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**Subject :** Advanced Database Systems Lab

# Experiment No. : 1

## Problem Statement 1 :

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

Solution:

```
ALTER SESSION SET container = xepdb1;

CREATE TYPE name AS OBJECT (
        fname VARCHAR(20),
        lname VARCHAR(20)
);

CREATE TYPE phone_no IS
    VARRAY(4) OF VARCHAR(20);

CREATE TYPE publisher AS OBJECT (
        pub_id   VARCHAR(20),
        pub_name VARCHAR(20),
        branch   VARCHAR(20)
)

CREATE TYPE keywords IS
    VARRAY(5) OF VARCHAR(20);

CREATE TYPE author_id IS
    VARRAY(10) OF VARCHAR(20);

CREATE TABLE author (
    author_id VARCHAR(20) PRIMARY KEY,
    name      name,
    phone_nos phone_no
)

CREATE TABLE book (
```

```
    isbn            INTEGER PRIMARY KEY,
    title           VARCHAR(30),
    author_ids      author_id,
    category_       VARCHAR(20),
    publisher_info publisher,
    keyword         keywords,
    price           NUMBER(10, 2)
)

INSERT INTO book VALUES (
    101,
    'Compiler Construction',
    author_id(
        'A01', 'A02'
    ),
    'Education',
    publisher(
        'P02', 'TATA McGraw Hill', 'US'
    ),
    keywords(
        'Compiler', 'Parsing'
    ),
    120
);

INSERT INTO book VALUES (
    102,
    'Data Structures',
    author_id(
        'A03', 'A04'
    ),
    'Education',
    publisher(
        'P03', 'Pearson', 'India'
    ),
    keywords(
        'Data', 'Algorithms'
    ),
    150
);

INSERT INTO book VALUES (
    103,
```

```
    'Operating Systems',
    author_id(
        'A05'
    ),
    'Technology',
    publisher(
        'P04', 'Wiley', 'US'
    ),
    keywords(
        'OS', 'Kernel'
    ),
    180
);

INSERT INTO book VALUES (
    104,
    'Database Engineering',
    author_id(
        'A06', 'A07'
    ),
    'Education',
    publisher(
        'P05', 'Addison Wesley', 'US'
    ),
    keywords(
        'SQL', 'NoSQL'
    ),
    200
);

INSERT INTO book VALUES (
    105,
    'Artificial Intelligence',
    author_id(
        'A08'
    ),
    'Technology',
    publisher(
        'P06', 'Reilly', 'US'
    ),
    keywords(
        'AI', 'Machine Learning'
    ),
```

```
    220
);

INSERT INTO book VALUES (
    106,
    'Web Development',
    author_id(
        'A09', 'A10'
    ),
    'Technology',
    publisher(
        'P07', 'Packt Publishing', 'UK'
    ),
    keywords(
        'HTML', 'CSS'
    ),
    130
);

INSERT INTO book VALUES (
    107,
    'Software Engineering',
    author_id(
        'A01'
    ),
    'Education',
    publisher(
        'P08', 'McGraw Hill', 'US'
    ),
    keywords(
        'SDLC', 'Agile'
    ),
    160
);

INSERT INTO book VALUES (
    108,
    'Cloud Computing',
    author_id(
        'A02', 'A03'
    ),
    'Technology',
    publisher(
```

```
        'P09', 'Springer', 'US'
    ),
    keywords(
        'Cloud', 'AWS'
    ),
    190
);

INSERT INTO book VALUES (
    109,
    'Cyber Security Handbook',
    author_id(
        'A04'
    ),
    'Technology',
    publisher(
        'P10', 'Wiley', 'UK'
    ),
    keywords(
        'Security', 'Encryption'
    ),
    170
);

INSERT INTO book VALUES (
    110,
    'Big Data Analytics',
    author_id(
        'A05', 'A06'
    ),
    'Technology',
    publisher(
        'P11', 'Cambridge Press', 'UK'
    ),
    keywords(
        'Data', 'Analytics'
    ),
    210
);

SELECT
    *
FROM
```

```
    book;

INSERT INTO author VALUES (
    'A01',
    name(
        'Dham', 'Dhere'
    ),
    phone_no(
        '8804127374', '9422847374'
    )
);

INSERT INTO author VALUES (
    'A02',
    name(
        'Narasimha', 'Karumanchi'
    ),
    phone_no(
        '9876543210', '9123456789'
    )
);

INSERT INTO author VALUES (
    'A03',
    name(
        'William', 'Stallings'
    ),
    phone_no(
        '9812345678', '9412345678'
    )
);

INSERT INTO author VALUES (
    'A04',
    name(
        'Shamkant', 'Navate'
    ),
    phone_no(
        '9823456789', '9123456780'
    )
);

INSERT INTO author VALUES (
```

```
    'A05',
    name(
        'Peter', 'Norvig'
    ),
    phone_no(
        '9900112233', '9800112233'
    )
);

INSERT INTO author VALUES (
    'A06',
    name(
        'Angela', 'Yu'
    ),
    phone_no(
        '9811223344', '9911223344'
    )
);

INSERT INTO author VALUES (
    'A07',
    name(
        'Neal', 'Ford'
    ),
    phone_no(
        '9833445566', '9933445566'
    )
);

INSERT INTO author VALUES (
    'A08',
    name(
        'Thomas', 'Erl'
    ),
    phone_no(
        '9844556677', '9944556677'
    )
);

INSERT INTO author VALUES (
    'A09',
    name(
        'Kevin', 'Mitnik'
```

```
    ),
    phone_no(
        '9855667788', '9955667788'
    )
);

INSERT INTO author VALUES (
    'A10',
    name(
        'Venkat', 'Ankam'
    ),
    phone_no(
        '9866778899', '9966778899'
    )
);

SELECT
    *
FROM
    author;

CREATE TABLE customer (
    customer_id VARCHAR(10) PRIMARY KEY,
    name        name,
    phone       phone_no
)

INSERT INTO customer VALUES (
    'C01',
    name(
        'Pushkaraj', 'Yadav'
    ),
    phone_no(
        '9403365600'
    )
);

INSERT INTO customer VALUES (
    'C02',
    name(
        'Aryan', 'Mangrule'
    ),
    phone_no(
```

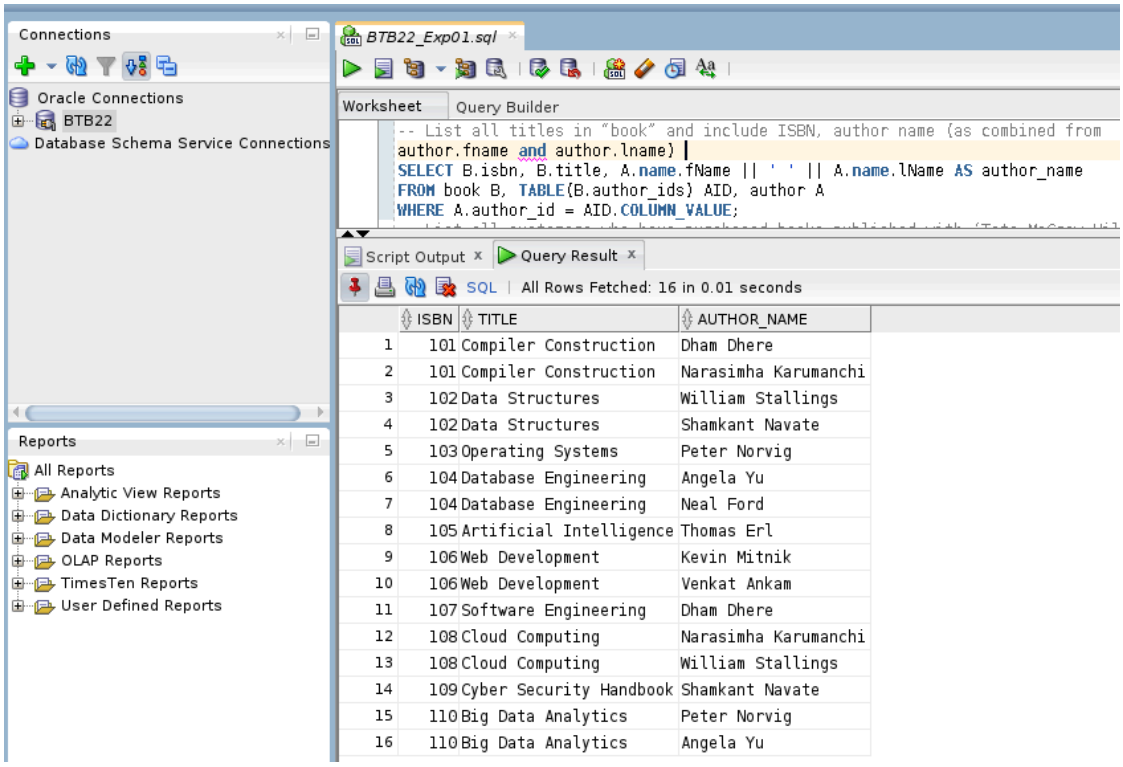
```
        '9812345670'
    )
);

INSERT INTO customer VALUES (
    'C03',
    name(
        'Shivraj', 'Patil'
    ),
    phone_no(
        '9823456781'
    )
);

INSERT INTO customer VALUES (
    'C04',
    name(
        'Kartikeya', 'Yadav'
    ),
    phone_no(
        '9834567892'
    )
);

INSERT INTO customer VALUES (
    'C05',
    name(
        'Aishwarya', 'Pavane'
    ),
    phone_no(
        '9845678903'
    )
);

INSERT INTO customer VALUES (
    'C06',
    name(
        'Prachi', 'Patil'
    ),
    phone_no(
        '9856789014'
    )
);
```

```
INSERT INTO customer VALUES (
    'C07',
    name(
        'Kedar', 'Salunkhe'
    ),
    phone_no(
        '9867890125'
    )
);

INSERT INTO customer VALUES (
    'C08',
    name(
        'Ankita', 'Desai'
    ),
    phone_no(
        '9878901236'
    )
);

INSERT INTO customer VALUES (
    'C09',
    name(
        'Avdhut', 'Pailwan'
    ),
    phone_no(
        '9889012347'
    )
);

INSERT INTO customer VALUES (
    'C10',
    name(
        'Ritesh', 'Bakare'
    ),
    phone_no(
        '9890123458'
    )
);

SELECT
    *
```

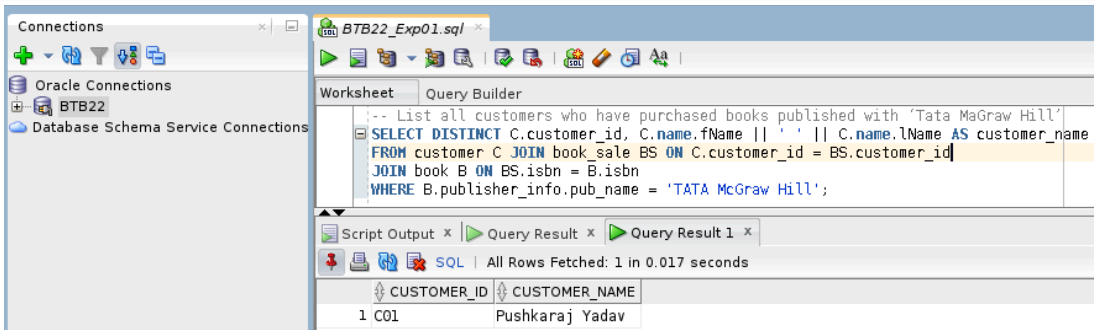
```
FROM
    customer;

CREATE TABLE book_sale (
    sale_id     VARCHAR(10) PRIMARY KEY,
    customer_id VARCHAR(10),
    isbn        INTEGER,
    FOREIGN KEY ( customer_id )
        REFERENCES customer ( customer_id ),
    FOREIGN KEY ( isbn )
        REFERENCES book ( isbn )
)

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 List all titles in "book" and include ISBN, author name (as combined
from
author.fname and author.lname)
SELECT B.isbn, B.title, A.name.fName || ' ' || A.name.lName AS author_name
FROM book B, TABLE(B.author_ids) AID, author A
WHERE A.author_id = AID.COLUMN_VALUE;
```

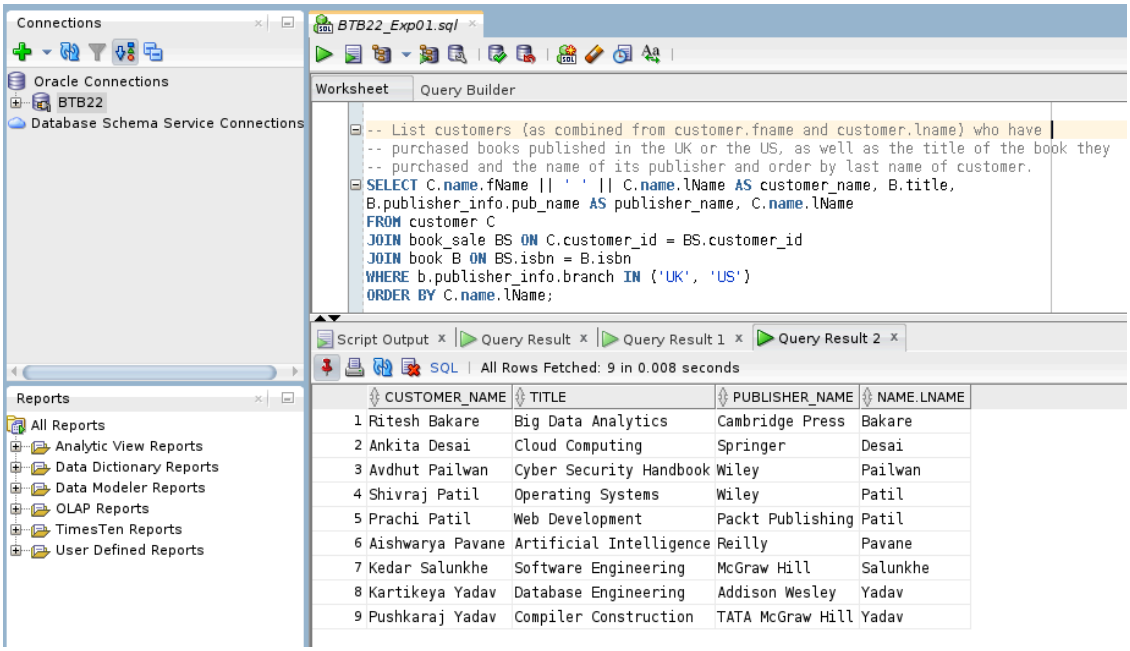



```sql
--Q.2 List all customers who have purchased books published with 'Tata MaGraw Hill'
SELECT DISTINCT C.customer_id, C.name.fName || ' ' || C.name.lName AS customer_name
FROM customer C JOIN book_sale BS ON C.customer_id = BS.customer_id
JOIN book B ON BS.isbn = B.isbn
WHERE B.publisher_info.pub_name = 'TATA McGraw Hill';
```

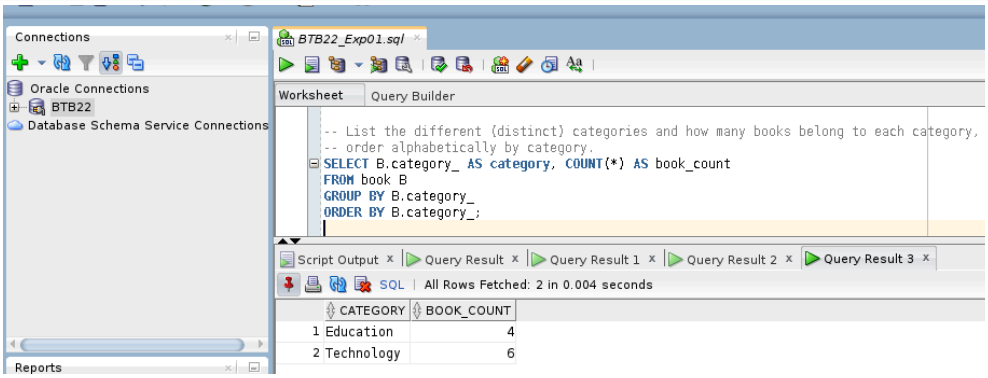



```sql
-- List customers (as combined from customer.fname and customer.lname) who have
-- purchased books published in the UK or the US, as well as the title of the book they
-- purchased and the name of its publisher and order by last name of
```

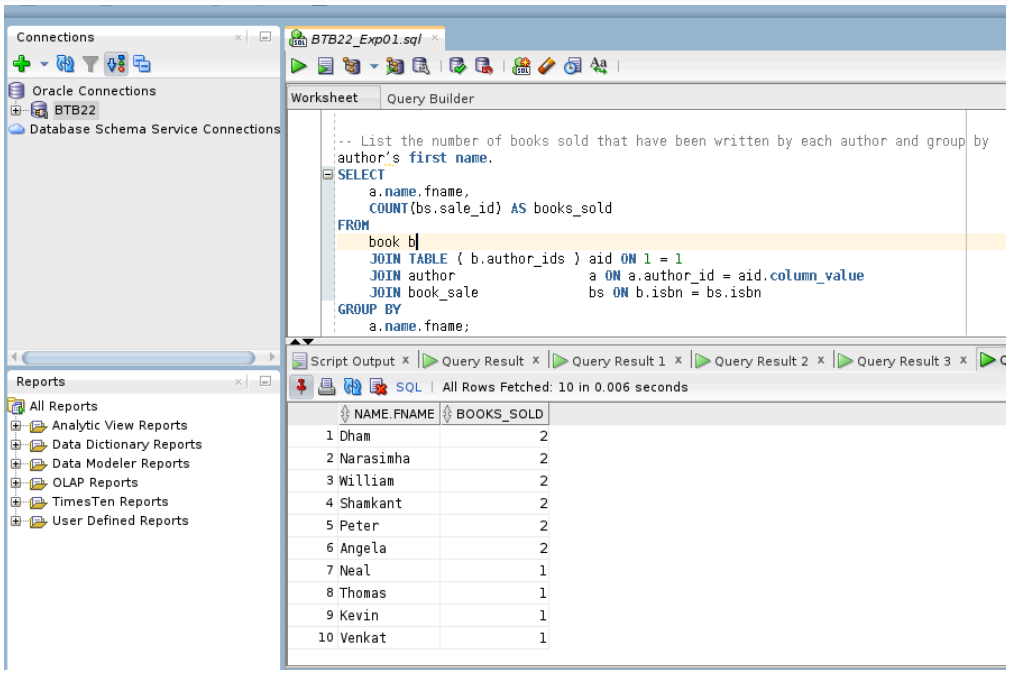
```
customer.
SELECT C.name.fName || ' ' || C.name.lName AS customer_name, B.title,
B.publisher_info.pub_name AS publisher_name, C.name.lName
FROM customer C
JOIN book_sale BS ON C.customer_id = BS.customer_id
JOIN book B ON BS.isbn = B.isbn
WHERE b.publisher_info.branch IN ('UK', 'US')
ORDER BY C.name.lName;
```




```
-- List the different (distinct) categories and how many books belong to
each category,
-- order alphabetically by category.
SELECT B.category_ AS category, COUNT(*) AS book_count
FROM book B
GROUP BY B.category_
ORDER BY B.category_;
```



```sql
-- List the number of books sold that have been written by each author and
group by
author's first name.
SELECT
    a.name.fname,
    COUNT(bs.sale_id) AS books_sold
FROM
    book b
    JOIN TABLE ( b.author_ids ) 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.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)
Create this database and solve queries on it.

Solution:

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

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

CREATE TYPE examset AS
    VARRAY(10) OF exam;

CREATE TYPE skill AS OBJECT (
        type  VARCHAR(50),
        exams examset
);

CREATE TYPE skillset AS
    VARRAY(10) OF skill;

CREATE TYPE childrenset AS
    VARRAY(10) OF child;

CREATE TABLE emp (
    ename    VARCHAR2(50),
    children childrenset,
    skills   skillset
);

INSERT INTO emp VALUES (
    'Avdhut Pailwan',
    childrenset(
        child(
            'Anil', TO_DATE('2001-05-15', 'YYYY-MM-DD')
        ), child(
            'Supriya', TO_DATE('1998-03-22', 'YYYY-MM-DD')
        )
    ),
    skillset(
        skill(
```

```
            'typing', examset(
                exam(
                    2023, 'Dayton'
                ), exam(
                    2021, 'Cleveland'
                )
            )
        ), skill(
            'programming', examset(
                exam(
                    2020, 'New York'
                )
            )
        )
    )
);

INSERT INTO emp VALUES (
    'Satej Patil',
    childrenset(
        child(
            'Ashish', TO_DATE('1999-07-30', 'YYYY-MM-DD')
        )
    ),
    skillset(
        skill(
            'accounting', examset(
                exam(
                    2019, 'Columbus'
                )
            )
        ), skill(
            'typing', examset(
                exam(
                    2022, 'Dayton'
                )
            )
        )
    )
);

INSERT INTO emp VALUES (
    'Arya Patil',
```

```
    childrenset(
        child(
            'Samrudhi', TO_DATE('2003-09-05', 'YYYY-MM-DD')
        ), child(
            'Sarthak', TO_DATE('2005-11-13', 'YYYY-MM-DD')
        )
    ),
    skillset(
        skill(
            'management', examset(
                exam(
                    2018, 'Chicago'
                )
            )
        ), skill(
            'programming', examset(
                exam(
                    2021, 'Boston'
                )
            )
        )
    )
);

INSERT INTO emp VALUES (
    'Pratik Patil',
    childrenset(
        child(
            'Samir', TO_DATE('2000-12-25', 'YYYY-MM-DD')
        )
    ),
    skillset(
        skill(
            'typing', examset(
                exam(
                    2023, 'Dayton'
                )
            )
        ), skill(
            'design', examset(
                exam(
                    2020, 'San Francisco'
                )
```

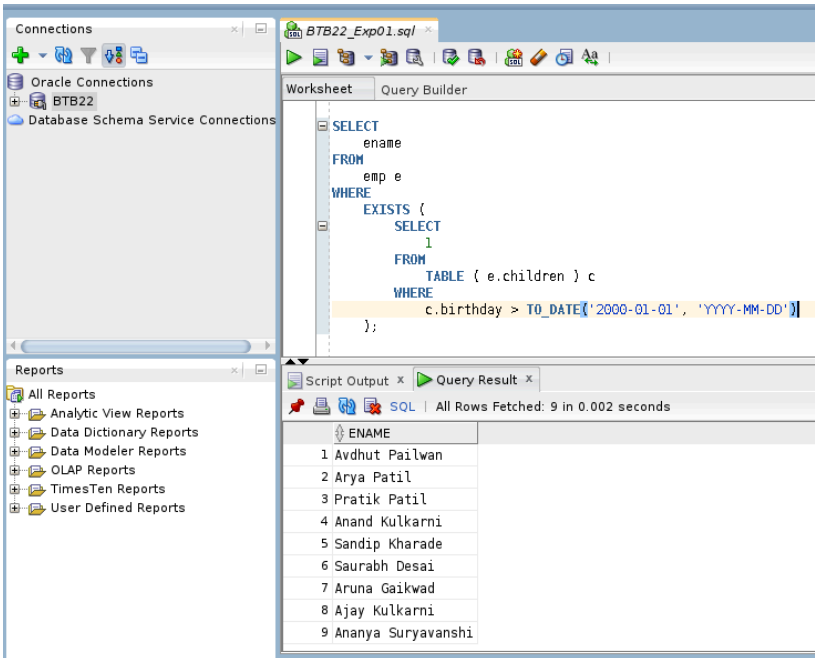
```
            )
        )
    )
);

INSERT INTO emp VALUES (
    'Anand Kulkarni',
    childrenset(
        child(
            'Abhinav', TO_DATE('2002-02-14', 'YYYY-MM-DD')
        ), child(
            'Akansha', TO_DATE('1997-10-19', 'YYYY-MM-DD')
        )
    ),
    skillset(
        skill(
            'data analysis', examset(
                exam(
                    2022, 'Seattle'
                )
            )
        ), skill(
            'typing', examset(
                exam(
                    2020, 'Dayton'
                )
            )
        )
    )
);

INSERT INTO emp VALUES (
    'Sandip Kharade',
    childrenset(
        child(
            'Nina', TO_DATE('2004-04-22', 'YYYY-MM-DD')
        )
    ),
    skillset(
        skill(
            'programming', examset(
                exam(
                    2019, 'Boston'
```

```
                )
            )
        ), skill(
            'typing', examset(
                exam(
                    2021, 'Dayton'
                )
            )
        )
    )
);

INSERT INTO emp VALUES (
    'Saurabh Desai',
    childrenset(
        child(
            'Samarjeet', TO_DATE('2000-08-07', 'YYYY-MM-DD')
        )
    ),
    skillset(
        skill(
            'typing', examset(
                exam(
                    2023, 'Dayton'
                )
            )
        ), skill(
            'management', examset(
                exam(
                    2022, 'Chicago'
                )
            )
        )
    )
);

INSERT INTO emp VALUES (
    'Aruna Gaikwad',
    childrenset(
        child(
            'Amar', TO_DATE('1996-01-17', 'YYYY-MM-DD')
        ), child(
            'Arun', TO_DATE('2003-12-29', 'YYYY-MM-DD')
```

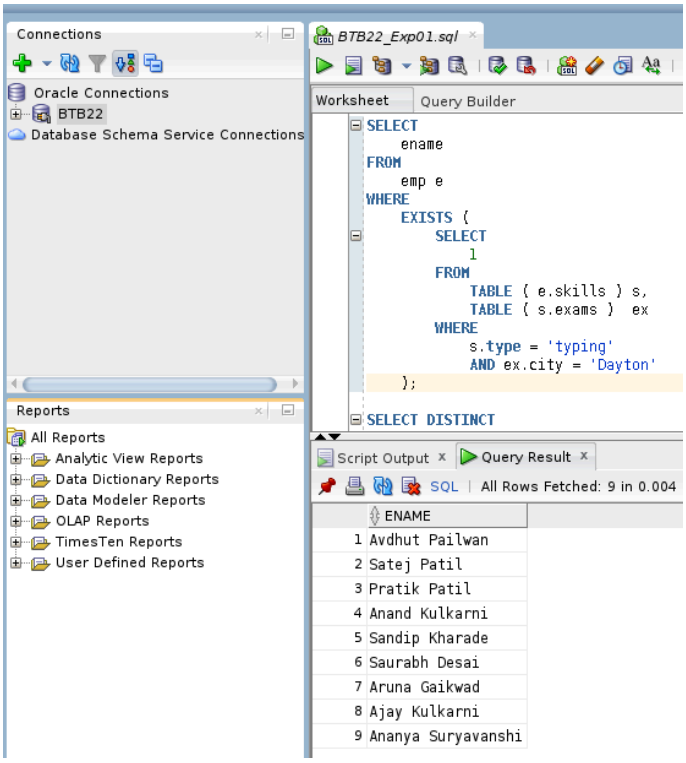
```
        )
    ),
    skillset(
        skill(
            'data analysis', examset(
                exam(
                    2021, 'Los Angeles'
                )
            )
        ), skill(
            'typing', examset(
                exam(
                    2022, 'Dayton'
                )
            )
        )
    )
);

INSERT INTO emp VALUES (
    'Ajay Kulkarni',
    childrenset(
        child(
            'Prashant', TO_DATE('2001-03-03', 'YYYY-MM-DD')
        )
    ),
    skillset(
        skill(
            'design', examset(
                exam(
                    2020, 'New York'
                )
            )
        ), skill(
            'typing', examset(
                exam(
                    2021, 'Dayton'
                )
            )
        )
    )
);
```

```
INSERT INTO emp VALUES (
    'Ananya Suryavanshi',
    childrenset(
        child(
            'Olivia', TO_DATE('2005-06-12', 'YYYY-MM-DD')
        )
    ),
    skillset(
        skill(
            'typing', examset(
                exam(
                    2023, 'Dayton'
                )
            )
        ), skill(
            'programming', examset(
                exam(
                    2019, 'San Francisco'
                )
            )
        )
    )
);

SELECT
    *
FROM
    emp;
```

```
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')
    );
```




```sql
-- 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'
    );
```




```sql
-- List all skill types in the relation Emp.
SELECT DISTINCT
    ( s.type ) AS skilltypes
FROM
    emp                 e,
    TABLE ( e.skills ) s;
```