Web?

- What’s out there on this “Web”?
  - Recipes
  - Cookbooks
  - Menus
  - Restaurant guides / reviewed by people
  - “Talk” about food in weblogs, on webpages
  - The culture and history of foods
How much is out there?

- Just look the number of recipe sites (each having between 10 and 10,000 recipes)

<table>
<thead>
<tr>
<th>Region</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>African</td>
<td>462</td>
</tr>
<tr>
<td>Asian</td>
<td>653</td>
</tr>
<tr>
<td>Cajun-Creole</td>
<td>61</td>
</tr>
<tr>
<td>Caribbean</td>
<td>65</td>
</tr>
<tr>
<td>European</td>
<td>762</td>
</tr>
<tr>
<td>Historic</td>
<td>66</td>
</tr>
<tr>
<td>Jewish</td>
<td>43</td>
</tr>
<tr>
<td>Latin American</td>
<td>218</td>
</tr>
<tr>
<td>Middle Eastern</td>
<td>122</td>
</tr>
<tr>
<td>North American</td>
<td>252</td>
</tr>
<tr>
<td>Oceania</td>
<td>115</td>
</tr>
<tr>
<td>Soups and Stews</td>
<td>401</td>
</tr>
</tbody>
</table>

- Google search:
  - “recipes”: 8,230,000 web pages (only counts English pages!)
  - “chicken recipes”: 860,000 web pages
  - “saffron recipes”: 48,600 web pages
How Easy is it to Navigate?

- Not very.
- Food websites are many, but only a small subset (40000/8mil=0.5%) are differentiated.
- Recipes not all structured.
- No simple, natural interfaces for food foraging on the Web. -> People won’t bother.

I’m in the mood for tangy Chinese food.
Making Use of the Food Web

- Using AI to find “structure”
  - Automatically recognize web pages as containing
    - a recipe, menu, history/culture, restaurant guide, restaurant reviews, and “chatter” about foods and restaurants

- Create simple and natural interfaces to browse and search for food
  - Let people search for food using plain English sentences... “I want ...”
  - Browse foods by different tastes, ingredients, nutrition, region, culture, etc, or by images

OK, great! So we’re done?
But that’s only half the battle.

- A Food Web browser/searcher needs knowledge about food, culture & tastes to understand what the user means
  - Ex: What does “spicy” mean? A recipe for “Chili chicken” may not have the keyword “spicy” in it.
- To manipulate the recipe (to make a substitution, to simplify a recipe, to understand the characteristics of a culture’s cuisine, etc.)
- Segue: We need commonsense about food!
  - “Chili peppers can be very spicy”.
Soup

Gathering “common sense” about foods on the Web

(and other ways to get it)
Why Commonsense?

- Any intelligent food foraging application that aims to relate high-level user desires (food type, properties, taste, nutrition, substitution, interactions with other foods) to low-level recipes and ingredients needs a lot of “commonsense” about food.
- People know that an orange is the color “orange,” is a fruit, is sweet and tangy, can be used in fruit salad, has a useful zest, etc, etc.
- Computers just don’t know this. We must teach it.
What Kinds of Commonsense?

- Classifying ingredients, dishes, techniques by culture, functions, etc.
- Describing the taste, texture, color, dominance, importance of ingredients
  - The Bachelor: In the mood for something tangy. A food browser must link recipes featuring citrus to “tangy”.
- Substitutability of ingredients
  - Mr. Practical doesn’t have nutmeg, but he does have cinnamon. (substitutions are very contextually sensitive: spice substitution vs. color substitution, etc.)
- Interactions between ingredients
Gathering it over the Web

- Open Mind Commonsense (www.openmind.org/commonsense) does this with ordinary commonsense
  - Gathered ½ million English sentences in 2 years
  - This database has been used in a large variety of applications that demonstrate some “intelligence” or real world competence
### Search Results for *orange*

<table>
<thead>
<tr>
<th>Author</th>
<th>Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>ThoughtTreasure</td>
<td>A juice sac is part of an orange</td>
</tr>
<tr>
<td>ThoughtTreasure</td>
<td>A rind is part of an orange</td>
</tr>
<tr>
<td>ThoughtTreasure</td>
<td>A seed is part of an orange</td>
</tr>
<tr>
<td>ThoughtTreasure</td>
<td>A segment is part of an orange</td>
</tr>
<tr>
<td>ThoughtTreasure</td>
<td>A wall is part of an orange</td>
</tr>
<tr>
<td>ThoughtTreasure</td>
<td>A zest is part of an orange</td>
</tr>
<tr>
<td>ThoughtTreasure</td>
<td>East Orange is part of New Jersey</td>
</tr>
<tr>
<td>ThoughtTreasure</td>
<td>Orange is part of California</td>
</tr>
<tr>
<td>jgagnon</td>
<td>an orange is a fruit</td>
</tr>
<tr>
<td>cheaguea</td>
<td>It is unlikely that an orange will be appointed secretary of state.</td>
</tr>
<tr>
<td>whiten</td>
<td>Orange is a color.</td>
</tr>
<tr>
<td>jgagnon</td>
<td>Red, orange, yellow, green, indigo, violet, purple, neon, fusa, aqua, grey, and black are all examples of colors.</td>
</tr>
</tbody>
</table>

Results: Page: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55
Building A Repository of Food Commonsense

- Knowledge gathering that is specifically focused on commonsense about food.

- Other sources:
  - Substitutability / food taxonomy websites online can be mined for information
  - Barbara Wheaton’s food db and ingredients ontology
  - Cookbooks, spice books, etc.
  - Statistical comparison (CS about key ingredients by examining recipe variants)

- Some knowledge can’t be cleanly mined from the Web, so we turn to the public.
Entrée

New CI projects: Focusing on food foraging

(Making food fun!)
Overview of Approaches

- Recipe Generator
- Food Web
- Cultural Food Browser
- Recipe Manipulator

(also, recipe understanding projects underway in Deb Roy’s group)
Recipe Generator

- Interface
  - A short conversation with the user generates a simple recipe
- Uses food commonsense repository
  - Commonsense doubles as explanation of reasoning. Gives user some intuition about recipe creation.
- Plug and play recipe templates (frames)
- Learns and utilizes a user profile:
  - User preferences and allergies
Searching/browsing for recipes, menus, and food history/backgrounds on the web.

User types:
- “I want to find popular Caribbean dishes”

System
- recognizes Caribbean as an ethnic cuisine; interprets popular as common;
- searches Caribbean recipes across several thousand recipe sites
- makes a list of most frequently occurring dishes
- Displays those to the user
- Shows links to recipes, menus, history, background of Caribbean food
Cultural Food Browser

- Culture has a lot to say about food.
- Explore food by cultural artifacts (art, music, literature, historical place and time, social stature, holidays, etc.)
Recipe Manipulator

- In-context substitutions based on available ingredients
- Simplify recipes
  - Uses notion of what a “key” ingredient is
- Elaborate recipes
  - Searches recipe databases for elaborations and variations
- Influence recipes
  - Add an “Indian” influence to a pasta carbonara

Entrée
Dessert

Some delicious ideas for food foraging technology
What is our technology?

- Finding the “structure” of food on the Web (recipes, stories, history, menus, ideas)
- Compiling a repository of “food commonsense”
  - will enable intelligent interfaces to understand the topic of food and reason about it like people can.
- Trying several approaches to online and offline food foraging through
  - Interactive recipe creation, cultural browsing, food web browsing, recipe tweaking.
What is the potential impact on people’s lives?

- People are conservative and practical about food.
  - We buy spaghetti and meat sauce because there are only two ingredients to remember!
  - We won’t buy an ingredient we can’t understand
- Recipes are an excuse for not having to really know anything about ingredients and food.
- Food Foraging Technology is really about educating people about food, giving them intuition and confidence to try and crave new things.
  - Intuition from culture, intuition about recipe creation and tweaking, intuition from food ideas on the web
Far(ther) Out Ideas

- **FoodJourney**: A Narrative Guide to Restaurant Menus
- **CultureThemes**: Experiencing cultural themes through harmonised music, food, art, fashion, entertainment.
- **Supermarket Recipe Kiosks** (like LeClerc in France):
  - Select dishes for dinner, prints out your shopping list
  - Scan the barcode on a food, tells you what you can make with it and what else you need.
- **FoodPersonalities**: Food Ingredients are characters that have personalities, socialize with other foods, etc. Teach food intuition.
You will spend 5 years of your life eating.

There’s a lot about food on the Web but people won’t bother with it if it is difficult.

Computers don’t know that an orange is a fruit.

Make food exploration fun and intuitive; people’s lives will be much improved.