

# Politecnico di Torino

## Database Management Systems

### *Homework nr. 3*

#### 1. Data Warehouse Design

A district-heating company is providing its services in many Italian cities. Hundreds of thousands of buildings have been connected to the district-heating network by means of special equipment, including an energy sensor able to measure the heating energy consumption of each building every 5 minutes. The equipment also includes an external sensor collecting local air temperature, humidity, pressure, and wind speed. These external data are analyzed by the company and transformed into a single syntetic index of climate level, computed for each sensor every hour. The climate level syntetic index can have a value among the following: hot, warm, cold, very cold. For each building, some structural information is known, such as: the year when it was first built, the total volume of the rooms to heat, the type of building (residential, offices, or public services), the address, the neighborhood, the city district. The district-heating company would like to build a data warehouse to analyze the total energy consumption and the average hourly and daily consumption according to the following dimensions:

- hour of the day, day period (morning 6-12, afternoon 12-18, evening 18-22, night 22-6);
- date, day of the week, holiday (yes/no), day of the year (1-365);
- month, 2-month period, quarter, year;
- billing period (billing periods are: September-October-November, December-January, February-March, and April-May), and heating season (each heating season is from September to May);
- climate level according the the syntetic index;
- building, year when it was first built, total volume of the rooms, type of building (residential, offices, or public services), neighborhood, city district, city, province, region (consider that each neighborhood is in one city district only).

The data warehous must be designed to answer to different queries, among which:

- For each building, for each climate level, and for each day period (morning, afternoon, evening, and night), select the average hourly consumption, and the difference between such value and the global average hourly consumption of each building (i.e., the hourly average across all climate levels and day periods).
- For each type of building and for each heating season, select the consumption percentage of the days of the week. For instance: 22% consumption on Mondays, 16% consumption on Tuesdays, etc.

#### **Design**

- (a) Design the data warehouse, including both the conceptual model and the fact and dimension tables, to address the given specifications. The data warehouse must also allow efficient execution of the following queries.
- (b) Write the following queries using extended SQL language.