# Experiment No. 1

Create Complex Data Types and Perform SQL operations

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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.

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```
create or replace type nameType as object(
    fname varchar(10),
    lname varchar(10)
);

create or replace type phoneArray as varray(10) of int;

create table Author(
    author_id varchar(20) PRIMARY KEY,
    name nameType,
    phone_no phoneArray
);

insert into Author(author_id,name,phone_no)
values('A12345',nameType('John','Doe'),phoneArray('1234567890', '9876543210'));
```

```
insert into Author(author_id, name, phone_no)
values ('B13579', nameType('Michael', 'Johnson'), phoneArray('4445556666', '7778889999'));

insert into Author(author_id, name, phone_no)
values ('D13579', nameType('William', 'Brown'), phoneArray('6667778888', '1231231234',
'9879879876'));

insert into Author(author_id, name, phone_no)
values ('A001', nameType('William', 'Brown'), phoneArray('6667778888', '1231231234',
'9879879876'));

select *
from Author;

create or replace type publisherType as object(
    pub_id int,
    pub_name varchar(20),
    branch varchar(20)
);

create or replace type author_id_array AS varray(10) of varchar(20);

create or replace type KeywordsTable as table of varchar(20);

create table Book(
    ISBN int primary key,
    title varchar(30),
```

```
    author_id author_id_array,
    category varchar(20),
    publisher PublisherType,
    keywords KeywordsTable,
    price NUMBER(10,2)
)
NESTED TABLE keywords STORE AS keywords_storage;

insert into Book(ISBN, title, author_id, category, publisher, keywords, price)
values(123456, 'The Great Book',author_id_array('A001', 'A002', 'A003'),'Fiction',
PublisherType(1, 'Tata McGraw Hill', 'Downtown'), KeywordsTable('Adventure', 'Drama',
'Mystery'), 29.99);

INSERT INTO Book(ISBN, title, author_id, category, publisher, keywords, price)
VALUES (000002, 'Key of Success',author_id_array('A007', 'A008', 'A009'),'Fiction',
PublisherType(1, 'Tata McGraw Hill', 'UK'), KeywordsTable('Adventure', 'Drama',
'Mystery'), 29.99);

INSERT INTO Book(ISBN, title, author_id, category, publisher, keywords, price)
VALUES (000001, 'Key of Success',author_id_array('A007', 'A008', 'A009'),'Fiction',
PublisherType(1, 'Tata McGraw Hill', 'Downtown'), KeywordsTable('Adventure', 'Drama',
'Mystery'), 29.99);

INSERT INTO Book(ISBN, title, author_id, category, publisher, keywords, price)
VALUES (987654, 'Wings of Fire',author_id_array('A004', 'A005', 'A006'),'Fiction',
PublisherType(1, 'Tata McGraw Hill', 'Downtown'), KeywordsTable('Adventure', 'Drama',
'Mystery'), 29.99);

INSERT INTO Book(ISBN, title, author_id, category, publisher, keywords, price)
```

```
VALUES (100006, 'Book Six', author_id_array('A011', 'A012'),'Thriller', PublisherType(6, 'Tata McGraw Hill', 'Branch F'), KeywordsTable('Crime', 'Mystery'), 20.00);


INSERT INTO Book(ISBN, title, author_id, category, publisher, keywords, price)

VALUES (100007, 'Book Seven',  author_id_array('A013', 'A014'),'Horror', PublisherType(7, 'Horror Publisher', 'Branch G'), KeywordsTable('Scary', 'Supernatural'), 21.50);


select *

from Book;


create table Customer(

   customer_id varchar(10) primary key,

   name nameType

);


INSERT INTO Customer(customer_id, name)

VALUES ('CUST001', nameType('Alice', 'Williams'));


INSERT INTO Customer(customer_id, name)

VALUES ('CUST002', nameType('Bob', 'Johnson'));


INSERT INTO Customer(customer_id, name)

VALUES ('CUST003', nameType('Carol', 'Smith'));


INSERT INTO Customer(customer_id, name)

VALUES ('CUST004', nameType('David', 'Brown'));


INSERT INTO Customer(customer_id, name)
```

```
VALUES ('CUST005', nameType('Eve', 'Davis'));

INSERT INTO Customer (customer_id, name)
VALUES ('CUST006', nameType('Sam', 'Dev'));

INSERT INTO Customer(customer_id, name)
VALUES ('CUST007', nameType('Viki', 'Dev'));

INSERT INTO Customer(customer_id, name)
VALUES ('CUST008', nameType('Yogi', 'Dev'));

create or replace type PhoneTable as table of int;

CREATE TABLE Book_Sale (
    phone PhoneTable,
    sale_id VARCHAR2(10) PRIMARY KEY,
    customer_id varchar(20),
    ISBN int,
    FOREIGN KEY (customer_id) REFERENCES Customer(customer_id),
    FOREIGN KEY (ISBN) REFERENCES Book(ISBN)
)
NESTED TABLE phone STORE AS phone_storage;

INSERT INTO Book_Sale(sale_id, customer_id, ISBN, phone)
VALUES ('SALE001', 'CUST001', 123456, PhoneTable(1234567890, 9876543210));

INSERT INTO Book_Sale(sale_id, customer_id, ISBN, phone)
```

VALUES ('SALE002', 'CUST002', 234567, PhoneTable(5551234567));

INSERT INTO Book_Sale (sale_id, customer_id, ISBN, phone)

VALUES ('SALE003', 'CUST003', 100007, PhoneTable(4445556666, 7778889999));

INSERT INTO Book_Sale (sale_id, customer_id, ISBN, phone)

VALUES ('SALE004', 'CUST004', 100006, PhoneTable(3332221111));

INSERT INTO Book_Sale (sale_id, customer_id, ISBN, phone)

VALUES ('SALE005', 'CUST005', 100007, PhoneTable(6667778888, 1231231234, 9879879876));

INSERT INTO Book_Sale (sale_id, customer_id, ISBN, phone)

VALUES ('SALE006', 'CUST006', 987654, PhoneTable(6667778888, 1231231234, 9879879876));

INSERT INTO Book_Sale (sale_id, customer_id, ISBN, phone)

VALUES ('SALE006', 'CUST007', 000001, PhoneTable(6667778888, 1231231234, 9879879876));

INSERT INTO Book_Sale(sale_id, customer_id, ISBN, phone)

VALUES ('SALE007', 'CUST008', 000002, PhoneTable(6667778888, 1231231234, 9879879876));

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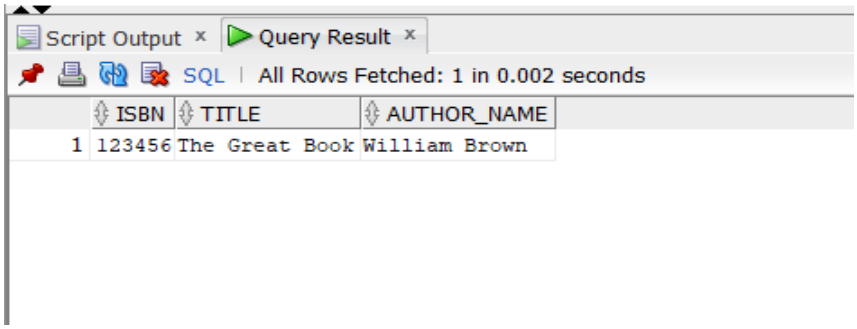
## 1. Flatten the VARRAY of author IDs in the Book2 table to join with Author2 table

```
SELECT  b.ISBN, b.title, a.name.fname || ' ' || a.name.lname AS author_name

FROM Book b

JOIN Author a ON a.author_id IN(select * from Table (b.author_id));
```



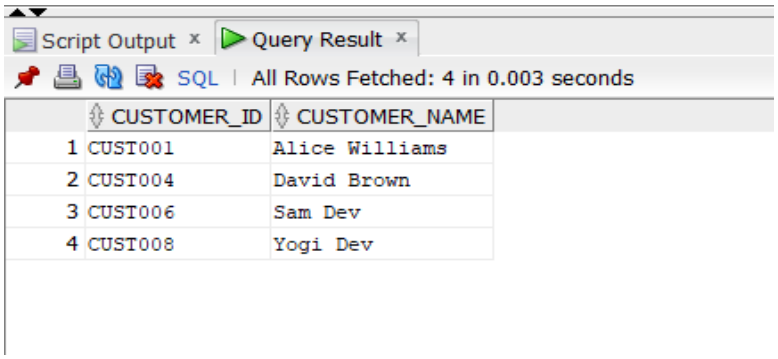

**2. List all customers who have purchased books published with Tata MaGraw Hill.**

SELECT DISTINCT c.customer_id, c.name.fname || ' ' || c.name.lname AS customer_name

FROM Book_Sale bs JOIN Book b ON bs.ISBN = b.ISBN JOIN Customer c

ON bs.customer_id = c.customer_id

WHERE b.publisher.pub_name = 'Tata McGraw Hill';




**3. List customers (as combined from customer.fname and customer.lname) who have purchased books published in the UK or the US, as well as the title of the book they purchased and the name of its publisher and order by last name of customer.**

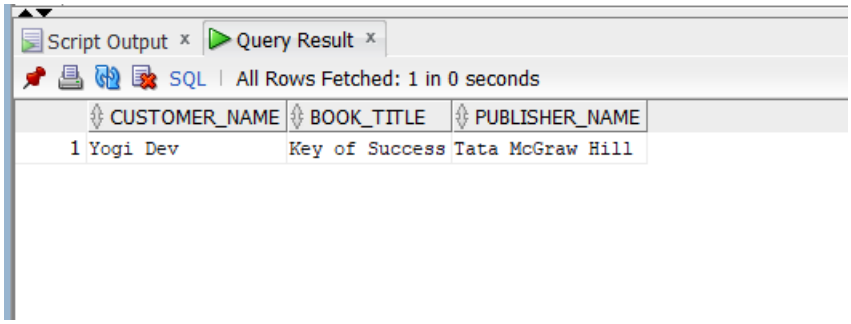
SELECT c.name.fname || ' ' || c.name.lname AS customer_name, b.title AS book_title, b.publisher.pub_name AS publisher_name

FROM Book_Sale bs JOIN Book b ON bs.ISBN = b.ISBN

JOIN Customer c ON bs.customer_id = c.customer_id

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

ORDER BY c.name.lname;

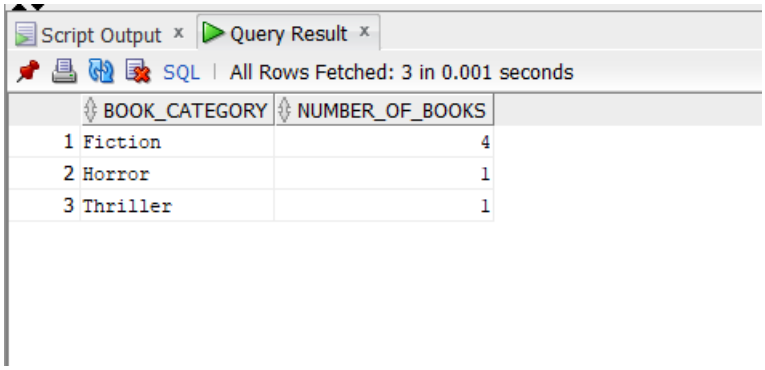



**4. List the different (distinct) categories and how many books belong to each category, order alphabetically by category.**

SELECT b.category AS book_category, COUNT(*) AS number_of_books

FROM Book b GROUP BY b.category

ORDER BY b.category;



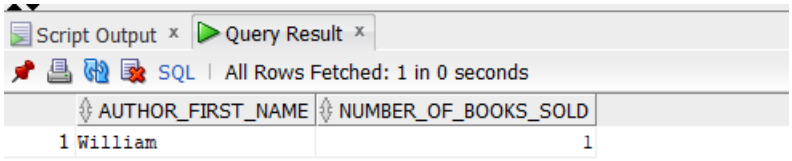

**5. List the number of books sold that have been written by each author and group by author s first name.**

SELECT a.name.fname AS author_first_name, COUNT(*) AS number_of_books_sold

FROM Book_Sale bs JOIN Book b ON bs.ISBN = b.ISBN

JOIN Author a ON a.author_id IN (SELECT * FROM TABLE(b.author_id))

GROUP BY a.name.fname ORDER BY a.name.fname;



**Problem Statement 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.**

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

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

CREATE TYPE ExamSet AS VARRAY(10) OF EXAMS;

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

CREATE TYPE SkillSet AS VARRAY(10) OF SKILLS;
```

```
CREATE TYPE ChildrenSet AS VARRAY(10) OF Children;

CREATE TABLE EMP (
 ename VARCHAR(50),
 children CHILDRENSET,
 skills SKILLSET
);

INSERT INTO EMP VALUES ('Rajesh
Sharma',CHILDRENSET(CHILDREN('Aman', TO_DATE('2001-05-15',
'YYYY-MM-DD')), CHILDREN('Neha',TO_DATE('1998-03-22', 'YYYY-MM-
DD'))),
SKILLSET(SKILLS('typing', EXAMSET(EXAMS(2023, 'Dayton'),
EXAMS(2021,'Cleveland'))),SKILLS('programming',
EXAMSET(EXAMS(2020, 'New York')))) ) ;

INSERT INTO EMP VALUES ('Amit Verma',
CHILDRENSET(CHILDREN('Rohit', TO_DATE('1999-07-30', 'YYYY-MM-
DD'))), SKILLSET(SKILLS('accounting', EXAMSET(EXAMS(2019,
'Columbus'))),
SKILLS('typing', EXAMSET(EXAMS(2022, 'Dayton')))));

INSERT INTO EMP VALUES ('Sunil
Mehta',CHILDRENSET(CHILDREN('Vikram', TO_DATE('2003-09-05',
'YYYY-MM-DD')), CHILDREN('Arjun',TO_DATE('2005-11-13', 'YYYY-MM-
DD'))),
SKILLSET(SKILLS('management', EXAMSET(EXAMS(2018,
'Chicago'))),SKILLS('programming', EXAMSET(EXAMS(2021, 'Boston')))));
```

```
INSERT INTO EMP VALUES ('Manoj
Patel',CHILDRENSET(CHILDREN('Ananya', TO_DATE('2000-12-25',
'YYYY-MM-DD'))),SKILLSET(SKILLS('typing', EXAMSET(EXAMS(2023,
'Dayton'))),

SKILLS('design', EXAMSET(EXAMS(2020, 'San Francisco'))));


INSERT INTO EMP VALUES ('Suman
Desai',CHILDRENSET(CHILDREN('Kabir', TO_DATE('2002-02-14', 'YYYY-
MM-DD')), CHILDREN('Diya',TO_DATE('1997-10-19', 'YYYY-MM-DD'))),

SKILLSET(SKILLS('data analysis', EXAMSET(EXAMS(2022,
'Seattle'))),SKILLS('typing', EXAMSET(EXAMS(2020, 'Dayton'))));


INSERT INTO EMP VALUES ('Rahul
Nair',CHILDRENSET(CHILDREN('Pooja', TO_DATE('2004-04-22', 'YYYY-
MM-DD'))),

SKILLSET(SKILLS('programming', EXAMSET(EXAMS(2019,
'Boston'))),SKILLS('typing', EXAMSET(EXAMS(2021, 'Dayton'))));


INSERT INTO EMP VALUES ('Priya
Iyer',CHILDRENSET(CHILDREN('Dev', TO_DATE('2000-08-07', 'YYYY-
MM-DD'))),SKILLSET(SKILLS('programming', EXAMSET(EXAMS(2023,
'Dayton'))),

SKILLS('management', EXAMSET(EXAMS(2022, 'Chicago'))));


INSERT INTO EMP VALUES ('Vikram
Singh',CHILDRENSET(CHILDREN('Karan', TO_DATE('1996-01-17', 'YYYY-
MM-DD')), CHILDREN('Riya',TO_DATE('2003-12-29', 'YYYY-MM-DD'))),

SKILLSET(SKILLS('data analysis', EXAMSET(EXAMS(2021, 'Los
Angeles'))),SKILLS('typing', EXAMSET(EXAMS(2022, 'Dayton'))));


INSERT INTO EMP VALUES ('Neha
Gupta',CHILDRENSET(CHILDREN('Arav', TO_DATE('2001-03-03', 'YYYY-
```

MM-DD'))),SKILLSET(SKILLS('design', EXAMSET(EXAMS(2020, 'New York'))),

SKILLS('typing', EXAMSET(EXAMS(2021, 'Dayton'))));

INSERT INTO EMP VALUES ('Anil Reddy',CHILDRENSET(CHILDREN('Sneha', TO_DATE('2005-06-12', 'YYYY-MM-DD'))),

SKILLSET(SKILLS('typing', EXAMSET(EXAMS(2023, 'Dayton'))),SKILLS('programming', EXAMSET(EXAMS(2019, 'San Francisco'))));

---

**b. Using the above schema, write the following queries in SQL.**

**1. Find the names of all employees who have a child born on or after January 1, 2000.**

```
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'));
```

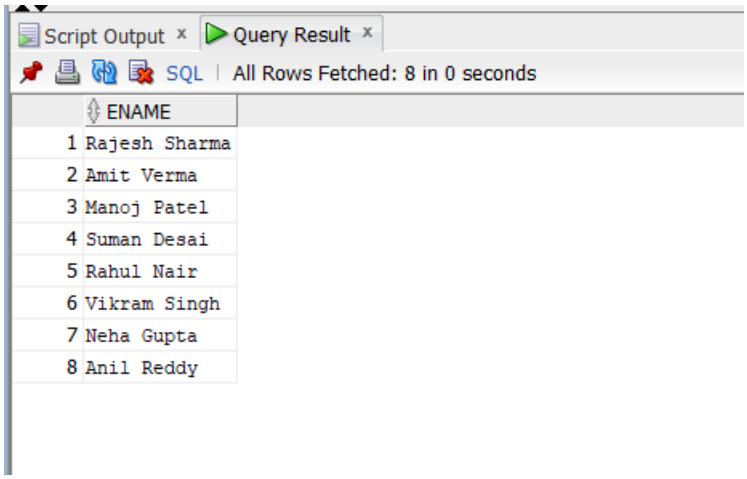
Script Output × Query Result ×

SQL | All Rows Fetched: 9 in 0.003 seconds

| | 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 |

**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');
```

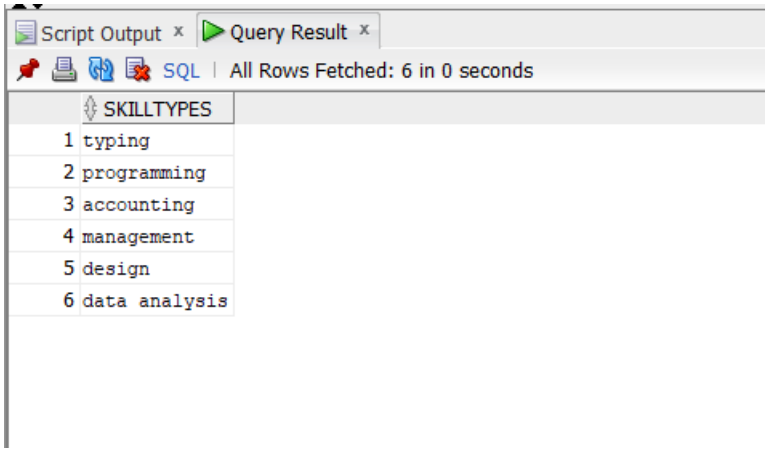

Script Output | Query Result

SQL | All Rows Fetched: 8 in 0 seconds

| | 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 |

**3. List all skill types in the relation Emp.**

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


Script Output | Query Result

SQL | All Rows Fetched: 6 in 0 seconds

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