Manual Expert System

Hogeschool van Amsterdam

Jan Dorresteijn
500713006

Bas van der Linden
500735218

27 maart 2020

Inhoudsopgave

1. Introductie

This document contains the manual of the second assignment.

In this document we will look at the workings of our vehicle types database. We will explain how we converted our expert system from the the first assignement to a database and what queries we have defined and their mathematical notation.

2. Application

2.1 Introduction

This section will go in detail about the workings, idea's and logic of our database and queries.

2.2 Application

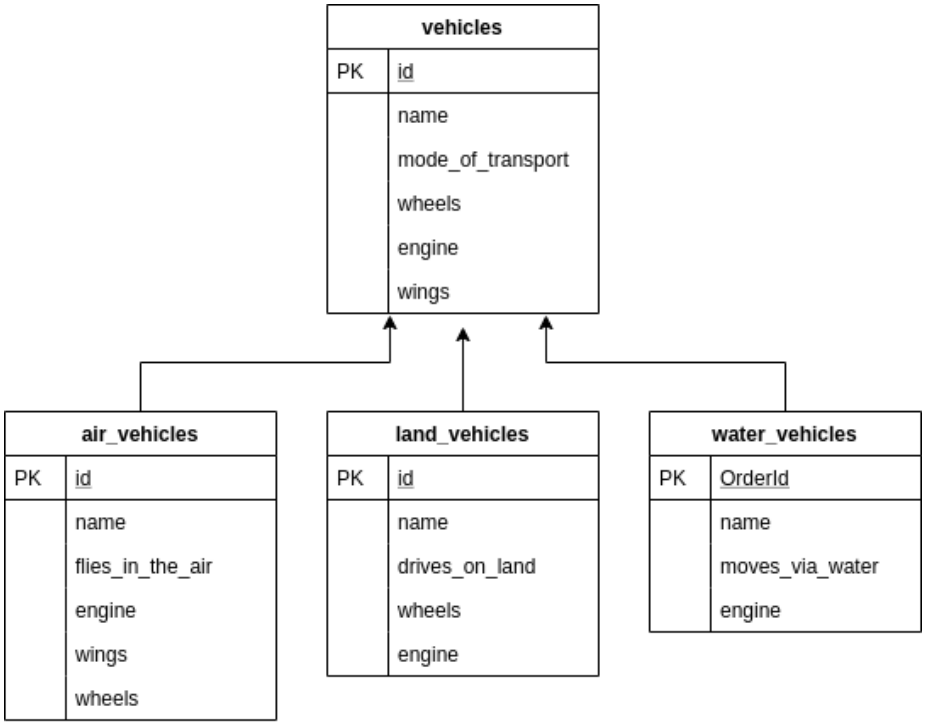
The database is based the expert system we have built in the previous assignment. This system identifies the vehicle type based on user input.

By answering specific questions that the expert system asks, the system is able to deduce and identify the type of a vehicle. An example of a vehicle type defined in our system is 'land vehicle'. A land vehicle, like other vehicle types in our system, also consists of subtypes. Subtypes of land vehicles are cars and bicycles in our expert system.

By answering 'yes' or 'no' to certain questions, the expert system is able to make an educated guess about the type of the vehicle.

This database and accompanying queries tries to translate this functionality into a database. Some vehicle data is inserted into tables. Vehicle subtypes each have their on table in our database (air vehicle, land vehicle, water vehicle). These three tables are merged into a bigger and more general 'vehicles' table. This 'vehicles' table is queried simulating the our vehicle types expert system.

2.2.1 Flowchart



Figuur 2.1: This figure shows a visual representation of our vehicle types database schema

2.3 Usage

The application is run by providing the following command **Rscript pa2.r** (Remove the '.txt' extension from the file if you haven't done so already).

Runnin initializes all functions, tables, queries and other data needed for the program. It also executes all queries at once along with a helpful message telling the user what the query has tried to retrieve from the database.

2.4 Queries

Below will be listed several queries that each test a rule in our expert system. The queries will be listed along with the responses of the system and comments providing extra information.

```
Query: vehicles <- full_join(air_vehicles, land_vehicles) %>%
    full_join(water_vehicles) %>% replace(is.na(.),FALSE)

Result:
% Showing all vehicles in a table
% # A tibble: 9 x 8
    % id name flies\_in\_the\_air engine wings wheels drives\_on\_land
  % <dbl> <chr> <lgl>         <lgl> <lgl> <dbl> <lgl>
    % 1 Airb... TRUE           TRUE  TRUE     20 FALSE
    % 2 Apol... TRUE           TRUE  FALSE     0 FALSE
    % 3 Lock... TRUE           TRUE  TRUE      6 FALSE
    % 1 Ferr... FALSE          TRUE  FALSE     4 TRUE
    % 2 Gaze... FALSE          FALSE FALSE     2 TRUE
    % 3 Yama... FALSE          TRUE  FALSE     2 TRUE
    % 1 Rega... FALSE          TRUE  FALSE     0 FALSE
    % 2 Lizz... FALSE          FALSE FALSE     0 FALSE
    % 3 Lazz... FALSE          TRUE  FALSE     0 FALSE
% # ... with 1 more variable: moves\_via\_water <lgl>
```

```
Query:
bicycles <- vehicles %>% filter(drives_on_land == TRUE, wheels == 2,
    engine == FALSE)

Result:
% Showing all bicycles in a table
% # A tibble: 1 x 8
    % id name flies\_in\_the\_air engine wings wheels drives\_on\_land
  % <dbl> <chr> <lgl>         <lgl> <lgl> <dbl> <lgl>
% 1    2 Gaze... FALSE         FALSE FALSE     2 TRUE
% # ... with 1 more variable: moves\_via\_water <lgl>
```

```
Query:
motor_bikes <- vehicles %>% filter(drives_on_land == TRUE, wheels == 2,
    engine == TRUE)

Result:
% Showing all motor bikes in a table
```

```
%
% # A tibble: 1 x 8
    % id name flies_in_the_air engine wings wheels drives_on_land
  % <dbl> <chr> <lgl>          <lgl> <lgl> <dbl> <lgl>
% 1     3 Yama... FALSE          TRUE   FALSE     2 TRUE
% # ... with 1 more variable: moves_via_water <lgl>
```

```
Query:
cars <- vehicles %>% filter(drives_on_land == TRUE, wheels == 4, engine
    == FALSE)

Result:
% Showing all cars in a table
%
% # A tibble: 0 x 8
% # ... with 8 variables: id <dbl>, name <chr>, flies_in_the_air <lgl>,
% #   engine <lgl>, wings <lgl>, wheels <dbl>, drives_on_land <lgl>,
% #   moves_via_water <lgl>
```

```
Query:
airplanes <- vehicles %>% filter(flies_in_the_air == TRUE, wings ==
    TRUE, engine == TRUE, wheels > 3)

Result:
% Showing all airplanes in a table
%
% # A tibble: 2 x 8
    % id name flies_in_the_air engine wings wheels drives_on_land
  % <dbl> <chr> <lgl>          <lgl> <lgl> <dbl> <lgl>
% 1     1 Airb... TRUE           TRUE   TRUE     20 FALSE
% 2     3 Lock... TRUE           TRUE   TRUE      6 FALSE
% # .... with 1 more variable: moves_via_water <lgl>
```

```
Query:
space_crafts <- vehicles %>% filter(flies_in_the_air == TRUE, engine ==
    TRUE, wheels == 0)


Result:
% Showing all space crafts in a table
%
% # A tibble: 1 x 8
```

```
    % id name flies_in_the_air engine wings wheels drives_on_land
  % <dbl> <chr> <lgl>         <lgl> <lgl> <dbl> <lgl>
% 1    2 Apol... TRUE          TRUE  FALSE     0 FALSE
% # ... with 1 more variable: moves_via_water <lgl>
```

```
Query:
boats <- vehicles %>% filter(moves_via_water == TRUE)

Result:
% Showing all boats in a table
%
% # A tibble: 3 x 8
    % id name flies\_in\_the\_air engine wings wheels drives_on_land
  % <dbl> <chr> <lgl>         <lgl> <lgl> <dbl> <lgl>
% 1    1 Rega... FALSE         TRUE  FALSE     0 FALSE
% 2    2 Lizz... FALSE         FALSE FALSE     0 FALSE
% 3    3 Lazz... FALSE         TRUE  FALSE     0 FALSE
% # ... with 1 more variable: moves_via_water <lgl>
```

2.5 Logical Correspondence between current program and expert system

Database	**Logical Correspondence**
vehicles <- full_join(air_vehicles, land_vehicles) %>% full_join(water_vehicles)...	$A \cup L \cup W = \{t \| t \in A \bigvee t \in L \bigvee t \in W\}$
bicycles <- vehicles %>% filter(drives_on_land == TRUE, wheels == 2, engine == FALSE)	$\{t \| t \in LandVehicles \bigwedge t.wheels = 2 \bigwedge t.engine = false)\}$
motor_bikes <- vehicles %>% filter(drives_on_land == TRUE, wheels == 2, engine == TRUE)	$\{t \| t \in LandVehicles \bigwedge t.wheels = 2 \bigwedge t.engine = true)\}$
cars <- vehicles %>% filter(drives_on_land == TRUE, wheels == 4, engine == TRUE)	$\{t \| t \in LandVehicles \bigwedge t.wheels = 4 \bigwedge t.engine = true)\}$
airplanes <- vehicles %>% filter(flies_in_the_air == TRUE, wings == TRUE, engine == TRUE, wheels > 3)	$\{t \| t \in AirVehicles \bigwedge t.wings = true \bigwedge t.engine = true \bigwedge t.wheels > 3)\}$
space_crafts <- vehicles %>% filter(flies_in_the_air == TRUE, engine == TRUE, wheels == 0)	$\{t \| t \in AirVehicles \bigwedge t.wheels = 0 \bigwedge t.engine = true)\}$
boats <- vehicles %>% filter(moves_on_water == TRUE)	$\{t \| t \in WaterVehicles\}$