

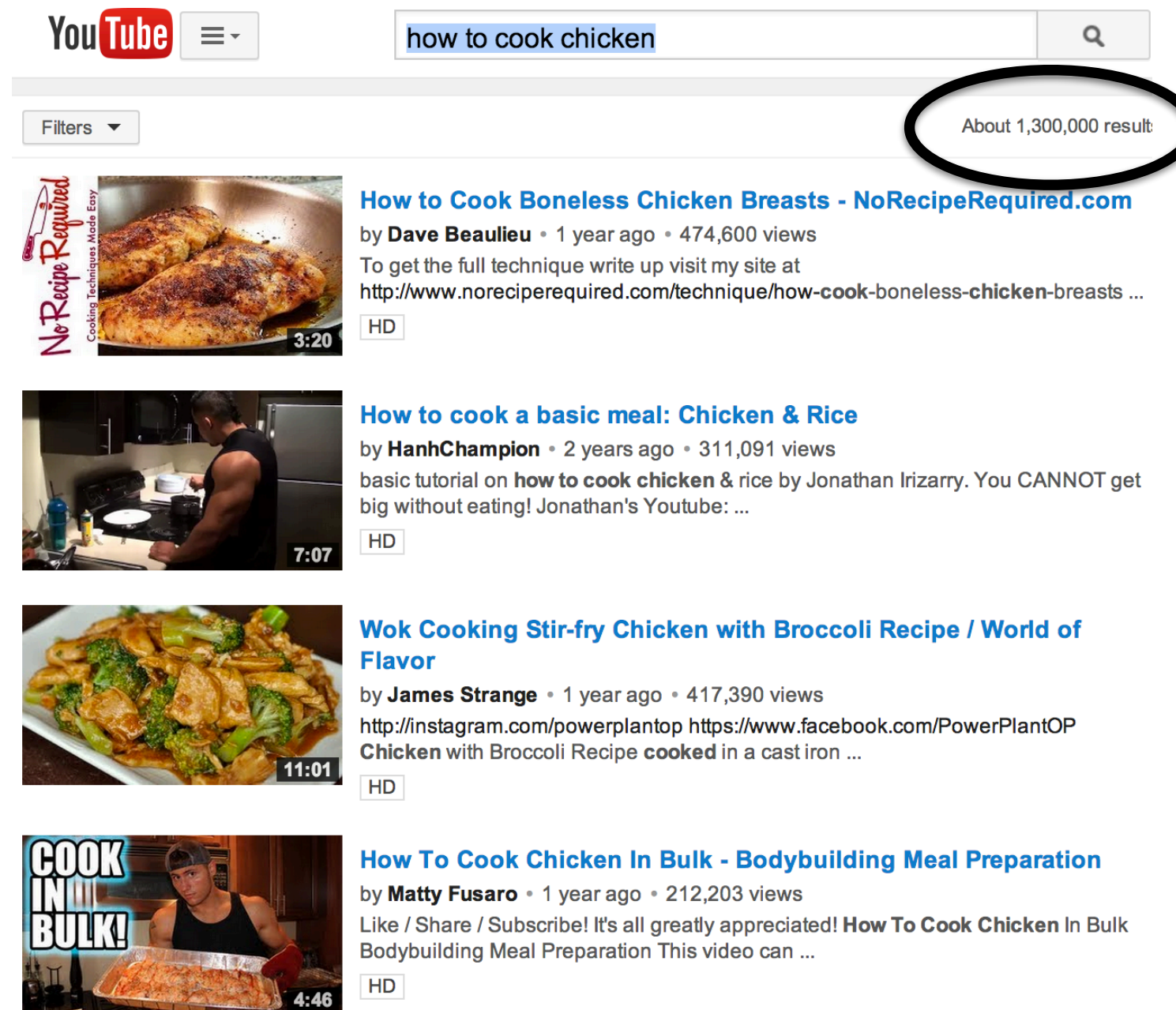
Cooking with Semantics

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ACL 2014 Semantic Parsing workshop


Overview + applications


- We want to parse how-to instructions from the open web
- Enable smart semantic search for instructions
- Improve accuracy of frame-semantic parsing with 'common sense' reasoning based on planning and affordances
- Aid model-based interpretation of how-to videos



The screenshot shows a YouTube search results page for the query "how to cook chicken". The search bar at the top contains the text "how to cook chicken" and a magnifying glass icon. Below the search bar, the text "About 1,300,000 results" is displayed. The results are listed in a grid format, each with a video thumbnail, title, and description.

YouTube 

how to cook chicken 

Filters 

About 1,300,000 results

How to Cook Boneless Chicken Breasts - NoRecipeRequired.com
by **Dave Beaulieu** • 1 year ago • 474,600 views
To get the full technique write up visit my site at [http://www.noreciperequired.com/technique/how-cook-boneless-chicken-breasts ...](http://www.noreciperequired.com/technique/how-cook-boneless-chicken-breasts...)
HD

How to cook a basic meal: Chicken & Rice
by **HanhChampion** • 2 years ago • 311,091 views
basic tutorial on **how to cook chicken** & rice by Jonathan Irizarry. You CANNOT get big without eating! Jonathan's Youtube: ...
HD

Wok Cooking Stir-fry Chicken with Broccoli Recipe / World of Flavor
by **James Strange** • 1 year ago • 417,390 views
<http://instagram.com/powerplantop> <https://www.facebook.com/PowerPlantOP>
Chicken with Broccoli Recipe **cooked** in a cast iron ...
HD

How To Cook Chicken In Bulk - Bodybuilding Meal Preparation
by **Matty Fusaro** • 1 year ago • 212,203 views
Like / Share / Subscribe! It's all greatly appreciated! **How To Cook Chicken** In Bulk Bodybuilding Meal Preparation This video can ...
HD

What makes it hard?

Arguments	Actions	Control
<ul style="list-style-type: none">• Elided• Implicitly available• Incompletely specified	<ul style="list-style-type: none">• Ambiguous senses• Omitted/implied	<ul style="list-style-type: none">• Conditionals• Sequencing• Alternatives

What makes it hard?

Arguments	Actions	Control
<ul style="list-style-type: none">• Elided• Implicitly available• Incompletely specified	<ul style="list-style-type: none">• Ambiguous senses• Omitted/implied	<ul style="list-style-type: none">• Conditionals• Sequencing• Alternatives

Elided:

Pour batter into prepared pans. Bake.

Implicitly available:

Blend confectioners' sugar, hot water and almond extract in a small bowl.

Our approach

Action ontology

Heat

- Object
- Method
- Temperature

Mix

- Location
- Method

...

Affordances

Fryable(Egg) = 8

Fryable(Milk) = -3

Learned through
co-occurrence statistics
across the whole web

Domain model

Heat($x::\text{Ingredient}$): $\text{InOven}(x) \rightarrow \text{IsHeated}(x)$

Mix(x_1, x_2): $\exists \text{Mixture}(x_1, x_2)$

Move($x_1::\text{Ingredient}, x_2::\text{Location}$): $\text{In}(x_1, x_2)$

Inference

Start with two eggs and one cup milk. Fry the eggs.

Frame parser

Fry	the eggs.
fry.01	Arg 1: 'the food'

Latent state

Kind	Quantity	Cooked
Egg	2 whole	No
Milk	1 cup	No

1. Propbank frame *fry.01* maps to *Heat(method=Fry)*
2. Compatibility(Heat.Object, **x**) = f(
 - A. Affordances(**x**.Kind) (*how cookable is x?*)
 - B. State(**x**) (*has this x already been cooked?*)
 - C. Recency(**x**) (*have I recently used x?*)
 - D. LexicalSimilarity("the eggs", **x**))
3. Heat.Object = argmax(Compatibility({**egg**, **milk**}))

Inference

Start with two eggs and one cup milk. Fry one egg.

Frame parser

Fry	the eggs.
fry.01	Arg 1: 'the food'

Latent state

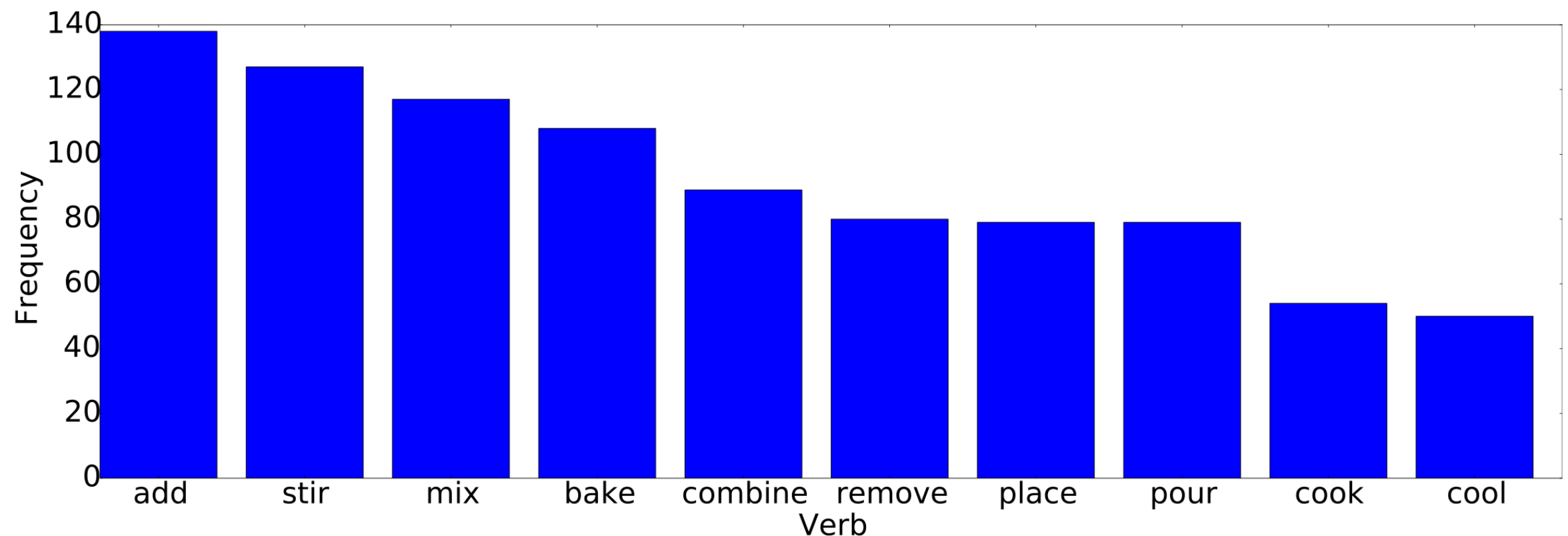
Kind	Quantity	Cooked
Egg	1 whole	No
Egg	1	Yes
Milk	1 cup	No

1. Propbank frame *fry.01* maps to *Heat(method=Fry)*
2. Compatibility(Heat.Object, **x**)=f(
 - A.Affordances(**x**.Kind) (*how cookable is x?*)
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 - C.Recency(**x**) (*have I recently used x?*)
 - D.LexicalSimilary("the eggs", **x**)))
3. Heat.Object <- argmax(Compatibility({**egg**, **milk**}))
4. Quantity analysis
5. Back-tracking planner

The inputs

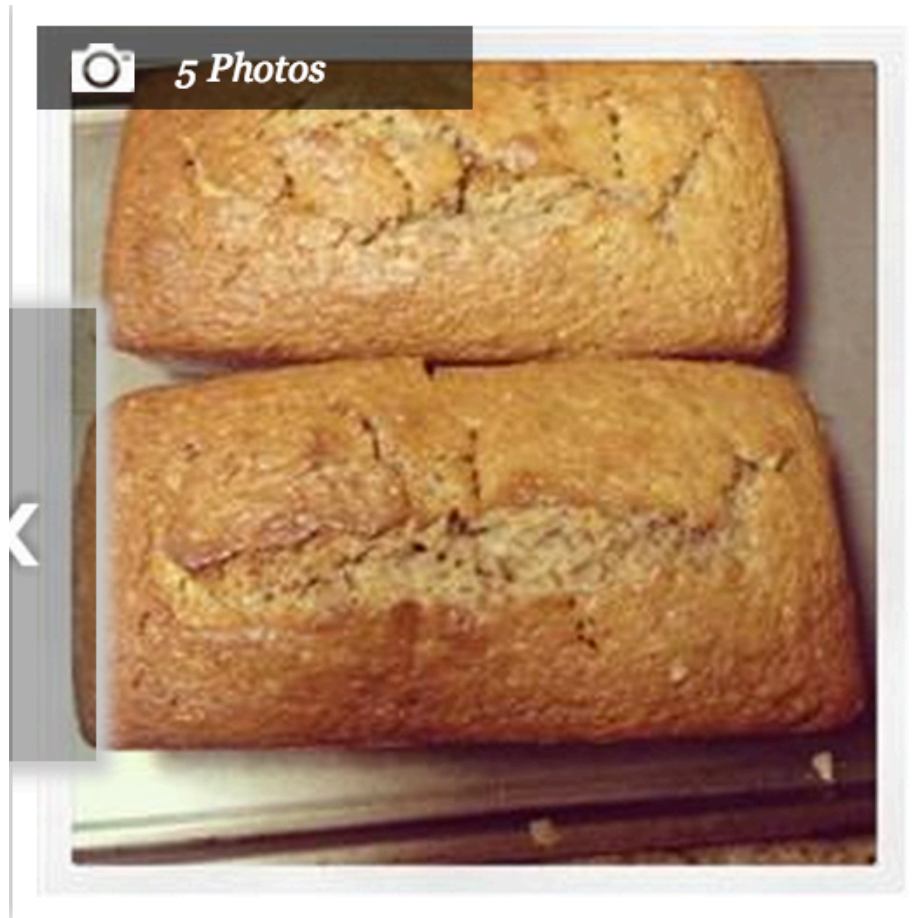
260 delicious recipes from allrecipes.com

Courtesy of the Carnegie Mellon CURD dataset*



*D. Tasse and N. Smith, 2008

Example parse



- | | |
|---|---|
| <input type="checkbox"/> 3 cups all-purpose flour | <input type="checkbox"/> 1 cup raisins (optional) |
| <input type="checkbox"/> 3 eggs | <input type="checkbox"/> 1 teaspoon ground cinnamon |
| <input type="checkbox"/> 2 cups white sugar | <input type="checkbox"/> 1 teaspoon baking soda |
| <input type="checkbox"/> 1 cup vegetable oil | <input type="checkbox"/> 1/4 teaspoon baking powder |
| <input type="checkbox"/> 2 cups applesauce | <input type="checkbox"/> 1/2 cup sour cream |

Check All

Add to Shopping List

Directions

1. Preheat oven to 350 degrees F (175 degrees C). Grease and flour two 9 x 5 inch loaf pans.
2. Beat together eggs, sugar, and oil. Blend in applesauce, and then sour cream or buttermilk. Mix in flour, baking powder, soda, and cinnamon. Stir in raisins. Pour batter into prepared pans.
3. Bake for 80 minutes. Cool on wire racks.

Source: allrecipes.com/recipe/applesauce-bread-i

“Preheat oven to 350 degrees F (175 degrees C). Grease and flour two 9 x 5 inch loaf pans. Beat together eggs, sugar and oil. Blend in applesauce, and then sour cream or buttermilk. Mix in flour, baking powder, soda, and cinnamon. Stir in raisins. Pour batter into prepared pans. Bake for 80 minutes. Cool on wire racks.”

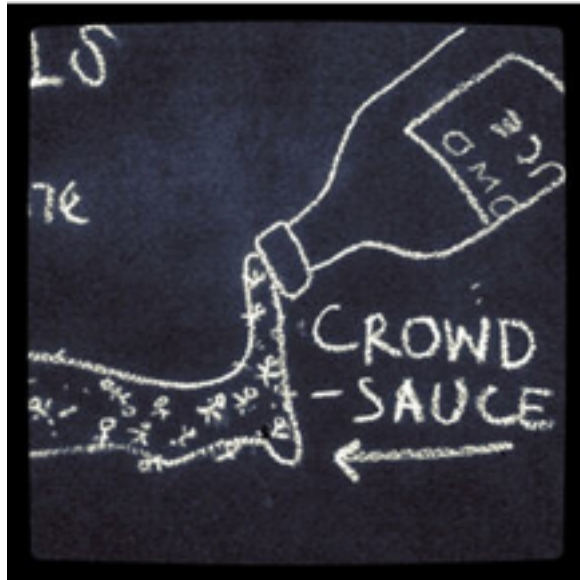
Inferred cooking
program:

1. **Preheat**(oven, temperature=“350 degrees F”)
2. **Let** bowl <- **NewLocation**() ← **Implicit actions**
3. **Move**({egg, sugar, oil}, bowl)
4. **Mix**(bowl, method=Beat)
5. **Move**(applesauce, bowl, method=Blend)
6. **Move**(sourcream, bowl, method=Blend)
7. **Move**({flour, soda, cinnamon}, bowl)
8. **Move**(raisins, bowl, method=Stir)
9. **Move**(bowl, oven)
10. **Heat**(bowl, time=80 minutes, method=Bake)

↑
Implicit argument

Next steps

Crowdsourced annotations



Model-based video understanding



New domains



Pragmatics understanding

Grice Maxims

- **Maxim of Quantity:** Be exactly as informative as required
 - Make your contribution as informative as required (for the current purposes of exchange)
 - Do not make your contribution more informative that is required
- **Maxim of Quality:** Try to make your contribution one that is true:
 - Do not say what you believe to be false
 - Do not say that for which you lack adequate evidence

Thanks to



- Google
- Members of Machine Intelligence
- Josh Tenenbaum and Ryan Adams
- Yoav, Tom, Jonathan for organizing