London Metropolitan University

CS7051- Semantic Technologies

Coursework –1

Group Report

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1. INTRODUCTION

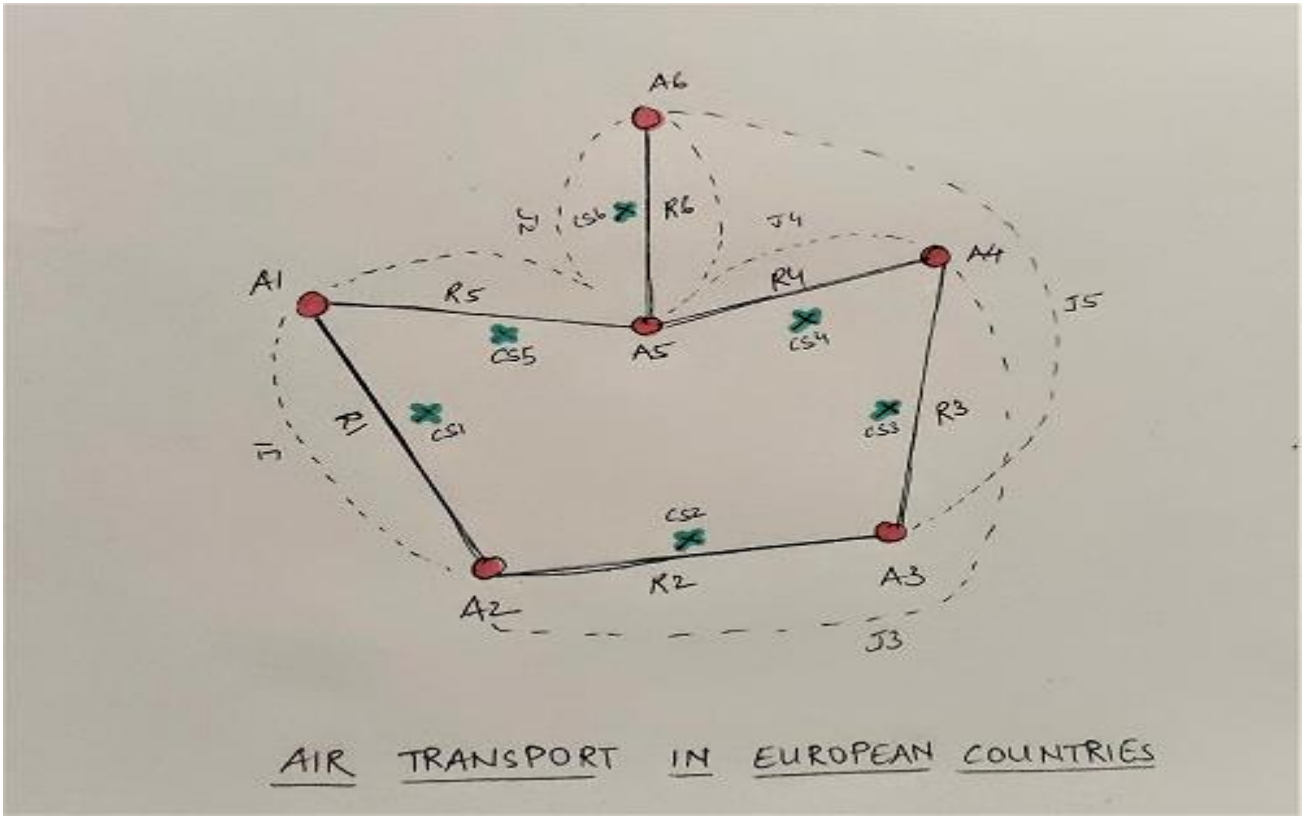
This coursework aims at logic modelling of a selected microworld of interest. We chose Air Transports for the modelling our micro-world.

Inorder to build the air transport microworld, we need to build a logical theory of the chosen system using first-order relational language and then convert it into a Horn clause theory.

The initial achievable item was to create a semantic model of our selected microworld with many individual objects in its universe. We the extracted the vocabulary for our model by stating the individual constants, some unary and binary predicates that will define some relations between our world objects. Also, we would then define some attribute functions which will return some object when used in design to validate and satisfy our semantic interpretation of the model that we constructed.

Finally, we would design our model based on logical theory of our microworld with some facts and heuristics to prove the satisfiability of the assumptions. This group report presents the developed theory.

2. SEMANTIC MODEL BASED ON AIR TRANSPORT



The given visual representation shows the air transport world of some of EU countries. The models has various objects which are as follows:

- Airports(A) connecting the Europe continents area through air routes.
- Routes(R) are travel connecting two airports.
- There are also Airlines (AL) which has some models of the Planes (P) executed in this transport system.
- Control Stations (CS) guides the planes in their Routes (R).
- Also there some External Factors (E) which may affect the plane journeys.
- Journey (J) are the start to end trip from one airport to end airport.
- Passengers (PS) are people travelling through air transport.
- Tickets (T) are the tickets for the Routes(R)

M = A ∪ R ∪ AL ∪ CS ∪ E ∪ J ∪ PL ∪ J U T where

A= {A1, A2, A3, A4, A5, A6} - objects are representing the airports in the model.

R= {R1, R2, R3, R4, R5, R6 } - Objects are representing routes to connect all airports in in the models.

AL= {AL1, AL2, AL3, AL4, AL5} - Objects are representing the Airlines in the constructed model.

P= {P1, P2, P3, P4, P5, ……P10 }- objects are representing the planes in this model.

CS= {CS1, CS2, CS3, CS4, CS5} - objects are representing the control stations.

E= {E1, E2, E3, E4, E5, E6 } - Objects are representing external factors consider for the model.

J= {J1, J2, J3, J4, J5}- Objects are representing the journey in the given semantic models.

PS= {PS1, PS2, PS3, PS4, PS5, PS6, PS7, PS8, PS9, PS10 }- objects are representing the passengers in this model.

T = {T1,T2……T20}- objects representing the tickets in the model.

3. VOCABULARY

Logical Constants:

{Reykjavik, Dublin,Vienna , Oslo, Kiev, Rome} - which are demonstrated Airports in the given model.

{R1, R2, R3, R4, R5,R6}- which are routes in the given model.

{Luftansa, British Airways, Air France, Ryan Air, Emirates }- These are demonstrated Airlines in the given model.

{P1, P2, P3, P4, P5, P6, P7, P8, P9, P10}- Which are demonstrate planes in the given model.

{CS1, CS2, CS3, CS4, CS5, CS6}- which are control stations in the given model.

{Rains, Fog, Thunder, Flooding, Snowstorm, Other}- which are external factors in the given model.

{J1, J2, J3, J4, J5}- which are demonstrated journeys in the given model.

{ PS1, PS2, PS3, PS4, PS5, PS6, PS7, PS8, PS9, PS10 }- are Passengers in the given model.

{T1,T2……T20}- are the tickets in the given model.

Unary Predicates P1= { Planes, Airports, Passengers, External factors, Control stations, Journey, Routes, Airlines, Tickets }

Binary Predicates P2 = { Person_in_Plane, Direct_Route, Planes_in_Airport, Journey_To, Informs, Airplane_in_Journey }

Ternary Predicates P3 = { Via_Airport, Passenger_in _Journey }

Attribute Functions F1 = { InterconnectRoute, PassthroughAirport, Guides, Intermediate_Stop, Airline-Of, Journey-Of, Ticket-Of }

4. SEMANTIC INTERPRETATION

Logical Constant

|| Reykjavik || = A1, || Dublin || = A2, || Kiev || = A3, || Vienna || = A4, ||Oslo|| = A5, ||Rome|| = A6

|| R1 || = R1, || R2 || = R2, || R3 || = R3, || R4 || = R4, || R5 || = R5, || R6 || = R6

||Luftansa|| = AL1, ||British Airways|| = AL2, ||Air France|| = AL3, ||RyanAir|| = AL4, ||Emirates|| = AL5

||BA138|| = P1, || AF185 || = P2, || LH757 || = P3, || RA468 || = P4, ……. || EK1 || = P10

|| CS1 || = CS1, || CS2 || = CS2, || CS3|| = CS3, || CS4|| = CS4, || CS5 || = CS5

|| Rains || = E1, || Fog || = E2, || Thunder || = E3, ||Flooding|| = E4, ||Snowstorm|| = E5, ||Other|| = E6

|| J1 || = J1, || J2 || = J2, || J3 || = J3, || J4 || = J4, || J5 || = J5

|| Priya || = PS1, || Divya Prackash || = PS2, || John Paul || = PS3,….., || Reetu || = PS10

|| AXUMB|| = T1, || BA1234 || = T2, || AF8877 || = T3, ….., || P4FGT || = T20

Unary Predicates

|| Airports || = {A1, A2, A3, A4, A5, A6} ⊂ A

|| Routes || = {R1, R2, R3, R4, R5, R6} ⊂ R

|| Airlines || = {AL1, AL2, AL3, AL4, AL5} ⊂ AL

|| Planes || = { P1, P2, P3, P4, P5, P6, P7, P8, P9, P10 } ⊂ P

|| Control Stations || = {CS1, CS2, CS3, CS4, CS5} ⊂ CS

|| External Factors || = {E1, E2, E3, E4, E5, E6 } ⊂ E

|| Journey || = {J1, J2, J3, J4, J5} ⊂ J

|| Passengers || = {PS1, PS2, PS3, PS4, PS5, PS6, PS7, PS8, PS9, PS10 } ⊂ PS

|| Tickets || = { T1,T2……T20} ⊂ T

Binary Predicates

|| Person_in_Plane || : $P \times PS = \{< P1, PS1 >, < P2, PS2 >, < P3, PS > \}$,

|| Direct_Route || : $A \times A = \{< A1, A2 >, < A2, A3 >, < A1, A3 > .....\}$,

|| Planes_in_Airport || : $P \times A = \{< A1, P1 >, < A2, P2 >, < A3, P3 > \cdots \}$

|| Journey_To || : $A \times A = \{< A1, A3 >, < R2, B2 >, < R3, B3 > .....\}$,

|| Informs || : $CS \times P = \{< CS1, P1 >, < CS2, P2 >, < CS3, P1 > \cdots \}$

|| Airplane_in_Journey || : $P \times J = \{< J1, P1 >, < J2, P2 >, < J3, P3 > \cdots \}$

Ternary Predicates

||Passenger_in_Journey|| : $PS \times P \times J$ = {<PS1,P4,J3> , <PS4,P10, J8>……}

||Via_Airport|| : $A \times A \times A$ = {<A1,A3,A2> , <A2,A5,A4> …….}

Attribute Functions

||JourneyOf|| : $T \times PS \times P \rightarrow J$ = {<T1,PS2,P3>, <T4,PS1,P1>, ……}

||Guides|| : $CS \times P \rightarrow R$ = {<CS1, P1>, <CS2, P2> , <CS1, P3>…….}

||Intermediate_Stop|| : $A \times A \rightarrow A = \{< A1, A2 >, < A2, A3 >, < A4, A5 >\}$

||Ticket-Of|| : $P \times J \rightarrow T = \{< P3, J1>, < P1, J4>, \ldots\ldots\}$

||Airline-Of|| : $A \rightarrow AL = \{< A1 >, < A3 >, < A4 > .....\}$

Relations

||PassthroughAirport|| : $J \rightarrow A$ = {<J1>, <J2> , <J3>…….}

5. THEORY

5.1 Facts

Airports (Kiev)

Airports (Rome)

Planes (BA138)

Control Stations (CS1)

Airlines (Virgin Atlantic)

Journey (J1)

External Factors (Rain)

Passengers (P2)

Ticket (T1)

Plane_in_Jouney(P1, J1)

Directs(CS1, P1)

Person_in_Plane(PS1, P1)

Pass_through_Airports(A1)

Direct_Route(A1, A2)

5.2 Heuristics

1. Universal
   a. Every plane in journey is directed by some control station
      ∀x ∀y Planes(x) ∩ Journey(y) ∩ Plane_in_Jouney(x,y) → ∃z Control Stations(z) ∩ Directs(x,z)

   b. Every plane in a journey has a passenger
      ∀x ∀y Planes(x) ∩ Journey(y) ∩ Plane_in_Jouney(x,y) → ∃z Passenger(z) ∩ Person_in_Plane(x,z)

   c. Every Journey has a ticket
      ∀x Journey (x) → ∃y Ticket(y) ∩ Ticket-of(y,x)

   d. Every person in a plane is on a journey

$\forall x \forall y$ Planes(x) $\cap$ Passenger(y) $\cap$ Person_in_Plane(x,y) $\rightarrow \exists z$ Ticket(z) $\cap$ Journey-of(z,x,y)

e. Every Journey is linked with airports

$\forall x$ Journey (x) $\rightarrow$ Pass_through_Airports(x)

2. Existential

a. Some journey do not have a direct route

$\exists$ x Journey (x) $\rightarrow \exists y \exists z$ Airports (y) $\cap$ Airports (z) $\cap$ ($\neg$ Direct_Route(y,z))

b. Some journey have external factors

$\exists x$ Journey(x) $\rightarrow \exists y$ External_Factors(y)

c. Some routes form a journey by itself

$\exists x$ Route(x) -> Journey(x)

d. Some Airlines do not do specific journeys

$\exists x$ Airlines(x) $\rightarrow \exists y \neg$Journey(y)