

Discovering Subsumption Relationships for Web-Based Ontologies

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Natasha Noy, Alon Halevy

**Carnegie
Mellon
University**

Computer
Science
Department

Google

WebDB: May 31, 2015



🔍 brother baba budan hours

About 1,740,000 results (0.57 seconds)

7:00 am – 5:00 pm

Brother Baba Budan, Saturday hours

[Feedback](#)

Brother Baba Budan

www.brotherbababudan.com.au/

4.5 ★★★★★ 128 Google reviews · [Write a review](#)

📍 359 Little Bourke St, Melbourne VIC 3000, Australia
+61 3 9606 0449

Brother Baba Budan - CBD - Melbourne | Urbanspoon

www.urbanspoon.com/rl.../Brother-Baba-Budan-Melbourne · Urbanspoon ·

★★★★★ Rating: 91% - 2,498 votes

... Budan, CBD. **Brother Baba Budan** reviews on Urbanspoon. ... Hours. Monday - Friday. 7:00am-6:00pm ... What dish do you like at **Brother Baba Budan**? Save ... [Photos](#) - [View menu](#) - [Nearby](#)

Brother Baba Budan (@brotherbudan) | Twitter

<https://twitter.com/brotherbudan>

The latest Tweets from **Brother Baba Budan** (@brotherbudan). ... Back to usual business hours tomorrow, for now hit up the good dudes at Traveller + Patricia.

Seven Seeds Specialty Coffee Roaster, Melbourne

sevenseeds.com.au/

Seven Seeds Specialty Coffee Roasters, Melbourne, Australia. Single Origin, blend, direct trade coffee. Seven Seeds, **Brother Baba Budan**, Traveller, Hortus.

[Cafe Locator](#) - [Coffee](#) - [Shop](#) - [Brew Guides](#)

Cafe Locator | Seven Seeds

sevenseeds.com.au/pages/cafe-locator

Follow us: @7seedscoffee. Made with Google My Maps. Seven Seeds Stockists. 7 Seeds Specialty Coffee. **Brother Baba Budan**. All Day Donuts. Cakes and Ale.

Brother Baba Budan - Broadsheet

www.broadsheet.com.au/melbourne/food-and.../brother-baba-budan

Brother Baba Budan, named after the 17th-century Sufi who smuggled seven seeds of coffee out of the Middle-East and brought coffee to the ... [Opening Hours](#).

Brother Baba Budan, Melbourne - TripAdvisor

www.tripadvisor.com.au > ... > [Melbourne Restaurants](#) · TripAdvisor LLC ·

★★★★★ Rating: 4.5 - 88 reviews

Brother Baba Budan, Melbourne: See 88 unbiased reviews of **Brother Baba Budan**, ... See all hours Travellers who viewed **Brother Baba Budan** also viewed.

Brother Baba Budan - Beanhunter

www.beanhunter.com/australia/victoria/melbourne/.../brother-baba-buda...

★★★★★ Rating: 4.3 - 362 reviews

Brother Baba Budan, Best coffee shops & cafes in Melbourne CBD, This is my first trip to Melbourne CBD for a while and BBB is still the best but but now only ...



Brother Baba Budan

[Directions](#)

4.5 ★★★★★ 128 Google reviews

Coffee Shop

Specialty coffee shop serving cakes in a quirky space with wood panelling and bar stools.

Address: 359 Little Bourke St, Melbourne VIC 3000, Australia

Phone: +61 3 9606 0449

Hours: **Closing soon** · 7:00 am – 5:00 pm

Reviews

[Write a review](#)



"Best **Chai latte** is at Neighbors in St. Kilda."



"Excellent coffee, with **staff** that seems to really care about what they're doing."



"I came here and ordered a **cold drip** and the coffee was delightful." 3 reviewers

[View all Google reviews](#)

People also search for

[View 15+ more](#)



7 Seeds Specialty Coffee



St Ali Coffee Roasters



Proud Mary

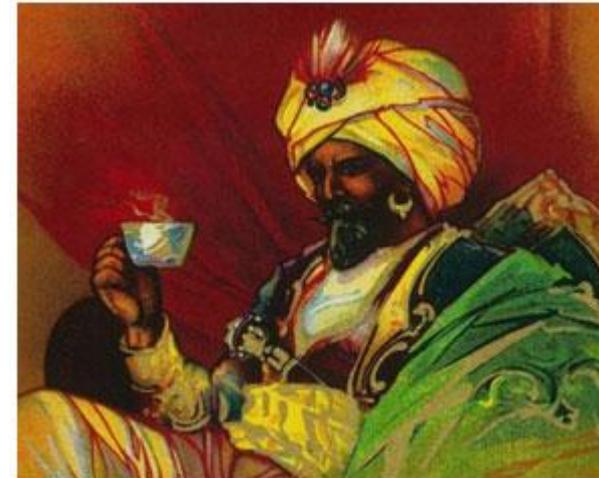


Manchester Press



The League of Honest Coffee

Are you the business owner?



brother baba budan seating capacity

About 681,000 results (1.13 seconds)

Brother Baba Budan - Cafes - Melbourne Victoria - Yelp

www.yelp.com › Restaurants › Cafes ▼ Yelp ▼

★★★★★ Rating: 4.5 - 71 reviews - Price range: \$

71 Reviews of **Brother Baba Budan** "Breakfast at this great coffee shop. ... Get a **seat** if you can, because the **space** is really cool, and try a pastry while you're at ...

Brother Baba Budan - CBD - Melbourne | Urbanspoon

www.urbanspoon.com › Melbourne › City › CBD ▼ Urbanspoon ▼

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... Blog Posts about **Brother Baba Budan**, CBD. **Brother Baba Budan** reviews on Urbanspoon. ... My Legendary Girlfriend. Interesting **Venue Names** - Melbourne.

Brother Baba Budan - Broadsheet

www.broadsheet.com.au/melbourne/food-and-.../brother-baba-budan ▼

Brother Baba Budan, named after the 17th-century Sufi who smuggled seven seeds of coffee out of ... The **space** is small, with a single communal table, a tiny bar and a total of about 15 **seats** (not including the ones on the ceiling); Budan is, ...

Brother Baba Budan, Melbourne - TripAdvisor

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Brother Baba Budan - Beanhunter

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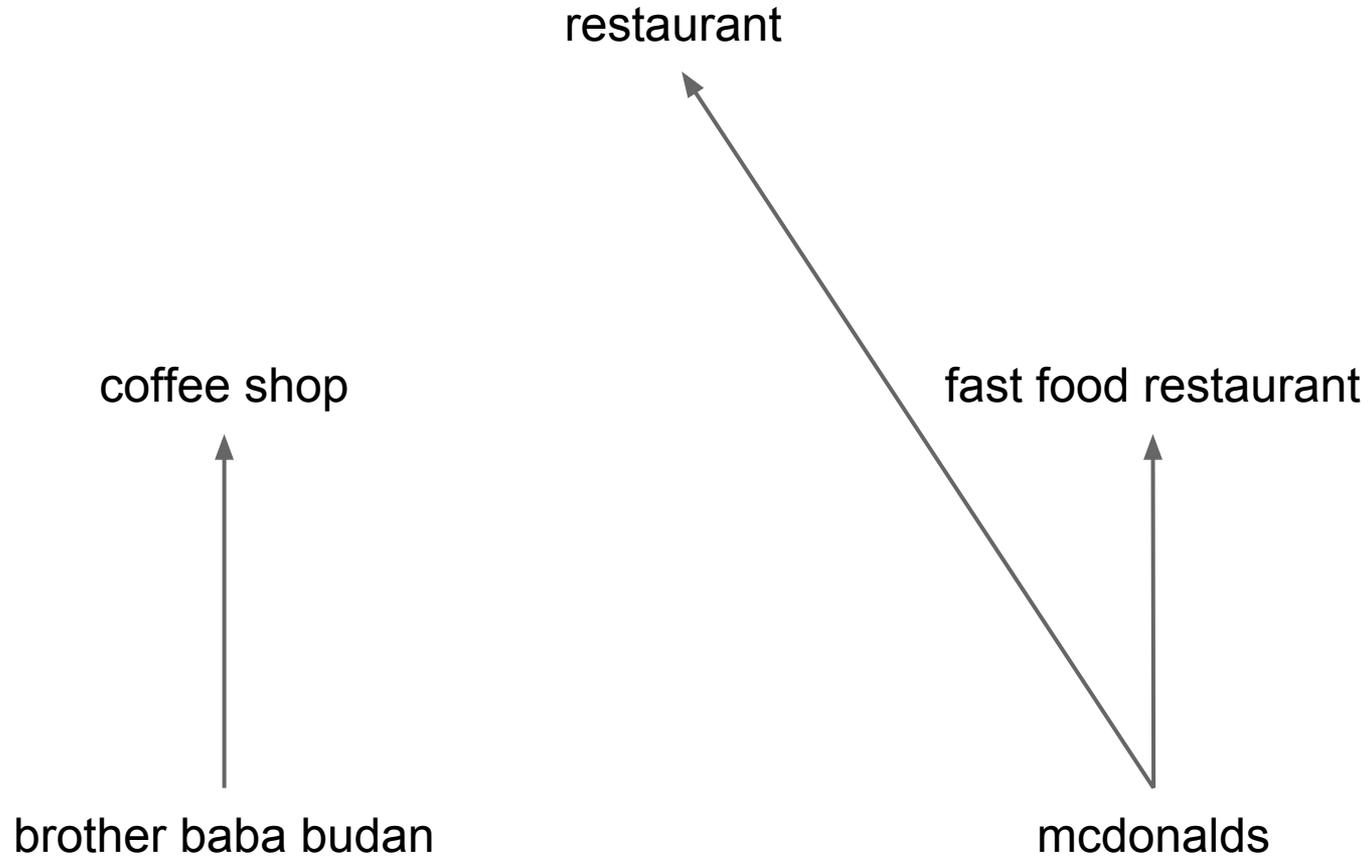
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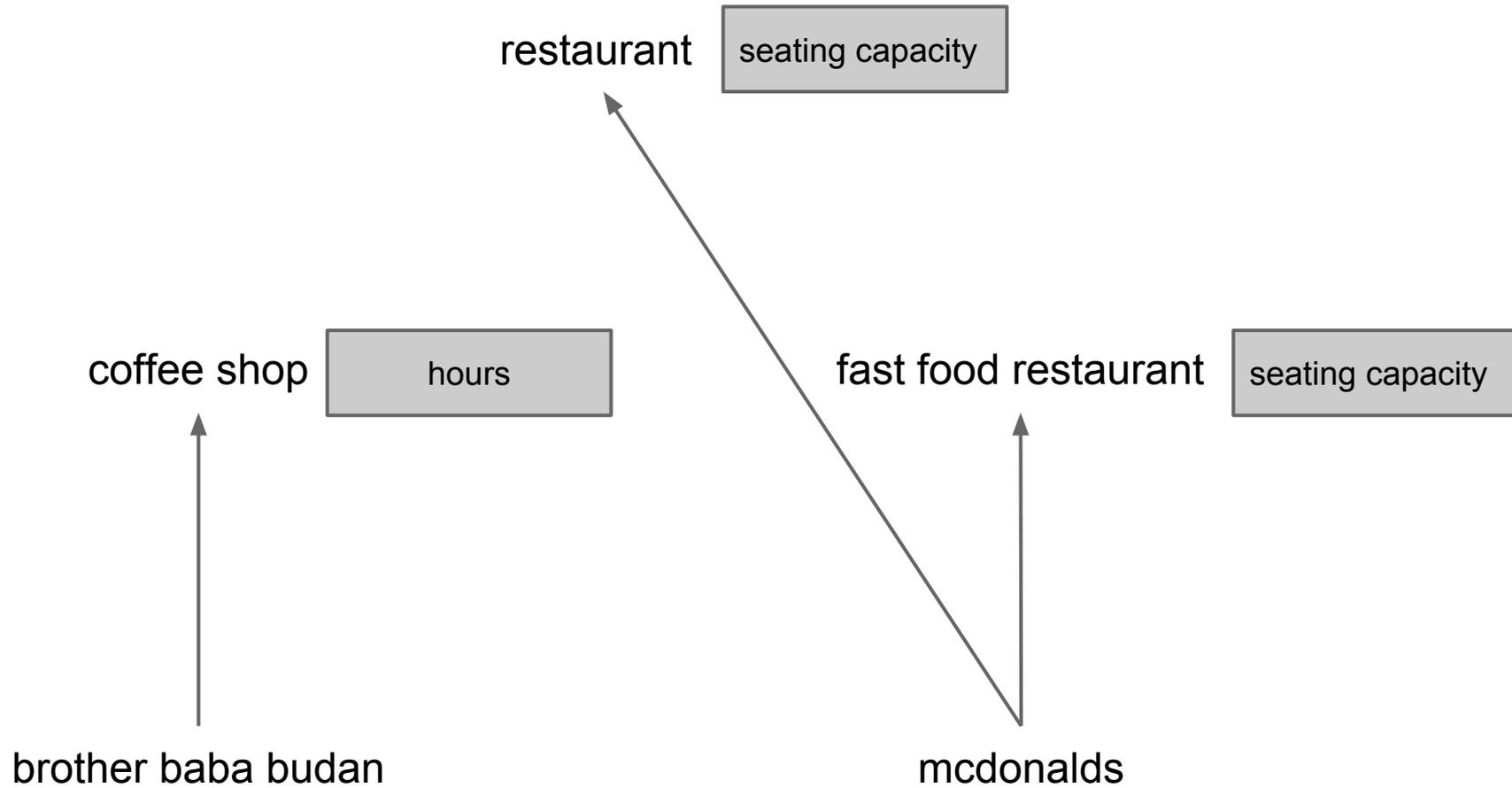
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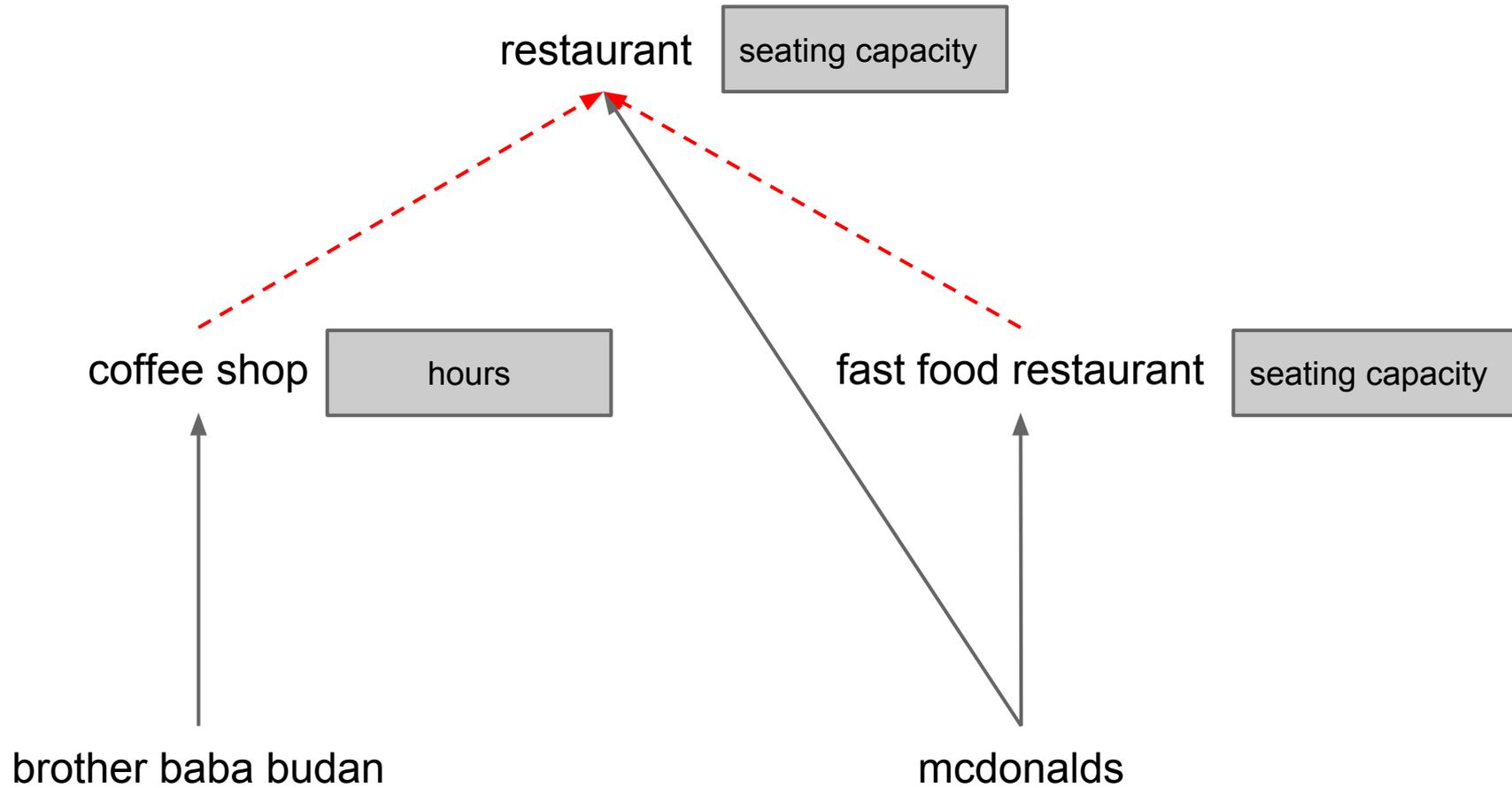
Is-A Relations



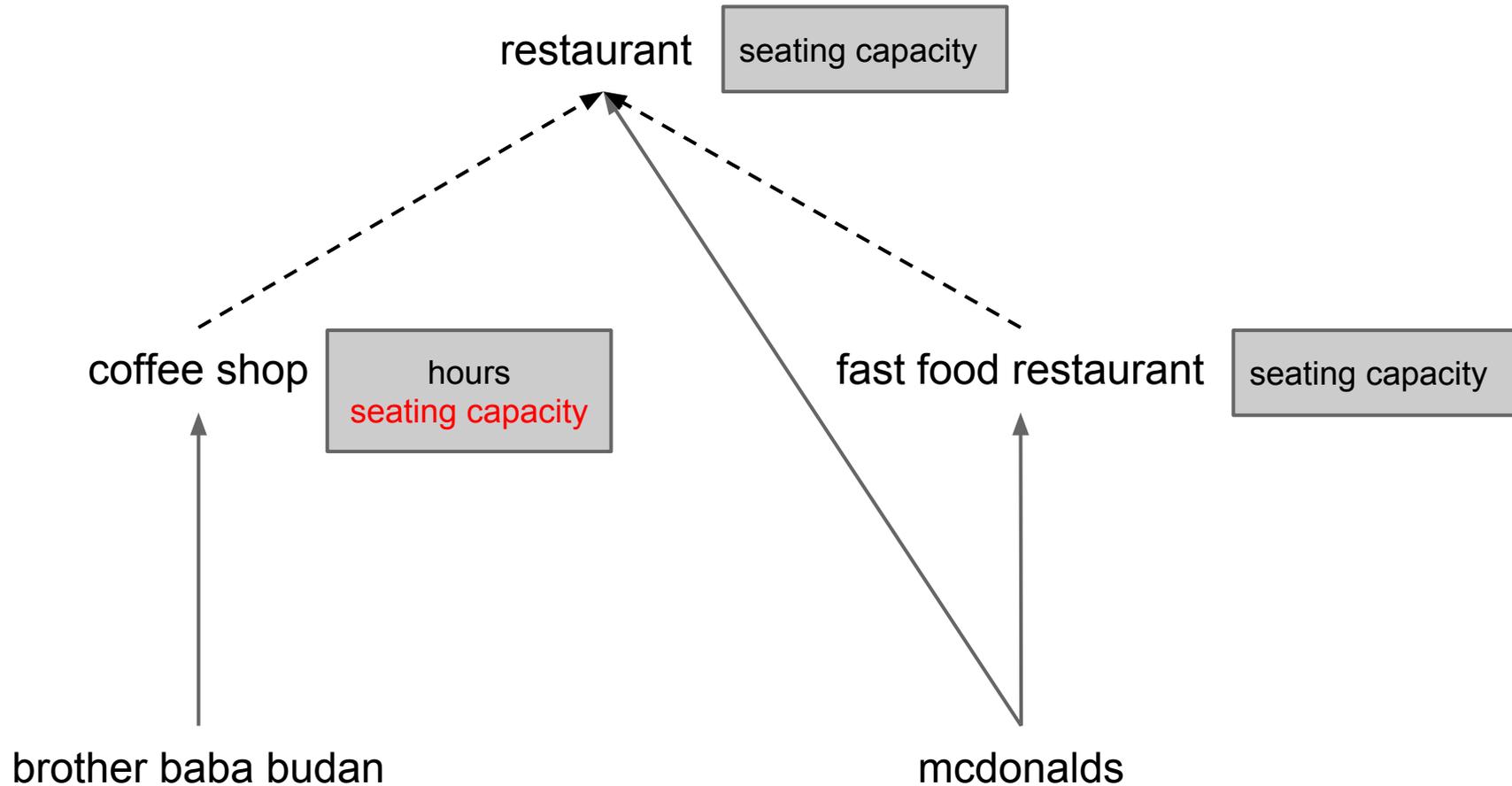
Is-A Relations



Subsumption Relations



Subsumption Relations



Strict Subsumption

restaurant

Formal Definition:

$C1 \sqsubseteq C2$ iff $\forall c \in C1, c \in C2$

Every instance of the sub-concept
also belongs to the super-concept

coffee shop

Strict Subsumption

restaurant

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Wikipedia: *Coffee shops, while similar to cafés, are not restaurants due to the fact that they primarily serve and derive the majority of their revenue from hot drinks.*

coffee shop

Merriam-
Webster:

Coffee shop: a small restaurant that serves coffee and other drinks as well as simple foods

Strict Subsumption

Users search coffee shop as if it were a restaurant

restaurant

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Latent Subsumption

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restaurant



coffee shop

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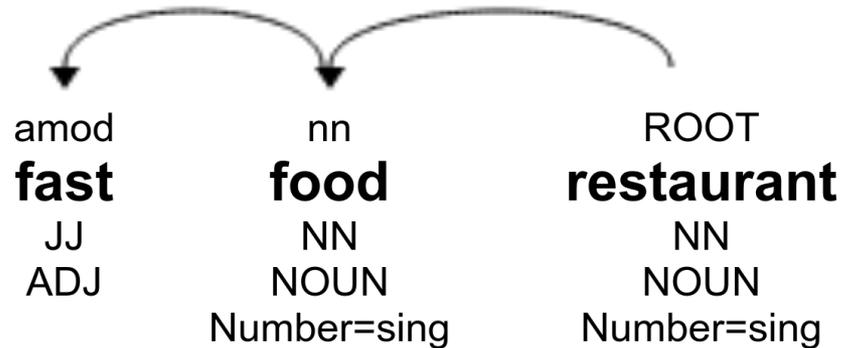
Baseline 1: Dependency Parsing

restaurant

fast food restaurant

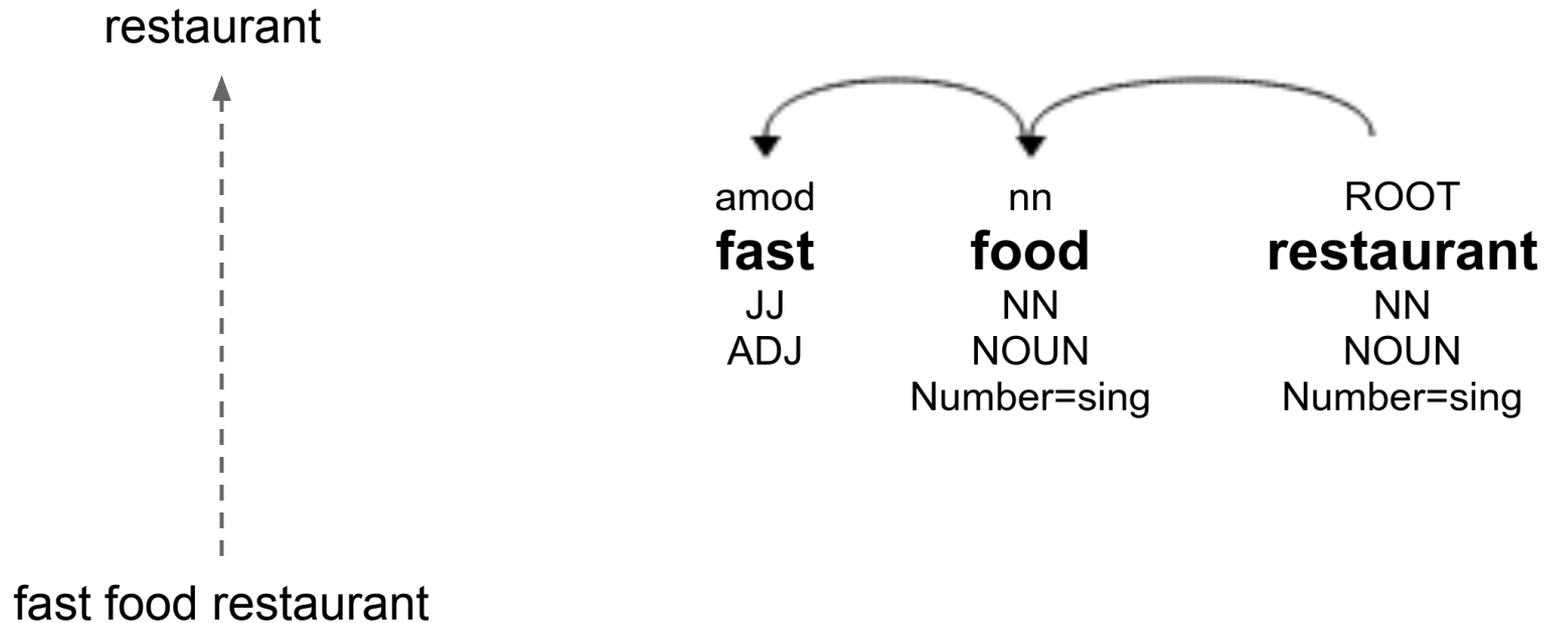
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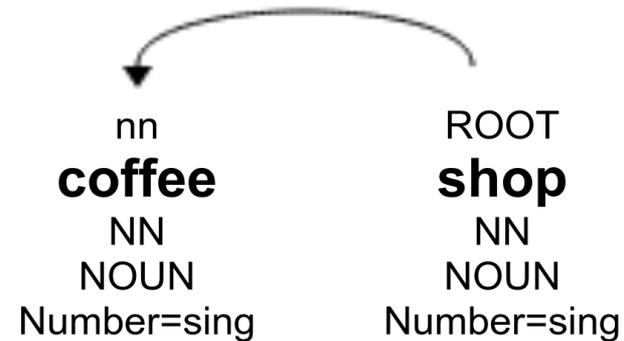
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restaurant

coffee shop

Baseline 1: Dependency Parsing

restaurant



coffee shop

Baseline 2: Word Vectors

restaurant

coffee shop

Baseline 2: Word Vectors

restaurant

*A **restaurant** called Little Tokyo ...*

*I'll meet you at the **restaurant** at 7:15 ...*

*you've never been to a **restaurant** before ...*

coffee shop

*A **coffee shop** called Jury on the old Pentridge ...*

*I'll meet you at the **coffee shop** and ...*

*You've never been to a **coffee shop** like this one ...*

Baseline 2: Word Vectors

restaurant

*A **restaurant** called Little Tokyo ...*

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word vector 1

coffee shop

*A **coffee shop** called Jury on the old Pentridge ...*

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word vector 2

Baseline 2: Word Vectors

restaurant



coffee shop

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word vector 1



(Compare)

*A **coffee shop** called Jury on the old Pentridge ...*

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word vector 2



Using Attributes

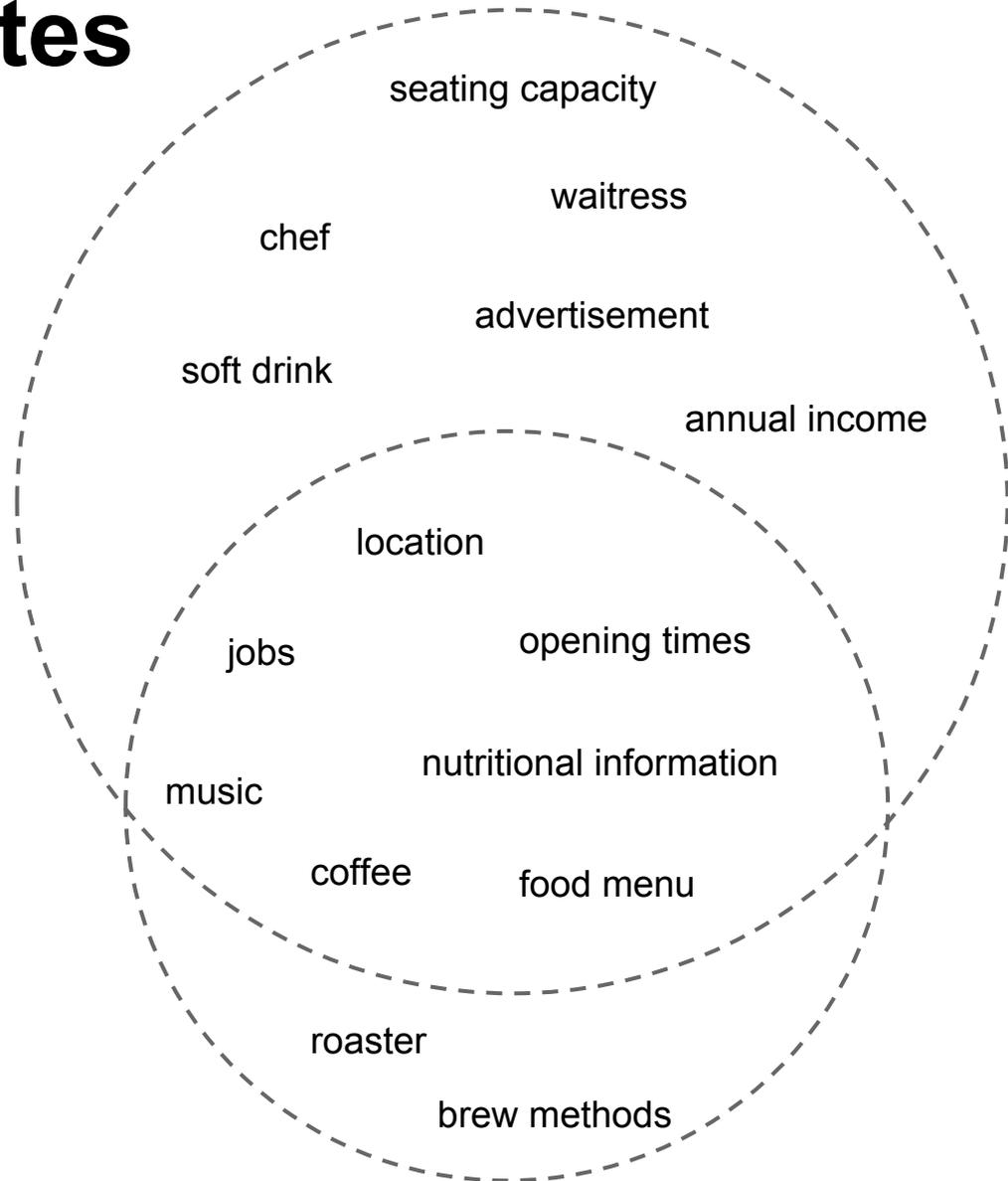
restaurant

coffee shop

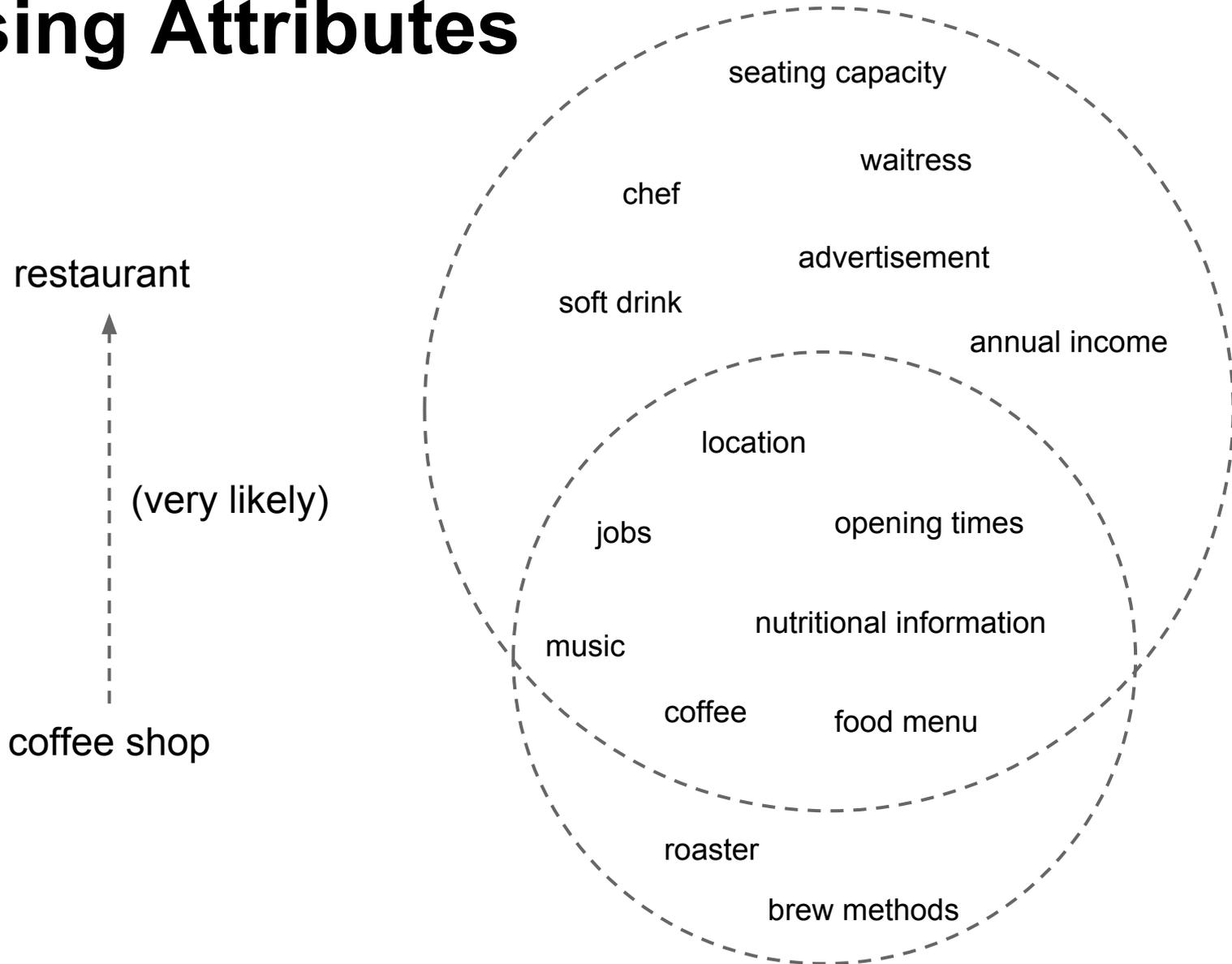
Using Attributes

restaurant

coffee shop



Using Attributes



Biperpedia [VLDB 14]

- Mines thousands of attributes for every concept from search queries and Web text
 - > 2 orders of magnitude larger than Freebase
 - Attributes ranked around 100K for country:
surveillance authorities, aerospace experts, antitrust chief, human resources firm, airport owner, ...
- Also identifies synonyms and mis-spells
 - *tourist attraction = tourist spot*
 - *moter: mother or motor (depending on Person or Car)*

Latte

fast food restaurant

restaurant

coffee shop

school

Latte

fast food restaurant

restaurant

coffee shop

school



Generate Candidates (using overlapping attributes)

restaurant

restaurant

school



fast food restaurant



coffee shop



restaurant

Latte

fast food restaurant

restaurant

coffee shop

school



Generate Candidates (using overlapping attributes)

restaurant

restaurant

school



fast food restaurant

coffee shop

restaurant



Generate Features (Attributes, Dependency Parse, Word Vectors) and classify candidates

restaurant



fast food restaurant

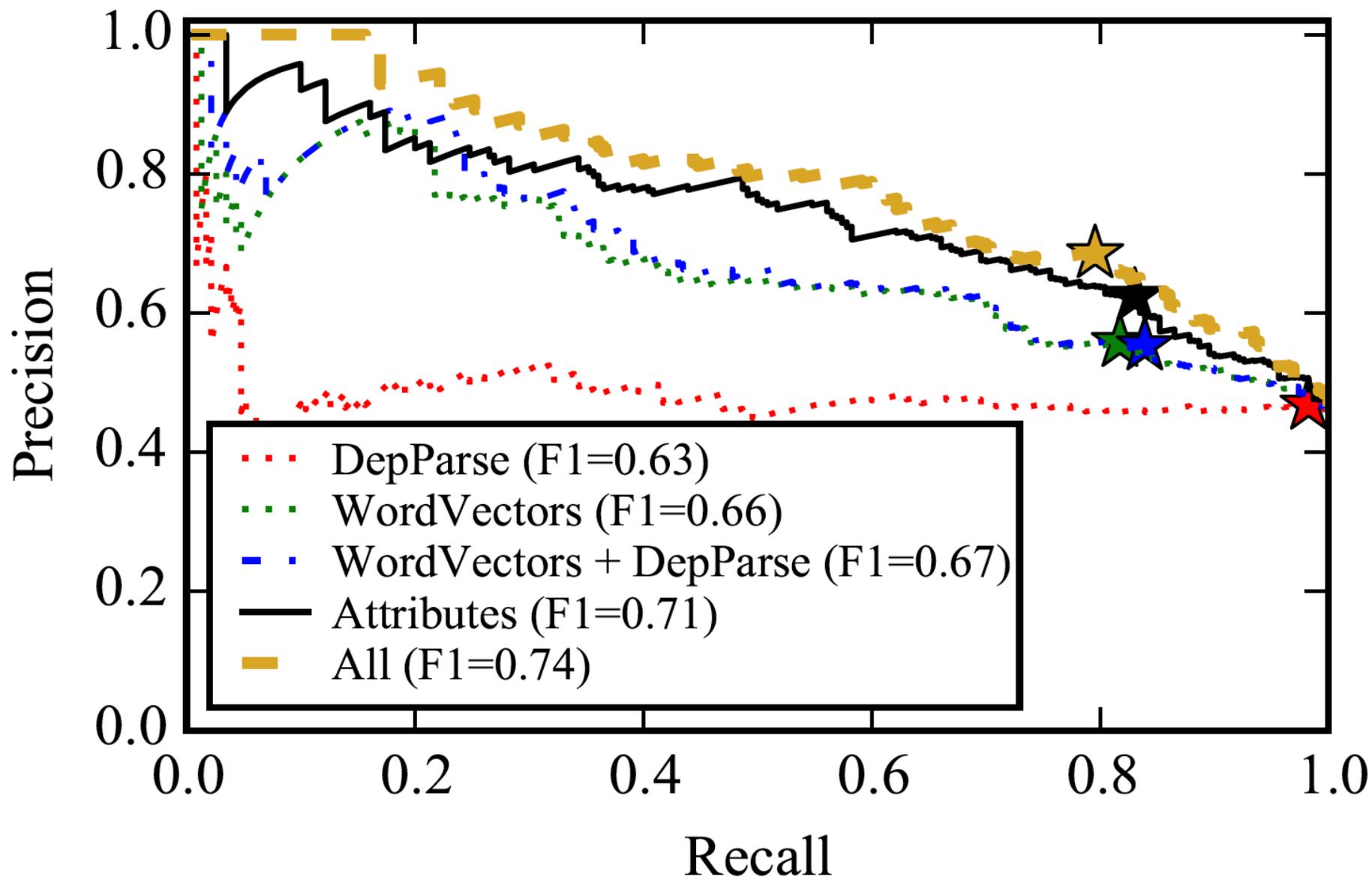
coffee shop

Attribute Features

- Basic Features
 - How “similar” are the concepts?
 - How “specialized” is one concept to another?
- Variants
 - Different weights for attributes
 - frequency, instances, rank
 - Synonym-based attribute matching

Experimental Setting

- Sources of concepts
 - Is-A Network (47K)
 - Apply patterns (e.g., ‘X is a Y’, ‘Y such as X’) on the Web
 - Discard nodes with fewer than 10 children
 - Freebase (10K)
- Training on Is-A Network concepts
 - 5.6K manually-labeled subsumption relations
 - Agreement among (three) experts was low: 74%

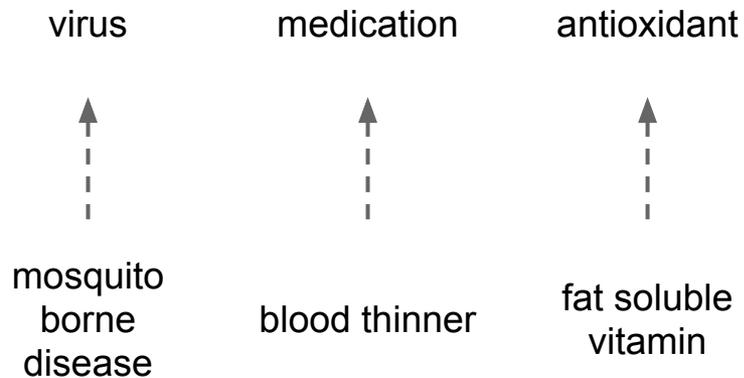


Large-scale Prediction

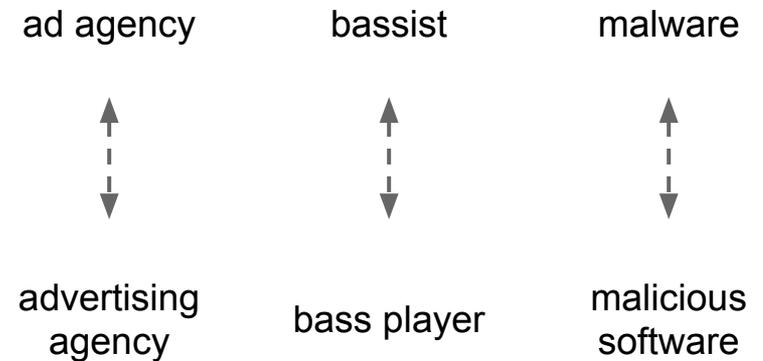
2.4M predicted relations

Top-k Samples:	100	1K	10K	100K
Estimated Precision:	1	0.94	0.72	0.68

Directional Predictions

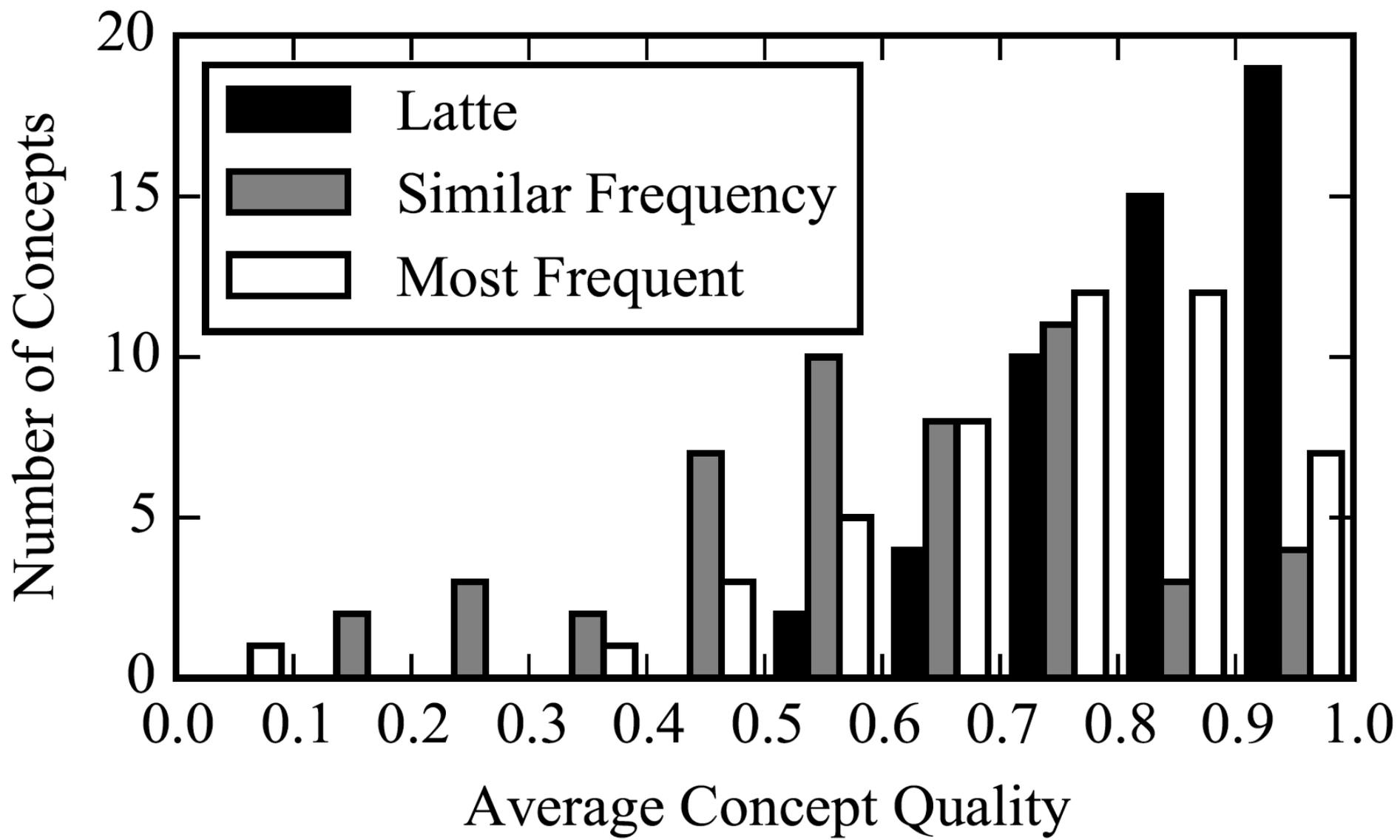


Bi-Directional Predictions (synonyms)

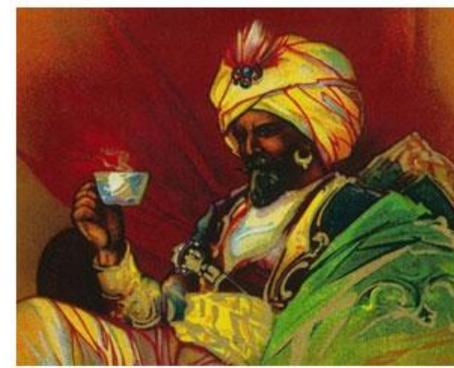


Finding High-Quality Concepts

- Intuition: concepts with many strong signals (i.e., subsumption relations) are likely to be of high quality
- Compare
 - **Latte**: 50 most frequent concepts among top 1K predictions
 - Is-A Network (**Similar Frequency**): 50 concepts with similar frequencies of Is-A relations
 - Is-A Network (**Most Frequent**): 50 most frequent concepts



Concluding Observations



- Latte finds latent subsumptions that are useful for search engines using attributes
 - Is-A Network: 0.74 F1 / 2.4M predictions
 - Freebase: 0.98 F1 / 734 predictions
- Can also be used to clean resources with noisy concepts
- Challenge: What is the real notion of subsumption for Web applications?

Thanks!