Exploiting the Semantic Web for the Automatic Extraction of Los Angeles City Data

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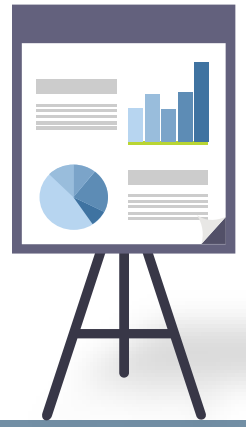
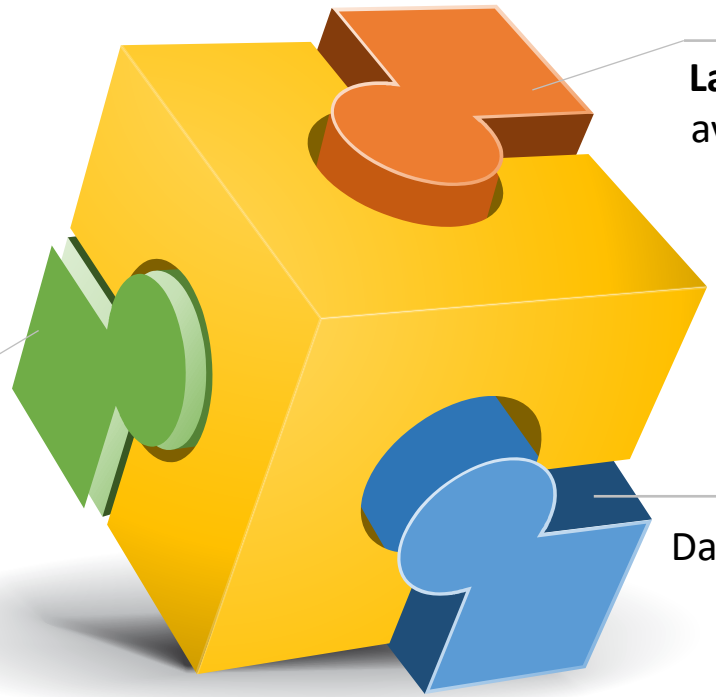
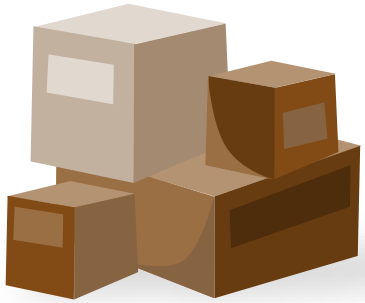
Introduction: Problem Identification



Departments within the city of Los Angeles are **unware of relevant datasets**



Large number of datasets available about the city of Los Angeles



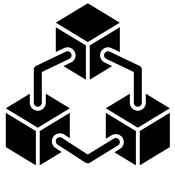
Data access and integration are not easy in the **Big Data environment**

(Dong et al. 2015)

The Solution

Provide a **better access** to the data the city already has

How?



Automatically extracting the **content** from each dataset in a form of a class

Preliminary Notions

The Web was designed as an information space with the goal to be useful for human-to-human communication, while the **Semantic Web** approach develops methods and languages for expressing information in a machine-processable form.

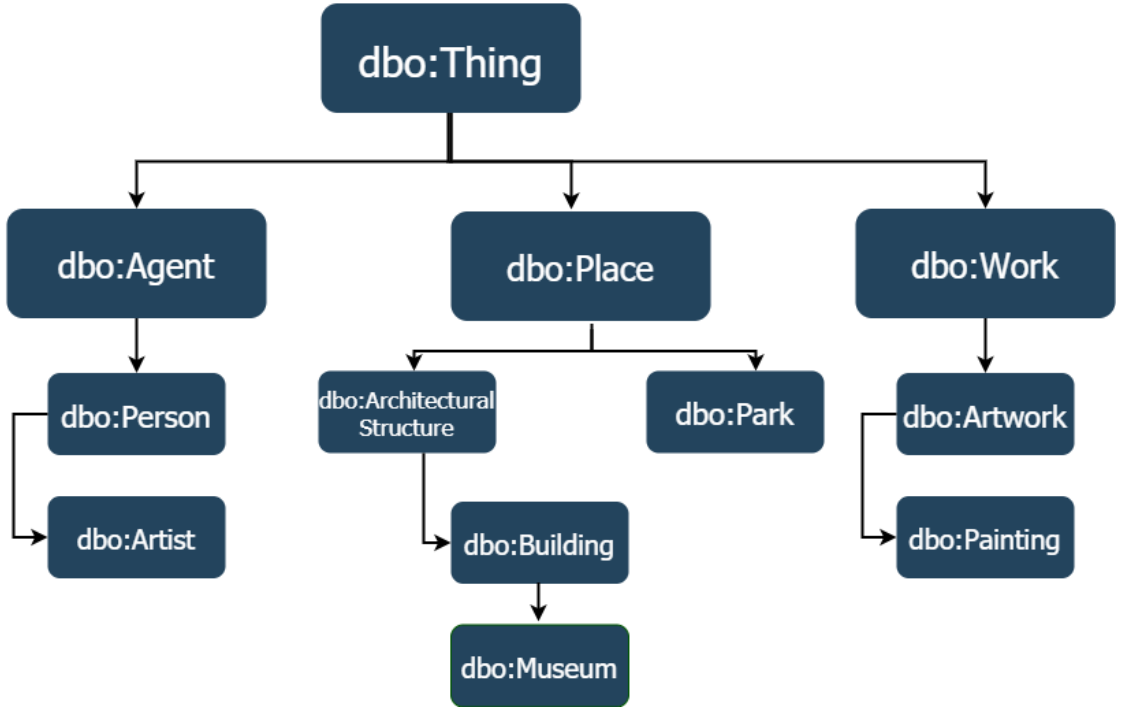
(Berners-Lee et al. 2001)

Ontologies are stores of information accessible through queries on the Web, which describe the contextual relations between concepts and specify logical rules for reasoning about them.

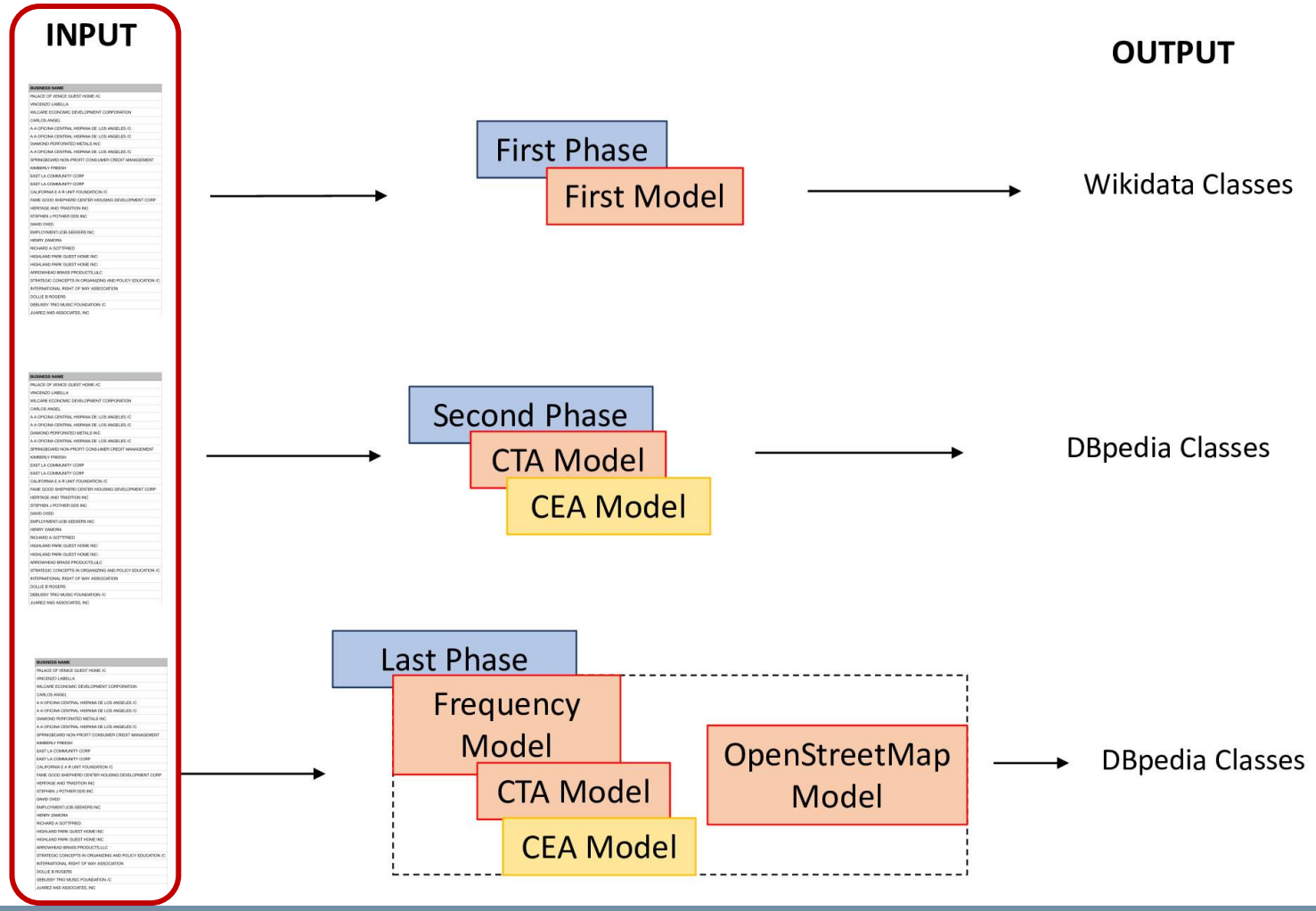
(Ismayilov et al. 2018)

WIKIDATA

DBpedia



The Model Development



Input: Column Selection Phase

From the observation of the datasets, we collected **some exclusion criteria** to isolate a single column from a dataset

INPUT

BUSINESS NAME	DBA NAME	STREET ADDRESS	CITY
PALACE OF VENICE GUEST HOME /C		1727 CRENSHAW BLVD	LOS ANGELES
VINCENZO LABELLA		521 SWARTHMORE AVENUE	PACIFIC PALISA
WILCARE ECONOMIC DEVELOPMENT CORPORATION		9911 AVALON BLVD	LOS ANGELES
CARLOS ANGEL		1221 W 7TH STREET SUITE #N-407	LOS ANGELES
A A OFICINA CENTRAL HISPANA DE LOS ANGELES /C		4917 S BROADWAY	LOS ANGELES
A A OFICINA CENTRAL HISPANA DE LOS ANGELES /C		1330 WILSHIRE BLVD #208	LOS ANGELES
DIAMOND PERFORATED METALS INC		11093 BEECH AVENUE	FONTANA
A A OFICINA CENTRAL HISPANA DE LOS ANGELES /C		2015 W TEMPLE STREET	LOS ANGELES
SPRINGBOARD NON-PROFIT CONSUMER CREDIT MANAGEMENT	MONEY MANAGEMENT INTERNATIONAL	1605 W OLYMPIC BLVD #9023	LOS ANGELES
KIMBERLY FREESH		10926 OWENSMOUTH AVENUE	CHATSWORTH
EAST LA COMMUNITY CORP		121 N CHICAGO STREET	LOS ANGELES
EAST LA COMMUNITY CORP		115 N SOTO STREET	LOS ANGELES
CALIFORNIA E A R UNIT FOUNDATION /C		29654 DRIVER AVENUE	CASTAIC
FAME GOOD SHEPHERD CENTER HOUSING DEVELOPMENT CORP		2420 S WESTERN AVENUE	LOS ANGELES
HERITAGE AND TRADITION INC		3756 ALOHA STREET	LOS ANGELES
STEPHEN J POTHIER DDS INC		9720 RESEDA BLVD #2	NORTHRIDGE
DAVID OVED		12304 SANTA MONICA BLVD #209	LOS ANGELES
EMPLOYMENT/JOB-SEEKERS INC		4205 10TH AVENUE #4	LOS ANGELES
HENRY ZAMORA		6730 TUJUNGA AVENUE	NORTH HOLLYW
RICHARD A GOTTFRIED	RICHARD A GOTTFRIED JD MBA MFT	12304 SANTA MONICA BLVD #215	LOS ANGELES
HIGHLAND PARK GUEST HOME INC	HIGHLAND PARK GST. HM INC | HIGHLAND PARK GUEST HOME	345 N AVENUE 57	LOS ANGELES
HIGHLAND PARK GUEST HOME INC		346 N AVENUE 57	LOS ANGELES
ARROWHEAD BRASS PRODUCTS,LLC		5147 ALHAMBRA AVENUE	LOS ANGELES
STRATEGIC CONCEPTS IN ORGANIZING AND POLICY EDUCATION /C	SCOPE	1715 W FLORENCE AVENUE	LOS ANGELES
INTERNATIONAL RIGHT OF WAY ASSOCIATION		19750 S VERMONT AVENUE #220	TORRANCE
DOLLIE B ROGERS		5420 COMPTON AVENUE	LOS ANGELES
DEBUSSY TRIO MUSIC FOUNDATION /C		223 S BUNDY DRIVE	LOS ANGELES
JUAREZ AND ASSOCIATES, INC		12139 NATIONAL BLVD	LOS ANGELES

Columns' Selection →

OUTPUT

BUSINESS NAME
PALACE OF VENICE GUEST HOME /C
VINCENZO LABELLA
WILCARE ECONOMIC DEVELOPMENT CORPORATION
CARLOS ANGEL
A A OFICINA CENTRAL HISPANA DE LOS ANGELES /C
A A OFICINA CENTRAL HISPANA DE LOS ANGELES /C
DIAMOND PERFORATED METALS INC
A A OFICINA CENTRAL HISPANA DE LOS ANGELES /C
SPRINGBOARD NON-PROFIT CONSUMER CREDIT MANAGEMENT
KIMBERLY FREESH
EAST LA COMMUNITY CORP
EAST LA COMMUNITY CORP
CALIFORNIA E A R UNIT FOUNDATION /C
FAME GOOD SHEPHERD CENTER HOUSING DEVELOPMENT CORP
HERITAGE AND TRADITION INC
STEPHEN J POTHIER DDS INC
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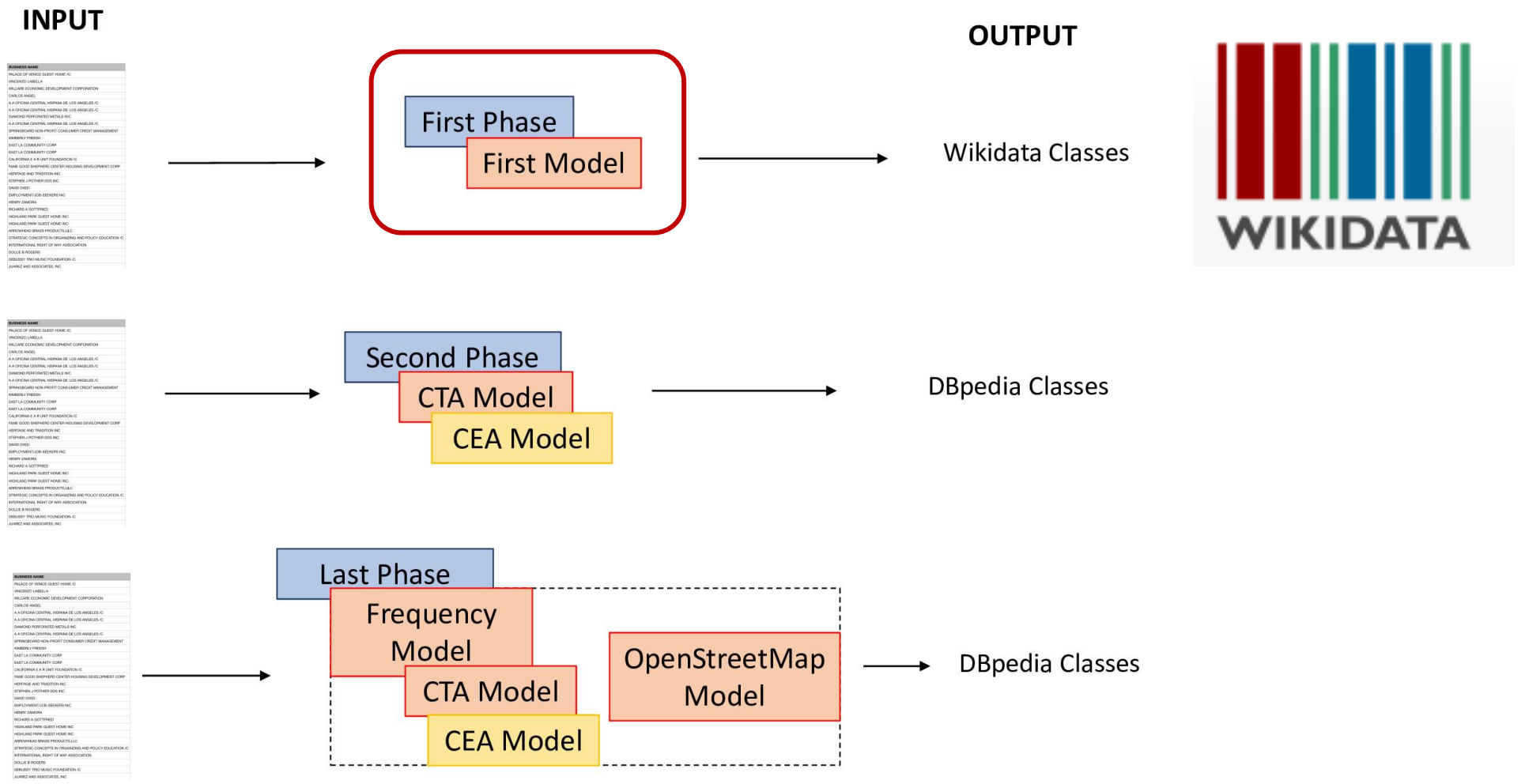
EMPLOYMENT/JOB-SEEKERS INC
HENRY ZAMORA
RICHARD A GOTTFRIED
HIGHLAND PARK GUEST HOME INC
HIGHLAND PARK GUEST HOME INC
ARROWHEAD BRASS PRODUCTS,LLC
STRATEGIC CONCEPTS IN ORGANIZING AND POLICY EDUCATION /C
INTERNATIONAL RIGHT OF WAY ASSOCIATION
DOLLIE B ROGERS
DEBUSSY TRIO MUSIC FOUNDATION /C
JUAREZ AND ASSOCIATES, INC

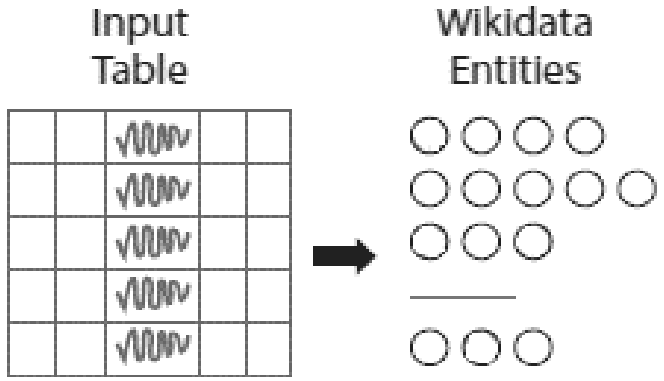
⇨

- Containing all **equal values**
- Including **numbers** for the majority of the rows (i.e. more than 50% of rows are of integer or float type)
- Containing specific **symbols** for the majority of the rows (i.e. more than 50% of rows have symbols)
- Containing **underlined text**
- Including any information related to **time** and **space** (i.e. dates)
- Containing **e-mail** addresses

The Model Development



First Phase: Wikidata Model



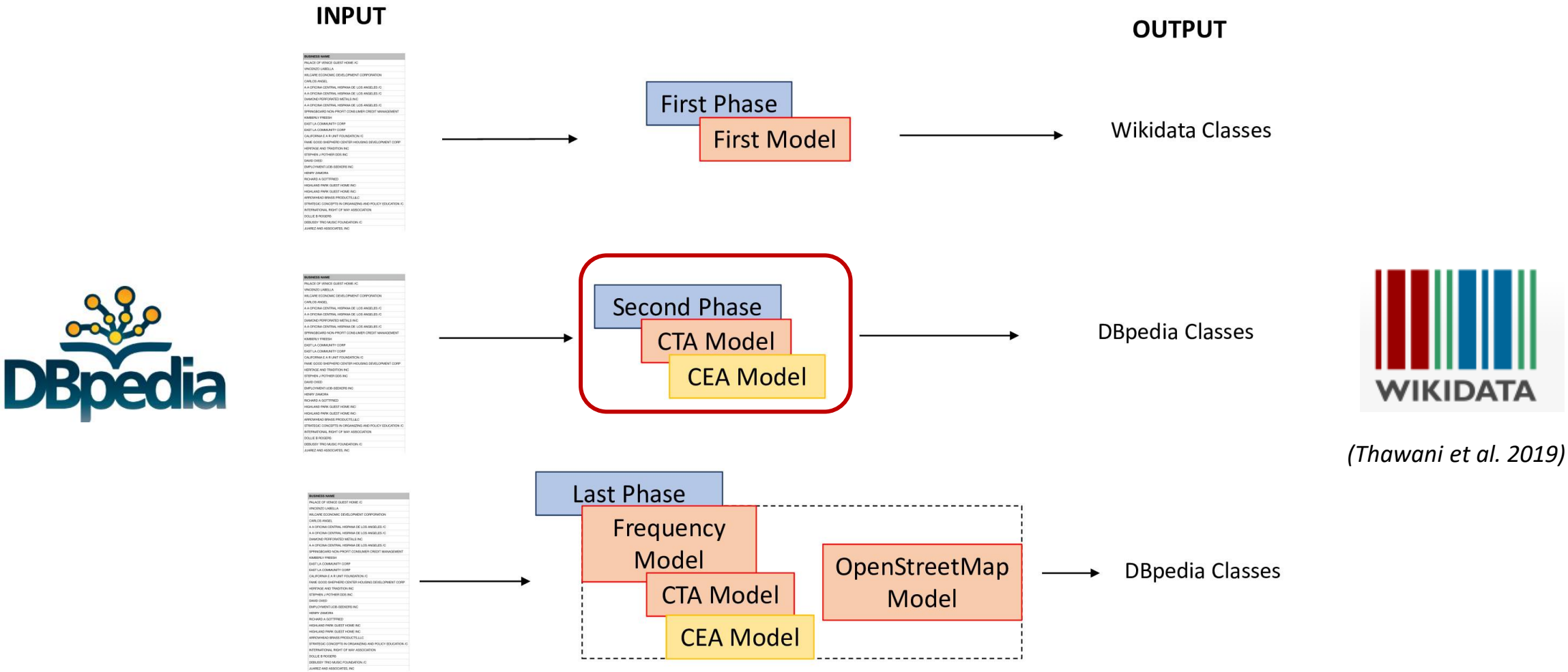
items	Q13220204	Q13360155	Q13410400	Q1496967
Autauga	1.0	1.0	1.0	5.0
Baldwin	2.0	2.0	2.0	3.0
Barbour	2.0	2.0	1.0	2.0
Bibb	2.0	2.0	1.0	2.0
Blount	2.0	2.0	1.0	3.0
Bullock	1.0	1.0	1.0	1.0
Butler	0.0	0.0	0.0	3.0
Calhoun	2.0	2.0	1.0	4.0

RESULTS

- Meaningless classes in Wikidata
- Correctness in the generation of the candidates

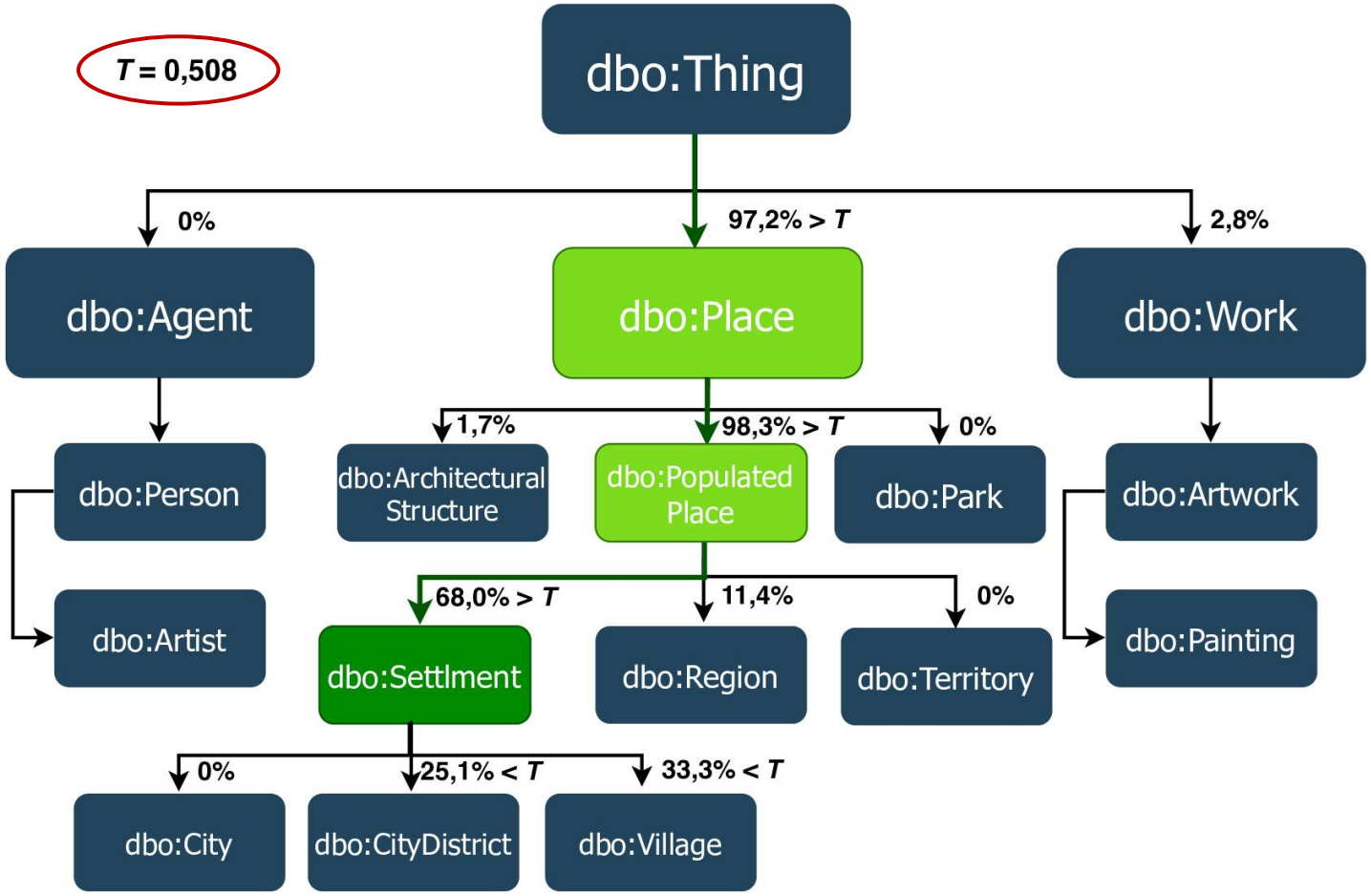
DATASET	OUTPUT	CLASS EXPECTED
Cultural Event	**Interaction**	Event
Department of Recreation	**Publication**	Park
Education Facilities	**Subject**	Educational Institution

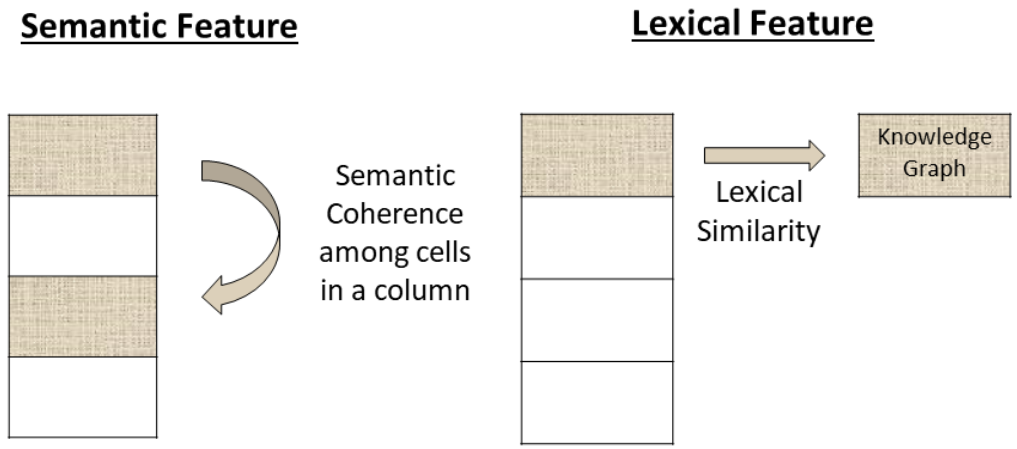
The Model Development



(Thawani et al. 2019)

Second Phase: the Column Type Annotation Model





Four Configurations

- **Levenshtein** Multiplied by **TFIDF**
- Weighted Average between **Levenshtein** and **TFIDF**
- **Jaro-Winkler** Multiplied by **TFIDF**
- Weighted Average between **Jaro-Winkler** and **TFIDF**

(Vembunarayanan, 2013)

Results Evaluation

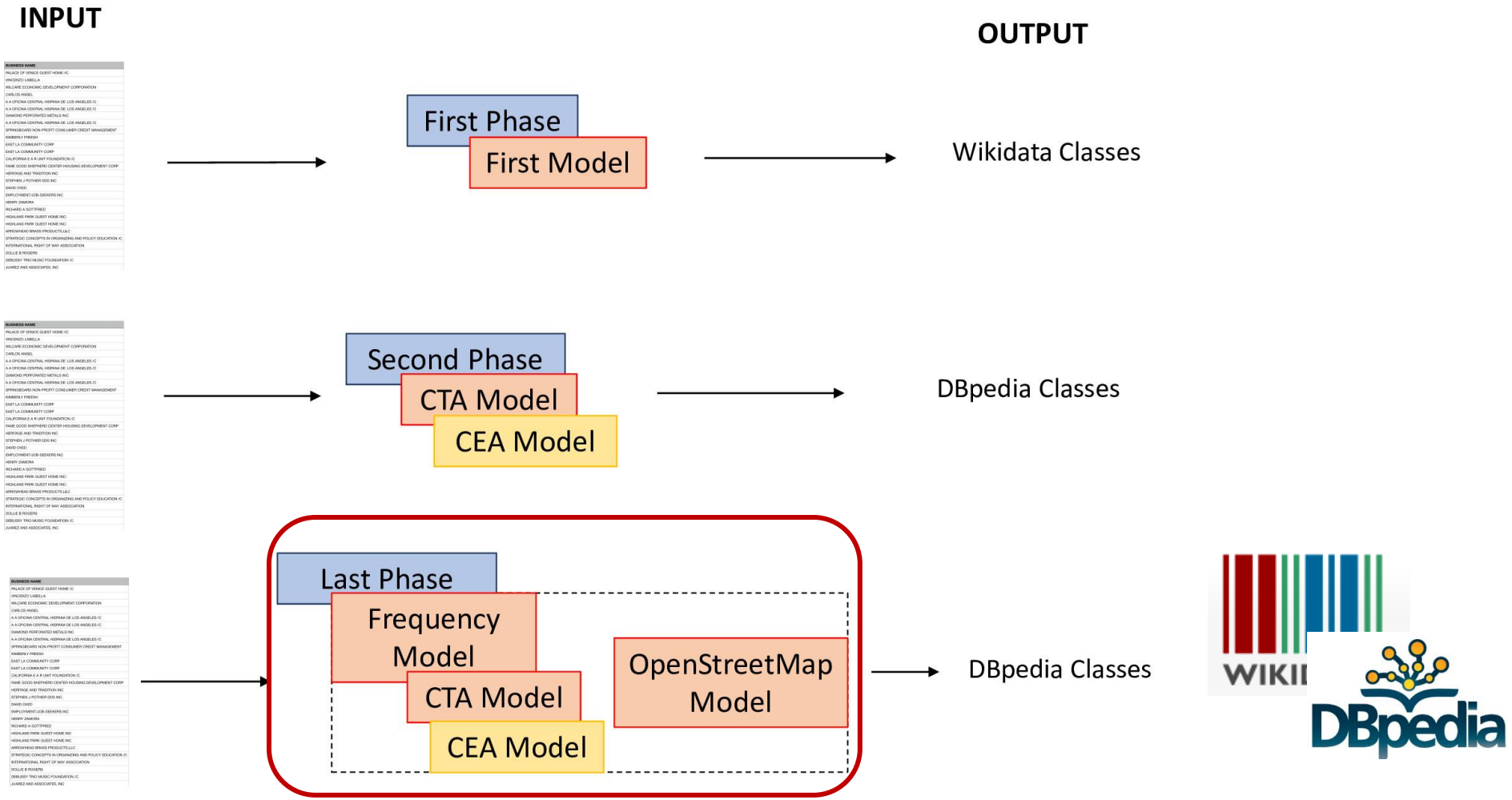
$$Accuracy_{\mathrm{i}} = \frac{n_{\mathrm{i}}}{D}$$

- *n* is the number of correct classes detected by the methodology *i* applied
- *D* is the total number of datasets evaluated (41)

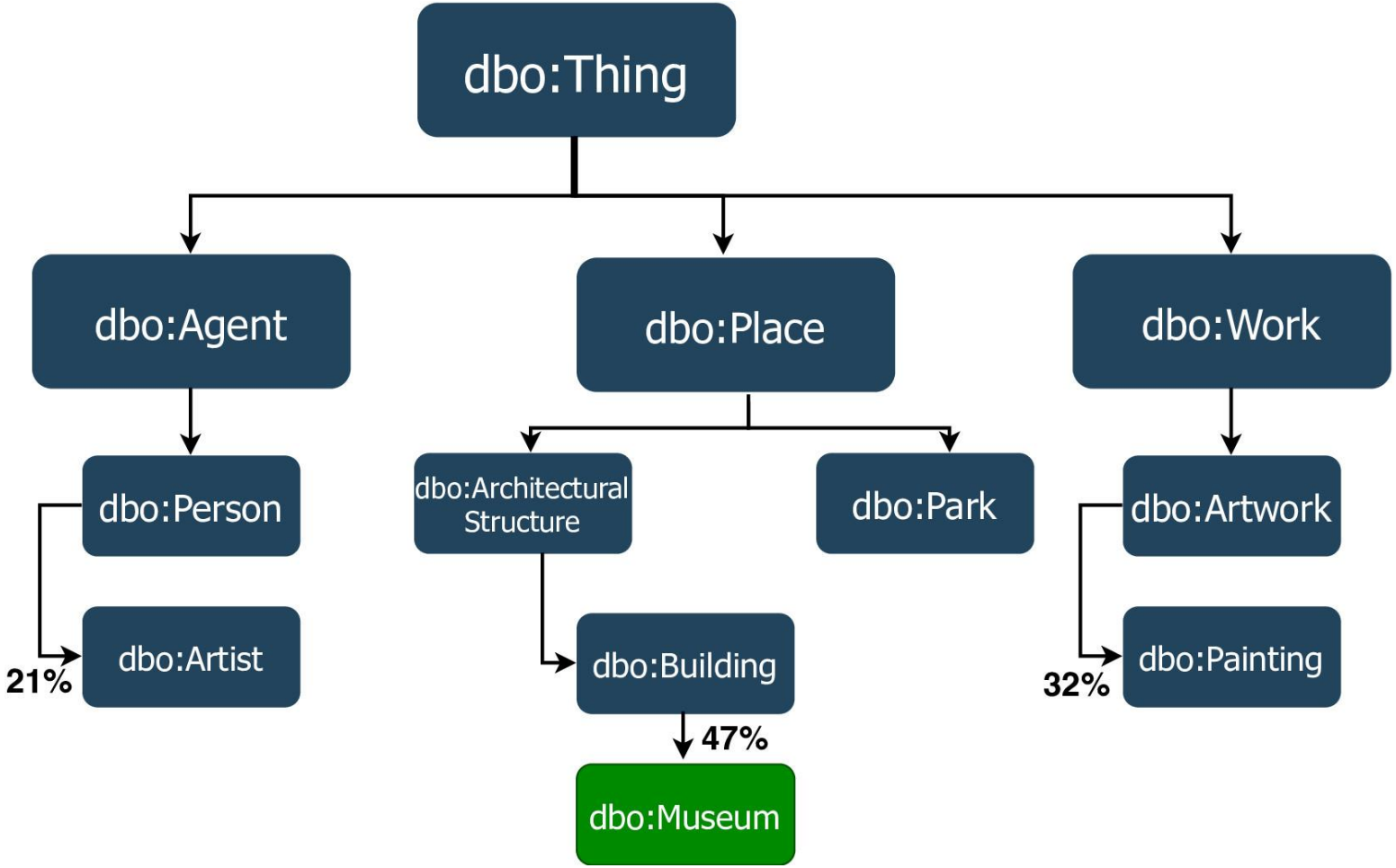
DATASET	OUTPUT	CLASS EXPECTED
Cultural Centers	Venue	Venue
Cultural Events	Museum	Event
Education Facilities	Organisation	Educational Institution

MEASURE	Levenshtein multiplied by the TFIDF
Permissive Accuracy	0,36585
Restrictive Accuracy	0,31707

The Model Development

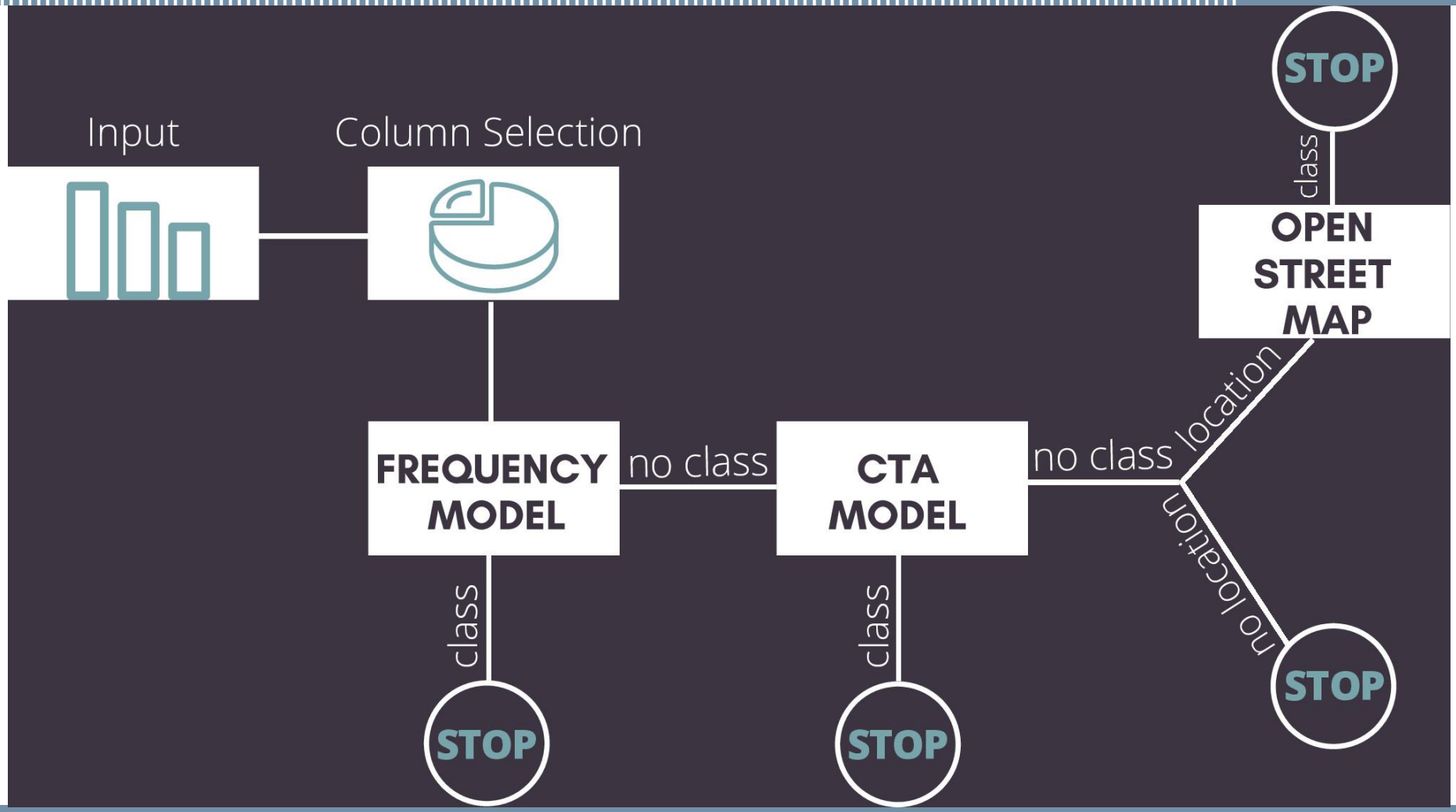


Last Phase: Final Model Development



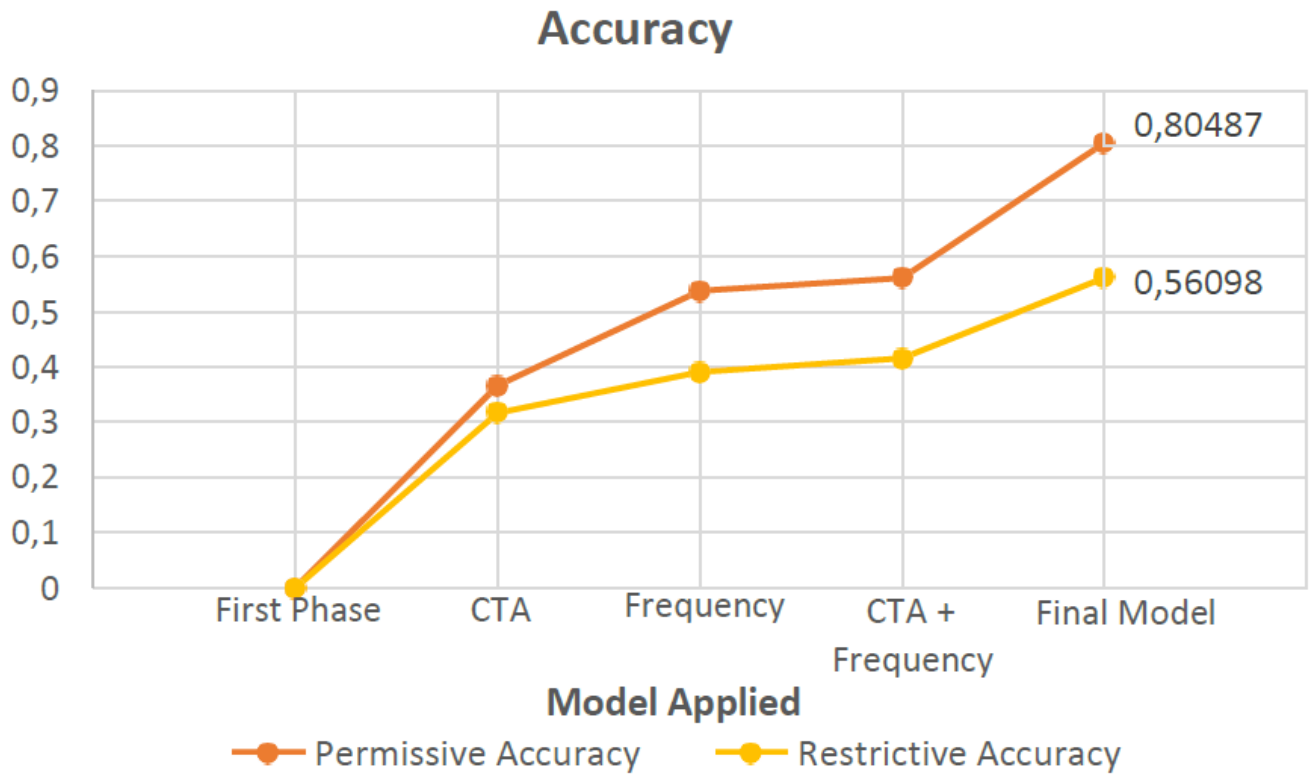
MEASURE	CTA	Frequency
Permissive Accuracy	0,36585	0,53658
Restrictive Accuracy	0,31707	0,39024

Final Model Design



Performance Evaluations

MEASURE	CTA + Frequency	Final Model
Permissive Accuracy	0,56098	**0,80487**
Restrictive Accuracy	0,41463	0,56098



Conclusions

Exploitation of Web ontologies

A good reasoning capacity by integrating different approaches

Seeking for efficiency

Improve candidates' generation phase

(Manning et. al, 2008)

Apply more advanced methodologies for column selection

(Pham et. al, 2016)

Introduce more sophisticated approaches for Frequency model

POLITECNICO
MILANO 1863

Thank you for the attention!

Any Questions?