

## 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', 'Er1'  
    ),  
    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;
```

The screenshot shows the SQL Developer interface with a query window titled 'BTB22\_Exp01.sql'. The query is as follows:

```
-- 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;
```

The query result is displayed in a table with 16 rows and 3 columns: ISBN, TITLE, and AUTHOR\_NAME.

	ISBN	TITLE	AUTHOR_NAME
1	101	Compiler Construction	Dham Dhere
2	101	Compiler Construction	Narasimha Karumanchi
3	102	Data Structures	William Stallings
4	102	Data Structures	Shamkant Navate
5	103	Operating Systems	Peter Norvig
6	104	Database Engineering	Angela Yu
7	104	Database Engineering	Neal Ford
8	105	Artificial Intelligence	Thomas Erl
9	106	Web Development	Kevin Mitnik
10	106	Web Development	Venkat Ankam
11	107	Software Engineering	Dham Dhere
12	108	Cloud Computing	Narasimha Karumanchi
13	108	Cloud Computing	William Stallings
14	109	Cyber Security Handbook	Shamkant Navate
15	110	Big Data Analytics	Peter Norvig
16	110	Big Data Analytics	Angela Yu

--Q.2 List all customers who have purchased books published with 'Tata McGraw 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';
```

The screenshot shows the SQL Developer interface with a query window titled 'BTB22\_Exp01.sql'. The query is as follows:

```
-- List all customers who have purchased books published with "Tata McGraw 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';
```

The query result is displayed in a table with 1 row and 2 columns: CUSTOMER\_ID and CUSTOMER\_NAME.

CUSTOMER_ID	CUSTOMER_NAME
1 C01	Pushkaraj Yadav

```
-- 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;
```

The screenshot shows the Oracle SQL Developer interface. On the left, the 'Connections' pane shows 'BTB22' selected. The main window displays a SQL query in the 'Query Builder' tab. The query is the same as the one in the previous block. Below the query, the 'Script Output' pane shows the query results. The results are displayed in a table with the following data:

CUSTOMER_NAME	TITLE	PUBLISHER_NAME	NAME.LNAME
1 Ritesh Bakare	Big Data Analytics	Cambridge Press	Bakare
2 Ankita Desai	Cloud Computing	Springer	Desai
3 Avdhut Pailwan	Cyber Security Handbook	Wiley	Pailwan
4 Shivraj Patil	Operating Systems	Wiley	Patil
5 Prachi Patil	Web Development	Packt Publishing	Patil
6 Aishwarya Pavane	Artificial Intelligence	Reilly	Pavane
7 Kedar Salunkhe	Software Engineering	McGraw Hill	Salunkhe
8 Kartikeya Yadav	Database Engineering	Addison Wesley	Yadav
9 Pushkaraj Yadav	Compiler Construction	TATA McGraw Hill	Yadav

-- 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_;
```

The screenshot shows the Oracle SQL Developer interface. On the left, the 'Connections' pane shows 'BTB22' selected. The main window displays a SQL query in the 'Query Builder' tab. The query is the same as the one in the previous block. Below the query, the 'Script Output' pane shows the query results. The results are displayed in a table with the following data:

CATEGORY	BOOK_COUNT
1 Education	4
2 Technology	6

```
-- 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;
```

The screenshot shows the Oracle SQL Developer interface. The 'Query Builder' tab is active, displaying the SQL query. Below the query, the 'Script Output' tab shows the execution results. The results are displayed in a table with two columns: 'NAME.FNAME' and 'BOOKS\_SOLD'. The table contains 10 rows of data, numbered 1 through 10.

NAME.FNAME	BOOKS_SOLD
1 Dham	2
2 Narasimha	2
3 William	2
4 Shankant	2
5 Peter	2
6 Angela	2
7 Neal	1
8 Thomas	1
9 Kevin	1
10 Venkat	1

## 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'
                )
            )
        )
    )
);

```

```

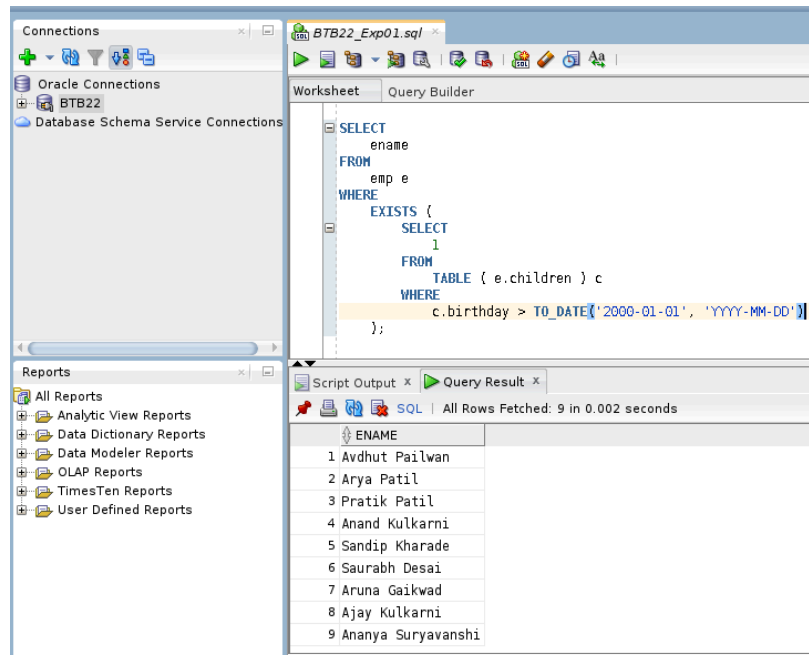
SELECT
    *
FROM
    emp;

```

```

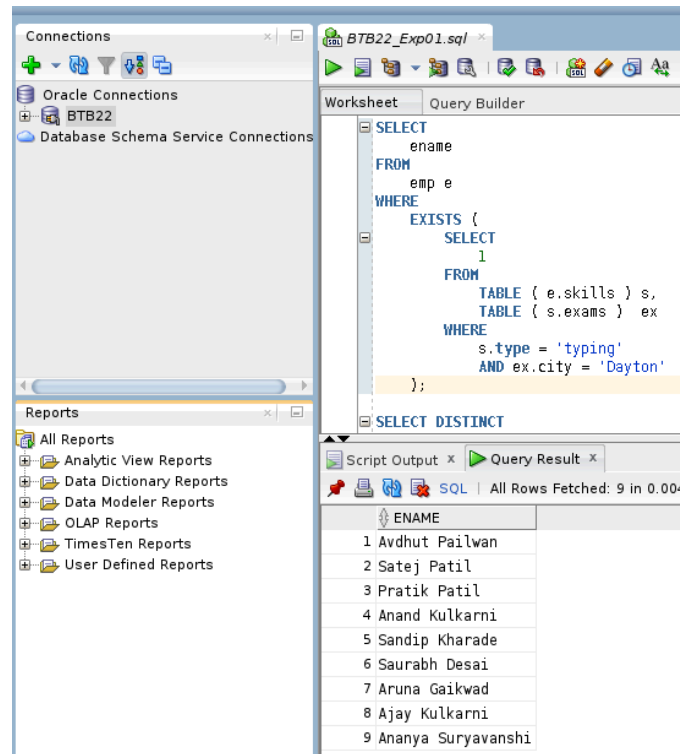
SELECT
    ename
FROM
    emp e
WHERE
    EXISTS (
        SELECT
            1
        FROM
            TABLE ( e.children ) c
        WHERE
            c.birthday > TO_DATE('2000-01-01', 'YYYY-MM-DD')
    );

```



-- 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'
  );
```



-- List all skill types in the relation Emp.

```
SELECT DISTINCT
  ( s.type ) AS skilltypes
FROM
  emp          e,
  TABLE ( e.skills ) s;
```

