Assignment Report 1

With a punctuality rate of nearly 95%, ÖBB ranked among the most reliable railway operators in Europe in 2023. Across the corporation around 42,000 employees working on the railway and bus networks (plus over 2,000 apprentices) ensure that some 1.3 million passengers safely reach their destinations every day.
In today's era, where the huge world has been discovered with a lot of places to explore and visit, this is all because of the mobility services available today which makes it easy to travel around the world.
I would like to use the **U-Bahn Transportation System** as my application for semantic technologies. By integrating ontology into railways it can provide information about different types of trains, the facilities, the shortest route, the destination and arrival station. It can also help the train company to understand the most crowded station and based on that the services can be upgraded for the customers benefit.

Competency Questions

1. **Where can I find attended (staffed) restrooms in the transportation network?**
2. **Which U-Bahn lines connect to the City Airport Train (CAT)?**
3. **Which ticket points provide services for the City Airport Train (CAT)?**
4. **Which train stations lack elevator access?**
5. **What is the color associated with each U-Bahn line?**
6. **Where are park-and-ride facilities located along the U-Bahn network?**
7. **Which U-Bahn stations have customer service centers?**
8. **How many U-Bahn lines serve each ticket information point?**
9. **Which U-Bahn stations are equipped with attended restrooms?**

Step - 1

In the initial step of constructing the ontology, a primary class, U-Bahn, was established to represent the subway system. This main class was further divided into subclasses for each line, initially covering U1, U2, U3, U4, and U6. Each of these line subclasses was then organized by incorporating individual stations as additional subclasses. The station subclasses followed a standardized naming convention, where each station was suffixed with its respective line identifier (e.g., StationName U1, StationName U2), ensuring a clear connection to the line it serves. Each line subclass contained approximately 15 to 20 station subclasses, accurately representing the route and stop order. This hierarchical structure supports an organized and scalable representation of the U-Bahn system, where additional lines or stations could easily be

added if necessary. The approach facilitates structured data retrieval and allows for easy query-building based on line and station-specific attributes.

Step - 2

After the completion of the main U-Bahn class, which contained several stations for different lines, the classes for the facilities in the stations were created. More specifically, the classes such as customer service, info and ticket points, park and ride, and service centers were constructed. The classes, in turn, were divided into different subclasses. The All Restroom class was divided into the Attended restroom and the restroom. The color class is an enumerate class with values being a list of individuals. Brown Green Orange, purple, Red which indicates the color of different U-Bahns. This is a small glimpse of CAT which runs from Vienna Airport to the city. Then there are other facilities as a class and there are lists of individuals denoted as stations at the place where the facility exists.

Step - 3

The last step for the classes' creation, is the creation of the class Accessible Services. This class indicates the list of all the equivalent facilities of customer service centers. There is also a class "No Elevator" which does not denote any facility but gives the information of the stations without the elevators.

Step - 4

Upon the completion of the classes' creation, the object properties were added to the ontology. In total, 4 object properties were created i.e. connectedTo, hasRestroom, isLocatedAt, provideAccessTo

The object property connectedTo has domain the U-Bahn class and range the U-Bahn class. The object property hasRestroom has domain the Restrooms class and range the U-Bahn class. The object property isLocatedAt has domain the Info and ticket points & CustomerServiceCenter class and range the U-bahn class. The object property provideAccessTo has domain the City_Airport_Train class and range the U-Bahn class.

Step - 5

The last step for the formulation of the U-Bahn Transportation System ontology, is the creation of the data properties. 5 data properties named hasAccessibilityFeature, hasColorCode, hasOperatingHours, hasParkingCapacity, hasRestroomType were introduced to the ontology. The data property hasAccessibilityFeature has Service Center as the domain and range string. The data property hasColorCode has domain the Color class and range string. The data property

hasOperatingHours has domain the InfoAndTicketPoints class and range boolean. The data property hasParkingCapacity has domain the ParkAndRide class and range boolean. The data property hasRestroomType has domain the Restrooms class and range boolean.

Enumeration and exemplification of the OWL features

Now that the initial RDF(S) ontology was created, several OWL features were used to extend the ontology. The OWL constructs, which were used, are:

1. class expressions
2. disjointness
3. logical connectors
4. property constraints in values
5. Cardinalities

1. **Class Expression:** I have created a class called AccessibleServices and defined it as **equivalent** to the union of CustomerService or ServiceCentre. This was done using a **class expression** with a logical connector (union, ⊔). This means that any instance that is either a CustomerService or a ServiceCentre is automatically considered an instance of AccessibleServices

2. **Disjoints**: I have made ParkAndRide, NoElevator, and CustomerService **disjoint** classes. This means that an individual cannot simultaneously belong to any of these classes, as they are mutually exclusive. This helps that there are no overlapping individuals among these classes, adding logical clarity to the ontology.

3. **Property Constraints:** I have used hasColorCode which is defined as a data property associated with the class **U-Bahn_Line**. The range for this property is typically a string, which allows us to represent color codes in various formats.

   I have used hasParkingCapacity which is defined as a data property associated with the class **U-Bahn_Line**.The range for this property is typically a boolean, which allows us to know whether there is a parking place available or not.

4. **Cardinalities:** This ensures that every **CAT** must be associated with at least one **U-Bahn line** .i.e every CAT train has to come to one or other U-Bahn line. It ensures that all CAT trains are covered by U-Bahn lines, providing users with clear options for transit.

5. Logical Connectors: the **Restrooms** class is defined as a union of two subclasses: **Restroom** and **AttendedRestroom**. This logical connector allows for a clear representation of different restroom types under the main category, ensuring that all variations are included. Each restroom type can be linked to U-Bahn lines through an

object property, and there can be either of one restrooms facilitating seamless navigation for users seeking restroom facilities within the transit system.