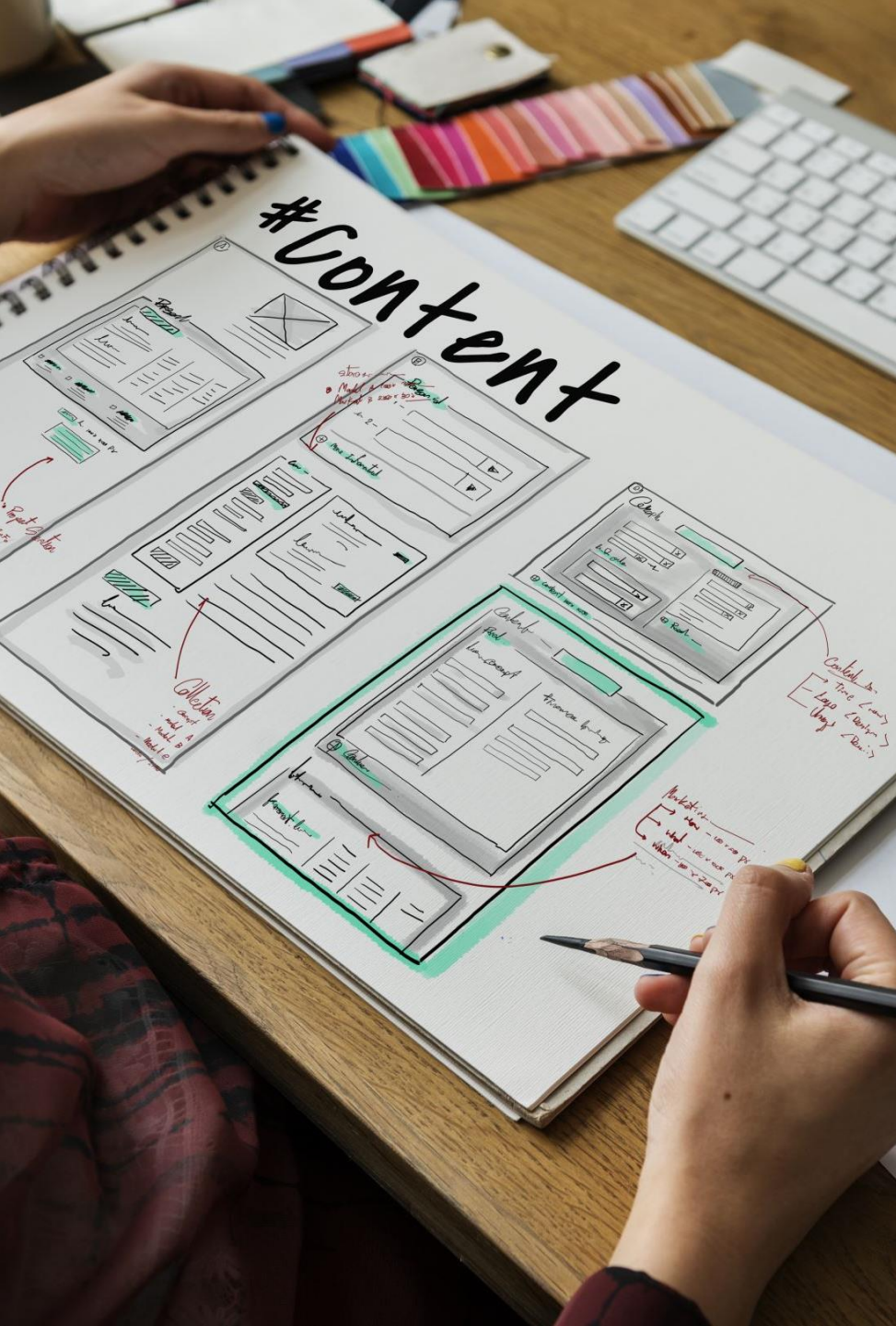


KNOWLEDGE AND DATA INTEGRATION: FOOD AND ACCOMMODATION

Byambakhishig Ganbold

Mithat Sinan Ergen



OUTLINE

- Project purpose
- Scenario and Personas
- Sources
- Inception phase
- Informal Model
- Formal Model
- Evaluation
- Data Integration
- Queries



PROJECT PURPOSE

- Provide users with information regarding food and accommodation in the Trentino region
- Users will be able to plan their vacations according to this information
- The accommodation information includes hotels, apartments, private rooms and camping with detailed information about price, facilities offered, number of stars, type of rooms in the Trentino region.
- The food information includes restaurants, bars, pizzerias, ice-cream shops and their detailed information such as phone number, email and website.

SCENARIO AND PERSONAS

- 8 personas of different ages and background
- Various scenarios such as:
 - sport festival
 - summer vacation
 - winter vacation
 - visit in the weekend.





SOURCES

- **Data Sources:**

- Open Data Trentino: open data source providing data for the Trentino region
- Inside Airbnb: independent, non-commercial set of tools to explore Airbnb data
- Open Street Map: a free collaborative project providing data of the world map



- **Knowledge Source:**

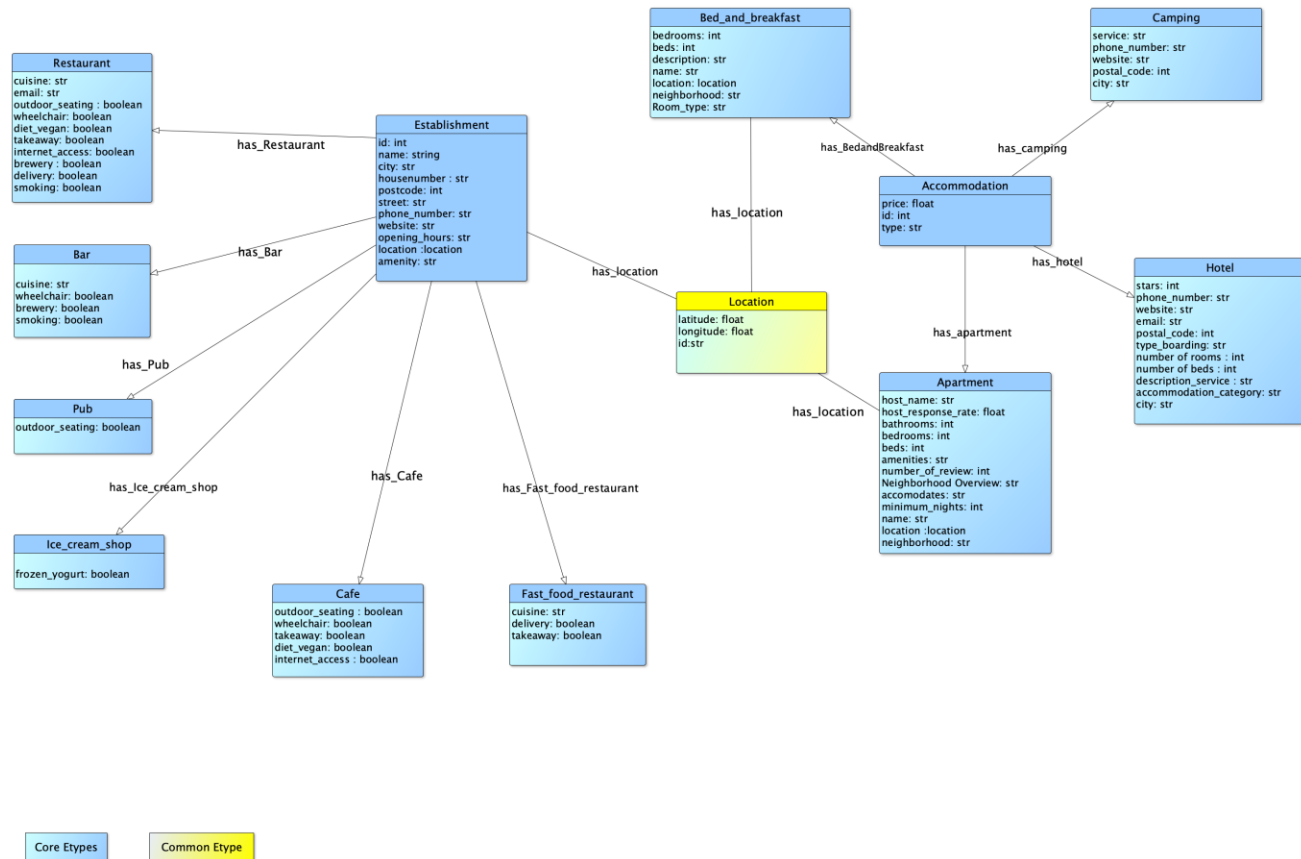
- Schema.org



INCEPTION PHASE

- Around 7-8 competency questions(CQ) per persona
- Common, core, contextual kernel concepts are decided
- **Location** as common kernel concept
- **Hotel, Restaurant, Apartment, Bar** as examples of core kernel concepts
- **Amenities, outdoor seating, internet access** as contextual kernel concepts

INFORMAL MODEL



- Common, core, contextual kernel concepts defined at e-type level
- ER Model is formed using yED tool
- Establishment and Accommodation as main e-types
- Location defined as common e-type



FORMAL MODEL

• ETG model

Classes

Active ontology x Entities x Classes x Individuals by class x OWLViz x

Annotation properties Datatypes Individuals
Classes Object properties Data properties

Class hierarchy: xsd:long (xsd:long) [?] [I] [E] [O] [X]

Asserted [v]

- owl:Thing
 - ComplexType
 - Entity_GID-1
 - Accommodation_GID-14254
 - Apartment_GID-14548
 - Bed_and_breakfast_GID-22651
 - Camping_GID-5440
 - Hotel_GID-19355
 - Action_kind_GID-120018
 - Context_GID-120016
 - Establishment_GID-43815
 - Bar_GID-14950
 - Cafe_GID-15804
 - Fast_food_restaurant_GID-40661
 - Ice_cream_shop_GID-41019
 - Pub_GID-22135
 - Restaurant_GID-22500
 - Function_kind_GID-120019
 - Location_GID-779
 - Real_kind_GID-120017
 - Itelos_complextype_GID-200002
 - Itelos_concept_GID-200014
 - Itelos_identifyingset_GID-200012
 - NLString
 - SemanticString
 - IdentifyingSet
 - xsd:long (xsd:long)

Object properties

Active ontology x Entities x Classes x Individuals by class x OWLViz x

Annotation properties Datatypes Individuals
Classes Object properties Data properties

Object property hierarchy: [?] [I] [E] [O] [X]

Asserted [v]

- owl:topObjectProperty
 - GID
 - hasIdentifyingSet
 - hasIdProperty
 - relationalAttribute
 - has_apartment_GID-14548_Type-14254
 - has_bar_GID-14950_Type-43815
 - has_bed_and_breakfast_GID-22651_Type-14254
 - has_beginning_GID-81324_Type-1
 - has_beginning_GID-81324_Type-200008
 - has_birthday_GID-81257_Type-118
 - has_birthplace_GID-45896_Type-118
 - has_birthplace_GID-45897_Type-45663
 - has_cafe_GID-15804_Type-43815
 - has_camping_GID-5440_Type-14254
 - has_contributor_GID-53267_Type-16921
 - has_creator_GID-51275_Type-16921
 - has_creator_GID-51275_Type-34892
 - has_date_of_death_GID-118224_Type-118
 - has_date_of_publication_GID-117691_Type-34892
 - has_description_GID-3_Type-1
 - has_description_GID-3_Type-200008
 - has_duration_GID-80582_Type-1
 - has_duration_GID-80582_Type-200008
 - has_end_GID-81330_Type-1
 - has_end_GID-81330_Type-200008
 - has_fast_food_GID-118172_Type-43815
 - has_first_name_GID-34006_Type-117693
 - has_has_itelos_actionfunction_GID-200020_Type-200003
 - has_has_itelos_actionobject_GID-200021_Type-200003
 - has_has_itelos_functionaction_GID-200022_Type-200004
 - has_has_itelos_functionobject_GID-200023_Type-200004

Data properties

Active ontology x Entities x Classes x Individuals by class x OWLViz x

Annotation properties Datatypes Individuals
Classes Object properties Data properties














Data property hierarchy: [?] [I] [E] [O] [X]

Asserted [v]

- owl:topDataProperty
 - datatypeAttribute
 - has_accommodation_category_GID-31828_Type-19355
 - has_accommodates_GID-300004_Type-14548
 - has_amenities_GID-26466_Type-14548
 - has_amenity_GID-2973_Type-43815
 - has_bathrooms_GID-24688_Type-14548
 - has_bed_GID-15089_Type-22651
 - has_bed_type_GID-15089_Type-14548
 - has_bedroom_GID-15104_Type-22651
 - has_bedrooms_GID-15104_Type-14548
 - has_beds_GID-15089_Type-14548
 - has_brewery_GID-15566_Type-14950
 - has_brewery_GID-15566_Type-22500
 - has_city_camping_GID-44481_Type-5440
 - has_City_GID-45969_Type-19355
 - has_city_GID-45969_Type-43815
 - has_cuisine_GID-40654_Type-22500
 - has_delivery_GID-1622_Type-22500
 - has_Delivery_GID-1622_Type-40661
 - has_description_GID-3_Type-22651
 - has_description_service_GID-3_Type-19355
 - has_diet_Vegan_GID-300002_Type-15804
 - has_diet_vegan_GID-300002_Type-22500
 - has_Email_GID-33745_Type-19355
 - has_email_GID-33745_Type-22500
 - has_frozen_yogurt_GID-41030_Type-41019
 - has_host_name_GID-2_Type-14548
 - has_host_response_rate_GID-300000_Type-14548
 - has_housenumber_GID-34489_Type-43815
 - has_id_apartment_GID-34489_Type-14548
 - has_id_bar_GID-34489_Type-14950
 - has_id_bed_and_breakfast_GID-34489_Type-22651
 - has_id_cafe_GID-34489_Type-15804
 - has_id_camping_GID-34489_Type-5440

DATA MANAGEMENT

- Clear data
- Translate Italian to English
- Convert *json* file

	Accommodation.json
	apartment.json
	bar.json
	bed_and_breakfast.json
	cafe.json
	camping.json
	Establishment.json
	fast_food.json
	hotel.json
	Ice_cream_shop.json
	location.json
	pub.json
	restaurant.json

EVALUATION

- Schema level

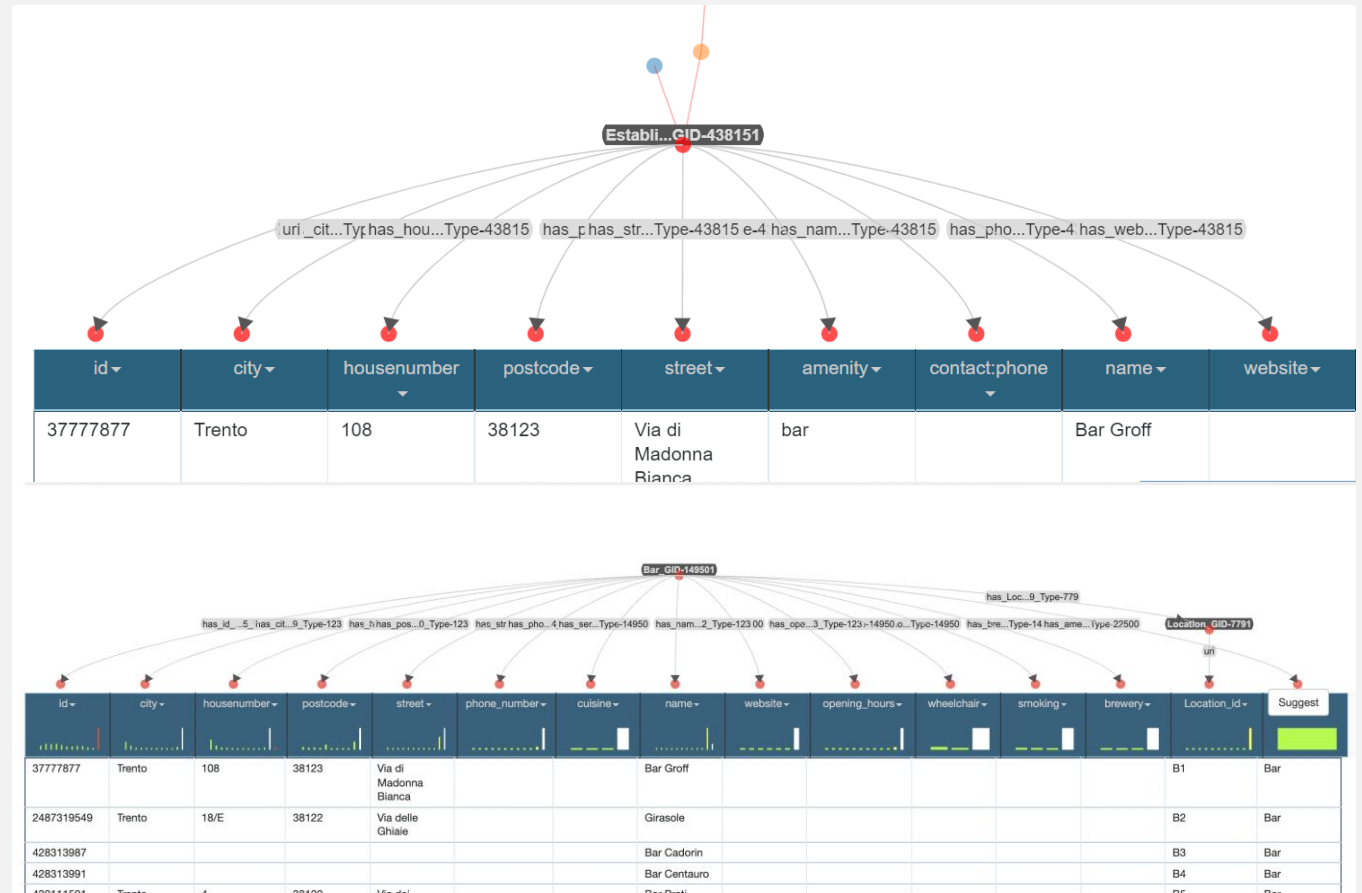
	Inception	Informal Modeling	Formal Modeling
E-type coverage	0.47	0.9	0.76
Property coverage	0.62	0.98	0.57
E-type extensiveness	0.56	0.16	0.54
Property extensiveness	0.74	0.34	0.62
E-type sparsity			0.58
Property sparsity			0.85

- Data level

	Inception	Informal Modeling
E-type coverage	0.9	0.5
Property coverage	0.98	0.3
E-type sparsity	0.45	0.23
Property sparsity	0.76	0.65

DATA INTEGRATION ~ KARMALINKER

- **Kamarlinker** allows us to well match the Datasets to the predefined annotated Ontology.
- The final step to create the **Food and Accommodation** knowledge graph





SPARQL QUERY I

```
PREFIX iri: <http://knowdive.disi.unitn.it/etype#>
PREFIX omgeo: <http://www.ontotext.com/owlim/geo#>
select ?name ?amenity ?housetnumber ?street ?postcode ?city ?latitude ?longitude

{
  { ?Establishment a iri:Establishment_GID-43815}
  UNION
  {?Establishment a iri:Bar_GID-14950}
    ?Establishment iri:has_Location_GID-779_Type-779 ?Location;
      iri:has_name_GID-2_Type-43815 ?name;
      iri:has_amenity_GID-2973_Type-43815 ?amenity;
      iri:has_housetnumber_GID-34489_Type-43815 ?housetnumber;
      iri:has_street_GID-24034_Type-43815 ?street;
      iri:has_postcode_GID-34110_Type-43815 ?postcode;
      iri:has_city_GID-45969_Type-43815 ?city.
      filter(?amenity = "Bar")
      filter(?city="Trento")

?Location iri:has_lattitude_GID-46264_Type-779 ?latitude;
      iri:has_longitude_GID-46270_Type-779 ?longitude.
  BIND (omgeo:distance(46.0671931, 11.1212042, ?latitude, ?longitude) AS ?distance)
    # Maximum allowed distance in Km
    FILTER (?distance < 5)

} limit 3
```

- Give the list of bars in the city center?
- Return list of bars with information's within 5 km from city center.

	name ⇅	amenity ⇅	housetnumber ⇅	street ⇅	postcode ⇅	city ⇅	latitude ⇅	longitude ⇅
1	"Girasole"	"Bar"	"18/E"	"Via delle Ghiaie"	"38122"	"Trento"	"46.0554208"	"11.1161172"
2	"Bar Prati"	"Bar"	"4"	"Via dei Muredei"	"38122"	"Trento"	"46.0572157"	"11.1180954"
3	"pausa kaffè"	"Bar"	"45"	"Via Giuseppe Giusti"	"38122"	"Trento"	"46.0589545"	"11.1190969"



SPARQL QUERY 2

```
PREFIX iri: <http://knowdive.disi.unitn.it/etype#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
select ?Name ?price ?beds ?host_response ?Neighborhood ?latitude ?longitude
{
  {?Apartment a iri:Apartment_GID-14548}
  UNION
  {?Apartment a iri:Accommodation_GID-14254}
  ?Apartment iri:has_Location_GID-779_Type-779 ?Location;
    iri:has_Name_GID-2_Type-14548?Name;
    iri:has_price_GID-70571_Type-14254?price;
    iri:has_beds_GID-15089_Type-14548?beds;
    iri:has_host_response_rate_GID-300000_Type-14548?host_response;
    iri:has_Neighborhood_GID-46483_Type-14548?Neighborhood.
    FILTER(xsd:integer(?price) < 80)
    filter contains(?Neighborhood,"Trentino")

  ?Location iri:has_latitude_GID-46264_Type-779 ?latitude;
    iri:has_longitude_GID-46270_Type-779 ?longitude.

} limit 3
```

- Give the list of apartment under the 80\$ in Trentino?
- Return list of apartments with data properties in Trentino.

	Name ↕	price ↕	beds ↕	host_response ↕	Neighborhood ↕	latitude ↕	longitude ↕
1	"un posto in paradiso"	"68"	"4"	"100%"	"Vigo di fassa, Trentino, Italy"	"46.42097"	"11.67438"
2	"SKIING AND SPAS IN PEIO"	"60"	"3"	"67%"	"Peio, Trentino-Alto Adige/South Tyrol, Italy"	"46.36243"	"10.67768"
3	"BILO4 A MARILLEVA 900 SCI E NON SLO"	"69"	"4"	"100%"	"Marilleva 900, Trentino-Alto Adige/South Tyrol, Italy"	"46.31381"	"10.80984"



SPARQL QUERY 3

```
PREFIX iri: <http://knowdive.disi.unitn.it/etype#>

select ?postcode ?boarding ?rooms ?city ?phone ?service
where {
  ?Hotel a iri:Hotel_GID-19355;
    iri:has_postal_code_GID-34110_Type-19355?postcode;
    iri:has_website_GID-34126_Type-19355?website;
    iri:has_type_boarding_GID-300001_Type-19355?boarding;
    iri:has_number_of_rooms_GID-22651_Type-19355?rooms;
    iri:has_City_GID-45969_Type-19355?city;
    iri:has_Email_GID-33745_Type-19355?email;
    iri:has_phone_number_GID-34494_Type-19355?phone;
    iri:has_description_service_GID-3_Type-19355?service.
    filter(?boarding = "full-board")
    filter(contains(?service "Terrace")
    filter(?city = "ANDALO")
}
LIMIT 3
```

- Give the list of hotels with full-board and terrace in Andalo?
- Return list of hotels with data properties in Andalo.

	postcode	boarding	rooms	city	phone	service
1	"38010"	"full-board"	"36"	"ANDALO"	"0461-589127"	"Terrace or garden solarium"
2	"38010"	"full-board"	"77"	"ANDALO"	"0461-585802"	"Terrace or garden solarium"
3	"38010"	"full-board"	"59"	"ANDALO"	"0461-585828"	"Terrace or garden solarium"



SPARQL QUERY 4

```
PREFIX iri: <http://knowdive.disi.unitn.it/etype#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX omgeo: <http://www.ontotext.com/owlim/geo#>
select ?name ?houzenumber ?street ?postcode ?city ?latitude ?longitude ?OutdoorSeating
{
  {?Establishment a iri:Establishment_GID-43815}
  UNION
  {?Establishment a iri:Cafe_GID-15804}

  ?Establishment iri:has_Location_GID-779_Type-779 ?Location;
    iri:has_name_GID-2_Type-43815 ?name;
    iri:has_amenity_GID-2973_Type-43815 ?amenity;
    iri:has_houzenumber_GID-34489_Type-43815 ?houzenumber;
    iri:has_street_GID-24034_Type-43815 ?street;
    iri:has_postcode_GID-34110_Type-43815 ?postcode;
    iri:has_city_GID-45969_Type-43815 ?city.
    FILTER(?amenity = "cafe")
    FILTER(?city ="Cles")

  OPTIONAL {
    ?Establishment iri:has_OutdoorSeating_GID-46525_Type-15804?OutdoorSeating;
      FILTER(?OutdoorSeating = "yes")
  }

  ?Location iri:has_lattitude_GID-46264_Type-779 ?latitude;
    iri:has_longitude_GID-46270_Type-779 ?longitude.
}
limit 3
```

- Give the list of café with outdoor seating in Cles?
- Return list of café with information's.

	name	houzenumber	street	postcode	city	latitude	longitude	OutdoorSeating
1	"Caffè Grazia"	"44"	"Via Alcide De-gasperi"	"38023"	"Cles"	"46.3628192"	"11.0328503"	
2	"Lanterna Magica"	"20"	"Via Romana"	"38023"	"Cles"	"46.3634483"	"11.0366814"	"yes"
3	"Bar Cles"	"2"	"Piazza Navarrino"	"38023"	"Cles"	"46.3648747"	"11.035348"	



SPARQL QUERY 5

```
PREFIX iri: <http://knowdive.disi.unitn.it/etype#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX omgeo: <http://www.ontotext.com/owlim/geo#>
select ?name ?street ?postcode ?city ?Servesuisine ?delivery ?opening_hours ?latitude ?longitude
WHERE{

  {?Establishment a iri:Establishment_GID-43815}
  UNION
  {?Establishment a iri:Fast_food_restaurant_GID-40661}

  ?Establishment iri:has_Location_GID-779_Type-779 ?Location;
    iri:has_name_GID-2_Type-43815 ?name;
    iri:has_amenity_GID-2973_Type-43815 ?amenity;
    iri:has_housenumber_GID-34489_Type-43815 ?housenumber;
    iri:has_street_GID-24034_Type-43815 ?street;
    iri:has_postcode_GID-34110_Type-43815 ?postcode;
    iri:has_city_GID-45969_Type-43815 ?city.
    filter(?amenity = "fast_food")
    filter(?city ="Trento")

  OPTIONAL {
    ?Establishment iri:has_Servesuisine_GID-40725_Type-40661?Servesuisine;
      iri:has_Delivery_GID-1622_Type-40661?delivery;
      iri:has_opening_hours_GID-80563_Type-43815?opening_hours;
      filter(?delivery = "yes")
  }

  ?Location iri:has_latitude_GID-46264_Type-779 ?latitude;
    iri:has_longitude_GID-46270_Type-779 ?longitude.

}
```

- Give the list of fast-food restaurant with delivery in Trento?
- Return list of fast food restaurant with data properties in Trento.

	name ↕	street ↕	postcode ↕	city ↕	Servesuisine ↕	delivery ↕	opening_hours ↕	latitude ↕	longitude ↕
1	"Bici Grill Trento"	"Via Lidorno"	"38123"	"Trento"				"46.0330434"	"11.1249111"
2	"Pizzeria Bella N apoli"	"Largo Eugenio Prati"	"38122"	"Trento"				"46.0573733"	"11.1181097"
3	"Pedro Pizza"	"Via delle Ghiaie"	"38122"	"Trento"	"pizza"	"yes"	"Mo-Fr 11:00-14:00;18:00-22:00; Sa-Su 18:00-22:00"	"46.0556134"	"11.1160854"
4	"Cavalleggeri"	"Viale Verona"	"38123"	"Trento"	"kebab;pizza"	"yes"	"Mo-Su 10:00-22:00"	"46.0586372"	"11.1275148"

THANK YOU FOR
LISTENING

Competency Questions	Common etype			Core Kernel Concepts		
	Object	Function	Action	Object	Function	Action
Give the list of hotels in city center		location		Accommodation	Hotel	
Give the list of hotels with lower price		location		Accommodation	Hotel	
Give the email of vegan restaurants in Trento		location		Food	Restaurant	
Give the list vegan restaurant with internet access in Rovereto		location		Food	Restaurant	
Give the phone numbers of restaurants with outdoor seating		location		Food	Restaurant	
Give the list of hotels with phone number information near train station		location		Accommodation	Hotel	
Give the comfortable hotels under 60€ near mountain and good view		location		Accommodation	Hotel	
Give the list of the pub in city center open 9 pm		location		Food	Pub	
Give the list of cafe with internet access and takeaway		location		Food	Cafe	
Give the list of 4 or 5 stars hotels with swimming pool in Trentino		location		Accommodation	Hotel	
Give the list of hotel with terrace?		location		Accommodation	Hotel	
Give the list of Airbnb private room near Garda Lake with car parking		location		Accommodation	Bed and breakfast	
Give the list of restaurant with outdoor seating in Garda Lake		location		Food	Restaurant	
Give the list of restaurants with brewery and outdoor seating		location		Food	Restaurant	
Give the address of bars in Trento		location		Food	bar	
Give the list of phone number of pizzas in Trento		location		Food	fast_food_restaurant	
Give the list of ice cream shops with frozen yogurt and outdoor seating		location		Food	Ice_cream-shop	
Give the list of Airbnb houses with lift for 4 people in Roverto		location		Accommodation	Apartment	
Give the list of Airbnb houses with middle level price		location		Accommodation	Apartment	
Give the list of Airbnb apartment with kitchen and TV		location		Accommodation	Apartment	
Give the list of Airbnb houses with heating near ski resorts		location		Accommodation	Apartment	
Give the list of restaurant with delivery near Andalo		location		Food	Restaurant	
Give the list of restaurant with wheelchair		location		Food	Restaurant	
Give the cafe with wheelchair and vegan food		location		Food	cafe	
Give the list of pubs with outdoor seating		location		Food	pub	

II CLASSES, 50 DATA PROPERTIES, 13 OBJECT PROPERTIES

EType	Object Properties	Data Properties
Hotel	has_hotel	
Hotel	has_hotel	has_price
Restaurant	has_restaurant	has_diet_vegan, has_email
Restaurant	has_restaurant	has_diet_vegan, has_internet_access, has_city
Restaurant	has_restaurant	has_outdoor_seating, has_phone_number
Hotel	has_hotel	has_phone_number
Hotel	has_hotel	has_price
Pub	has_pub	has_open_hours
Cafe	has_cafe	has_internet_access, has_takeaway
Hotel	has_hotel	has_description_service, has_starsRating
Hotel	has_hotel	has_description_service
Bed and breakfast room	has_bed_and_breakfast	has_Description
Restaurant	has_restaurant	has_outdoor_seating, has_brewery, has_city
Restaurant	has_restaurant	has_outdoor_seating, has_brewery
bar	has_bar	has_street_bar, has_house_number, has_phone_number, has_bar
fast_food_restaurant	has_fast_food_restaurant	has_cuisine, has_city, has_phone_number
Ice_cream-shop	has_ice_cream-shop	has_frozen_yougurt, has_outdoor_seating
Apartment	has_apartment	has_Amenities
Apartment	has_apartment	has_price
Apartment	has_apartment	has_Amenities
Apartment	has_apartment	has_Amenities, has_Neighborhood_Overview
Restaurant	has_restaurant	has_delivery, has_city
Restaurant	has_restaurant	has_wheel_chair
cafe	has_cafe	has_wheel_chair_cafe, has_vegan_cafe
pub	has_pub	has_outdoor-seating_pub
Camping	has_camping	has_service
Hotel	has_hotel	has_type_boarding
Camping	has_camping	has_service
Camping	has_camping	has_phone_number
fast_food_restaurant	has_fast_food_restaurant	has_takeaway
fast_food_restaurant	has_fast_food_restaurant	has_cuisine
fast_food_restaurant	has_fast_food_restaurant	has_delivery, has_phone_number
bar	has_bar	has_smoking_bar
Hotel	has_hotel	
Hotel	has_hotel	