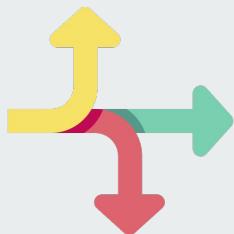




20 December 2021

# Trentino Transportation



Carlo Corradini § Xuanli Li

Knowledge and Data Integration



# Contents

## Introduction

- 1. Inception Phase**
- 2. Informal Modeling Phase**
- 3. Formal Modeling Phase**
- 4. Data Integration**
- Conclusions**





# General Material

The entire **Project Material** is available **publicly** and **freely**:



## GitHub Repository

[https://github.com/carlocorradini/Trentino\\_Transportation](https://github.com/carlocorradini/Trentino_Transportation)



## Google Drive

[https://drive.google.com/drive/folders/12p27lFsmy9Us4AD2lw\\_0fEvI1k7BaIMk](https://drive.google.com/drive/folders/12p27lFsmy9Us4AD2lw_0fEvI1k7BaIMk)



# Who we are ?



Computer  
Science

★ Domain Expert

★ Data Scientist



## Carlo Corradini



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OF TRENTO



## Xuanli Li



Data  
Science

Knowledge Engineer ★

Data Scientist ★





## Domain

"This project aims to comprehensively consider the transportation situations under the specific Trentino region, not only involving the public transportation services but also the sharing vehicle information. Collecting the latest temporal and spatial information then integrating the data and knowledge from diverse sources. Public transportation services, vehicles, bus stations, train stations, railways, public transportation service timelines, trip schedules and fares are the important elements that will be mainly paid attention, besides, the parks of sharing bikes and cars as well as taxi are explored."





## Purpose



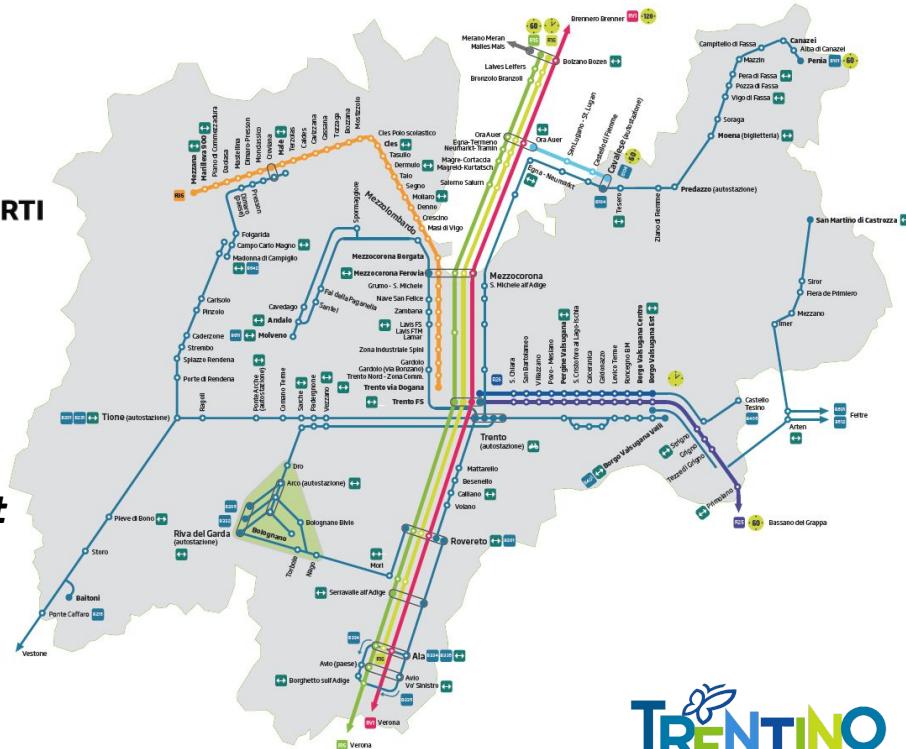
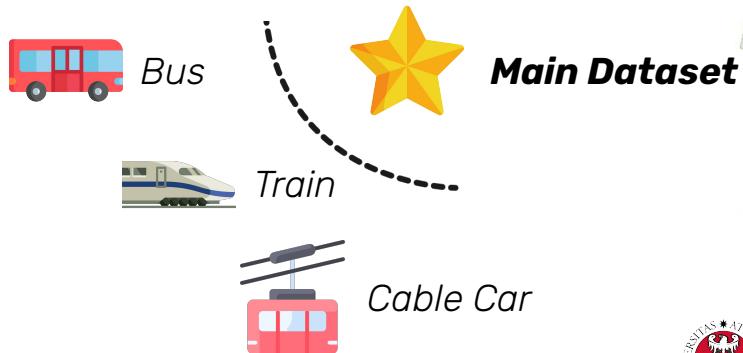
"This project focuses on integrating all the public transportation as well as sharing vehicles information within Trentino so that a more complete transport information system could help people make a better decision and save time or money as much as possible. Specifically, we also pay attention to the application of vehicles that GTFS has not covered, such as sharing bikes, sharing cars, and so on so forth, which is added to the system, and then residents have more choices when determining paths."





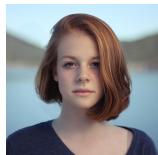
# Overview

Trentino Trasporti  
is the public transport company  
of the Autonomous Province of  
Trento





# Personas



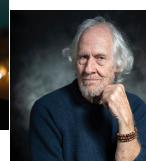
Student



Waitress



Professor



Retired



Also us!



Unemployed



Plumber



Saleswoman



Shop Owner

ID
Name
Surname
Age
Gender
Occupation
Photo
Driving License
Car

## Metadata

Transportation Subscription
Stable Income
Home Address
Working Address
Story

[https://docs.google.com/spreadsheets/d/10PesZf9N8eaJC7oPmifQePTWP9U7N3I\\_lbzdzjimMng/edit?usp=sharing](https://docs.google.com/spreadsheets/d/10PesZf9N8eaJC7oPmifQePTWP9U7N3I_lbzdzjimMng/edit?usp=sharing)



# Scenarios



Raining



Strike



Night



Rush Hour



Accident



Hot Summer



Special Event



Normal Day

## Metadata

- #ID
- Name
- Photo
- Description

In order to fit in better with life, we pick out **8 common and non-common scenarios.**

Under diverse scenarios, people will choose different transportation regarding the conditions.

<https://docs.google.com/spreadsheets/d/1h3cEqzhYnF1psl0shf5KY0F5SfUzx86B9p2HfPDzpw/edit?usp=sharing>



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# Inception Phase





## Reusability & Shareability

1. Choose the open and public knowledge or data resources. 
2. Apply reference schemas or ontologies to integrate our information as much as possible. 
3. Classifying the transportation resources is also indispensable, which helps others to identify and adopt related resources more easily. 
4. The outcomes comply with the principle of reusability and shareability. 





# Competency Questions (CQ)

Based on 10 different persons and 8 scenarios with diverse properties,  
**31 Competency Questions** are put forward.

The whole project research revolves around these questions.

#	Persona	Scenario	Raw Competency Question	Kernel Competency Question	Analysed Competency Question		
					Common Kernel Concepts	Core Kernel Concepts	Contextual Kernel Concepts
1	1	1	I've finished school, at ITT Buonarroti, at 1PM and I want to go to the public library for preparing an exam for tomorrow. Since I've forgotten the subscription card and it's raining outside, which is the best way to arrive to the destination without being too wet?	Person, Establishment, Building, School, Time, Library, Location, Day, Subscription Card, Weather, Raining, Place, Stop, Time Table, Public Transport, Commuter, Date, Cor, Bus, Train, Electric Scooter, Bicycle, Taxi, Vehicle, Cable Car	Person, Establishment, Building, Time, Day, Place, Location, Public Transport, Commuter, Date, Weather, Vehicle, Current Position	Car, Bus, Train, Electric Scooter, Bicycle, Taxi, Cable Car, Stop, Time Table	Library, School, Raining, Subscription Card, Current Position
5	2	3	Today it's my grandmother's birthday and our family come to her home around Verona's avenue. We had a lot of fun with our relatives on this birthday party as it's not easy for us to get together and we don't want to leave. Now it's quite late, but it's not bad because tomorrow it's Sunday. What are all the possible transports available at this hour so we can get home properly and safely?	Person, Group, Family, Home, Establishment, Building, House, Location, Street, Avenue, Transport, Emotion, Fun, Relatives, Birthday, Party, Event, Late, Day, Sunday, Time Table, Time, Night, Date, Cor, Bus, Train, Electric Scooter, Bicycle, Taxi, Cable Car, Safety, Emotion, Comfortable, Stop	Person, Group, Family, Home, Establishment, Building, House, Street, Avenue, Transport, Emotion, Fun, Relatives, Birthday, Party, Event, Day, Time, Date, Late, Safety, Emotion, Comfortable	Time Table, Cor, Bus, Train, Electric Scooter, Bicycle, Taxi, Cable Car, Stop	Location, Night, Sunday
7	3	1	According to my schedule, I have to give a class to my students in the city center at 11:00 am. It rains heavily and I don't have good eyesight when the rains fall on my car windows. Which transport I can take to go the classroom safely and not being late?	Person, Schedule, Class, School, Building, Establishment, Student, Morning, Time, Date, Day, Weather, Raining, Water, Body, Eye, Eyesight, Cor, Window, Driving License, Transportation, Vehicle, Health, Bus, Train, Electric Scooter, Cicycle, Taxi, Cable Car, Stop, Time Table, Schedule, Late, Safe, Location	Person, Schedule, Class, School, Building, Establishment, Student, Time, Date, Day, Weather, Water, Body, Eye, Eyesight, Window, Transportation, Vehicle, Health, Late, Safe	Car, Bus, Train, Electric Scooter, Bicycle, Taxi, Cable Car, Stop, Time Table	Morning, Location, Raining, Driving License

[https://docs.google.com/spreadsheets/d/1N9qLqLU9G7plSmv7zBi0qeNRvPdKCqm343s7qDS\\_WY/edit?usp=sharing](https://docs.google.com/spreadsheets/d/1N9qLqLU9G7plSmv7zBi0qeNRvPdKCqm343s7qDS_WY/edit?usp=sharing)

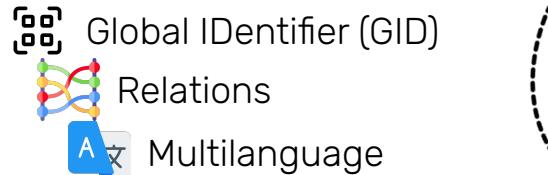




# Resource collection | Linguistic Resources

## Universal Knowledge Core (UKC)

<http://ukc.datascientia.eu>



Global IDentifier (GID)

Relations

Multilanguage

## Schema.org



<https://schema.org>



New concept

New GID

**arrivalTime**  
A Schema.org Property  
Thing > Property :: arrivalTime  
The expected arrival time.

Values expected to be one of these types  
DateTime  
Time

Used on these types  
Trip



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# Resource collection | Knowledge Resources

## General Transit Feed Specification (GTFS)



<https://developers.google.com/transit/gtfs>

**GTFS** defines a common format for public transportation schedules and associated geographic information.

A GTFS feed is composed of a series of text files (CSV) collected in a ZIP file.



## Keyhole Markup Language (KML)



<https://www.ogc.org/standards/kml>

**KML** is a file format used to display geographic data in an Earth browser such as Google Earth.

KML uses a tag-based structure with nested elements and attributes and is based on the XML standard.



# Resource collection | Data Resources

1. Trentino Trasporti  **Main Dataset**
2. Trasporti Pubblici del Trentino
3. Parcheggio Protetto per Biciclette
4. Stazioni Bikesharing Trento
5. C'entro in Bici
6. Car Sharing
7. Taxi



... and don't forget about **Metadata** → [https://drive.google.com/drive/folders/1FIFPKZoBK\\_byPvTwOyEGP-H7ChnjmUv1?usp=sharing](https://drive.google.com/drive/folders/1FIFPKZoBK_byPvTwOyEGP-H7ChnjmUv1?usp=sharing)



<https://www.trentinotrasporti.it/open-data>



<https://dati.trentino.it>



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# Informal Modeling Phase



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# Classified Competency Questions

CQs are pretty specifically and explicitly offers many crucial concepts and relations.

Competency Question	Common Kernel Concepts			Core Kernel Concepts			Contextual Kernel Concepts		
	Object	Function	Action	Object	Function	Action	Object	Function	Action
1	Person, Establishment, Building, Time, Place, Date, Weather, Vehicle, Location	Day, Public Transport, Commuter, Current Position		Stop, Time Table	Car, Bus, Train, Electric Scooter, Bicycle, Taxi, Cable Car			Library, School, Subscription Card	Raining
2	Person, Establishment, Building, Event, Place, Vehicle, Tool, Date, Time, Experience, Location, Unexpected	Public Transport, Private Transport		Stop	Electric Scooter, Electric Scooter Depot, Bus		Application	Protest, Coupon, Delay, Distance, Current Position	
3	Person, Establishment, Building, Time, Place, Date, Tool, Feeling, Sensation, Location	Day, Public Transport, Private Transport, Home, Friend		Time Table	Taxi, Taxi Station		Application, City, Money	Cinema, Safe, Phone Number, Distance, Current Position	
4	Person, Time, Date, Area, Place, Experience, Location	Friend, Day			Bike, Bike Depot, Place			Subscription Card, Distance, Current Position	

<https://docs.google.com/spreadsheets/d/13T-xD4i06TMJ40iW36mcC0Yuox1SobK3FttRxVwETIA/edit?usp=sharing>



# Attributed Competency Questions

The essential **Etype(s)** and their corresponding **Object Properties** and **Data Properties** are developed from CQs and reference ontologies.

The extracted Etypes and the properties lay the foundation for the ER model.

EType	Object Properties	Data Properties
TransportEnum		value
Agency		name email phone url
Location		name latitude longitude
PublicTransportStop	location: Location zone: Location type: [TransportEnum] wheelchair: SupportedEnum	



**20 Etype(s)**

**24 Object Properties**

**39 Data Properties**

<https://docs.google.com/spreadsheets/d/1ds2FexkYWfTJRGfzacoustX16LRh3liratE1fGJ8Sy4/edit?usp=sharing>

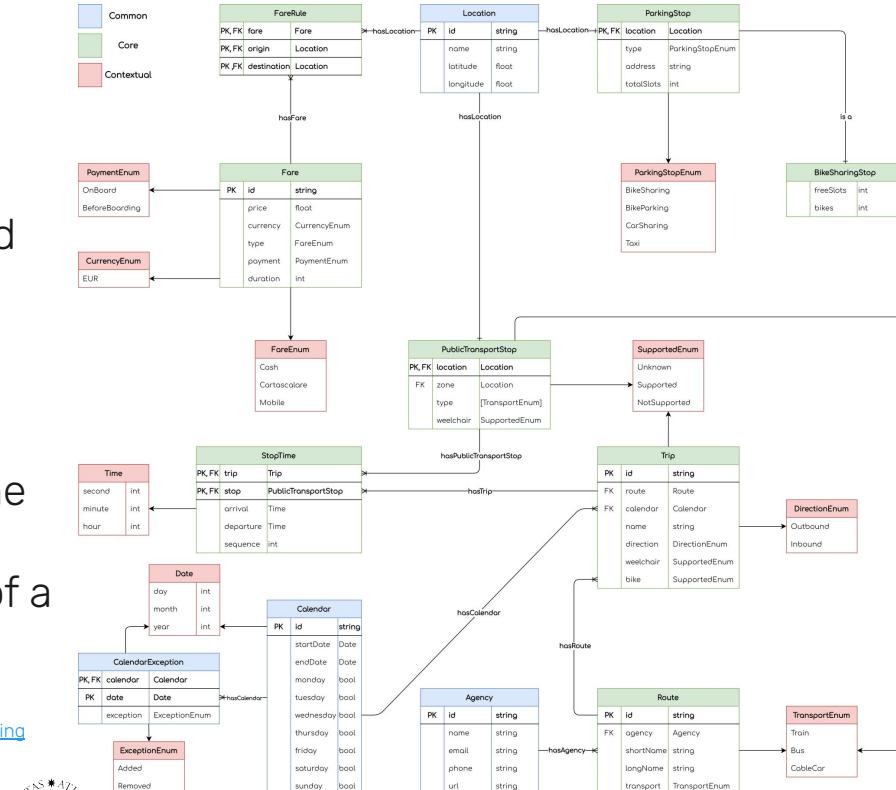




# ER model

**Etype(s), Object Properties, and Data Properties** are assembled into the **ER model**, which is the extensive version of the schema. Clearly shows the **correlations**, functions and actions between the different Etype(s). Moreover, defines the **datatype** of a property.

<https://drive.google.com/drive/folders/1HojudAbhxltGRuYuflofrETte-pL6iEt?usp=sharing>





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# Formal Modeling Phase





# ETG model

## Classes



## Object Properties

## Data Properties





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# Data Integration





# Data Alignment

We extracted all the useful data and conducted alignment according to Etype(s), Properties and Enumerations.

## Input

```
└── data
    ├── bikesharing_lavis.json
    ├── bikesharing_mezzocorona.json
    ├── bikesharing_mezzolombardo.json
    ├── bikesharing_rovereto.json
    ├── bikesharing_sannicchelealladige.json
    └── bikesharing_trento.json
    └── car_sharing.kml
    └── centro_in_bici.kml
    └── extraurban_fare.zip
    └── extraurban.zip
    └── parcheggio_protetto_biciclette.kml
    └── taxi.kml
    └── urban_fare.zip
    └── urban.zip
```



## Alignment Execution

```
PS C:\Users\carlo\Desktop\Carlo\University\knowledge_and_data_integration\kdi> cargo run --release
Finished release [optimized] target(s) in 5.22s
     Running `target\release\kdi.exe`

2021-12-20T14:22:42Z INFO kdi: Removing `./alignment` directory
2021-12-20T14:22:42Z INFO kdi: Creating `./alignment` directory
2021-12-20T14:22:44Z INFO kdi: Reading `./data/extraurban.zip`
2021-12-20T14:22:44Z INFO kdi: Reading `./data/urban.zip`
2021-12-20T14:22:44Z INFO kdi: Reading `./data/extraurban_fare.zip`
2021-12-20T14:22:44Z INFO kdi: Reading `./data/urban_fare.zip`
2021-12-20T14:22:44Z INFO kdi: Reading `./data/car_sharing.kml`
2021-12-20T14:22:44Z INFO kdi: Reading `./data/centro_in_bici.kml`
2021-12-20T14:22:44Z INFO kdi: Reading `./data/parcheggio_protetto_biciclette.kml`
2021-12-20T14:22:44Z INFO kdi: Reading `./data/taxi.kml`
2021-12-20T14:22:44Z INFO kdi: Reading `./data/bikesharing_lavis.json`
2021-12-20T14:22:44Z INFO kdi: Reading `./data/bikesharing_mezzocorona.json`
2021-12-20T14:22:44Z INFO kdi: Reading `./data/bikesharing_mezzolombardo.json`
2021-12-20T14:22:44Z INFO kdi: Reading `./data/bikesharing_rovereto.json`
2021-12-20T14:22:44Z INFO kdi: Reading `./data/bikesharing_sannicchelealladige.json`
2021-12-20T14:22:44Z INFO kdi: Reading `./data/bikesharing_trento.json`
2021-12-20T14:22:44Z INFO kdi: Aligning `Common::Location`
2021-12-20T14:22:44Z DEBUG kdi: Aligning extraurban `Common::Location::Zone`
2021-12-20T14:22:44Z DEBUG kdi: Aligning urban `Common::Location::Zone`
2021-12-20T14:22:44Z DEBUG kdi: Aligning extraurban `Common::Location::PublicTransportStop`
2021-12-20T14:22:44Z DEBUG kdi: Aligning urban `Common::Location::PublicTransportStop`
2021-12-20T14:22:44Z DEBUG kdi: Aligning `Common::Location::CarSharing`
2021-12-20T14:22:44Z DEBUG kdi: Aligning `Common::Location::CentroInBici`
2021-12-20T14:22:44Z DEBUG kdi: Aligning `Common::Location::ParcheggioProtettoBiciclette`
2021-12-20T14:22:44Z DEBUG kdi: Aligning `Common::Location::Taxi`
2021-12-20T14:22:44Z DEBUG kdi: Aligning `Common::Location::Bikesharing`
2021-12-20T14:22:44Z INFO kdi: Writing `locations.json` file
2021-12-20T14:22:44Z INFO kdi: Aligning `Common::CalendarException`
2021-12-20T14:22:44Z DEBUG kdi: Aligning extraurban `Common::CalendarException`
2021-12-20T14:22:44Z DEBUG kdi: Aligning urban `Common::CalendarException`
2021-12-20T14:22:44Z INFO kdi: Writing `calendar_exceptions.json` file
2021-12-20T14:22:44Z INFO kdi: Aligning `Common::Calendar`
2021-12-20T14:22:44Z DEBUG kdi: Aligning extraurban `Common::Calendar`
2021-12-20T14:22:44Z DEBUG kdi: Aligning urban `Common::Calendar`
2021-12-20T14:22:44Z INFO kdi: Writing `calendars.json` file
2021-12-20T14:22:44Z INFO kdi: Aligning `Common::Agency`
2021-12-20T14:22:44Z DEBUG kdi: Writing `agencies.json` file
2021-12-20T14:22:44Z DEBUG kdi: Aligning `Core::FareRule`
2021-12-20T14:22:44Z DEBUG kdi: Aligning extraurban `Core::FareRule`
2021-12-20T14:22:44Z DEBUG kdi: Aligning urban `Core::FareRule`
2021-12-20T14:22:49Z DEBUG kdi: Writing `fare_rules.json` file
2021-12-20T14:22:49Z DEBUG kdi: Writing `fare_rules.json` chunkie file
2021-12-20T14:22:49Z DEBUG kdi: Writing `fare_rules_0.json` file
2021-12-20T14:22:49Z DEBUG kdi: Writing `fare_rules_1.json` file
2021-12-20T14:22:49Z DEBUG kdi: Writing `fare_rules_2.json` file
2021-12-20T14:22:49Z DEBUG kdi: Writing `fare_rules_3.json` file
2021-12-20T14:22:49Z DEBUG kdi: Writing `fare_rules_4.json` file
2021-12-20T14:22:49Z DEBUG kdi: Writing `fare_rules_5.json` file
```



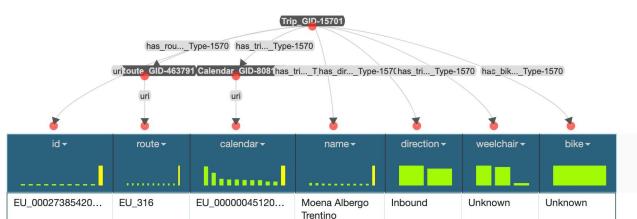
## Output

```
└── alignment
    ├── agencies.json
    ├── bike_sharing_stops.json
    ├── calendar_exceptions.json
    ├── calendars.json
    ├── currency_enum.json
    ├── direction_enum.json
    ├── exception_enum.json
    ├── fare_enum.json
    ├── fare_rules_0.json
    ├── fare_rules_1.json
    ├── fare_rules_2.json
    ├── fare_rules_3.json
    ├── fare_rules_4.json
    ├── fare_rules_5.json
    ├── fare_rules_6.json
    ├── fare_rules_7.json
    ├── fare_rules_8.json
    ├── fare_rules_9.json
    ├── fares.json
    ├── locations.json
    ├── parking_stop_enum.json
    ├── parking_stops.json
    ├── payment_enum.json
    ├── public_transport_stops.json
    ├── routes.json
    ├── stop_times.json
    ├── supported_enum.json
    ├── transport_enum.json
    └── trips.json
```

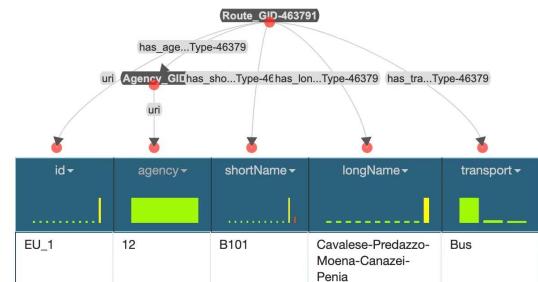


# Data integration ~ Karmalinker

**Kamarlinker** allows us to well match the **Datasets** to the predefined annotated **Ontology**.  
This is the final step to create the **Trentino Transportation Knowledge Graph** (TTEG).



Public..._GID-465711					
uri	Named..._It Named..._ID-29	has_pub..._Type-46571	has_zon..._Type-46571	uri	uri
id	location	zone	type	wheelchair	wheelchair
EU_1	EU_1	ZONE_EU_0001	Bus	Unknown	
EU_10	EU_10	ZONE_EU_1060	Bus	Unknown	
EU_100	EU_100	ZONE_EU_1078	Bus	Unknown	
EU_1000	EU_1000	ZONE_EU_4570	Bus	Unknown	
EU_1001	EU_1001	ZONE_EU_4570	Bus	Unknown	
EU_1002	EU_1002	ZONE_EU_4570	Bus	Unknown	
EU_1003	EU_1003	ZONE_EU_4100	Bus	Unknown	
EU_1004	EU_1004	ZONE_EU_4100	Bus	Unknown	
EU_1005	EU_1005	ZONE_EU_4200	Bus	Unknown	
EU_1006	EU_1006	ZONE_EU_4250	Bus	Unknown	
EU_1007	EU_1007	ZONE_EU_4250	Bus	Unknown	
EU_1008	EU_1008	ZONE_EU_4260	Bus	Unknown	



<https://usc-isi-i2.github.io/home>



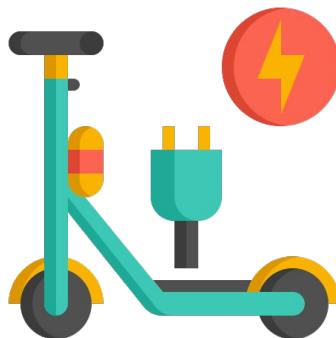
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# Conclusions





## Open Issues



Electric Scooter

**BIT**

**WIND**



Train | Trenitalia



<https://www.comune.trento.it/Aree-tematiche/Ambiente-e-territorio/Mobilita-e-traffico-urbano/Servizi/Monopattini-elettrici-condivisi>



Enumerated type

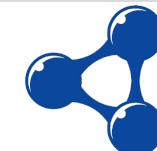
Enumerator names are usually identifiers that behave as constants



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SPARQL

Enhance SPARQL queries & graph visualization

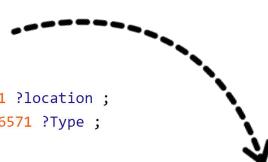




# Hands on | SPARQL Query 1

```
1 PREFIX iri: <http://knowdive.disi.unitn.it/etype#>
2
3 SELECT ?departure
4 {
5   ?stopTime a iri:Stop_time_GID-34825 ;
6     iri:has_trip_GID-1570_Type-34825 ?trip ;
7     iri:has_stop_GID-46571_Type-34825 ?stop ;
8     iri:has_departure_GID-300017_Type-34825 ?departure ;
9     iri:has_sequence_GID-27840_Type-34825 ?sequence ;
10    FILTER (?sequence = 1)
11
12  ?stop iri:has_public_transport_stop_location_GID-779_Type-46571 ?location ;
13    iri:has_public_transport_stop_type_GID-300012_Type-46571 ?Type ;
14    FILTER REGEX (?Type, "Bus")
15
16  ?location iri:has_location_name_GID-2_Type-300007 ?lName ;
17    FILTER (?lName = "Piazza Dante \\"Stazione Fs\\"")
18
19  ?trip iri:has_route_GID-22592_Type-1570 ?route .
20
21  ?route iri:has_short_name_GID-1842_Type-46379 ?shortName ;
22    FILTER (?shortName = "5/")
23 }
24 ORDER BY ASC (?departure)
25 LIMIT 1
```

*"Return the first available departure time of Bus 5/ from the stop Piazza Dante"*



departure	
1	"0000-01-01T07:54:00"^^xsd:dateTime





# Hands on | SPARQL Query 2



```

1 PREFIX iri: <http://knowdive.disi.unitn.it/etype#>
2
3 SELECT ?type ?price ?currency ?duration
4 {
5     ?fareRule a iri:Fare_rule_GID-300014 ;
6         iri:has_fare_GID-70599_Type-300014 ?fare ;
7         iri:has_origin_GID-45883_Type-300014 ?origin ;
8         iri:has_destination_GID-46122_Type-300014 ?destination .
9
10    ?origin iri:has_location_name_GID-2_Type-300007 ?oName ;
11        FILTER (?oName = "Trento")
12
13    ?destination iri:has_location_name_GID-2_Type-300007 ?dName ;
14        FILTER (?dName = "Padernone")
15
16    ?fare iri:has_fare_type_GID-300015_Type-70599 ?type ;
17        iri:has_price_GID-70571_Type-70599 ?price ;
18        iri:has_currency_GID-71038_Type-70599 ?currency ;
19        iri:has_duration_GID-80582_Type-70599 ?duration .
20
21 ORDER BY ASC (?price) DESC(?duration)

```

*"Return all the available cost for the trip from Trento to Padernone and sort for the most cheaper (and ticket duration)."*

	type	price	currency	duration
1	"Mobile"	"1.8"^^xsd:float	"EUR"	"21600"^^xsd:int
2	"Cartascalare"	"2.0"^^xsd:float	"EUR"	"21600"^^xsd:int
3	"Cash"	"2.0"^^xsd:float	"EUR"	"21600"^^xsd:int



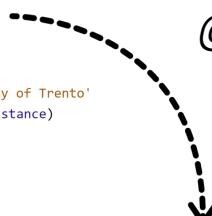


## Hands on | SPARQL Query 3



```
1 PREFIX iri: <http://knowdive.disi.unitn.it/etype#>
2 PREFIX omgeo: <http://www.ontotext.com/owlim/geo#>
3
4 SELECT ?name ?latitude ?longitude ?distance
5 {
6   ?stop a iri:Public_transport_stop_GID-46571 ;
7     iri:has_public_transport_stop_location_GID-779_Type-46571 ?location ;
8     iri:has_public_transport_stop_type_GID-300012_Type-46571 ?type ;
9     FILTER REGEX (?type, "Train")
10
11   ?location iri:has_latitude_GID-46263_Type-132 ?latitude ;
12     iri:has_longitude_GID-46270_Type-132 ?longitude ;
13     iri:has_location_name_GID-2_Type-300007 ?name ;
14     # Calculate distance from
15     # 'Department of Information Engineering and Computer Science @ University of Trento'
16     BIND (omgeo:distance(46.0677084, 11.1500311, ?latitude, ?longitude) AS ?distance)
17     # Maximum allowed distance in Km
18     FILTER (?distance < 1)
19 }
20 ORDER BY ASC (?distance)
```

*"Return the nearest train stop from the "Department of Information Engineering and Computer Science @ University of Trento" within a range of 1 Km"*



	name	latitude	longitude	distance
1	"Povo-Mesiano"	"46.06612"^^xsd:float	"11.142769"^^xsd:float	"0.5874043474184484"^^xsd:float



# Hands on | SPARQL Query 4



```
1 PREFIX iri: <http://knowdive.disi.unitn.it/etype#>
2 PREFIX omgeo: <http://www.ontotext.com/owlim/geo#>
3
4 SELECT ?name ?latitude ?longitude ?distance ?address ?totalSlots ?freeSlots ?bikes
5 {
6     # Combine generic & specialized 'BikeSharing'
7     { ?stop a iri:Parking_stop_GID-73254 }
8     UNION
9     { ?stop a iri:Bike_sharing_stop_GID-300008 }
10
11    ?stop iri:has_parking_stop_location_GID-779_Type-73254 ?location ;
12        iri:has_address_GID-45803_Type-73254 ?address ;
13        iri:has_total_slots_GID-300010_Type-73254 ?totalSlots ;
14        iri:has_parking_stop_type_GID-300005_Type-73254 ?type ;
15        FILTER (?type = "BikeSharing")
16
17    OPTIONAL {
18        # Specialized 'BikeSharing' predicates
19        ?stop iri:has_free_slots_GID-300001_Type-300008 ?freeSlots ;
20            iri:has_bikes_GID-300018_Type-300008 ?bikes ;
21            # Stop with at least one bike available
22            FILTER (?bikes > 0)
23    }
24
25    ?location iri:has_location_name_GID-2_Type-300007 ?name ;
26        iri:has_latitude_GID-46263_Type-132 ?latitude ;
27        iri:has_longitude_GID-46270_Type-132 ?longitude ;
28        # Calculate distance from
29        # 'Piazza Duomo @ Trento'
30        BIND (omgeo:distance(46.0671931, 11.1212042, ?latitude, ?longitude) AS ?distance)
31        # Maximum allowed distance in Km
32        FILTER (?distance < 5)
33    }
34 ORDER BY ASC (?distance) DESC (?bikes)
```

*Return all generic and specialized bike sharing stops within 5 Km from "Piazza Duomo @ Trento" and sort them by distance. For specialized only obtain also free slots and bikes.*



	name	latitude	longitude	distance	address	totalSlots	freeSlots	bikes
1	"10.06 Stazione Auto corrifer"	"46.0702355381064 1° 47' 10.2355381064"	"11.1198494306884 24° 11.98494306884"	"0.354269112999388 74° 10.354269112999388"	"Via Pozzo / Via Torre Vanga"	"20"^^xsd:int	"17"^^xsd:int	"3"^^xsd:int
2	"10.07 Biblioteca"	"46.0704339591025 4° 42.0704339591025"	"11.12139984232794 65° 12.139984232794"	"0.36086405775084 55° 36.086405775084"	"Via Alfieri / Via Torre Vanga"	"22"^^xsd:int	"18"^^xsd:int	"4"^^xsd:int
3	"PIAZZA DANTE: via Torre Vanga - stazione autocorriere"	"46.0703781641567 4° 42.0703781641567"	"11.119819738161901 24° 11.9819738161901"	"0.369945780414200 72° 36.9945780414200"	"PIAZZA DANTE: via Torre Vanga - stazione autocorriere"	"8"^^xsd:int		





# Hands on | SPARQL Query 5



```
1 PREFIX iri: <http://knowdive.disi.unitn.it/etype#>
2 PREFIX omeo: <http://www.ontotext.com/owlim/geo#>
3
4 SELECT ?stopName ?latitude ?longitude ?departure ?distance
5 {
6   ?stopTime a iri:Stop_time_GID-34825 ;
7     iri:has_trip_GID-1570_Type-34825 ?trip ;
8     iri:has_departure_GID-300017_Type-34825 ?departure ;
9     iri:has_stop_GID-46571_Type-34825 ?stop ;
10    # 'Departure' must be after (inclusive) '11:30:00'
11    FILTER (STR(?departure) >= "0000-01-01T11:30:00")
12
13 ?trip iri:has_route_GID-22592_Type-1570 ?route ;
14   iri:has_trip_calendar_GID-80813_Type-1570 ?calendar ;
15   iri:has_trip_wheelchair_GID-300011_Type-1570 ?tripWheelchair ;
16   iri:has_direction_GID-73593_Type-1570 ?direction ;
17   # 'Wheelchair' boarding & 'inbound' direction
18   FILTER (?tripWheelchair = "Supported" && ?direction = "Inbound")
19
20 ?stop iri:has_public_transport_stop_wheelchair_GID-300012_Type-46571 ?stopWheelchair ;
21   iri:has_public_transport_stop ?location_GID-779_Type-46571 ?location ;
22   # 'Wheelchair' accessible
23   FILTER (?stopWheelchair = "Supported")
24
25 ?location iri:has_latitude_GID-46263_Type-132 ?latitude ;
26   iri:has_longitude_GID-46270_Type-132 ?longitude ;
27   iri:has_location_name_GID-2_Type-300007 ?stopName ;
28   # Calculate distance from
29   # 'Department of Information Engineering and Computer Science @ University of Trento'
30   BIND (omeo:distance(46.0677084, 11.1500311, ?latitude, ?longitude) AS ?distance)
31   # Maximum allowed distance in Km
32   FILTER (?distance < 0.5)
33
34 ?route iri:has_short_name_GID-1842_Type-46379 ?shortName ;
35   iri:has_transport_GID-16756_Type-46379 ?transport ;
36   # 'Bus' number '5'
37   FILTER (?shortName = "5" && ?transport = "Bus")
38
39 ?calendar iri:has_wednesday_GID-80760_Type-80813 ?wednesday ;
40   iri:has_start_date_GID-300002_Type-80813 ?startDate ;
41   iri:has_end_date_GID-300004_Type-80813 ?endDate ;
42   # Supported date '2021-12-15' on a 'wednesday' day
43   FILTER (
44     ?wednesday
45       && ?startDate <= "2021-12-15T00:00:00"^^xsd:dateTime
46       && ?endDate >= "2021-12-15T00:00:00"^^xsd:dateTime
47   )
48
49 ORDER BY ASC (?departure) ASC (?distance)
```

	stopName	latitude	longitude	departure	distance
1	"Povo Fac. Scienze"	"46.063316"	"11.150206"	"0000-01-01T11:44:00"	"0.48841103677195546"
2	"Povo Valoni"	"46.065747"	"11.1465323"	"0000-01-01T11:45:00"	"0.35967491808089724"
3	"Povo Fac. Scienze"	"46.063316"	"11.150206"	"0000-01-01T12:04:00"	"0.48841103677195546"
4	"Povo Valoni"	"46.065747"	"11.1465323"	"0000-01-01T12:05:00"	"0.35967491808089724"
5	"Povo Fac. Scienze"	"46.063316"	"11.150206"	"0000-01-01T12:24:00"	"0.48841103677195546"
6	"Povo Valoni"	"46.065747"	"11.1465323"	"0000-01-01T12:25:00"	"0.35967491808089724"
7	"Povo Valoni"	"46.065747"	"11.1465323"	"0000-01-01T12:34:00"	"0.35967491808089724"
8	"Povo Fac. Scienze"	"46.063316"	"11.150206"	"0000-01-01T12:44:00"	"0.48841103677195546"





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# Thanks for the attention!



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