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1 Data Management WS2019/20: Exercise 01 – Data Modeling

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This exercise on data modeling aims to provide practical experience in Entity-Relationship (ER) modeling, ER-relational mapping, and relational normalization. The expected result is a PDF file named `DB.Exercise01-<studentID>.pdf`, submitted in TeachCenter.

1.1 ER Modeling: Airports and Airlines (10/25 points)

Create an ER diagram in Modified Chen (MC) notation—including entity types, relationship types, attribute types, cardinalities, and keys¹—for managing the data of airports, airlines and routes. It's up to you if you use existing tools for data modeling or draw this by hand. The schema should capture the following discourse information:

- Each *airport* has a name, is located in a specific *city*, has geographic coordinates (latitude, longitude and altitude), and has unique 3-letter IATA (International Air Transport Association) and 4-letter ICAO (International Civil Aviation Organization) codes.
- Each *city* is located in exactly one *country* and time zone, which also determines a type of daylight saving time (E—Europe, A—US/Canada, S—South America, O—Australia, Z—New Zealand, N—None or U—Unknown).
- Each *airline* has a name, is or was incorporated in exactly one *country*, has unique 2-letter IATA and 3-letter ICAO codes, and is either active or inactive. *Airlines* cooperate with up to four *frequent flyer programs*, and there are no programs without airlines.
- Each *Route* connects a departure and a destination *airport* and is operated by a single *airline* with up to 16 *plane* types. There are several airports without routes and airlines that do not operate any route though. Each *plane* has a name and is identified by 3-letter IATA and 4-letter ICAO codes.

1.2 Mapping ER Diagrams into the Relational Model (10/25 points)

Create a relational schema for the ER diagram designed in Task 1.1. This schema should include the relations and typed attributes, as well as all primary and foreign keys. It's up to you if you provide a SQL DDL script, or use the following text notation:

`<Table>(<Primary_key>:<type>, <Attribute>:<type>, ..., <Foreign_key>:<type>)`

¹Please, use surrogate keys in case of missing unique identifiers or strings longer than 4 letters.

1.3 Relational Normalization (5/25 points)

Bring the relational schema from Task 1.2 into third normal form by listing any necessary schema changes. Furthermore, please explain in detail—with specifics of your particular schema—why this schema is in 3rd normal form (hence in 1st and 2nd).

1.4 Extra Credit (5 points)

Provide an additional list of all relationship types from Task 1.1 in (min,max)-notation using the following notation:

`<entity1> (min,max) - <relationship> - (min,max) <entity2>`

Furthermore, please list at least four additional semantic or domain constraints for ensuring integrity of the relational schema from Task 1.2 (e.g., see cardinalities in (min,max)-notation, restricted data types, etc).