Name: Aryan Mangrule

Roll No.: BTB46

PRN: 2122000220

Experiment No.: 1

Problem Statement 1:

Create Book Store database using complex data types such as structure, array and set. Solve the queries on that database.

Problem Statement 2:

Q 2. Consider a database schema with a relation Emp whose attributes are as shown below, with types specified for multivalued attributes.

Emp= (ename, ChildrenSet multiset(Children), SkillSet multiset(Skills))

Children = (name, birthday)

Skills = (type, ExamSet setof(Exams))

Exams = (year, city)

- a. Define the above schema in SQL, with appropriate types for each attribute.
- b. Using the above schema, write the following queries in SQL.
 - i. Find the names of all employees who have a child born on or after January 1, 2000.
 - ii. Find those employees who took an examination for the skill type "typing" in the city "Dayton".
- iii. List all skill types in the relation Emp.

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Q.1]
CREATE TYPE NAMETYPE as OBJECT (
  firstName VARCHAR(20),
 lastName VARCHAR(20)
)
CREATE TYPE PHONENUMARRAY as VARRAY(3) OF VARCHAR(10);
CREATE TABLE author (
  author_id VARCHAR(10) NOT NULL PRIMARY KEY,
  name NAMETYPE NOT NULL,
  phone PHONENUMARRAY NOT NULL
);
Drop table author;
CREATE TYPE AUTHORIDARRAY as VARRAY(5) OF VARCHAR(20);
CREATE TYPE PUBLISHERTYPE AS OBJECT (
  pub_id VARCHAR(20),
  pub_name VARCHAR(50),
 branch VARCHAR(20)
)
CREATE TYPE KEYWORDARRAY AS VARRAY(20) OF VARCHAR(20);
CREATE TABLE book (
  isbn INT NOT NULL PRIMARY KEY,
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title VARCHAR(50) NOT NULL,
  author_id AUTHORIDARRAY NOT NULL,
  categ VARCHAR(20) NOT NULL,
  publisher PUBLISHERTYPE NOT NULL,
  keywords KEYWORDARRAY,
  price NUMBER(10,2)
);
Drop table book;
CREATE TABLE customer (
  customer_id VARCHAR(10) NOT NULL PRIMARY KEY,
  name NAMETYPE,
  phone PHONENUMARRAY
);
Drop table customer;
CREATE TABLE book_sale (
  sale_id VARCHAR(10) NOT NULL PRIMARY KEY,
  customer_id VARCHAR(10),
  isbn INT,
  FOREIGN KEY (customer_id) REFERENCES CUSTOMER(customer_id),
  FOREIGN KEY (isbn) REFERENCES BOOK(isbn)
);
Drop table book_sale;
INSERT INTO AUTHOR VALUES ('A01', NAMETYPE('James', 'Anderson'),
PHONENUMARRAY('9104127374','9522847374'));
INSERT INTO AUTHOR VALUES ('A02', NAMETYPE('Emily', 'Smith'),
PHONENUMARRAY('9176543210','9323456789'));
         INTO AUTHOR VALUES ('A03', NAMETYPE('Michael', 'Johnson'),
PHONENUMARRAY('9112345678','9512345678'));
          INTO AUTHOR VALUES ('A04', NAMETYPE('Sophia', 'Williams'),
PHONENUMARRAY('9123456789','9223456780'));
```

INSERT INTO AUTHOR VALUES ('A05', NAMETYPE('David', 'Brown'), PHONENUMARRAY('9200112233','9300112233'));

INSERT INTO AUTHOR VALUES ('A06', NAMETYPE('Olivia', 'Jones'), PHONENUMARRAY('9111223344','9211223344'));

INSERT INTO AUTHOR VALUES ('A07', NAMETYPE('Daniel', 'Garcia'), PHONENUMARRAY('9133445566','9233445566'));

INSERT INTO AUTHOR VALUES ('A08', NAMETYPE('Isabella', 'Martinez'), PHONENUMARRAY('9144556677','9244556677'));

INSERT INTO AUTHOR VALUES ('A09', NAMETYPE('Matthew', 'Lee'), PHONENUMARRAY('9155667788','9255667788'));

INSERT INTO AUTHOR VALUES ('A10', NAMETYPE('Charlotte', 'Taylor'), PHONENUMARRAY('9166778899','9266778899'));

SELECT * FROM Author;

Insert INTO BOOK VALUES (101, 'Compiler Construction', AUTHORIDARRAY('A01','A02'), 'Education', PUBLISHERTYPE('P02', 'TATA McGraw Hill', 'US'), KEYWORDARRAY('Lexical Analysis', 'Syntax Trees'), 120);

Insert INTO BOOK VALUES (102, 'Data Structures', AUTHORIDARRAY('A03','A04'), 'Education', PUBLISHERTYPE('P03', 'Pearson', 'India'), KEYWORDARRAY('Stacks', 'Trees'), 150);

Insert INTO BOOK VALUES (103, 'Operating Systems', AUTHORIDARRAY('A05'), 'Technology', PUBLISHERTYPE('P04', 'Wiley', 'US'), KEYWORDARRAY('Concurrency', 'Memory Management'), 180);

Insert INTO BOOK VALUES (104, 'Software Engineering', AUTHORIDARRAY('A01'), 'Education', PUBLISHERTYPE('P08', 'McGraw Hill', 'US'), KEYWORDARRAY('Design Patterns', 'Project Management'), 160);

Insert INTO BOOK VALUES (105, 'Database Systems', AUTHORIDARRAY('A06','A07'), 'Education', PUBLISHERTYPE('P05', 'Addison Wesley', 'US'), KEYWORDARRAY('Relational Databases', 'Data Models'), 200);

Insert INTO BOOK VALUES (106, 'Computer Networks', AUTHORIDARRAY('A02', 'A04'), 'Technology', PUBLISHERTYPE('P07', 'Prentice Hall', 'US'), KEYWORDARRAY('TCP/IP', 'Network Protocols'), 190);

Insert INTO BOOK VALUES (107, 'Machine Learning', AUTHORIDARRAY('A05', 'A06'), 'Technology', PUBLISHERTYPE('P09', 'Springer', 'Germany'), KEYWORDARRAY('Supervised Learning', 'Regression'), 210);

Insert INTO BOOK VALUES (108, 'Artificial Intelligence', AUTHORIDARRAY('A08'), 'Technology', PUBLISHERTYPE('P06', 'Reilly', 'US'), KEYWORDARRAY('Neural Networks', 'Deep Learning'), 220);

Insert INTO BOOK VALUES (109, 'Cyber Security', AUTHORIDARRAY('A07', 'A09'), 'Technology', PUBLISHERTYPE('P10', 'Cambridge University Press', 'UK'), KEYWORDARRAY('Cryptography', 'Network Security'), 170);

Insert INTO BOOK VALUES (110, 'Quantum Computing', AUTHORIDARRAY('A10'), 'Technology', PUBLISHERTYPE('P11', 'MIT Press', 'US'), KEYWORDARRAY('Qubits', 'Quantum Algorithms'), 230);

SELECT * FROM BOOK;

Insert INTO CUSTOMER VALUES ('CO1', NAMETYPE('Aarav', 'Sharma'), PHONENUMARRAY('9403365600'));

Insert INTO CUSTOMER VALUES ('CO2', NAMETYPE('Ishita', 'Verma'), PHONENUMARRAY('9812345670'));

Insert INTO CUSTOMER VALUES ('CO3', NAMETYPE('Rajiv', 'Mehta'), PHONENUMARRAY('9823456781'));

Insert INTO CUSTOMER VALUES ('CO4', NAMETYPE('Ananya', 'Gupta'), PHONENUMARRAY('9834567892'));

Insert INTO CUSTOMER VALUES ('C05', NAMETYPE('Arjun', 'Reddy'), PHONENUMARRAY('9845678903'));

Insert INTO CUSTOMER VALUES ('C06', NAMETYPE('Sneha', 'Patel'), PHONENUMARRAY('9856789014'));

Insert INTO CUSTOMER VALUES ('C07', NAMETYPE('Vikram', 'Singh'), PHONENUMARRAY('9867890125'));

Insert INTO CUSTOMER VALUES ('C08', NAMETYPE('Neha', 'Kumar'), PHONENUMARRAY('9878901236'));

Insert INTO CUSTOMER VALUES ('C09', NAMETYPE('Deepak', 'Joshi'), PHONENUMARRAY('9889012347'));

Insert INTO CUSTOMER VALUES ('C10', NAMETYPE('Swati', 'Nair'), PHONENUMARRAY('9890123458'));

SELECT *FROM Customer;

INSERT INTO Book Sale VALUES ('S01', 'C01', 101);

INSERT INTO Book Sale VALUES ('S02', 'C02', 102);

INSERT INTO Book_Sale VALUES ('S03', 'C03', 103);

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INSERT INTO Book_Sale VALUES ('S04', 'C04', 104);
INSERT INTO Book_Sale VALUES ('S05', 'C05', 105);
INSERT INTO Book_Sale VALUES ('S06', 'C06', 106);
INSERT INTO Book_Sale VALUES ('S07', 'C07', 107);
INSERT INTO Book_Sale VALUES ('S08', 'C08', 108);
INSERT INTO Book_Sale VALUES ('S09', 'C09', 109);
INSERT INTO Book_Sale VALUES ('S10', 'C10', 110);
select * from Book_Sale;
```

--Q.1

SELECT B.isbn, B.title, A.name.firstName | | ' ' | | A.name.lastName AS author_name
FROM book B, TABLE(B.author_id) AID, author A
WHERE A.author_id = AID.COLUMN_VALUE;

ANS:

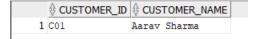
	∯ ISBN	∜ TITLE	
1	101	Compiler Construction	James Anderson
2	101	Compiler Construction	Emily Smith
3	102	Data Structures	Michael Johnson
4	102	Data Structures	Sophia Williams
5	103	Operating Systems	David Brown
6	104	Software Engineering	James Anderson
7	105	Database Systems	Olivia Jones
8	105	Database Systems	Daniel Garcia
9	106	Computer Networks	Emily Smith
10	106	Computer Networks	Sophia Williams
11	107	Machine Learning	David Brown
12	107	Machine Learning	Olivia Jones
13	108	Artificial Intelligence	Isabella Martine:

-- Q.2

SELECT DISTINCT C.customer_id, C.name.firstName || ' ' || C.name.lastName AS customer_name
FROM customer C JOIN book_sale BS ON C.customer_id = BS.customer_id

JOIN book B ON BS.isbn = B.isbn

WHERE B.publisher.pub_name = 'TATA McGraw Hill';



-- Q.3

SELECT C.name.firstName | | ' ' | | C.name.lastName AS customer_name, B.title, B.publisher.pub_name AS publisher_name, C.name.lastName

FROM customer C

JOIN book_sale BS ON C.customer_id = BS.customer_id

JOIN book B ON BS.isbn = B.isbn

WHERE B.publisher.branch IN ('UK', 'US')

ORDER BY C.name.lastName;

Ans:

		∜ TITLE	₱ PUBLISHER_NAME	NAME.LASTNAME
1	Ananya Gupta	Software Engineering	McGraw Hill	Gupta
2	Deepak Joshi	Cyber Security	Cambridge University Press	Joshi
3	Neha Kumar	Artificial Intelligence	Reilly	Kumar
4	Rajiv Mehta	Operating Systems	Wiley	Mehta
5	Swati Nair	Quantum Computing	MIT Press	Nair
6	Sneha Patel	Computer Networks	Prentice Hall	Patel
7	Arjun Reddy	Database Systems	Addison Wesley	Reddy
8	Aarav Sharma	Compiler Construction	TATA McGraw Hill	Sharma

-- Q.4

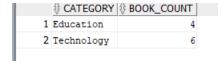
SELECT B.categ AS category, COUNT(*) AS book_count

FROM book B

GROUP BY B.categ

ORDER BY B.categ;

Ans:



-- Q.5

SELECT A.name.firstName, COUNT(BS.sale_id) AS books_sold

FROM book B

JOIN TABLE(B.author_id) AID ON 1 = 1

JOIN author A ON A.author_id = AID.COLUMN_VALUE

JOIN book_sale BS ON B.isbn = BS.isbn

GROUP BY A.name.firstName;

	NAME.FIRSTNAME	BOOKS_SOLD
1	James	2
2	Emily	2
3	Michael	1
4	Sophia	2
5	David	2
6	Olivia	2
7	Daniel	2
8	Isabella	1
9	Matthew	1
10	Charlotte	1

Q2.]

```
CREATE TYPE ExamType AS OBJECT (
year NUMBER,
city VARCHAR2(50)
);

CREATE TYPE ChildType AS OBJECT (
name VARCHAR2(50),
birthday DATE
);

CREATE TYPE ExamSet AS VARRAY(10) OF EXAMTYPE;

CREATE TYPE SkillType AS OBJECT (
type VARCHAR2(50),
exams ExamSet
);
```

```
CREATE TYPE SkillSet AS VARRAY(10) OF SKILLTYPE;
CREATE TYPE ChildrenSet AS VARRAY(10) OF ChildType;
CREATE TABLE EMP (
  ename VARCHAR(50),
  children CHILDRENSET.
  skills SKILLSET
);
INSERT INTO EMP VALUES (
    'Rajesh Sharma',
    CHILDRENSET(CHILDTYPE('Aman', TO_DATE('2001-05-15', 'YYYY-MM-DD')), CHILDTYPE('Neha',
TO_DATE('1998-03-22', 'YYYY-MM-DD'))),
    SKILLSET(SKILLTYPE('typing', EXAMSET(EXAMTYPE(2023, 'Dayton'), EXAMTYPE(2021,
'Cleveland'))),
    SKILLTYPE('programming', EXAMSET(EXAMTYPE(2020, 'New York'))))
  );
INSERT INTO EMP VALUES (
    'Amit Verma',
    CHILDRENSET(CHILDTYPE('Rohit', TO_DATE('1999-07-30', 'YYYY-MM-DD'))),
    SKILLSET(SKILLTYPE('accounting', EXAMSET(EXAMTYPE(2019, 'Columbus'))),
    SKILLTYPE('typing', EXAMSET(EXAMTYPE(2022, 'Dayton')))));
INSERT INTO EMP VALUES (
    'Sunil Mehta',
    CHILDRENSET(CHILDTYPE('Vikram', TO_DATE('2003-09-05', 'YYYY-MM-DD')), CHILDTYPE('Arjun',
TO_DATE('2005-11-13', 'YYYY-MM-DD'))),
    SKILLSET(SKILLTYPE('management', EXAMSET(EXAMTYPE(2018, 'Chicago'))),
    SKILLTYPE('programming', EXAMSET(EXAMTYPE(2021, 'Boston'))))
  );
INSERT INTO EMP VALUES (
    'Manoj Patel',
```

```
CHILDRENSET(CHILDTYPE('Ananya', TO_DATE('2000-12-25', 'YYYY-MM-DD'))),
    SKILLSET(SKILLTYPE('typing', EXAMSET(EXAMTYPE(2023, 'Dayton'))),
    SKILLTYPE('design', EXAMSET(EXAMTYPE(2020, 'San Francisco'))))
  );
INSERT INTO EMP VALUES (
    'Suman Desai',
    CHILDRENSET(CHILDTYPE('Kabir', TO_DATE('2002-02-14', 'YYYY-MM-DD')), CHILDTYPE('Diya',
TO_DATE('1997-10-19', 'YYYY-MM-DD'))),
    SKILLSET(SKILLTYPE('data analysis', EXAMSET(EXAMTYPE(2022, 'Seattle'))),
    SKILLTYPE('typing', EXAMSET(EXAMTYPE(2020, 'Dayton'))))
  );
INSERT INTO EMP VALUES (
    'Rahul Nair',
    CHILDRENSET(CHILDTYPE('Pooja', TO_DATE('2004-04-22', 'YYYY-MM-DD'))),
    SKILLSET(SKILLTYPE('programming', EXAMSET(EXAMTYPE(2019, 'Boston'))),
    SKILLTYPE('typing', EXAMSET(EXAMTYPE(2021, 'Dayton'))))
  );
INSERT INTO EMP VALUES (
    'Priya Iyer',
    CHILDRENSET(CHILDTYPE('Dev', TO DATE('2000-08-07', 'YYYY-MM-DD'))),
    SKILLSET(SKILLTYPE('programming', EXAMSET(EXAMTYPE(2023, 'Dayton'))),
    SKILLTYPE('management', EXAMSET(EXAMTYPE(2022, 'Chicago'))))
  );
INSERT INTO EMP VALUES (
    'Vikram Singh',
    CHILDRENSET(CHILDTYPE('Karan', TO DATE('1996-01-17', 'YYYY-MM-DD')), CHILDTYPE('Riya',
TO_DATE('2003-12-29', 'YYYY-MM-DD'))),
    SKILLSET(SKILLTYPE('data analysis', EXAMSET(EXAMTYPE(2021, 'Los Angeles'))),
    SKILLTYPE('typing', EXAMSET(EXAMTYPE(2022, 'Dayton'))))
  );
INSERT INTO EMP VALUES (
    'Neha Gupta',
```

```
CHILDRENSET(CHILDTYPE('Arav', TO_DATE('2001-03-03', 'YYYY-MM-DD'))),
    SKILLSET(SKILLTYPE('design', EXAMSET(EXAMTYPE(2020, 'New York'))),
    SKILLTYPE('typing', EXAMSET(EXAMTYPE(2021, 'Dayton'))))
  );
INSERT INTO EMP VALUES (
    'Anil Reddy',
    CHILDRENSET(CHILDTYPE('Sneha', TO_DATE('2005-06-12', 'YYYY-MM-DD'))),
    SKILLSET(SKILLTYPE('typing', EXAMSET(EXAMTYPE(2023, 'Dayton'))),
    SKILLTYPE('programming', EXAMSET(EXAMTYPE(2019, 'San Francisco'))))
  );
SELECT * from EMP;
Q1.]
SELECT ENAME
FROM EMP E
WHERE EXISTS (
  SELECT 1
  FROM TABLE(E.CHILDREN) C
  WHERE C.BIRTHDAY > TO_DATE('2000-01-01', 'YYYY-MM-DD')
);
1 Rajesh Sharma
   2 Sunil Mehta
   3 Manoj Patel
    4 Suman Desai
    5 Rahul Nair
    6 Priya Iyer
    7 Vikram Singh
```

Q.2]-- Find those employees who took an examination for the skill type typing in the city Dayton

SELECT ENAME

8 Neha Gupta
9 Anil Reddy

```
FROM EMP E

WHERE EXISTS (

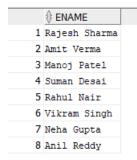
SELECT 1

FROM TABLE(E.SKILLS) S, TABLE(S.EXAMS) EX

WHERE S.TYPE = 'typing'

AND EX.CITY = 'Dayton'
);
```

ANS:



Q.3]-- List all skill types in the relation Emp.

SELECT DISTINCT(S.TYPE) AS SKILLTYPES

FROM EMP E, TABLE(E.SKILLS) S;

