COM499 Artificial Intelligence

Assignment 1

Investigative Report on Ontology in Practice:

An ontology for the music industry

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Contents

1) Introduction and case study problem

In the context of Computer Science, ontology is a representation of knowledge in a particular domain, by a set of concepts with their properties, and the relationship between these concepts. Ontology is used for Artificial Intelligence, and for the Semantic Web, among other things. (Man, 2013)

Music is defined by the Cambridge Dictionary as “a pattern of sounds made by musical instruments, voices, or computers, or a combination of these, intended to give pleasure to people listening to it” (Cambridge University Press, 2020). Music, at its simplest, is a form of art, which connects an artist to an audience. In practice, however, there are many more people and factors involved, and a whole industry is present, ensuring effective communication between them. This ontology serves as an overview of this convoluted system of entities and relationships known as the music industry.

Artists can have different goals they hope to achieve. Some just want to make music for the joy of it, some want all the money and fame, and others can be somewhere in between. What they have in common, however, is that often times they are inexperienced in the business side of things. Signing to a record label might sound tempting, because they can grant you the maximal exposure possible, and they can take the weight of managing things off your shoulders, letting you concentrate on the one thing you do know about: making music. However, these labels might not have your best interest in mind and you might end up with a bad deal.

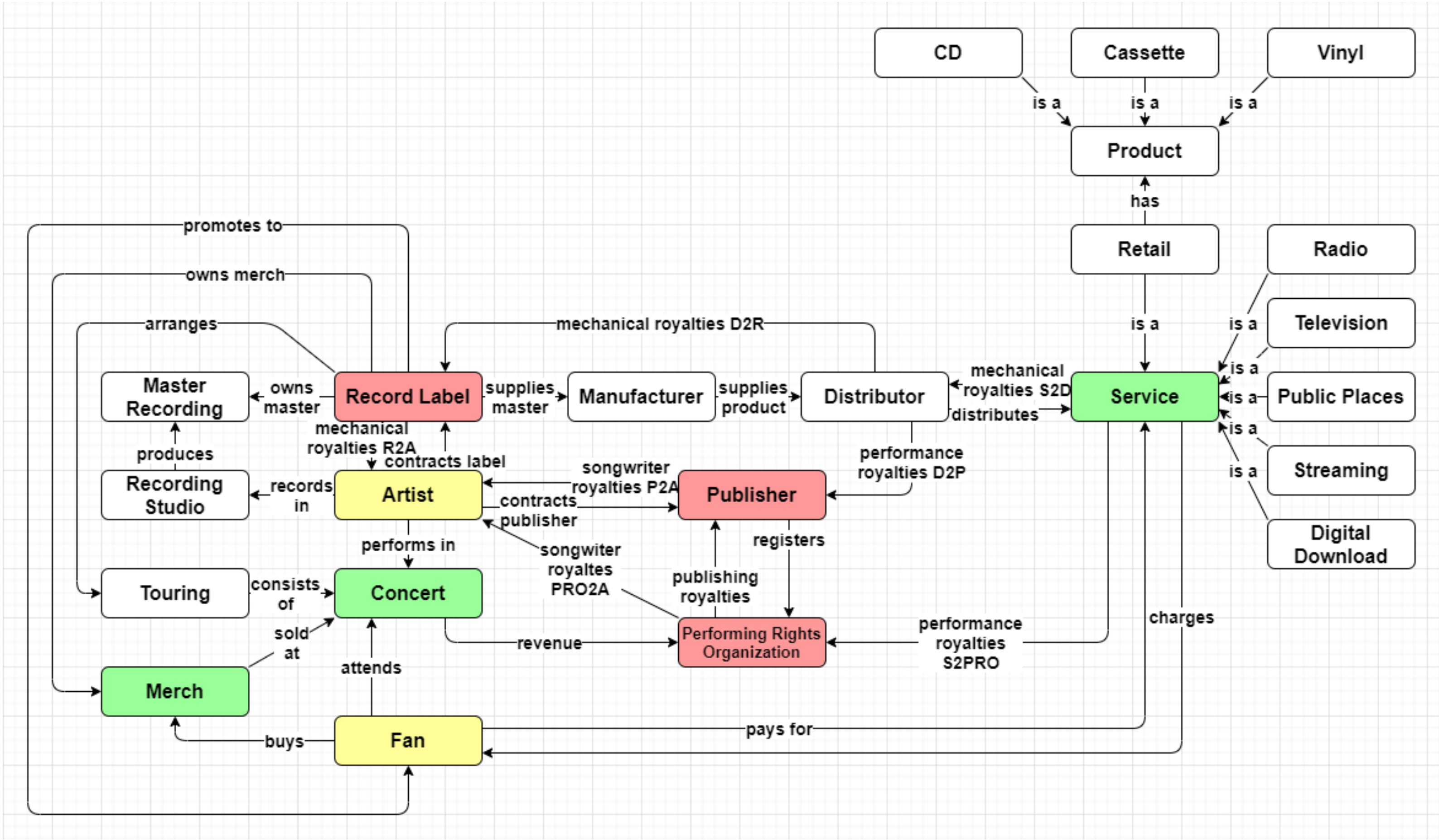
Lisa 'Left Eye' Lopes of 'TLC', the second-best-selling girl group of all time, after Spice Girls (Lipshutz, 2017) said this in an interview: “…Trust me, you can sell 10 million albums and be broke if you have greedy people behind you…” (Behind the Music: TLC, 1999), as she proceeded to break down her earnings. Another musician, Jared Leto of rock band 'Thirty Seconds to Mars' referred to the music industry as a “strange, convoluted system that you have to be a lawyer to really understand, or a mathematician” (Artifact, 2012), so that is exactly what the AI solution using this ontology is set out to be; a mathematician, helping musicians make the best choices, depending on their circumstances (like the volume of their fanbase), and their preferences regarding the balance between their artistic integrity, desired exposure, financial possibilities, and willingness to self-manage in certain aspects.

This AI would give them estimates of best- and worst-case scenarios for every possible career choice, and heavily advise against them if they would certainly not end well, advise for them if they seemed like a favourable choice, or simply list them as options if the outcome was unclear, or inconsequential. It could also advise the artist which particular area they should concentrate on at that moment in their career (like touring, merch sales, album recording), in order to get to the next step.

This way the artist would always have a clear view of the financial outcome of record deals they would maybe normally realise only years later, and this would help them avoid getting in debt to their record label, or ending up with less money than what they would have earned by then with a minimum wage job (Blake, 2019). It would also be useful for cutting out the middlemen if their services were unnecessary.

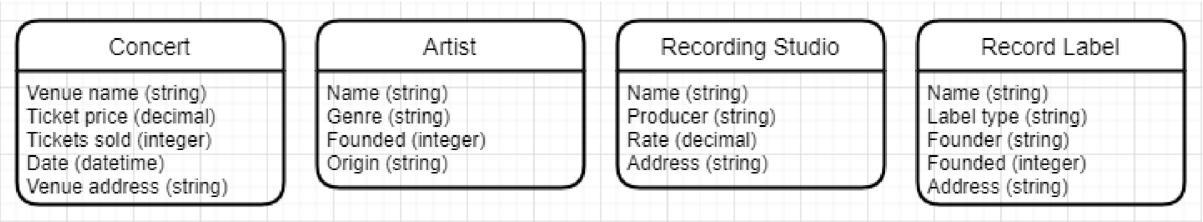
2) Presenting the information relevant to the scenario

Here is what the entity-relationship diagram of this ontology looks like.



It is important to note, that in its current form, it is not capable of supporting the aforementioned AI, as it is oversimplified for that job. Only the key entities are present, in an artist's career, like the two endpoints of music (yellow), significant sources of income (green), and the key actors they encounter along the way to get to these, including the ones who uphold copyrights (red). Another assumption that was made, was that the artist is both the songwriter and the performer, is not performing anything written by someone else, and no one else is performing their songs. This was done to simplify the flow of revenues. Furthermore, an independent artist may serve as their own publisher, manufacturer, distributor, and so on. In those cases, the diagram would somewhat differ from this. The diagram here only refers to a typical scenario. Lastly, the information present in the ontology and in this diagram was gathered from different online sources (Indie Music Academy, 2020) (Shepard, 2019).

Royalties go a long way until they arrive at the Artist, and each stop along the way takes a certain percentage from them. To illustrate that these relationships are technically separate, abbreviations have been appended to their titles, such as 'R2A' (Record Label to Artist) and S2PRO (Service to Performing Rights Organization).

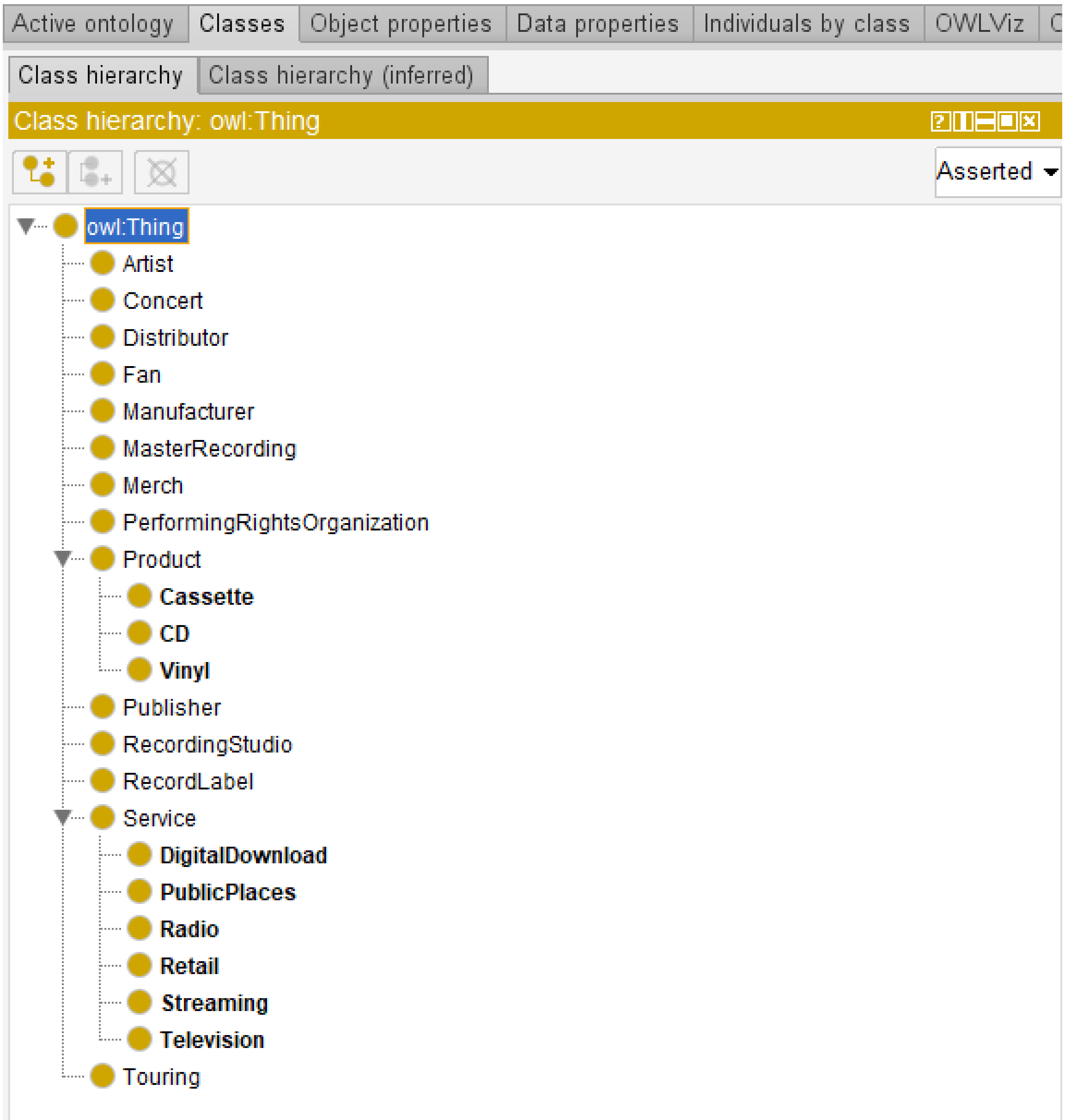


Concert	Artist	Recording Studio	Record Label
Venue name (string)	Name (string)	Name (string)	Name (string)
Ticket price (decimal)	Genre (string)	Producer (string)	Label type (string)
Tickets sold (integer)	Founded (integer)	Rate (decimal)	Founder (string)
Date (datetime)	Origin (string)	Address (string)	Founded (integer)
Venue address (string)			Address (string)

A few classes were chosen to have attributes, as examples of data properties in this ontology. This is not all-encompassing, as every single class could have attributes, but these are some of the more illustrative attributes, along with their data type.

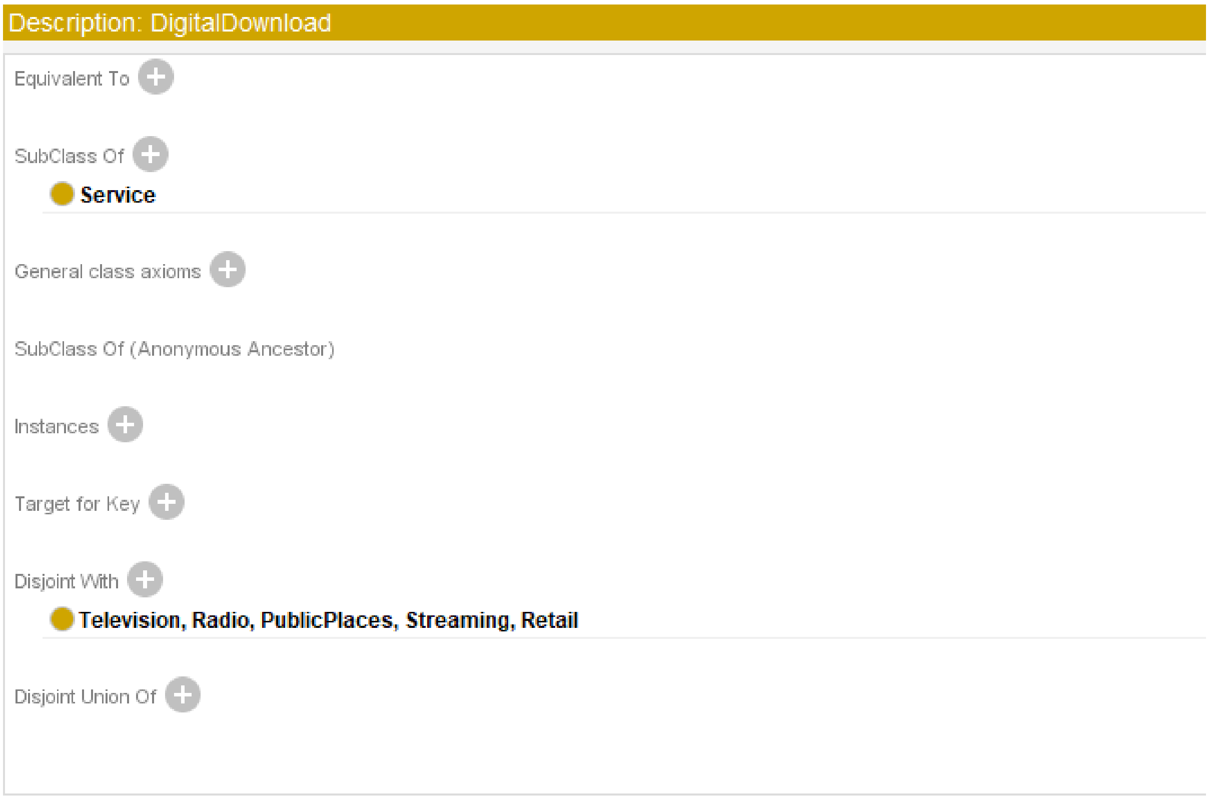
3) Ontology construction

Next up, the ERD has been implemented in Protégé, to produce an ontology. The first step was creating the classes. This is fairly straightforward. Every entity on the diagram corresponds to a class, and every 'is a' relationship means a subclass, as it can be seen in the hierarchy.



- owl:Thing
  - Artist
  - Concert
  - Distributor
  - Fan
  - Manufacturer
  - MasterRecording
  - Merch
  - PerformingRightsOrganization
  - Product
    - **Cassette**
    - **CD**
    - **Vinyl**
  - Publisher
  - RecordingStudio
  - RecordLabel
  - Service
    - **DigitalDownload**
    - **PublicPlaces**
    - **Radio**
    - **Retail**
    - **Streaming**
    - **Television**
  - Touring

While on the ‘Classes’ tab, some disjoints have been created among subclasses of the ‘Product’ class, as well as the ‘Service’ class, as neither products, nor services can be of multiple nature simultaneously.



Description: DigitalDownload

Equivalent To +

SubClass Of +

● Service

General class axioms +

SubClass Of (Anonymous Ancestor)

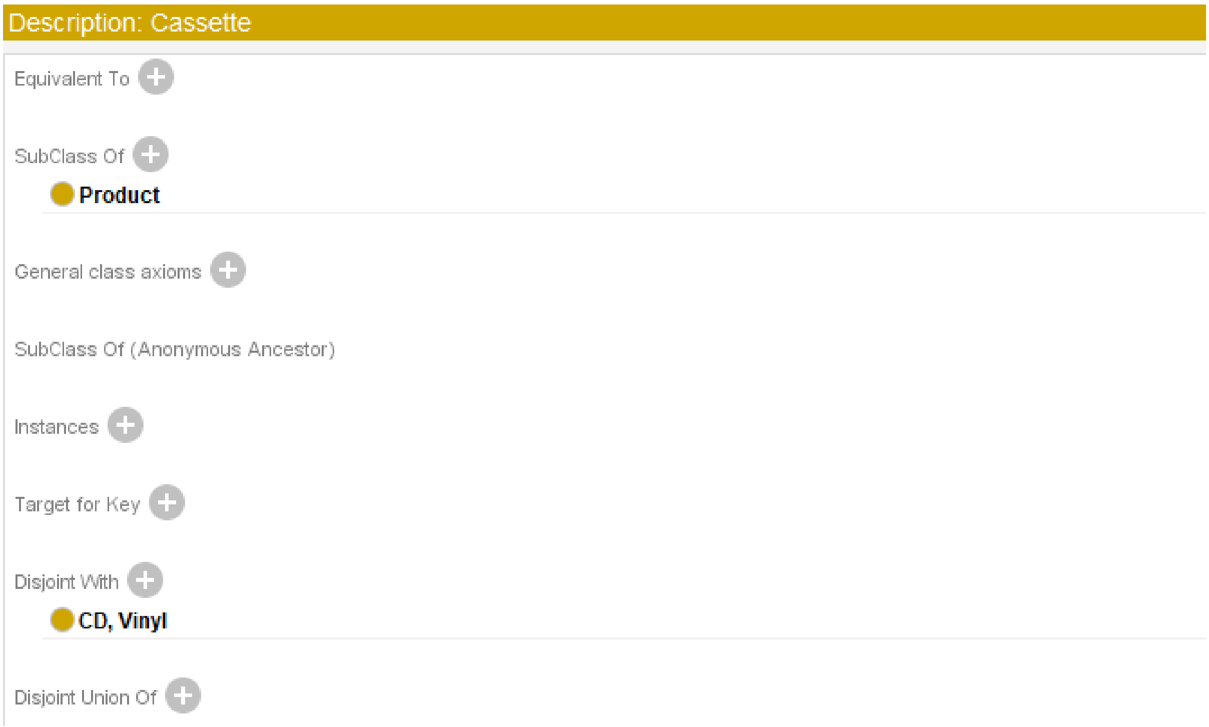
Instances +

Target for Key +

Disjoint With +

● Television, Radio, PublicPlaces, Streaming, Retail

Disjoint Union Of +



Description: Cassette

Equivalent To +

SubClass Of +

● Product

General class axioms +

SubClass Of (Anonymous Ancestor)

Instances +

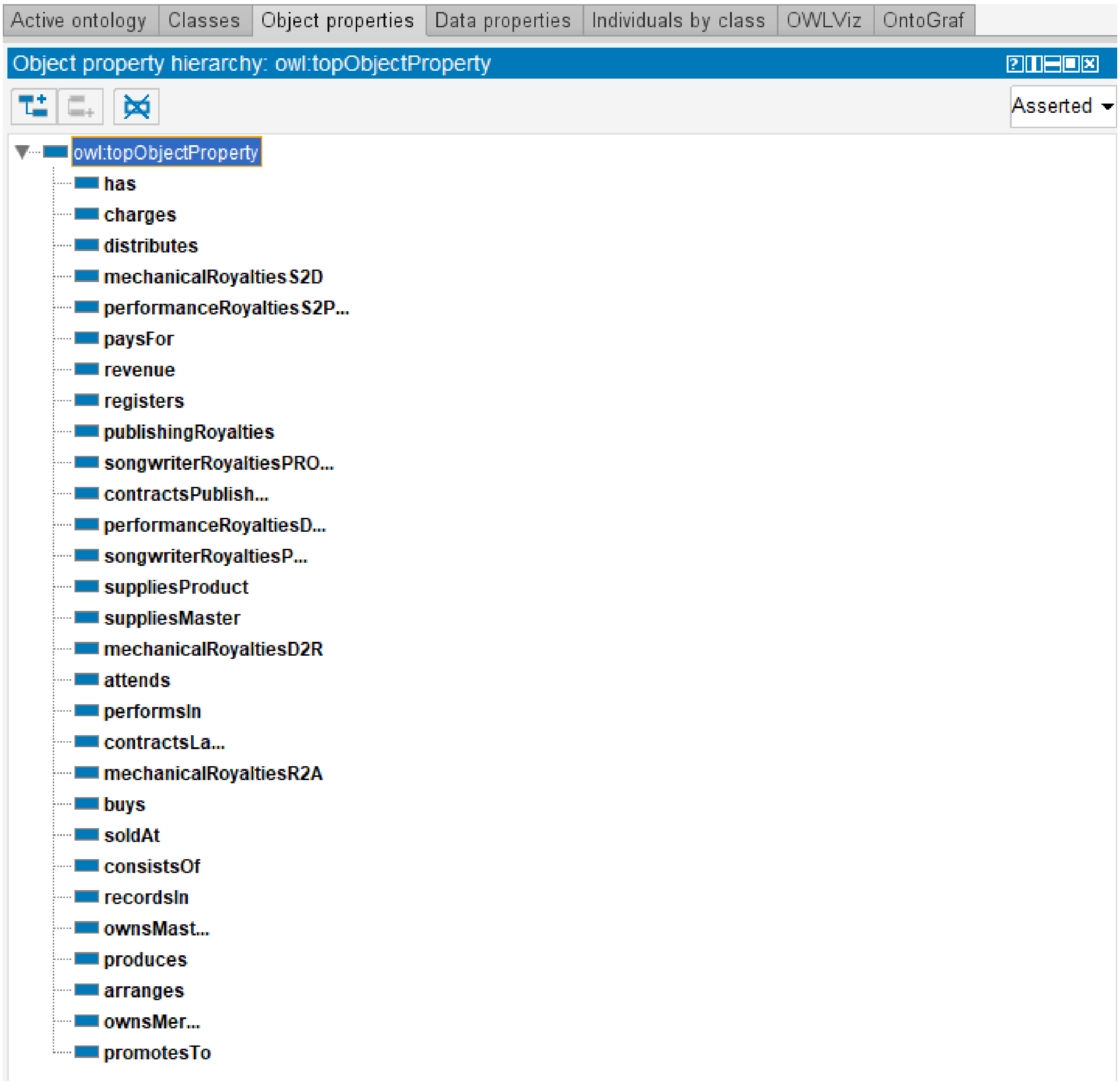
Target for Key +

Disjoint With +

● CD, Vinyl

Disjoint Union Of +

Moving on to the ‘Object properties’ tab, all the arrows from the ERD have been translated into object properties for the ontology, all being the child of ‘topObjectProperty’.

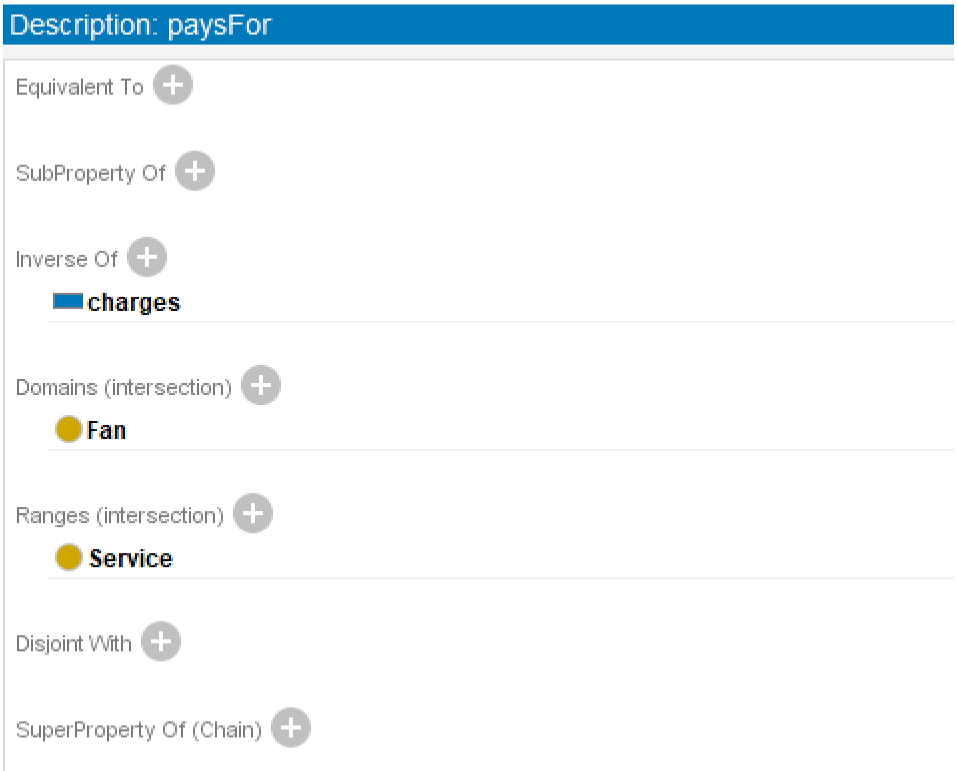


Object property hierarchy: owl:topObjectProperty

- owl:topObjectProperty
  - has
  - charges
  - distributes
  - mechanicalRoyaltiesS2D
  - performanceRoyaltiesS2P...
  - paysFor
  - revenue
  - registers
  - publishingRoyalties
  - songwriterRoyaltiesPRO...
  - contractsPublish...
  - performanceRoyaltiesD...
  - songwriterRoyaltiesP...
  - suppliesProduct
  - suppliesMaster
  - mechanicalRoyaltiesD2R
  - attends
  - performsIn
  - contractsLa...
  - mechanicalRoyaltiesR2A
  - buys
  - soldAt
  - consistsOf
  - recordsIn
  - ownsMast...
  - produces
  - arranges
  - ownsMer...
  - promotesTo

Object properties ‘paysFor’ and ‘charges’, from domain and range ‘Fan’ and ‘Service’ and vice versa, have been defined as inverses of one another, as the service charging fans, and fans paying for the service means the same thing. Similar inverses could be created for all the other object properties as well, for it would improve the AI.

With the object properties now present, a brief return to the previous ‘Classes’ tab was necessary, because now creating object restrictions have become possible. In the ‘Touring’ class, ‘consistsOf’ from the list of object properties has been selected as the restricted property, ‘Concert’ has been selected as the restriction filler, and the restriction type has been set to ‘Some’. What this essentially means, is that a tour must consist of some concerts.



Description: paysFor

Equivalent To

SubProperty Of

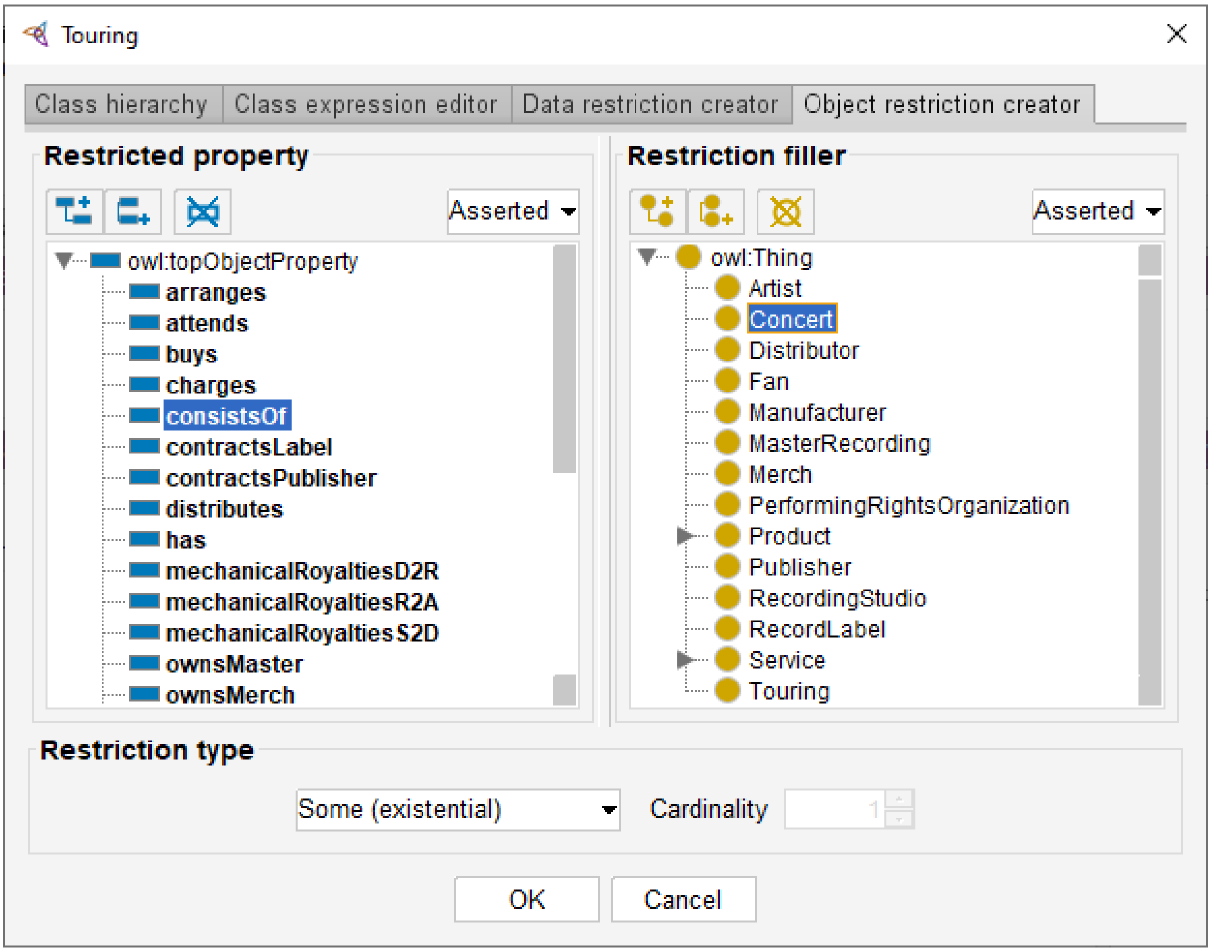
Inverse Of
- charges

Domains (intersection)
- Fan

Ranges (intersection)
- Service

Disjoint With

SuperProperty Of (Chain)



Touring

Restricted property

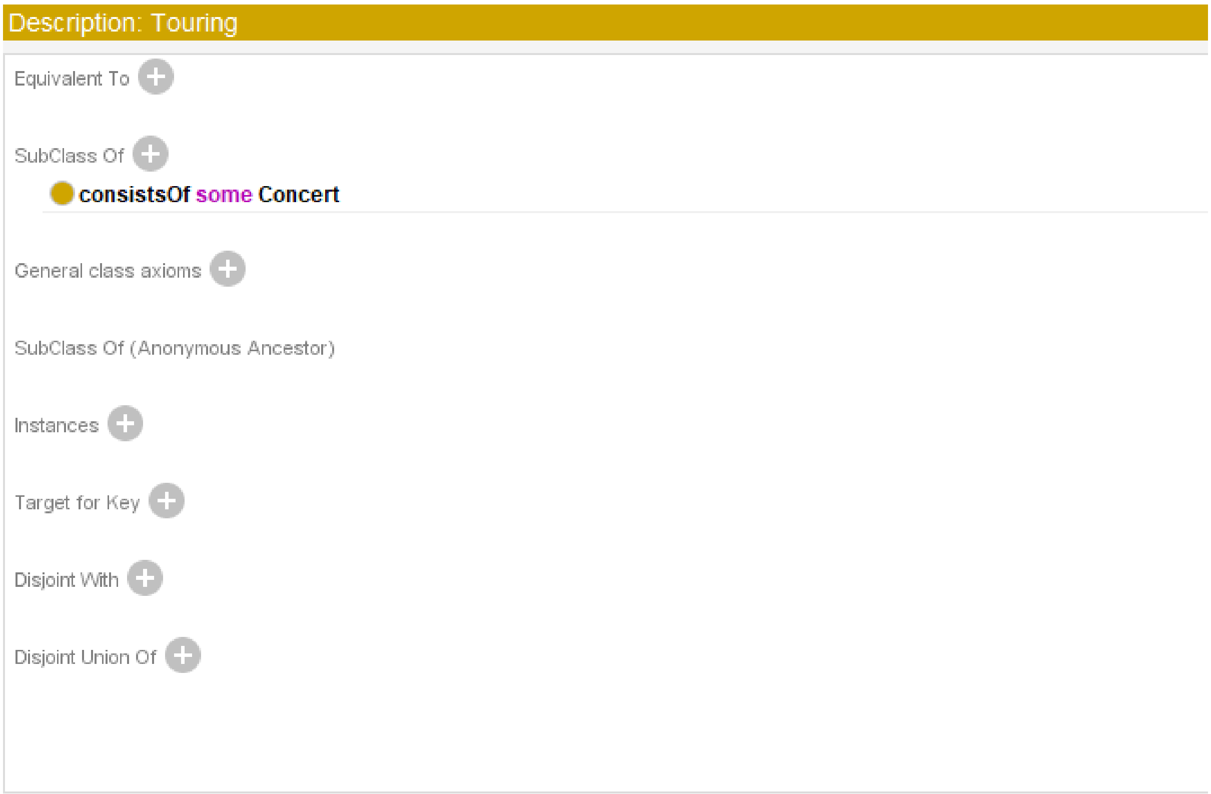
- owl:topObjectProperty
  - arranges
  - attends
  - buys
  - charges
  - consistsOf
  - contractsLabel
  - contractsPublisher
  - distributes
  - has
  - mechanicalRoyaltiesD2R
  - mechanicalRoyaltiesR2A
  - mechanicalRoyaltiesS2D
  - ownsMaster
  - ownsMerch

Restriction filler

- owl:Thing
  - Artist
  - Concert
  - Distributor
  - Fan
  - Manufacturer
  - MasterRecording
  - Merch
  - PerformingRightsOrganization
  - Product
  - Publisher
  - RecordingStudio
  - RecordLabel
  - Service
  - Touring

Restriction type

Some (existential)   Cardinality 1



Description: Touring

Equivalent To

SubClass Of

consistsOf some Concert

General class axioms

SubClass Of (Anonymous Ancestor)

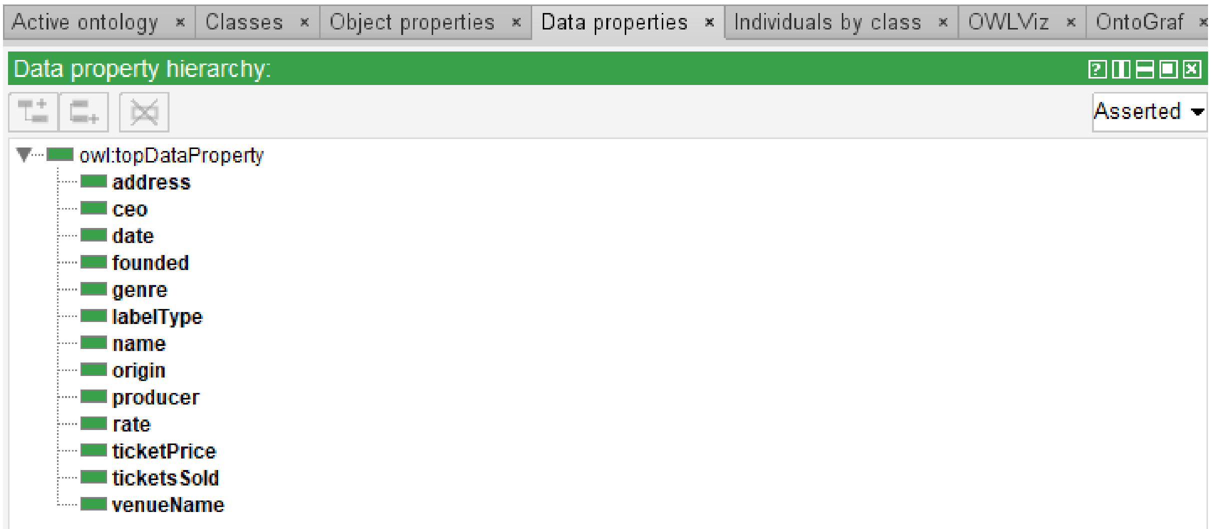
Instances

Target for Key

Disjoint With

Disjoint Union Of

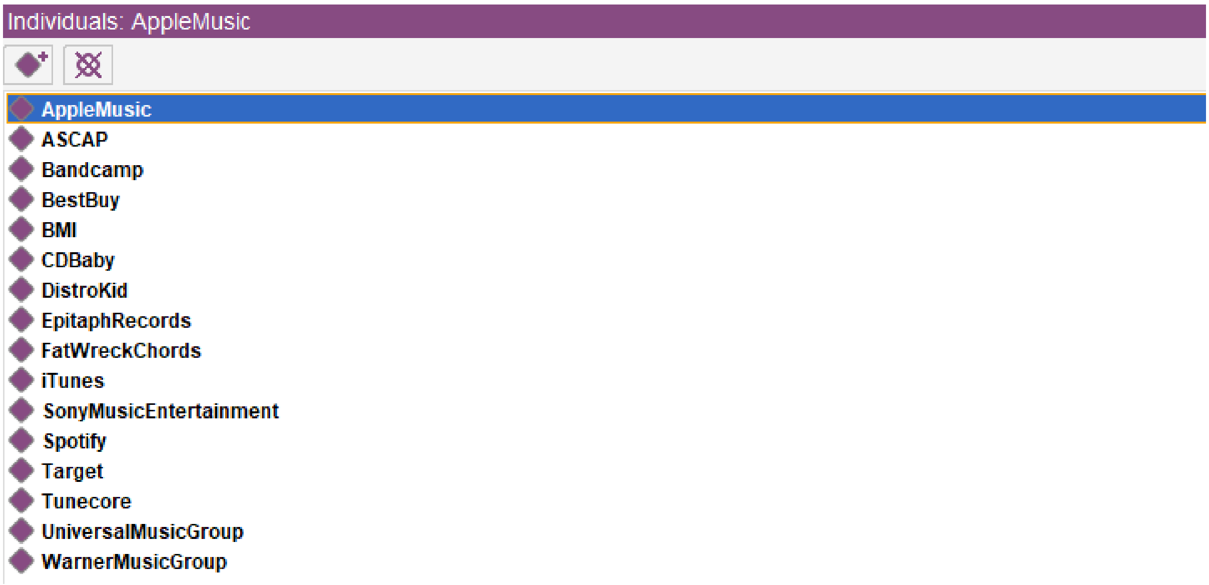
In the ‘Data properties’ tab, we make the previously mentioned attributes into data properties. Some of these, like ‘name’ and ‘address’, will be used by multiple classes. At this stage, we also set the type of these data properties.



Data property hierarchy:

- owl:topDataProperty
  - address
  - ceo
  - date
  - founded
  - genre
  - labelType
  - name
  - origin
  - producer
  - rate
  - ticketPrice
  - ticketsSold
  - venueName

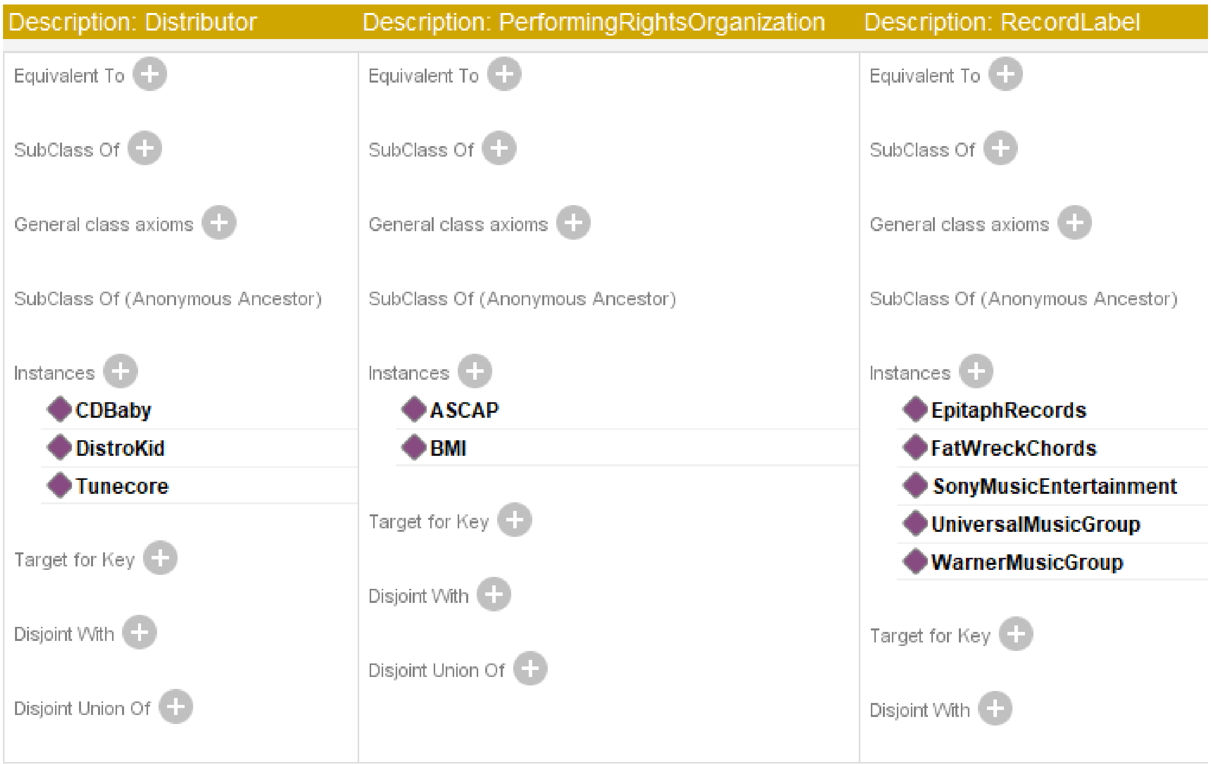
The following tab is 'Individuals'. Below is the list of total individuals created for this ontology.



Individuals: AppleMusic

- AppleMusic
- ASCAP
- Bandcamp
- BestBuy
- BMI
- CDBaby
- DistroKid
- EpitaphRecords
- FatWreckChords
- iTunes
- SonyMusicEntertainment
- Spotify
- Target
- Tunecore
- UniversalMusicGroup
- WarnerMusicGroup

The next image depicts the same individuals, but grouped by the classes they belong to.



Description: Distributor

Equivalent To

SubClass Of

General class axioms

SubClass Of (Anonymous Ancestor)

Instances
- CDBaby
- DistroKid
- Tunecore

Target for Key

Disjoint With

Disjoint Union Of

Description: PerformingRightsOrganization

Equivalent To

SubClass Of

General class axioms

SubClass Of (Anonymous Ancestor)

Instances
- ASCAP
- BMI

Target for Key

Disjoint With

Disjoint Union Of

Description: RecordLabel

Equivalent To

SubClass Of

General class axioms

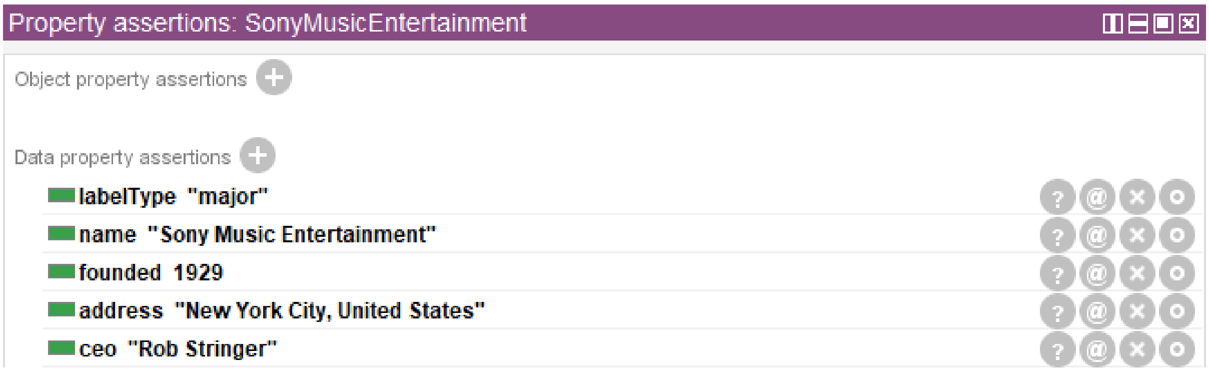
SubClass Of (Anonymous Ancestor)

Instances
- EpitaphRecords
- FatWreckChords
- SonyMusicEntertainment
- UniversalMusicGroup
- WarnerMusicGroup

Target for Key

Disjoint With

Some values have been entered for the data properties belonging to the individuals of the 'RecordLabel' class. These individuals are the three biggest record labels of the world, as well as two indie labels in addition.

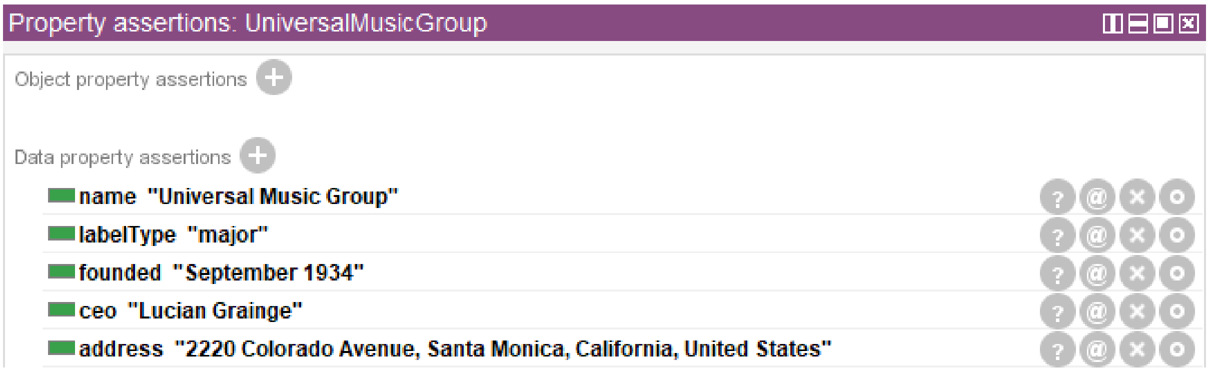


Property assertions: SonyMusicEntertainment

Object property assertions

Data property assertions

labelType "major"
name "Sony Music Entertainment"
founded 1929
address "New York City, United States"
ceo "Rob Stringer"

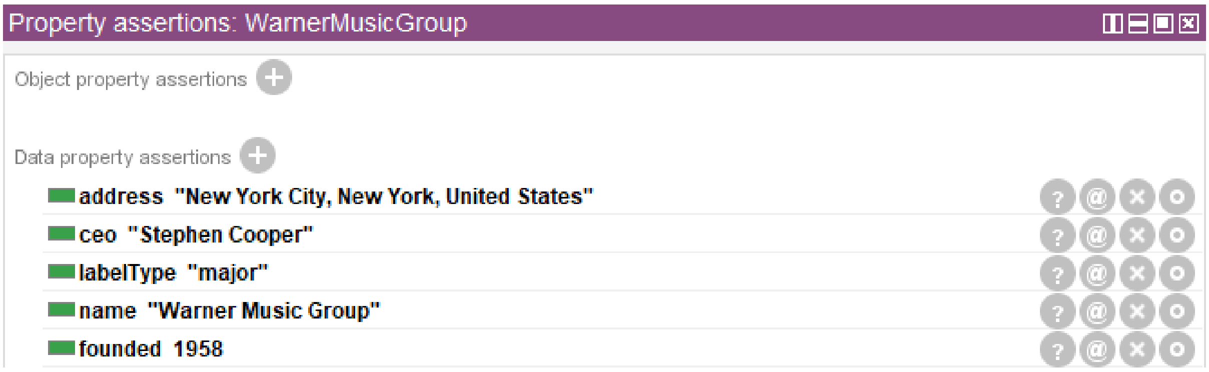


Property assertions: UniversalMusicGroup

Object property assertions

Data property assertions

name "Universal Music Group"
labelType "major"
founded "September 1934"
ceo "Lucian Grainge"
address "2220 Colorado Avenue, Santa Monica, California, United States"

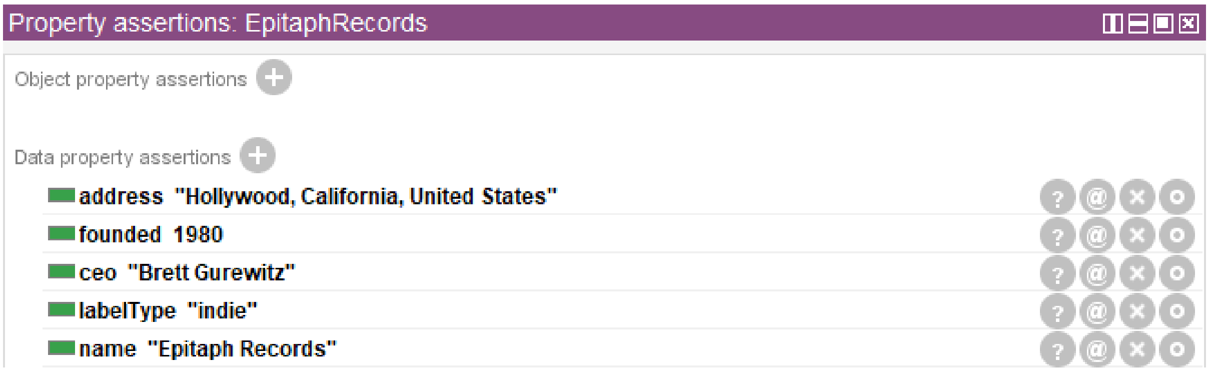


Property assertions: WarnerMusicGroup

Object property assertions

Data property assertions

address "New York City, New York, United States"
ceo "Stephen Cooper"
labelType "major"
name "Warner Music Group"
founded 1958

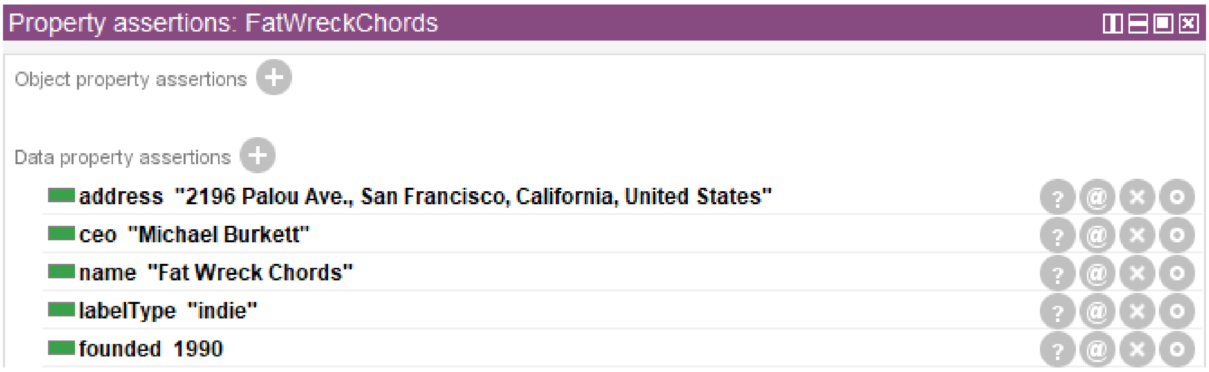


Property assertions: EpitaphRecords

Object property assertions

Data property assertions

address "Hollywood, California, United States"
founded 1980
ceo "Brett Gurewitz"
labelType "indie"
name "Epitaph Records"



Property assertions: FatWreckChords

Object property assertions

Data property assertions

🟩 address "2196 Palou Ave., San Francisco, California, United States"

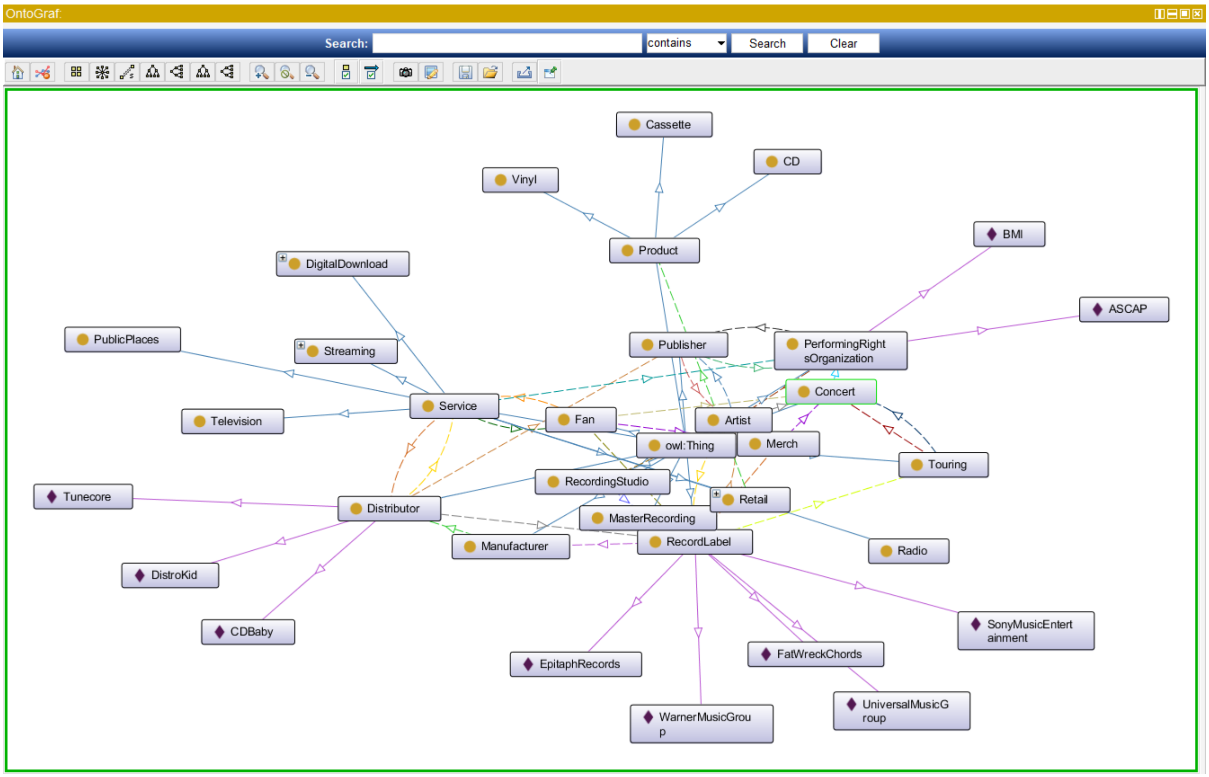
🟩 ceo "Michael Burkett"

🟩 name "Fat Wreck Chords"

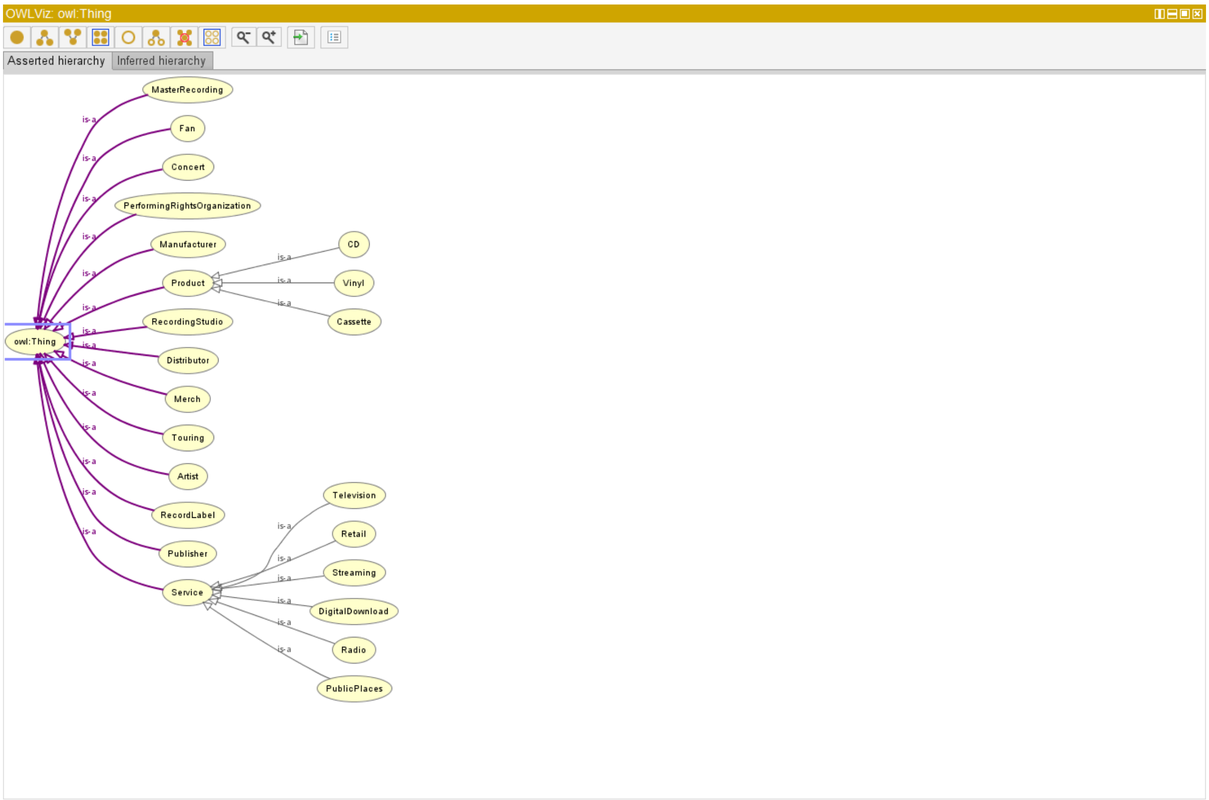
🟩 labelType "indie"

🟩 founded 1990

Each of these data property values serve a purpose. For example, if the label type is indie instead of major, the AI understands that the artist gets less exposure from these labels, but more percentage of their royalties. The year the label was founded can indicate how long they have been on the market and how experienced they must be. The name of the CEO and the address of the label's headquarters can be useful contact information.



This is the OntoGraf view of our ontology.



Lastly, OWLViz shows us the visual representation of the ontology's hierarchy tree.

4) Discussion and conclusion

This is the end of this ontology. As a summary, the main entities of the music industry have been created, from the artist's perspective, the relationship between these entities and the artist have been represented, and a few examples have been given for procedures in Protégé, like setting inverse object properties, and creating disjoints and object restrictions. Some data properties have been added, as well as values to some of them, and some individuals have been created for a couple of classes.

Challenges faced during the creation of this ontology included determining the volume of it, selecting the more important entities of the industry and organising them in terms of their relationships. Another challenge was looking up the inner workings of this industry, and understanding it as a layman. The gathered sources mainly applied to how the music industry operates in the US, although other countries should be fairly similar.

As previously stated, this ontology is just a broad outline of an actual, more detailed ontology, which would be needed to support this AI idea. Also, handling this AI would still be a considerably manual task, as completely automating it would require another type of ontology, one that understands legal language and can extract relevant data from contracts and other paperwork on its own and compare different record deal possibilities for example. With only this ontology, these data would need to be entered by the user.

As far as possibilities go, the end goal could be an AI which can actually exchange emails with people in the business, organise meetings, book concerts at venues, and generally act like a manager for the artist. It would be a complex task, but the very first step in that direction is this ontology, which is why it has been chosen as the subject of this assignment.

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Appendix

music.owl