Experiment 01

Problem Statement 1:

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

1. List all titles in “book” and include ISBN, author name (as combined from author.fname and author.lname).
2. List all customers who have purchased books published with ‘Tata MaGraw 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.
4. List the different (distinct) categories and how many books belong to each category, order alphabetically by category.
5. List the number of books sold that have been written by each author and group by author’s first name.

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.
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.

Answer 1:

Create Data Types

```
CREATE TYPE NAMETYPE AS OBJECT (
    firstName VARCHAR(20), lastName VARCHAR(20)
);
CREATE TYPE PHONENUMARRAY AS VARRAY(3) OF VARCHAR(10);
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 Tables

```
CREATE TABLE author (
    author_id VARCHAR(10) NOT NULL PRIMARY KEY,
    NAME NAMETYPE NOT NULL,
    phone PHONENUMARRAY NOT NULL
);
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)
);
CREATE TABLE customer (
    customer_id VARCHAR(10) NOT NULL PRIMARY KEY,
    NAME NAMETYPE, phone PHONENUMARRAY
);
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)
);
```

Insert Data into the author Table

```
INSERT INTO author VALUES (
    'A001', NAMETYPE('John', 'Smith'),
    PHONENUMARRAY('1234567890', '0987654321', '1122334455')
);
INSERT INTO author VALUES (
    'A002', NAMETYPE('Jane', 'Doe'),
    PHONENUMARRAY('2233445566', '3344556677')
);
INSERT INTO author VALUES (
    'A003', NAMETYPE('Alice', 'Johnson'),
    PHONENUMARRAY('4455667788', '5566778899')
);
INSERT INTO author VALUES (
    'A004', NAMETYPE('Bob', 'Williams'), PHONENUMARRAY('6677889900')
);
```

Insert Data into the book Table

```
INSERT INTO book VALUES (
    100000,
    'Introduction to Algorithms',
    AUTHORIDARRAY('A001', 'A002'),
    'Algorithms',
    PUBLISHERTYPE('P001', 'Tata McGraw Hill', 'New Delhi'),
    KEYWORDARRAY('Algorithms', 'Data Structures', 'Computer Science'),
    59.99
);
INSERT INTO book VALUES (
    200000,
    'Artificial Intelligence: A Modern Approach',
    AUTHORIDARRAY('A003', 'A004'),
    'Artificial Intelligence',
    PUBLISHERTYPE('P002', 'Pearson Education', 'Bangalore'),
    KEYWORDARRAY('AI', 'Machine Learning', 'Neural Networks'),
    69.99
);
INSERT INTO book VALUES (
    300000,
    'The C Programming Language',
    AUTHORIDARRAY('A001'),
```

```
    'Programming',
    PUBLISHERTYPE('P001', 'Tata McGraw Hill', 'New Delhi'),
    KEYWORDARRAY('C', 'Programming', 'Computer Science'),
    45.99
);
INSERT INTO book VALUES (
    400000,
    'Design Patterns: Elements of Reusable Object-Oriented Software',
    AUTHORIDARRAY('A002', 'A003'),
    'Software Engineering',
    PUBLISHERTYPE('P003', 'Addison-Wesley', 'Mumbai'),
    KEYWORDARRAY('Design Patterns', 'Object-Oriented', 'Software
Engineering'),
    54.99
);
```

Insert Data into the customer Table

```
INSERT INTO customer VALUES (
    'C001', NAMETYPE('Michael', 'Brown'),
    PHONENUMARRAY('7890123456', '8901234567')
);
INSERT INTO customer VALUES (
    'C002', NAMETYPE('Sarah', 'Davis'),
    PHONENUMARRAY('9012345678')
);
INSERT INTO customer VALUES (
    'C003', NAMETYPE('David', 'Wilson'),
    PHONENUMARRAY('1234567890', '2345678901')
);
```

Insert Data into the book_sale Table

```
INSERT INTO book_sale VALUES ('S001', 'C001', 100000);
INSERT INTO book_sale VALUES ('S002', 'C002', 200000);
INSERT INTO book_sale VALUES ('S003', 'C003', 300000);
INSERT INTO book_sale VALUES ('S004', 'C001', 400000);
```

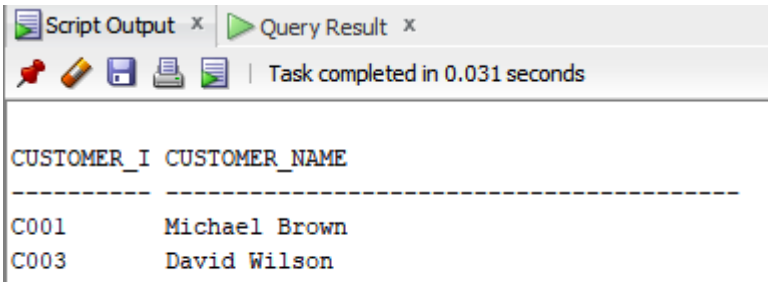
1. Answer

```
SELECT B.isbn, B.title, AID.COLUMN_VALUE AS author_id
FROM book B, TABLE(B.author_id) AID;
```

	ISBN	TITLE	AUTHOR_ID
1	1001	Introduction to Algorithms	A001
2	1001	Introduction to Algorithms	A002
3	1002	Artificial Intelligence	A003
4	1002	Artificial Intelligence	A004
5	1003	The C Programming Language	A001
6	1004	Design Patterns	A002
7	1004	Design Patterns	A003

2. Answer

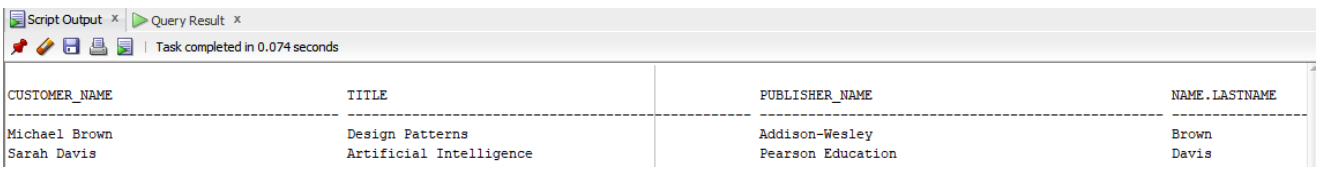
```
SELECT DISTINCT c.customer_id, c.NAME.firstName || ' ' ||
c.NAME.lastName AS customer_name
FROM customer c
JOIN book_sale bs ON c.customer_id = bs.customer_id
JOIN book b ON bs.isbn = b.isbn
WHERE b.publisher.pub_name = 'Tata McGraw Hill';
```




```
CUSTOMER_I CUSTOMER_NAME
---------- ----------------------------------------
C001       Michael Brown
C003       David Wilson
```

3. Answer

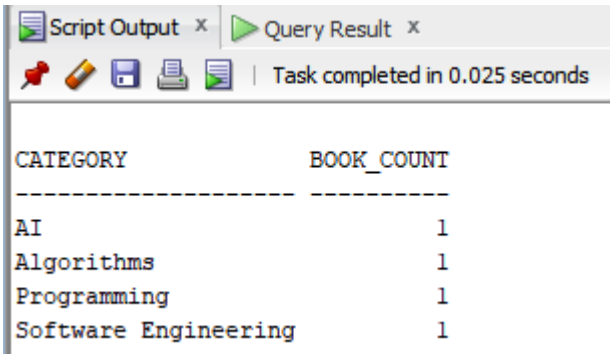
```
SELECT C.name.firstName || ' ' || C.name.lastName AS customer_name,
B.title,
B.publisher.pub_name AS publisher_name, C.name.lastName
FROM customer C
JOIN book_sale BS ON C.customer_id = BS.customer_id
JOIN book B ON BS.isbn = B.isbn
WHERE B.publisher.branch IN ('Mumbai', 'Bangalore')
ORDER BY C.name.lastName;
```




```
CUSTOMER_NAME                            TITLE                                              PUBLISHER_NAME                                     NAME.LASTNAME
---------------------------------------- -------------------------------------------------- -------------------------------------------------- --------------------
Michael Brown                            Design Patterns                                    Addison-Wesley                                     Brown
Sarah Davis                              Artificial Intelligence                            Pearson Education                                  Davis
```

4. Answer

```
SELECT B.categ AS category, COUNT(*) AS book_count
FROM book B
GROUP BY B.categ
ORDER BY B.categ;
```



CATEGORY	BOOK_COUNT
AI	1
Algorithms	1
Programming	1
Software Engineering	1

Answer 1:

a. Answer

```
-- Create object types
CREATE TYPE examtype AS OBJECT (YEAR NUMBER, city VARCHAR2(50));
CREATE TYPE childtype AS OBJECT (name VARCHAR2(50), birthday DATE);

-- Create varray types
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
CREATE TABLE emp (
  ename VARCHAR2(50),
  children childrenset,
  skills skillset
);

-- Insert data
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')))
  )
);
```

Script Output × Query Result ×

SQL | All Rows Fetched: 10 in 0.002 seconds

	ENAME	CHILDREN	SKILLS
1	Rajesh Sharma	ZIFRZ.CHILDRENSET([ZIFRZ.CHILDTYPE], [ZIFRZ.CHILDTYPE])	ZIFRZ.SKILLSET([ZIFRZ.SKILLTYPE], [ZIFRZ.SKILLTYPE])
2	Amit Verma	ZIFRZ.CHILDRENSET([ZIFRZ.CHILDTYPE])	ZIFRZ.SKILLSET([ZIFRZ.SKILLTYPE], [ZIFRZ.SKILLTYPE])
3	Sunil Mehta	ZIFRZ.CHILDRENSET([ZIFRZ.CHILDTYPE], [ZIFRZ.CHILDTYPE])	ZIFRZ.SKILLSET([ZIFRZ.SKILLTYPE], [ZIFRZ.SKILLTYPE])
4	Manoj Patel	ZIFRZ.CHILDRENSET([ZIFRZ.CHILDTYPE])	ZIFRZ.SKILLSET([ZIFRZ.SKILLTYPE], [ZIFRZ.SKILLTYPE])
5	Suman Desai	ZIFRZ.CHILDRENSET([ZIFRZ.CHILDTYPE], [ZIFRZ.CHILDTYPE])	ZIFRZ.SKILLSET([ZIFRZ.SKILLTYPE], [ZIFRZ.SKILLTYPE])
6	Rahul Nair	ZIFRZ.CHILDRENSET([ZIFRZ.CHILDTYPE])	ZIFRZ.SKILLSET([ZIFRZ.SKILLTYPE], [ZIFRZ.SKILLTYPE])
7	Priya Iyer	ZIFRZ.CHILDRENSET([ZIFRZ.CHILDTYPE])	ZIFRZ.SKILLSET([ZIFRZ.SKILLTYPE], [ZIFRZ.SKILLTYPE])
8	Vikram Singh	ZIFRZ.CHILDRENSET([ZIFRZ.CHILDTYPE], [ZIFRZ.CHILDTYPE])	ZIFRZ.SKILLSET([ZIFRZ.SKILLTYPE], [ZIFRZ.SKILLTYPE])
9	Neha Gupta	ZIFRZ.CHILDRENSET([ZIFRZ.CHILDTYPE])	ZIFRZ.SKILLSET([ZIFRZ.SKILLTYPE], [ZIFRZ.SKILLTYPE])
10	Anil Reddy	ZIFRZ.CHILDRENSET([ZIFRZ.CHILDTYPE])	ZIFRZ.SKILLSET([ZIFRZ.SKILLTYPE], [ZIFRZ.SKILLTYPE])

b. Answer

i. 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')
);
```

	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

ii. 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'
);
```

	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

iii. Find those employees who took an examination for the skill type “typing” in the city “Dayton”.

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

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