

Second milestone of knowledge representation and reasoning project : Ontology Engineering

MVOMO ETO Wilfried
BAKHOLDIN Peter
DELPORTE Guillaume

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1 Description of the ontology-engineering process

1.1 Non-technical aspects

In our information system, based on the Entity Relationship Diagram described in the previous milestone, we will build an ontology comprising four core concepts: person, location, statistics and team. To develop these concepts, we will adopt a top-down approach.

Considering that football revolves around human involvement, the primary actors in our ontology are categorized as either male or female. Additionally, football teams are not mixed; they are exclusively composed of either male or female players. Hence, the concept of 'gender' emerges as the initial consideration in our context. These actors fulfill distinct roles, leading us to establish the concept of 'person'. Also, we consider that the same person cannot play all the different roles. Within this concept, we encompass players, managers, and referees, all of whom are human individuals we seek to identify. Identification is based on their surnames, first names, and place of birth, and we also indicate their nationality. Within our context, each person is associated with a single nationality and a single place of birth. Consequently, the derived concept here is 'location'.

Our focus also lies on the statistics generated by both players and teams. Additionally, teams can be either clubs or national teams, resulting in the introduction of the last two concepts: 'team' and 'statistics'. A player can participate in both their national team and their club, allowing for the logical inclusion of national team statistics for that player. The concept of 'statistics' encompasses the statistical data pertaining to both players and teams. Similarly, like a player, a team can have one or more associated statistics. Since the Logical Description is considered to be the founder of ontology, we can get the following description:

1.2 Technical aspects

1.2.1 Choice of OWL 2 profile

To avoid one doing complex joins in SQL on the our database, we need an ontology. OWL 2 QL Profile is required for this task, as it is specifically tailored for querying and reasoning over large knowledge bases with a focus on efficient query answering. *SRQIQ(D)* - OWL 2's underlying formalism will allow us to describe our ontology in the following.

1.2.2 The different concepts

The following definitions describe the concepts represented by the corresponding classes in our ontology:

City	A class that represents a city. It is a subclass of foot:Location (geographical location).
Club	A class that represents a club. It is a subclass of foot:Team.
ClubManager	A class that represents a club manager. It is a subclass of Manager.
ClubPlayer	A class that represents a club player. It is a subclass of Player.
ClubStatistics	A class that represents club statistics. It is a subclass of TeamStatistics and disjoint with foot:NationalTeamStatistics.
Continent	A class that represents a continent. It is a subclass of Location.
Country	A class that represents a country. It is a subclass of Location.
InternationalReferee	A class that represents an international referee. It is a subclass of Referee.
Location	A class that represents a geographical location.
Manager	A class that represents a manager. It is a subclass of Person.
NationalReferee	A class that represents a national referee. It is a subclass of Referee.
NationalTeam	A class that represents a national team. It is a subclass of Team.
NationalTeamManager	A class that represents a national team manager. It is a subclass of foot:Manager.
NationalTeamPlayer	A class that represents a national team player. It is a subclass of Player.
NationalTeamStatistics	A class that represents national team statistics. It is a subclass of foot:TeamStatistics.
Person	A class that represents a person.
Player	A class that represents a player. It is a subclass of Person.
PlayerClubStatistics	A class that represents player statistics in a club. It is a subclass of PlayerStatistics.
PlayerNationalTeamStatistics	A class that represents player statistics with the national team. It is a subclass of PlayerStatistics.
PlayerStatistics	A class that represents player statistics. It is a subclass of foot:Statistics.
Referee	A class that represents a referee. It is a subclass of Person.
Stadium	A class that represents a stadium. It is a subclass of Location.
Statistics	A class that represents statistics.
Team	A class that represents a team.
TeamStatistics	A class that represents team statistics. It is a subclass of Statistics.

These class declarations and their relationships allow for the representation of various concepts and

specific relationships within the domain of football.

City \sqsubseteq Location	
Club \sqsubseteq Team	ClubManager \sqsubseteq Manager
ClubPlayer \sqsubseteq Player	ClubStatistics \sqsubseteq TeamStatistics
Continent \sqsubseteq Location	
Country \sqsubseteq Location	InternationalReferee \sqsubseteq Referee
Manager \sqsubseteq Person	
NationalReferee \sqsubseteq Referee	NationalTeam \sqsubseteq Team
NationalTeamManager \sqsubseteq Manager	
NationalTeamPlayer \sqsubseteq Player	NationalTeamStatistics \sqsubseteq TeamStatistics
Player \sqsubseteq foot:Person	
PlayerClubStatistics \sqsubseteq PlayerStatistics	PlayerNationalTeamStatistics \sqsubseteq PlayerStatistics
PlayerStatistics \sqsubseteq Statistics	Referee \sqsubseteq Person
Stadium \sqsubseteq Location	
TeamStatistics \sqsubseteq Statistics	

1.2.3 The different relations

The different relations between the different concepts of our ontology are defined as follows:

ClubHasManager

Description: Relates a club to its manager.

Domain: Club

Range: ClubManager

ClubOwnsStadium

Description: Relates a club to the stadium it owns.

Domain: Club

Range: Stadium

ClubStatistics

Description: Relates a club to its statistics.

Domain: Club

Range: ClubStatistics

ManagerHasNationality

Description: Relates a manager to the country of their nationality.

Domain: Manager

Range: Country

ManagerPlaceOfBirth

Description: Relates a manager to their place of birth.

Domain: Manager

Range: City

NationalTeamHasStatistics

Description: Relates a national team to its statistics.

Domain: NationalTeam

Range: NationalTeamStatistics

NationalTeamManager

Description: Relates a national team to its manager.

Domain: NationalTeam

Range: Manager

NationalTeamOwnsStadium

Description: Relates a national team to the stadium it owns.

Domain: NationalTeam

Range: Stadium

foot:PlayerHasClub

Description: Relates a player to the club they belong to.

Range: Player

PlayerHasClubStatistics

Description: Relates a player to their statistics in a club.

Domain: ClubPlayer

Range: ClubStatistics

PlayerHasNationalTeam

Description: Relates a player to the national team they belong to.

Domain: Player

Range: NationalTeam

foot:PlayerHasNationality

Description: Relates a player to the country of their nationality.

Domain: Player

Range: Country

PlayerPlaceOfBirth

Description: Relates a player to their place of birth.

Domain: Player

Range: City

PlaysHasNationalTeamStatistics

Description: Relates a national team player to their statistics with the national team.

Domain: NationalTeamPlayer

Range: PlayerClubStatistics

foot:RefereeHasNationality

Description: Relates a referee to the country of their nationality.

Domain: Referee

Range: Country

foot:RefereePlaceOfBirth

Description: Relates a referee to their place of birth.

Domain: Referee

Range: City

cityTeamRelation

Description: Relates a city to a team.

Domain: City

Range: Team

continentCountryRelation

Description: Relates a continent to a country.

Domain: Continent

Range: Country

foot:countryCityRelation

Description: Relates a country to a city.

Domain: Country

Range: City

inverseCityTeamRelation

Description: Inverse of the cityTeamRelation (Team to City).

inverseContinentCountryRelation

Description: Inverse of the continentCountryRelation (Country to Continent).

inverseCountryCityRelation

Description: Inverse of the countryCityRelation (City to Country).

inverseTeamManagerRelation

Description: Inverse of the teamManagerRelation (Manager to Team).

inverseTeamPlayerRelation

Description: Inverse of the teamPlayerRelation (Player to Team).

playerPlayerStatisticsRelation

Description: Relates a player to their player statistics.

Domain: Player
Range: PlayerStatistics
teamManagerRelation
Description: Relates a team to its manager.
Domain: Team
Range: Manager
teamPlayerRelation
Description: Relates a team to its players.
Domain: Team
Range: Player
teamTeamStatisticsRelation
Description: Relates a team to its team statistics.
Domain: Team
Range: TeamStatistics

2 Various problems encountered

The non-technical aspect of developing our ontology is that each continent, country, stadium and team has a single name. What's more, each city is located in a country, each person has a single birth name, and so on. This induces properties and functional data properties. However, OWL 2 QL does not accept functional properties and data properties. This problem of uniqueness is the major problem.

To overcome these issues, we used the **owl:cardinality 1** attribute which specifies the cardinality of a property in an ontology. The value "1" indicates that the property has a cardinality of "exactly one". This means that an individual linked to this property (or data property) must have exactly one value for this property.

Finally, to ensure the consistency of our ontology, we instantiated some individuals according to the Unique Name Assumption principle.

The contributors :

- BAKHOLDIN Peter,
- DELPORTE Guillaume, description of the ontology process (non-technical aspect and choice of OWL 2 profile), implementation of the ontology
- Mvomo Eto Wilfried, description of the ontology process (technical aspect), implementation of the ontology, various problems encountered