

Mercantile Ships

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Abstract

In this document I will showcase the 3 stages of design of the "Mercantile Ships" Database.

In this effort, and under permission from the requirements file, I made some decisions regarding the techniques and tools used in the design process.

In some extreme cases I had to settle for a less than optimal solution either for conformity purposes (the solution conforms best to the design stage) or for practicality, or for highlighting the optimal solution.

Design and Tool Choices

Having Ubuntu linux as my main operating system, I had a small set of tools to choose from, the obvious ones anyways.

For the Conceptual Schema, Dia was the most suggested on general forums, but it is highly outdated and full of bugs (as tested on my system), also it didn't offer any integrated features.

This is why I chose **MySQL Workbench**, it comes the most recommended from DB professionals, doesn't offer ER design capability, but better, it comes equipped with an EER designer, it offers backward engineering, forward engineering, SQL scripting, python scripting, SQL database connection, and with its SQL linter/debugger, the three stages of the DB design get improved live and professionally.

One note on MySQL Workbench, on its default settings, it only cares about relationships that translate into Foreign Keys, all other operations can be added as SQL routines(procedures)/triggers/scripts. Which makes sense, because this is how we actually translate from Conceptual Design to Logical Design.

But, the EER model in MySQL Workbench can be tweaked a little if someone wants to to add non-key-type relations. However, I chose to stick with the defaults.

Final note, MySQL Workbench provides both Conceptual EERD and Logical EERD: the first being offered with Crow's Foot Notation, the second with "Matching Columns to Columns" to simulate a graphical logical schema.

There are some other tools which I found (rather late), like draw.io, it's just a modeling tool, much like Dia, but it is more up to date and it has some nice features like adding your own shape (you have to script it in xml) so you can represent any special types of entities or relationships that are not present in the default palette.

Also, initially I only looked for tools concerning MySQL, but after doing a big portion of the project, I discovered pgModeler for PostgreSQL, which would have been better in terms of Conceptual Design because it represents non-key-type relations more out of the box and much better.

For testing the database I initially used phpMyAdmin, but due to its lack of proper support for delimiters in stored procedure I had to switch to **Adminer**.

As for the documentation, nothing beats **Latex** and **texstudio**!

Conceptual Schema

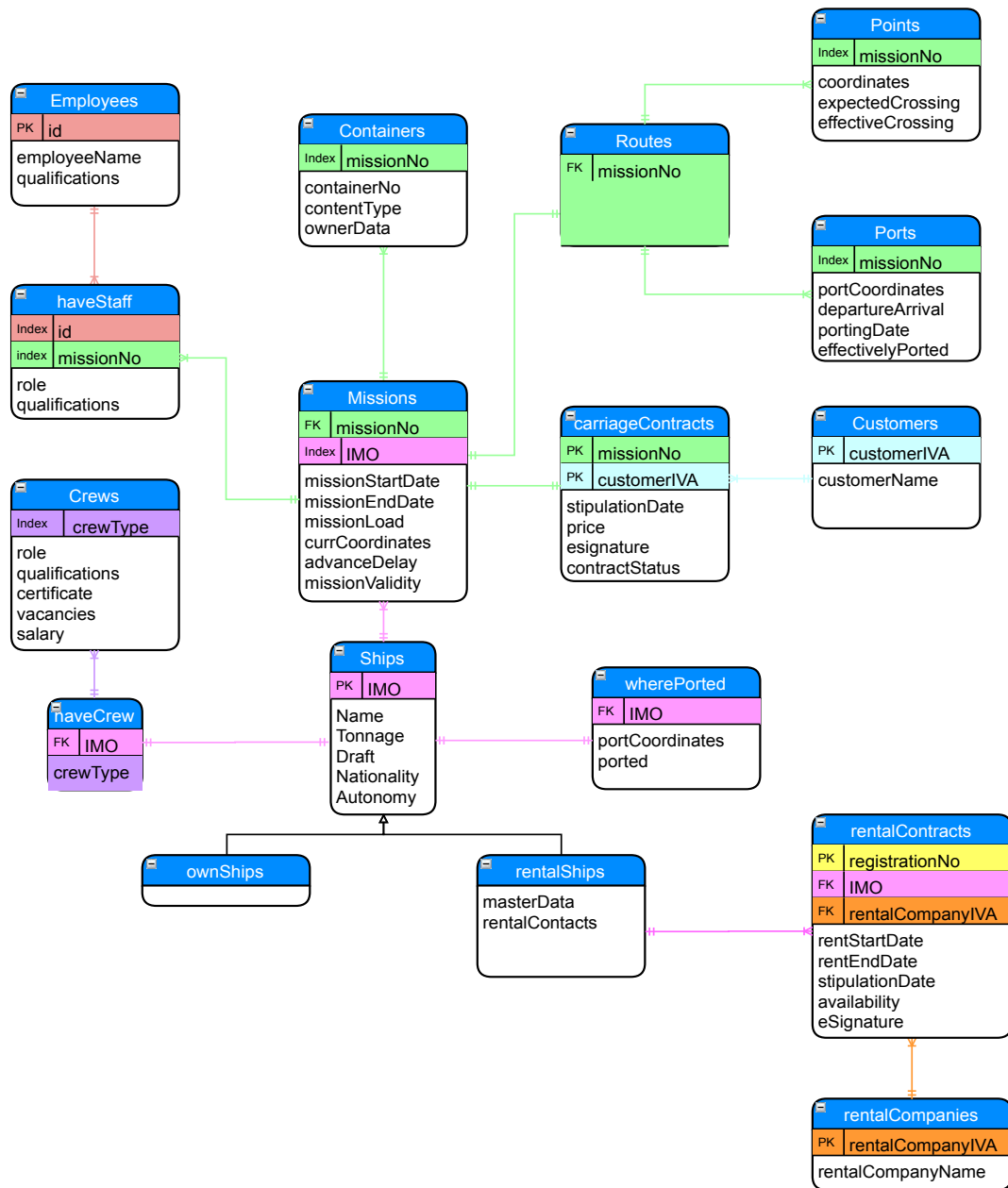
In this schema I used Crow's Foot notation, mainly because it is the one adopted by the two CASE tools I used (MySQL WorkBench, draw.io).

With this notation, relationships cannot have attributes. Where necessary, relationships are promoted to entities in their own right. Where relationships are not promoted to entities, they represent external identifiers as foreign key or index attributes present in both entities on the left and right hand side.

This results in the following:

- adaptation of external identifiers into foreign keys early on in the conceptual design stage.
- selection of primary identifiers can also be done in the conceptual design stage.
- many-to-many relationships are replaced with entities right in the conceptual design stage.

Conceptual ERD with Crow's Foot (IE) Notation



Data Dictionary - Entities

Entity	Description	Attributes	Identifier
Ships	Represents all Ships.	IMO, name, tonnage, nationality, draft, autonomy	IMO
ownShips	Represents Company Ships.	IMO	IMO
rentalShips	Represents Ship Rented from Rental Companies.	IMO, masterData, rentalCompanyContacts	IMO
rentalCompanies	Companies we rent ships from	rentalCompanyIVA, rentalCompanyName, registrationNo,	rentalCompanyIVA
rentalContracts	Contracts between our company and the companies we rent ships from.	rentalCompanyIVA, IMO, rentStartDate, rentEndDate, availability, esignature	registrationNo
haveCrew	Represents associations between certain ships and certain crew types.	IMO, crewType	IMO
Crews	represent the various roles of the various crew types.	Pk, crewType, role, qualifications, certificate, vacancies, salary	pk
wherePorted	represents the current port of each ship in the present, independent of mission ports.	IMO, portCoordinates, ported	IMO
Missions	represents the missions corresponding to carriage contracts.	missionNo, IMO, missionStartDate, missionEndDate, missionLoad, advanceDelay, currCoordinates, missionValidity	missionNo
Employees	represents all the employees of the company, regardless of their current specific occupation at the company.	id, employeeName, qualifications	id
haveStaff	represents the staff of each mission, who are picked from the employees according to crew type.	missionNo, id, role, qualifications.	missionNo
Customers	represents the customers who want to request carriage missions.	customerIVA, customerName	customerIVA
carriageContracts	carriage contracts between our company and a customer.	missionNo, customerIVA, stipulationDate, price, esignature, contractStatus	missionNo
Containers	describes each individual container of each mission.	missionNo, containerNo, contentType, ownerData	missionNo
routes	identifies the route of each mission	missionNo	missionNo
Points	represents the geographic points of each route.	missionNo, coordinates, expectedCrossing, effectiveCrossing	missionNo
Ports	represents ports associated with missions.	missionNo, portCoordinates, departureArrival, portingDate, effectivelyPorted	missionNo

Business Rules – Constraints

- BR1 Every rentalShips or ownShips entry must have a Ships entry to associate it with.
Every rentalContracts Entry must have a rentalShip and a rentalCompany added to their tables respectively.
- BR2
- BR3 Every haveCrew entry must have a Ship to associate it with.
- BR4 Every wherePorted entry must have a Ship to associate it with.
- BR5 Every Crews entry must have a haveCrew entry to associate it with.
- BR6 Every carriageContracts entry must have a Customers entry to associate it with.
Every Missions entry must have both a carriageContracts entry and a Ships entry to associate it with.
- BR7
- BR8 Every haveStaff must only be added after a proper Ships entry has been assigned to the Missions entry.
- BR9 Every haveStaff entry must only be added if the staff is available in the Missions entry date parameters.
- BR10 Every Ships entry associated with the Missions entry must satisfy availability within the Missions entry date Parameters.
- BR11 Every Ships entry associated with the Missions entry must satisfy same wherePorted or Ports entry in respect to the Missions entry date parameters.
- BR12 Every haveStaff entry should satisfy the Qualifications of the Crews entry associated via haveCrew entry to the Ships entry which is in turn associated with the Missions entry.
- BR13 Every haveStaff entry must correspond to a Employees entry already present.
- BR14 Every containers entry must correspond to a Missions entry already present.
- BR15 Every Routes entry must correspond to a Missions entry already present.
- BR16 Every Points entry must correspond to a Routes entry already present.
- BR17 Every Ports entry must correspond to a Routes entry already present.

Business Rules – Derivations

- BR18 calculateTurnOver of the last 30 days is obtained by summing price cell of the Missions entries that have stipulationDate cell which has less than 30 days difference from now.
detectCollision is obtained by comparing likeliness in coordinates cell in Points entries corresponding to Routes entries corresponding to Missions entries that have intersecting startDate and endDate cell values.
- BR19
- BR20 missionLoad is obtained by summing the number of Containers entries associated with the Missions entry.
- BR21 missionValidity is obtained by comparing missionLoad of the Missions entry to the tonnage of the associated Ships entry
- BR22 checkPersonnelNo is obtained by summing the number of haveStaff entries corresponding to the Missions entry.

From ER to Relational Model

During the Conceptual design stage I made sure to analyze and reduce redundancies as I was constructing the entities, I also made sure no entity crossed with another and therefor there was no need for collapse or merger of entities (except for the route entity which I alerted to its presence in the Notes on Efficiency section).

The only thing left to do was removal of a generalization, which I chose to do it following the **”Substitution of the generalization with relationships”** method.

The resulting translated tables were as the following:

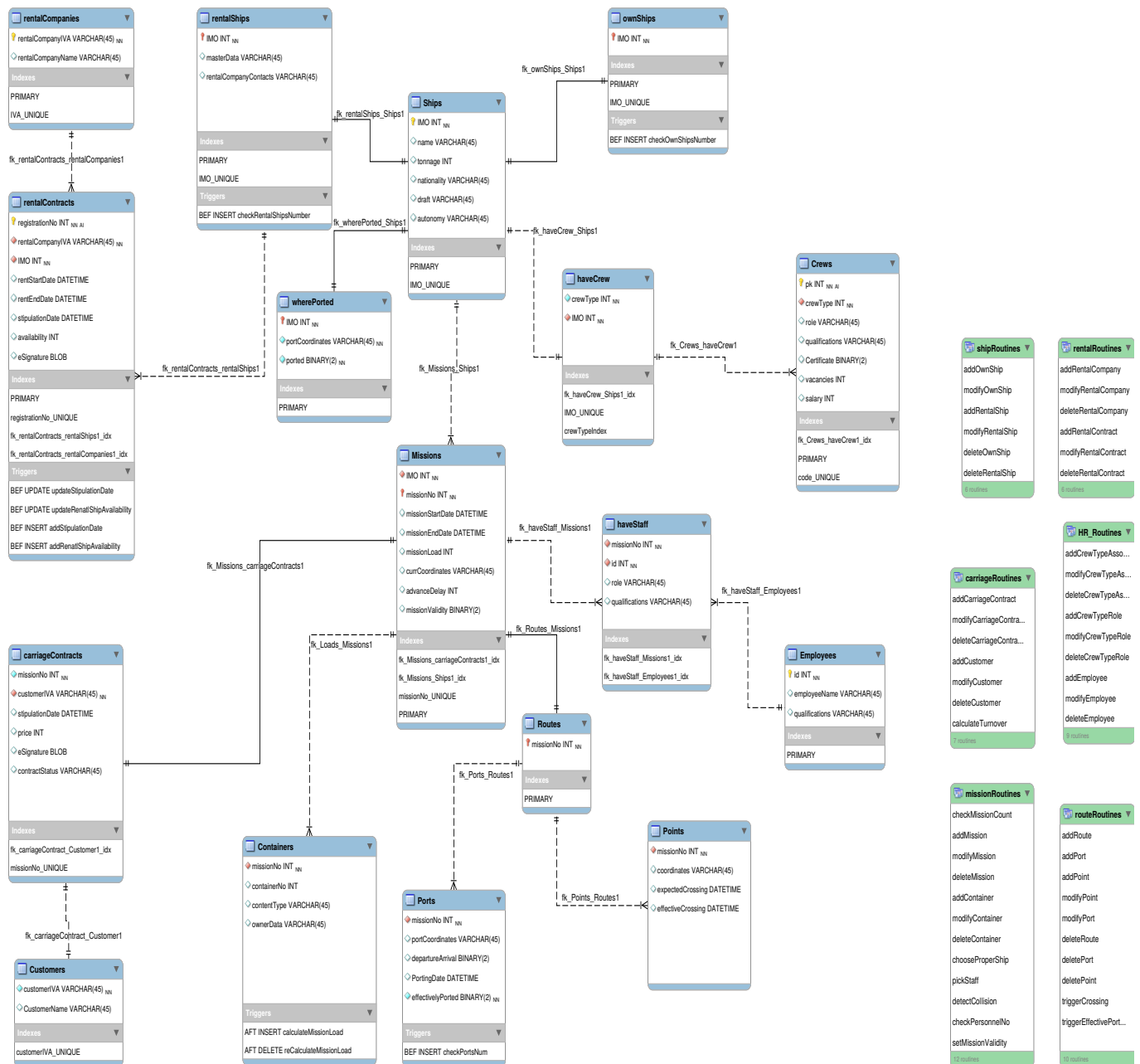
Ships(IMO, name, tonnage, draft, autonomy, nationality)
ownShips(IMO)
rentalShips(IMO, masterData, rentalContacts)
rentalCompanies(rentalCompanyIVA, rentalCompanyName)
rentalContracts(registrationNo, rentalCompanyIVA, IMO, rentStartDate, rentEndDate, availability, eSignature)
wherePorted(IMO, portCoordinates, ported)
haveCrew(IMO, crewType)
Crews(*crewType*, role, qualifications, certificate, vacancies, salary)¹
Missions(missionNo, IMO, missionStartDate, missionEndDate, missionLoad, currCoordinates, advanceDelay, missionValidity)
Customers(customerIVA, customerName)
Employees(id, employeeName, qualifications)
carriageContracts(missionNo, customerIVA, stipulationDate, price, eSignature, contractStatus)
haveStaff (*id*, *missionNo*, role, qualifications)¹
Containers(*missionNo*, containerNo, contentType, ownerData)¹
Routes(missionNo)
Ports(*missionNo*, portCoordinates, departureArrival, portingDate, effectivelyPorted)¹
Points(*missionNo*, coordinates, expectedCrossing, effectiveCrossing)¹

¹attributes in italic represent indexes

The resulting translated foreign key relations were as the following:

```
fk_rentalContracts_rentalCompanies1(rentalContracts.rentalCompanyIVA,  
rentalCompanies.rentalCompanyIVA)  
fk_rentalContracts_rentalShips1(rentalContracts.IMO, rentalShips.IMO)  
fk_rentalShips_Ships1(rentalShips.IMO,Ships.IMO)  
fk_ownShips_Ships1(ownShips.IMO, Ships.IMO)  
fk_wherePorted_Ships1(wherePorted.IMO, Ships.IMO)  
fk_haveCrew_Ships1(haveCrew.IMO, Ships.IMO)  
fk_Crews_haveCrew1(Crews.crewType, haveCrews.crewType)  
fk_Missions_Ships1(Missions.IMO, Ships.IMO)  
fk_carriageContract_Customer1(carriageContracts.customerIVA, Customers.customerIVA)  
fk_Missions_carriageContracts1(Missions.MissionNo, carriageContracts.MissionNo)  
fk_haveStaff_Employees1(haveStaff.id, Employees.id)  
fk_haveStaff_Missions1(haveStaff.missionNo, Missions.missionNo)  
fk_Loads_Missions1(Containers.missionNo, Missions.missionNo)  
fk_Routes_Missions1(Routes.missionNo, Missions.missionNo)  
fk_Ports_Routes1(Ports.missionNo, Routes.missionNo)  
fk_Points_Routes1(Points.missionNo, Routes.missionNo)
```

Relational EERD with Crow's Foot (IE) Notation



Logical EERD with Column Matching Notation

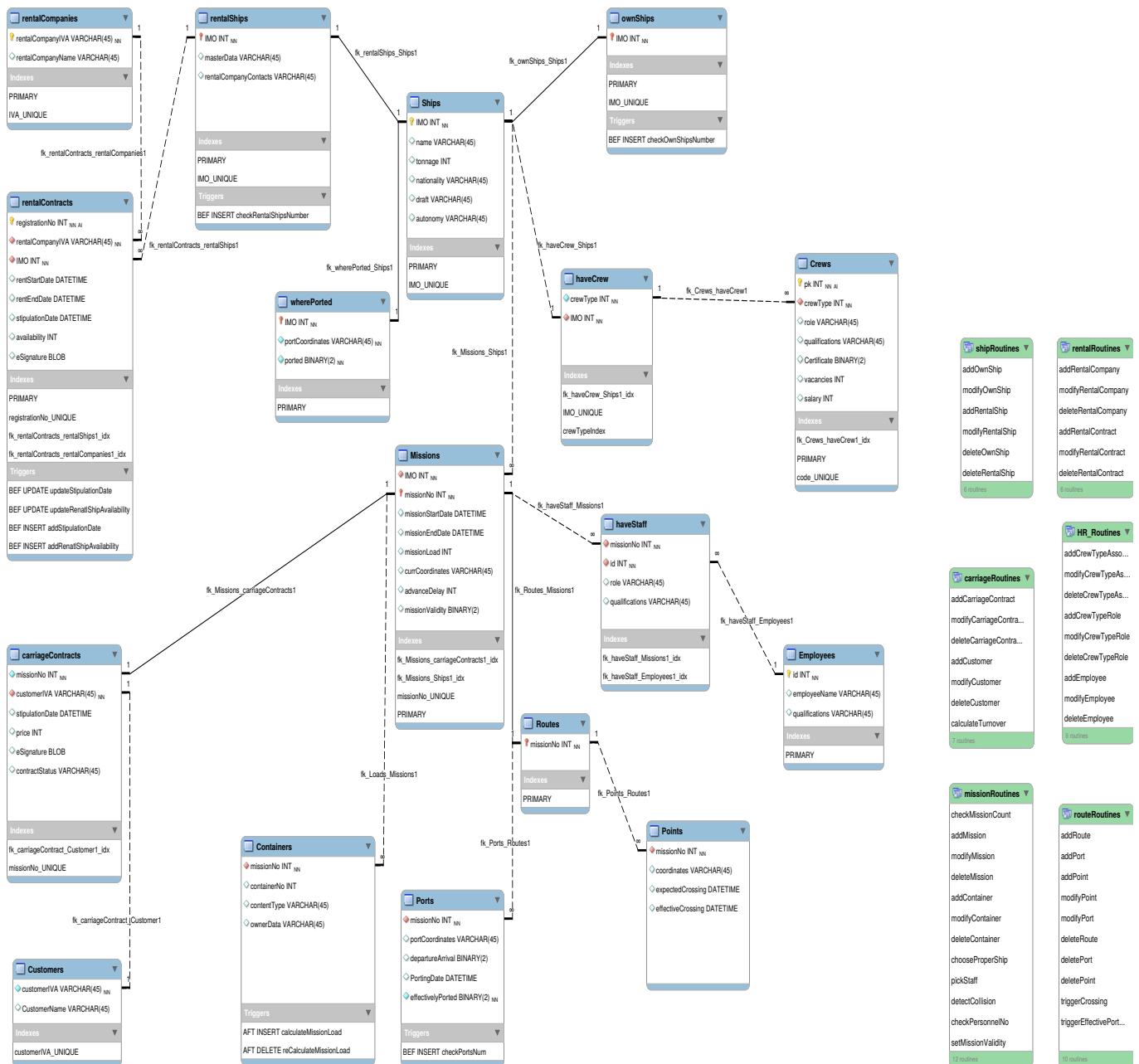


Table of Volumes (after 1 Year)

Table	Size Range	Notes
Ships	30 – 100	30 total ships on average, amped up to 100 to fill a 100 missions in a worst case scenario.
ownShips	10 – 10	
rentalShips	20 – 90	20 rental ships on average, amped up to 90 to fill a 100 missions in a worst case scenario.
rentalCompanies	1 – 90	
rentalContracts	20 – 90	
wherePorted	30 – 100	
haveCrew	30 – 100	
Crews	25 – 2500	100 missions, 25 crew roles (2500 in a worst case scenario).
Customers	1 – 100	
Missions	100 – 100	
carriageContracts	100 – 100	
Containers	300000 – 600000	
Employees	25 – 2500	
haveStaff	2500 – 2500	
routes	100 – 100	each mission has 25 unique staff entries, 100 missions have 2500.
Points	$100 * x - 100 * y$	100 missions per year, unknown number of points.
Ports	200 – 200	100 missions per year, 2 ports each.

Table of Routines

Procedure/Trigger	Frequency (per Year)	Notes
calculateTurnover	12	12 months per year
chooseProperShip	100	100 missions per year
pickStaff	100	
detectCollision	100	
checkPersonnelNo	100	
setMissionValidity	100	
triggerEffectivePorting	200	100 missions per year, 2 ports each.
triggerEffectiveCrossing	$100 * x - 100 * y$	100 missions per year, unknown number of points.
calculateMissionLoad	100	100 missions per year
reCalculateMissionLoad	297000 – 594000	100 missions per year, 3000 – 6000 containers each.
checkOwnShipsNumber	0 – 10	10 company ships
checkRentalShipsNumber	0 – 90	
addStipulationDate	0 – 90	
updateStipulationDate	0 – 90	
addRentalShipAvailability	0 – 90	
updateRentalShipAvailability	0 – 90	

Tables of Accesses

Table	Accesses (per Day)	Type
Ships	0 – 360	R
Missions	0 – 120	R
ownShips	0 – 330	R
rentalShips	0 – 30	R
Containers	90000 – 180000	W
haveStaff	1800	R
haveStaff	0 – 750	W
Routes	0 – 120	R
Points	0 – 120 * x	R
Points	0 – 30 * x	W
Ports	0 – 150	R
Ports	0 – 60	W
Employees	0 – 60	R
Routes	0	R/W
haveCrew	0 – 60	R
Crews	30	R
wherePorted	30	R

Note: each of these entries were calculated by taking into consideration that all entries could be accessed by the procedures in a day (for example, all 30/30 ships on average) then multiplying that number by the number of accesses (Select in case of Read, Insert/Update in case of Write).

Notes on Efficiency

As we can see in the table of accesses, the **Routes** table is accessed very rarely, and it imposes an un-necessary structural redundancy (only contains missionNo), therefor should be deleted and substituted with the "**missionNo**" attribute in the **Missions** table.

Also, the **ownShips** table is accessed as frequently as the **Ships** table, but poses another un-necessary structural redundancy, therefor should be deleted and substituted with a binary attribute "**isOwn**" in the **Ships** table.

Physical Schema - MySQL Code (Tables, Constraints, Triggers, Procedures)

```
-- MySQL Script generated by MySQL Workbench
-- dom 14 gen 2018 02:07:18 CET
-- Model: Mercantile Ships    Version: 1.0
-- MySQL Workbench Forward Engineering

SET @OLD_UNIQUE_CHECKS=@@UNIQUE_CHECKS, UNIQUE_CHECKS=0;
SET @OLD_FOREIGN_KEY_CHECKS=@@FOREIGN_KEY_CHECKS, FOREIGN_KEY_CHECKS=0;
SET @OLD_SQL_MODE=@@SQL_MODE, SQL_MODE='TRADITIONAL,ALLOW_INVALID_DATES';

-- -----
-- Schema Mercantile Ships
-- -----

-- -----
-- Schema Mercantile Ships
-- -----

CREATE SCHEMA IF NOT EXISTS 'Mercantile Ships' DEFAULT CHARACTER SET utf8 ;
USE 'Mercantile Ships' ;

-- -----
-- Table 'Mercantile Ships'. 'Ships'
-- -----

CREATE TABLE IF NOT EXISTS 'Mercantile Ships'. 'Ships' (
  'IMO' INT NOT NULL,
  'name' VARCHAR(45) NULL,
  'tonnage' INT NULL,
  'nationality' VARCHAR(45) NULL,
  'draft' VARCHAR(45) NULL,
  'autonomy' VARCHAR(45) NULL,
  PRIMARY KEY ('IMO'),
  UNIQUE INDEX 'IMO_UNIQUE' ('IMO' ASC))
ENGINE = InnoDB;

-- -----
-- Table 'Mercantile Ships'. 'rentalCompanies'
-- -----

CREATE TABLE IF NOT EXISTS 'Mercantile Ships'. 'rentalCompanies' (
  'rentalCompanyIVA' VARCHAR(45) NOT NULL,
  'rentalCompanyName' VARCHAR(45) NULL,
  PRIMARY KEY ('rentalCompanyIVA'),
  UNIQUE INDEX 'IVA_UNIQUE' ('rentalCompanyIVA' ASC))
ENGINE = InnoDB;

-- -----
-- Table 'Mercantile Ships'. 'rentalShips'
-- -----

CREATE TABLE IF NOT EXISTS 'Mercantile Ships'. 'rentalShips' (
  'IMO' INT NOT NULL,
  'masterData' VARCHAR(45) NULL,
  'rentalCompanyContacts' VARCHAR(45) NULL,
  PRIMARY KEY ('IMO'),
  UNIQUE INDEX 'IMO_UNIQUE' ('IMO' ASC),
```

```

CONSTRAINT 'fk_rentalShips_Ships1'
  FOREIGN KEY ('IMO')
  REFERENCES 'Mercantile Ships'.'Ships' ('IMO')
  ON DELETE CASCADE
  ON UPDATE CASCADE)
ENGINE = InnoDB;

```

```

-----
-- Table 'Mercantile Ships'.'ownShips'
-----

```

```

CREATE TABLE IF NOT EXISTS 'Mercantile Ships'.'ownShips' (
  'IMO' INT NOT NULL,
  PRIMARY KEY ('IMO'),
  UNIQUE INDEX 'IMO_UNIQUE' ('IMO' ASC),
  CONSTRAINT 'fk_ownShips_Ships1'
    FOREIGN KEY ('IMO')
    REFERENCES 'Mercantile Ships'.'Ships' ('IMO')
    ON DELETE CASCADE
    ON UPDATE CASCADE)
ENGINE = InnoDB;

```

```

-----
-- Table 'Mercantile Ships'.'rentalContracts'
-----

```

```

CREATE TABLE IF NOT EXISTS 'Mercantile Ships'.'rentalContracts' (
  'registrationNo' INT NOT NULL AUTO_INCREMENT,
  'rentalCompanyIVA' VARCHAR(45) NOT NULL,
  'IMO' INT NOT NULL,
  'rentStartDate' DATETIME NULL,
  'rentEndDate' DATETIME NULL,
  'stipulationDate' DATETIME NULL,
  'availability' INT NULL,
  'eSignature' BLOB NULL,
  PRIMARY KEY ('registrationNo'),
  UNIQUE INDEX 'registrationNo_UNIQUE' ('registrationNo' ASC),
  INDEX 'fk_rentalContracts_rentalShips1_idx' ('IMO' ASC),
  INDEX 'fk_rentalContracts_rentalCompanies1_idx' ('rentalCompanyIVA' ASC),
  CONSTRAINT 'fk_rentalContracts_rentalShips1'
    FOREIGN KEY ('IMO')
    REFERENCES 'Mercantile Ships'.'rentalShips' ('IMO')
    ON DELETE CASCADE
    ON UPDATE CASCADE,
  CONSTRAINT 'fk_rentalContracts_rentalCompanies1'
    FOREIGN KEY ('rentalCompanyIVA')
    REFERENCES 'Mercantile Ships'.'rentalCompanies' ('rentalCompanyIVA')
    ON DELETE CASCADE
    ON UPDATE CASCADE)
ENGINE = InnoDB;

```

```

-----
-- Table 'Mercantile Ships'.'Customers'
-----

```

```

CREATE TABLE IF NOT EXISTS 'Mercantile Ships'.'Customers' (
  'customerIVA' VARCHAR(45) NOT NULL,
  'CustomerName' VARCHAR(45) NULL,

```



```

    UNIQUE INDEX 'customerIVA_UNIQUE' ('customerIVA' ASC))
ENGINE = InnoDB;

```

```

-----
-- Table 'Mercantile Ships'. 'carriageContracts'
-----

```

```

CREATE TABLE IF NOT EXISTS 'Mercantile Ships'. 'carriageContracts' (
    'missionNo' INT NOT NULL,
    'customerIVA' VARCHAR(45) NOT NULL,
    'stipulationDate' DATETIME NULL,
    'price' INT NULL,
    'eSignature' BLOB NULL,
    'contractStatus' VARCHAR(45) NULL,
    INDEX 'fk_carriageContract_Customer1_idx' ('customerIVA' ASC),
    UNIQUE INDEX 'missionNo_UNIQUE' ('missionNo' ASC),
    CONSTRAINT 'fk_carriageContract_Customer1'
        FOREIGN KEY ('customerIVA')
        REFERENCES 'Mercantile Ships'. 'Customers' ('customerIVA')
        ON DELETE CASCADE
        ON UPDATE CASCADE)
ENGINE = InnoDB;

```

```

-----
-- Table 'Mercantile Ships'. 'Missions'
-----

```

```

CREATE TABLE IF NOT EXISTS 'Mercantile Ships'. 'Missions' (
    'IMO' INT NOT NULL,
    'missionNo' INT NOT NULL,
    'missionStartDate' DATETIME NULL,
    'missionEndDate' DATETIME NULL,
    'missionLoad' INT NULL,
    'currCoordinates' VARCHAR(45) NULL,
    'advanceDelay' INT NULL,
    'missionValidity' BINARY(2) NULL DEFAULT 0,
    INDEX 'fk_Missions_carriageContracts1_idx' ('missionNo' ASC),
    INDEX 'fk_Missions-Ships1_idx' ('IMO' ASC),
    UNIQUE INDEX 'missionNo_UNIQUE' ('missionNo' ASC),
    PRIMARY KEY ('missionNo'),
    CONSTRAINT 'fk_Missions_carriageContracts1'
        FOREIGN KEY ('missionNo')
        REFERENCES 'Mercantile Ships'. 'carriageContracts' ('missionNo')
        ON DELETE CASCADE
        ON UPDATE CASCADE,
    CONSTRAINT 'fk_Missions-Ships1'
        FOREIGN KEY ('IMO')
        REFERENCES 'Mercantile Ships'. 'Ships' ('IMO')
        ON DELETE CASCADE
        ON UPDATE CASCADE)
ENGINE = InnoDB;

```

```

-----
-- Table 'Mercantile Ships'. 'haveCrew'
-----

```

```

CREATE TABLE IF NOT EXISTS 'Mercantile Ships'. 'haveCrew' (
    'crewType' INT NOT NULL,

```

```

    'IMO' INT NOT NULL,
    INDEX 'fk_haveCrew_Ships1_idx' ('IMO' ASC),
    UNIQUE INDEX 'IMO_UNIQUE' ('IMO' ASC),
    INDEX 'crewTypeIndex' ('crewType' ASC),
    CONSTRAINT 'fk_haveCrew_Ships1'
        FOREIGN KEY ('IMO')
        REFERENCES 'Mercantile Ships'.'Ships' ('IMO')
        ON DELETE CASCADE
        ON UPDATE CASCADE)
ENGINE = InnoDB;

```

```

-----
-- Table 'Mercantile Ships'.'Crews'
-----

```

```

CREATE TABLE IF NOT EXISTS 'Mercantile Ships'.'Crews' (
    'pk' INT NOT NULL AUTO_INCREMENT,
    'crewType' INT NOT NULL,
    'role' VARCHAR(45) NULL,
    'qualifications' VARCHAR(45) NULL,
    'Certificate' BINARY(2) NULL,
    'vacancies' INT NULL,
    'salary' INT NULL,
    INDEX 'fk_Crews_haveCrew1_idx' ('crewType' ASC),
    PRIMARY KEY ('pk'),
    UNIQUE INDEX 'code_UNIQUE' ('pk' ASC),
    CONSTRAINT 'fk_Crews_haveCrew1'
        FOREIGN KEY ('crewType')
        REFERENCES 'Mercantile Ships'.'haveCrew' ('crewType')
        ON DELETE CASCADE
        ON UPDATE CASCADE)
ENGINE = InnoDB;

```

```

-----
-- Table 'Mercantile Ships'.'Routes'
-----

```

```

CREATE TABLE IF NOT EXISTS 'Mercantile Ships'.'Routes' (
    'missionNo' INT NOT NULL,
    PRIMARY KEY ('missionNo'),
    CONSTRAINT 'fk_Routes_Missions1'
        FOREIGN KEY ('missionNo')
        REFERENCES 'Mercantile Ships'.'Missions' ('missionNo')
        ON DELETE CASCADE
        ON UPDATE CASCADE)
ENGINE = InnoDB;

```

```

-----
-- Table 'Mercantile Ships'.'Points'
-----

```

```

CREATE TABLE IF NOT EXISTS 'Mercantile Ships'.'Points' (
    'missionNo' INT NOT NULL,
    'coordinates' VARCHAR(45) NULL,
    'expectedCrossing' DATETIME NULL,
    'effectiveCrossing' DATETIME NULL,
    CONSTRAINT 'fk_Points_Routes1'
        FOREIGN KEY ('missionNo')

```

```

REFERENCES 'Mercantile Ships'. 'Routes' ('missionNo')
ON DELETE CASCADE
ON UPDATE CASCADE)
ENGINE = InnoDB;

```

```

-----
-- Table 'Mercantile Ships'. 'Ports'
-----

```

```

CREATE TABLE IF NOT EXISTS 'Mercantile Ships'. 'Ports' (
  'missionNo' INT NOT NULL,
  'portCoordinates' VARCHAR(45) NULL,
  'departureArrival' BINARY(2) NULL,
  'PortingDate' DATETIME NULL,
  'effectivelyPorted' BINARY(2) NOT NULL DEFAULT false,
  CONSTRAINT 'fk_Ports_Routes1'
    FOREIGN KEY ('missionNo')
    REFERENCES 'Mercantile Ships'. 'Routes' ('missionNo')
    ON DELETE CASCADE
    ON UPDATE CASCADE)
ENGINE = InnoDB;

```

```

-----
-- Table 'Mercantile Ships'. 'Containers'
-----

```

```

CREATE TABLE IF NOT EXISTS 'Mercantile Ships'. 'Containers' (
  'missionNo' INT NOT NULL,
  'containerNo' INT NULL,
  'contentType' VARCHAR(45) NULL,
  'ownerData' VARCHAR(45) NULL,
  CONSTRAINT 'fk_Loads_Missions1'
    FOREIGN KEY ('missionNo')
    REFERENCES 'Mercantile Ships'. 'Missions' ('missionNo')
    ON DELETE CASCADE
    ON UPDATE CASCADE)
ENGINE = InnoDB;

```

```

-----
-- Table 'Mercantile Ships'. 'Employees'
-----

```

```

CREATE TABLE IF NOT EXISTS 'Mercantile Ships'. 'Employees' (
  'id' INT NOT NULL,
  'employeeName' VARCHAR(45) NULL,
  'qualifications' VARCHAR(45) NULL,
  PRIMARY KEY ('id'))
ENGINE = InnoDB;

```

```

-----
-- Table 'Mercantile Ships'. 'haveStaff'
-----

```

```

CREATE TABLE IF NOT EXISTS 'Mercantile Ships'. 'haveStaff' (
  'missionNo' INT NOT NULL,
  'id' INT NOT NULL,
  'role' VARCHAR(45) NULL,
  'qualifications' VARCHAR(45) NULL,

```

```

INDEX 'fk_haveStaff_Missions1_idx' ('missionNo' ASC),
INDEX 'fk_haveStaff_Employees1_idx' ('id' ASC),
CONSTRAINT 'fk_haveStaff_Missions1'
    FOREIGN KEY ('missionNo')
    REFERENCES 'Mercantile Ships'.'Missions' ('missionNo')
    ON DELETE CASCADE
    ON UPDATE CASCADE,
CONSTRAINT 'fk_haveStaff_Employees1'
    FOREIGN KEY ('id')
    REFERENCES 'Mercantile Ships'.'Employees' ('id')
    ON DELETE CASCADE
    ON UPDATE CASCADE)
ENGINE = InnoDB;

```

```

-----
-- Table 'Mercantile Ships'.'wherePorted'
-----

```

```

CREATE TABLE IF NOT EXISTS 'Mercantile Ships'.'wherePorted' (
    'IMO' INT NOT NULL,
    'portCoordinates' VARCHAR(45) NOT NULL,
    'ported' BINARY(2) NOT NULL DEFAULT true,
    PRIMARY KEY ('IMO'),
    CONSTRAINT 'fk_wherePorted-Ships1'
        FOREIGN KEY ('IMO')
        REFERENCES 'Mercantile Ships'.'Ships' ('IMO')
        ON DELETE CASCADE
        ON UPDATE CASCADE)
ENGINE = InnoDB;

```

```

USE 'Mercantile Ships' ;

```

```

-----
-- procedure addMission
-----

```

```

DELIMITER $$
USE 'Mercantile Ships' $$
create procedure 'Mercantile Ships'.'addMission'(in n_missionNo int, in n_missionStartDate
→ datetime, in n_missionEndDate datetime, in n_missionLoad int, in n_arrivalPortCoordinates
→ varchar(45), in n_departurePortCoordinates varchar(45), in n_arrivalPortingDate datetime, in
→ n_departurePortingDate datetime)
reads sql data
begin
    insert ignore into 'Ships' values(-1, 'dummyShip', 0, 'martian', 'none', 'none');
    insert into 'Mercantile Ships'.'Missions'(IMO, missionNo, missionStartDate,
→ missionEndDate, missionLoad) values (-1, n_missionNo, n_missionStartDate, n_missionEndDate,
→ n_missionLoad);
    call 'addRoute'(n_missionNo);
    call 'addPort'(n_missionNo, n_departurePortCoordinates, true, n_departurePortingDate);
    call 'addPort'(n_missionNo, n_arrivalPortCoordinates, false, n_arrivalPortingDate);
    call 'chooseProperShip'(n_missionNo, n_missionStartDate, n_missionEndDate, n_missionLoad,
→ n_arrivalPortCoordinates, n_departurePortCoordinates, @c_IMO);
    call 'pickStaff'(n_missionNo, @c_IMO, n_missionStartDate, n_missionEndDate);
end $$

```

```

DELIMITER ;

```

```

-- -----
-- procedure addPort
-- -----

```

```

DELIMITER $$
USE 'Mercantile Ships' $$
create procedure 'Mercantile Ships'.'addPort' (in n_missionNo int, in portCoordinates
↪ varchar(45), in n_departureArrival binary(2), in n_portingDate datetime)
reads sql data
begin
    insert into 'Mercantile Ships'.'Ports' values(n_missionNo, portCoordinates,
↪ n_departureArrival, n_portingDate, false);
end $$

```

DELIMITER ;

```

-- -----
-- procedure addContainer
-- -----

```

```

DELIMITER $$
USE 'Mercantile Ships' $$
create procedure 'Mercantile Ships'.'addContainer' (in n_missionNo int, in n_containerNo int, in
↪ n_contentType varchar(45), in n_ownerData varchar(45))
reads sql data
begin
    insert into 'Mercantile Ships'.'Containers' values (n_missionNo, n_containerNo,
↪ n_contentType, n_ownerData);
end $$

```

DELIMITER ;

```

-- -----
-- procedure addPoint
-- -----

```

```

DELIMITER $$
USE 'Mercantile Ships' $$
create procedure 'Mercantile Ships'.'addPoint' (in n_missionNo int, in n_coordinates varchar(45),
↪ in n_expectedCrossing datetime)
reads sql data
begin
    insert into 'Mercantile Ships'.'Points' values (n_missionNo, n_coordinates,
↪ n_expectedCrossing, null, null);
end $$

```

DELIMITER ;

```

-- -----
-- procedure addRoute
-- -----

```

```

DELIMITER $$
USE 'Mercantile Ships' $$
create procedure 'Mercantile Ships'.'addRoute' (in n_missionNo int)
reads sql data
begin

```

```

        insert into 'Mercantile Ships'.'Routes' values(n_missionNo);
end$$

DELIMITER ;

-- -----
-- procedure modifyPoint
-- -----

DELIMITER $$
USE 'Mercantile Ships'$$
create procedure 'Mercantile Ships'.'modifyPoint' (in s_missionNo int, in s_coordinates
↪ varchar(45), in n_coordinates varchar(45), in n_expectedCrossing datetime)
reads sql data
begin
    update 'Points' set coordinates = n_coordinates, expectedCrossing = n_expectedCrossing
↪ where missionNo = s_missionNo and coordinates like s_coordinates;
end$$

DELIMITER ;

-- -----
-- procedure modifyPort
-- -----

DELIMITER $$
USE 'Mercantile Ships'$$
create procedure 'Mercantile Ships'.'modifyPort' (in s_missionNo int, in n_portCoordinates
↪ varchar(45), in n_departureArrival binary(2), in n_effectivelyPorted binary(2))
reads sql data
begin
    update 'Ports' set portCoordinates = n_portCoordinates, departureArrival =
↪ n_departureArrival, effectivelyPorted = n_effectivelyPorted where missionNo = s_missionNo;
end$$

DELIMITER ;

-- -----
-- procedure deleteRoute
-- -----

DELIMITER $$
USE 'Mercantile Ships'$$
create procedure 'Mercantile Ships'.'deleteRoute' (in s_missionNo int)
reads sql data
begin
    delete from 'Routes' where missionNo = s_missionNo;
end$$

DELIMITER ;

-- -----
-- procedure deletePort
-- -----

DELIMITER $$
USE 'Mercantile Ships'$$

```

```

create procedure 'Mercantile Ships'.'deletePort' (in s_missionNo int, in s_portCoordinates
↳ varchar(45))
reads sql data
begin
    delete from 'Ports' where missionNo = s_missionNo and portCoordinates like
↳ s_portCoordinates;
end$$

DELIMITER ;

-- -----
-- procedure deletePoint
-- -----

DELIMITER $$
USE 'Mercantile Ships'$$
create procedure 'Mercantile Ships'.'deletePoint' (in s_missionNo int, in s_coordinates
↳ varchar(45))
reads sql data
begin
    delete from 'Points' where missionNo = s_missionNo and coordinates like s_coordinates;
end$$

DELIMITER ;

-- -----
-- procedure triggerCrossing
-- -----

DELIMITER $$
USE 'Mercantile Ships'$$
create procedure 'Mercantile Ships'.'triggerCrossing' (in s_missionNo int, in s_coordinates
↳ varchar(45), in n_effectiveCrossing datetime)
reads sql data
begin
    update 'Points' set effectiveCrossing = n_effectiveCrossing where missionNo = s_missionNo
↳ and coordinates like s_coordinates;
    set @expectedCrossing = (select expectedCrossing from 'Points' where missionNo = s_missionNo
↳ and coordinates = s_coordinates);
    update 'Missions' set advanceDelay = TIMESTAMPDIFF(MINUTE, @expectedCrossing,
↳ n_effectiveCrossing) where missionNo = s_missionNo;
end$$

DELIMITER ;

-- -----
-- procedure addOwnShip
-- -----

DELIMITER $$
USE 'Mercantile Ships'$$
CREATE PROCEDURE 'Mercantile Ships'.'addOwnShip'(in n_IMO int, in n_shipName varchar(45), in
↳ n_tonnage int, in n_nationality varchar(45), in n_draft varchar(45), in n_autonomy
↳ varchar(45), in n_crewType int, in n_portCoordinates varchar(45))
READS SQL DATA
BEGIN

```

```

        INSERT INTO 'Mercantile Ships'.'Ships' VALUES(n_IMO, n_shipName, n_tonnage, n_nationality,
↪ n_draft, n_autonomy);
        INSERT INTO 'Mercantile Ships'.'ownShips' VALUES(n_IMO);
        INSERT INTO 'Mercantile Ships'.'haveCrew' VALUES(n_crewType, n_IMO);
        insert into 'wherePorted' values(n_IMO, n_portCoordinates, true);
END$$

```

DELIMITER ;

```

-----
-- procedure modifyOwnShip
-----

```

```

DELIMITER $$
USE 'Mercantile Ships'$$
CREATE PROCEDURE 'Mercantile Ships'.'modifyOwnShip'(IN s_IMO INT, IN n_shipName VARCHAR(45), in
↪ n_tonnage int, in n_nationality varchar(45), in n_draft varchar(45), in n_autonomy
↪ varchar(45), in n_crewType int, in n_portCoordinates varchar(45), in n_ported binary)
READS SQL DATA
BEGIN
        UPDATE 'Mercantile Ships'.'Ships' SET shipName = n_shipName, tonnage = n_tonnage,
↪ nationality = n_nationality, draft = n_draft, autonomy = n_autonomy WHERE IMO = s_IMO;
        UPDATE 'Mercantile Ships'.'haveCrew' set crewType = n_crewType where IMO = s_IMO;
        update 'wherePorted' set portCoordinates = n_portCoordinates, ported = n_ported where IMO =
↪ s_IMO;
END$$

```

DELIMITER ;

```

-----
-- procedure addRentalShip
-----

```

```

DELIMITER $$
USE 'Mercantile Ships'$$
CREATE PROCEDURE 'Mercantile Ships'.'addRentalShip'(in n_IMO int, in n_shipName varchar(45), in
↪ n_tonnage int, in n_nationality varchar(45), in n_draft varchar(45), in n_autonomy
↪ varchar(45), in n_masterData varchar(45), in n_rentalCompanyContacts varchar(45), in
↪ n_crewType int, in n_portCoordinates varchar(45))
READS SQL DATA
BEGIN
        INSERT INTO 'Mercantile Ships'.'Ships' VALUES(n_IMO, n_shipName, n_tonnage, n_nationality,
↪ n_draft, n_autonomy);
        INSERT INTO 'Mercantile Ships'.'rentalShips' VALUES(n_IMO, n_masterData,
↪ n_rentalCompanyContacts);
        INSERT INTO 'Mercantile Ships'.'haveCrew' VALUES(n_crewType, n_IMO);
        insert into 'wherePorted' values(n_IMO, n_portCoordinates, true);
END$$

```

DELIMITER ;

```

-----
-- procedure modifyRentalShip
-----

```

```

DELIMITER $$
USE 'Mercantile Ships'$$

```



```

CREATE PROCEDURE 'Mercantile Ships'.'modifyRentalShip'(IN s_IMO INT, IN n_shipName VARCHAR(45),
↳ in n_tonnage int, in n_nationality varchar(45), in n_draft varchar(45), in n_autonomy
↳ varchar(45), in n_masterData varchar(45), in n_rentalCompanyContacts varchar(45), in
↳ n_crewType int, in n_portCoordinates varchar(45), in n_ported binary)
READS SQL DATA
BEGIN
    UPDATE 'Mercantile Ships'.'Ships' SET shipName = n_shipName, tonnage = n_tonnage,
↳ nationality = n_nationality, draft = n_draft, autonomy = n_autonomy WHERE IMO = s_IMO;
    UPDATE 'Mercantile Ships'.'rentalShips' set masterData = n_masterData,
↳ rentalCompanyContacts = n_rentalComanyContacts where IMO = s_IMO;
    UPDATE 'Mercantile Ships'.'haveCrew' set crewType = n_crewType where IMO = s_IMO;
    update 'wherePorted' set portCoordinates = n_portCoordinates, ported = n_ported where IMO =
↳ s_IMO;
END$$

DELIMITER ;

-----
-- procedure chooseProperShip
-----

DELIMITER $$
USE 'Mercantile Ships'$$
create procedure 'Mercantile Ships'.'chooseProperShip'(in n_missionNo int, in n_missionStartDate
↳ datetime, in n_missionEndDate datetime, in s_missionLoad int, in n_arrivalPortCoordinates
↳ varchar(45), in n_departurePortCoordinates varchar(45), out c_IMO int)
reads sql data
begin
    declare s_IMO int;
    declare s_tonnage int;
    declare notRental int;
    declare shipNotAvailable int;
    declare freeShip int;
    declare missionConflict int;
    declare lastPortChecks int;
    DECLARE done INT DEFAULT FALSE;
    DECLARE allShips cursor for SELECT IMO, tonnage from 'Ships' order by tonnage asc;
    DECLARE CONTINUE HANDLER FOR NOT FOUND SET done = TRUE;
    open allShips;
    go: loop
        fetch allShips into s_IMO, s_tonnage;
        if done then
            leave go;
        end if;
        if s_missionLoad <= s_tonnage then
            select count(*) into notRental from(select * from 'ownShips' where IMO =
↳ s_IMO) as nr;
            if notRental = 0 then
                select count(*) into shipNotAvailable from (select rentStartDate,
↳ rentEndDate from 'rentalContracts' where IMO = s_IMO and ((rentStartDate >
↳ n_missionStartDate and rentStartDate < n_missionEndDate) or (rentEndDate >
↳ n_missionStartDate and rentEndDate < n_missionEndDate))) as t1;
            else
                select 0 into shipNotAvailable;
            end if;

```

```

        select count(*) into freeShip from (select portCoordinates from
↪ 'wherePorted' where portCoordinates like n_departurePortCoordinates and IMO = s_IMO and IMO
↪ not in (select IMO from 'Missions' where ((missionEndDate > n_missionStartDate and
↪ missionEndDate < n_missionEndDate) or (missionStartDate > n_missionStartDate and
↪ missionStartDate < n_missionEndDate)) and missionNo != n_missionNo)) as fs;
        if shipNotAvailable = 0 and freeShip > 0 then
            update 'Missions' set IMO = s_IMO where missionNo = n_missionNo;
        select s_IMO into c_IMO;
        leave go;
        end if;

        select count(*) into lastPortChecks from (select portCoordinates from
↪ 'Ports' where portingDate = (select max(portingDate) from 'Ports' where DepartureArrival =
↪ false and missionNo in (select missionNo from 'Missions' where IMO = s_IMO) and
↪ portCoordinates like n_departurePortCoordinates ) and missionNo !=n_missionNo) as t2;
        select count(*) into missionConflict from (select * from 'Ports' where
↪ (DepartureArrival = false and portingDate > n_missionStartDate and portingDate <
↪ n_missionEndDate) and (DepartureArrival = true and portingDate > n_missionStartDate and
↪ portingDate < n_missionEndDate) and missionNo !=n_missionNo) as t3;
        if shipNotAvailable = 0 and missionConflict = 0 and lastPortChecks>0 then
            update 'Missions' set IMO = s_IMO where missionNo = n_missionNo;
        select s_IMO into c_IMO;
        leave go;
        end if;

    end if;
end loop go;
close allShips;
end$$

DELIMITER ;

```

```

-- -----
-- procedure deleteOwnShip
-- -----

```

```

DELIMITER $$
USE 'Mercantile Ships'$$
create procedure 'Mercantile Ships'.'deleteOwnShip' (in s_IMO int)
reads sql data
begin
    delete from 'ownShips' where IMO = s_IMO;
    delete from 'Ships' where IMO = s_IMO;
end$$

DELIMITER ;

```

```

-- -----
-- procedure deleteRentalShip
-- -----

```

```

DELIMITER $$
USE 'Mercantile Ships'$$
create procedure 'Mercantile Ships'.'deleteRentalShip' (in s_IMO int)
reads sql data
begin
    delete from 'rentalShips' where IMO = s_IMO;

```

```

        delete from 'Ships' where IMO = s_IMO;
end$$

DELIMITER ;

-- -----
-- procedure addRentalContract
-- -----

DELIMITER $$
USE 'Mercantile Ships'$$
create procedure 'Mercantile Ships'.'addRentalContract' (in n_registrationNo int, in
↳ n_rentalCompanyIVA varchar(45), in n_IMO int, in n_rentStartDate datetime, in n_rentEndDate
↳ datetime, in n_eSignature blob)
reads sql data
begin
    insert into 'rentalContracts' values(n_registrationNo, n_rentalCompanyIVA, n_IMO,
↳ n_rentStartDate, n_rentEndDate, null, null, n_eSignature);
end$$

DELIMITER ;

-- -----
-- procedure modifyRentalContract
-- -----

DELIMITER $$
USE 'Mercantile Ships'$$
create procedure 'Mercantile Ships'.'modifyRentalContract' (in s_registrationNo int, in
↳ n_rentalCompanyIVA int, in n_IMO int, in n_rentStartDate datetime, in n_rentEndDate
↳ datetime, in n_eSignature blob)
reads sql data
begin
    update 'rentalContracts' set registrationNo = s_registrationNo, rentalCompanyIVA =
↳ n_rentalCompanyIVA, IMO = n_IMO, rentStartDate = n_rentStartDate, rentEndDate =
↳ n_rentEndDate, eSignature = n_eSignature;
end$$

DELIMITER ;

-- -----
-- procedure deleteRentalContract
-- -----

DELIMITER $$
USE 'Mercantile Ships'$$
create procedure 'Mercantile Ships'.'deleteRentalContract' (in s_registrationNo int)
reads sql data
begin
    delete from 'rentalContracts' where registrationNo = s_registrationNo;
end$$

DELIMITER ;

-- -----
-- procedure modifyMission
-- -----

```

```

DELIMITER $$
USE 'Mercantile Ships'$$
create procedure 'Mercantile Ships'.'modifyMission' (in s_missionNo int, in n_missionStartDate
↪ datetime, in n_missionEndDate datetime, in n_missionLoad int)
reads sql data
begin
    update 'Mercantile Ships'.'Missions' set missionStartDate = n_missionStartDate,
↪ missionEndDate = n_missionEndDate, missionLoad = n_missionLoad where missionNo =
↪ s_missionNo;
    call 'addRoute'(s_missionNo);
    call 'addPort'(s_missionNo, n_departurePortCoordinates, true, n_departureProtingDate);
    call 'addPort'(s_missionNo, n_arrivalPortCoordinates, false, n_arrivalProtingDate);
    call 'chooseProperShip'(s_missionNo, n_missionStartDate, n_missionEndDate, n_missionLoad,
↪ n_arrivalPortCoordinates, n_departurePortCoordinates, @c_IMO);
    call 'pickStaff'(s_missionNo, @c_IMO, n_missionStartDate, n_missionEndDate);
end$$

DELIMITER ;

-- -----
-- procedure pickStaff
-- -----

DELIMITER $$
USE 'Mercantile Ships'$$
create procedure 'Mercantile Ships'.'pickStaff' (in n_missionNo int, in n_IMO int, in
↪ n_missionStartDate datetime, in n_missionEndDate datetime)
reads sql data
begin
    DECLARE done INT DEFAULT FALSE;
    Declare s_id INT;
    declare s_qualifications varchar(45);
    declare s_role varchar(45);
    DECLARE idRange cursor for SELECT e.id, e.qualifications, c.role FROM 'Employees' e inner
↪ join 'Crews' c on c.crewType in (select crewType from 'haveCrew' where IMO = n_IMO) and
↪ e.qualifications like c.qualifications;
    DECLARE CONTINUE HANDLER FOR NOT FOUND SET done = TRUE;
    OPEN idRange;
    outer_loop: LOOP
        FETCH idRange into s_id, s_qualifications, s_role;
        IF done THEN
            LEAVE outer_loop;
        END IF;
        employeeAvailability: begin
            declare done2 INT DEFAULT FALSE;
            declare timeDescrepancy int default false;
            declare filledVacancies int;
            declare totalVacancies int;
            declare MED datetime;
            declare MEDs cursor for SELECT missionEndDate from 'Missions' where
↪ missionNo in (select missionNo from 'haveStaff' where id = s_id);
            DECLARE CONTINUE HANDLER FOR NOT FOUND SET done2 = TRUE;
            open MEDs;
            inner_loop: loop
                fetch MEDS into MED;
                if done2 then
                    leave inner_loop;

```

```

        end if;
        IF (MED > n_missionStartDate and MED < n_missionEndDate) THEN
            set timeDescrepancy = true;
        leave inner_loop;
        end if;
    end loop;
    if not timeDescrepancy then
        select vacancies into filledVacancies from 'Crews' where qualifications
↪ like s_qualifications and crewType = (select crewType from 'haveCrew' where IMO = n_IMO);
        select count(*) into totalVacancies from (select id from 'haveStaff'
↪ where missionNo = n_MissionNo and id = any (select id from 'Employees' where
↪ qualifications=s_qualifications)) as idd;
        set @vacancyCheck := filledVacancies - totalVacancies;
        if @vacancyCheck > 0 then
            INSERT INTO haveStaff (id, missionNo, role, qualifications)
↪ VALUES (s_id, n_missionNo, s_role, s_qualifications);
        end if;
    end if;
end employeeAvailability;
END LOOP;
CLOSE idRange;
end$$$

```

DELIMITER ;

```

-- -----
-- procedure deleteMission
-- -----

```

```

DELIMITER $$$
USE 'Mercantile Ships'$$$
create procedure 'Mercantile Ships'.'deleteMission' (in s_missionNo int)
reads sql data
begin
    delete from 'Ports' where missionNo = s_missionNo;
    delete from 'Points' where missionNo = s_missionNo;
    delete from 'Routes' where missionNo = s_missionNo;
    delete from 'Containers' where missionNo = s_missionNo;
    delete from 'haveStaff' where missionNo = s_missionNo;
    delete from 'Missions' where missionNo = s_missionNo;
end$$$

```

DELIMITER ;

```

-- -----
-- procedure modifyContainer
-- -----

```

```

DELIMITER $$$
USE 'Mercantile Ships'$$$
create procedure 'Mercantile Ships'.'modifyContainer' (in s_missionNo int, in n_containerNo int,
↪ in n_contentType varchar(45), in n_ownerData varchar(45))
reads sql data
begin
    update 'Mercantile Ships'.'Containers' set containerNo = n_containerNo, contentType =
↪ n_contentType, ownerData = n_ownerData where missionNo = n_missionNo;
end$$$

```

DELIMITER ;

```
-- -----  
-- procedure deleteContainer  
-- -----
```

```
DELIMITER $$  
USE 'Mercantile Ships' $$  
create procedure 'Mercantile Ships'.'.deleteContainer' (in s_missionNo int, in s_containerNo int)  
reads sql data  
begin  
    delete from 'Containers' where missionNo = s_missionNo and containerNo = s_containerNo;  
end $$
```

DELIMITER ;

```
-- -----  
-- procedure addCarriageContract  
-- -----
```

```
DELIMITER $$  
USE 'Mercantile Ships' $$  
create procedure 'Mercantile Ships'.'.addCarriageContract' (in n_missionNo int, in n_customerIVA  
↪ varchar(45), in n_price int, in n_eSignature blob, in n_contractStatus varchar(45))  
reads sql data  
begin  
    insert into 'carriageContracts' values(n_missionNo, n_customerIVA, now(), n_Price,  
↪ n_eSignature, n_contractStatus);  
end $$
```

DELIMITER ;

```
-- -----  
-- procedure modifyCarriageContract  
-- -----
```

```
DELIMITER $$  
USE 'Mercantile Ships' $$  
create procedure 'Mercantile Ships'.'.modifyCarriageContract' (in s_missionNo int, in  
↪ n_customerIVA varchar(45), in n_price int, in n_eSignature blob, in n_contractStatus  
↪ varchar(45))  
reads sql data  
begin  
    update 'carriageContracts' set customerIVA = n_customerIVA, stipulationDate = now(),  
↪ price = n_Price, eSignature = n_eSignature, contractStatus = n_contractStatus where  
↪ missionNo = s_missionNo;  
end $$
```

DELIMITER ;

```
-- -----  
-- procedure addCustomer  
-- -----
```

```
DELIMITER $$  
USE 'Mercantile Ships' $$
```

```

create procedure 'Mercantile Ships'.'addCustomer'(in n_customerIVA varchar(45), in n_customerName
↳ varchar(45))
reads sql data
begin
    insert into 'Customers' values(n_customerIVA, n_customerName);
end$$

```

DELIMITER ;

```

-- -----
-- procedure modifyCustomer
-- -----

```

```

DELIMITER $$
USE 'Mercantile Ships'$$
create procedure 'Mercantile Ships'.'modifyCustomer'(in s_customerIVA varchar(45), in
↳ n_customerName varchar(45))
reads sql data
begin
    update 'Customers' set customerName = n_customerName where customerIVA like
↳ s_customerIVA;
end$$

```

DELIMITER ;

```

-- -----
-- procedure deleteCustomer
-- -----

```

```

DELIMITER $$
USE 'Mercantile Ships'$$
create procedure 'Mercantile Ships'.'deleteCustomer'(in s_customerIVA varchar(45))
reads sql data
begin
    declare customerMission int;
    declare done int default false;
    declare customerMissions cursor for select missionNo from 'carriageContracts' where
↳ customerIVA like s_customerIVA;
    declare continue handler for not found set done = true;
    open customerMissions;
    go: loop
        fetch customerMissions into customerMission;
        if done then
            leave go;
        end if;
        call 'deleteCarriageContract'(customerMission);
        call 'deleteMission'(customerMission);
    end loop go;
    close customerMissions;
    delete from 'Customers' where customerIVA like s_customerIVA;
end$$

```

DELIMITER ;

```

-- -----
-- procedure addRentalCompany
-- -----

```

```

DELIMITER $$
USE 'Mercantile Ships'$$
create procedure 'Mercantile Ships'.'addRentalCompany' (in n_rentalCompanyIVA varchar(45), in
↳ n_rentalCompanyName varchar(45))
reads sql data
begin
    insert into 'rentalCompanies' values (n_rentalCompanyIVA, n_rentalCompanyName);
end$$

DELIMITER ;

-----
-- procedure modifyRentalCompany
-----

DELIMITER $$
USE 'Mercantile Ships'$$
create procedure 'Mercantile Ships'.'modifyRentalCompany' (in n_crewType int, in s_IMO int)
reads sql data
begin
    update 'rentalCompanies' set crewType = n_crewType where IMO = s_IMO;
end$$

DELIMITER ;

-----
-- procedure deleteRentalCompany
-----

DELIMITER $$
USE 'Mercantile Ships'$$
create procedure 'Mercantile Ships'.'deleteRentalCompany' (in s_rentalCompanyIVA varchar(45))
reads sql data
begin
    delete from 'rentalCompanies' where rentalCompanyIVA like s_rentalCompanyIVA;
end$$

DELIMITER ;

-----
-- procedure addEmployee
-----

DELIMITER $$
USE 'Mercantile Ships'$$
create procedure 'Mercantile Ships'.'addEmployee' (in n_id int, in n_employeeName varchar(45), in
↳ n_qualifications varchar(45))
reads sql data
begin
    insert into 'Employees' values(n_id, n_employeeName, n_qualifications);
end$$

DELIMITER ;

-----
-- procedure modifyEmployee
-----

```



```

-----
DELIMITER $$
USE 'Mercantile Ships'$$
create procedure 'Mercantile Ships'.'modifyEmployee' (in s_id int, in n_employeeName varchar(45),
↳ in n_qualifications varchar(45))
reads sql data
begin
    update 'Employees' set employeeName = n_employeeName, qualifications = n_qualifications
↳ where id = s_id;
end$$

```

```
DELIMITER ;
```

```

-----
-- procedure deleteEmployee
-----

```

```

DELIMITER $$
USE 'Mercantile Ships'$$
create procedure 'Mercantile Ships'.'deleteEmployee' (in s_id int)
reads sql data
begin
    delete from 'Employees' where id = s_id;
end$$

```

```
DELIMITER ;
```

```

-----
-- procedure detectCollision
-----

```

```

DELIMITER $$
USE 'Mercantile Ships'$$
create procedure 'Mercantile Ships'.'detectCollision' (in n_missionNo int, in n_missionStartDate
↳ datetime)
reads sql data
begin
    declare done1 int default false;
    declare s_missionNo int;
    declare s_missionStartDate int;
    declare s_missionEndDate int;
    declare e_Missions cursor for select missionNo, missionStartDate, missionEndDate from
↳ 'Missions' where missionEndDate > n_missionStartDate and
↳ TIMESTAMPDIFF(MINUTE,n_missionStartDate,missionEndDate) < 60;
    declare continue handler for not found set done1 = true;
    open e_Missions;
    go: loop
        fetch e_Missions into s_missionNo, s_missionStartDate, s_missionEndDate;
        if done1 then
            leave go;
        end if;
        set @CollisionNo = (select count(*) from(select * from 'Ports' inner join (select * from
↳ 'Ports' where missionNo = n_missionNo) as this where missionNo = s_missionNo and
↳ portCoordinates like this.portCoordinates ) as collisions);
        if @CollisionNo > 0 then
            set @message = concat(@CollisionNo, ' risks of collision detected');

```

```

        signal sqlstate '45000' set message_text = @message;
    end if;
end loop;
close e_Missions;
end$$

```

DELIMITER ;

```

-- -----
-- procedure calculateTurnover
-- -----

```

```

DELIMITER $$
USE 'Mercantile Ships'$$
create procedure 'Mercantile Ships'.'calculateTurnover'(out turnover int)
reads sql data
begin
    declare wins int default 0;
    declare done int default false;
    declare s_price int;
    declare e_cc cursor for select price from 'carriageContracts' where
↪ timestampdiff(day,stipulationDate, now()) < 30;
    declare continue handler for not found set done = true;
    open e_cc;
    go: loop
        fetch e_cc into s_price;
        if done then
            leave go;
        end if;
        set wins = wins + s_price;
    end loop;
    close e_cc;
    set turnover = wins;
end$$

```

DELIMITER ;

```

-- -----
-- procedure checkPersonnelNo
-- -----

```

```

DELIMITER $$
USE 'Mercantile Ships'$$
create procedure 'Mercantile Ships'.'checkPersonnelNo'(in s_missionNo int)
reads sql data
begin
    set @personnelCount = (select COUNT(*) from (select id from 'haveStaff' where missionNo =
↪ s_missionNo) as idd);
    if @personnelCount > 30 or @personnelCount < 20 then
        signal sqlstate '45000' set message_text = 'irregular crew count';
    end if;
end$$

```

DELIMITER ;

```

-- -----
-- procedure setMissionValidity
-- -----

```

```

-----
DELIMITER $$
USE 'Mercantile Ships'$$
create procedure 'Mercantile Ships'.'setMissionValidity'(in s_missionNo int)
reads sql data
begin
    declare s_IMO int;
    set s_IMO = (select IMO from 'Missions' where missionNo = s_missionNo);
    update 'Missions' set missionValidity = true where IMO = s_IMO and missionLoad >
↪ 80*(select tonnage from 'Ships' where IMO = s_IMO)/100;
    update 'Missions' set missionValidity = false where IMO = s_IMO and missionLoad <
↪ 80*(select tonnage from 'Ships' where IMO = s_IMO)/100;
end$$

```

DELIMITER ;

```

-----
-- procedure triggerEffectivePorting
-----

```

```

DELIMITER $$
USE 'Mercantile Ships'$$
create procedure 'Mercantile Ships'.'triggerEffectivePorting'(in n_missionNo int, in s_IMO int,
↪ in n_portCoordinates varchar(45))
reads sql data
begin
    update 'Ports' set portingDate = now(), effectivelyPorted = true where missionNo =
↪ n_missionNo and portCoordinates like n_portCoordinates;
    set @departureArrival = (select count(*) from (select departureArrival from 'Ports' where
↪ missionNo = n_missionNo and portCoordinates like n_portCoordinates and departureArrival =
↪ false) as da);
    if @departureArrival = 1 then
        update 'wherePorted' set portCoordinates = n_portCoordinates, ported = true where IMO =
↪ s_IMO;
    end if;
end$$

```

DELIMITER ;

```

-----
-- procedure checkMissionCount
-----

```

```

DELIMITER $$
USE 'Mercantile Ships'$$
create procedure 'Mercantile Ships'.'checkMissionCount'()
reads sql data
begin
    set @missionCount = (select count(*) from (select missionStartDate from 'Missions' where
↪ (TIMESTAMPDIFF(month, missionStartDate, now())<=12)) as mC);
    if @missionCount > 110 then
        signal sqlstate '45000' set message_text = 'you are exceeding the missions quota
↪ of the year';
    end if;
end$$

```

DELIMITER ;

```
-- -----  
-- procedure addCrewTypeAssociation  
-- -----
```

DELIMITER \$\$

```
USE 'Mercantile Ships'$$  
create procedure 'Mercantile Ships'.'addCrewTypeAssociation' (in n_crewType int, in n_IMO int)  
reads sql data  
begin  
    insert into 'haveCrew' values (n_crewType, n_IMO);  
end$$
```

DELIMITER ;

```
-- -----  
-- procedure modifyCrewTypeAssociation  
-- -----
```

DELIMITER \$\$

```
USE 'Mercantile Ships'$$  
create procedure 'Mercantile Ships'.'modifyCrewTypeAssociation' (in n_crewType int, in s_IMO int)  
reads sql data  
begin  
    update 'haveCrew' set crewType = n_crewType where IMO = s_IMO;  
end$$
```

DELIMITER ;

```
-- -----  
-- procedure deleteCrewTypeAssociation  
-- -----
```

DELIMITER \$\$

```
USE 'Mercantile Ships'$$  
create procedure 'Mercantile Ships'.'deleteCrewTypeAssociation' (in s_IMO int)  
reads sql data  
begin  
    delete from 'haveCrew' where IMO = s_IMO;  
end$$
```

DELIMITER ;

```
-- -----  
-- procedure addCrewTypeRole  
-- -----
```

DELIMITER \$\$

```
USE 'Mercantile Ships'$$  
create procedure 'Mercantile Ships'.'addCrewTypeRole' (in n_crewType int, in n_role varchar(45),  
    ↪ in n_qualifications varchar(45), in n_certificate binary(2), in n_vacancies int, in n_salary  
    ↪ int)  
reads sql data  
begin  
    insert into 'Crews' values(n_crewType, n_role, n_qualifications, n_certificate,  
    ↪ n_vacancies, n_salary);
```

```

end$$

DELIMITER ;

-- -----
-- procedure deleteCarriageContract
-- -----

DELIMITER $$
USE 'Mercantile Ships'$$
create procedure 'Mercantile Ships'.'deleteCarriageContract'(in s_missionNo int)
reads sql data
begin
    call 'deleteMission'(s_missionNo);
    delete from 'Mercantile Ships'.'carriageContracts' where missionNo = s_missionNo;
end$$

DELIMITER ;

-- -----
-- procedure modifyCrewTypeRole
-- -----

DELIMITER $$
USE 'Mercantile Ships'$$
create procedure 'Mercantile Ships'.'modifyCrewTypeRole' (in s_crewType int, in n_role
↳ varchar(45), in n_qualifications varchar(45), in n_certificate binary(2), in n_vacancies
↳ int, in n_salary int)
reads sql data
begin
    update 'Crews' set role = n_role, qualifications = n_qualifications, certificate =
↳ n_certificate, vacancies = n_vacancies, salary = n_salary where crewType = n_crewType;
end$$

DELIMITER ;

-- -----
-- procedure deleteCrewTypeRole
-- -----

DELIMITER $$
USE 'Mercantile Ships'$$
create procedure 'Mercantile Ships'.'deleteCrewTypeRole' (in s_crewType int)
reads sql data
begin
    delete from 'Crews' where crewType = s_crewType;
end$$

DELIMITER ;
USE 'Mercantile Ships';

DELIMITER $$
USE 'Mercantile Ships'$$
CREATE DEFINER = CURRENT_USER TRIGGER 'Mercantile Ships'.'checkRentalShipsNumber' BEFORE INSERT
↳ ON 'rentalShips' FOR EACH ROW
BEGIN

```

```

        if (select count(*) from (select * from 'rentalShips' where IMO in (select IMO from
→ 'Missions' where missionEndDate > NOW())) as shipsNumber) > 20 then
            signal sqlstate '45000'
            SET MESSAGE_TEXT = 'you can not have more than 20 active rental ships';
        end if;
        if (select count(*) from (select * from 'ownShips' where IMO = new.IMO) as shipsNumber) >
→ 0 then
            signal sqlstate '45000'
            SET MESSAGE_TEXT = 'this is a company ship';
        end if;
END$$

USE 'Mercantile Ships'$$
CREATE DEFINER = CURRENT_USER TRIGGER 'Mercantile Ships'.'checkOwnShipsNumber' BEFORE INSERT ON
→ 'ownShips' FOR EACH ROW
BEGIN
    if (select count(*) from (select * from 'ownShips') as shipsNumber) > 10 then
        signal sqlstate '45000'
        SET MESSAGE_TEXT = 'you can not insert more than 10 ships';
    end if;
    if (select count(*) from (select * from 'rentalShips' where IMO = new.IMO) as shipsNumber) >
→ 0 then
        signal sqlstate '45000'
        SET MESSAGE_TEXT = 'this is a rental ship';
    end if;
END$$

USE 'Mercantile Ships'$$
CREATE DEFINER = CURRENT_USER TRIGGER 'Mercantile Ships'.'addRenatlShipAvailability' BEFORE
→ INSERT ON 'rentalContracts' FOR EACH ROW
BEGIN
    set new.availability = TIMESTAMPDIFFF(hour, new.rentStartDate, new.rentEndDate);
END$$

USE 'Mercantile Ships'$$
CREATE DEFINER = CURRENT_USER TRIGGER 'Mercantile Ships'.'addStipulationDate' BEFORE INSERT ON
→ 'rentalContracts' FOR EACH ROW
BEGIN
    set new.stipulationDate = NOW();
END$$

USE 'Mercantile Ships'$$
CREATE DEFINER = CURRENT_USER TRIGGER 'Mercantile Ships'.'updateStipulationDate' BEFORE UPDATE ON
→ 'rentalContracts' FOR EACH ROW
BEGIN
    set new.stipulationDate = NOW();
END$$

USE 'Mercantile Ships'$$
CREATE DEFINER = CURRENT_USER TRIGGER 'Mercantile Ships'.'updateRenatlShipAvailability' BEFORE
→ UPDATE ON 'rentalContracts' FOR EACH ROW
BEGIN
    set new.availability = TIMESTAMPDIFFF(hour, new.rentStartDate, new.rentEndDate);
END$$

USE 'Mercantile Ships'$$

```

```

CREATE DEFINER = CURRENT_USER TRIGGER 'Mercantile Ships'.'checkPortsNum' BEFORE INSERT ON 'Ports'
↳ FOR EACH ROW
BEGIN
    if ((select count(*) from (select * from 'Ports' where missionNo = new.missionNo) as fc)
↳ > 2) then
        set new.missionNo = null;
    end if;
END$$

USE 'Mercantile Ships'$$
CREATE DEFINER = CURRENT_USER TRIGGER 'Mercantile Ships'.'calculateMissionLoad' AFTER INSERT ON
↳ 'Containers' FOR EACH ROW
BEGIN
    update 'Missions' set missionLoad = missionLoad + 1;
END$$

DELIMITER ;

SET SQL_MODE=@OLD_SQL_MODE;
SET FOREIGN_KEY_CHECKS=@OLD_FOREIGN_KEY_CHECKS;
SET UNIQUE_CHECKS=@OLD_UNIQUE_CHECKS;

```

Tool setup on Ubuntu 16.04 (Bash File)

```
#!/bin/bash
```

```
# install pre-requisites
```

```
sudo apt install apache2 php phpmyadmin mysql-server mysql-client mysql-workbench
```

```
# update apache2 conf file to include phpmyadmin conf file
```

```
if grep -qF "Include /etc/phpmyadmin/apache.conf" /etc/apache2/apache2.conf;then  
    sudo bash -c 'echo "Include /etc/phpmyadmin/apache.conf" >> /etc/apache2/apache2.conf'  
fi
```

```
sudo systemctl restart apache2 # now to use phpmyadmin, visit the following url:
```

```
↪ http://127.0.0.1/phpmyadmin
```

```
# install adminer the right way!
```

```
sudo mkdir /usr/share/adminer
```

```
sudo wget "http://www.adminer.org/latest.php" -O /usr/share/adminer/latest.php
```

```
sudo ln -s /usr/share/adminer/latest.php /usr/share/adminer/adminer.php
```

```
echo "Alias /adminer.php /usr/share/adminer/adminer.php" | sudo tee
```

```
↪ /etc/apache2/conf-available/adminer.conf
```

```
sudo a2enconf adminer.conf
```

```
sudo service apache2 restart # now to use adminer, visit the following url:
```

```
↪ http://127.0.0.1/adminer.php
```


Code Repository

A Github repository exists for this project under:

`https://github.com/AlyShmahell/Navibus-Mercatoriis`

References

- [1] **MySQL 5.7 Reference Manual:** <https://downloads.mysql.com/docs/refman-5.7-en.a4.pdf>
- [2] **MySQL Workbench 6.3 Reference Manual:** <https://downloads.mysql.com/docs/workbench-en.a4.pdf>