Northumbria University NEWCASTLE

Department of Computer & Information Sciences

ASSESSMENT SUBMISSION	
Module Title:	Advanced Databases
Module Code:	KL7011
Academic Year / Semester:	2022-23 / Semester 1
Module Tutor / Email (all queries):	Akhtar Ali akhtar.ali@northumbria.ac.uk
% Weighting (to overall module):	60%
Assessment Title:	Assignment 1: individual work
Date of Handout to Students:	14th October 2022
Mechanism for Handout:	Module Blackboard Site
Deadline for Submission Attempt by Students:	Thursday 24th November 2022 @ 23:59 GMT
Mechanism for Submission:	Document upload to Module Blackboard Site
Submission Format / Word Count	Please upload your written report as a single PDF document
Date by which Work, Feedback and Marks will be returned:	23rd December 2022
Mechanism for return of Feedback and Marks:	Mark and individual written feedback will be uploaded to the Module Site on Blackboard. For further queries please email module tutor.

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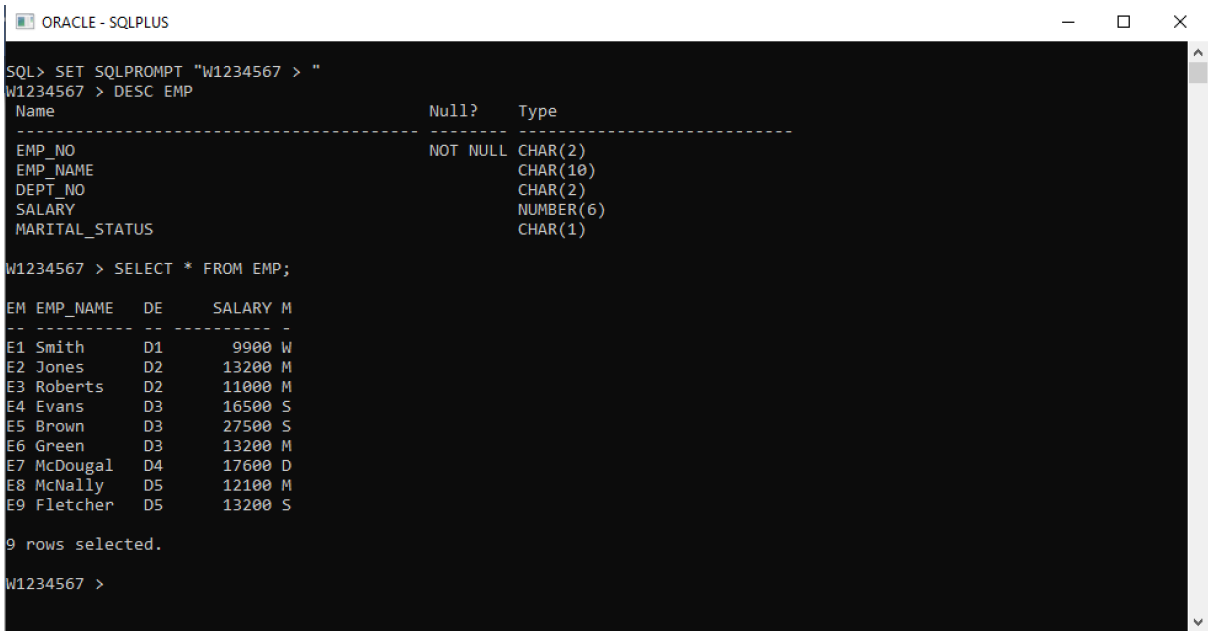
Personalising your SQL output/prompt

Before executing any **SQL code** for this assignment, you should personalise your SQL output / prompt by running SET SQLPROMPT “UniversityUserName > ”, i.e., *double-quote* followed by your UniversityUserName followed by > and then a *space* and *double-quote* as shown in the screenshot below:



Assignment Questions

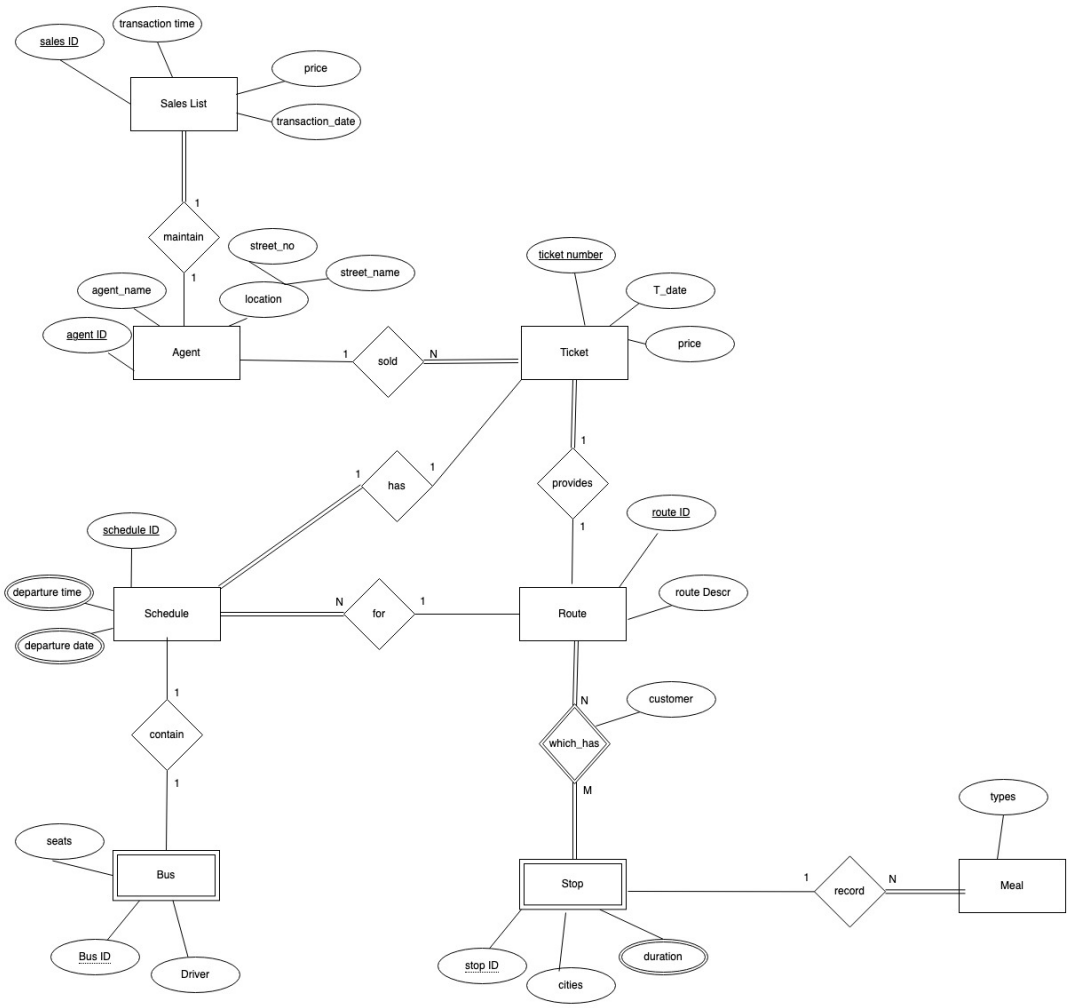
Part 1 (35 marks)

This part is based on the TRAVELNORTH scenario as described in the Appendix.

(A) Using entity-relationship (ER) OR enhanced entity-relationship (EER) modelling, produce a conceptual design for the database to support the TRAVELNORTH business activities.

(10 marks)

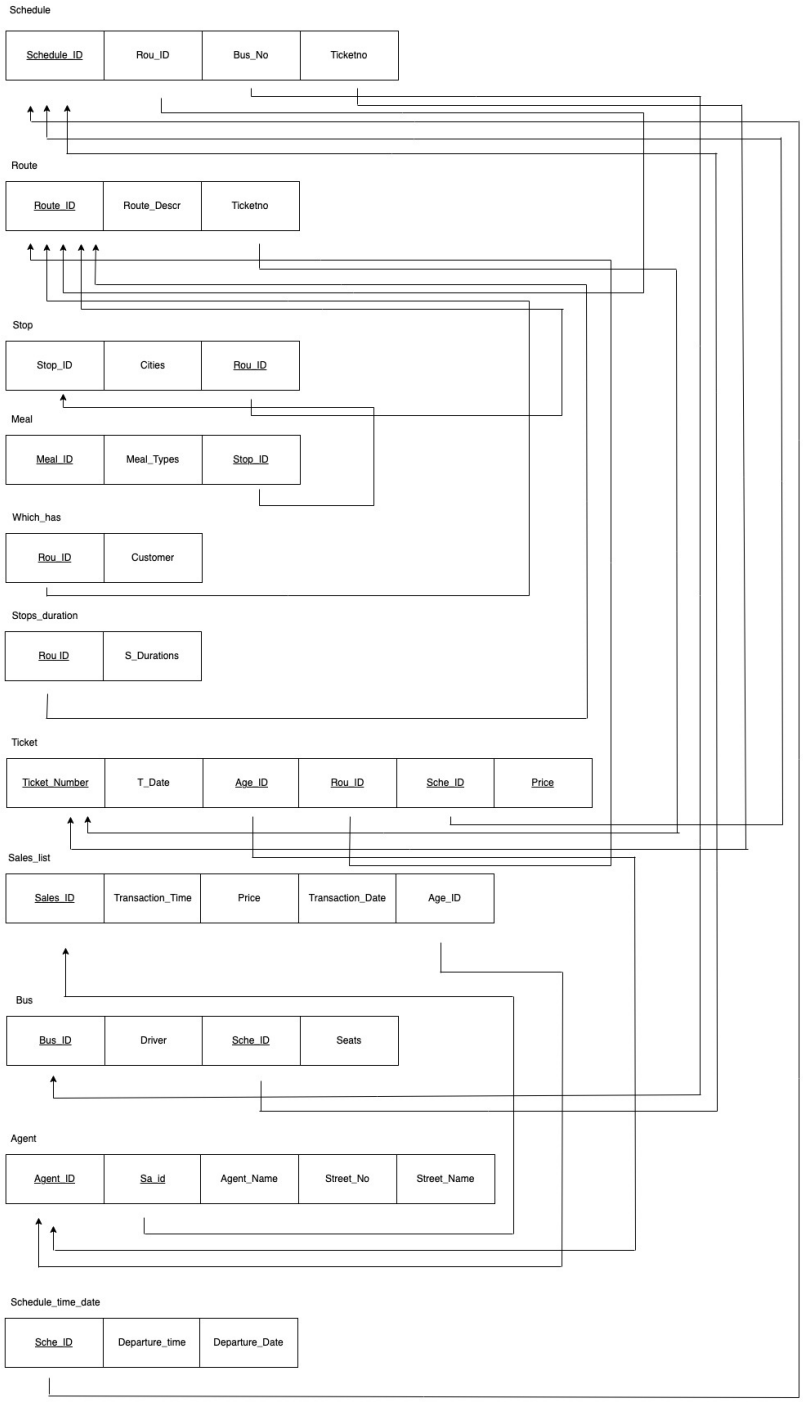
Answer Part 1 A: Insert your ER or EER Diagram Below



(B) Convert the ER / EER diagram from Part 1(A) to produce a logical relational schema using ER / EER to relational mapping.

(10 marks)

Answer Part 1 B: Provide your Logical Relational Design/Schema Below



Answer Part 1 B: Provide your Data Dictionary Below (*in a tabular form and must be presented as text rather than an image or picture*)

(5 marks)

Table Name	Column Name	Other names	Data Type	Constraint	Description
Schedule	Schedule_ID	Sche_ID	Char(6)	PK, NOT NULL	A six-character code, not necessarily all digits
	Rou_ID	Route_ID	Varchar(3)	References Route (Route ID)	The Route ID code
	Bus_No	Bus_ID	Varchar(4)	References Bus(Bus ID)	The Bus ID code
	Ticketno	Ticket_ID	Number(8)	References Ticket (Ticket ID)	Unique number on the ticket
Route	Route_ID	Rou_ID	Varchar(3)	PK	The Route ID code
	Route_Descr	Route_Description	Varchar(20)	NOT NULL	The route description from the starting point to the end point
	Ticketno	Ticket_Number	Number(8)	References Ticket (Ticket ID)	Unique number on the ticket
Stop	Rou_ID	Route_ID	Varchar(3)	PK, NOT NULL, References Route(Route ID)	The Route ID code

	Stop_ID		Varchar(4)	NOT NULL	Unique stops id
	Cities		Varchar(20)	NOT NULL	The cities at each stop
Meal	Meal_ID		Varchar(4)	NOT NULL	Unique meal id
	Stop_ID		Varchar(4)	PK, NOT NULL, References Stop(Stop ID)	Unique stops id
	Meal_Types		Varchar(20)	NOT NULL	Meal types served at each stop
Stop_durations	Rou_ID	Route_ID	Varchar(3)	PK, NOT NULL, References Route(Route ID)	The Route ID code
	S_Durations		Varchar(10)	NOT NULL	Duration at each stop
Which_has	Rou_ID	Route_ID	Varchar(3)	PK, NOT NULL, References Route(Route ID)	The Route ID code
	Customer		Varchar(10)	NOT NULL	Name of customer who purchased ticket
Ticket	Ticket_Number	Ticketno	Number(8)	PK, NOT NULL	Unique number on the ticket
	T_Date	Transaction_Date	Date	Check (Date = 'DD-MM-YYYY')	The date the ticket was

					purchase
	Age_ID	Agent_ID	Varchar(3)	References Agent (Agent ID)	Unique ID of agent
	Rou_ID	Route_ID	Varchar(3)	References Route(Route ID)	The Route ID code
	Sche_ID	Schedule_ID	Char(6)	References Schedule(Schedule ID)	A six-character code, not necessarily all digits
	Price		Decimal(4,2)	NOT NULL	The ticket price
Sales_list	Sales_ID	Sa_ID	Varchar(3)	PK, NOT NULL	Primary key of the Sales_list table
	Age_id	Agent_ID	Varchar(3)	References Agent(Agent ID)	Unique ID of agent
	Transaction_Time		Timestamp	Check (datetime = 'DD-MM-YYYY HH : MM : SS')	The time the sale took place
	Price		Decimal(4,2)	NOT NULL	The ticket price
	Transaction_Date		Date	Check (Date = 'DD-MM-YYYY')	The date the sale took place
Bus	Bus_ID	Vehicle_No	Varchar(4)	PK, NOT NULL	The Bus ID code
	Driver		Varchar(10)	Unique	The driver for a bus

	Sche_ID	Schedule_ID	Char(6)	References Schedule(Schedule ID)	A six-character code, not necessarily all digits
	Seats		Number(2)	NOT NULL	The number of seats left in a bus
Agent	Agent ID		Varchar(3)	PK, NOT NULL	Primary key of the agent table
	Agent_Name	Age_Name	Varchar(10)	NOT NULL	Unique name of agent
	Sa_ID	Sales_ID	Varchar(3)	References Sales_List (Sales ID)	Primary key of the Sales_list table
	Street_No		Number(4)	NOT NULL	The street number where the agent is located
	Street_Name		Varchar(20)	NOT NULL	The street name where the agent is located
Schedule_time_date	Departure_Time		Timestamp	Check (datetime = 'DD-MM-YYYY HH : MM : SS')	Time to leave

	Departure_Date		Date	Check (Date = 'DD-MM-YYYY ')	The date set for the journey
	Sche_ID	Schedule_ID	Char(6)	References Schedule(Schedule ID)	A six-character code, not necessarily all digits

(C) Based on your logical design from Part 1 (B) and the information available in the scenario, produce an SQL script file using Oracle 11g/12c/higher.

(10 marks)

Answer Part 1 C: Provide SQL DDL Script file contents (i.e., the SQL code for creating / altering your Tables / Constraints etc)

```
Rem   Everything must first be dropped from the data base.
DROP TABLE SCHEDULE CASCADE CONSTRAINTS PURGE;
DROP TABLE ROUTE CASCADE CONSTRAINTS PURGE;
DROP TABLE STOP CASCADE CONSTRAINTS PURGE;
DROP TABLE MEAL CASCADE CONSTRAINTS PURGE;
DROP TABLE WHICH_HAS CASCADE CONSTRAINTS PURGE;
DROP TABLE STOP_DURATIONS CASCADE CONSTRAINTS PURGE;
DROP TABLE TICKET CASCADE CONSTRAINTS PURGE;
DROP TABLE SALES_LIST CASCADE CONSTRAINTS PURGE;
DROP TABLE BUS CASCADE CONSTRAINTS PURGE;
DROP TABLE AGENT CASCADE CONSTRAINTS PURGE;
DROP TABLE SCHEDULE_TIME_DATE CASCADE CONSTRAINTS PURGE;

Rem   Now we can create the data base Tables:

CREATE TABLE SCHEDULE
    (SCHEDULE_ID            CHAR(6) NOT NULL
        CONSTRAINT PKEY_SCHEDULE PRIMARY KEY,
     ROU_ID                 VARCHAR(3)
```

```
        CONSTRAINT  UNIQ_ROUTE UNIQUE,
    BUS_NO             VARCHAR(4)
        CONSTRAINT  UNIQ_BUS UNIQUE,
    TICKETNO               NUMBER(8)
        CONSTRAINT  UNIQ_TICKET UNIQUE
    );

CREATE TABLE ROUTE
    (ROUTE_ID              VARCHAR(3) NOT NULL
        CONSTRAINT PKEY_ROUTE PRIMARY KEY,
    ROUTE_DESCR            VARCHAR(80) NOT NULL,
    TICKETNO               NUMBER(8)
    );


CREATE TABLE STOP
    (ROU_ID                VARCHAR(3) NOT NULL
        CONSTRAINT PKEY_STOP PRIMARY KEY,
    STOP_ID                VARCHAR(4) NOT NULL
        CONSTRAINTS    UNIQ_STOP UNIQUE,
    CITIES                 VARCHAR(20) NOT NULL
    );

CREATE TABLE MEAL
    (ROU_ID                VARCHAR(4) NOT NULL
        CONSTRAINT PKEY_MEAL PRIMARY KEY,
    MEAL_ID                VARCHAR(4) NOT NULL
        CONSTRAINTS    UNIQ_MEAL UNIQUE,
    MEAL_TYPES                 VARCHAR(20) NOT NULL
    );

CREATE TABLE STOP_DURATIONS
    (ROU_ID                VARCHAR(3) NOT NULL
        CONSTRAINT PKEY_DURATIONS PRIMARY KEY,
    STOP_DURATIONS         VARCHAR(10) NOT NULL
    );

CREATE TABLE WHICH_HAS
    (ROU_ID                VARCHAR(3) NOT NULL
        CONSTRAINT PKEY_WHICH PRIMARY KEY,
    CUSTOMERS              VARCHAR(10) NOT NULL
    );
```

```
CREATE TABLE TICKET
    (TICKET_NUMBER          NUMBER(8) NOT NULL
        CONSTRAINT PKEY_TICKET PRIMARY KEY,
     TRANSACTION_DATE       DATE NOT NULL,
     AGE_ID                 VARCHAR(3),
     ROU_ID                 VARCHAR(3),
     SCHE_ID                CHAR(6),
     PRICE                  DECIMAL(4,2) NOT NULL
     );


CREATE TABLE SALES_LIST
    (SALES_ID               VARCHAR(3) NOT NULL
        CONSTRAINT PKEY_SALES PRIMARY KEY,
     AGE_ID                 VARCHAR(3),
     TRANSACTION_TIME       TIMESTAMP NOT NULL,
     PRICE                  DECIMAL(4,2),
     TRANSACTION_DATE       DATE
     );

CREATE TABLE BUS
    (BUS_ID                 VARCHAR(4) NOT NULL
        CONSTRAINT PKEY_BUS PRIMARY KEY ,
     DRIVER                 VARCHAR(10),
     SCHE_ID                CHAR(6),
     SEATS                  NUMBER(2) NOT NULL
     );


CREATE TABLE AGENT
    (AGENT_ID                  VARCHAR(3)
       CONSTRAINT PKEY_AGENT PRIMARY KEY,
     AGENT_NAME                 VARCHAR(15) NOT NULL,
     SA_ID                      VARCHAR(3)
        CONSTRAINT  UNIQ_SALES UNIQUE,
     STREET_NO                  NUMBER(4),
     STREET_NAME                VARCHAR(50)
     );
```

```
CREATE TABLE SCHEDULE_TIME_DATE
    (SCHE_ID                        CHAR(6)
        CONSTRAINT PKEY_SCHETIME  PRIMARY KEY,
     DEPARTURE_TIME                 TIMESTAMP,
     DEPARTURE_DATE                 DATE
    );

Rem Now we alter the table to add constraints
ALTER TABLE SCHEDULE ADD CONSTRAINT FKEY_ROUTESCHE  FOREIGN KEY (ROU_ID)
REFERENCES ROUTE (ROUTE_ID) DEFERRABLE;

ALTER TABLE SCHEDULE ADD CONSTRAINT FKEY_BUSSCHE FOREIGN KEY (BUS_NO)
REFERENCES BUS (BUS_ID) DEFERRABLE;

ALTER TABLE SCHEDULE ADD CONSTRAINT FKEY_TICKETSCHE FOREIGN KEY (TICKETNO)
REFERENCES TICKET (TICKET_NUMBER) DEFERRABLE;

ALTER TABLE ROUTE ADD CONSTRAINT FKEY_TICKETROU FOREIGN KEY (TICKETNO)
REFERENCES TICKET (TICKET_NUMBER) DEFERRABLE;

ALTER TABLE STOP ADD CONSTRAINT FKEY_ROUTESTOP FOREIGN KEY (ROU_ID)
REFERENCES ROUTE (ROUTE_ID) DEFERRABLE;

ALTER TABLE MEAL ADD CONSTRAINT FKEY_ROUTEMEAL FOREIGN KEY (ROU_ID)
REFERENCES ROUTE (ROUTE_ID) DEFERRABLE;


ALTER TABLE WHICH_HAS ADD CONSTRAINT FKEY_ROUTEHAS FOREIGN KEY (ROU_ID)
REFERENCES ROUTE (ROUTE_ID) DEFERRABLE;

ALTER TABLE STOP_DURATIONS ADD CONSTRAINT FKEY_ROUTEDURA FOREIGN KEY (ROU_ID)
REFERENCES ROUTE (ROUTE_ID) DEFERRABLE;

ALTER TABLE TICKET ADD CONSTRAINT FKEY_AGENTTICK FOREIGN KEY (AGE_ID)
REFERENCES AGENT (AGENT_ID) DEFERRABLE;

ALTER TABLE TICKET ADD CONSTRAINT FKEY_ROUTETICK FOREIGN KEY (ROU_ID)
REFERENCES ROUTE (ROUTE_ID) DEFERRABLE;

ALTER TABLE TICKET ADD CONSTRAINT FKEY_SCHETICK FOREIGN KEY (SCHE_ID)
REFERENCES SCHEDULE (SCHEDULE_ID) DEFERRABLE;
```

```
ALTER TABLE SALES_LIST ADD CONSTRAINT FKEY_SALEAGENT FOREIGN KEY (AGE_ID)
REFERENCES AGENT (AGENT_ID) DEFERRABLE;

ALTER TABLE BUS ADD CONSTRAINT FKEY_SCHEBUS FOREIGN KEY (SCHE_ID) REFERENCES
SCHEDULE (SCHEDULE_ID) DEFERRABLE;

ALTER TABLE AGENT ADD CONSTRAINT FKEY_SALESAGE FOREIGN KEY (SA_ID) REFERENCES
SALES_LIST (SALES_ID) DEFERRABLE;

ALTER TABLE SCHEDULE_TIME_DATE ADD CONSTRAINT FKEY_SCHETIDE FOREIGN KEY
(SCHE_ID) REFERENCES SCHEDULE (SCHEDULE_ID) DEFERRABLE;
```

Answer Part 1 C: SQL DDL Output (e.g., SPOOL file contents or output you got when you executed your above SQL Table Creation code, this should show the SQL code as well as its output). Make sure the output is simple TEXT and NOT a screenshot / image or picture

```
REM DROP TABLE SCHEDULE IN THE ORACLE DATABASE
W21051498 >DROP TABLE SCHEDULE CASCADE CONSTRAINTS PURGE;

Table dropped.

REM DROP TABLE ROUTE IN THE ORACLE DATABASE
W21051498 >DROP TABLE ROUTE CASCADE CONSTRAINTS PURGE;
DROP TABLE ROUTE CASCADE CONSTRAINTS PURGE
           *
ERROR at line 1:
ORA-00942: table or view does not exist

REM DROP TABLE STOP IN THE ORACLE DATABASE
W21051498 >DROP TABLE STOP CASCADE CONSTRAINTS PURGE;
DROP TABLE STOP CASCADE CONSTRAINTS PURGE
           *
ERROR at line 1:
ORA-00942: table or view does not exist

REM DROP TABLE MEAL IN THE ORACLE DATABASE
W21051498 >DROP TABLE MEAL CASCADE CONSTRAINTS PURGE;
DROP TABLE MEAL CASCADE CONSTRAINTS PURGE
           *
ERROR at line 1:
ORA-00942: table or view does not exist


REM DROP TABLE WHICH_HAS IN THE ORACLE DATABASE
W21051498 >DROP TABLE WHICH_HAS CASCADE CONSTRAINTS PURGE;
DROP TABLE WHICH_HAS CASCADE CONSTRAINTS PURGE
           *
ERROR at line 1:
ORA-00942: table or view does not exist

REM DROP TABLE STOP_DURATIONS IN THE ORACLE DATABASE
W21051498 >DROP TABLE STOP_DURATIONS CASCADE CONSTRAINTS PURGE;
DROP TABLE STOP_DURATIONS CASCADE CONSTRAINTS PURGE
```

```
           *
ERROR at line 1:
ORA-00942: table or view does not exist

REM DROP TABLE TICKET IN THE ORACLE DATABASE
W21051498 >DROP TABLE TICKET CASCADE CONSTRAINTS PURGE;
DROP TABLE TICKET CASCADE CONSTRAINTS PURGE
           *
ERROR at line 1:
ORA-00942: table or view does not exist

REM DROP TABLE SALES_LIST IN THE ORACLE DATABASE
W21051498 >DROP TABLE SALES_LIST CASCADE CONSTRAINTS PURGE;
DROP TABLE SALES_LIST CASCADE CONSTRAINTS PURGE
           *
ERROR at line 1:
ORA-00942: table or view does not exist

REM DROP TABLE BUS IN THE ORACLE DATABASE
W21051498 >DROP TABLE BUS CASCADE CONSTRAINTS PURGE;
DROP TABLE BUS CASCADE CONSTRAINTS PURGE
           *
ERROR at line 1:
ORA-00942: table or view does not exist

REM DROP TABLE AGENT IN THE ORACLE DATABASE
W21051498 >DROP TABLE AGENT CASCADE CONSTRAINTS PURGE;
DROP TABLE AGENT CASCADE CONSTRAINTS PURGE
           *
ERROR at line 1:
ORA-00942: table or view does not exist

REM DROP TABLE SCHEDULE_TIME_DATE IN THE ORACLE DATABASE
W21051498 >DROP TABLE SCHEDULE_TIME_DATE CASCADE CONSTRAINTS PURGE;
DROP TABLE SCHEDULE_TIME_DATE CASCADE CONSTRAINTS PURGE
           *
ERROR at line 1:
ORA-00942: table or view does not exist

REM CREATE THE SCHEDULE TABLE
W21051498 >CREATE TABLE SCHEDULE
  2      (SCHEDULE_ID               CHAR(6) NOT NULL
```

```
  3           CONSTRAINT PKEY_SCHEDULE PRIMARY KEY,
  4       ROU_ID                          VARCHAR(3)
  5           CONSTRAINT  UNIQ_ROUTE UNIQUE,
  6       BUS_NO                    VARCHAR(4)
  7           CONSTRAINT  UNIQ_BUS UNIQUE,
  8       TICKETNO                  NUMBER(8)
  9           CONSTRAINT  UNIQ_TICKET UNIQUE
 10       );

Table created.
REM CREATE THE ROUTE TABLE
W21051498 >CREATE TABLE ROUTE
  2      (ROUTE_ID                  VARCHAR(3) NOT NULL
  3           CONSTRAINT PKEY_ROUTE PRIMARY KEY,
  4       ROUTE_DESCR               VARCHAR(80) NOT NULL,
  5       TICKETNO                  NUMBER(8)
  6       );

Table created.

REM CREATE THE STOP TABLE
W21051498 >CREATE TABLE STOP
  2      (ROU_ID                     VARCHAR(3) NOT NULL
  3           CONSTRAINT PKEY_STOP PRIMARY KEY,
  4      STOP_ID                    VARCHAR(4) NOT NULL
  5           CONSTRAINTS    UNIQ_STOP UNIQUE,
  6       CITIES                     VARCHAR(20) NOT NULL
  7       );

Table created.

REM CREATE THE MEAL TABLE
W21051498 >CREATE TABLE MEAL
  2      (ROU_ID                          VARCHAR(3) NOT NULL
  3           CONSTRAINT PKEY_MEAL PRIMARY KEY,
  4      MEAL_ID                          VARCHAR(4) NOT NULL
  5           CONSTRAINTS    UNIQ_MEAL UNIQUE,
  6      MEAL_TYPES                        VARCHAR(20) NOT NULL
  7      );

Table created.
```

```
REM CREATE THE STOP_DURATIONS TABLE
W21051498 >CREATE TABLE STOP_DURATIONS
  2      (ROU_ID                          VARCHAR(3) NOT NULL
  3           CONSTRAINT PKEY_DURATIONS PRIMARY KEY,
  4       STOP_DURATIONS         VARCHAR(10) NOT NULL
  5       );

Table created.

REM CREATE THE WHICH_HAS TABLE
W21051498 >CREATE TABLE WHICH_HAS
  2      (ROU_ID                          VARCHAR(3) NOT NULL
  3           CONSTRAINT PKEY_WHICH PRIMARY KEY,
  4       CUSTOMERS                VARCHAR(10) NOT NULL
  5       );

Table created.

REM CREATE THE TICKET TABLE
W21051498 >CREATE TABLE TICKET
  2      (TICKET_NUMBER             NUMBER(8) NOT NULL
  3           CONSTRAINT PKEY_TICKET PRIMARY KEY,
  4       TRANSACTION_DATE     DATE NOT NULL,
  5       AGE_ID                           VARCHAR(3),
  6       ROU_ID                           VARCHAR(3),
  7       SCHE_ID                          CHAR(6),
  8       PRICE                             DECIMAL(4,2) NOT NULL
  9       );

Table created.

REM CREATE THE SALES_LIST TABLE
W21051498 >CREATE TABLE SALES_LIST
  2      (SALES_ID                  VARCHAR(3) NOT NULL
  3           CONSTRAINT PKEY_SALES PRIMARY KEY,
  4       AGE_ID                           VARCHAR(3),
  5       TRANSACTION_TIME       TIMESTAMP NOT NULL,
  6       PRICE                             DECIMAL(4,2),
  7       TRANSACTION_DATE       DATE
  8       );

Table created.
```

```
REM CREATE THE BUS TABLE
W21051498 >CREATE TABLE BUS
  2      (BUS_ID                 VARCHAR(4) NOT NULL
  3           CONSTRAINT PKEY_BUS PRIMARY KEY ,
  4       DRIVER                 VARCHAR(10),
  5       SCHE_ID                CHAR(6),
  6       SEATS                  NUMBER(2) NOT NULL
  7       );

Table created.

REM CREATE THE AGENT TABLE
W21051498 >CREATE TABLE AGENT
  2      (AGENT_ID                       VARCHAR(3)
  3          CONSTRAINT PKEY_AGENT PRIMARY KEY,
  4       AGENT_NAME                VARCHAR(15) NOT NULL,
  5       SA_ID                          VARCHAR(3)
  6           CONSTRAINT  UNIQ_SALES UNIQUE,
  7       STREET_NO                      NUMBER(4),
  8       STREET_NAME               VARCHAR(50)
  9       );

Table created.

REM CREATE THE SCHEDULE_TIME_DATE TABLE
W21051498 >CREATE TABLE SCHEDULE_TIME_DATE
  2      (SCHE_ID                        CHAR(6)
  3          CONSTRAINT PKEY_SCHETIME  PRIMARY KEY,
  4       DEPARTURE_TIME                 TIMESTAMP,
  5       DEPARTURE_DATE                 DATE
  6      );

Table created.

REM ALTER THE TABLE STRUCTURE TO INCLUDE THE FOREIGN KEYS

W21051498 >ALTER TABLE SCHEDULE ADD CONSTRAINT FKEY_ROUTESCHE  FOREIGN KEY
(ROU_ID) REFERENCES ROUTE (ROUTE_ID) DEFERRABLE;

Table altered.
```

```
W21051498 >ALTER TABLE SCHEDULE ADD CONSTRAINT FKEY_BUSSCHE FOREIGN KEY
(BUS_NO) REFERENCES BUS (BUS_ID) DEFERRABLE;

Table altered.

W21051498 >ALTER TABLE SCHEDULE ADD CONSTRAINT FKEY_TICKETSCHE FOREIGN KEY
(TICKETNO) REFERENCES TICKET (TICKET_NUMBER) DEFERRABLE;

Table altered.

W21051498 >ALTER TABLE ROUTE ADD CONSTRAINT FKEY_TICKETROU FOREIGN KEY
(TICKETNO) REFERENCES TICKET (TICKET_NUMBER) DEFERRABLE;

Table altered.

W21051498 >ALTER TABLE STOP ADD CONSTRAINT FKEY_ROUTESTOP FOREIGN KEY
(ROU_ID) REFERENCES ROUTE (ROUTE_ID) DEFERRABLE;

Table altered.

W21051498 >ALTER TABLE MEAL ADD CONSTRAINT FKEY_ROUTEMEAL FOREIGN KEY
(ROU_ID) REFERENCES ROUTE (ROUTE_ID) DEFERRABLE;

Table altered.

W21051498 >ALTER TABLE WHICH_HAS ADD CONSTRAINT FKEY_ROUTEHAS FOREIGN KEY
(ROU_ID) REFERENCES ROUTE (ROUTE_ID) DEFERRABLE;

Table altered.

W21051498 >ALTER TABLE STOP_DURATIONS ADD CONSTRAINT FKEY_ROUTEDURA FOREIGN
KEY (ROU_ID) REFERENCES ROUTE (ROUTE_ID) DEFERRABLE;

Table altered.

W21051498 >ALTER TABLE TICKET ADD CONSTRAINT FKEY_AGENTTICK FOREIGN KEY
(AGE_ID) REFERENCES AGENT (AGENT_ID) DEFERRABLE;

Table altered.

W21051498 >ALTER TABLE TICKET ADD CONSTRAINT FKEY_ROUTETICK FOREIGN KEY
(ROU_ID) REFERENCES ROUTE (ROUTE_ID) DEFERRABLE;
```

```
Table altered.

W21051498 >ALTER TABLE TICKET ADD CONSTRAINT FKEY_SCHETICK FOREIGN KEY
(SCHE_ID) REFERENCES SCHEDULE (SCHEDULE_ID) DEFERRABLE;

Table altered.

W21051498 >ALTER TABLE SALES_LIST ADD CONSTRAINT FKEY_SALEAGENT FOREIGN KEY
(AGE_ID) REFERENCES AGENT (AGENT_ID) DEFERRABLE;

Table altered.

W21051498 >ALTER TABLE BUS ADD CONSTRAINT FKEY_SCHEBUS FOREIGN KEY
(SCHE_ID) REFERENCES SCHEDULE (SCHEDULE_ID) DEFERRABLE;

Table altered.

W21051498 >ALTER TABLE AGENT ADD CONSTRAINT FKEY_SALESAGE FOREIGN KEY
(SA_ID) REFERENCES SALES_LIST (SALES_ID) DEFERRABLE;

Table altered.

W21051498 >ALTER TABLE SCHEDULE_TIME_DATE ADD CONSTRAINT FKEY_SCHETIDE
FOREIGN KEY (SCHE_ID) REFERENCES SCHEDULE (SCHEDULE_ID) DEFERRABLE;

Table altered.
```

Part 2 (20 marks)

This part is based on your answer / solution to Part 1, i.e., design and implementation of the database for the TRAVELNORTH scenario.

(A) Populate the database with some sample data (e.g., you should generate your own dummy data and load it into the TRAVELNORTH database, consider 5 to 10 rows for each table and enough data to see meaningful output for the queries below).

(10 marks)

Answer Part 2 A: Provide SQL code below for populating the above relational database

```
REM INSERT INTO THE SALES_LIST TABLE
INSERT INTO SALES_LIST
    VALUES ('WA1', 'DTT', '11-SEP-2022 14:36:00', '11.50', '11-SEP-2022');
INSERT INTO SALES_LIST
    VALUES ('MM2', 'TBB', '13-SEP-2022 16:04:00', '8.90', '13-SEP-2022');
INSERT INTO SALES_LIST
    VALUES ('TT3', 'INS', '12-SEP-2022 15:05:00', '12.90', '12-SEP-2022');
INSERT INTO SALES_LIST
    VALUES ('TA4', 'BON', '11-SEP-2022 12:26:00', '25.90', '11-SEP-2022');
INSERT INTO SALES_LIST
    VALUES ('KD5', 'WAK', '09-OCT-2022 17:16:00', '3.80', '09-NOV-2022');
INSERT INTO SALES_LIST
    VALUES ('LG6', 'SPR', '10-OCT-2022 10:06:00', '5.60', '10-OCT-2022');
INSERT INTO SALES_LIST
    VALUES ('GA7', 'WAK', '14-OCT-2022 15:15:00', '7.60', '14-OCT-2022');


REM INSERT INTO THE AGENT TABLE
INSERT INTO AGENT
    VALUES ('DTT', 'DARATRAVELS', 'WA1', '10', 'CAMPDEN STREET,NEWCASTLE');
INSERT INTO AGENT
    VALUES ('TBB', 'TRAVELBETA', 'MM2', '10', 'FLORENCE STREET,NEWCASTLE');
INSERT INTO AGENT
    VALUES ('INS', 'INSURANTIPS','TT3', '10', 'OXFORD STREET,NEWCASTLE');
INSERT INTO AGENT
    VALUES ('BON', 'BONVOGAGE','TA4', '20', 'FAWCETT STREET, SUNDERLAND');
INSERT INTO AGENT
    VALUES ('WAK', 'WAKANOW', 'KD5', '3', 'CHESTER-LEE, DURHAM');
INSERT INTO AGENT
    VALUES ('SPR', 'SPECITRIPS', 'LG6', '6', 'MEGIDO, DURHAM');
INSERT INTO AGENT
    VALUES ('WAN', 'WAKANOW', 'GA7', '3', 'CHESTER-LEE, DURHAM');


REM INSERT INTO THE SCHEDULE TABLE
INSERT INTO SCHEDULE
        VALUES ('S10243', 'NC1', 'LEX1', '78602152');
INSERT INTO SCHEDULE
        VALUES ('S10565', 'DS1', 'ACU2', '79424931');
INSERT INTO SCHEDULE
```

```
        VALUES ('S11125', 'NM1', 'HON3', '79424987');
INSERT INTO SCHEDULE
        VALUES ('S38976', 'NP2', 'MAZ4', '76424964');
INSERT INTO SCHEDULE
        VALUES ('S10034', 'DC3', 'TOY5', '79424850');
INSERT INTO SCHEDULE
        VALUES ('S10443', 'PC2', 'CAM6', '79420994');
INSERT INTO SCHEDULE
        VALUES ('S20649', 'FA5', 'HYD7', '70420658');


REM INSERT INTO THE ROUTE TABLE
INSERT INTO ROUTE
    VALUES ('NC1', 'NEWCASTLE-CARLISLE', '78602152');
INSERT INTO ROUTE
    VALUES ('DS1', 'DURHAM-STOCKTON', '79424931');
INSERT INTO ROUTE
    VALUES ('NM1', 'NEWCASTLE-MIDDLESBROUGH', '79424987');
INSERT INTO ROUTE
    VALUES ('NP2', 'NEWCASTLE-ALSTON-PENRITH', '76424964');
INSERT INTO ROUTE
    VALUES ('DC3', 'NEWCASTLE-HAYMARKET', '79424850');
INSERT INTO ROUTE
    VALUES ('PC2', 'NEWCASTLE-WINDERMERE', '79420994');
INSERT INTO ROUTE
    VALUES ('FA5', 'WASHIGTON-BEDE', '70420658');



REM INSERT INTO THE STOP TABLE
INSERT INTO STOP
    VALUES ('NC1', 'STP1','CARLISLE');
INSERT INTO STOP
    VALUES ('DS1', 'STP2','STOCKTON');
INSERT INTO STOP
    VALUES ('NM1', 'STP3', 'MIDDLESBROUGH');
INSERT INTO STOP
    VALUES ('NP2', 'STP4', 'PENRITH');
INSERT INTO STOP
    VALUES ('DC3', 'STP5', 'HAYMARKET');
INSERT INTO STOP
    VALUES ('PC2', 'STP6', 'WINDERMERE');
INSERT INTO STOP
    VALUES ('FA5', 'STP7', 'BEDE');


REM INSERT INTO THE MEAL TABLE
INSERT INTO MEAL
    VALUES ('NC1', 'MEA1', 'EGG TOAST');
INSERT INTO MEAL
    VALUES ('DS1', 'MEA2', 'CHEESE');
INSERT INTO MEAL
    VALUES ('NM1', 'MEA3', 'RICE CHILI');
INSERT INTO MEAL
    VALUES ('NP2', 'MEA4', 'BACON');
INSERT INTO MEAL
    VALUES ('DC3', 'MEA5', 'RAVIOLI');
INSERT INTO MEAL
    VALUES ('PC2', 'MEA6', 'CHIPS');
INSERT INTO MEAL
    VALUES ('FA5', 'MEA7', 'TUNA');
```

```
REM INSERT INTO THE STOP_DURATIONS TABLE
INSERT INTO STOP_DURATIONS
    VALUES ('NC1', '10 Secs');
INSERT INTO STOP_DURATIONS
    VALUES ('DS1', '50 Secs');
INSERT INTO STOP_DURATIONS
    VALUES ('NM1', '40 Secs');
INSERT INTO STOP_DURATIONS
    VALUES ('NP2', '4 Secs');
INSERT INTO STOP_DURATIONS
    VALUES ('DC3', '30 Secs');
INSERT INTO STOP_DURATIONS
    VALUES ('PC2', '2 hrs');
INSERT INTO STOP_DURATIONS
    VALUES ('FA5', '3 hrs');


REM INSERT INTO THE WHICH_HAS TABLE
INSERT INTO WHICH_HAS
    VALUES ('NC1', 'MALCOM');
INSERT INTO WHICH_HAS
    VALUES ('DS1', 'SHERRY');
INSERT INTO WHICH_HAS
    VALUES ('NM1', 'CLARA');
INSERT INTO WHICH_HAS
    VALUES ('NP2', 'HENRY');
INSERT INTO WHICH_HAS
    VALUES ('DC3', 'KATE');
INSERT INTO WHICH_HAS
    VALUES ('PC2', 'CHARLES');
INSERT INTO WHICH_HAS
    VALUES ('FA5', 'DAVID');



REM INSERT INTO THE TICKET TABLE
INSERT INTO TICKET
    VALUES ('78602152', '11-SEP-2022', 'DTT', 'NC1', 'S10243','11.50');
INSERT INTO TICKET
    VALUES ('79424931', '13-SEP-2022', 'TBB', 'DS1', 'S10565','8.90');
INSERT INTO TICKET
    VALUES ('79424987', '12-SEP-2022', 'INS', 'NM1', 'S11125', '12.90');
INSERT INTO TICKET
    VALUES ('76424964', '11-SEP-2022', 'BON', 'NP2', 'S38976', '25.90');
INSERT INTO TICKET
    VALUES ('79424850', '09-OCT-2022', 'WAK', 'DC3', 'S10034','20.95');
INSERT INTO TICKET
    VALUES ('79420994', '10-OCT-2022', 'SPR', 'PC2', 'S10443', '15.08');
INSERT INTO TICKET
    VALUES ('70420658', '14-OCT-2022', 'WAN', 'FA5', 'S20649', '10.03');



REM INSERT INTO THE BUS TABLE
INSERT INTO BUS
    VALUES ('LEX1', 'ABBEY', 'S10243','2');
INSERT INTO BUS
    VALUES ('ACU2', 'PEDRO', 'S10565', '14');
INSERT INTO BUS
    VALUES ('HON3', 'TASHA', 'S11125', '28');
INSERT INTO BUS
    VALUES ('MAZ4', 'KISH', 'S38976', '50');
INSERT INTO BUS
```

```
    VALUES ('TOY5', 'MIGUEL', 'S10034', '10');
INSERT INTO BUS
    VALUES ('CAM6', 'JOHN', 'S10443', '6');
INSERT INTO BUS
    VALUES ('HYD7', 'KYLE', 'S20649', '9');

REM INSERT INTO THE SCHEDULE_TIME_DATE TABLE
INSERT INTO SCHEDULE_TIME_DATE
    VALUES ('S10243','12-SEP-2022 09:00:00', '12-SEP-2022');
INSERT INTO SCHEDULE_TIME_DATE
    VALUES ('S10565','14-SEP-2022 14:30:00', '14-SEP-2022');
INSERT INTO SCHEDULE_TIME_DATE
    VALUES ('S11125','13-SEP-2022 15:30:00', '13-SEP-2022');
INSERT INTO SCHEDULE_TIME_DATE
    VALUES ('S38976','12-SEP-2022 08:00:00', '12-SEP-2022');
INSERT INTO SCHEDULE_TIME_DATE
    VALUES ('S10034','10-OCT-2022 07:00:00', '10-OCT-2022');
INSERT INTO SCHEDULE_TIME_DATE
    VALUES ('S10443','11-OCT-2022 10:05:00', '11-OCT-2022');
INSERT INTO SCHEDULE_TIME_DATE
    VALUES ('S20649','15-OCT-2022 15:15:00', '15-OCT-2022');
```

Answer Part 2 A: Provide below output from running the above SQL code for populating your relational database (e.g., contents from Spool file or copy & paste of outputs from the SQL plus window). Make sure the output is simple TEXT and NOT a screenshot / image or picture

```
REM INSERT VALUES INTO THE SALE_LIST TABLE

W21051498 >INSERT INTO SALES_LIST
  2       VALUES ('WA1', 'DTT', '11-SEP-2022 14:36:00', '11.50', '11-SEP-
2022');

1 row created.

W21051498 >INSERT INTO SALES_LIST
  2       VALUES ('MM2', 'TBB', '13-SEP-2022 16:04:00', '8.90', '13-SEP-
2022');

1 row created.

W21051498 >INSERT INTO SALES_LIST
  2       VALUES ('TT3', 'INS', '12-SEP-2022 15:05:00', '12.90', '12-SEP-
2022');

1 row created.

W21051498 >INSERT INTO SALES_LIST
  2       VALUES ('TA4', 'BON', '11-SEP-2022 12:26:00', '25.90', '11-SEP-
2022');

1 row created.

W21051498 >INSERT INTO SALES_LIST
  2       VALUES ('KD5', 'WAK', '09-OCT-2022 17:16:00', '3.80', '09-NOV-
2022');

1 row created.

W21051498 >INSERT INTO SALES_LIST
  2       VALUES ('LG6', 'SPR', '10-OCT-2022 10:06:00', '5.60', '10-OCT-
2022');

1 row created.

W21051498 >INSERT INTO SALES_LIST
  2       VALUES ('GA7', 'WAK', '14-OCT-2022 15:15:00', '7.60', '14-OCT-
2022');

1 row created.

REM INSERT VALUES INTO THE ROUTE TABLE

W21051498 >INSERT INTO AGENT
  2       VALUES ('DTT', 'DARATRAVELS', 'WA1', '10', 'CAMPDEN
STREET,NEWCASTLE');

1 row created.

W21051498 >INSERT INTO AGENT
  2       VALUES ('TBB', 'TRAVELBETA', 'MM2', '10', 'FLORENCE
STREET,NEWCASTLE');
```

```
1 row created.

W21051498 >INSERT INTO AGENT
  2      VALUES ('INS', 'INSURANTIPS','TT3', '10', 'OXFORD
STREET,NEWCASTLE');

1 row created.

W21051498 >INSERT INTO AGENT
  2      VALUES ('BON', 'BONVOGAGE','TA4', '20', 'FAWCETT STREET,
SUNDERLAND');

1 row created.

W21051498 > INSERT INTO AGENT
  2      VALUES ('WAK', 'WAKANOW', 'KD5', '3', 'CHESTER-LEE, DURHAM');

1 row created.

W21051498 > INSERT INTO AGENT
  2      VALUES ('SPR', 'SPECITRIPS', 'LG6', '6', 'MEGIDO, DURHAM');

1 row created.

W21051498 > INSERT INTO AGENT
  2      VALUES ('WAN', 'WAKANOW', 'GA7', '3', 'CHESTER-LEE, DURHAM');

1 row created.

REM INSERT VALUES INTO THE SCHEDULE TABLE
W21051498 > INSERT INTO SCHEDULE
  2          VALUES ('S10243', 'NC1', 'LEX1', '78602152');

1 row created.

W21051498 > INSERT INTO SCHEDULE
  2          VALUES ('S10565', 'DS1', 'ACU2', '79424931');

1 row created.

W21051498 > INSERT INTO SCHEDULE
  2          VALUES ('S11125', 'NM1', 'HON3', '79424987');

1 row created.

W21051498 > INSERT INTO SCHEDULE
  2          VALUES ('S38976', 'NP2', 'MAZ4', '76424964');

1 row created.

W21051498 > INSERT INTO SCHEDULE
  2          VALUES ('S10034', 'DC3', 'TOY5', '79424850');

1 row created.

W21051498 > INSERT INTO SCHEDULE
  2          VALUES ('S10443', 'PC2', 'CAM6', '79420994');

1 row created.

W21051498 > INSERT INTO SCHEDULE
  2          VALUES ('S20649', 'FA5', 'HYD7', '70420658');
```

```
1 row created.


REM INSERT VALUES INTO THE ROUTE TABLE
W21051498 > INSERT INTO ROUTE
  2      VALUES ('NC1', 'NEWCASTLE-CARLISLE', '78602152');

1 row created.

W21051498 > INSERT INTO ROUTE
  2      VALUES ('DS1', 'DURHAM-STOCKTON', '79424931');

1 row created.

W21051498 > INSERT INTO ROUTE
  2      VALUES ('NM1', 'NEWCASTLE-MIDDLESBROUGH', '79424987');

1 row created.

W21051498 > INSERT INTO ROUTE
  2      VALUES ('NP2', 'NEWCASTLE-ALSTON-PENRITH', '76424964');

1 row created.

W21051498 > INSERT INTO ROUTE
  2      VALUES ('DC3', 'NEWCASTLE-HAYMARKET', '79424850');

1 row created.

W21051498 > INSERT INTO ROUTE
  2      VALUES ('PC2', 'NEWCASTLE-WINDERMERE', '79420994');

1 row created.

W21051498 > INSERT INTO ROUTE
  2      VALUES ('FA5', 'WASHIGTON-BEDE', '70420658');

1 row created.

REM INSERT VALUES INTO THE STOP TABLE
W21051498 > INSERT INTO STOP
  2      VALUES ('NC1', 'STP1','CARLISLE');

1 row created.

W21051498 > INSERT INTO STOP
  2      VALUES ('DS1', 'STP2','STOCKTON');

1 row created.

W21051498 > INSERT INTO STOP
  2      VALUES ('NM1', 'STP3', 'MIDDLESBROUGH');

1 row created.

W21051498 > INSERT INTO STOP
  2      VALUES ('NP2', 'STP4', 'PENRITH');

1 row created.

W21051498 > INSERT INTO STOP
```

```
  2      VALUES ('DC3', 'STP5', 'WINDERMERE');

1 row created.

W21051498 > INSERT INTO STOP
  2      VALUES ('PC2', 'STP6', 'HAYMARKET');

1 row created.

W21051498 > INSERT INTO STOP
  2      VALUES ('FA5', 'STP7', 'BEDE');

1 row created.

REM INSERT VALUES INTO THE MEAL TABLE
W21051498 > INSERT INTO MEAL
  2      VALUES ('NC1', 'MEA1', 'EGG TOAST');

1 row created.

W21051498 > INSERT INTO MEAL
  2      VALUES ('DS1', 'MEA2', 'CHEESE');

1 row created.

W21051498 > INSERT INTO MEAL
  2      VALUES ('NM1', 'MEA3', 'RICE CHILI');

1 row created.

W21051498 > INSERT INTO MEAL
  2      VALUES ('NP2', 'MEA4', 'BACON');

1 row created.

W21051498 > INSERT INTO MEAL
  2      VALUES ('DC3', 'MEA5', 'RAVIOLI');

1 row created.

W21051498 > INSERT INTO MEAL
  2      VALUES ('PC2', 'MEA6', 'CHIPS');

1 row created.

W21051498 > INSERT INTO MEAL
  2      VALUES ('FA5', 'MEA7', 'TUNA');

1 row created.


REM INSERT VALUES INTO THE STOP_DURATIONS TABLE
W21051498 > INSERT INTO STOP_DURATIONS
  2      VALUES ('NC1', '10 Secs');

1 row created.

W21051498 > INSERT INTO STOP_DURATIONS
  2      VALUES ('DS1', '50 Secs');

1 row created.
```

```
W21051498 > INSERT INTO STOP_DURATIONS
  2      VALUES ('NM1', '40 Secs');

1 row created.

W21051498 > INSERT INTO STOP_DURATIONS
  2      VALUES ('NP2', '4 Secs');

1 row created.

W21051498 > INSERT INTO STOP_DURATIONS
  2      VALUES ('DC3', '30 Secs');

1 row created.

W21051498 > INSERT INTO STOP_DURATIONS
  2      VALUES ('PC2', '2 hrs');

1 row created.

W21051498 > INSERT INTO STOP_DURATIONS
  2      VALUES ('FA5', '3 hrs');

1 row created.

REM INSERT VALUES INTO THE WHICH_HAS TABLE
W21051498 > INSERT INTO WHICH_HAS
  2      VALUES ('NC1', 'MALCOM');

1 row created.

W21051498 > INSERT INTO WHICH_HAS
  2      VALUES ('DS1', 'SHERRY');

1 row created.

W21051498 > INSERT INTO WHICH_HAS
  2      VALUES ('NM1', 'CLARA');

1 row created.

W21051498 > INSERT INTO WHICH_HAS
  2      VALUES ('NP2', 'HENRY');

1 row created.

W21051498 > INSERT INTO WHICH_HAS
  2      VALUES ('DC3', 'KATE');

1 row created.

W21051498 > INSERT INTO WHICH_HAS
  2      VALUES ('PC2', 'CHARLES');

1 row created.

W21051498 > INSERT INTO WHICH_HAS
  2      VALUES ('FA5', 'DAVID');

1 row created.

REM INSERT VALUES INTO THE TICKET TABLE
```

```
W21051498 > INSERT INTO TICKET
  2      VALUES ('78602152', '11-SEP-2022', 'DTT', 'NC1',
'S10243','11.50');

1 row created.

W21051498 > INSERT INTO TICKET
  2      VALUES ('79424931', '13-SEP-2022', 'TBB', 'DS1', 'S10565','8.90');

1 row created.

W21051498 > INSERT INTO TICKET
  2      VALUES ('79424987', '12-SEP-2022', 'INS', 'NM1', 'S11125',
'12.90');

1 row created.

W21051498 > INSERT INTO TICKET
  2      VALUES ('76424964', '11-SEP-2022', 'BON', 'NP2', 'S38976',
'25.90');

1 row created.

W21051498 > INSERT INTO TICKET
  2      VALUES ('79424850', '09-OCT-2022', 'WAK', 'DC3',
'S10034','20.95');

1 row created.

W21051498 > INSERT INTO TICKET
  2      VALUES ('79420994', '10-OCT-2022', 'SPR', 'PC2', 'S10443',
'15.08');

1 row created.

W21051498 > INSERT INTO TICKET
  2      VALUES ('70420658', '14-OCT-2022', 'WAN', 'FA5', 'S20649',
'10.03');

1 row created.


REM INSERT VALUES INTO THE BUS TABLE
W21051498 > INSERT INTO BUS
  2      VALUES ('LEX1', 'ABBEY', 'S10243', '2');

1 row created.

W21051498 > INSERT INTO BUS
  2      VALUES ('ACU2', 'PEDRO', 'S10565', '14');

1 row created.

W21051498 > INSERT INTO BUS
  2      VALUES ('HON3', 'TASHA', 'S11125', '28');

1 row created.

W21051498 > INSERT INTO BUS
  2      VALUES ('MAZ4', 'KISH', 'S38976', '50');

1 row created.
```

```
W21051498 > INSERT INTO BUS
  2      VALUES ('TOY5', 'MIGUEL', 'S10034', '10');

1 row created.

W21051498 > INSERT INTO BUS
  2      VALUES ('CAM6', 'JOHN', 'S10443', '6');

1 row created.

W21051498 > INSERT INTO BUS
  2      VALUES ('HYD7', 'KYLE', 'S20649', '9');

1 row created.


REM INSERT VALUES INTO THE SCHEDULE TABLE
W21051498 > INSERT INTO SCHEDULE_TIME_DATE
  2      VALUES ('S10243','12-SEP-2022 09:00:00', '12-SEP-2022');

1 row created.

W21051498 > INSERT INTO SCHEDULE_TIME_DATE
  2      VALUES ('S10565','14-SEP-2022 14:30:00', '14-SEP-2022');

1 row created.

W21051498 > INSERT INTO SCHEDULE_TIME_DATE
  2      VALUES ('S11125','13-SEP-2022 15:30:00', '13-SEP-2022');

1 row created.

W21051498 > INSERT INTO SCHEDULE_TIME_DATE
  2      VALUES ('S38976','12-SEP-2022 08:00:00', '12-SEP-2022');

1 row created.

W21051498 > INSERT INTO SCHEDULE_TIME_DATE
  2      VALUES ('S10034','10-OCT-2022 07:00:00', '10-OCT-2022');

1 row created.

W21051498 > INSERT INTO SCHEDULE_TIME_DATE
  2      VALUES ('S10443','11-OCT-2022 10:05:00', '11-OCT-2022');

1 row created.

W21051498 > INSERT INTO SCHEDULE_TIME_DATE
  2      VALUES ('S20649','15-OCT-2022 15:15:00', '15-OCT-2022');

1 row created.
```

(B) Answer the following queries (retrievals) using Relational Algebra and SQL.

(10 marks)

q1) Display details of schedules for travelling between Newcastle and Windermere with five or more available seats in the next ten days.

Provide Relational Algebra expression below:

π SCHEDULE_ID, ROUTE_ID, ROUTE_DESCR, DEPARTURE_TIME, PRICE, SEAT ← (σ WHERE ROUTE_DESCR= 'NEWCASTLE-WINDERMERE' $\wedge$ SEAT > 5 $\wedge$ DEPARTURE_DATE <=+10(SCHEDULE $\bowtie$ ROUTE $\bowtie$ BUS $\bowtie$ SCHEDULE_TIME_DATE))

Provide SQL query code and output below (simple TEXT not image / screenshot / picture):

```
W21051498 >  SELECT
  2    SCHEDULE.SCHEDULE_ID,
  3    ROUTE.ROUTE_ID,
  4    ROUTE.ROUTE_DESCR,
  5    SCHEDULE_TIME_DATE.DEPARTURE_TIME,
  6    TICKET.PRICE,
  7    BUS.SEATS
  8    FROM SCHEDULE
  9    JOIN ROUTE
 10    ON SCHEDULE.ROU_ID = ROUTE.ROUTE_ID
 11    JOIN BUS
 12    ON BUS.SCHE_ID = SCHEDULE.SCHEDULE_ID
 13    JOIN SCHEDULE_TIME_DATE
 14      ON SCHEDULE_TIME_DATE.SCHE_ID = SCHEDULE.SCHEDULE_ID
 15    JOIN TICKET
 16    ON TICKET.SCHE_ID = SCHEDULE.SCHEDULE_ID
 17    WHERE ROUTE.ROUTE_DESCR = 'NEWCASTLE-WINDERMERE'
 18    AND BUS.SEATS > 4 AND SCHEDULE_TIME_DATE.DEPARTURE_DATE <= SYSDATE
+10;

SCHEDU ROU
------ ---
ROUTE_DESCR
--------------------------------------------------------------------------------
-----
DEPARTURE_TIME
--------------------------------------------------------------------------------
     PRICE      SEATS
```

```
---------- ----------
S10443 PC2
NEWCASTLE-WINDERMERE
11-OCT-22 10.05.00.000000
     15.08          6
```

q2) Display details of the travel agent(s) with the most ticket sales in the month of October 2022.

Provide Relational Algebra expression below:

π COUNT(PRICE), AGENT_NAME, STREET_NO, STREET_NAME. ← (σ WHERE TRANSACTION_DATE >= '01-OCT-2022' ∧ TRANSACTION_DATE < '31-OCT-2022' (AGENT ⋈ SALES_LIST ⋈ TICKET))

Provide SQL query code and output below (simple TEXT not image / screenshot / picture):

```
W21051498 >SELECT
  2  COUNT(TICKET.PRICE),
  3  AGENT.AGENT_NAME, AGENT.STREET_NO,
  4  AGENT.STREET_NAME FROM AGENT
  5  INNER JOIN SALES_LIST
  6  ON AGENT.SA_ID = SALES_LIST.SALES_ID
  7  JOIN TICKET
  8  ON TICKET.AGE_ID = AGENT.AGENT_ID
  9  WHERE TICKET.TRANSACTION_DATE >= '01-OCT-2022' and
TICKET.TRANSACTION_DATE <  '31-OCT-2022'
 10  group by AGENT.AGENT_NAME, AGENT.STREET_NO, AGENT.STREET_NAME;

COUNT(TICKET.PRICE) AGENT_NAME       STREET_NO
------------------- --------------- ----------
STREET_NAME
--------------------------------------------------
                  2 WAKANOW                    3
CHESTER-LEE, DURHAM

                  1 SPECITRIPS                 6
MEGIDO, DURHAM
```

Part 3 (35 marks)

This part is based on your answer / solution to Part 1 (A), i.e., conceptual design of the database for the TRAVELNORTH scenario.

(A) Choose and justify what aspects of TRAVELNORTH conceptual design would be better off if implemented using object-relational database; then provide logical design and implementation of the subset of the TRAVELNORTH using ER/EER to object-relational mapping and object-relational features of Oracle Database System (Kannan); populate the object-tables with sample data and demonstrate your choice of design and implementation by running two complex queries on your object-tables.

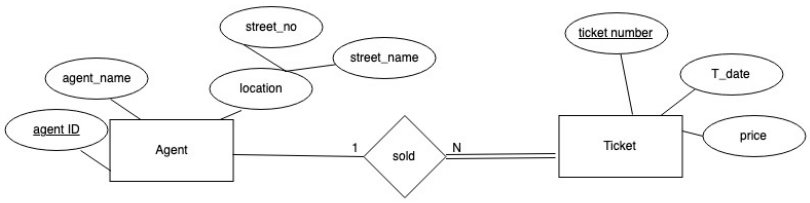
(20 marks)

Answer Part 3 A

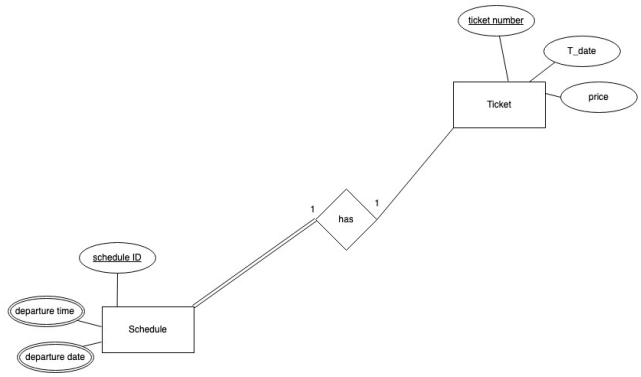
1) Provide below your choice and justification of what aspects (subset) of the TRAVELNORTH conceptual design from Part 1.A you would like to implement using object relational databases (2 marks)

Two subsets were identified,

- The subset of the relationship Agent and Ticket



- The subset of the relationship between Schedule and Ticket



The selected subsets (Agent & ticket and schedule & ticket) could be implemented better with an object-relational database because of the following shortcomings when implemented on a relational database

- It is currently lacking in supporting complex information.
- The agent & ticket subset cannot easily be shared from one system to another due to its incompleteness alone unless it is linked with the sales_list & schedule subset hence it becomes an island of information.
- The Sales_list table has structured limits, the number of tickets sold per agent must be specified to fit into a column.

Implementing the subsets to an object-relational database gives the following benefits

- It allows for reuse and sharing where the functionality is extended.
- The object-relational database can retain the relational model and the strengths.
- It supports complex data types and object-relational design.
- Also, there is increased productivity in the sales_list & agent subset.

2) Provide below the logical design for your chosen subset using ER/EER to object-relational mapping (2 marks)

- Showing the logical design for the Agent and Ticket subset

Agent

Agent_ID	Agent_Name	Street_NO	Street_Name	Tickets
DTT	Daratravels	10	CAMPDEN STREET, NEWCASTLE	Nested Tab [TicketRef1]

Ticket

Ticket_number	Transaction_date	price	Sold by
78602152	11-SEP-2022	11.50	AgentRef1*

Agent sold many tickets:

Agent 1..1 <-- sold -->> 0..* Ticket

Schema
Agent has a nested table of REF to Ticket and Ticket has a REF to Agent

Agent (agent_ID, agent_name, street_no, street_name, tick: nested table [REF Ticket])

Ticket (ticket_number, t_date, price, sold by: REF Agent)

- Another logical design can be showed showing the Schedule and ticket subset

Schedule

Schedule_id	Departure_time	Departure_date	ticket
S10243	09:00:00	12-SEP-2022	Nested table [REF ticket]
	14:30:00	14-SEP-2022	

Ticket

Ticket_number	Transaction_date	price
78602152	11-SEP-2022	11.50

Schedule (schedule_id, departure_time (schedule_time), departure_date (schedule_date), ticket: Nested table [REF ticket])

Ticket (ticket_number, transaction_date, price)

3) Provide below the SQL code and output (simple TEXT only) for implementing your above logical object-relational design (8 marks)

```
REM FOR AGENT AND TICKET SUBSET
w21051498>CREATE OR REPLACE Type Agent_t as Object
  2  (Agent_ID    varchar(3),
  3  Agent_name   char(20),
  4  Street_no    number(4),
  5  Street_name  varchar(50)
  6  )
  7  /

Type created.

w21051498>Create Type Agent_Tnb as table of Agent_t
  2  /

Type created.

w21051498>CREATE Table Tiicket_t
  2  (Ticket_number      number(8),
  3  Transaction_date    date,
  4  Price               decimal(4,2),
  5  Agent               Agent_Tnb)
  6  Nested Table AGENT Store As Agent_Ticket_NTab;

Table created.

REM FOR SCHEDULE AND TICKET SUBSET
w21051498> Create Type sticket as Object(
  2  sticket_numer  number(8,0),
  3  Transaction_date  date,
  4  price  decimal(4,2)
  5  )
  6  /

Type created.

w21051498> Create Type sticket_ref_t as Object(
  2  TicketRef REF sticket)
  3  /
```

```
Type created.

w21051498> Create Table sTicket_Tab of sticket(
  2  Primary key (sticket_numer));

Table created.

w21051498> Create Type sticket_set_t as Table of sticket_ref_t
  2  /

Type created.

w21051498> Create Type ddeparture_date_t as Object(
  2  departure_date  date)
  3  /

Type created.

w21051498> Create Type ddeparture_date_Tab as Table of ddeparture_date_t
  2  /

Type created.

w21051498> Create Type ddeparture_time_t as Object(
  2  departure_time  date)
  3  /

Type created.

w21051498> Create Type ddeparture_time_Tab as Table of ddeparture_time_t
  2  /

Type created.

w21051498> Create Type sschedule_t as Object(
  2  schedule_id char(6),
  3  departure_date ddeparture_date_Tab,
  4  departure_time  ddeparture_time_Tab,
  5  ticket sticket_set_t)
  6  /
```

```
Type created.
w21051498> Create Table sschedule of sschedule_t(
  2  Primary key(schedule_id))
  3  Nested Table departure_date Store As schedule_departure_date
  4  Nested Table departure_time Store As schedule_departure_time
  5  Nested Table ticket Store As schedule_ticket
  6  /

Table created.
```

4) Provide below the SQL code and output (simple TEXT only) for populating your above object-relational subset of the TRAVELNORTH database (4 marks)

```
REM FOR AGENT AND TICKET SUBSET
w21051498>INSERT INTO Tiicket_t
  2   VALUES ('78602152', '11-SEP-2022','11.50', Agent_Tnb(Agent_t('DTT',
'Daratravels', 10, 'CAMPDEN STREET, NEWCASTLE')) )
  3  /

1 row created.

w21051498>INSERT INTO Tiicket_t
  2   VALUES ('79424931', '13-SEP-2022','8.90', Agent_Tnb(Agent_t('TBB',
'TraveBeta', '10', 'FLORENCE STREET, NEWCASTLE')) )
  3  /

1 row created.

w21051498>INSERT INTO Tiicket_t
  2   VALUES ('79424987', '12-SEP-2022', '12.90', Agent_Tnb(Agent_t('INS',
'INSURANTIPS', '10', 'OXFORD STREET,NEWCASTLE')) )
  3  /

1 row created.

w21051498>INSERT INTO Tiicket_t
  2   VALUES ('76424964', '11-SEP-2022', '25.90', Agent_Tnb(Agent_t('BON',
'BONVOGAGE', '20', 'FAWCETT STREET, SUNDERLAND')) )
  3  /

1 row created.

w21051498>INSERT INTO Tiicket_t
  2   VALUES ('79424850', '09-OCT-2022', '20.95', Agent_Tnb(Agent_t('WAK',
'WAKANOW', '3', 'CHESTER-LEE, DURHAM')) )
  3  /

1 row created.
```

```
w21051498>INSERT INTO Tiicket_t
  2   VALUES ('79420994', '10-OCT-2022', '15.08', Agent_Tnb(Agent_t('SPR',
'SPECITRIPS', '6', 'MEGIDO, DURHAM')) )
  3  /

1 row created.

w21051498>INSERT INTO Tiicket_t
  2   VALUES ('70420658', '14-OCT-2022', '10.03', Agent_Tnb(Agent_t('WAN',
'WAKANOW', '3', 'CHESTER-LEE, DURHAM')) )
  3  /

1 row created.

REM FOR SCHEDULE AND TICKET SUBSET
w21051498> INSERT INTO sTicket_Tab
  2  VALUES ('78602152', '11-SEP-2022','11.50')
  3  /

1 row created.

w21051498> INSERT INTO sTicket_Tab
  2  VALUES ('79424931', '13-SEP-2022','8.90')
  3  /

1 row created.

w21051498> INSERT INTO sTicket_Tab
  2  VALUES ('79424987', '12-SEP-2022', '12.90')
  3  /

1 row created.

w21051498> INSERT INTO sTicket_Tab
  2  VALUES ('76424964', '11-SEP-2022', '25.90')
  3  /

1 row created.

w21051498> INSERT INTO sTicket_Tab
  2  VALUES ('79424850', '09-OCT-2022', '20.95')
  3  /
```

```
1 row created.

w21051498> INSERT INTO sTicket_Tab
  2  VALUES ('79420994', '10-OCT-2022', '15.08')
  3  /

1 row created.

w21051498> INSERT INTO sTicket_Tab
  2  VALUES ('70420658', '14-OCT-2022', '10.03')
  3  /

1 row created.

w21051498>  insert  into  sschedule  values  ('S10243',ddeparture_date_Tab(
ddeparture_date_t ('12-SEP-2022'),
                              ddeparture_time_Tab(ddeparture_time_t       (
'09:00:00') ),
                   sticket_set_t()
                  )
/

w21051498> INSERT INTO TABLE (
  SELECT  S.ticket
  FROM   sschedule S
  WHERE  S.schedule_ID = 'S10243')
SELECT REF(m)
       FROM sTicket_Tab m
       WHERE m.Transaction_date in ('12-SEP-2022')
/

w21051498> insert into sschedule values ('S10565'),
                   ddeparture_date_Tab( ddeparture_date_t ('14-SEP-2022')),
                              ddeparture_time_Tab(ddeparture_time_t       (
'14:30:00') ),
                   sticket_set_t()
                  )
/
w21051498> INSERT INTO TABLE (
  SELECT  S.ticket
  FROM   sschedule S
```

```
  WHERE  S.schedule_ID = 'S10565')
SELECT REF(m)
       FROM sTicket_Tab m
       WHERE m.Transaction_date in ('13-SEP-2022')
/

w21051498> insert into sschedule values ('S11125'),
                  ddeparture_date_Tab( ddeparture_date_t ('14-SEP-2022')),
                            ddeparture_time_Tab(ddeparture_time_t       (
'14:30:00') ),
                  sticket_set_t()
                 )
/

w21051498> INSERT INTO TABLE (
  SELECT  S.ticket
  FROM   sschedule S
  WHERE  S.schedule_ID = 'S11125')
SELECT REF(m)
       FROM sTicket_Tab m
       WHERE m.Transaction_date in ('12-SEP-2022')
/

w21051498> insert into sschedule values ('S38976'),
                  ddeparture_date_Tab( ddeparture_date_t ('14-SEP-2022')),
                            ddeparture_time_Tab(ddeparture_time_t       (
'14:30:00') ),
                  sticket_set_t()
                 )
/

w21051498> INSERT INTO TABLE (
  SELECT  S.ticket
  FROM   sschedule S
  WHERE  S.schedule_ID = 'S38976')
SELECT REF(m)
       FROM sTicket_Tab m
       WHERE m.Transaction_date in ('11-SEP-2022')
/

w21051498> insert into sschedule values ('S10034'),
                  ddeparture_date_Tab( ddeparture_date_t ('14-SEP-2022')),
```

```
                              ddeparture_time_Tab(ddeparture_time_t       (
'14:30:00') ),
                   sticket_set_t()
                  )
/

w21051498> INSERT INTO TABLE (
  SELECT  S.ticket
  FROM   sschedule S
  WHERE  S.schedule_ID = 'S10034')
SELECT REF(m)
       FROM sTicket_Tab m
       WHERE m.Transaction_date in ('09-OCT-2022')
/

w21051498> insert into sschedule values ('S10443'),
                   ddeparture_date_Tab( ddeparture_date_t ('14-SEP-2022')),
                              ddeparture_time_Tab(ddeparture_time_t       (
'14:30:00') ),
                   sticket_set_t()
                  )
/

w21051498> INSERT INTO TABLE (
  SELECT  S.ticket
  FROM   sschedule S
  WHERE  S.schedule_ID = 'S10443')
SELECT REF(m)
       FROM sTicket_Tab m
       WHERE m.Transaction_date in ('10-OCT-2022')
/

w21051498> insert into sschedule values ('S20649'),
                   ddeparture_date_Tab( ddeparture_date_t ('14-SEP-2022')),
                              ddeparture_time_Tab(ddeparture_time_t       (
'14:30:00') ),
                   sticket_set_t()
                  )
/

w21051498> INSERT INTO TABLE (
  SELECT  S.ticket
```

```
  FROM   sschedule S
  WHERE  S.schedule_ID = 'S20649')
SELECT REF(m)
       FROM sTicket_Tab m
       WHERE m.Transaction_date in ('14-OCT-2022')
/
```

5) Provide below the SQL code and (only simple TEXT only) for running two complex queries on the object-relational subset of the above TRAVELNORTH database (4 marks)

```
REM CODE 1
w21051498>SELECT  Ticket_number,  Transaction_date,  Price,  n.Agent_name,
n.Street_no, n.Street_name
  2  FROM Tiicket_t,table(Tiicket_t.Agent)n;

TICKET_NUMBER TRANSACTI      PRICE AGENT_NAME            STREET_NO
------------- --------- ---------- -------------------- ----------
STREET_NAME
--------------------------------------------------
     78602152 11-SEP-22       11.5 Daratravels                  10
CAMPDEN STREET, NEWCASTLE

     79424931 13-SEP-22        8.9 TraveBeta                    10
FLORENCE STREET, NEWCASTLE

     79424987 12-SEP-22       12.9 INSURANTIPS                  10
OXFORD STREET,NEWCASTLE


TICKET_NUMBER TRANSACTI      PRICE AGENT_NAME            STREET_NO
------------- --------- ---------- -------------------- ----------
STREET_NAME
--------------------------------------------------
     76424964 11-SEP-22       25.9 BONVOGAGE                    20
FAWCETT STREET, SUNDERLAND

     79424850 09-OCT-22      20.95 WAKANOW                       3
CHESTER-LEE, DURHAM
```

```
     79420994 10-OCT-22      15.08 SPECITRIPS                    6
MEGIDO, DURHAM


TICKET_NUMBER TRANSACTI      PRICE AGENT_NAME            STREET_NO
------------- --------- ---------- -------------------- ----------
STREET_NAME
--------------------------------------------------
     70420658 14-OCT-22      10.03 WAKANOW                       3
CHESTER-LEE, DURHAM


7 rows selected.

REM CODE 2
w21051498>SELECT Ticket_number, Transaction_date, Price
  2  FROM Tiicket_t,table(Tiicket_t.Agent)n
  3  WHERE n.Agent_name='Daratravels';

TICKET_NUMBER TRANSACTI      PRICE
------------- --------- ----------
     78602152 11-SEP-22       11.5
```

(B) Analyse the conceptual database design from Part 1 (A) and the TRAVELNORTH scenario in the Appendix and propose what aspects of the TRAVELNORTH database would benefit from incorporating NoSQL Database concepts. Illustrate your answer with code from a representative code from NoSQL Database implementation.

(15 marks)

Answer Part 3 B

1) Provide below your choice and justification of what aspects (subset) of the ***TRAVELNORTH*** databases would benefit from incorporating NoSQL Database concepts (3 marks)

NoSQL database support non-relational models which provide for a range of NoSQL design for non-relational data. The relationship between agent and sales_list was selected because of the unstructured nature of the data. The inflexible nature when it is implemented on relational database while also considering the type of data that will be store in the table.

Agents will not always file their sales list in a structured or ordered manner hence the NoSQL implementation. Also, the sales_list table will require normalisation to be compatible with a relational database but that is not required using NoSQL and data are stored hierarchically in JSON. NoSQL focuses on high performance, availability, data replication and scalability. It also requires no schema.

2) Provide below code and output (simple TEXT only) for implementing your proposed NoSQL Database subset of the ***TRAVELNORTH*** database, populate it with some data, and example queries & outputs (simple TEXT only) (12 Marks)

```
> // to create a collection for Sales_list table

> db.createCollection("Sales_list")
{ "ok" : 1 }
>
> // to create a collection for Agent table
>
> db.createCollection("Agent")
{ "ok" : 1 }

> // Insert values into Sales_list table
```

```
> db.Sales_list.insertMany(
... [
... { Sales_id: "WA1", Age_id: "DTT", Transaction_time: "14:36:00", Price:
11.50, Transaction_date: Date("11-SEP-2022")},
... { Sales_id: "MM2", Age_id: "TBB", Transaction_time: "16:04:00", Price:
8.90, Transaction_date: Date("13-SEP-2022")},
... { Sales_id: "TT3", Age_id: "INS", Transaction_time: "15:05:00", Price:
12.90, Transaction_date: Date("12-SEP-2022")},
... { Sales_id: "TA4", Age_id: "BON", Transaction_time: "12:26:00", Price:
25.90, Transaction_date: Date("11-SEP-2022")},
... { Sales_id: "KD5", Age_id: "WAK", Transaction_time: "17:16:00", Price:
3.80, Transaction_date: Date("09-NOV-2022") },
... { Sales_id: "LG6", Age_id: "SPR", Transaction_time: "10:06:00", Price:
5.60, Transaction_date: Date("10-OCT-2022") },
... { Sales_id: "GA7", Age_id: "WAN", Transaction_time: "15:15:00", Price:
7.60, Transaction_date: Date("14-OCT-2022") }
... ]);
{
        "acknowledged" : true,
        "insertedIds" : [
                ObjectId("637d671b80c83c68f15b1fe2"),
                ObjectId("637d671b80c83c68f15b1fe3"),
                ObjectId("637d671b80c83c68f15b1fe4"),
                ObjectId("637d671b80c83c68f15b1fe5"),
                ObjectId("637d671b80c83c68f15b1fe6"),
                ObjectId("637d671b80c83c68f15b1fe7"),
                ObjectId("637d671b80c83c68f15b1fe8")
        ]
}

> //  Display the values in the Sales_list table

> db.Sales_list.find();
{ "_id" : ObjectId("637d671b80c83c68f15b1fe2"), "Sales_id" : "WA1",
"Age_id" : "DTT", "Transaction_time" : "14:36:00", "Price" : 11.5,
"Transaction_date" : "Wed Nov 23 2022 00:19:39 GMT+0000 (GMT Standard
Time)" }
{ "_id" : ObjectId("637d671b80c83c68f15b1fe3"), "Sales_id" : "MM2",
"Age_id" : "TBB", "Transaction_time" : "16:04:00", "Price" : 8.9,
"Transaction_date" : "Wed Nov 23 2022 00:19:39 GMT+0000 (GMT Standard
Time)" }
{ "_id" : ObjectId("637d671b80c83c68f15b1fe4"), "Sales_id" : "TT3",
"Age_id" : "INS", "Transaction_time" : "15:05:00", "Price" : 12.9,
"Transaction_date" : "Wed Nov 23 2022 00:19:39 GMT+0000 (GMT Standard
Time)" }
{ "_id" : ObjectId("637d671b80c83c68f15b1fe5"), "Sales_id" : "TA4",
"Age_id" : "BON", "Transaction_time" : "12:26:00", "Price" : 25.9,
"Transaction_date" : "Wed Nov 23 2022 00:19:39 GMT+0000 (GMT Standard
Time)" }
{ "_id" : ObjectId("637d671b80c83c68f15b1fe6"), "Sales_id" : "KD5",
"Age_id" : "WAK", "Transaction_time" : "17:16:00", "Price" : 3.8,
"Transaction_date" : "Wed Nov 23 2022 00:19:39 GMT+0000 (GMT Standard
Time)" }
{ "_id" : ObjectId("637d671b80c83c68f15b1fe7"), "Sales_id" : "LG6",
"Age_id" : "SPR", "Transaction_time" : "10:06:00", "Price" : 5.6,
"Transaction_date" : "Wed Nov 23 2022 00:19:39 GMT+0000 (GMT Standard
Time)" }
{ "_id" : ObjectId("637d671b80c83c68f15b1fe8"), "Sales_id" : "GA7",
"Age_id" : "WAN", "Transaction_time" : "15:15:00", "Price" : 7.6,
"Transaction_date" : "Wed Nov 23 2022 00:19:39 GMT+0000 (GMT Standard
Time)" }
```

```
> // Insert values into Agent table

> db.Agent.insertMany(
... [
... { Agent_id: "DTT", Sa_id: "WA1", Agent_name: "DARATRAVELS", Street_no:
10, Street_name: "CAMPDEN STREET, NEWCASTLE"},
... { Agent_id: "TBB", Sa_id: "MM2", Agent_name: "TRAVELBETA", Street_no:
10, Street_name: "FLORENCE STREET, NEWCASTLE"},
... { Agent_id: "INS", Sa_id: "TT3", Agent_name: "INSURANTIPS", Street_no:
10, Street_name: "OXFORD STREET, NEWCASTLE"},
... { Agent_id: "BON", Sa_id: "TA4", Agent_name: "BONVOGAGE", Street_no:
20, Street_name: "FAWCETT STREET, SUNDERLAND"},
... { Agent_id: "WAK", Sa_id: "KD5", Agent_name: "WAKANOW", Street_no: 3,
Street_name: "CHESTER-LEE, DURHAM"},
... { Agent_id: "SPR", Sa_id: "LG6", Agent_name: "SPECITRIPS", Street_no:
6, Street_name: "MEGIDO, DURHAM"},
... { Agent_id: "WAN", Sa_id: "GA7", Agent_name: "WAKANOW", Street_no: 3,
Street_name: "CHESTER-LEE, DURHAM" }
... ]);
{
        "acknowledged" : true,
        "insertedIds" : [
                ObjectId("637d691880c83c68f15b1fe9"),
                ObjectId("637d691880c83c68f15b1fea"),
                ObjectId("637d691880c83c68f15b1feb"),
                ObjectId("637d691880c83c68f15b1fec"),
                ObjectId("637d691880c83c68f15b1fed"),
                ObjectId("637d691880c83c68f15b1fee"),
                ObjectId("637d691880c83c68f15b1fef")
        ]
}

> // Display the values in the Agent table

> db.Agent.find();
{ "_id" : ObjectId("637d691880c83c68f15b1fe9"), "Agent_id" : "DTT", "Sa_id"
: "WA1", "Agent_name" : "DARATRAVELS", "Street_no" : 10, "Street_name" :
"CAMPDEN STREET, NEWCASTLE" }
{ "_id" : ObjectId("637d691880c83c68f15b1fea"), "Agent_id" : "TBB", "Sa_id"
: "MM2", "Agent_name" : "TRAVELBETA", "Street_no" : 10, "Street_name" :
"FLORENCE STREET, NEWCASTLE" }
{ "_id" : ObjectId("637d691880c83c68f15b1feb"), "Agent_id" : "INS", "Sa_id"
: "TT3", "Agent_name" : "INSURANTIPS", "Street_no" : 10, "Street_name" :
"OXFORD STREET, NEWCASTLE" }
{ "_id" : ObjectId("637d691880c83c68f15b1fec"), "Agent_id" : "BON", "Sa_id"
: "TA4", "Agent_name" : "BONVOGAGE", "Street_no" : 20, "Street_name" :
"FAWCETT STREET, SUNDERLAND" }
{ "_id" : ObjectId("637d691880c83c68f15b1fed"), "Agent_id" : "WAK", "Sa_id"
: "KD5", "Agent_name" : "WAKANOW", "Street_no" : 3, "Street_name" :
"CHESTER-LEE, DURHAM" }
{ "_id" : ObjectId("637d691880c83c68f15b1fee"), "Agent_id" : "SPR", "Sa_id"
: "LG6", "Agent_name" : "SPECITRIPS", "Street_no" : 6, "Street_name" :
"MEGIDO, DURHAM" }
{ "_id" : ObjectId("637d691880c83c68f15b1fef"), "Agent_id" : "WAN", "Sa_id"
: "GA7", "Agent_name" : "WAKANOW", "Street_no" : 3, "Street_name" :
"CHESTER-LEE, DURHAM" }
>
> // JOIN THE COLLECTION AGENT AND SALES_LIST USING THE PRIMARY KEY"
AGENT_ID" AND FOREIGN KEY "AGE_ID"

> db.Agent.aggregate ([
...  {
...    $lookup:
```

```
...      {
...        from: "Sales_list",
...        localField: "Agent_id",
...        foreignField: "Age_id",
...        as: "Agents"
...      }
...  }
... ]);
{ "_id" : ObjectId("637d691880c83c68f15b1fe9"), "Agent_id" : "DTT", "Sa_id"
: "WA1", "Agent_name" : "DARATRAVELS", "Street_no" : 10, "Street_name" :
"CAMPDEN STREET, NEWCASTLE", "Agents" : [ { "_id" :
ObjectId("637d671b80c83c68f15b1fe2"), "Sales_id" : "WA1", "Age_id" : "DTT",
"Transaction_time" : "14:36:00", "Price" : 11.5, "Transaction_date" : "Wed
Nov 23 2022 00:19:39 GMT+0000 (GMT Standard Time)" } ] }
{ "_id" : ObjectId("637d691880c83c68f15b1fea"), "Agent_id" : "TBB", "Sa_id"
: "MM2", "Agent_name" : "TRAVELBETA", "Street_no" : 10, "Street_name" :
"FLORENCE STREET, NEWCASTLE", "Agents" : [ { "_id" :
ObjectId("637d671b80c83c68f15b1fe3"), "Sales_id" : "MM2", "Age_id" : "TBB",
"Transaction_time" : "16:04:00", "Price" : 8.9, "Transaction_date" : "Wed
Nov 23 2022 00:19:39 GMT+0000 (GMT Standard Time)" } ] }
{ "_id" : ObjectId("637d691880c83c68f15b1feb"), "Agent_id" : "INS", "Sa_id"
: "TT3", "Agent_name" : "INSURANTIPS", "Street_no" : 10, "Street_name" :
"OXFORD STREET, NEWCASTLE", "Agents" : [ { "_id" :
ObjectId("637d671b80c83c68f15b1fe4"), "Sales_id" : "TT3", "Age_id" : "INS",
"Transaction_time" : "15:05:00", "Price" : 12.9, "Transaction_date" : "Wed
Nov 23 2022 00:19:39 GMT+0000 (GMT Standard Time)" } ] }
{ "_id" : ObjectId("637d691880c83c68f15b1fec"), "Agent_id" : "BON", "Sa_id"
: "TA4", "Agent_name" : "BONVOGAGE", "Street_no" : 20, "Street_name" :
"FAWCETT STREET, SUNDERLAND", "Agents" : [ { "_id" :
ObjectId("637d671b80c83c68f15b1fe5"), "Sales_id" : "TA4", "Age_id" : "BON",
"Transaction_time" : "12:26:00", "Price" : 25.9, "Transaction_date" : "Wed
Nov 23 2022 00:19:39 GMT+0000 (GMT Standard Time)" } ] }
{ "_id" : ObjectId("637d691880c83c68f15b1fed"), "Agent_id" : "WAK", "Sa_id"
: "KD5", "Agent_name" : "WAKANOW", "Street_no" : 3, "Street_name" :
"CHESTER-LEE, DURHAM", "Agents" : [ { "_id" :
ObjectId("637d671b80c83c68f15b1fe6"), "Sales_id" : "KD5", "Age_id" : "WAK",
"Transaction_time" : "17:16:00", "Price" : 3.8, "Transaction_date" : "Wed
Nov 23 2022 00:19:39 GMT+0000 (GMT Standard Time)" } ] }
{ "_id" : ObjectId("637d691880c83c68f15b1fee"), "Agent_id" : "SPR", "Sa_id"
: "LG6", "Agent_name" : "SPECITRIPS", "Street_no" : 6, "Street_name" :
"MEGIDO, DURHAM", "Agents" : [ { "_id" :
ObjectId("637d671b80c83c68f15b1fe7"), "Sales_id" : "LG6", "Age_id" : "SPR",
"Transaction_time" : "10:06:00", "Price" : 5.6, "Transaction_date" : "Wed
Nov 23 2022 00:19:39 GMT+0000 (GMT Standard Time)" } ] }
{ "_id" : ObjectId("637d691880c83c68f15b1fef"), "Agent_id" : "WAN", "Sa_id"
: "GA7", "Agent_name" : "WAKANOW", "Street_no" : 3, "Street_name" :
"CHESTER-LEE, DURHAM", "Agents" : [ { "_id" :
ObjectId("637d671b80c83c68f15b1fe8"), "Sales_id" : "GA7", "Age_id" : "WAN",
"Transaction_time" : "15:15:00", "Price" : 7.6, "Transaction_date" : "Wed
Nov 23 2022 00:19:39 GMT+0000 (GMT Standard Time)" } ] }

>// JOIN THE COLLECTION SALES_LIST AND AGENT USING THE PRIMARY KEY"
SALES_ID" AND FOREIGN KEY "SA_ID

> db.Sales_list.aggregate ([
...  {
...    $lookup:
...      {
...        from: "Agent",
...        localField: "Sales_id",
...        foreignField: "Sa_id",
...        as: "Saless"
...      }
```

```
...  }
... ]);
{ "_id" : ObjectId("637d671b80c83c68f15b1fe2"), "Sales_id" : "WA1",
"Age_id" : "DTT", "Transaction_time" : "14:36:00", "Price" : 11.5,
"Transaction_date" : "Wed Nov 23 2022 00:19:39 GMT+0000 (GMT Standard
Time)", "Saless" : [ { "_id" : ObjectId("637d691880c83c68f15b1fe9"),
"Agent_id" : "DTT", "Sa_id" : "WA1", "Agent_name" : "DARATRAVELS",
"Street_no" : 10, "Street_name" : "CAMPDEN STREET, NEWCASTLE" } ] }
{ "_id" : ObjectId("637d671b80c83c68f15b1fe3"), "Sales_id" : "MM2",
"Age_id" : "TBB", "Transaction_time" : "16:04:00", "Price" : 8.9,
"Transaction_date" : "Wed Nov 23 2022 00:19:39 GMT+0000 (GMT Standard
Time)", "Saless" : [ { "_id" : ObjectId("637d691880c83c68f15b1fea"),
"Agent_id" : "TBB", "Sa_id" : "MM2", "Agent_name" : "TRAVELBETA",
"Street_no" : 10, "Street_name" : "FLORENCE STREET, NEWCASTLE" } ] }
{ "_id" : ObjectId("637d671b80c83c68f15b1fe4"), "Sales_id" : "TT3",
"Age_id" : "INS", "Transaction_time" : "15:05:00", "Price" : 12.9,
"Transaction_date" : "Wed Nov 23 2022 00:19:39 GMT+0000 (GMT Standard
Time)", "Saless" : [ { "_id" : ObjectId("637d691880c83c68f15b1feb"),
"Agent_id" : "INS", "Sa_id" : "TT3", "Agent_name" : "INSURANTIPS",
"Street_no" : 10, "Street_name" : "OXFORD STREET, NEWCASTLE" } ] }
{ "_id" : ObjectId("637d671b80c83c68f15b1fe5"), "Sales_id" : "TA4",
"Age_id" : "BON", "Transaction_time" : "12:26:00", "Price" : 25.9,
"Transaction_date" : "Wed Nov 23 2022 00:19:39 GMT+0000 (GMT Standard
Time)", "Saless" : [ { "_id" : ObjectId("637d691880c83c68f15b1fec"),
"Agent_id" : "BON", "Sa_id" : "TA4", "Agent_name" : "BONVOGAGE",
"Street_no" : 20, "Street_name" : "FAWCETT STREET, SUNDERLAND" } ] }
{ "_id" : ObjectId("637d671b80c83c68f15b1fe6"), "Sales_id" : "KD5",
"Age_id" : "WAK", "Transaction_time" : "17:16:00", "Price" : 3.8,
"Transaction_date" : "Wed Nov 23 2022 00:19:39 GMT+0000 (GMT Standard
Time)", "Saless" : [ { "_id" : ObjectId("637d691880c83c68f15b1fed"),
"Agent_id" : "WAK", "Sa_id" : "KD5", "Agent_name" : "WAKANOW", "Street_no"
: 3, "Street_name" : "CHESTER-LEE, DURHAM" } ] }
{ "_id" : ObjectId("637d671b80c83c68f15b1fe7"), "Sales_id" : "LG6",
"Age_id" : "SPR", "Transaction_time" : "10:06:00", "Price" : 5.6,
"Transaction_date" : "Wed Nov 23 2022 00:19:39 GMT+0000 (GMT Standard
Time)", "Saless" : [ { "_id" : ObjectId("637d691880c83c68f15b1fee"),
"Agent_id" : "SPR", "Sa_id" : "LG6", "Agent_name" : "SPECITRIPS",
"Street_no" : 6, "Street_name" : "MEGIDO, DURHAM" } ] }
{ "_id" : ObjectId("637d671b80c83c68f15b1fe8"), "Sales_id" : "GA7",
"Age_id" : "WAN", "Transaction_time" : "15:15:00", "Price" : 7.6,
"Transaction_date" : "Wed Nov 23 2022 00:19:39 GMT+0000 (GMT Standard
Time)", "Saless" : [ { "_id" : ObjectId("637d691880c83c68f15b1fef"),
"Agent_id" : "WAN", "Sa_id" : "GA7", "Agent_name" : "WAKANOW", "Street_no"
: 3, "Street_name" : "CHESTER-LEE, DURHAM" } ] }

//TO SHOW THE VALUES IN THE AGENT COLLECTION

> db.Agent.find().pretty();
{
        "_id" : ObjectId("637f4659c780aabdda9a5d24"),
        "Agent_id" : "DTT",
        "Sa_id" : "WA1",
        "Agent_name" : "DARATRAVELS",
        "Street_no" : 10,
        "Street_name" : "CAMPDEN STREET, NEWCASTLE"
}
{
        "_id" : ObjectId("637f4659c780aabdda9a5d25"),
        "Agent_id" : "TBB",
        "Sa_id" : "MM2",
        "Agent_name" : "TRAVELBETA",
        "Street_no" : 10,
        "Street_name" : "FLORENCE STREET, NEWCASTLE"
```

```
}
{
        "_id" : ObjectId("637f4659c780aabdda9a5d26"),
        "Agent_id" : "INS",
        "Sa_id" : "TT3",
        "Agent_name" : "INSURANTIPS",
        "Street_no" : 10,
        "Street_name" : "OXFORD STREET, NEWCASTLE"
}
{
        "_id" : ObjectId("637f4659c780aabdda9a5d27"),
        "Agent_id" : "BON",
        "Sa_id" : "TA4",
        "Agent_name" : "BONVOGAGE",
        "Street_no" : 20,
        "Street_name" : "FAWCETT STREET, SUNDERLAND"
}
{
        "_id" : ObjectId("637f4659c780aabdda9a5d28"),
        "Agent_id" : "WAK",
        "Sa_id" : "KD5",
        "Agent_name" : "WAKANOW",
        "Street_no" : 3,
        "Street_name" : "CHESTER-LEE, DURHAM"
}
{
        "_id" : ObjectId("637f4659c780aabdda9a5d29"),
        "Agent_id" : "SPR",
        "Sa_id" : "LG6",
        "Agent_name" : "SPECITRIPS",
        "Street_no" : 6,
        "Street_name" : "MEGIDO, DURHAM"
}
{
        "_id" : ObjectId("637f4659c780aabdda9a5d2a"),
        "Agent_id" : "WAN",
        "Sa_id" : "GA7",
        "Agent_name" : "WAKANOW",
        "Street_no" : 3,
        "Street_name" : "CHESTER-LEE, DURHAM"
}
{
        "_id" : ObjectId("637f47d65f26c3608f9002e0"),
        "Agent_id" : "DTT",
        "Sa_id" : "WA1",
        "Agent_name" : "DARATRAVELS",
        "Street_no" : 10,
        "Street_name" : "CAMPDEN STREET, NEWCASTLE"
}
{
        "_id" : ObjectId("637f47d65f26c3608f9002e1"),
        "Agent_id" : "TBB",
        "Sa_id" : "MM2",
        "Agent_name" : "TRAVELBETA",
        "Street_no" : 10,
        "Street_name" : "FLORENCE STREET, NEWCASTLE"
}
{
        "_id" : ObjectId("637f47d65f26c3608f9002e2"),
        "Agent_id" : "INS",
        "Sa_id" : "TT3",
        "Agent_name" : "INSURANTIPS",
        "Street_no" : 10,
```

```
        "Street_name" : "OXFORD STREET, NEWCASTLE"
}
{
        "_id" : ObjectId("637f47d65f26c3608f9002e3"),
        "Agent_id" : "BON",
        "Sa_id" : "TA4",
        "Agent_name" : "BONVOGAGE",
        "Street_no" : 20,
        "Street_name" : "FAWCETT STREET, SUNDERLAND"
}
{
        "_id" : ObjectId("637f47d65f26c3608f9002e4"),
        "Agent_id" : "WAK",
        "Sa_id" : "KD5",
        "Agent_name" : "WAKANOW",
        "Street_no" : 3,
        "Street_name" : "CHESTER-LEE, DURHAM"
}
{
        "_id" : ObjectId("637f47d65f26c3608f9002e5"),
        "Agent_id" : "SPR",
        "Sa_id" : "LG6",
        "Agent_name" : "SPECITRIPS",
        "Street_no" : 6,
        "Street_name" : "MEGIDO, DURHAM"
}
{
        "_id" : ObjectId("637f47d65f26c3608f9002e6"),
        "Agent_id" : "WAN",
        "Sa_id" : "GA7",
        "Agent_name" : "WAKANOW",
        "Street_no" : 3,
        "Street_name" : "CHESTER-LEE, DURHAM"
}
>

//TO SHOW THE VALUES IN THE SALES_LIST COLLECTION

> db.Sales_list.find().pretty();
{
        "_id" : ObjectId("637f4640c780aabdda9a5d1d"),
        "Sales_id" : "WA1",
        "Age_id" : "DTT",
        "Transaction_time" : "14:36:00",
        "Price" : 11.5,
        "Transaction_date" : "Thu Nov 24 2022 10:24:00 GMT+0000 (GMT
Standard Time)"
}
{
        "_id" : ObjectId("637f4640c780aabdda9a5d1e"),
        "Sales_id" : "MM2",
        "Age_id" : "TBB",
        "Transaction_time" : "16:04:00",
        "Price" : 8.9,
        "Transaction_date" : "Thu Nov 24 2022 10:24:00 GMT+0000 (GMT
Standard Time)"
}
{
        "_id" : ObjectId("637f4640c780aabdda9a5d1f"),
        "Sales_id" : "TT3",
        "Age_id" : "INS",
        "Transaction_time" : "15:05:00",
        "Price" : 12.9,
```

```
        "Transaction_date" : "Thu Nov 24 2022 10:24:00 GMT+0000 (GMT
Standard Time)"
}
{
        "_id" : ObjectId("637f4640c780aabdda9a5d20"),
        "Sales_id" : "TA4",
        "Age_id" : "BON",
        "Transaction_time" : "12:26:00",
        "Price" : 25.9,
        "Transaction_date" : "Thu Nov 24 2022 10:24:00 GMT+0000 (GMT
Standard Time)"
}
{
        "_id" : ObjectId("637f4640c780aabdda9a5d21"),
        "Sales_id" : "KD5",
        "Age_id" : "WAK",
        "Transaction_time" : "17:16:00",
        "Price" : 3.8,
        "Transaction_date" : "Thu Nov 24 2022 10:24:00 GMT+0000 (GMT
Standard Time)"
}
{
        "_id" : ObjectId("637f4640c780aabdda9a5d22"),
        "Sales_id" : "LG6",
        "Age_id" : "SPR",
        "Transaction_time" : "10:06:00",
        "Price" : 5.6,
        "Transaction_date" : "Thu Nov 24 2022 10:24:00 GMT+0000 (GMT
Standard Time)"
}
{
        "_id" : ObjectId("637f4640c780aabdda9a5d23"),
        "Sales_id" : "GA7",
        "Age_id" : "WAN",
        "Transaction_time" : "15:15:00",
        "Price" : 7.6,
        "Transaction_date" : "Thu Nov 24 2022 10:24:00 GMT+0000 (GMT
Standard Time)"
}
{
        "_id" : ObjectId("637f47d65f26c3608f9002d9"),
        "Sales_id" : "WA1",
        "Age_id" : "DTT",
        "Transaction_time" : "14:36:00",
        "Price" : 11.5,
        "Transaction_date" : "Thu Nov 24 2022 10:30:46 GMT+0000 (GMT
Standard Time)"
}
{
        "_id" : ObjectId("637f47d65f26c3608f9002da"),
        "Sales_id" : "MM2",
        "Age_id" : "TBB",
        "Transaction_time" : "16:04:00",
        "Price" : 8.9,
        "Transaction_date" : "Thu Nov 24 2022 10:30:46 GMT+0000 (GMT
Standard Time)"
}
{
        "_id" : ObjectId("637f47d65f26c3608f9002db"),
        "Sales_id" : "TT3",
        "Age_id" : "INS",
        "Transaction_time" : "15:05:00",
        "Price" : 12.9,
```

```
        "Transaction_date" : "Thu Nov 24 2022 10:30:46 GMT+0000 (GMT
Standard Time)"
}
{
        "_id" : ObjectId("637f47d65f26c3608f9002dc"),
        "Sales_id" : "TA4",
        "Age_id" : "BON",
        "Transaction_time" : "12:26:00",
        "Price" : 25.9,
        "Transaction_date" : "Thu Nov 24 2022 10:30:46 GMT+0000 (GMT
Standard Time)"
}
{
        "_id" : ObjectId("637f47d65f26c3608f9002dd"),
        "Sales_id" : "KD5",
        "Age_id" : "WAK",
        "Transaction_time" : "17:16:00",
        "Price" : 3.8,
        "Transaction_date" : "Thu Nov 24 2022 10:30:46 GMT+0000 (GMT
Standard Time)"
}
{
        "_id" : ObjectId("637f47d65f26c3608f9002de"),
        "Sales_id" : "LG6",
        "Age_id" : "SPR",
        "Transaction_time" : "10:06:00",
        "Price" : 5.6,
        "Transaction_date" : "Thu Nov 24 2022 10:30:46 GMT+0000 (GMT
Standard Time)"
}
{
        "_id" : ObjectId("637f47d65f26c3608f9002df"),
        "Sales_id" : "GA7",
        "Age_id" : "WAN",
        "Transaction_time" : "15:15:00",
        "Price" : 7.6,
        "Transaction_date" : "Thu Nov 24 2022 10:30:46 GMT+0000 (GMT
Standard Time)"
}

>// TO DISPLAY THE COLLECTION

> show collections
Agent
Sales_list
```

Part 4 (10 marks)

Consider the TRAVELNORTH scenario in the Appendix. Produce a report for the managing director of the TRAVELNORTH company – elaborating on professional, legal, ethical and security issues that need to be considered and make recommendations that you think are appropriate for TRAVELNORTH.

(10 marks)

The report should be concise and comprehensive and in the region of 800-900 words. You should use Harvard style of citation and referencing by following the guidelines in Pears and Shields (2008).

Answer Part 4: 10 Marks [8 for the quality of report covering all the above issues, 1 for the quality of referencing and citation and adhering to the Harvard style, 1 for presentation]

A transportation network is a crucial system with many structures which enables movement and the delivery of goods (The Geography of Transport Systems, 2022). Owners and operators of transportation infrastructure around the world recognize that its efficiency is critical to the economy and the progress of economy. Over the years, the need to navigate has increased with added complexity as the society become more developed and infrastructure become concentrated in bigger units. The average length of a journey has grown by 42 per cent since the early days while the number of journeys per individual has increase by 8 per cent (Social Exclusion Unit, 2003). To enhance decision-making, the following professional, legal, ethical and security issues were considered with possible recommendations.

Professional consideration: which is defined as what is contemplated or appropriate. This includes adhering to service and security standards. In 2020, Restrictions were put in place during the Covid-19 lockdown that conveyed different lifestyles. To ensure their personal health safety, private cars became the preferred choice, which would have increased traffic if left to exist (McKinsey & Company, 2021). As such, Travel north needs to always consider public wellbeing and trust and increase reliance on the system by insisting on safety measures, commuters can easily comply with. Another aspect to consider is the digitization of the transport system, where the experience becomes more efficient and comfortable and sustainable, where the effects of carbon emission, air quality emission and noise levels are reduced. Travel

north system needs to be improved upon where bus delays and other forms such as vandalism, weather and trespassing could disrupt the bus schedules.

Recommendation: Providing longer-term stability and predictability for easy route planning. Increased reliance on electric, hybrid and lower-emission buses. Providing an improved bus experience. Integrating buses and commuters with technology for speedy access to schedule information, delays etc. Providing incident and emergency management.

Legal considerations: This involves compliance with transport laws while considering disabled people and other races by making services more accessible. The Bus Services Act 2017 presents changes, and which can unravel new opportunities for the industry to increase its offerings for commuters. Travel north is also required to provide services such as assistance to get on and off the bus, and assistance to the available seat which should be effective and in a respectful and dignified manner, this is required by the Equality Act 2010 which states that companies that provide public transportation cannot discriminate against disabled people (Department of Transport, 2017).

Recommendation: The following steps are to be provided by Travel north, making sure that there is physical access e.g., operating a ramp or stopping the bus so that exit can be made safely. To have priority seats and seats for disabled people and to take some steps to ensure that the entrance to these seats is obstacle free for disabled passengers when necessary. Ensuring the right stops are illuminated and visible. Approving tariffs/fares for various routes. Ensuring vehicle registration and record-keeping of ticket sales.

Ethical Considerations are defined as the rules, and principles used to judge the value of human actions. Equality, equity, fairness, and justice must be considered with no restrictions, where commuters can sit anywhere in the bus, tickets are procured easily from the agents, and customer data are protected and not shared with third parties (Van Wee, 2011).

Recommendation can also include avoiding conflicts of interest and maintaining commuter confidentiality. Ensuring commuters are well informed and avoid contributing to the commission of illegal activities.

Security Consideration: It can be defined as installing safeguards in place against loss of lives and properties. Some individuals are unable to use public buses because of fear of crime or anti-social behaviours, or fear of road crash, based on a survey, about 53 percent of women and 23 percent of men says they feel unsafe when waiting on a bus stop after dark (Social Exclusion Unit, 2003). The transport network plays an important role because poor safety measures have significantly impacted public opinion about bus networks. Innovations can help to maintain ridership numbers and satisfaction (Icomera, 2021). Measures which help to sustain public perception by maintaining safe and efficient movement of people to and from their destination should continually be a priority due to the increased scrutiny upon transportation due to instant social media communication. Also safeguards against criminal and terrorist activities which can cause irreparable damage to the business.

Recommendations: includes installing a video surveillance system to monitor activities in buses**.** The use of ticket gates eliminates fraudulent travel because it keeps off people who sometimes wander onto the platform causing trouble**.** Also, extending the bus system to support communities with poor transport network and making bus more accessible to disabled people. Artificial intelligence can be incorporated into video surveillance to automatically detect security risk areas**.** Installing automatic fare collection gates which prevent fraud and enhance security.

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Van Wee, B. (2011) Transport and Ethics: Ethics and the Evaluation of Transport Policies and Projects. Cheltenham, UK: Edward Elgar.