CI6320: Advanced Database System
Swift Southern Railway Design Exercise

1 Background.

Swift Southern Railway (SSR) is a freight railway company whose business is the transport of goods within the UK by train on behalf of its customers. The company has a very dated system to record data and requires a database system to devise train schedules which will make efficient use of its rolling stock.

2 Information Requirements

SSR operates on the UK network similar to the one shown in Figure 1. The company collects and delivers goods from and to the stations shown on this map. There are 3 files (on Canvas) that you can use to determine possible routes.

- routes.tsv – a list of routes operated by the company
- stations.csv - a list of stations
- edges.csv – shows the distance between 2 stations

SSR owns a substantial amount of rolling stock (locomotives and freight wagons). The stock falls into classes with a name, e.g. Class 07, a serial number, e.g. 07, and the number owned as follows:

Rolling Stock	Serial Numbers	Number Owned
Locomotives:		
Class 07	07xxx	5
Class 08	08xxx	5
Class 09	09xxx	3
Freight wagons:		
Flat wagon	90xxx	30
Open wagon	91xxx	30
Covered wagon	92xxx	40
Car carrier	93xxx	15
Tank wagon	94xxx	20

Each item of rolling stock is allocated a five-digit serial number where the first two digits specify the locomotive class or type of freight wagon. For each class of locomotive, the maximum towing weight (in tonnes) and the length (in metres) is also recorded as shown in the table below. In some cases the locomotive can also be known by a familiar name.

Locomotive	Serial Number	Maximum towing weight (tonnes)	Length (metres)
Class 07	07100 07101 (Red Arrow) 07102 07103 (Tug) 07104	1500	16.4
Class 08	08200 08201 (Buckets) 08203 08204	1600	17.8
Class 09	09001 (Rapid Bullet) 09002 09003	2000	21.4

For each class of freight wagon, the following information is held:

Freight Wagon	Description	Tare Weight (tonnes)	Maximum Payload	Length (metres)
Flat wagon	A low-sided open wagon for the transportation of cable drums and machinery	21.0	66.0	14.6
Open wagon	A high-sided open-box wagon for the transportation of scrap steel.	33.0	69.0	16.2
Covered wagon	A plastic sheeting covered wagon for the transportation of palletised goods and general cargo.	23.5	66.5	20.6
Car carrier	A covered wagon for the transportation of cars and vans.	35.0	15.0	24.3
Tank wagon	A stainless steel chemical tank for the transportation of petroleum and industrial products.	27.3	62.7	18.9

The capacity of a freight wagon in terms of the goods it can carry is determined by the goods to be transported. For example, a car carrier can carry up to 15 cars depending on the weight of the car. In order to determine the number or volume of goods that can be carried in a freight wagon, details of the goods, i.e. description and unit weight (or unit volume) need to be held.

A train can carry consignments belonging to more than one customer and SSR will determine the route for the transportation of the consignments on their wagons. Detailed information of each consignment does not need to be stored as this is done on a separate system but the type of consignment needs to be recorded.

For each company, the following information would need to be stored: company name, contact name, address, phone number and email address.

Typical goods assignments are as follows:

Collection From	**Delivery To**	**Goods**
Plymouth	Birmingham	1000 tonnes of cement
Rugby	Swansea	200 cars each weighing 1.2 tonnes
Birmingham	Euston	500 pallets of perishable goods each weighing 0.8 tonnes
Manchester	Glasgow	1000 tonnes of mineral oil
York	Edinburgh	2000 tonnes of cement

A train consists of a locomotive and several freight wagons where the total gross weight (tare + payload) of the wagons does not exceed the maximum towing weight of the locomotive. To comply with UK regulations the total length of the train must not exceed 400 metres. Because of these weight and length restrictions more than one train may be needed to convey a goods consignment.

The company employs several train drivers each of whom is qualified to drive one or more of the classes of locomotive owned by the company. A certificate is issued to the train driver and this details the types of rolling stock which the driver may drive. Each train is operated by two qualified drivers. For each driver, the following personal information would need to be stored: full name, date of birth, address, phone number and email address. The driver's employment start date and train driving licence (TDL) number also need to be stored. A train driving licence number is valid for 10 years. Only a copy of the current licence needs to be stored.

The details of a train to convey a particular goods consignment showing the allocation of locomotive and freight trains can be summarised as follows:

Collection from:	Plymouth
Delivery to:	Birmingham
Goods:	1000 tonnes of cement
Route:	Plymouth, Exeter, Taunton, Bristol, Birmingham
Journey distance:	209 miles
Driver:	Bert Smith
Co-driver:	Edward Jones
Locomotive:	07100
Freight wagons:	94005, 94007, 94102, 94103, 94104, 94203, 94204, 94205,94206, 94501, 94502, 94503, 94506, 94507, 94508, 94600
Total train length:	320.2 metres
Gross freight weight:	1436.8 tonnes

The routing of a train is determined from a list held of each station within the SSR network and the distance (in miles) between two stations. So, for example, the stage Exeter to Taunton would be 45 miles and Exeter to Plymouth would be 57 miles. So a route would consist of a number of stages where each stage has a start and an end station.

3 System Requirements

A system is required to support the information requirements set out in the previous section. Specifically it should be capable of supporting the following activities:

- Maintaining details of the rail network in order to work out the routing of trains
- Recording details of the rolling stock and availability for allocation to trains
- Recording details of goods conveyed
- Production of train schedules which will utilise the rolling stock efficiently for the transportation of goods. Specifically, given a particular goods consignment, the system should be able to determine a route, calculate the journey distance and allocate the appropriate number of trains to convey the goods from the currently available items of rolling stock and drivers.

You may assume that locomotives and freight wagons are located in the correct place to be allocated to a train and do not have to record details of rolling stock current position.

4 Coursework Requirements

Conceptual Design Stage

Design a class diagram that will capture the data, associations and constraints capable of supporting the requirements outlined above. The figures provide some sample data to give you additional information on the kind of data you will need to store. Specifically the system should be capable of helping the company meet its aims described above.

You are expected to submit an initial draft of your class diagram onto Canvas by Thursday, 9th November.

Relational Design Stage

You will then undertake the first step in designing the database. This will involve the following activities:

- Revise your class diagram in the light of the feedback you have received.
- Convert the class diagram into a relational model.

Implementation Stage

The final stage will be to implement your design using Oracle APEX and write a final report. You will need to perform the following activities:

- Convert your relational model into an SQL database
- Populate your database with some sample data
- Test your database. You will need to consider testing the database to ensure that the database meets the information requirements of the system. You need to create and run SQL queries that produce the information required.

5 Coursework Assessment

The coursework component of the module will be assessed in three stages.

1. Class diagram
2. Final report
3. Demonstration

Class Diagram

You will be required to submit an initial draft of your class diagram on the 9th November. This is worth 20% of this assignment.

This part will also be submitted with the final report in January and you will have the option to improve your mark if you make changes based on any feedback you receive.

If you do not submit your class diagram at this stage, then you will receive no marks for this part in your final report.

The Demonstration

The demonstration will be assessed on Wednesday, 13th December and you will be given an opportunity to choose a timeslot for your demonstration. You will be expected to demonstrate six queries that demonstrate that your database meets the requirements of the system.

If you wish, there will be earlier opportunities to do your demonstration. You will need to book this by email with either Pushpa or Beryl. Demonstrations must be completed by the end of Wednesday, 13th December.

The Final Report

The report will require the following chapters:

Chapter 1: Introduction – one page description of the aims and objectives of the report.

Chapter 2: The Class Diagram with constraints and assumptions.

Chapter 3: A discussion of the major design decisions taken in construction of the class diagram and a discussion of any design decisions taken in converting the class diagram into a relational model.

Chapter 4: The Relational Model.

Chapter 5: Implementation. Provide a listing of the SQL table definitions.

Chapter 6: The six queries (and output) that were used in your demonstration. (marks for these will have been given at the demonstration)

Chapter 7: Conclusion. A critical evaluation of your final product and a review of the entire exercise.

Further details are available on the report mark sheet that is available on Canvas in the Assignments folder. The report should be submitted onto Canvas by **Monday, 8th January, 11:59pm.**

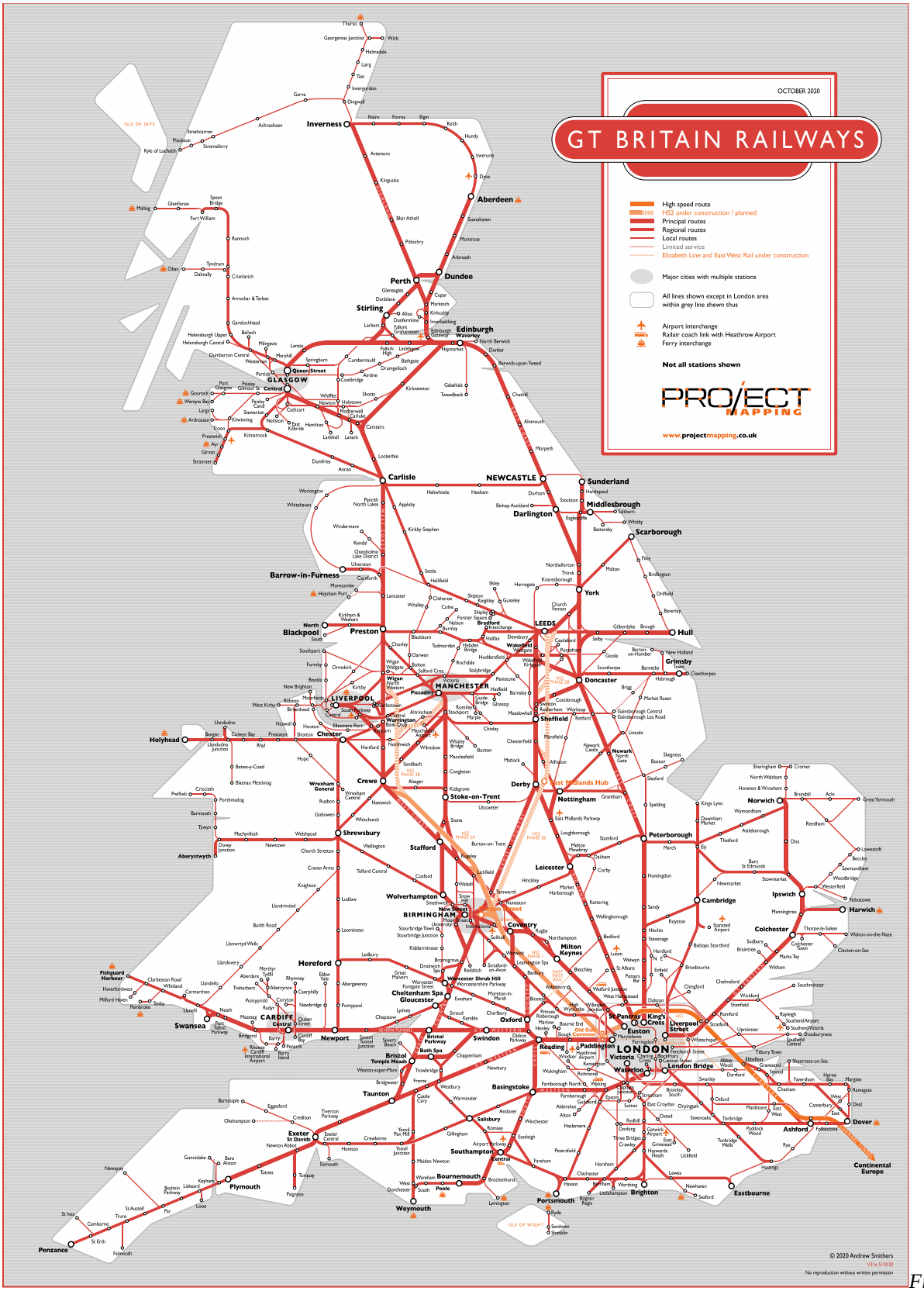

Figure 1: The UK Network in which SSR operates
http://projectmapping.co.uk/Resources/Rail%20map%20v31%20GBR%20curvy.pdf