An Automated Approach for Product Taxonomy Mapping in E-commerce

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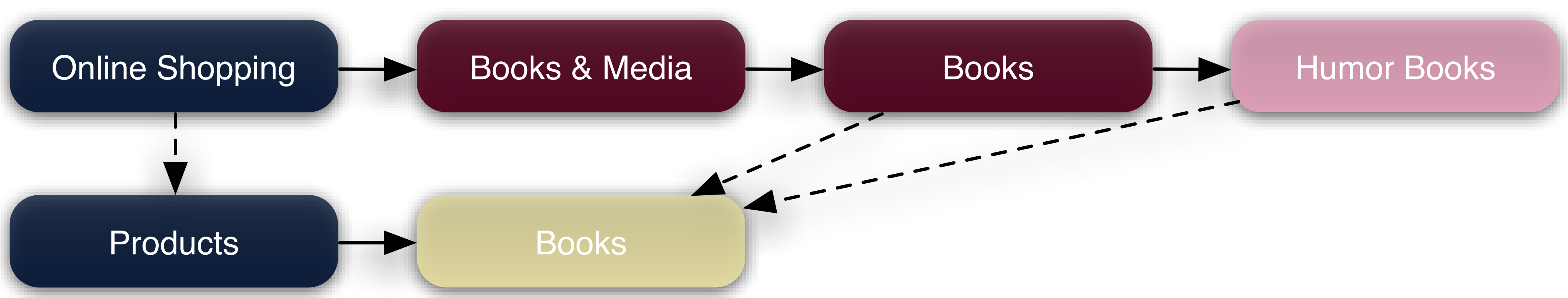
Terminology

- source taxonomy
- target taxonomy
- category = single node in a taxonomy
- (category) path = list of nodes (starting from root node)

Product taxonomies

Important aspects of product taxonomies:

- composite categories
- varying degree of granularity
- root category of taxonomies



Related work

- The algorithm by Park & Kim
  "*Ontology Mapping between Heterogeneous Product Taxonomies in an Electronic Commerce Environment*"

- PROMPT algorithm in PROMPT Suite
  "*The PROMPT Suite: Interactive Tools for Ontology Merging and Mapping*"

Algorithm overview

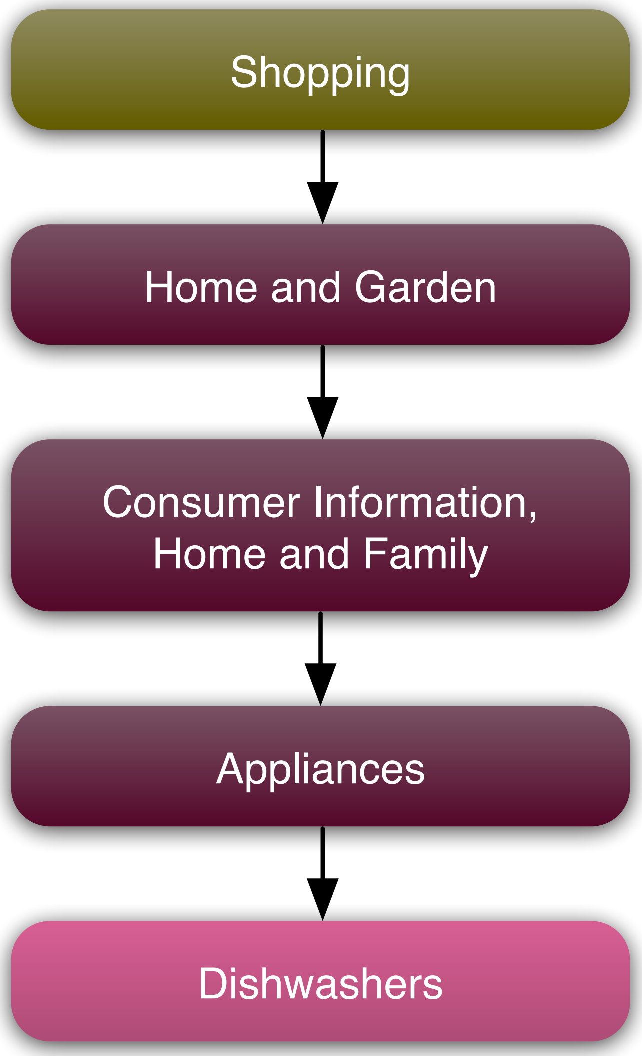
- Input is a source category path
- Output is a target category path (or ‘None’)
- There are three steps
    1. source category disambiguation
    2. candidate target category selection
    3. candidate target path key comparison

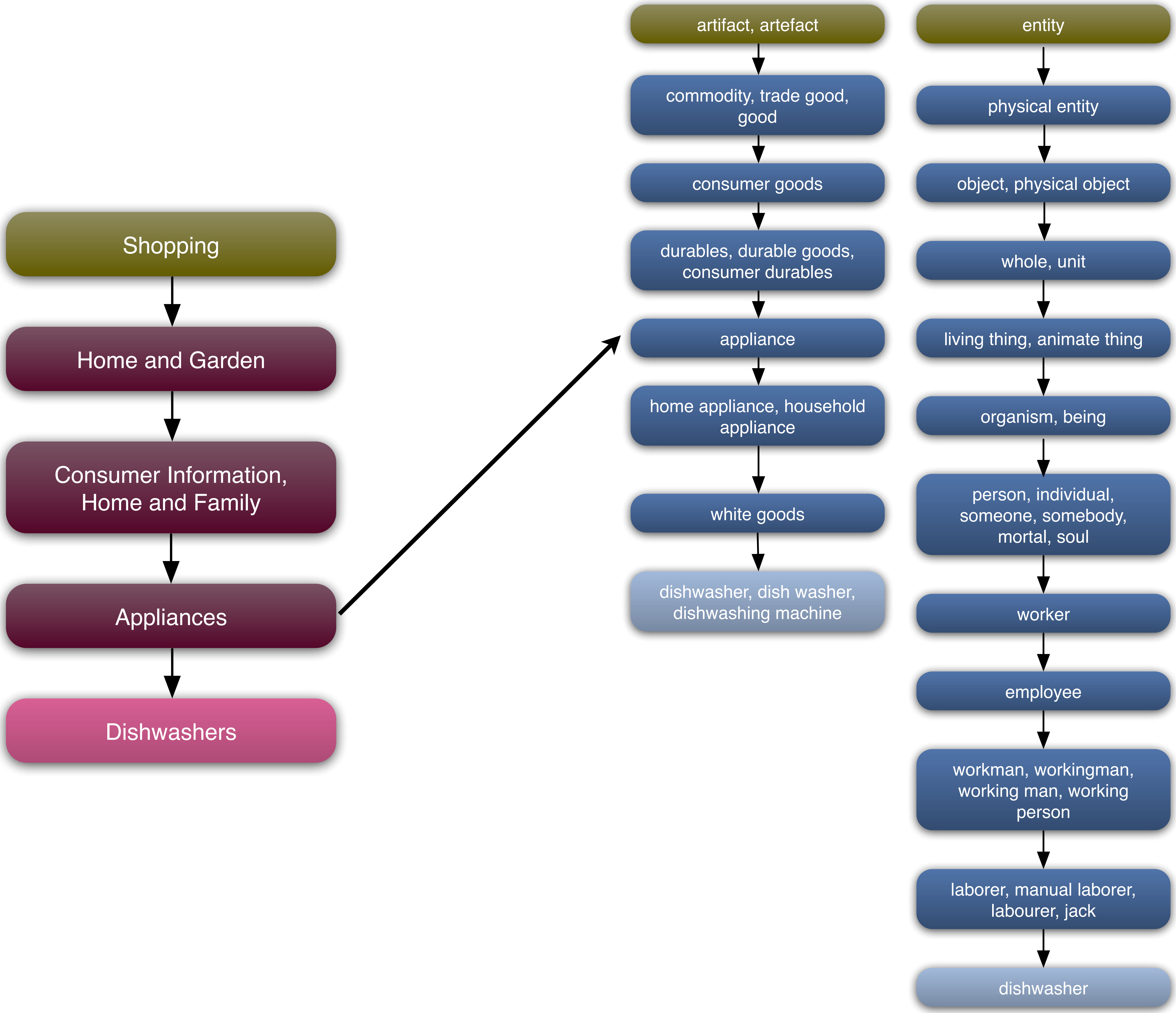
Algorithm overview

1. **source category disambiguation**
2. candidate target category selection
3. candidate target path key comparison

Source category disambiguation

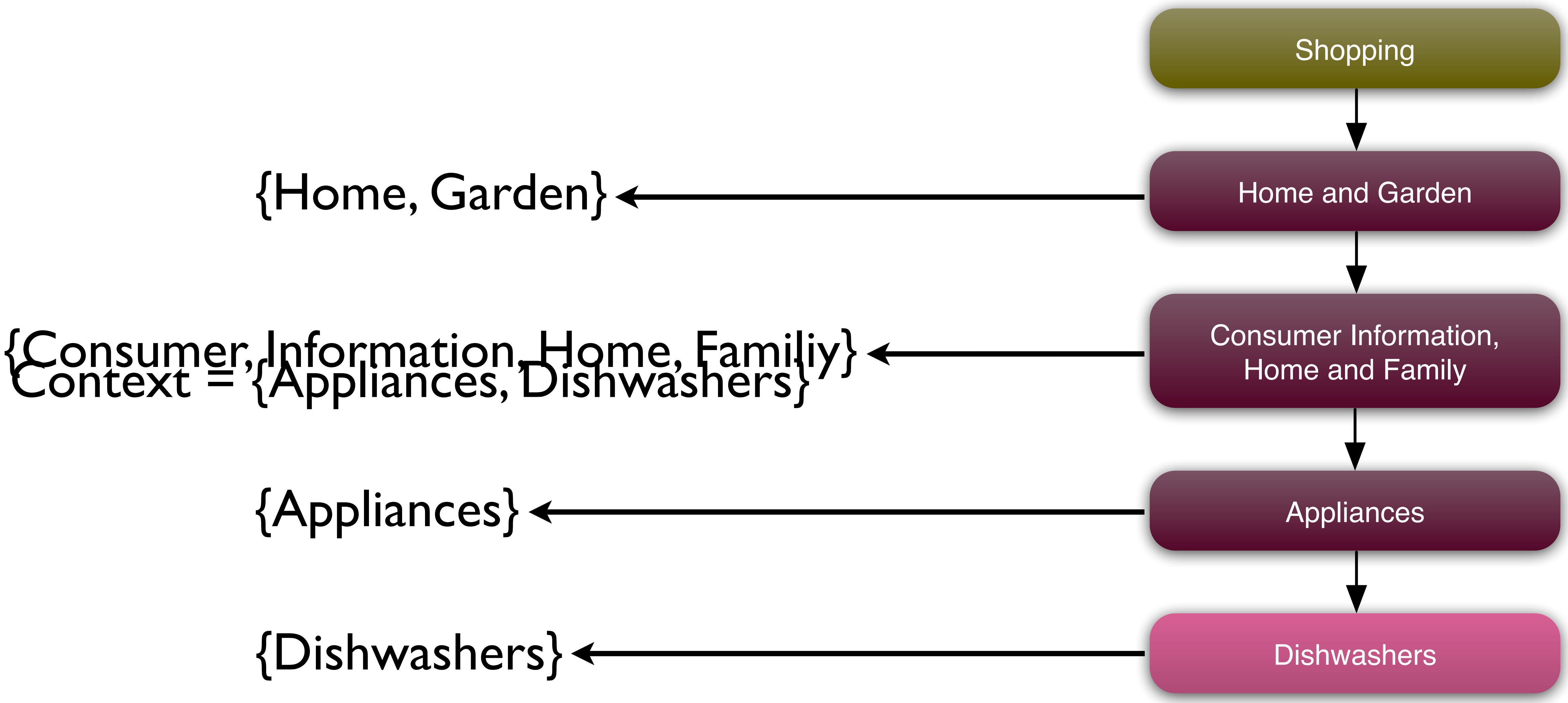
- Example category path
  - Dishwashers can have two meanings
  - From the path, the meaning is clear to humans
- Based on the Lesk algorithm





Shopping
Home and Garden
Consumer Information, Home and Family
Appliances
Dishwashers
artifact, artefact
commodity, trade good, good
consumer goods
durables, durable goods, consumer durables
appliance
home appliance, household appliance
white goods
dishwasher, dish washer, dishwashing machine
entity
physical entity
object, physical object
whole, unit
living thing, animate thing
organism, being
person, individual, someone, somebody, mortal, soul
worker
employee
workman, workingman, working man, working person
laborer, manual laborer, labourer, jack
dishwasher

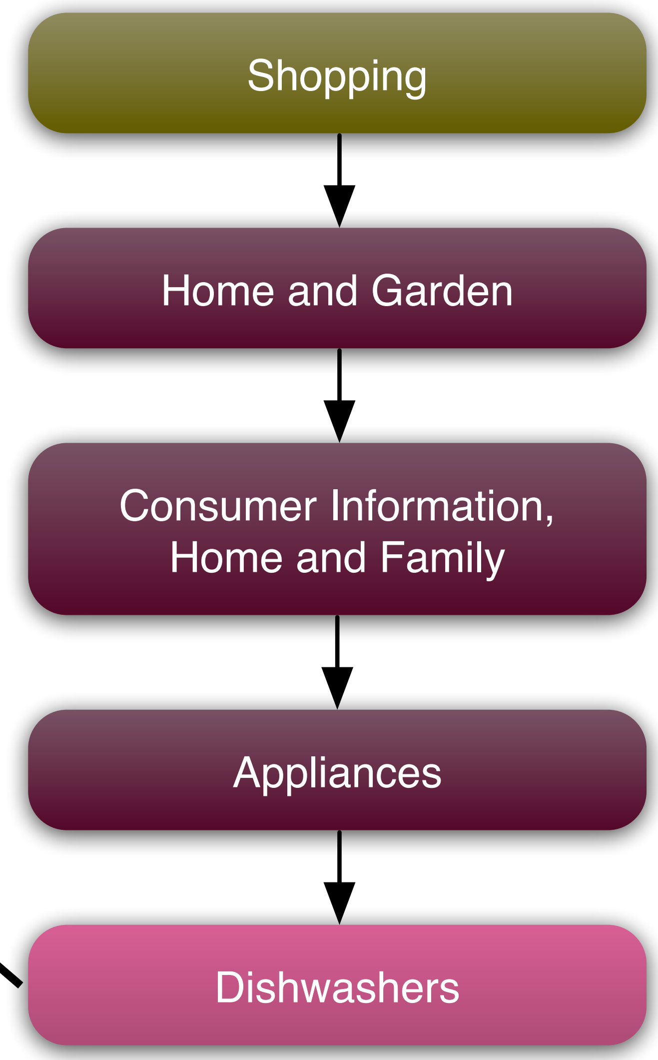
Source category disambiguation



Source category disambiguation

Context = {Appliances, Dishwashers}

{Dishwashers}



Extended Split Term Set = {*extendedTermSet*, ...}

Synonyms of 'Dishwashers' with the correct meaning

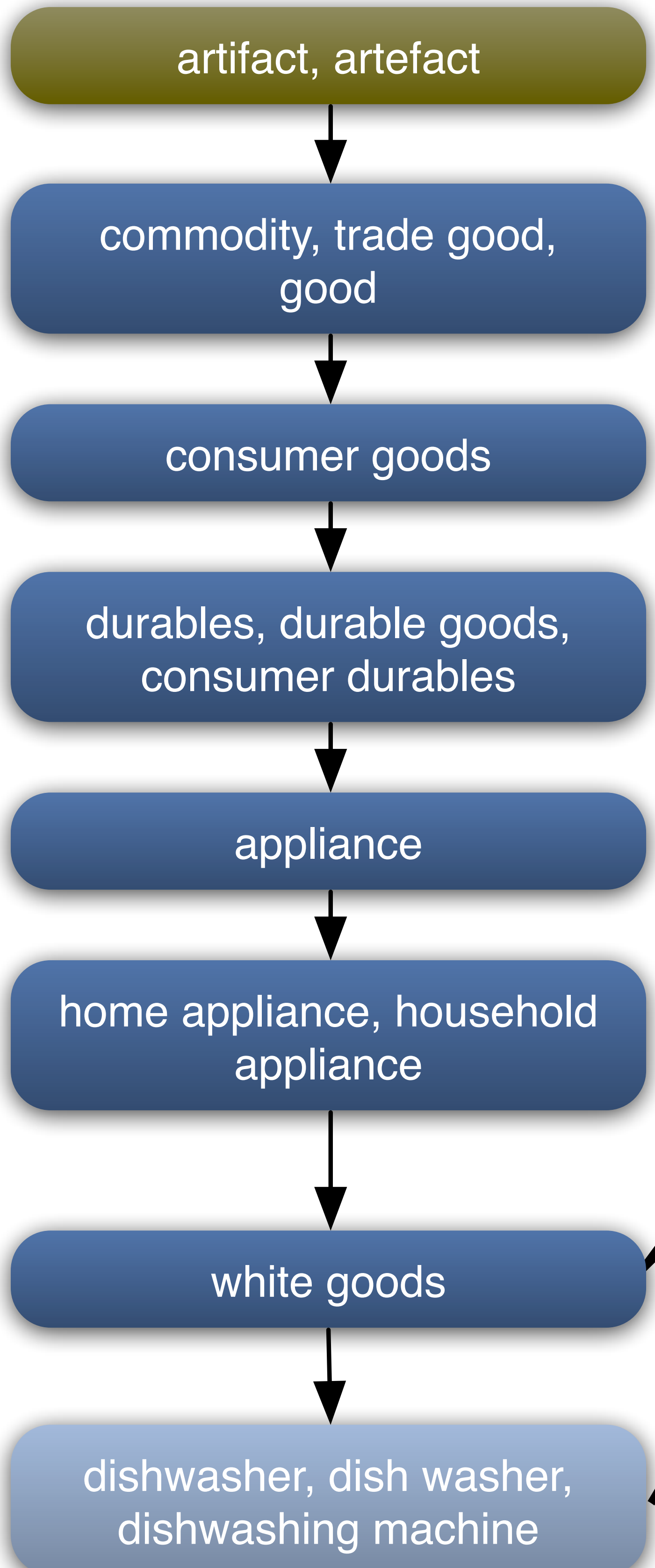
Source category disambiguation

S1 = dishwasher, dish washer, dishwashing machine (<u>a machine for washing dishes</u>)

S2 = dishwasher (<u>someone who washes dishes</u>)

Compute sense score for each sense, highest is selected as correct sense

Related synsets based on hypernymy, hyponymy, meronymy and holonymy



Context = {

Appliances,

...

Dishwashers

}

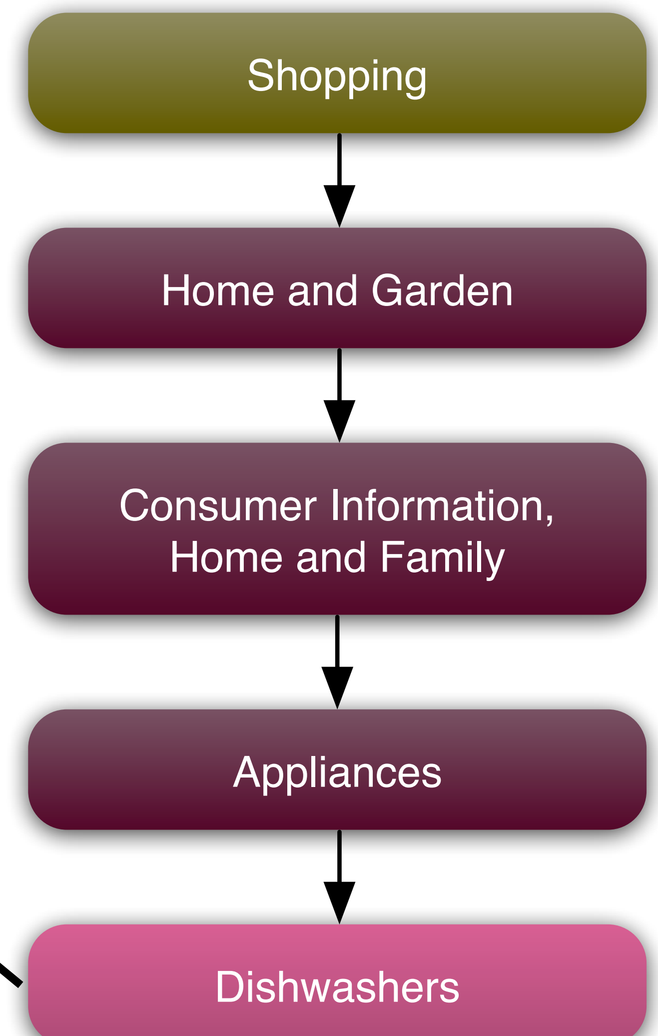
longest common substring is used to compute the score

S1 = dishwasher, ... (a machine for washing dishes)

Source category disambiguation

Context = {Appliances, Dishwashers}

{Dishwashers}



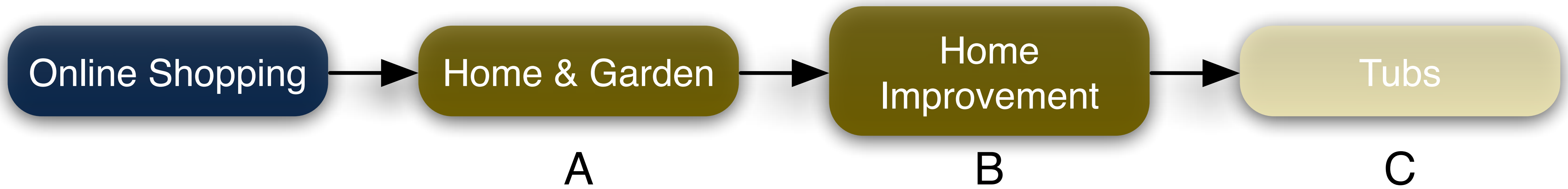
Extended Split Term Set = {*extendedTermSet*, ...}

{Dishwashers, dishwasher, dish washer, dishwashing machine}

Candidate target category selection

- Algorithm ‘Semantic Search’
- Input:
  - a source category name and ‘Extended Split Term Set’
  - a target category name
- Output: true if source category matches and is a subset of target category

Candidate target category selection



Disambiguation result for ‘Tubs’:
{{Tubs, bathtub, bathing tub, bath, tub}}

Candidate target category selection

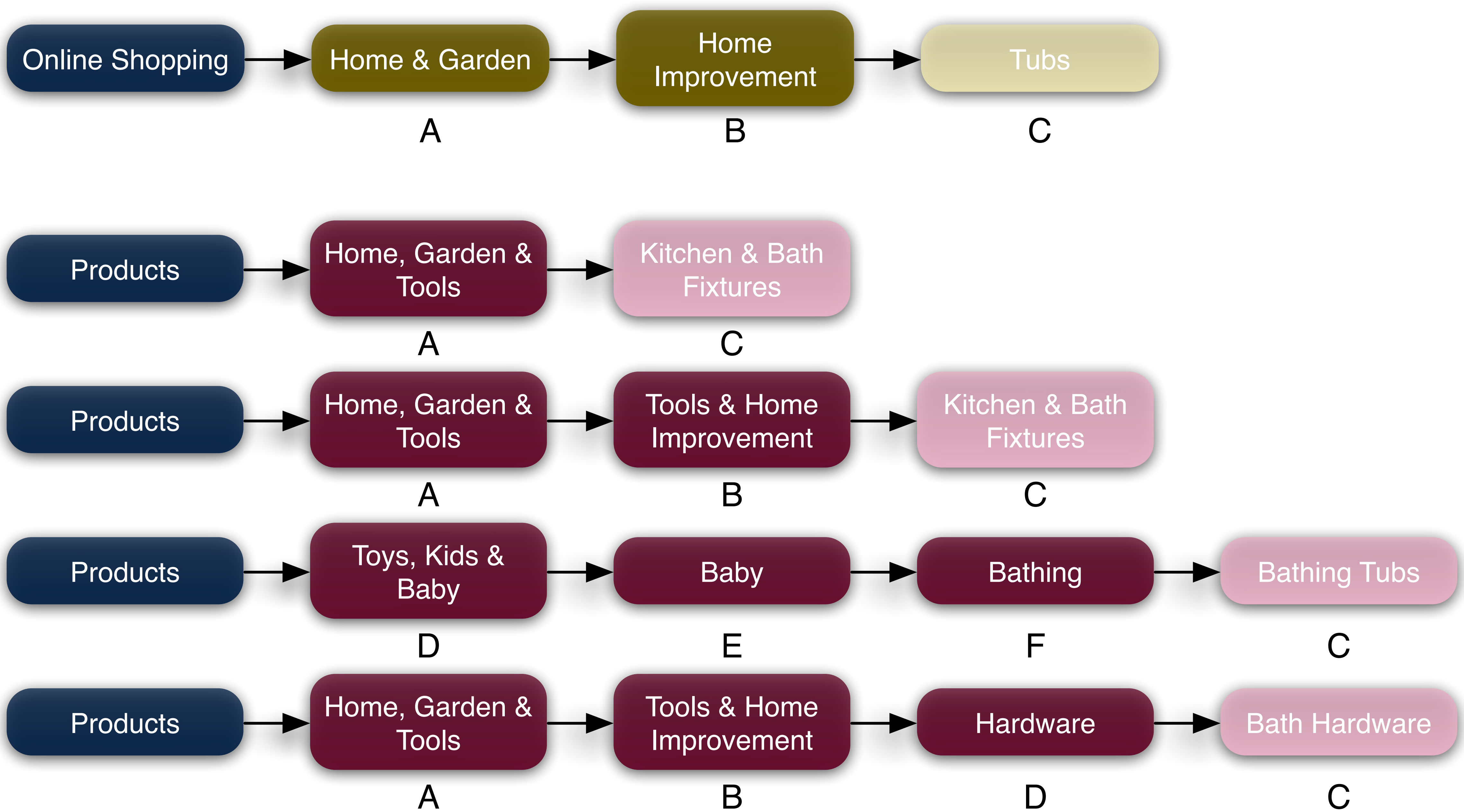
Disambiguation result for ‘Tubs’:
{{Tubs, bathtub, bathing tub, bath, tub}}

Target category: Kitchen & Bath Fixtures

Match for at least one split term:
- source term is part of target category as separate term, or
- normalized Levenshtein similarity is above a certain threshold

For each extended term set

Candidate target category selection



Algorithm overview

1. source category disambiguation
2. candidate target category selection
3. **candidate target path key comparison**

Candidate target path key comparison

- Damerau-Levenshtein applied on paths
- Category paths are converted to list of generated ID’s
- Equal nodes get the same ID
- Equality determined by ‘Semantic Search’ algorithm (candidate target selection)

Candidate target path key comparison

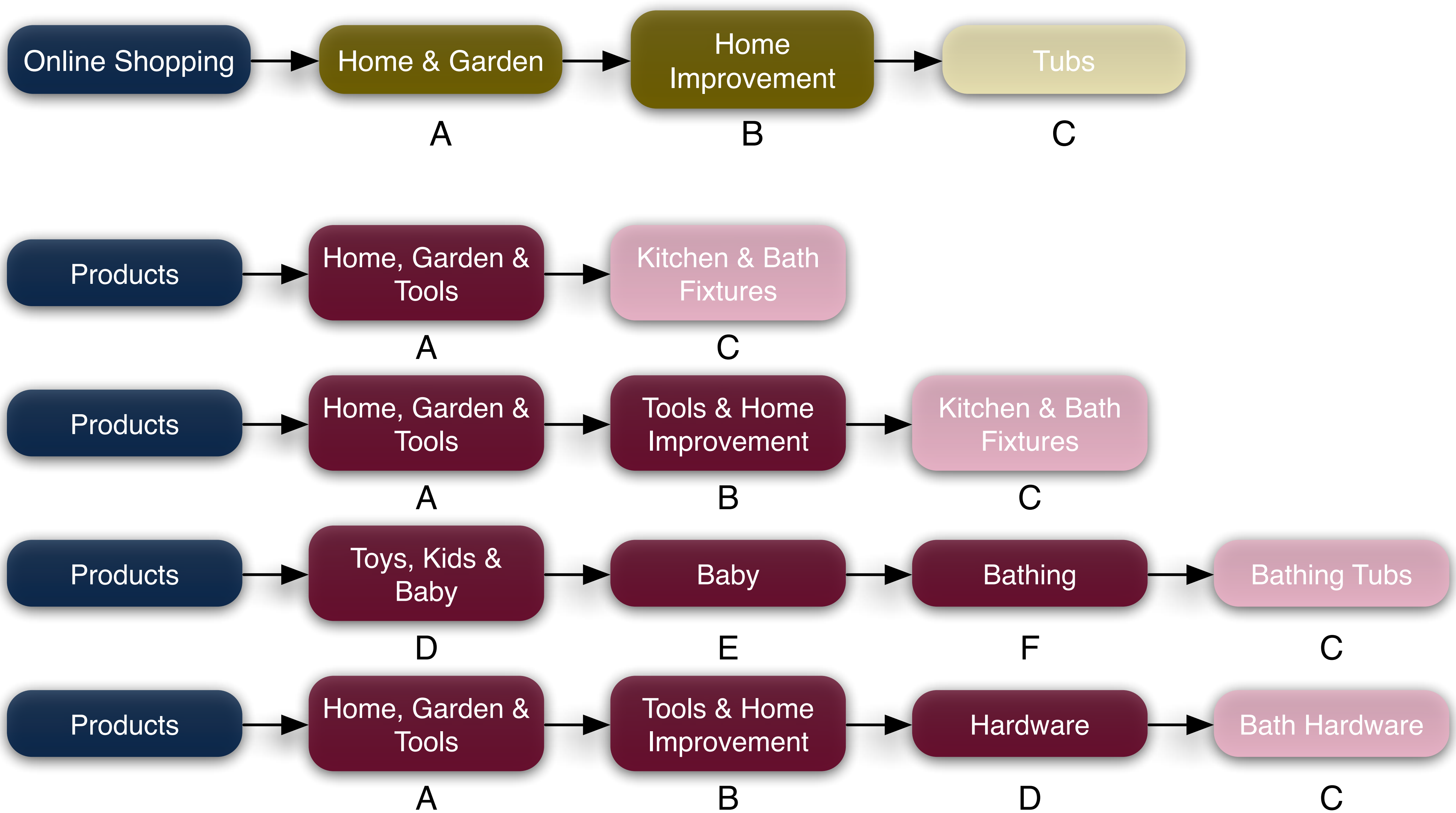
Final score:

$$score\left(K_{src},K_{cand}\right)=1-\frac{\mathrm{damLev}\left(K_{src},K_{cand}\right)+p}{\max\left(\mathrm{len}(K_{src}),\mathrm{len}(K_{cand})\right)+p}$$

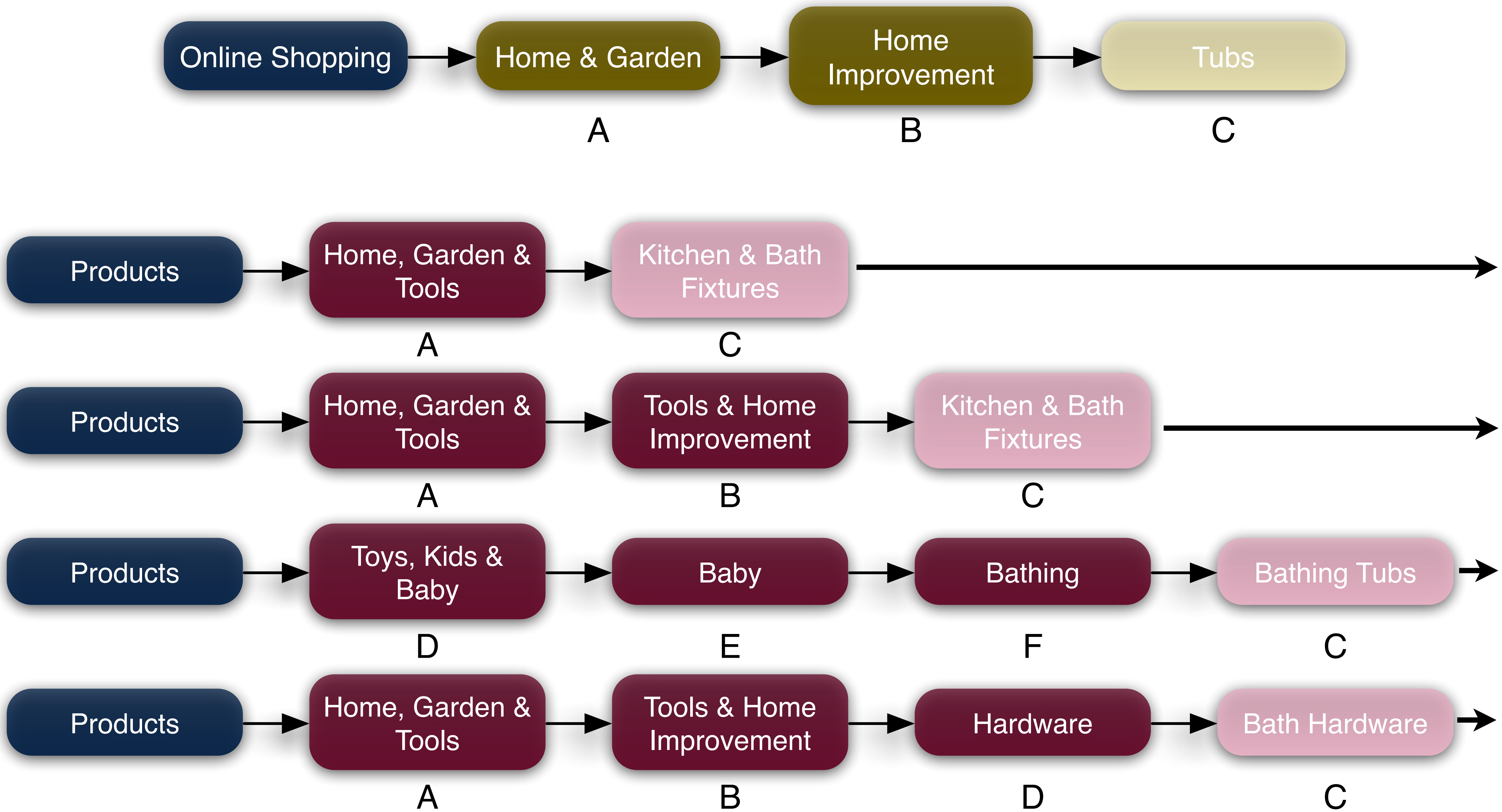
where:

- K is a key list
- p is the penalty (# absent nodes in candidate path)
- damLev() computes the Damerau-Levenshtein distance between two key lists

Candidate target category selection



Candidate target category selection



$$1-\frac{1+0}{3+0}=\frac{2}{3}$$

$$1-\frac{0+0}{3+0}=1$$

$$1-\frac{3+3}{4+3}=\frac{1}{7}$$

$$1-\frac{1+1}{4+1}=\frac{3}{5}$$

Evaluation

- Datasets
  - Amazon.com, ~2,500 categories
  - Overstock.com, ~1,000 categories
  - Dmoz.org, ~44,000 categories
- Manually mapped 3000 categories with
  - 6 data set combinations (sample size 500)
  - 3 individuals

Evaluation

Overall results

Algorithm	Precision	Recall	F_1	# Senses found	WSD accuracy
PROMPT	28.93%	16.69%	20.75%	n/a	n/a
Park & Kim	47.77%	25.19%	32.52%	5.70%	83.72%
Our approach	42.21%	80.73%	55.10%	82.03%	84.01%

Questions?