Recipe Adaptation with Language Models

Daniel Hershcovich, DIKU
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Food, language and identity

- Food is a communicative medium
- Food is a carrier of meaning
- Food is tightly linked to identity
Recipes

A useful way to express food in language

Part of the creative process of food creation

Used by both professional and home cooks

Name: chocolate mousse charlotte

Ingredients:
- instant chocolate pudding mix
- ladyfingers
- milk
- heavy cream
- whipped cream

Steps:
- line a springform pan bottom and sides with ladyfingers
- follow directions on pudding mix, using 2 cups of milk
- add cream
- beat until thick with heavy peaks
- pour into ladyfinger-lined pan and let set
- if you like, finish off top with additional whipped cream
Recipe adaptation

Dietary restrictions, e.g., vegan

Cross-cultural differences

Can we automate this process?

Chinese Okra Salad

Ingredients
- 8 oz (225 g) okra
- 2 teaspoons light soy sauce (or soy sauce)
- 1/2 teaspoons green Sichuan pepper oil (or more to taste)

Instructions
- Bring a medium pot of water to a boil. Add 1 teaspoon vegetable oil and a pinch of salt...
Language models

Parrots are among the most intelligent

Prompt

Vered Shwartz, Everything you wanted to know about ChatGPT
Language models

Vered Shwartz, Everything you wanted to know about ChatGPT
Language models

Parrots are among the most intelligent birds.

Vered Shwartz, Everything you wanted to know about ChatGPT
Large Language Models (LLMs)
Strengths and weaknesses

LLMs are good at

• Writing fluent and well-formed language
• Explaining their answers
• Summarizing long documents
• Writing programming code
• ...

They are not so good at

• Accessing up-to-date knowledge (but can search)
• Math (but can use plugins)
• Real-world common sense
• Knowing what they don't know
• ...

...
Veganizing recipes using language models

Bachelor project by Jonathan Sigh Musso at DIKU
(co-supervised by Morten Arendt Rasmussen and myself)

**Name:** Vegan Chocolate Mousse Charlotte

**Ingredients:**
- Chocolate flavored instant pudding mix (vegan)
- Vegan ladyfingers (biscuits or cookies)
- Plant-based milk (such as oat milk or almond milk)
- Vegan heavy cream alternative (such as coconut cream or cashew cream)
- Vegan whipped cream alternative (such as aquafaba or coconut whipped cream)

**Steps:**
1. Line a springform pan bottom and sides with vegan ladyfingers
2. Follow directions on vegan chocolate pudding mix, using 2 cups of plant-based milk
3. Add vegan heavy cream alternative and beat until thick with heavy peaks
4. Pour the chocolate mousse into the ladyfinger-lined pan and let set in the refrigerator for at least 1 hour
5. Finish off the top with vegan whipped cream alternative, if desired

**Tips:**
- To make the vegan heavy cream alternative, chill a can of full-fat coconut milk and scoop out the thick cream on the top. Alternatively, soak raw cashews overnight, blend them with water, and strain the mixture to create cashew cream.
- Aquafaba is the liquid leftover from a can of chickpeas and can be whipped into a fluffy, white vegan whipped cream.
Cultural adaptation of recipes

- Ongoing project, targeting translation that accounts for cultural differences

- Current focus:
  - English→Chinese
  - Chinese→English

Culture Adaptation  Direct Translation

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- Bring a medium pot of water to a boil. Add 1 teaspoon vegetable oil and a pinch of salt...
What is culture?

**shared** beliefs, values, practices, behaviors, and artifacts

a system of **symbols**

characterizes a **social** group

**learned**, not innate

integrated with daily **experience**

**taken-for-granted** notions, rules, moralities, and behaviors

dynamic **process** through which social meanings are constructed

*Cultural anthropology: Asking questions about humanity* (Welsch and Vivanco, 2015)
## Granularities of variation

<table>
<thead>
<tr>
<th>Linguistic variation</th>
<th>Cultural variation</th>
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<tbody>
<tr>
<td>• Idiolect</td>
<td>• Individual, personality</td>
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<td>• Sociolect</td>
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<td>• Dialect</td>
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<td>• Language groups and families</td>
<td>• Global cultural community</td>
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Cultural dimensions in language technology

Challenges and Strategies in Cross-Cultural NLP (Hershcovich et al., ACL 2022)
Give me a one-sentence **kale chips** recipe in English, Hebrew, Arabic, Danish, Mandarin Chinese, Korean, Greek, Hindi, Bulgarian and Turkish. Do not say which languages they are.

Kale chips recipe: Preheat the oven to 350°F, tear kale into bite-sized pieces, toss with olive oil and salt, and bake for 10-15 minutes until crispy; אפשר לעלי סלט י(UUID: חמש את התנורים ל-350 מעלות, קרוע את עלי הקלי לאלות קטנות, תורר אותם עם שמן זית ומלח, ורביישו בקערת שומן זית ל-15 דקות עד שטף. Do not say which languages they are.

Kale chips opskrift: Forvarm ovnen til 180 grader, riv kale i små bit, bland med olivenolie og salt, og bag i ovnen i ca. 15 minutter; アスパラガスのチップスレシピ: 烤箱至180度, 將羽衣甘藍撕成小塊, 加入橄欖油和鹽調味, 烤10-15分鐘, 直到變脆，Kale chipsレシピ: オーブンを180度で15分間焼く。
Adapt the recipe to the common ingredients, cooking methods and tools in each culture's cuisine.

- **English**: Preheat oven to 300°F (150°C). Rinse kale and dry thoroughly, then toss with olive oil and salt. Bake for 10-15 minutes until crispy.

- **Hebrew**: Preheat oven to 150°C. Rinse kale and dry thoroughly, then toss with olive oil and salt. Bake for 10-15 minutes until crispy.

- **Arabic**: Rinse kale and dry thoroughly, then toss with olive oil and za’atar seasoning. Fry in hot oil until crispy.

- **Danish**: Preheat oven to 150°C. Rinse kale and dry thoroughly, then toss with rapeseed oil and salt. Bake for 10-15 minutes until crispy.

- **Mandarin Chinese**: Preheat oven to 150°C. Rinse kale and dry thoroughly, then toss with sesame oil and soy sauce. Bake for 10-15 minutes until crispy.

- **Korean**: Preheat oven to 150°C. Rinse kale and dry thoroughly, then toss with sesame oil, gochujang sauce, and sesame seeds. Bake for 10-15 minutes until crispy.

- **Greek**: Preheat oven to 150°C. Rinse kale and dry thoroughly, then toss with olive oil, lemon juice, and oregano. Bake for 10-15 minutes until crispy.

- **Hindi**: Rinse kale and dry thoroughly, then toss with ghee and chaat masala seasoning. Fry in hot oil until crispy.

- **Bulgarian**: Preheat oven to 150°C. Rinse kale and dry thoroughly, then toss with sunflower oil and salt. Bake for 10-15 minutes until crispy.

- **Turkish**: Preheat oven to 150°C. Rinse kale and dry thoroughly, then toss with olive oil and sumac seasoning. Bake for 10-15 minutes until crispy.
Conceptualization

(а) Both images contain a lot of masala vadas.”, concept: வடா (VADA, a popular Indian food), label: FALSE

Visually Grounded Reasoning across Languages and Cultures (Liu et al., EMNLP 2021)
Give me one-sentence recipes for different culture-specific dishes in the following languages (without specifying the dish names): English, Hebrew, Arabic, Danish, Mandarin Chinese, Korean, Greek, Hindi, Bulgarian and Turkish.

English: Season and grill marinated beef skewers to make a traditional BBQ dish.
Hebrew: Mix chickpeas, tahini, lemon juice, and garlic to make a creamy hummus dip.
Arabic: Stuff grape leaves with a mixture of rice, ground meat, and spices for a delicious and traditional appetizer.
Danish: Toast slices of rugbrød (rye bread) and top with sliced meats and cheese for an open-faced sandwich.
Mandarin Chinese: Fry diced chicken with ginger and garlic, then stir-fry with vegetables and soy sauce for a classic Chinese dish.
Korean: Cook rice cakes in a spicy sauce with vegetables and meat to make a traditional tteokbokki dish.
Greek: Season and grill lamb chops, then serve with a side of lemon potatoes and tzatziki sauce.
Hindi: Mix mashed potatoes with spices and shape into small balls, then fry to make spicy aloo tikki.
Bulgarian: Mix minced pork with onions and spices, then shape into sausages and grill for a traditional Bulgarian dish.
Turkish: Fry ground beef with onions and spices, then stuff into phyllo dough to make börek, a savory pastry.
Objectives and values

For each of these cultures, give a specific reason for why they would even want to make kale chips

Reasons

• Variety
• Sustainability
• Enjoyment
• Health

- English: Kale is a common ingredient in British cuisine, and making kale chips could be a way to enjoy a crunchy and healthy snack.
- Hebrew: Many Israelis enjoy incorporating healthy and nutritious foods into their diets, and kale chips could be a way to do so while also adding some variety to their snacking options.
- Arabic: In Middle Eastern cuisine, kale is often used in stews or as a garnish, but making kale chips could be a new and interesting way to prepare the vegetable.
- Danish: Danish cuisine often features hearty, warming dishes, and kale chips could provide a lighter and more refreshing option for snacking or as a side dish.
- Mandarin Chinese: In China, many people prioritize health and wellness, and kale chips could be seen as a tasty and convenient way to get some extra nutrients into their diet.
- Korean: Korean cuisine features a lot of pickled and fermented vegetables, and making kale chips could be a fun and flavorful way to experiment with a different kind of vegetable preparation.
- Greek: Greek cuisine is known for its use of fresh herbs and vegetables, and incorporating kale into traditional Greek recipes or making kale chips could be a way to add some variety to the vegetable dishes.
- Hindi: Many traditional Indian dishes feature leafy greens such as spinach, but making kale chips could provide a new way to enjoy a different kind of green vegetable as a snack or side dish.
- Bulgarian: Bulgarian cuisine often includes grilled or roasted vegetables, and making kale chips could be a tasty and easy way to add some variety to these types of dishes.
- Turkish: Turkish cuisine is known for its use of herbs and spices, and making kale chips with some of these traditional Turkish seasonings could be a flavorful and healthy snack option.
My overall research agenda

Understanding culture's role in language technology

Identifying cultural bias in language models

Using language models to bridge between cultures

Building culture-adaptive language models
Domains for cultural adaptation

Objectives and Values

Goals people strive for; what is desired or desirables

Opinion pieces
Reviews
Political speeches
Travel guides

Linguistic Form and Style

How things are expressed in language

Literature
Textbooks
Recipes
City plans
DIY guides
Navigation

Common Ground

Shared knowledge based on which people reason and communicate

Aboutness
Topics; what information people care to convey in language
Recipe differences across cultures

- Ingredient availability and preference
- Measurement units, writing style
- Available equipment and tools
- Known techniques, typical ordering
- Desired flavours
- Desired texture

**Cabbage Beef Soup**

**Ingredients**

- 1 lb. ground beef
- 1 onion, chopped
- 2 soup cans water
- 1 can tomato soup
- 1 can beef bouillon soup
- 1 can drained kidney beans
- 0.5 head cabbage
- Salt and pepper
- 1 spoon of Hot sauce
- 1 can tomatoes, diced into small pieces

**Cooking Steps**

1. Pressure cook cabbage for 8 minutes or cook on the stove and drain.
2. Brown crumbled ground beef and onion.
3. Then place all the above ingredients into a crock-pot.
4. Cook on low for 8 hours (add additional water), or on high for 7 to 8 hours.
5. Serves 4.

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**Cabbage Tomato Beef Soup**

**Ingredients**

- 250g beef
- 1 large tomato
- Moderate amount of onion, ginger
- Moderate amount of sugar, salt
- A few cabbage leaves

**Cooking Steps**

1. Cut beef into small pieces, blanched.
2. Wash beef, add green onion and ginger slices, and simmer for 0.5h.
3. Take out the onion and ginger, put it into the stew pot and simmer overnight.
4. Peel the tomatoes and cut into cubes. Pour in the beef broth, add some sugar and salt, and continue to simmer.
5. After the beef is stewed, add the cabbage and continue to simmer for 15-20 minutes.

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**Recipe Differences Across Cultures**

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Preliminary data collection

- 2M **English** recipes from various websites (e.g., food.com)
- 1.5M **Chinese** recipes from xiaochufang.com

Automatic pairing based on assumptions:

- If two recipes have the **same** title, they describe the same dish.
- If two recipes have a **semantically equivalent** title (possibly in another language), they describe the same dish.
Models and preliminary results

- Language models and machine translation systems trained on **automatically paired** reference recipes
- Evaluating against **automatically paired** reference recipes

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**MT-zs:** Title: cabbage tomato broth, **Ingrids:** 250 grams of beef 1 large tomatoes several rolls of cabbage leaf, appropriate sugar, salt, **Steps:** beef slices, shoals, washing up and then pouring onions and ginger chips, boiling for about half an hour, extracting a ginger, pouring it into a cup of tea and cutting it all night. Fall in beef soup, adding the right amount of sugar and salt, and continuing cooking.

**MT-ft:** Title: Cabbage And Beef Soup, **Ingredients:** 2 tablespoons olive oil 1 large onion, chopped 2 garlic cloves, minced 1 teaspoon minced fresh gingerroot 1/2 teaspoon ground cumin 1/4 teaspoon crushed red pepper flakes 1 (14 1/2 ounce) can diced tomatoes, undrained 1 (14 ounce) can beef broth 2 cups water 1 cup shredded cabbage 1/2 cup shredded cheddar cheese, **Steps:** Heat oil in a large saucepan over medium heat. Add onion and garlic; cook and stir 5 minutes or until tender. Stir in ginger, cumin, and crushed red pepper. Add tomatoes, broth, water, cabbage, and cheese; bring to a boil. Reduce heat; simmer, uncovered, 20 minutes or until cabbage is tender.

**mT5:** Title: Cabbage And Tomato Soup; **Ingredients:** 1 lb ground beef 1 medium onion, chopped 1 can tomatoes 1 can tomato soup 1 can water 1 can tomato paste 1 can tomato juice 1 tsp salt 1/2 tsp pepper, **Steps:** Brown ground beef and onion. Add tomatoes, tomato soup, water, tomato paste, salt, pepper and tomato juice. Simmer for 1 hour.
Human evaluation

Grammar

Consistency

Preservation

Cultural appropriateness

Starting crowdsourcing on Prolific.
Online platform for evaluation:
https://recipecoastalproject.studio/

Recipe Evaluation (Chinese to English)

Please read the Golden Chinese recipe (left) and culturally adapted English recipe (right), and rate the subsequent questions.

Source Recipes

标题:
红豆汤

配料:
1. 适量红豆
2. 汤米酒
3. 适量零皮老薑

步骤:
1. 将切成丝, 和红豆放入米酒中, 铁匀浸泡8小时
2. 浸泡好的红豆放入锅内, 大火煮沸, 搅拌一下, 限成小火熬成汤。

Adapted Recipes

Title:
Pinto Bean Soup

Ingredients:
1 lb pinto beans, soaked overnight and drained 2 quarts water 1 large onion, chopped 2 large carrot, chopped 1 stalk celery, chopped 2 garlic cloves, minced 1 teaspoon salt 1 teaspoon pepper 1 teaspoon cumin 1 teaspoon oregano 1 teaspoon dried parsley 1 bay leaf

Steps:
Combine all ingredients in a large pot and bring to a boil. Reduce heat and simmer for 2 hours. Remove bay leaf before serving.
Ongoing work

• Goal: evaluate against **human-written** references recipes
• Requires English+Chinese speakers
• Please stay for the next hour to help us!

https://recipecoastalproject.studio/
Thanks!

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@dh
Language Models are *Linguistically Biased*

- BERT ([Devlin et al., 2019](https://dev-ai.cmu.edu/))
- GPT-2 ([Radford et al., 2018](https://openai.com/))
- GPT-3 ([Brown et al., 2020](https://arxiv.org/))
- GPT-4 (OpenAI, 2023)
- T5 ([Raffel et al., 2019](https://arxiv.org/))
- BART ([Lewis et al., 2020](https://arxiv.org/))
- mBERT ([Devlin et al., 2019](https://dev-ai.cmu.edu/))
- XLM, XLM-R ([Conneau et al., 2020](https://arxiv.org/))
- mBART ([Liu et al., 2020](https://arxiv.org/))
- mT5 ([Xue et al., 2021](https://arxiv.org/))
- XGLM ([Lin et al., 2021](https://arxiv.org/))
- BLOOM ([Le Scao et al., 2022](https://arxiv.org/))

Trained on (mostly) **English**

Trained on **multilingual** text
Language Models are *Linguistically* Biased

The State and Fate of Linguistic Diversity and Inclusion in the NLP World
(Joshi et al., ACL 2020)
Language Models are *Culturally* Biased

Having Beer after Prayer? Measuring Cultural Bias in Large Language Models (Naous et al., 2023)
Language Models are *Culturally* Biased

Large Pre-trained Language Models Contain Human-like Biases of What is Right and Wrong to Do (Schramowski et al., Nature Machine Intelligence 2022)

Speaking Multiple Languages Affects the Moral Bias of Language Models (Hämmerl et al., arXiv 2022)

Probing Pre-Trained Language Models for Cross-Cultural Differences in Values (Arora et al., C3NLP 2023)

Assessing Cross-Cultural Alignment between ChatGPT and Human Societies: An Empirical Study (Cao et al., C3NLP 2023)
A Dataset of Sustainable Diet Arguments on Twitter

1. Corpus of 32840 English tweets
2. 600 arguments annotated for 5 topics
3. Trained NLP models with strong performance

- We should reduce the consumption of meat
- Plant based food should be encouraged
- Meat alternatives should be encouraged
- Vegan and vegetarian diets should be encouraged
- We should pursue policies that promote sustainable foods

Potential applications

- Surveying public attitudes and exposing misinformation
- Generation of convincing arguments for communication campaigns
- Understanding public knowledge of sustainable diets
Argumentation

Can AI convince consumers of diverse backgrounds to change their habitual behavior?

What characterizes successful arguments for behavior change in public discourse?
Denmark's Official Dietary Guidelines

- Eat plant-rich, varied and not too much
- Eat more vegetables and fruit
- Eat less meat – choose legumes and fish
- Eat wholegrain foods
- Choose vegetable oils and low-fat dairy products
- Eat less sweet, salty and fatty food
- Thirsty? Drink water

https://altomkost.dk/english
Enriching Arguments with Diverse Perspectives

- Denmark's Official Dietary Guidelines argues "for health and climate"
- What about cultural, economic, ethical perspectives?