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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.

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,
```

```
    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'));
INSERT      INTO AUTHOR VALUES ('A03', NAMETYPE('Michael', 'Johnson'),
PHONENUMARRAY('9112345678','9512345678'));
INSERT        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 ('C01', NAMETYPE('Aarav', 'Sharma'),
PHONENUMARRAY('9403365600'));

Insert    INTO CUSTOMER VALUES ('C02', NAMETYPE('Ishita', 'Verma'),
PHONENUMARRAY('9812345670'));

Insert    INTO CUSTOMER VALUES ('C03', NAMETYPE('Rajiv', 'Mehta'),
PHONENUMARRAY('9823456781'));

Insert    INTO CUSTOMER VALUES ('C04', 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);
```

```
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	AUTHOR_NAME
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';
```

	CUSTOMER_ID	CUSTOMER_NAME
1	C01	Aarav Sharma

-- 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:

	CUSTOMER_NAME	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:

	CATEGORY	BOOK_COUNT
1	Education	4
2	Technology	6

-- 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')
);
```

	ENAME
1	Rajesh Sharma
2	Sunil Mehta
3	Manoj Patel
4	Suman Desai
5	Rahul Nair
6	Priya Iyer
7	Vikram Singh
8	Neha Gupta
9	Anil Reddy

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

```
SELECT ENAME
```

```
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:

	ENAME
1	Rajesh Sharma
2	Amit Verma
3	Manoj Patel
4	Suman Desai
5	Rahul Nair
6	Vikram Singh
7	Neha Gupta
8	Anil Reddy

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

```
SELECT DISTINCT(S.TYPE) AS SKILLTYPES
FROM EMP E, TABLE(E.SKILLS) S;
```

1	typing
2	programming
3	accounting
4	management
5	design
6	data analysis