Part – A

I. Entity-Relationship Model

The Entity – relationship model (ER model) defines a database structure using a diagram, known as the Entity Relationship Diagram (ER Diagram). An ER model is a database template or prototype, which can be implemented as a database later (SINGH 2020).

The ER Diagram consists of three primary components:

1. **Entity**
   An entity is a data object, or component. In an ER diagram an entity is represented as a rectangle.
   A total of 7 entities are used in this project, which are:
   a. Library
   b. Employee
   c. Book
   d. Magazine
   e. Ebook
   f. Publisher *[is created as a weak entity because publisher has no relevance inside a library database unless and until it is connected with book/magazine.]*
   g. Reader

2. **Attribute**
   One attribute describes an entity 's property. In an ER diagram an attribute will be depicted as an oval.
   There are four types of attributes:
   a. **Key Attribute**
      A key attribute may distinguish an entity distinct from a collection of entities. Book id, for example, can uniquely identify a book from a set of books. The key attribute is represented by the same oval as other attributes, but the key attribute text is highlighted.
   b. **Composite attribute**
      An attribute which combines other attributes is called a composite attribute. For example, the library address is a composite attribute in the library entity since an address is composed of other attributes such as street, city, postcode.
   c. **Multivalued attribute**
      An attribute capable of carrying several values is called the multivalued attribute. It is represented in an ER Diagram with double ovals. For example – A publisher may have more than one phone numbers so that the attribute to the phone number is multivalued.
   d. **Derived attribute**
      A derived attribute is one with a dynamic value which is derived from another attribute. It is represented in an ER Diagram with a dashed oval. For example, return before date of magazine can be derived by adding 14 days to issue date.

Attributes used are:

a. Library
   - Branch_id
   - Contact numbers
   - Address library
     - Street library
     - City library
     - Post code library

b. Employee
   - Employee id
   - Position
   - Employee name
     - First name employee
     - Last name employee

c. Book
    - Book id
    - Book title
    - Book author
    - Book pages
    - Book year
    - Available no. of copies book
    - Total no. of copies
    - Genre book
d. Magazine
    - Magazine id
    - Mag title
    - Mag issue number
    - No. of copies mag
    - Available no. of copies mag
e. Ebook
    - ebook id
    - Book title
    - Book author
    - Book pages
    - Book year
    - url
    - Genre book
f. Publisher
    - Pub id
    - Pub name
    - Pub phone number
    - Pub email
    - Pub countries
    - Pub address
        - Street pub
        - City pub
        - Postcode pub
g. Reader
    - Reader id
    - Items borrowing
    - Reader registration date
    - Reader address
        - Street reader
        - City reader
        - Post code reader
    - Reader name
        - First name reader
        - Last name reader

3. Relationship and Participation Constraints

In ER diagram a relationship is defined by diamond form, showing the relationship between entities, and like entities, relationships can also have attributes.

There are 3 types of relationship:

a. One to One Relationship

When an entity's single instance is associated with a single instance of another entity then it is called one-to-one relationships and it is not present in the project ER diagram.

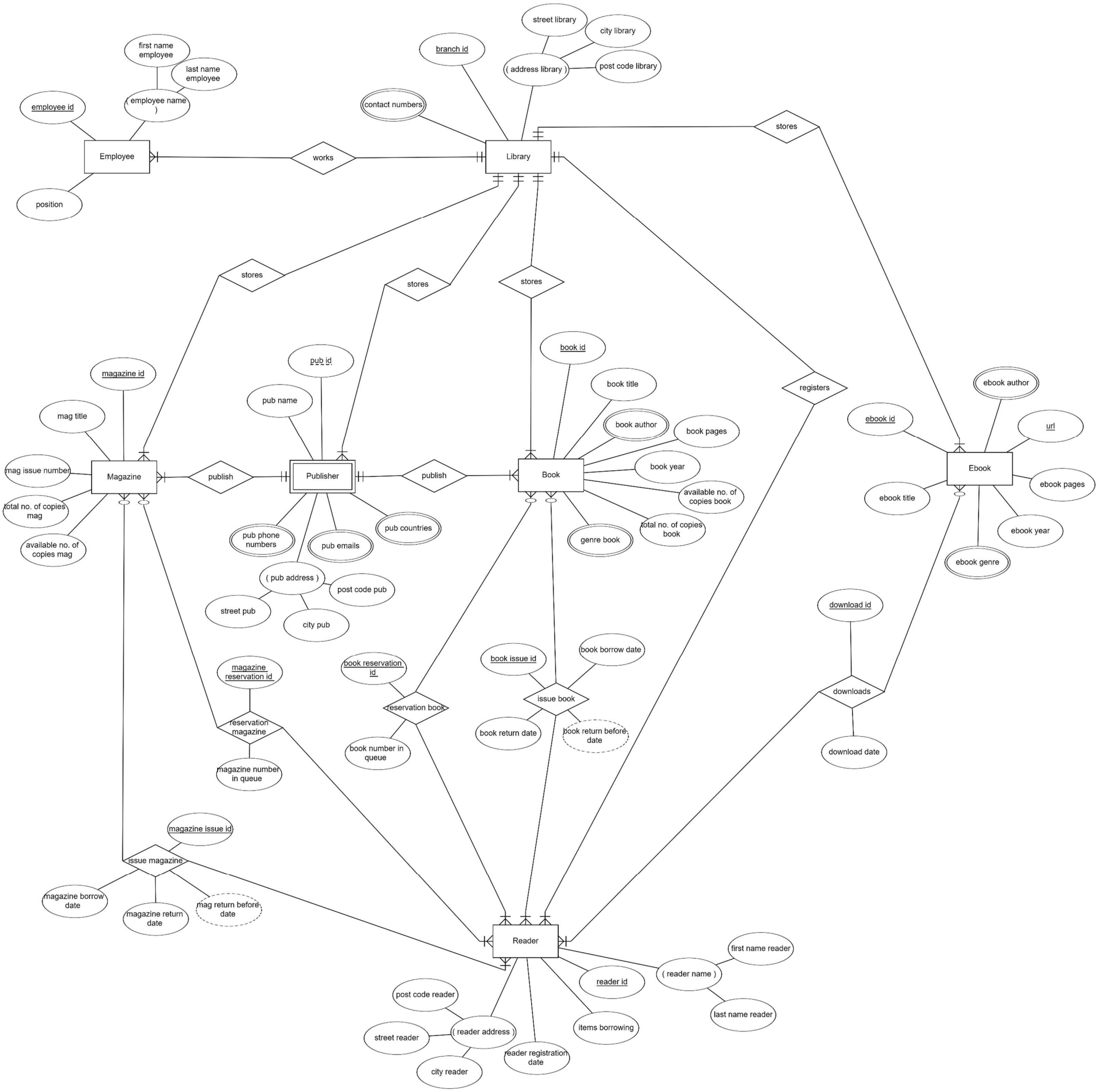


Figure 1 ER Diagram

b. One to Many Relationship

When associating a single instance of an entity with more than one instance of another entity, then it is considered one to many relationships. All 1 – many relationships in diagram are

- Library stores many Magazine
- Library stores many books
- Library stores many publishers
- Library stores many ebooks
- Many employees work in a Library
- Many readers register in a Library
- One publisher publishes many books
- One publisher publishes many magazine

c. **Many to Many Relationship**
When associating more than one instance of an entity with more than one instance of another entity, then it is considered many to many relationships. Many to many relationships are
   - Many readers can issue multiple books
   - Many readers can issue multiple magazines
   - Many readers can reserve multiple books
   - Many readers can reserve multiple magazines
   - Many readers can download multiple ebooks

Participation Constraints: Determines whether all (mandatory participation) (*For example, every book should have a publisher*) or only some (optional participation) (*For example, not every reader has to issue a book or magazine*) entity instances participate in a relationship.

Entity Relationship Matrix is developed before developing an ER diagram. It helps visualizing the relationships between each entity and can be also used to verify any mistakes in the ER diagram. The ER matrix is shown in the figure.

	A	B	C	D	E	F	G	H
1		**Entity-Relationship Matrix**						
2								
3		**Library**	**Employee**	**Readers**	**Book**	**Ebook**	**Magazine**	**Publications**
4	**Library**		X	X	X	X	X	X
5	**Employee**	X						
6	**Readers**	X			X	X	X	
7	**Book**	X		X				X
8	**Ebook**	X		X				
9	**Magazine**	X		X				X
10	**Publications**	X			X		X	

Figure 2 ER Matrix

II. Relational Schema

In a relational database system, a relational schema describes the relationships and layout of the database (Melendez 2019). Entities and attributes are represented as tables along with the corresponding relationship. Relational schema provides a crystal-clear picture to the developer about the database to be designed whereas the ER diagram is just a pictorial representation of database.

An ER diagram can be converted to a relational schema, it includes 8 steps which are (Bakirov 2020a):

1. Regular entities are converted to relations.
2. Weak entities are converted to relations and foreign key references are made for each of them.
3. One to one relations are converted into unique foreign key references.
4. One to many relations are converted into foreign key references from the many-side to the one-side.
5. Many to many relations are made into relations with the foreign key references.
6. Multi-valued attributes are converted into relations with composite primary key, relations are made with primary key of the corresponding entity and the attribute value.
7. N-ary relationships are converted along with the foreign key reference.
8. Subclasses and super-classes are converted, and foreign keys are placed in the subclass relations.

ERD plus (https://erdplus.com/) website is used for creating ER diagram as well as for converting ER diagram into relational schema.

Normalisation of relational schema is performed to check for logical redundancies and improve data integrity (Wikipedia, 2020).

3 forms are used for rectification of this problem:

1. First normal form:
    - Repeat categories in individual tables removed
    - Build a separate table for the respective set of data
    - Identify a primary key for every collection of related data (Bakirov,2020a)
2. Second normal form
    - It should satisfy First Normal Form
    - Partial dependencies must be removed (Upadhyay, 2020)
3. Third normal form
    - It should be in First and Second Normal Form
    - Non-prime attributes must not have any transitive dependencies (Upadhyay, 2020)

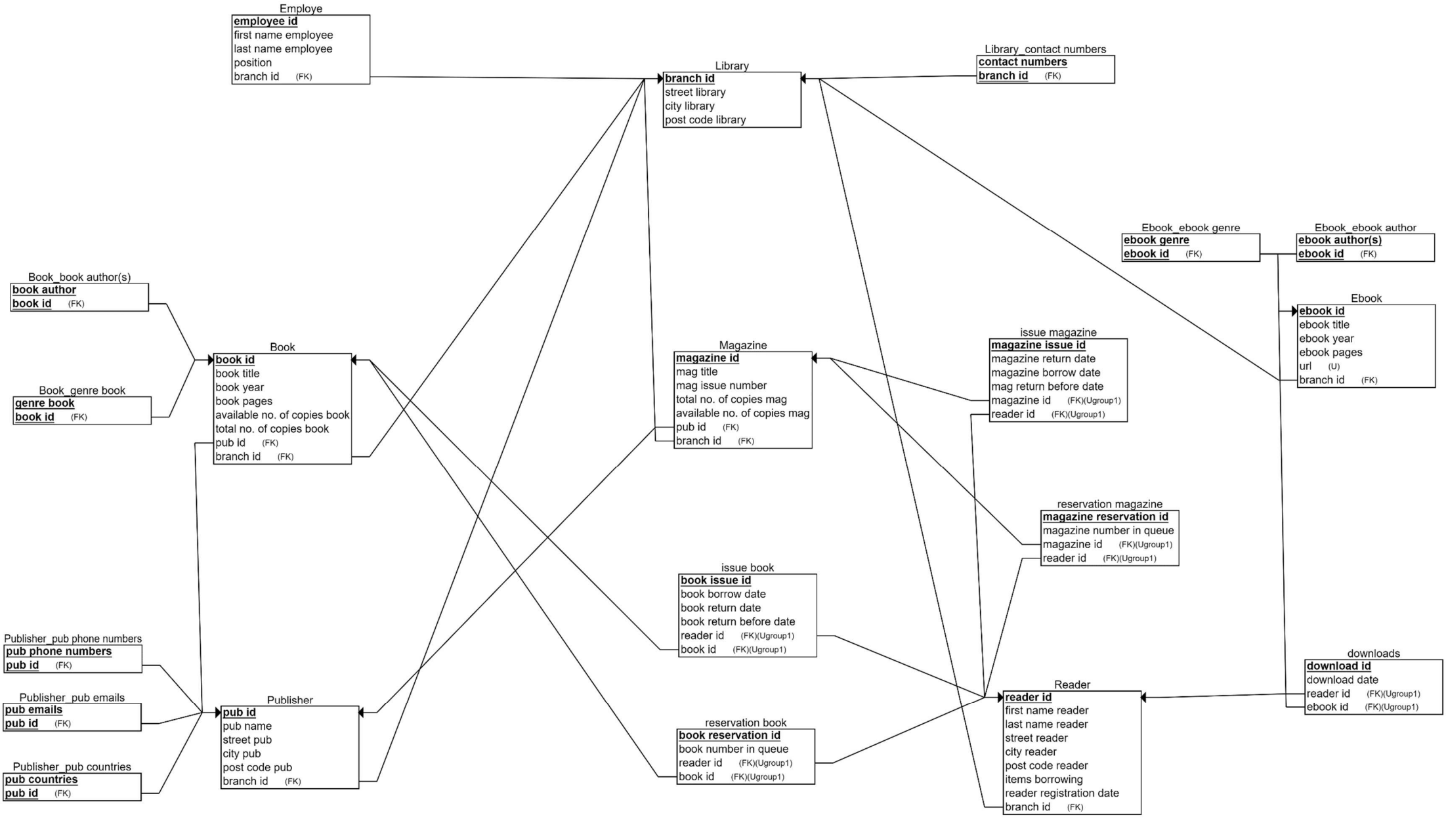


Figure 3 Relational Schema

III. SQL

SQL is the abbreviation for Structured Query Language. SQL lets user access and accordingly change databases (W3 Schools, 2020). **Oracle SQL Developer** was used to develop this project.
SQL has mainly two functions.

a. **Data Manipulation** or **Database Scheme**
   - Creating tables
   - Altering table definition
   - Deleting tables

b. **Data Retrieval** or **Data**
   - Inserting data
   - Altering data
   - Deleting data (Bakirov, 2020b)

SQL code is explained below with screenshots of the output, and whole process is divided into three parts (**creating tables, inserting sample data, and queries**). A total of 3 or more relative entities where only asked to implement in each technology, but in order to get a complete outlook of the database whole relational scheme is implemented. If 4 entities where only implemented, it would be **Library, Reader, Book, Publication** because these four are the basic elements of a library.

A. Creating Tables

Tables are created in SQL database not only for entities but also for every relation in the relational scheme.

```
CREATE TABLE Library
(
  branch_id VARCHAR2(6) NOT NULL,
  street_library VARCHAR2(35) NOT NULL,
  city_library VARCHAR2(25) NOT NULL,
  post_code_library VARCHAR2(7) NOT NULL,
  PRIMARY KEY (branch_id)
);
```

quueries.sql | LIBRARY

Columns | Data | Model | Constraints | Grants | Statistics | Triggers | Flashback | Dependencies | Details | Partitions | Indexes | SQL

Actions...

	COLUMN_NAME	DATA_TYPE	NULLABLE	DATA_DEFAULT	COLUMN_ID	COMMENTS
1	BRANCH_ID	VARCHAR2(6 BYTE)	No	(null)	1	(null)
2	STREET_LIB...	VARCHAR2(35 BYTE)	No	(null)	2	(null)
3	CITY_LIBRARY	VARCHAR2(25 BYTE)	No	(null)	3	(null)
4	POST_CODE_...	VARCHAR2(7 BYTE)	No	(null)	4	(null)

Figure 4 Table Library

```
CREATE TABLE Library_contact_numbers
(
  contact_numbers VARCHAR2(20) NOT NULL,
  branch_id VARCHAR2(6) NOT NULL,
  PRIMARY KEY (contact_numbers),
  FOREIGN KEY (branch_id) REFERENCES Library(branch_id)
);
```

quueries.sql | LIBRARY_CONTACT_NUMBERS

Columns | Data | Model | Constraints | Grants | Statistics | Triggers | Flashback | Dependencies | Details | Partitions | Indexes

Actions...

	COLUMN_NAME	DATA_TYPE	NULLABLE	DATA_DEFAULT	COLUMN_ID	COMMENTS
1	CONTACT_NU...	VARCHAR2(20 BYTE)	No	(null)	1	(null)
2	BRANCH_ID	VARCHAR2(6 BYTE)	No	(null)	2	(null)

Figure 5 Table Library Contact Number

```
CREATE TABLE Employee
(
  employee_id VARCHAR2(6) NOT NULL,
  first_name_employee VARCHAR2(20) NOT NULL,
  last_name_employee VARCHAR2(20) NOT NULL,
  designation VARCHAR2(15) NOT NULL,
  branch_id VARCHAR2(6) NOT NULL,
  PRIMARY KEY (employee_id),
  FOREIGN KEY (branch_id) REFERENCES Library(branch_id)
);
```

quueries.sql | EMPLOYEE

Columns | Data | Model | Constraints | Grants | Statistics | Triggers | Flashback | Dependencies | Details | Partitions | Indexes | SQ

Actions...

	COLUMN_NAME	DATA_TYPE	NULLABLE	DATA_DEFAULT	COLUMN_ID	COMMENTS
1	EMPLOYEE_ID	VARCHAR2(6 BYTE)	No	(null)	1	(null)
2	FIRST_NAME...	VARCHAR2(20 BYTE)	No	(null)	2	(null)
3	LAST_NAME_...	VARCHAR2(20 BYTE)	No	(null)	3	(null)
4	DESIGNATION	VARCHAR2(15 BYTE)	No	(null)	4	(null)
5	BRANCH_ID	VARCHAR2(6 BYTE)	No	(null)	5	(null)

Figure 6 Table Employee

```
CREATE TABLE Reader
(
  reader_id VARCHAR2(6) NOT NULL,
  first_name_reader VARCHAR2(20) NOT NULL,
  last_name_reader VARCHAR2(20) NOT NULL,
  street_reader VARCHAR2(35) NOT NULL,
  city_reader VARCHAR2(25) NOT NULL,
  post_code_reader VARCHAR2(10) NOT NULL,
  items_borrowing NUMBER(1),
  reader_registration_date DATE NOT NULL,
  branch_id VARCHAR2(6) NOT NULL,
  PRIMARY KEY (reader_id),
  FOREIGN KEY (branch_id) REFERENCES Library(branch_id)
);
```

quueries.sql | READER

Columns | Data | Model | Constraints | Grants | Statistics | Triggers | Flashback | Dependencies | Details | Partitions | Indexes

Actions...

	COLUMN_NAME	DATA_TYPE	NULLABLE	DATA_DEFAULT	COLUMN_ID	COMMENTS
1	READER_ID	VARCHAR2(6 BYTE)	No	(null)	1	(null)
2	FIRST_NAME...	VARCHAR2(20 BYTE)	No	(null)	2	(null)
3	LAST_NAME_...	VARCHAR2(20 BYTE)	No	(null)	3	(null)
4	STREET_READER	VARCHAR2(35 BYTE)	No	(null)	4	(null)
5	CITY_READER	VARCHAR2(25 BYTE)	No	(null)	5	(null)
6	POST_CODE_...	VARCHAR2(10 BYTE)	No	(null)	6	(null)
7	ITEMS_BORR...	NUMBER(1,0)	Yes	(null)	7	(null)
8	READER_REG...	DATE	No	(null)	8	(null)
9	BRANCH_ID	VARCHAR2(6 BYTE)	No	(null)	9	(null)

Figure 7 Table Reader

```
CREATE TABLE Ebook
```

```
(
  ebook_id VARCHAR2(6) NOT NULL,
  ebook_title VARCHAR2(100) NOT NULL,
  ebook_year NUMBER(4) NOT NULL,
  ebook_pages NUMBER(4) NOT NULL,
  ebook_url VARCHAR2(1000) NOT NULL,
  branch_id VARCHAR2(6) NOT NULL,
  PRIMARY KEY (ebook_id),
  FOREIGN KEY (branch_id) REFERENCES Library(branch_id),
  UNIQUE (ebook_url)
);
```

quueries.sql | EBOOK

Columns | Data | Model | Constraints | Grants | Statistics | Triggers | Flashback | Dependencies | Details | Partitions | Indexes |

Actions...

	COLUMN_NAME	DATA_TYPE	NULLABLE	DATA_DEFAULT	COLUMN_ID	COMMENTS
1	EBOOK_ID	VARCHAR2(6 BYTE)	No	(null)	1	(null)
2	EBOOK_TITLE	VARCHAR2(100 BYTE)	No	(null)	2	(null)
3	EBOOK_YEAR	NUMBER(4,0)	No	(null)	3	(null)
4	EBOOK_PAGES	NUMBER(4,0)	No	(null)	4	(null)
5	EBOOK_URL	VARCHAR2(1000 B...	No	(null)	5	(null)
6	BRANCH_ID	VARCHAR2(6 BYTE)	No	(null)	6	(null)

Figure 8 Table Ebook

```
CREATE TABLE Ebook_ebook_author
(
  ebook_author VARCHAR2(30) NOT NULL,
  ebook_id VARCHAR2(6) NOT NULL,
  PRIMARY KEY (ebook_author, ebook_id),
  FOREIGN KEY (ebook_id) REFERENCES Ebook(ebook_id)
);
```

quueries.sql | EBOOK_EBOOK_AUTHOR

Columns | Data | Model | Constraints | Grants | Statistics | Triggers | Flashback | Dependencies | Details | Partitions | Indexes | SC

Actions...

	COLUMN_NAME	DATA_TYPE	NULLABLE	DATA_DEFAULT	COLUMN_ID	COMMENTS
1	EBOOK_AUTHOR	VARCHAR2(30 BYTE)	No	(null)	1	(null)
2	EBOOK_ID	VARCHAR2(6 BYTE)	No	(null)	2	(null)

Figure 9 TABLE Ebook_ebook_author

```
CREATE TABLE Ebook_ebook_genre
(
  ebook_genre VARCHAR2(30) NOT NULL,
  ebook_id VARCHAR2(6) NOT NULL,
  PRIMARY KEY (ebook_genre, ebook_id),
  FOREIGN KEY (ebook_id) REFERENCES Ebook(ebook_id)
);
```

quueries.sql | EBOOK_EBOOK_GENRE

Columns | Data | Model | Constraints | Grants | Statistics | Triggers | Flashback | Dependencies | Details | Partitions | Indexes | S

Actions...

	COLUMN_NAME	DATA_TYPE	NULLABLE	DATA_DEFAULT	COLUMN_ID	COMMENTS
1	EBOOK_GENRE	VARCHAR2(30 BYTE)	No	(null)	1	(null)
2	EBOOK_ID	VARCHAR2(6 BYTE)	No	(null)	2	(null)

Figure 10 TABLE Ebook_ebook_genre

```
CREATE TABLE Publisher
(
  pub_id VARCHAR2(6) NOT NULL,
  pub_name VARCHAR2(100) NOT NULL,
```

```
  street_pub VARCHAR2(35) NOT NULL,
  city_pub VARCHAR2(25) NOT NULL,
  post_code_pub VARCHAR(10) NOT NULL,
  branch_id VARCHAR2(6) NOT NULL,
  PRIMARY KEY (pub_id),
  FOREIGN KEY (branch_id) REFERENCES Library(branch_id)
);
```

quueries.sql | PUBLISHER

Columns | Data | Model | Constraints | Grants | Statistics | Triggers | Flashback | Dependencies | Details | Partitions | Indexes | S

Actions...

	COLUMN_NAME	DATA_TYPE	NULLABLE	DATA_DEFAULT	COLUMN_ID	COMMENTS
1	PUB_ID	VARCHAR2(6 BYTE)	No	(null)	1	(null)
2	PUB_NAME	VARCHAR2(100 BYTE)	No	(null)	2	(null)
3	STREET_PUB	VARCHAR2(35 BYTE)	No	(null)	3	(null)
4	CITY_PUB	VARCHAR2(25 BYTE)	No	(null)	4	(null)
5	POST_CODE_PUB	VARCHAR2(10 BYTE)	No	(null)	5	(null)
6	BRANCH_ID	VARCHAR2(6 BYTE)	No	(null)	6	(null)

Figure 11 TABLE Publisher

```
CREATE TABLE Publisher_pub_countries
(
  pub_countries VARCHAR2(20) NOT NULL,
  pub_id VARCHAR2(6) NOT NULL,
  PRIMARY KEY (pub_countries, pub_id),
  FOREIGN KEY (pub_id) REFERENCES Publisher(pub_id)
);
```

quueries.sql | PUBLISHER_PUB_COUNTRIES

Columns | Data | Model | Constraints | Grants | Statistics | Triggers | Flashback | Dependencies | Details | Partitions | Indexes | S

Actions...

	COLUMN_NAME	DATA_TYPE	NULLABLE	DATA_DEFAULT	COLUMN_ID	COMMENTS
1	PUB_COUNTRIES	VARCHAR2(20 BYTE)	No	(null)	1	(null)
2	PUB_ID	VARCHAR2(6 BYTE)	No	(null)	2	(null)

Figure 12 TABLE Publisher_pub_countries

```
CREATE TABLE Publisher_pub_phone_numbers
(
  pub_phone_numbers VARCHAR2(20) NOT NULL,
  pub_id VARCHAR2(6) NOT NULL,
  PRIMARY KEY (pub_phone_numbers),
  FOREIGN KEY (pub_id) REFERENCES Publisher(pub_id)
);
```

quueries.sql | PUBLISHER_PUB_PHONE_NUMBERS

Columns | Data | Model | Constraints | Grants | Statistics | Triggers | Flashback | Dependencies | Details | Partitions | Indexes | S

Actions...

	COLUMN_NAME	DATA_TYPE	NULLABLE	DATA_DEFAULT	COLUMN_ID	COMMENTS
1	PUB_PHONE_...	VARCHAR2(20 BYTE)	No	(null)	1	(null)
2	PUB_ID	VARCHAR2(6 BYTE)	No	(null)	2	(null)

Figure 13 TABLE Publisher_pub_phone_numbers

```
CREATE TABLE Publisher_pub_emails
(
  pub_emails VARCHAR2(50) NOT NULL,
  pub_id VARCHAR2(6) NOT NULL,
  PRIMARY KEY (pub_emails),
  FOREIGN KEY (pub_id) REFERENCES Publisher(pub_id)
);
```

queueries.sql | PUBLISHER_PUB_EMAILS

Columns | Data | Model | Constraints | Grants | Statistics | Triggers | Flashback | Dependencies | Details | Partitions | Indexes

Actions...

	COLUMN_NAME	DATA_TYPE	NULLABLE	DATA_DEFAULT	COLUMN_ID	COMMENTS
1	PUB_EMAILS	VARCHAR2(50 BYTE)	No	(null)	1	(null)
2	PUB_ID	VARCHAR2(6 BYTE)	No	(null)	2	(null)

Figure 14 TABLE Publisher_pub_emails

```
CREATE TABLE Book
(
  book_id VARCHAR2(6) NOT NULL,
  book_title VARCHAR2(100) NOT NULL,
  book_year NUMBER(4) NOT NULL,
  book_pages NUMBER(6) NOT NULL,
  avail_book_no NUMBER(2),
  total_book_no NUMBER(2),
  pub_id VARCHAR2(6) NOT NULL,
  branch_id VARCHAR2(6) NOT NULL,
  PRIMARY KEY (book_id),
  FOREIGN KEY (pub_id) REFERENCES Publisher(pub_id),
  FOREIGN KEY (branch_id) REFERENCES Library(branch_id)
);
```

queueries.sql | BOOK

Columns | Data | Model | Constraints | Grants | Statistics | Triggers | Flashback | Dependencies | Details | Partitions | Indexes

Actions...

	COLUMN_NAME	DATA_TYPE	NULLABLE	DATA_DEFAULT	COLUMN_ID	COMMENTS
1	BOOK_ID	VARCHAR2(6 BYTE)	No	(null)	1	(null)
2	BOOK_TITLE	VARCHAR2(100 BYTE)	No	(null)	2	(null)
3	BOOK_YEAR	NUMBER(4,0)	No	(null)	3	(null)
4	BOOK_PAGES	NUMBER(6,0)	No	(null)	4	(null)
5	AVAIL_BOOK_NO	NUMBER(2,0)	Yes	(null)	5	(null)
6	TOTAL_BOOK_NO	NUMBER(2,0)	Yes	(null)	6	(null)
7	PUB_ID	VARCHAR2(6 BYTE)	No	(null)	7	(null)
8	BRANCH_ID	VARCHAR2(6 BYTE)	No	(null)	8	(null)

Figure 15 TABLE Book

```
CREATE TABLE Book_book_author
(
  book_author VARCHAR2(50) NOT NULL,
  book_id VARCHAR2(6) NOT NULL,
  PRIMARY KEY (book_author, book_id),
  FOREIGN KEY (book_id) REFERENCES Book(book_id)
);
```

queueries.sql | BOOK_BOOK_AUTHOR

Columns | Data | Model | Constraints | Grants | Statistics | Triggers | Flashback | Dependencies | Details | Partitions | Indexes

Actions...

	COLUMN_NAME	DATA_TYPE	NULLABLE	DATA_DEFAULT	COLUMN_ID	COMMENTS
1	BOOK_AUTHOR	VARCHAR2(50 BYTE)	No	(null)	1	(null)
2	BOOK_ID	VARCHAR2(6 BYTE)	No	(null)	2	(null)

Figure 16 TABLE Book_book_author

```
CREATE TABLE Book_genre_book
(
  genre_book VARCHAR2(30) NOT NULL,
  book_id VARCHAR2(6) NOT NULL,
  PRIMARY KEY (genre_book, book_id),
  FOREIGN KEY (book_id) REFERENCES Book(book_id)
);
```

quueries.sql | BOOK_GENRE_BOOK

Columns | Data | Model | Constraints | Grants | Statistics | Triggers | Flashback | Dependencies | Details | Partitions | Indexes

Actions...

	COLUMN_NAME	DATA_TYPE	NULLABLE	DATA_DEFAULT	COLUMN_ID	COMMENTS
1	GENRE_BOOK	VARCHAR2(30 BYTE)	No	(null)	1	(null)
2	BOOK_ID	VARCHAR2(6 BYTE)	No	(null)	2	(null)

Figure 17 TABLE Book_genre_book

```
CREATE TABLE Magazine
(
  magazine_id VARCHAR2(6) NOT NULL,
  mag_title VARCHAR2(100) NOT NULL,
  mag_issue_number NUMBER(7) NOT NULL,
  total_mag_no NUMBER(2),
  avail_mag_no NUMBER(2),
  pub_id VARCHAR2(6) NOT NULL,
  branch_id VARCHAR2(6) NOT NULL,
  PRIMARY KEY (magazine_id),
  FOREIGN KEY (pub_id) REFERENCES Publisher(pub_id),
  FOREIGN KEY (branch_id) REFERENCES Library(branch_id)
);
```

quueries.sql | MAGAZINE

Columns | Data | Model | Constraints | Grants | Statistics | Triggers | Flashback | Dependencies | Details | Partitions | Indexes

Actions...

	COLUMN_NAME	DATA_TYPE	NULLABLE	DATA_DEFAULT	COLUMN_ID	COMMENTS
1	MAGAZINE_ID	VARCHAR2(6 BYTE)	No	(null)	1	(null)
2	MAG_TITLE	VARCHAR2(100 BYTE)	No	(null)	2	(null)
3	MAG_ISSUE_...	NUMBER(7,0)	No	(null)	3	(null)
4	TOTAL_MAG_NO	NUMBER(2,0)	Yes	(null)	4	(null)
5	AVAIL_MAG_NO	NUMBER(2,0)	Yes	(null)	5	(null)
6	PUB_ID	VARCHAR2(6 BYTE)	No	(null)	6	(null)
7	BRANCH_ID	VARCHAR2(6 BYTE)	No	(null)	7	(null)

Figure 18 TABLE Magazine

```
CREATE TABLE downloads
(
  download_id VARCHAR2(6) NOT NULL,
  download_date DATE NOT NULL,
  reader_id VARCHAR2(6) NOT NULL,
  ebook_id VARCHAR2(6) NOT NULL,
  PRIMARY KEY (download_id),
  FOREIGN KEY (reader_id) REFERENCES Reader(reader_id),
  FOREIGN KEY (ebook_id) REFERENCES Ebook(ebook_id)
);
```

quueries.sql | DOWNLOADS

Columns | Data | Model | Constraints | Grants | Statistics | Triggers | Flashback | Dependencies | Details | Partitions | Indexes

Actions...

	COLUMN_NAME	DATA_TYPE	NULLABLE	DATA_DEFAULT	COLUMN_ID	COMMENTS
1	DOWNLOAD_ID	VARCHAR2(6 BYTE)	No	(null)	1	(null)
2	DOWNLOAD_DATE	DATE	No	(null)	2	(null)
3	READER_ID	VARCHAR2(6 BYTE)	No	(null)	3	(null)
4	EBOOK_ID	VARCHAR2(6 BYTE)	No	(null)	4	(null)

Figure 19 TABLE downloads

```
CREATE TABLE issue_book
(
  book_issue_id VARCHAR2(6) NOT NULL,
```

```
  book_borrow_date_ DATE NOT NULL,
  book_return_before_date DATE NOT NULL,
  book_return_date DATE ,
  reader_id VARCHAR2(6) NOT NULL,
  book_id VARCHAR2(6) NOT NULL,
  PRIMARY KEY (book_issue_id),
  FOREIGN KEY (reader_id) REFERENCES Reader(reader_id),
  FOREIGN KEY (book_id) REFERENCES Book(book_id)
);
```

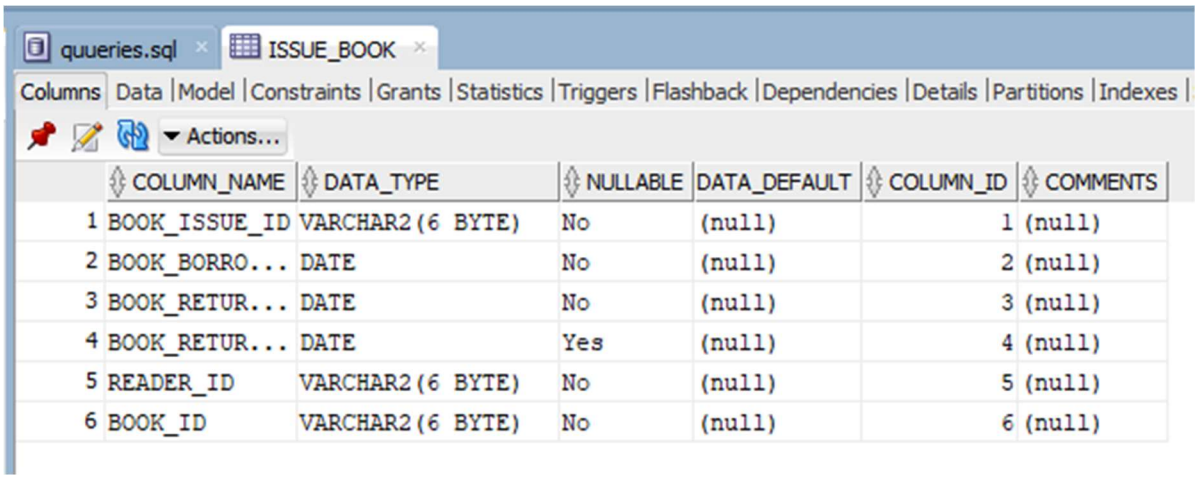


Figure 20 TABLE issue_book

```
CREATE TABLE reservation_book
(
  book_reservation_id VARCHAR2(6) NOT NULL,
  book_number_in_queue NUMBER(2) NOT NULL,
  reader_id VARCHAR2(6) NOT NULL,
  book_id VARCHAR2(6) NOT NULL,
  PRIMARY KEY (book_reservation_id),
  FOREIGN KEY (reader_id) REFERENCES Reader(reader_id),
  FOREIGN KEY (book_id) REFERENCES Book(book_id)
);
```

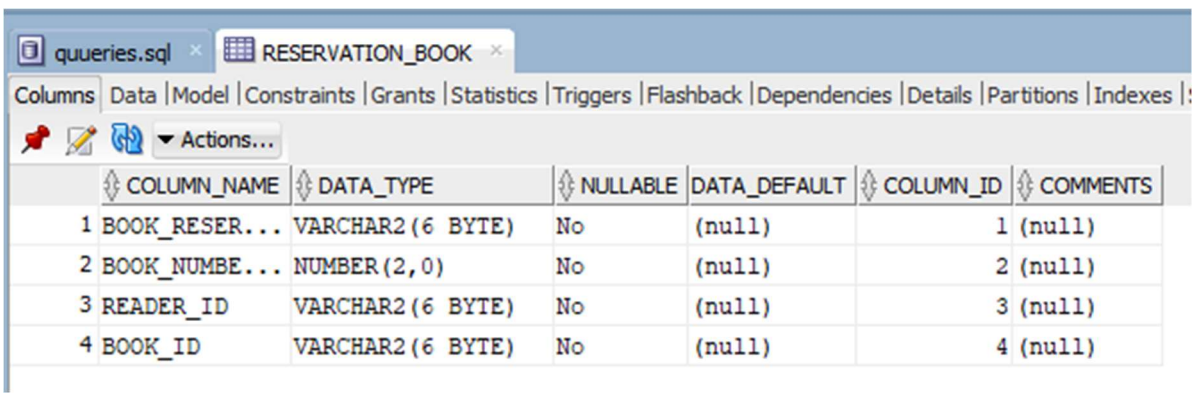


Figure 21 TABLE reservation_book

```
CREATE TABLE issue_magazine
(
  magazine_issue_id VARCHAR2(6) NOT NULL,
  magazine_borrow_date DATE NOT NULL,
  mag_return_before_date DATE NOT NULL,
  magazine_return_date DATE ,
  magazine_id VARCHAR2(6) NOT NULL,
  reader_id VARCHAR2(6) NOT NULL,
  PRIMARY KEY (magazine_issue_id),
  FOREIGN KEY (magazine_id) REFERENCES Magazine(magazine_id),
  FOREIGN KEY (reader_id) REFERENCES Reader(reader_id)
);
```

quueries.sql | ISSUE_MAGAZINE

Columns | Data | Model | Constraints | Grants | Statistics | Triggers | Flashback | Dependencies | Details | Partitions | Indexes | SQ

Actions...

	COLUMN_NAME	DATA_TYPE	NULLABLE	DATA_DEFAULT	COLUMN_ID	COMMENTS
1	MAGAZINE_I...	VARCHAR2(6 BYTE)	No	(null)	1	(null)
2	MAGAZINE_B...	DATE	No	(null)	2	(null)
3	MAG_RETURN...	DATE	No	(null)	3	(null)
4	MAGAZINE_R...	DATE	Yes	(null)	4	(null)
5	MAGAZINE_ID	VARCHAR2(6 BYTE)	No	(null)	5	(null)
6	READER_ID	VARCHAR2(6 BYTE)	No	(null)	6	(null)

Figure 22 TABLE issue_magazine

```
CREATE TABLE reservation_magazine
(
  magazine_reservation_id VARCHAR2(6) NOT NULL,
  magazine_number_in_queue NUMBER(2) NOT NULL,
  magazine_id VARCHAR2(6) NOT NULL,
  reader_id VARCHAR2(6) NOT NULL,
  PRIMARY KEY (magazine_reservation_id),
  FOREIGN KEY (magazine_id) REFERENCES Magazine(magazine_id),
  FOREIGN KEY (reader_id) REFERENCES Reader(reader_id)
);
```

quueries.sql | RESERVATION_MAGAZINE

Columns | Data | Model | Constraints | Grants | Statistics | Triggers | Flashback | Dependencies | Details | Partitions | Indexes |

Actions...

	COLUMN_NAME	DATA_TYPE	NULLABLE	DATA_DEFAULT	COLUMN_ID	COMMENTS
1	MAGAZINE_R...	VARCHAR2(6 BYTE)	No	(null)	1	(null)
2	MAGAZINE_N...	NUMBER(2,0)	No	(null)	2	(null)
3	MAGAZINE_ID	VARCHAR2(6 BYTE)	No	(null)	3	(null)
4	READER_ID	VARCHAR2(6 BYTE)	No	(null)	4	(null)

Figure 23 TABLE reservation_magazine

B. Inserting Sample Data

Sample data for created tables are inserted into the database.

```
insert into Library
values('BR1000','144 WINDHAM ROAD','BOURNEMOUTH','BH1 4RA');

select * from library;
```

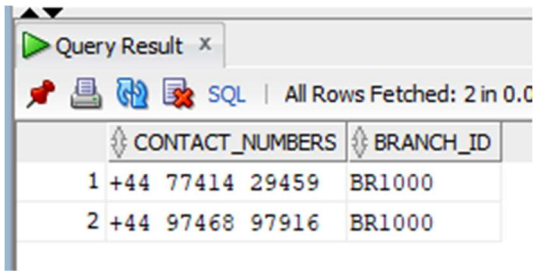
Query Result

SQL | All Rows Fetched: 1 in 0.072 seconds

	BRANCH_ID	STREET_LIBRARY	CITY_LIBRARY	POST_CODE_LIBRARY
1	BR1000	144 WINDHAM ROAD	BOURNEMOUTH	BH1 4RA

Figure 24 Library data

```
insert into library_contact_numbers
VALUES('+44 77414 29459','BR1000');
insert into library_contact_numbers
VALUES('+44 97468 97916','BR1000');

select * from library_contact_numbers;
```


Query Result

SQL | All Rows Fetched: 2 in 0.0

	CONTACT_NUMBERS	BRANCH_ID
1	+44 77414 29459	BR1000
2	+44 97468 97916	BR1000

Figure 25 library_contact_numbers data

```
INSERT ALL
  INTO employee  VALUES ('EM1001','VINEETH','KRISHNAKUMAR','MANAGER','BR1000')
  INTO employee  VALUES ('EM1002','VARUN','BLAKE','ASST. MANAGER','BR1000')
  INTO employee  VALUES ('EM1003','AB','DE VILLIERS','STORE KEEPER','BR1000')
  INTO employee  VALUES ('EM1004','VIRAT','KOHLI','STORE KEEPER','BR1000')
  INTO employee  VALUES ('EM1005','RICKY','PONTING','STORE KEEPER','BR1000')
  INTO employee  VALUES ('EM1006','JASON','ROY','MAINTENCE','BR1000')
  INTO employee  VALUES ('EM1007','CHRIS','GAYLE','MAINTENCE','BR1000')
SELECT * FROM dual;

select * from employee;
```


Query Result

SQL | All Rows Fetched: 7 in 0.04 seconds

	EMPLOYEE_ID	FIRST_NAME_EMPLOYEE	LAST_NAME_EMPLOYEE	DESIGNATION	BRANCH_ID
1	EM1001	VINEETH	KRISHNAKUMAR	MANAGER	BR1000
2	EM1002	VARUN	BLAKE	ASST. MANAGER	BR1000
3	EM1003	AB	DE VILLIERS	STORE KEEPER	BR1000
4	EM1004	VIRAT	KOHLI	STORE KEEPER	BR1000
5	EM1005	RICKY	PONTING	STORE KEEPER	BR1000
6	EM1006	JASON	ROY	MAINTENCE	BR1000
7	EM1007	CHRIS	GAYLE	MAINTENCE	BR1000

Figure 26 employee data

```
INSERT ALL
  INTO reader  VALUES ('RE1001','DALE','STEYN','5 Tolpuddle Gardens','BOURNEMOUTH','BH9
3RE',NULL,to_date('25-05-2010','dd-mm-yyyy'), 'BR1000')
  INTO reader  VALUES ('RE1002','GREAME','SMITH','30 Osborne Road','New Milton','BH25 BAD',NULL,to_date('25-05-
2010','dd-mm-yyyy'), 'BR1000')
  INTO reader  VALUES ('RE1003','STEVE','SMITH','Throop Road','BOURNEMOUTH','BH8 0DQ',NULL,to_date('25-05-
2010','dd-mm-yyyy'), 'BR1000')
  INTO reader  VALUES ('RE1004','MS','DHONI','53 Wimborne Road','BOURNEMOUTH','BH3 TAJ',NULL,to_date('05-06-
2010','dd-mm-yyyy'), 'BR1000')
  INTO reader  VALUES ('RE1005','HASHIM','AMLA','16a St Anthonys Road','BOURNEMOUTH','BH2
BPD',NULL,to_date('15-07-2010','dd-mm-yyyy'), 'BR1000')
  INTO reader  VALUES ('RE1006','DAVID','WARNER','Horton Road','BOURNEMOUTH','BH24 ZEE',NULL,to_date('30-
07-2010','dd-mm-yyyy'), 'BR1000')
  INTO reader  VALUES ('RE1007','BEN','STOKES','57 Talbot Avenue','BOURNEMOUTH','BH1 4DS',NULL,to_date('12-
10-2010','dd-mm-yyyy'), 'BR1000')
  INTO reader  VALUES ('RE1008','JAMES','ANDERSON','Ringwood Road','Wimborne','BH21 BRD',NULL,to_date('01-01-
2011','dd-mm-yyyy'), 'BR1000')
  INTO reader  VALUES ('RE1009','STUART','BROAD','15/17 Boscombe Spa Road','BOURNEMOUTH','BH5
1AR',NULL,to_date('02-02-2011','dd-mm-yyyy'), 'BR1000')
  INTO reader  VALUES ('RE1010','YUVRAJ','SINGH','Thornbury Road','BOURNEMOUTH','BHS 4HR',NULL,to_date('06-
03-2012','dd-mm-yyyy'), 'BR1000')
  INTO reader  VALUES ('RE1011','SACHIN','TENDULKAR','2 Bellevue Road','Swanage','BH19 2HR',NULL,to_date('16-
11-2014','dd-mm-yyyy'), 'BR1000')
  INTO reader  VALUES ('RE1012','BRAIN','LARA','19 Stourwood Avenue','BOURNEMOUTH','BHB
3PW',NULL,to_date('22-12-2015','dd-mm-yyyy'), 'BR1000')
  INTO reader  VALUES ('RE1013','ADAM','GILCHRIST','Riverside Avenue','BOURNEMOUTH','BH7
7EE',NULL,to_date('08-04-2016','dd-mm-yyyy'), 'BR1000')
  INTO reader  VALUES ('RE1014','MATHEW','HAYDEN','9 Percy Road','BOURNEMOUTH','BH5 1JF',NULL,to_date('24-
05-2017','dd-mm-yyyy'), 'BR1000')
```

```
  INTO reader  VALUES ('RE1015','GLENN','MCGRATH','Spetisbury','Blandford','DT11 9EB',NULL,to_date('17-09-2018','dd-mm-yyyy'), 'BR1000')
  INTO reader  VALUES ('RE1016','ZAHEER','KHAN','14 East Avenue','Bournemouth ','BH3 7BY',NULL,to_date('25-08-2019','dd-mm-yyyy'), 'BR1000')
  INTO reader  VALUES ('RE1017','IMRAN','KHAN','14 Stour Road','Christchurch ','BH23 1PS',NULL, to_date('01-01-2020','dd-mm-yyyy'), 'BR1000')
SELECT * FROM dual;

select * from reader;
```

Query Result ×

SQL | All Rows Fetched: 17 in 0.06 seconds

	READER_ID	FIRST_NAME_READER	LAST_NAME_READER	STREET_READER	CITY_READER	POST_CODE_READER	ITEMS_BORROWING	READER_REGISTRATION_DATE	BRANCH_ID
1	RE1001	DALE	STEYN	5 Tolpuddle Gardens	BOURNEMOUTH	BH9 3RE	3	25-MAY-10	BR1000
2	RE1002	GREAME	SMITH	30 Osborne Road	New Milton	BH25 BAD	0	25-MAY-10	BR1000
3	RE1003	STEVE	SMITH	Throop Road	BOURNEMOUTH	BH8 0DQ	(null)	25-MAY-10	BR1000
4	RE1004	MS	DHONI	53 Wimborne Road	BOURNEMOUTH	BH3 TAJ	(null)	05-JUN-10	BR1000
5	RE1005	HASHIM	AMLA	16a St Anthonys Road	BOURNEMOUTH	BH2 BPD	(null)	15-JUL-10	BR1000
6	RE1006	DAVID	WARNER	Horton Road	BOURNEMOUTH	BH24 ZEE	1	30-JUL-10	BR1000
7	RE1007	BEN	STOKES	57 Talbot Avenue	BOURNEMOUTH	BH1 4DS	0	12-OCT-10	BR1000
8	RE1008	JAMES	ANDERSON	Ringwood Road	Wimborne	BH21 BRD	(null)	01-JAN-11	BR1000
9	RE1009	STUART	BROAD	15/17 Boscombe Spa Road	BOURNEMOUTH	BH5 1AR	(null)	02-FEB-11	BR1000
10	RE1010	YUVRAJ	SINGH	Thornbury Road	BOURNEMOUTH	BHS 4HR	0	06-MAR-12	BR1000
11	RE1011	SACHIN	TENDULKAR	2 Bellevue Road	Swanage	BH19 2HR	(null)	16-NOV-14	BR1000
12	RE1012	BRAIN	LARA	19 Stourwood Avenue	BOURNEMOUTH	BHB 3PW	0	22-DEC-15	BR1000
13	RE1013	ADAM	GILCHRIST	Riverside Avenue	BOURNEMOUTH	BH7 7EE	(null)	08-APR-16	BR1000
14	RE1014	MATHEW	HAYDEN	9 Percy Road	BOURNEMOUTH	BH5 1JF	(null)	24-MAY-17	BR1000
15	RE1015	GLENN	MCGRATH	Spetisbury	Blandford	DT11 9EB	0	17-SEP-18	BR1000
16	RE1016	ZAHEER	KHAN	14 East Avenue	Bournemouth	BH3 7BY	0	25-AUG-19	BR1000
17	RE1017	IMRAN	KHAN	14 Stour Road	Christchurch	BH23 1PS	(null)	01-JAN-20	BR1000

Figure 27 reader data

```
SET DEFINE OFF;

INSERT ALL
  INTO Ebook  VALUES ('EB1001','Children from the Other America',2016,125,'https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.action?docID=4674031&query=A','BR1000')
  INTO Ebook_ebook_author  VALUES ('Michele López, The','EB1001')
  INTO Ebook_ebook_author  VALUES ('Stafford Levy','EB1001')
  INTO Ebook_ebook_genre  VALUES ('Poverty','EB1001')

  INTO Ebook  VALUES ('EB1002','Handbook of Nutrition and Food',2007,324,'https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.action?docID=3059606&query=A','BR1000')
  INTO Ebook_ebook_author  VALUES ('Carolyn D. Berdanier','EB1002')
  INTO Ebook_ebook_author  VALUES ('Johanna Dwyer','EB1002')
  INTO Ebook_ebook_author  VALUES ('Elaine B. Feldman','EB1002')
  INTO Ebook_ebook_genre  VALUES ('FOOD','EB1002')

  INTO Ebook  VALUES ('EB1003','Future of Christian Theology',2011,225,'https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.action?docID=661739&query=A','BR1000')
  INTO Ebook_ebook_author  VALUES ('David F. Ford','EB1003')
  INTO Ebook_ebook_genre  VALUES ('Christian','EB1003')
  INTO Ebook_ebook_genre  VALUES ('Theology','EB1003')

  INTO Ebook  VALUES ('EB1004','Ethics in Accounting : A Decision-Making Approach',2015,335,'https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.action?docID=4845227&query=A','BR1000')
  INTO Ebook_ebook_author  VALUES ('Neha Kumar','EB1004')
  INTO Ebook_ebook_author  VALUES ('Gordon Klein','EB1004')
  INTO Ebook_ebook_genre  VALUES ('Accounting ','EB1004')

  INTO Ebook  VALUES ('EB1005','Adams Vs. Jefferson : The Tumultuous Election of 1800',2004,104,'https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.action?docID=279495&query=A','BR1000')
```

```
  INTO Ebook_ebook_author  VALUES ('John Ferling','EB1005')
  INTO Ebook_ebook_genre  VALUES ('History','EB1005')
  INTO Ebook_ebook_genre  VALUES ('Elecetion','EB1005')

  INTO Ebook  VALUES ('EB1006','The Consequences of Decision-
Making',2007,175,'https://ebookcentral.proquest.com/lib/bournemouth-
ebooks/reader.action?docID=415847&query=A','BR1000')
  INTO Ebook_ebook_author  VALUES ('Nils Brunsson','EB1006')
  INTO Ebook_ebook_genre  VALUES ('Decision-Making','EB1006')

  INTO Ebook  VALUES ('EB1007','Media and the Rwanda Genocide,
The',2007,480,'https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.action?docID=289467&query=A','BR1000')
  INTO Ebook_ebook_author  VALUES ('A. Thompson','EB1007')
  INTO Ebook_ebook_author  VALUES ('Kofi Annan','EB1007')
  INTO Ebook_ebook_genre  VALUES ('Journalism','EB1007')
  INTO Ebook_ebook_genre  VALUES ('History','EB1007')
  INTO Ebook_ebook_genre  VALUES ('Genocide','EB1007')

  INTO Ebook  VALUES ('EB1008','This is Service Design Thinking : Basics-Tools-
Cases',2012,658,'https://ebookcentral.proquest.com/lib/bournemouth-
ebooks/reader.action?docID=2095550&query=A','BR1000')
  INTO Ebook_ebook_author  VALUES ('Marc Stickdorn','EB1008')
  INTO Ebook_ebook_author  VALUES ('Jakob Schneider','EB1008')
  INTO Ebook_ebook_genre  VALUES ('ECONOMICS ','EB1008')
  INTO Ebook_ebook_genre  VALUES ('BUSINESS','EB1008')
  INTO Ebook_ebook_genre  VALUES ('DESIGN ','EB1008')

  INTO Ebook  VALUES ('EB1009','On The Generation Of
Animals',2000,107,'https://ebookcentral.proquest.com/lib/bournemouth-
ebooks/reader.action?docID=3314396&query=A','BR1000')
  INTO Ebook_ebook_author  VALUES ('Aristotle','EB1009')
  INTO Ebook_ebook_genre  VALUES ('PHILOSOPHY','EB1009')
  INTO Ebook_ebook_genre  VALUES ('History','EB1009')
  INTO Ebook_ebook_genre  VALUES ('Surveys ','EB1009')
  INTO Ebook_ebook_genre  VALUES ('Ancient ','EB1009')
  INTO Ebook_ebook_genre  VALUES ('Classical','EB1009')

  INTO Ebook  VALUES ('EB1010','Reflections On The Revolution In
France',2000,160,'https://ebookcentral.proquest.com/lib/bournemouth-
ebooks/reader.action?docID=3314353&query=A','BR1000')
  INTO Ebook_ebook_author  VALUES ('Edmund Burke','EB1010')
  INTO Ebook_ebook_genre  VALUES ('FICTION ','EB1010')

  INTO Ebook  VALUES ('EB1011','Patterns for the Edge of
Network',2002,422,'https://ebookcentral.proquest.com/lib/bournemouth-
ebooks/reader.action?docID=3306630&query=A','BR1000')
  INTO Ebook_ebook_author  VALUES ('IBM Redbooks','EB1011')
  INTO Ebook_ebook_genre  VALUES ('COMPUTERS','EB1011')
  INTO Ebook_ebook_genre  VALUES ('Networking','EB1011')


  INTO Ebook  VALUES ('EB1012','Planet of Cities',2012,362,'https://ebookcentral.proquest.com/lib/bournemouth-
ebooks/reader.action?docID=3327986&query=A','BR1000')
  INTO Ebook_ebook_author  VALUES ('Shlomo Angel','EB1012')
  INTO Ebook_ebook_genre  VALUES ('LAW ','EB1012')
  INTO Ebook_ebook_genre  VALUES ('POLITICAL SCIENCE','EB1012')

  INTO Ebook  VALUES ('EB1013','Meno',2000,33,'https://ebookcentral.proquest.com/lib/bournemouth-
ebooks/reader.action?docID=3314610&query=A','BR1000')
  INTO Ebook_ebook_author  VALUES ('Plato','EB1013')
  INTO Ebook_ebook_genre  VALUES ('PHILOSOPHY ','EB1013')
  INTO Ebook_ebook_genre  VALUES ('History','EB1013')
  INTO Ebook_ebook_genre  VALUES ('Surveys ','EB1013')
  INTO Ebook_ebook_genre  VALUES ('Ancient ','EB1013')
```

```
  INTO Ebook_ebook_genre  VALUES ('Classical','EB1013')

  INTO Ebook  VALUES ('EB1014','Pictures From Italy',2000,122,'https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.action?docID=3314465&query=A','BR1000')
  INTO Ebook_ebook_author  VALUES ('Charles Dickens','EB1014')
  INTO Ebook_ebook_genre  VALUES ('FICTION ','EB1014')

  INTO Ebook  VALUES ('EB1015','Rover, The',2000,80,'https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.action?docID=3314367&query=A','BR1000')
  INTO Ebook_ebook_author  VALUES ('Aphra Behn','EB1015')
  INTO Ebook_ebook_genre  VALUES ('FICTION ','EB1015')

  INTO Ebook  VALUES ('EB1016','Discourse On The Method Of Rightly Conducting The Reason, And Seeking Truth In The Sciences',2000,33,'https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.action?docID=3314500&query=A','BR1000')
  INTO Ebook_ebook_author  VALUES ('Rene Descartes','EB1016')
  INTO Ebook_ebook_genre  VALUES ('Science','EB1016')
  INTO Ebook_ebook_genre  VALUES ('Methodology.','EB1016')

  INTO Ebook  VALUES ('EB1017','Essays Of Travel',2000,109,'https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.action?docID=3314882&query=A','BR1000')
  INTO Ebook_ebook_author  VALUES ('Robert Louis Stevenson','EB1017')
  INTO Ebook_ebook_genre  VALUES ('LITERARY COLLECTIONS','EB1017')
  INTO Ebook_ebook_genre  VALUES ('Essays','EB1017')

  INTO Ebook  VALUES ('EB1018','Of Tragedy',2000,7,'https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.action?docID=3314514&query=A','BR1000')
  INTO Ebook_ebook_author  VALUES ('David Hume','EB1018')
  INTO Ebook_ebook_genre  VALUES ('PHILOSOPHY ','EB1018')
  INTO Ebook_ebook_genre  VALUES ('History  ','EB1018')
  INTO Ebook_ebook_genre  VALUES ('Surveys  ','EB1018')
  INTO Ebook_ebook_genre  VALUES ('Modern ','EB1018')


  INTO Ebook  VALUES ('EB1019','Poor Richard Improved',2000,7,'https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.action?docID=3314418&query=A','BR1000')
  INTO Ebook_ebook_author  VALUES ('Benjamin Franklin','EB1019')
  INTO Ebook_ebook_genre  VALUES ('LITERARY','EB1019')
  INTO Ebook_ebook_genre  VALUES ('American','EB1019')

  INTO Ebook  VALUES ('EB1020','American Notes For General Circulation',2000,179,'https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.action?docID=3314419&query=A','BR1000')
  INTO Ebook_ebook_author  VALUES ('Charles Dickens','EB1020')
  INTO Ebook_ebook_genre  VALUES ('Biography.','EB1020')
  INTO Ebook_ebook_genre  VALUES ('Description and travel..','EB1020')
  INTO Ebook_ebook_genre  VALUES ('Social life and customs','EB1020')
SELECT * FROM dual;

select * from Ebook;
```

Query Result

SQL | All Rows Fetched: 20 in 0.043 seconds

	EBOOK_ID	EBOOK_TITLE	EBOOK_YEAR	EBOOK_PAGES	EBOOK_URL	BRAN...
1	EB1001	Children from the Other America	2016	125	https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.a...	BR1000
2	EB1002	Handbook of Nutrition and Food	2007	324	https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.a...	BR1000
3	EB1003	Future of Christian Theology	2011	225	https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.a...	BR1000
4	EB1004	Ethics in Accounting : A Decision-Making Approach	2015	335	https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.a...	BR1000
5	EB1005	Adams Vs. Jefferson : The Tumultuous Election of 1800	2004	104	https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.a...	BR1000
6	EB1006	The Consequences of Decision-Making	2007	175	https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.a...	BR1000
7	EB1007	Media and the Rwanda Genocide, The	2007	480	https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.a...	BR1000
8	EB1008	This is Service Design Thinking : Basics-Tools-Cases	2012	658	https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.a...	BR1000
9	EB1009	On The Generation Of Animals	2000	107	https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.a...	BR1000
10	EB1010	Reflections On The Revolution In France	2000	160	https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.a...	BR1000
11	EB1011	Patterns for the Edge of Network	2002	422	https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.a...	BR1000
12	EB1012	Planet of Cities	2012	362	https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.a...	BR1000
13	EB1013	Meno	2000	33	https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.a...	BR1000
14	EB1014	Pictures From Italy	2000	122	https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.a...	BR1000
15	EB1015	Rover, The	2000	80	https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.a...	BR1000
16	EB1016	Discourse On The Method Of Rightly Conducting The Reason, ...	2000	33	https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.a...	BR1000
17	EB1017	Essays Of Travel	2000	109	https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.a...	BR1000
18	EB1018	Of Tragedy	2000	7	https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.a...	BR1000
19	EB1019	Poor Richard Improved	2000	7	https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.a...	BR1000
20	EB1020	American Notes For General Circulation	2000	179	https://ebookcentral.proquest.com/lib/bournemouth-ebooks/reader.a...	BR1000

Figure 28 Ebook data

select * from Ebook_ebook_author;

Query Result

SQL | All Rows Fetched: 26 in 0.012 secc

	EBOOK_AUTHOR	EBOOK_ID
1	A. Thompson	EB1007
2	Aphra Behn	EB1015
3	Aristotle	EB1009
4	Benjamin Franklin	EB1019
5	Carolyn D. Berdanier	EB1002
6	Charles Dickens	EB1014
7	Charles Dickens	EB1020
8	David F. Ford	EB1003
9	David Hume	EB1018
10	Edmund Burke	EB1010
11	Elaine B. Feldman	EB1002
12	Gordon Klein	EB1004
13	IBM Redbooks	EB1011
14	Jakob Schneider	EB1008
15	Johanna Dwyer	EB1002
16	John Ferling	EB1005
17	Kofi Annan	EB1007
18	Marc Stickdorn	EB1008
19	Michele López, The	EB1001
20	Neha Kumar	EB1004
21	Nils Brunsson	EB1006
22	Plato	EB1013
23	Rene Descartes	EB1016
24	Robert Louis Stevenson	EB1017
25	Shlomo Angel	EB1012
26	Stafford Levy	EB1001

Figure 29 Ebook_ebook_author data

select * from Ebook_ebook_genre;

Query Result ×

SQL | All Rows Fetched: 44 in 0.009 secc

	EBOOK_GENRE	EBOOK_ID
1	Accounting	EB1004
2	American	EB1019
3	Ancient	EB1009
4	Ancient	EB1013
5	BUSINESS	EB1008
6	Biography.	EB1020
7	COMPUTERS	EB1011
8	Christian	EB1003
9	Classical	EB1009
10	Classical	EB1013
11	DESIGN	EB1008
12	Decision-Making	EB1006
13	Description and travel..	EB1020
14	ECONOMICS	EB1008
15	Elecetion	EB1005
16	Essays	EB1017
17	FICTION	EB1010
18	FICTION	EB1014
19	FICTION	EB1015
20	FOOD	EB1002
21	Genocide	EB1007
22	History	EB1005
23	History	EB1007
24	History	EB1009
25	History	EB1013
26	History	EB1018
27	Journalism	EB1007
28	LAW	EB1012
29	LITERARY	EB1019
30	LITERARY COLLECTIONS	EB1017
31	Methodology.	EB1016
32	Modern	EB1018
33	Networking	EB1011
34	PHILOSOPHY	EB1009
35	PHILOSOPHY	EB1013
36	PHILOSOPHY	EB1018
37	POLITICAL SCIENCE	EB1012
38	Poverty	EB1001
39	Science	EB1016
40	Social life and customs	EB1020
41	Surveys	EB1009
42	Surveys	EB1013
43	Surveys	EB1018
44	Theology	EB1003

Figure 30 Ebook_ebook_genre data

```
INSERT ALL
  INTO Publisher VALUES ('PU1001','Taylor & Francis Group','Milton Park','Oxfordshire','OX14 4RY','BR1000')
  INTO Publisher_pub_countries VALUES ('UK','PU1001')
  INTO Publisher_pub_phone_numbers VALUES ('+44 (0) 20 7017 6000','PU1001')
  INTO Publisher_pub_emails VALUES ('SocietyPartners@tandf.co.uk','PU1001')
  INTO Book  VALUES ('B1001','Politics UK',2011,713,1,1,'PU1001','BR1000')
  INTO Book_book_author  VALUES ('Bill Jones','B1001')
  INTO Book_genre_book  VALUES ('Politics','B1001')

  INTO Publisher VALUES ('PU1002','John Wiley & Sons, Inc.','Southern Gate, Chichester','West Sussex','PO19
8SQ','BR1000')
  INTO Publisher_pub_countries VALUES ('UK','PU1002')
  INTO Publisher_pub_countries VALUES ('Germany','PU1002')
  INTO Publisher_pub_countries VALUES ('Denmark','PU1002')
  INTO Publisher_pub_countries VALUES ('USA','PU1002')
  INTO Publisher_pub_phone_numbers VALUES ('44.1243.779777','PU1002')
  INTO Publisher_pub_phone_numbers VALUES ('44.1243.775878','PU1002')
  INTO Publisher_pub_emails VALUES ('customer@wiley.com','PU1002')
```

```
  INTO Book  VALUES ('B1002','Clinical Dilemmas in Primary Liver Cancer',2011,241,1,1,'PU1002','BR1000')
  INTO Book_book_author  VALUES ('Roger Williams','B1002')
  INTO Book_book_author  VALUES ('Simon D. Taylor-Robinson','B1002')
  INTO Book_genre_book  VALUES ('Gastroenterology','B1002')
  INTO Book_genre_book  VALUES ('Oncology','B1002')

  INTO Publisher VALUES ('PU1003','Edinburgh University Press','The Tun - Holyrood Road','Edinburgh','EH8
8PJ','BR1000')
  INTO Publisher_pub_countries VALUES ('UK','PU1003')
  INTO Publisher_pub_phone_numbers VALUES ('+44 (0)131 650 4218','PU1003')
  INTO Publisher_pub_emails VALUES ('editorial@eup.ed.ac.uk','PU1003')
  INTO Book  VALUES ('B1003','UK Parliament',2009,241,2,2,'PU1003','BR1000')
  INTO Book_book_author  VALUES ('Moyra Grant','B1003')
  INTO Book_genre_book  VALUES ('POLITICAL SCIENCE','B1003')
  INTO Book_genre_book  VALUES (' Legislative Branch','B1003')

  INTO Publisher VALUES ('PU1004','Lerner Publishing Group','1251 Washington Ave N','Minneapolis','MN
55401','BR1000')
  INTO Publisher_pub_countries VALUES ('USA','PU1004')
  INTO Publisher_pub_phone_numbers VALUES ('1-800-328-4929','PU1004')
  INTO Publisher_pub_emails VALUES ('custserv@lernerbooks.com','PU1004')
  INTO Book  VALUES ('B1004','Anne of Avonlea',2020,170,2,2,'PU1004','BR1000')
  INTO Book_book_author  VALUES ('Lucy Maud Montgomery','B1004')
  INTO Book_genre_book  VALUES ('FICTION ','B1004')
  INTO Book_genre_book  VALUES ('JUVENILE ','B1004')

  INTO Publisher VALUES ('PU1005','Oxford University Press','Great Clarendon Street','Oxford','OX2 6DP','BR1000')
  INTO Publisher_pub_countries VALUES ('UK','PU1005')
  INTO Publisher_pub_phone_numbers VALUES ('+44 (0) 1865 556767','PU1005')
  INTO Publisher_pub_emails VALUES ('onlinequeries.uk@oup.com','PU1005')
  INTO Book  VALUES ('B1005','Spectra of Atoms and Molecules',2020,459,2,2,'PU1005','BR1000')
  INTO Book_book_author  VALUES ('Peter F. Bernath','B1005')
  INTO Book_genre_book  VALUES ('SCIENCE','B1005')
  INTO Book_genre_book  VALUES ('Spectroscopy','B1005')

  INTO Publisher VALUES ('PU1006','University of Nebraska Press','1111 Lincoln Mall','Lincoln','NE 68588','BR1000')
  INTO Publisher_pub_countries VALUES ('UK','PU1006')
  INTO Publisher_pub_phone_numbers VALUES ('402-472-3581','PU1006')
  INTO Publisher_pub_emails VALUES ('presswebmail@unl.edu','PU1006')
  INTO Publisher_pub_emails VALUES ('mpress@unl.edu','PU1006')
  INTO Publisher_pub_emails VALUES ('lmilliken2@unl.edu','PU1006')
  INTO Book  VALUES ('B1006','This Is Not the Ivy League',2020,225,1,1,'PU1006','BR1000')
  INTO Book_book_author  VALUES ('Mary Clearman Blew','B1006')
  INTO Book_genre_book  VALUES ('AUTOBIOGRAPHY','B1006')

  INTO Book  VALUES ('B1007','Stories and Minds',2020,235,2,2,'PU1006','BR1000')
  INTO Book_book_author  VALUES ('Lars Bernaerts','B1007')
  INTO Book_book_author  VALUES ('Dirk de Geest','B1007')
  INTO Book_book_author  VALUES ('Luc Herman','B1007')
  INTO Book_book_author  VALUES ('Bart Vervaeck','B1007')
  INTO Book_genre_book  VALUES ('LITERARY CRITICISM','B1007')

  INTO Book  VALUES ('B1008','Post-Westerns Cinema, Region, West',2020,429,1,1,'PU1006','BR1000')
  INTO Book_book_author  VALUES ('Neil Campbell','B1008')
  INTO Book_genre_book  VALUES ('HISTORY','B1008')
  INTO Book_genre_book  VALUES ('PERFORMING ARTS','B1008')
  INTO Book_genre_book  VALUES ('Film ','B1008')
  INTO Book_genre_book  VALUES ('Criticism','B1008')

  INTO Book  VALUES ('B1009','Mysteries of the Jaguar Shamans of the Northwest
Amazon',2020,406,1,1,'PU1006','BR1000')
  INTO Book_book_author  VALUES ('Robin M. Wright','B1009')
  INTO Book_genre_book  VALUES ('HISTORY ','B1009')
  INTO Book_genre_book  VALUES ('SOCIAL SCIENCE ','B1009')
```

```
  INTO Book  VALUES ('B1010','A Dictionary of Media and Communication',2020,1090,2,2,'PU1005','BR1000')
  INTO Book_book_author  VALUES ('Daniel Chandler','B1010')
  INTO Book_book_author  VALUES ('Rod Munday','B1010')
  INTO Book_genre_book  VALUES ('Media Studies','B1010')

  INTO Book  VALUES ('B1011','Bust Greece, the Euro and the Sovereign Debt Crisis',2010,290,1,1,'PU1002','BR1000')
  INTO Book_book_author  VALUES ('Matthew Lynn','B1011')
  INTO Book_genre_book  VALUES ('BUSINESS','B1011')
  INTO Book_genre_book  VALUES ('ECONOMICS','B1011')

SELECT * FROM dual;

INSERT ALL
  INTO Publisher VALUES ('PU1007','TRMedia Ltd','The Old Dairy, Brewer Street','Surrey','RH1 4QP','BR1000')
  INTO Publisher_pub_countries VALUES ('UK','PU1007')
  INTO Publisher_pub_phone_numbers VALUES ('+44 203 2393 666','PU1007')
  INTO Publisher_pub_emails VALUES ('enquiries@trmedia.co.uk','PU1007')
  INTO Magazine VALUES ('M1001','Digital forensics magazine','42',2,2,'PU1007','BR1000')
  INTO Magazine VALUES ('M1002','Digital forensics magazine','43',2,2,'PU1007','BR1000')
  INTO Magazine VALUES ('M1003','Digital forensics magazine','44',2,2,'PU1007','BR1000')

INTO Publisher VALUES ('PU1008','International hotel association','55 AV MARCEAU','PARIS','75116','BR1000')
INTO Publisher_pub_countries VALUES ('FRANCE','PU1008')
INTO Publisher_pub_countries VALUES ('SWITZERLAND','PU1008')
INTO Publisher_pub_phone_numbers VALUES ('+331530-13279','PU1008')
INTO Publisher_pub_emails VALUES ('president@ih-ra.org','PU1008')
INTO Magazine VALUES ('M1004','Hotels & restaurants international','66',1,1,'PU1008','BR1000')
INTO Magazine VALUES ('M1005','Hotels & restaurants international','67',1,1,'PU1008','BR1000')
INTO Magazine VALUES ('M1006','Hotels & restaurants international','68',1,1,'PU1008','BR1000')
INTO Magazine VALUES ('M1007','Hotels & restaurants international','69',1,1,'PU1008','BR1000')
INTO Magazine VALUES ('M1008','Hotels & restaurants international','70',1,1,'PU1008','BR1000')
INTO Magazine VALUES ('M1009','Hotels & restaurants international','71',1,1,'PU1008','BR1000')
INTO Magazine VALUES ('M1010','Hotels & restaurants international','72',1,1,'PU1008','BR1000')

INTO Publisher VALUES ('PU1009','Forbes Media','499 Washington Blvd','New Jersey','NJ 07310','BR1000')
INTO Publisher_pub_countries VALUES ('USA','PU1009')
INTO Publisher_pub_phone_numbers VALUES ('(800) 295-0893','PU1009')
INTO Publisher_pub_emails VALUES ('readers@forbes.com','PU1009')
INTO Publisher_pub_emails VALUES ('feedback@forbes.com','PU1009')
INTO Publisher_pub_emails VALUES ('PR@forbes.com','PU1009')
INTO Magazine VALUES ('M1011','Forbes','1234',1,1,'PU1009','BR1000')
INTO Magazine VALUES ('M1012','Forbes','1235',1,1,'PU1009','BR1000')
INTO Magazine VALUES ('M1013','Forbes','1236',1,1,'PU1009','BR1000')
  INTO Magazine VALUES ('M1014','Forbes','1237',1,1,'PU1009','BR1000')

  INTO Magazine VALUES ('M1015','Luxury Hoteliers','8',1,1,'PU1008','BR1000')
  INTO Magazine VALUES ('M1016','Luxury Hoteliers','9',1,1,'PU1008','BR1000')
  INTO Magazine VALUES ('M1017','Luxury Hoteliers','10',1,1,'PU1008','BR1000')
  INTO Magazine VALUES ('M1018','Luxury Hoteliers','11',1,1,'PU1008','BR1000')

  INTO Magazine VALUES ('M1019','From ideas to assets','333',1,1,'PU1002','BR1000')
  INTO Magazine VALUES ('M1020','From ideas to assets','334',1,1,'PU1002','BR1000')
  INTO Magazine VALUES ('M1021','From ideas to assets','335',1,1,'PU1002','BR1000')
  INTO Magazine VALUES ('M1022','From ideas to assets','336',1,1,'PU1002','BR1000')

SELECT * FROM dual;

select * from Publisher;
```

Query Result | SQL | All Rows Fetched: 9 in 0.064 seconds

	PUB_ID	PUB_NAME	STREET_PUB	CITY_PUB	POST_CODE_PUB	BRANCH_ID
1	PU1001	Taylor & Francis Group	Milton Park	Oxfordshire	OX14 4RY	BR1000
2	PU1002	John Wiley & Sons, Inc.	Southern Gate, Chichester	West Sussex	PO19 8SQ	BR1000
3	PU1003	Edinburgh University Press	The Tun - Holyrood Road	Edinburgh	EH8 8PJ	BR1000
4	PU1004	Lerner Publishing Group	1251 Washington Ave N	Minneapolis	MN 55401	BR1000
5	PU1005	Oxford University Press	Great Clarendon Street	Oxford	OX2 6DP	BR1000
6	PU1006	University of Nebraska Press	1111 Lincoln Mall	Lincoln	NE 68588	BR1000
7	PU1007	TRMedia Ltd	The Old Dairy, Brewer Street	Surrey	RH1 4QP	BR1000
8	PU1008	International hotel association	55 AV MARCEAU	PARIS	75116	BR1000
9	PU1009	Forbes Media	499 Washington Blvd	New Jersey	NJ 07310	BR1000

Figure 31 Publisher data

select * from Publisher_pub_countries;

Query Result | Query Result 1 | SQL | All Rows Fetched:

	PUB_COUNTRIES	PUB_ID
1	Denmark	PU1002
2	FRANCE	PU1008
3	Germany	PU1002
4	SWITZERLAND	PU1008
5	UK	PU1001
6	UK	PU1002
7	UK	PU1003
8	UK	PU1005
9	UK	PU1006
10	UK	PU1007
11	USA	PU1002
12	USA	PU1004
13	USA	PU1009

Figure 32 Publisher_pub_countries data

select * from Publisher_pub_phone_numbers;

Query Result | Query Result 1 | SQL | All Rows Fetched: 10 in 0.0

	PUB_PHONE_NUMBERS	PUB_ID
1	+44 (0) 20 7017 6000	PU1001
2	44.1243.779777	PU1002
3	44.1243.775878	PU1002
4	+44 (0)131 650 4218	PU1003
5	1-800-328-4929	PU1004
6	+44 (0) 1865 556767	PU1005
7	402-472-3581	PU1006
8	+44 203 2393 666	PU1007
9	+331530-13279	PU1008
10	(800) 295-0893	PU1009

Figure 33 Publisher_pub_phone_numbers data

select * from Publisher_pub_emails;

Query Result | Query Result 1 | Query Result 2

SQL | All Rows Fetched: 13 in 0.034 second

	PUB_EMAILS	PUB_ID
1	SocietyPartners@tandf.co.uk	PU1001
2	customer@wiley.com	PU1002
3	editorial@eup.ed.ac.uk	PU1003
4	custserv@lernerbooks.com	PU1004
5	onlinequeries.uk@oup.com	PU1005
6	presswebmail@unl.edu	PU1006
7	mpress@unl.edu	PU1006
8	lmilliken2@unl.edu	PU1006
9	enquiries@trmedia.co.uk	PU1007
10	president@ih-ra.org	PU1008
11	readers@forbes.com	PU1009
12	feedback@forbes.com	PU1009
13	PR@forbes.com	PU1009

Figure 34 Publisher_pub_emails data

```
INSERT ALL
  INTO downloads VALUES ('D1001',to_date('25-05-2010','dd-mm-yyyy'),'RE1001','EB1010')
  INTO downloads VALUES ('D1002',to_date('16-08-2010','dd-mm-yyyy'),'RE1001','EB1020')
  INTO downloads VALUES ('D1003',to_date('01-01-2013','dd-mm-yyyy'),'RE1007','EB1009')
  INTO downloads VALUES ('D1004',to_date('05-01-2013','dd-mm-yyyy'),'RE1005','EB1008')
  INTO downloads VALUES ('D1005',to_date('13-10-2015','dd-mm-yyyy'),'RE1010','EB1001')
  INTO downloads VALUES ('D1006',to_date('18-04-2017','dd-mm-yyyy'),'RE1013','EB1016')
  INTO downloads VALUES ('D1007',to_date('18-05-2017','dd-mm-yyyy'),'RE1013','EB1010')
  INTO downloads VALUES ('D1008',to_date('07-03-2018','dd-mm-yyyy'),'RE1014','EB1009')
  INTO downloads VALUES ('D1009',to_date('06-12-2019','dd-mm-yyyy'),'RE1001','EB1010')
  INTO downloads VALUES ('D1010',to_date('03-03-2020','dd-mm-yyyy'),'RE1017','EB1006')
  INTO downloads VALUES ('D1011',to_date('04-03-2020','dd-mm-yyyy'),'RE1017','EB1007')
  INTO downloads VALUES ('D1012',to_date('06-03-2020','dd-mm-yyyy'),'RE1011','EB1005')
  INTO downloads VALUES ('D1013',to_date('25-05-2020','dd-mm-yyyy'),'RE1002','EB1001')
SELECT * FROM dual;
```

```
select * from downloads;
```

Query Result | Query Result 1 | Query Result 2 | Query Resu

SQL | All Rows Fetched: 13 in 0.024 seconds

	DOWNLOAD_ID	DOWNLOAD_DATE	READER_ID	EBOOK_ID
1	D1001	25-MAY-10	RE1001	EB1010
2	D1002	16-AUG-10	RE1001	EB1020
3	D1003	01-JAN-13	RE1007	EB1009
4	D1004	05-JAN-13	RE1005	EB1008
5	D1005	13-OCT-15	RE1010	EB1001
6	D1006	18-APR-17	RE1013	EB1016
7	D1007	18-MAY-17	RE1013	EB1010
8	D1008	07-MAR-18	RE1014	EB1009
9	D1009	06-DEC-19	RE1001	EB1010
10	D1010	03-MAR-20	RE1017	EB1006
11	D1011	04-MAR-20	RE1017	EB1007
12	D1012	06-MAR-20	RE1011	EB1005
13	D1013	25-MAY-20	RE1002	EB1001

Figure 35 downloads data

```
select * from Book;
```

Script Output | Query Result | Query Result 1 | Query Result 2 | Query Result 3

SQL | All Rows Fetched: 11 in 0.026 seconds

	BOOK_ID	BOOK_TITLE	BOOK_YEAR	BOOK_PAGES	AVAIL_BOOK_NO	TOTAL_BOOK_NO	PUB_ID	BRANCH_ID
1	B1001	Politics UK	2011	713	1	1	PU1001	BR1000
2	B1002	Clinical Dilemmas in Primary Liver Cancer	2011	241	1	1	PU1002	BR1000
3	B1003	UK Parliament	2009	241	2	2	PU1003	BR1000
4	B1004	Anne of Avonlea	2020	170	2	2	PU1004	BR1000
5	B1005	Spectra of Atoms and Molecules	2020	459	2	2	PU1005	BR1000
6	B1006	This Is Not the Ivy League	2020	225	1	1	PU1006	BR1000
7	B1007	Stories and Minds	2020	235	2	2	PU1006	BR1000
8	B1008	Post-Westerns Cinema, Region, West	2020	429	1	1	PU1006	BR1000
9	B1009	Mysteries of the Jaguar Shamans of the Northwest Amazon	2020	406	1	1	PU1006	BR1000
10	B1010	A Dictionary of Media and Communication	2020	1090	2	2	PU1005	BR1000
11	B1011	Bust Greece, the Euro and the Sovereign Debt Crisis	2010	290	1	1	PU1002	BR1000

Figure 36 Book data

select * from Book_book_author;

Script Output | Query Result | Query Result

SQL | All Rows Fetched: 16 in 0.003 sec

	BOOK_AUTHOR	BOOK_ID
1	Bart Vervaeck	B1007
2	Bill Jones	B1001
3	Daniel Chandler	B1010
4	Dirk de Geest	B1007
5	Lars Bernaerts	B1007
6	Luc Herman	B1007
7	Lucy Maud Montgomery	B1004
8	Mary Clearman Blew	B1006
9	Matthew Lynn	B1011
10	Moyra Grant	B1003
11	Neil Campbell	B1008
12	Peter F. Bernath	B1005
13	Robin M. Wright	B1009
14	Rod Munday	B1010
15	Roger Williams	B1002
16	Simon D. Taylor-Robinson	B1002

Figure 37 Book_book_author data

select * from Book_genre_book;

Script Output | Query Result | Query

SQL | All Rows Fetched: 20 in 0.

	GENRE_BOOK	BOOK_ID
1	Legislative Branch	B1003
2	AUTOBIOGRAPHY	B1006
3	BUSINESS	B1011
4	Criticism	B1008
5	ECONOMICS	B1011
6	FICTION	B1004
7	Film	B1008
8	Gastroenterology	B1002
9	HISTORY	B1008
10	HISTORY	B1009
11	JUVENILE	B1004
12	LITERARY CRITICISM	B1007
13	Media Studies	B1010
14	Oncology	B1002
15	PERFORMING ARTS	B1008
16	POLITICAL SCIENCE	B1003
17	Politics	B1001
18	SCIENCE	B1005
19	SOCIAL SCIENCE	B1009
20	Spectroscopy	B1005

Figure 38 Book_genre_book data

select * from Magazine;

Script Output | Query Result | Query Result 1 | Query Result 2 | Query Result 3

SQL | All Rows Fetched: 22 in 0.005 seconds

	MAGAZINE_ID	MAG_TITLE	MAG_ISSUE_NUMBER	TOTAL_MAG_NO	AVAIL_MAG_NO	PUB_ID	BRANCH_ID
1	M1001	Digital forensics magazine	42	2	2	PU1007	BR1000
2	M1002	Digital forensics magazine	43	2	2	PU1007	BR1000
3	M1003	Digital forensics magazine	44	2	2	PU1007	BR1000
4	M1004	Hotels & restaurants international	66	1	1	PU1008	BR1000
5	M1005	Hotels & restaurants international	67	1	1	PU1008	BR1000
6	M1006	Hotels & restaurants international	68	1	1	PU1008	BR1000
7	M1007	Hotels & restaurants international	69	1	1	PU1008	BR1000
8	M1008	Hotels & restaurants international	70	1	1	PU1008	BR1000
9	M1009	Hotels & restaurants international	71	1	1	PU1008	BR1000
10	M1010	Hotels & restaurants international	72	1	1	PU1008	BR1000
11	M1011	Forbes	1234	1	1	PU1009	BR1000
12	M1012	Forbes	1235	1	1	PU1009	BR1000
13	M1013	Forbes	1236	1	1	PU1009	BR1000
14	M1014	Forbes	1237	1	1	PU1009	BR1000
15	M1015	Luxury Hoteliers	8	1	1	PU1008	BR1000
16	M1016	Luxury Hoteliers	9	1	1	PU1008	BR1000
17	M1017	Luxury Hoteliers	10	1	1	PU1008	BR1000
18	M1018	Luxury Hoteliers	11	1	1	PU1008	BR1000
19	M1019	From ideas to assets	333	1	1	PU1002	BR1000
20	M1020	From ideas to assets	334	1	1	PU1002	BR1000
21	M1021	From ideas to assets	335	1	1	PU1002	BR1000
22	M1022	From ideas to assets	336	1	1	PU1002	BR1000

Figure 39 Magazine data

```
--UPDATING DATA OF ISSUED AND RETURNED BOOK/MAGAZINE
INSERT ALL
  INTO issue_book  VALUES ('IB1001',to_date('30-07-2010','dd-mm-yyyy'),to_date('13-08-2010','dd-mm-yyyy'),to_date('12-08-2010','dd-mm-yyyy'),'RE1006','B1008')
  INTO issue_book  VALUES ('IB1002',to_date('30-07-2010','dd-mm-yyyy'),to_date('13-08-2010','dd-mm-yyyy'),to_date('12-08-2010','dd-mm-yyyy'),'RE1006','B1003')
  INTO issue_book  VALUES ('IB1003',to_date('10-08-2010','dd-mm-yyyy'),to_date('24-08-2010','dd-mm-yyyy'),to_date('24-08-2010','dd-mm-yyyy'),'RE1002','B1003')
  INTO issue_book  VALUES ('IB1004',to_date('20-11-2012','dd-mm-yyyy'),to_date('04-12-2012','dd-mm-yyyy'),to_date('04-12-2012','dd-mm-yyyy'),'RE1010','B1010')
  INTO issue_book  VALUES ('IB1005',to_date('01-01-2016','dd-mm-yyyy'),to_date('15-01-2016','dd-mm-yyyy'),to_date('10-01-2016','dd-mm-yyyy'),'RE1012','B1007')

  INTO issue_magazine  VALUES ('IM1001',to_date('10-08-2017','dd-mm-yyyy'),to_date('24-08-2017','dd-mm-yyyy'),to_date('24-08-2017','dd-mm-yyyy'),'M1001','RE1001')
  INTO issue_magazine  VALUES ('IM1002',to_date('01-05-2018','dd-mm-yyyy'),to_date('15-05-2018','dd-mm-yyyy'),to_date('15-05-2018','dd-mm-yyyy'),'M1003','RE1007')
  INTO issue_magazine  VALUES ('IM1003',to_date('11-09-2019','dd-mm-yyyy'),to_date('25-09-2019','dd-mm-yyyy'),to_date('24-09-2019','dd-mm-yyyy'),'M1013','RE1015')
  INTO issue_magazine  VALUES ('IM1004',to_date('01-01-2020','dd-mm-yyyy'),to_date('15-01-2020','dd-mm-yyyy'),to_date('15-01-2020','dd-mm-yyyy'),'M1018','RE1006')
  INTO issue_magazine  VALUES ('IM1005',to_date('06-03-2020','dd-mm-yyyy'),to_date('21-03-2020','dd-mm-yyyy'),to_date('21-03-2020','dd-mm-yyyy'),'M1020','RE1006')

SELECT * FROM dual;

select * from issue_book;
```

Script Output | Query Result | SQL | All Rows Fetched: 5 in 0.007 seconds

	BOOK_ISSUE_ID	BOOK_BORROW_DATE_	BOOK_RETURN_BEFORE_DATE	BOOK_RETURN_DATE	READER_ID	BOOK_ID
1	IB1001	30-JUL-10	13-AUG-10	12-AUG-10	RE1006	B1008
2	IB1002	30-JUL-10	13-AUG-10	12-AUG-10	RE1006	B1003
3	IB1003	10-AUG-10	24-AUG-10	24-AUG-10	RE1002	B1003
4	IB1004	20-NOV-12	04-DEC-12	04-DEC-12	RE1010	B1010
5	IB1005	01-JAN-16	15-JAN-16	10-JAN-16	RE1012	B1007

Figure 40 issue_book data

select * from issue_magazine;

Script Output | Query Result | SQL | All Rows Fetched: 5 in 0.008 seconds

	MAGAZINE_ISSUE_ID	MAGAZINE_BORROW_DATE	MAG_RETURN_BEFORE_DATE	MAGAZINE_RETURN_DATE	MAGAZINE_ID	READER_ID
1	IM1001	10-AUG-17	24-AUG-17	24-AUG-17	M1001	RE1001
2	IM1002	01-MAY-18	15-MAY-18	15-MAY-18	M1003	RE1007
3	IM1003	11-SEP-19	25-SEP-19	24-SEP-19	M1013	RE1015
4	IM1004	01-JAN-20	15-JAN-20	15-JAN-20	M1018	RE1006
5	IM1005	06-MAR-20	21-MAR-20	21-MAR-20	M1020	RE1006

Figure 41 issue_magazine data

IDENTIFY READER WHO NEVER TOOK A BOOK/MAGAZINE

update reader set items_borrowing=0 where reader_id='RE1006';
update reader set items_borrowing=0 where reader_id='RE1002';
update reader set items_borrowing=0 where reader_id='RE1010';
update reader set items_borrowing=0 where reader_id='RE1012';
update reader set items_borrowing=0 where reader_id='RE1001';
update reader set items_borrowing=0 where reader_id='RE1007';
update reader set items_borrowing=0 where reader_id='RE1015';

select * from reader;

Script Output | Query Result | SQL | All Rows Fetched: 17 in 0.018 seconds

	READER_ID	FIRST_NAME_READER	LAST_NAME_READER	STREET_READER	CITY_READER	POST_CODE_READER	ITEMS_BORROWING	READER_REGISTRATION_DATE	BRANCH_ID
1	RE1001	DALE	STEYN	5 Tolpuddle Gardens	BOURNEMOUTH	BH9 3RE	0	25-MAY-10	BR1000
2	RE1002	GREAME	SMITH	30 Osborne Road	New Milton	BH25 BAD	0	25-MAY-10	BR1000
3	RE1003	STEVE	SMITH	Throop Road	BOURNEMOUTH	BH8 0DQ	(null)	25-MAY-10	BR1000
4	RE1004	MS	DHONI	53 Wimborne Road	BOURNEMOUTH	BH3 TAJ	(null)	05-JUN-10	BR1000
5	RE1005	HASHIM	AMLA	16a St Anthonys Road	BOURNEMOUTH	BH2 BPD	(null)	15-JUL-10	BR1000
6	RE1006	DAVID	WARNER	Horton Road	BOURNEMOUTH	BH24 ZEE	0	30-JUL-10	BR1000
7	RE1007	BEN	STOKES	57 Talbot Avenue	BOURNEMOUTH	BH1 4DS	0	12-OCT-10	BR1000
8	RE1008	JAMES	ANDERSON	Ringwood Road	Wimborne	BH21 BRD	(null)	01-JAN-11	BR1000
9	RE1009	STUART	BROAD	15/17 Boscombe Spa Road	BOURNEMOUTH	BH5 1AR	(null)	02-FEB-11	BR1000
10	RE1010	YUVRAJ	SINGH	Thornbury Road	BOURNEMOUTH	BHS 4HR	0	06-MAR-12	BR1000
11	RE1011	SACHIN	TENDULKAR	2 Bellevue Road	Swanage	BH19 2HR	(null)	16-NOV-14	BR1000
12	RE1012	BRAIN	LARA	19 Stourwood Avenue	BOURNEMOUTH	BHB 3PW	0	22-DEC-15	BR1000
13	RE1013	ADAM	GILCHRIST	Riverside Avenue	BOURNEMOUTH	BH7 7EE	(null)	08-APR-16	BR1000
14	RE1014	MATHEW	HAYDEN	9 Percy Road	BOURNEMOUTH	BH5 1JF	(null)	24-MAY-17	BR1000
15	RE1015	GLENN	MCGRATH	Spetisbury	Blandford	DT11 9EB	0	17-SEP-18	BR1000
16	RE1016	ZAHEER	KHAN	14 East Avenue	Bournemouth	BH3 7BY	(null)	25-AUG-19	BR1000
17	RE1017	IMRAN	KHAN	14 Stour Road	Christchurch	BH23 1PS	(null)	01-JAN-20	BR1000

Figure 42 reader data

C. QUERIES

1. ISSUEING AND RESERVING BOOK/MAGAZINE

INSERT ALL
 INTO issue_book VALUES ('IB1006',to_date('26-04-2020','dd-mm-yyyy'),to_date('09-05-2020','dd-mm-yyyy'),NULL,'RE1016','B1001')
 INTO issue_book VALUES ('IB1007',to_date('26-04-2020','dd-mm-yyyy'),to_date('09-05-2020','dd-mm-yyyy'),NULL,'RE1016','B1002')

INTO issue_book VALUES ('IB1008',to_date('26-04-2020','dd-mm-yyyy'),to_date('09-05-2020','dd-mm-yyyy'),NULL,'RE1016','B1003')

INTO issue_magazine VALUES ('IM1006',to_date('26-04-2020','dd-mm-yyyy'),to_date('09-05-2020','dd-mm-yyyy'),NULL,'M1003','RE1016')
INTO issue_magazine VALUES ('IM1007',to_date('26-04-2020','dd-mm-yyyy'),to_date('09-05-2020','dd-mm-yyyy'),NULL,'M1010','RE1016')
SELECT * FROM dual;

select * from issue_book;

Script Output | Query Result | Query Result 1 | Query Result 2

SQL | All Rows Fetched: 8 in 0.006 seconds

	BOOK_ISSUE_ID	BOOK_BORROW_DATE_	BOOK_RETURN_BEFORE_DATE	BOOK_RETURN_DATE	READER_ID	BOOK_ID
1	IB1001	30-JUL-10	13-AUG-10	12-AUG-10	RE1006	B1008
2	IB1002	30-JUL-10	13-AUG-10	12-AUG-10	RE1006	B1003
3	IB1003	10-AUG-10	24-AUG-10	24-AUG-10	RE1002	B1003
4	IB1004	20-NOV-12	04-DEC-12	04-DEC-12	RE1010	B1010
5	IB1005	01-JAN-16	15-JAN-16	10-JAN-16	RE1012	B1007
6	IB1006	26-APR-20	09-MAY-20	(null)	RE1016	B1001
7	IB1007	26-APR-20	09-MAY-20	(null)	RE1016	B1002
8	IB1008	26-APR-20	09-MAY-20	(null)	RE1016	B1003

Figure 43 issue_book data

select * from issue_magazine;

Script Output | Query Result | Query Result 1 | Query Result 2

SQL | All Rows Fetched: 7 in 0.003 seconds

	MAGAZINE_ISSUE_ID	MAGAZINE_BORROW_DATE	MAG_RETURN_BEFORE_DATE	MAGAZINE_RETURN_DATE	MAGAZINE_ID	READER_ID
1	IM1001	10-AUG-17	24-AUG-17	24-AUG-17	M1001	RE1001
2	IM1002	01-MAY-18	15-MAY-18	15-MAY-18	M1003	RE1007
3	IM1003	11-SEP-19	25-SEP-19	24-SEP-19	M1013	RE1015
4	IM1004	01-JAN-20	15-JAN-20	15-JAN-20	M1018	RE1006
5	IM1005	06-MAR-20	21-MAR-20	21-MAR-20	M1020	RE1006
6	IM1006	26-APR-20	09-MAY-20	(null)	M1003	RE1016
7	IM1007	26-APR-20	09-MAY-20	(null)	M1010	RE1016

Figure 44 issue_magazine data

SINCE READER IS ISSUEING FOR FIRST TIME, NULL IS CHANGED TO ZERO
update reader set items_borrowing=0 where reader_id='RE1016';
update reader set items_borrowing=items_borrowing+5 where reader_id='RE1016';
select * from reader where reader_id='RE1016';

Script Output | Query Result | Query Result 1 | Query Result 2

SQL | All Rows Fetched: 1 in 0.001 seconds

	READER_ID	FIRST_NAME_READER	LAST_NAME_READER	STREET_READER	CITY_READER	POST_CODE_READER	ITEMS_BORROWING	READER_REGISTRATION_DATE	BRANCH_ID
1	RE1016	ZAHEER	KHAN	14 East Avenue	Bournemouth	BH3 7BY	5	25-AUG-19	BR1000

Figure 45 reader RE1016

EACH TIME AN ITEM IS ISSUED AVAILABLE ITEM IN THE LIBRARY IS DECREMENTED BY 1
update Book set avail_book_no =avail_book_no-1 where book_id ='B1001';
update Book set avail_book_no =avail_book_no-1 where book_id ='B1002';
update Book set avail_book_no =avail_book_no-1 where book_id ='B1003';
update Magazine set avail_mag_no =avail_mag_no-1 where magazine_id ='M1003';
update Magazine set avail_mag_no =avail_mag_no-1 where magazine_id ='M1010';

select * from Book where book_id = 'B1001' or book_id = 'B1002' or book_id = 'B1003' ;

Script Output | Query Result | Query Result 1 | Query Result 2

SQL | All Rows Fetched: 3 in 0.01 seconds

	BOOK_ID	BOOK_TITLE	BOOK_YEAR	BOOK_PAGES	AVAIL_BOOK_NO	TOTAL_BOOK_NO	PUB_ID	BRANCH_ID
1	B1001	Politics UK	2011	713	0	1	PU1001	BR1000
2	B1002	Clinical Dilemmas in Primary Liver Cancer	2011	241	0	1	PU1002	BR1000
3	B1003	UK Parliament	2009	241	1	2	PU1003	BR1000

Figure 46 Book B1001, B1002, B1003

select * from Magazine where magazine_id ='M1003' or magazine_id ='M1010' ;

Script Output | Query Result | Query Result 1 | Query Result 2

SQL | All Rows Fetched: 2 in 0.003 seconds

	MAGAZINE_ID	MAG_TITLE	MAG_ISSUE_NUMBER	TOTAL_MAG_NO	AVAIL_MAG_NO	PUB_ID	BRANCH_ID
1	M1003	Digital forensics magazine	44	2	1	PU1007	BR1000
2	M1010	Hotels & restaurants international	72	1	0	PU1008	BR1000

Figure 47 Magazine M1003, M1010

FOR FINDING THE VALUE OF QUEUE IN RESERVATION TABLE

select count('M1010') from reservation_magazine;

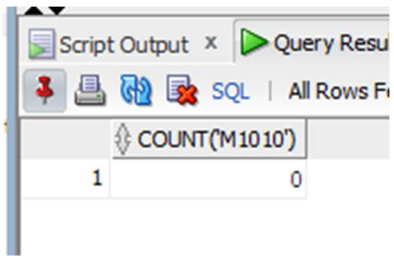


Figure 48 count('M1010') from reservation_magazine

select count('B1001') from reservation_book;

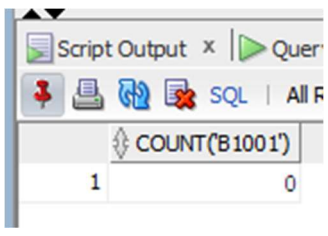


Figure 49 count('B1001') from reservation_book

READER RE1006 ISSUING AND RESERVING BOOK AND MAGAZINE

```
INSERT ALL
  INTO issue_book VALUES ('IB1009',to_date('30-04-2020','dd-mm-yyyy'),to_date('13-05-2020','dd-mm-
yyyy'),NULL,'RE1006','B1003')
  INTO issue_magazine  VALUES ('IM1008',to_date('30-04-2020','dd-mm-yyyy'),to_date('13-05-2020','dd-mm-
yyyy'),NULL,'M1022','RE1006')
  INTO reservation_magazine VALUES ('RM1001',1,'M1010','RE1006')
  INTO reservation_book VALUES ('RB1001',1,'RE1006','B1001' )
SELECT * FROM dual;
update reader set items_borrowing=items_borrowing+2 where reader_id='RE1006';
update Book set avail_book_no =avail_book_no-1 where book_id ='B1003';
update Magazine set avail_mag_no =avail_mag_no-1 where magazine_id  ='M1022';

select count('M1010') from reservation_magazine;
select count('B1001') from reservation_book;
```

READERS ISSUING AND RESERVING BOOK AND MAGAZINE

```
INSERT ALL
  INTO issue_book VALUES ('IB1010',to_date('01-05-2020','dd-mm-yyyy'),to_date('15-05-2020','dd-mm-
yyyy'),NULL,'RE1001','B1005')
  INTO issue_book VALUES ('IB1011',to_date('01-05-2020','dd-mm-yyyy'),to_date('15-05-2020','dd-mm-
yyyy'),NULL,'RE1001','B1006')
  INTO issue_book VALUES ('IB1012',to_date('01-05-2020','dd-mm-yyyy'),to_date('15-05-2020','dd-mm-
yyyy'),NULL,'RE1001','B1011')
```

```
  INTO reservation_magazine VALUES ('RM1002',2,'M1010','RE1001')
  INTO reservation_book VALUES ('RB1002',2,'RE1001','B1001')
SELECT * FROM dual;
update reader set items_borrowing=items_borrowing+3 where reader_id='RE1001';
update Book set avail_book_no =avail_book_no-1 where book_id ='B1005';
update Book set avail_book_no =avail_book_no-1 where book_id ='B1006';
update Book set avail_book_no =avail_book_no-1 where book_id ='B1011';
```

MULTIPLE USERS RESERVING BOOK/MAGAZINE

```
INSERT ALL
  INTO reservation_magazine VALUES ('RM1003',1,'M1022','RE1007')
  INTO reservation_magazine VALUES ('RM1004',2,'M1022','RE1010')
  INTO reservation_magazine VALUES ('RM1005',3,'M1022','RE1012')
  INTO reservation_book VALUES ('RB1003',1,'RE1007','B1011')
  INTO reservation_book VALUES ('RB1004',2,'RE1010','B1011')
  INTO reservation_book VALUES ('RB1005',3,'RE1012','B1011')
SELECT * FROM dual;
```

READERS CURRENTLY BORROWING

```
select * from reader where items_borrowing>0;
```

Script Output | Query Result | Query Result 1 | Query Result 2 | Query Result 3 | Query Result 4 | Query Result 5 | Query Result 6 | Query Result 7

SQL | All Rows Fetched: 3 in 0.006 seconds

	READER_ID	FIRST_NAME_READER	LAST_NAME_READER	STREET_READER	CITY_READER	POST_CODE_READER	ITEMS_BORROWING	READER_REGISTRATION_DATE	BRANCH_ID
1	RE1001	DALE	STEYN	5 Tolpuddle Gardens	BOURNEMOUTH	BH9 3RE	3	25-MAY-10	BR1000
2	RE1006	DAVID	WARNER	Horton Road	BOURNEMOUTH	BH24 ZEE	2	30-JUL-10	BR1000
3	RE1016	ZAHEER	KHAN	14 East Avenue	Bournemouth	BH3 7BY	5	25-AUG-19	BR1000

Figure 50 reader where items_borrowing>0

```
select * from Book;
```

Script Output | Query Result | Query Result 1 | Query Result 2 | Query Result 3 | Query Result 4 | Query Result 5 | Query Result 6 | Query Result 7

SQL | All Rows Fetched: 11 in 0.005 seconds

	BOOK_ID	BOOK_TITLE	BOOK_YEAR	BOOK_PAGES	AVAIL_BOOK_NO	TOTAL_BOOK_NO	PUB_ID	BRANCH_ID
1	B1001	Politics UK	2011	713	0	1	PU1001	BR1000
2	B1002	Clinical Dilemmas in Primary Liver Cancer	2011	241	0	1	PU1002	BR1000
3	B1003	UK Parliament	2009	241	0	2	PU1003	BR1000
4	B1004	Anne of Avonlea	2020	170	2	2	PU1004	BR1000
5	B1005	Spectra of Atoms and Molecules	2020	459	1	2	PU1005	BR1000
6	B1006	This Is Not the Ivy League	2020	225	0	1	PU1006	BR1000
7	B1007	Stories and Minds	2020	235	2	2	PU1006	BR1000
8	B1008	Post-Westerns Cinema, Region, West	2020	429	1	1	PU1006	BR1000
9	B1009	Mysteries of the Jaguar Shamans of the Northwest Amazon	2020	406	1	1	PU1006	BR1000
10	B1010	A Dictionary of Media and Communication	2020	1090	2	2	PU1005	BR1000
11	B1011	Bust Greece, the Euro and the Sovereign Debt Crisis	2010	290	0	1	PU1002	BR1000

Figure 51 Book

```
select * from Magazine;
```

Script Output | Query Result | Query Result 1 | Query Result 2 | Query Result 3 | Query Result 4 | Query Result 5 | Query R

SQL | All Rows Fetched: 22 in 0.005 seconds

	MAGAZINE_ID	MAG_TITLE	MAG_ISSUE_NUMBER	TOTAL_MAG_NO	AVAIL_MAG_NO	PUB_ID	BRANCH_ID
1	M1001	Digital forensics magazine	42	2	2	PU1007	BR1000
2	M1002	Digital forensics magazine	43	2	2	PU1007	BR1000
3	M1003	Digital forensics magazine	44	2	1	PU1007	BR1000
4	M1004	Hotels & restaurants international	66	1	1	PU1008	BR1000
5	M1005	Hotels & restaurants international	67	1	1	PU1008	BR1000
6	M1006	Hotels & restaurants international	68	1	1	PU1008	BR1000
7	M1007	Hotels & restaurants international	69	1	1	PU1008	BR1000
8	M1008	Hotels & restaurants international	70	1	1	PU1008	BR1000
9	M1009	Hotels & restaurants international	71	1	1	PU1008	BR1000
10	M1010	Hotels & restaurants international	72	1	0	PU1008	BR1000
11	M1011	Forbes	1234	1	1	PU1009	BR1000
12	M1012	Forbes	1235	1	1	PU1009	BR1000
13	M1013	Forbes	1236	1	1	PU1009	BR1000
14	M1014	Forbes	1237	1	1	PU1009	BR1000
15	M1015	Luxury Hoteliers	8	1	1	PU1008	BR1000
16	M1016	Luxury Hoteliers	9	1	1	PU1008	BR1000
17	M1017	Luxury Hoteliers	10	1	1	PU1008	BR1000
18	M1018	Luxury Hoteliers	11	1	1	PU1008	BR1000
19	M1019	From ideas to assets	333	1	1	PU1002	BR1000
20	M1020	From ideas to assets	334	1	1	PU1002	BR1000
21	M1021	From ideas to assets	335	1	1	PU1002	BR1000
22	M1022	From ideas to assets	336	1	0	PU1002	BR1000

Figure 52 Magazine

select * from issue_book;

Script Output | Query Result 3 | Query Result 4 | Query Result 5 | Query Result 6 | Query Result 7

SQL | All Rows Fetched: 12 in 0.004 seconds

	BOOK_ISSUE_ID	BOOK_BORROW_DATE_	BOOK_RETURN_BEFORE_DATE	BOOK_RETURN_DATE	READER_ID	BOOK_ID
1	IB1001	30-JUL-10	13-AUG-10	12-AUG-10	RE1006	B1008
2	IB1002	30-JUL-10	13-AUG-10	12-AUG-10	RE1006	B1003
3	IB1003	10-AUG-10	24-AUG-10	24-AUG-10	RE1002	B1003
4	IB1004	20-NOV-12	04-DEC-12	04-DEC-12	RE1010	B1010
5	IB1005	01-JAN-16	15-JAN-16	10-JAN-16	RE1012	B1007
6	IB1006	26-APR-20	09-MAY-20	(null)	RE1016	B1001
7	IB1007	26-APR-20	09-MAY-20	(null)	RE1016	B1002
8	IB1008	26-APR-20	09-MAY-20	(null)	RE1016	B1003
9	IB1009	30-APR-20	13-MAY-20	(null)	RE1006	B1003
10	IB1010	01-MAY-20	15-MAY-20	(null)	RE1001	B1005
11	IB1011	01-MAY-20	15-MAY-20	(null)	RE1001	B1006
12	IB1012	01-MAY-20	15-MAY-20	(null)	RE1001	B1011

Figure 53 issue_book

select * from issue_magazine;

Script Output | Query Result 4 | Query Result 5 | Query Result 6 | Query Result 7

SQL | All Rows Fetched: 8 in 0.005 seconds

	MAGAZINE_ISSUE_ID	MAGAZINE_BORROW_DATE	MAG_RETURN_BEFORE_DATE	MAGAZINE_RETURN_DATE	MAGAZINE_ID	READER_ID
1	IM1001	10-AUG-17	24-AUG-17	24-AUG-17	M1001	RE1001
2	IM1002	01-MAY-18	15-MAY-18	15-MAY-18	M1003	RE1007
3	IM1003	11-SEP-19	25-SEP-19	24-SEP-19	M1013	RE1015
4	IM1004	01-JAN-20	15-JAN-20	15-JAN-20	M1018	RE1006
5	IM1005	06-MAR-20	21-MAR-20	21-MAR-20	M1020	RE1006
6	IM1006	26-APR-20	09-MAY-20	(null)	M1003	RE1016
7	IM1007	26-APR-20	09-MAY-20	(null)	M1010	RE1016
8	IM1008	30-APR-20	13-MAY-20	(null)	M1022	RE1006

Figure 54 issue_magazine

select * from reservation_book;

Script Output | Query Result 4 | Query Result 5 | Query Result 6

SQL | All Rows Fetched: 5 in 0.025 seconds

	BOOK_RESERVATION_ID	BOOK_NUMBER_IN_QUEUE	READER_ID	BOOK_ID
1	RB1001	1	RE1006	B1001
2	RB1002	2	RE1001	B1001
3	RB1003	1	RE1007	B1011
4	RB1004	2	RE1010	B1011
5	RB1005	3	RE1012	B1011

Figure 55 reservation_book

select * from reservation_magazine;

Script Output | Query Result 4 | Query Result 5 | Query Result 6

SQL | All Rows Fetched: 5 in 0.004 seconds

	MAGAZINE_RESERVATION_ID	MAGAZINE_NUMBER_IN_QUEUE	MAGAZINE_ID	READER_ID
1	RM1001	1	M1010	RE1006
2	RM1002	2	M1010	RE1001
3	RM1003	1	M1022	RE1007
4	RM1004	2	M1022	RE1010
5	RM1005	3	M1022	RE1012

Figure 56 reservation_magazine

2. READER 'RE1016' RETURNS (When a reader returns actual return date is changed from NULL to a date**)**

```
update issue_book set book_return_date =to_date('09-05-2020','dd-mm-yyyy') where book_issue_id='IB1006';
update issue_book set book_return_date =to_date('09-05-2020','dd-mm-yyyy') where book_issue_id='IB1007';
update issue_book set book_return_date =to_date('09-05-2020','dd-mm-yyyy') where book_issue_id='IB1008';
update issue_magazine set magazine_return_date =to_date('09-05-2020','dd-mm-yyyy') where magazine_issue_id ='IM1006';
update issue_magazine set magazine_return_date =to_date('09-05-2020','dd-mm-yyyy') where magazine_issue_id ='IM1007';

update reader set items_borrowing=items_borrowing-5 where reader_id='RE1016';

update Book set avail_book_no =avail_book_no+1 where book_id ='B1001';
update Book set avail_book_no =avail_book_no+1 where book_id ='B1002';
update Book set avail_book_no =avail_book_no+1 where book_id ='B1003';
update Magazine set avail_mag_no =avail_mag_no+1 where magazine_id  ='M1003';
update Magazine set avail_mag_no =avail_mag_no+1 where magazine_id  ='M1010';

select * from issue_book where book_issue_id='IB1006' or book_issue_id='IB1007' or book_issue_id='IB1008';
```

Query Result | Query Result 1 | Query Result 2 | Query Result 3 | Query Result 4

SQL | All Rows Fetched: 3 in 0.006 seconds

	BOOK_ISSUE_ID	BOOK_BORROW_DATE_	BOOK_RETURN_BEFORE_DATE	BOOK_RETURN_DATE	READER_ID	BOOK_ID
1	IB1006	26-APR-20	09-MAY-20	09-MAY-20	RE1016	B1001
2	IB1007	26-APR-20	09-MAY-20	09-MAY-20	RE1016	B1002
3	IB1008	26-APR-20	09-MAY-20	09-MAY-20	RE1016	B1003

Figure 57 issue_book

select * from issue_magazine where magazine_issue_id ='IM1006' or magazine_issue_id ='IM1007';

Query Result | Query Result 1 | Query Result 2 | Query Result 3 | Query Result 4

SQL | All Rows Fetched: 2 in 0.004 seconds

	MAGAZINE_ISSUE_ID	MAGAZINE_BORROW_DATE	MAG_RETURN_BEFORE_DATE	MAGAZINE_RETURN_DATE	MAGAZINE_ID	READER_ID
1	IM1006	26-APR-20	09-MAY-20	09-MAY-20	M1003	RE1016
2	IM1007	26-APR-20	09-MAY-20	09-MAY-20	M1010	RE1016

Figure 58 issue_magazine

select * from reader where reader_id='RE1016';

Query Result | Query Result 1 | Query Result 2 | Query Result 3 | Query Result 4

SQL | All Rows Fetched: 1 in 0.002 seconds

	READER_ID	FIRST_NAME_READER	LAST_NAME_READER	STREET_READER	CITY_READER	POST_CODE_READER	ITEMS_BORROWING	READER_REGISTRATION_DATE	BRANCH_ID
1	RE1016	ZAHEER	KHAN	14 East Avenue	Bournemouth	BH3 7BY	0	25-AUG-19	BR1000

Figure 59 reader 'RE1016'

select * from Book where book_id ='B1001' or book_id ='B1002' or book_id ='B1003';

Query Result | Query Result 1 | Query Result 2 | Query Result 3 | Query Result 4

SQL | All Rows Fetched: 3 in 0.004 seconds

	BOOK_ID	BOOK_TITLE	BOOK_YEAR	BOOK_PAGES	AVAIL_BOOK_NO	TOTAL_BOOK_NO	PUB_ID	BRANCH_ID
1	B1001	Politics UK	2011	713	1	1	PU1001	BR1000
2	B1002	Clinical Dilemmas in Primary Liver Cancer	2011	241	1	1	PU1002	BR1000
3	B1003	UK Parliament	2009	241	1	2	PU1003	BR1000

Figure 60 Book 'B1001', 'B1002', 'B1003'

select * from Magazine where magazine_id ='M1003' or magazine_id ='M1010';

Query Result | Query Result 1 | Query Result 2 | Query Result 3 | Query Result 4

SQL | All Rows Fetched: 2 in 0.001 seconds

	MAGAZINE_ID	MAG_TITLE	MAG_ISSUE_NUMBER	TOTAL_MAG_NO	AVAIL_MAG_NO	PUB_ID	BRANCH_ID
1	M1003	Digital forensics magazine	44	2	2	PU1007	BR1000
2	M1010	Hotels & restaurants international	72	1	1	PU1008	BR1000

Figure 61 Magazine 'M1003', 'M1010'

3. Print Inactive user (Readers who never borrowed a book or a magazine or downloaded an ebook)

SELECT READER_ID FROM reader where ITEMS_BORROWING is NULL
minus
SELECT READER_ID from downloads;

Script Output | Task completed in 0.093 seconds

```
READER
------
RE1003
RE1004
RE1008
RE1009
```

Figure 62 Inactive user

4. Book with Publisher Details

select * from book left join publisher on book.pub_id = publisher.pub_id;

BOOK_ID	BOOK_TITLE	BOOK_YEAR	BOOK_PAGES	AVAIL_BOOK_NO	TOTAL_BOOK_NO	PUB_ID	BRANCH_ID	PUB_ID_1	PUB_NAME	STREET_PUB	CITY_PUB	POST_CODE_PUB	BRANCH_ID_1
B1001	Politics UK	2011	713	1	1	PU1001	BR1000	PU1001	Taylor & Francis Group	Milton Park	Oxfordshire	OX14 4RY	BR1000
B1002	Clinical Dilemmas in Primary Liver Cancer	2011	241	1	1	PU1002	BR1000	PU1002	John Wiley & Sons, Inc.	Southern Gate, Chichester	West Sussex	PO19 8SQ	BR1000
B1011	Bust Greece, the Euro and the Sovereign Debt Crisis	2010	290	0	1	PU1002	BR1000	PU1002	John Wiley & Sons, Inc.	Southern Gate, Chichester	West Sussex	PO19 8SQ	BR1000
B1003	UK Parliament	2009	241	1	2	PU1003	BR1000	PU1003	Edinburgh University Press	The Tun - Holyrood Road	Edinburgh	EH8 8PJ	BR1000
B1004	Anne of Avonlea	2020	170	2	2	PU1004	BR1000	PU1004	Lerner Publishing Group	1251 Washington Ave N	Minneapolis	MN 55401	BR1000
B1005	Spectra of Atoms and Molecules	2020	459	1	2	PU1005	BR1000	PU1005	Oxford University Press	Great Clarendon Street	Oxford	OX2 6DP	BR1000
B1010	A Dictionary of Media and Communication	2020	1090	2	2	PU1005	BR1000	PU1005	Oxford University Press	Great Clarendon Street	Oxford	OX2 6DP	BR1000
B1006	This Is Not the Ivy League	2020	225	0	1	PU1006	BR1000	PU1006	University of Nebraska Press	1111 Lincoln Mall	Lincoln	NE 68588	BR1000
B1007	Stories and Minds	2020	235	2	2	PU1006	BR1000	PU1006	University of Nebraska Press	1111 Lincoln Mall	Lincoln	NE 68588	BR1000
B1008	Post-Westerns Cinema, Region, West	2020	429	1	1	PU1006	BR1000	PU1006	University of Nebraska Press	1111 Lincoln Mall	Lincoln	NE 68588	BR1000
B1009	Mysteries of the Jaguar Shamans of the Northwest Amazon	2020	406	1	1	PU1006	BR1000	PU1006	University of Nebraska Press	1111 Lincoln Mall	Lincoln	NE 68588	BR1000

Figure 63 Book with Publisher Details

5. Print Download list with reader and ebook details in descending order of download date

select * from downloads join reader on downloads.READER_ID=reader.reader_id join ebook on downloads.EBOOK_ID=ebook.EBOOK_ID
order by downloads.download_date desc;

DOW...	DOWNLO...	READER_ID	EBOOK_ID	READER...	FIRST_...	LAST_NAME...	STREET_READER	CITY_READER	POST_CO...	ITEM...	READER...	BRA...	EBOO...	EBOOK_TITLE	EBOO...	EB...	EBOOK_URL	BRANCH_ID_1
D1013	25-05-20	RE1002	EB1001	RE1002	GREAME	SMITH	30 Osborne Road	New Milton	BH25 BAD	0	25-05-10	BR1000	EB1001	Children from the Other America	2016	125	https://ebookcentral.proquest.com/l.	BR1000
D1012	06-03-20	RE1011	EB1005	RE1011	SACHIN	TENDULKAR	2 Bellevue Road	Swanage	BH19 2HR	(null)	16-11-14	BR1000	EB1005	Adams Vs. Jefferson : The Tumultuous El...	2004	104	https://ebookcentral.proquest.com/l.	BR1000
D1011	04-03-20	RE1017	EB1007	RE1017	IMRAN	KHAN	14 Stour Road	Christchurch	BH23 1PS	(null)	01-01-20	BR1000	EB1007	Media and the Rwanda Genocide, The	2007	480	https://ebookcentral.proquest.com/l.	BR1000
D1010	03-03-20	RE1017	EB1006	RE1017	IMRAN	KHAN	14 Stour Road	Christchurch	BH23 1PS	(null)	01-01-20	BR1000	EB1006	The Consequences of Decision-Making	2007	175	https://ebookcentral.proquest.com/l.	BR1000
D1009	06-12-19	RE1001	EB1010	RE1001	DALE	STEYN	5 Tolpuddle Gardens	BOURNEMOUTH	BH9 3RE	3	25-05-10	BR1000	EB1010	Reflections On The Revolution In France	2000	160	https://ebookcentral.proquest.com/l.	BR1000
D1008	07-03-18	RE1014	EB1009	RE1014	MATHEW	HAYDEN	9 Percy Road	BOURNEMOUTH	BH5 1JF	(null)	24-05-17	BR1000	EB1009	On The Generation Of Animals	2000	107	https://ebookcentral.proquest.com/l.	BR1000
D1007	18-05-17	RE1013	EB1010	RE1013	ADAM	GILCHRIST	Riverside Avenue	BOURNEMOUTH	BH7 7EE	(null)	08-04-16	BR1000	EB1010	Reflections On The Revolution In France	2000	160	https://ebookcentral.proquest.com/l.	BR1000
D1006	18-04-17	RE1013	EB1016	RE1013	ADAM	GILCHRIST	Riverside Avenue	BOURNEMOUTH	BH7 7EE	(null)	08-04-16	BR1000	EB1016	Discourse On The Method Of Rightly Cond...	2000	33	https://ebookcentral.proquest.com/l.	BR1000
D1005	13-10-15	RE1010	EB1001	RE1010	YUVRAJ	SINGH	Thornbury Road	BOURNEMOUTH	BH8 4HR	0	06-03-12	BR1000	EB1001	Children from the Other America	2016	125	https://ebookcentral.proquest.com/l.	BR1000
D1004	05-01-13	RE1005	EB1008	RE1005	HASHIM	AMLA	16a St Anthonys Road	BOURNEMOUTH	BH2 BPD	(null)	15-07-10	BR1000	EB1008	This is Service Design Thinking : Basic...	2012	658	https://ebookcentral.proquest.com/l.	BR1000
D1003	01-01-13	RE1007	EB1009	RE1007	BEN	STOKES	57 Talbot Avenue	BOURNEMOUTH	BH1 4DS	0	12-10-10	BR1000	EB1009	On The Generation Of Animals	2000	107	https://ebookcentral.proquest.com/l.	BR1000
D1002	16-08-10	RE1001	EB1020	RE1001	DALE	STEYN	5 Tolpuddle Gardens	BOURNEMOUTH	BH9 3RE	3	25-05-10	BR1000	EB1020	American Notes For General Circulation	2000	179	https://ebookcentral.proquest.com/l.	BR1000
D1001	25-05-10	RE1001	EB1010	RE1001	DALE	STEYN	5 Tolpuddle Gardens	BOURNEMOUTH	BH9 3RE	3	25-05-10	BR1000	EB1010	Reflections On The Revolution In France	2000	160	https://ebookcentral.proquest.com/l.	BR1000

Figure 64 User + Dowloads + Ebook in desc order of download date

Implementing Entities in Neo4j

Entities implemented using neo4j

- Customers
- Books
- Ebooks
- Magazine
- Author
- Genre(which was an attribute in ER diagram)

Reasons for choosing these entities

Neo4j is a graphical database.Graphs are very well used in database.Considering the conventional relational models these models are more close to the real world and easy to visualise . Graph databases are not used for storing the static data(Reif 2018)In this condition our data is not static for the entities like customers,books, author,ebooks,magazine.There is always a chance to change in the number of customers. In the case of books,ebooks,magazines this random behaviour happens.New item gets added and new authors are added.So using these entities in neo4j is more effective.

In our library database multiple genres are possible for a book,ebook. In relational databases many join tables are needed to solve this.Apart from that , joining tables is done in query time and consumes a large amount of computational memory .For this costs are very high(Relational Databases vs. Graph Databa...).In neo4j, genre it is more easier when we take genre as a node. So multiple matching is possible and it will be easier to filter a book using its genre.

Comparing the ER diagram attributes like bookid,ebookid are removed because in graph models the relationship between entities are of equivalent importance as data. So connecting between entities using foriegn keys is no longer needed in the neo4j(Relational Databases vs. Graph Databa...).Relationship in the graph database can have properties like nodes.Adding multiple properties to relation will help in developing metadata for algorithms,increase the quality and weight of a relationship and to binding the run time queries(Robinson et al. 2013).In our problem borrowing date,return date of books,ebooks and magazines can be easily retrieved from the relationship.

Creating the database using cypher

```
create
(`0` :Book {isbn:"0618260307",title:"The Hobbit",pages:"310",publishyear:"1937",noofcopies:"10"}),
(`1` :Book {isbn:"0393310728",title:"How to Lie with Statistics",pages:"128",publishyear:"1954",noofcopies:"3"}),
(`2` :Book {isbn:"0908606664",title:"Slinky Malinki",pages:"32",publishyear:"1990",noofcopies:"4"}),
(`3` :Book {isbn:"0908783116",title:"Mechanical Harry",pages:"28",publishyear:"1996",noofcopies:"5"}),
(`4` :Book {isbn:"0908606273",title:"My Cat Likes to Hide in Boxes",pages:"55",publishyear:"1973",noofcopies:"7"}),
(`500` :Genre {genre1:"fantasy"}) ,
(`501` :Genre {genre1:"Novel"}) ,
(`502` :Genre {genre1:"general"}),
(`503` :Genre {genre1:"statistics"}),
(`504` :Genre {genre1:"mathematics"}),
```

(`505` :Genre {genre1:"fiction"}) ,

(`506` :Genre {genre1:"Children's literature"}) ,

(`507` :Genre {genre1:"graphic"}) ,

(`508` :Genre {genre1:"Romance"}) ,

(`509` :Genre {genre1:"Adventure"}) ,

(`510` :Genre {genre1:"Apocalyptic"}) ,

(`511` :Genre {genre1:"Mystery"}) ,

(`512` :Genre {genre1:"Thriller"}) ,

(`10` :Customer {num_item:4,rfirstname:"Bob",rlastname:"Dylan",registereddate:"20-may-2019",raddress1:"133",raddress2:"christchurch",rcity:"Bournemouth",rpostcode:"BH14RF"}),

(`11` :Customer {num_item:0,rfirstname:"Adam",rlastname:"John",registereddate:"20-may-2019",raddress1:"3s",raddress2:"Boscombe",rcity:"Bournemouth",rpostcode:"BH1RF"}),

(`12` :Customer {num_item:1,rfirstname:"John",rlastname:"Snow",registereddate:"12-oct-2019",raddress1:"1E",raddress2:"winton road",rcity:"London",rpostcode:"L14RF"}),

(`13` :Customer {num_item:2,rfirstname:"Charlse",rlastname:"Pop",registereddate:"25-sept-2019",raddress1:"88b",raddress2:"lansdowne",rcity:"Bournemouth",rpostcode:"BH1DS"}),

(`14` :Customer {num_item:3,rfirstname:"Christ",rlastname:"Tom",registereddate:"02-aug-2019",raddress1:"1d",raddress2:"sunbanks",rcity:"Chelse",rpostcode:"CH1RB"}),

(`15` :Author {firstname:"J",lastname:"R. R.",surname:"Tolkien"}) ,

(`16` :Author {firstname:"W.",lastname:"W.",surname:"Norton"}) ,

(`17` :Author {firstname:"Mallinson",lastname:"",surname:"Rendel"}) ,

(`18` :Author {firstname:"Bob",lastname:"",surname:"Kerr"}) ,

(`19` :Author {firstname:"Eve",lastname:"",surname:"Sutton"}) ,

(`20` :Author {firstname:"Lynley",lastname:"",surname:"Dodd"}) ,

(`21` :Ebook {ebooktitle:"The Hunger Games",ebookpages:"372",ebookpublishyear:"2008",url:"https://www.goodreads.com/book/show/2767052-the-hunger-games"}) ,

(`22` :Ebook {ebooktitle:"The Girl on the Train",ebookpages:"320",ebookpublishyear:"2015",url:"https://www.goodreads.com/book/show/22557272-the-girl-on-the-train"}),

(`23` :Ebook {ebooktitle:"Divergent ",ebookpages:"487",ebookpublishyear:"2011",url:"https://www.goodreads.com/book/show/13335037-divergent"}),

(`24` :Ebook {ebooktitle:"The Fault in Our Stars",ebookpages:"352",ebookpublishyear:"2013",url:"https://www.goodreads.com/book/show/11870085-the-fault-in-our-stars"}),

(`25` :Ebook {ebooktitle:"The Martian ",ebookpages:"369",ebookpublishyear:"2011",url:"https://www.goodreads.com/book/show/18007564-the-martian"}),

(`26` :Author {firstname:" Suzanne",lastname:"",surname:"Collins"}) ,

(`27` :Author {firstname:"Paula",lastname:"",surname:"Paula Hawkins"}) ,

(`28` :Author {firstname:" Veronica",lastname:"",surname:"Roth"}) ,

(`29` :Author {firstname:"John",lastname:"",surname:"Green"}) ,

(`30` :Author {firstname:" Andy",lastname:"",surname:" Andy Weir"}) ,

(`31` :Magazine {magazinetitle:"All About Space",magazineissuenumber:"12131/2020",totalnoofcopies:"13"}) ,

(`32` :Magazine {magazinetitle:"Science + Nature",magazineissuenumber:"18671/2020",totalnoofcopies:"13"}) ,

(`33` :Magazine {magazinetitle:"BBC Science Focus",magazineissuenumber:"11121/2020",totalnoofcopies:"9"}) ,
(`34` :Magazine {magazinetitle:"New Scientist",magazineissuenumber:"10087/2020",totalnoofcopies:"7"}) ,
(`35` :Magazine {magazinetitle:"Sky at Night",magazineissuenumber:"100767/2020",totalnoofcopies:"5"}) ,
(`0`)-[:`bookgenre`]->(`500`),
(`0`)-[:`bookgenre`]->(`501`),
(`0`)-[:`bookgenre`]->(`509`),

(`1`)-[:`bookgenre`]->(`502`),
(`1`)-[:`bookgenre`]->(`503`),
(`1`)-[:`bookgenre`]->(`504`),
(`2`)-[:`bookgenre`]->(`500`),
(`2`)-[:`bookgenre`]->(`501`),
(`2`)-[:`bookgenre`]->(`506`),
(`3`)-[:`bookgenre`]->(`505`),
(`3`)-[:`bookgenre`]->(`506`),
(`3`)-[:`bookgenre`]->(`507`),
(`4`)-[:`bookgenre`]->(`505`),
(`4`)-[:`bookgenre`]->(`506`),
(`21`)-[:`ebookgenre`]->(`500`),
(`21`)-[:`ebookgenre`]->(`501`),
(`21`)-[:`ebookgenre`]->(`505`),
(`21`)-[:`ebookgenre`]->(`510`),
(`22`)-[:`ebookgenre`]->(`505`),
(`22`)-[:`ebookgenre`]->(`511`),
(`22`)-[:`ebookgenre`]->(`512`),
(`23`)-[:`ebookgenre`]->(`500`),
(`23`)-[:`ebookgenre`]->(`505`),
(`23`)-[:`ebookgenre`]->(`511`),
(`24`)-[:`ebookgenre`]->(`505`),
(`24`)-[:`ebookgenre`]->(`508`),
(`25`)-[:`ebookgenre`]->(`512`),
(`25`)-[:`ebookgenre`]->(`505`),
(`0`)-[:`writtenby`]->(`15`),
(`1`)-[:`writtenby`]->(`16`),
(`2`)-[:`writtenby`]->(`17`),
(`3`)-[:`writtenby`]->(`18`),
(`4`)-[:`writtenby`]->(`19`),
(`4`)-[:`writtenby`]->(`20`),
(`21`)-[:`writtenby`]->(`26`),
(`22`)-[:`writtenby`]->(`27`),

(`23`)-[:`writtenby`]->(`28`),

(`24`)-[:`writtenby`]->(`29`),

(`25`)-[:`writtenby`]->(`30`),

(`10`)-[:`downloads` {downloadid:"de001",downloaddate:"20-may-2020"}]->(`21`),

(`13`)-[:`downloads` {downloadid:"de002",downloaddate:"02-may-2020"}]->(`23`),

(`14`)-[:`downloads` {downloadid:"de003",downloaddate:"02-apr-2020"}]->(`24`),

(`0`)-[:`Borrowedby` {borrowdate:"17-may-2020",returneddate:"16-jun-2020",maxborrowdate:"18-jun-2020"}]->(`10`),

(`1`)-[:`Borrowedby` {borrowdate:"13-may-2020",returneddate:"13-jun-2020",maxborrowdate:"14-jun-2020"}]->(`11`),

(`2`)-[:`Borrowedby` {borrowdate:"03-may-2020",returneddate:"03-jun-2020",maxborrowdate:"05-jun-2020"}]->(`12`),

(`3`)-[:`Borrowedby` {borrowdate:"07-may-2020",returneddate:"09-jun-2020",maxborrowdate:"12-jun-2020"}]->(`13`),

(`14`)-[:`reservationlist` {reservationdate:"13-may2020"}]->(`0`),

(`11`)-[:`reservationlist` {reservationdate:"13-may2020"}]->(`3`),

(`13`)-[:`reservedmagazine` {reservationdate:"01-may-2020"}]->(`31`),

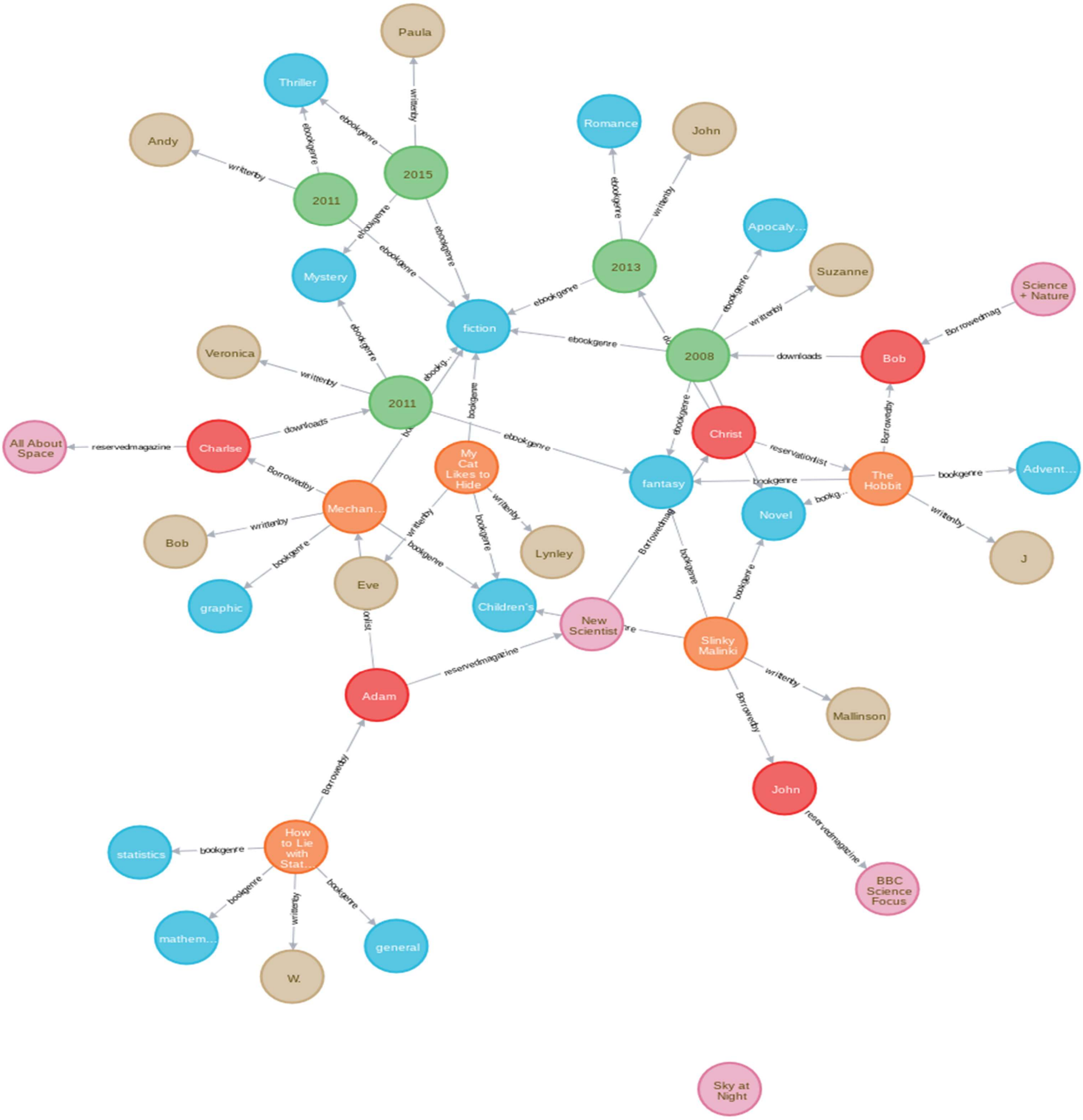
(`12`)-[:`reservedmagazine` {reservationdate:"09-may-2020"}]->(`33`),

(`11`)-[:`reservedmagazine` {reservationdate:"04-may-2020"}]->(`34`),

(`32`)-[:`Borrowedmag` {mborrowdate:"12-april-2020",mreturneddate:"12-may-2020",mmaxborrowdate:"14-may-2020"}]->(`10`),

(`34`)-[:`Borrowedmag` {mborrowdate:"02-april-2020",mreturneddate:"07-may-2020",mmaxborrowdate:"09-may-2020"}]->(`14`)

Graphical representation of database



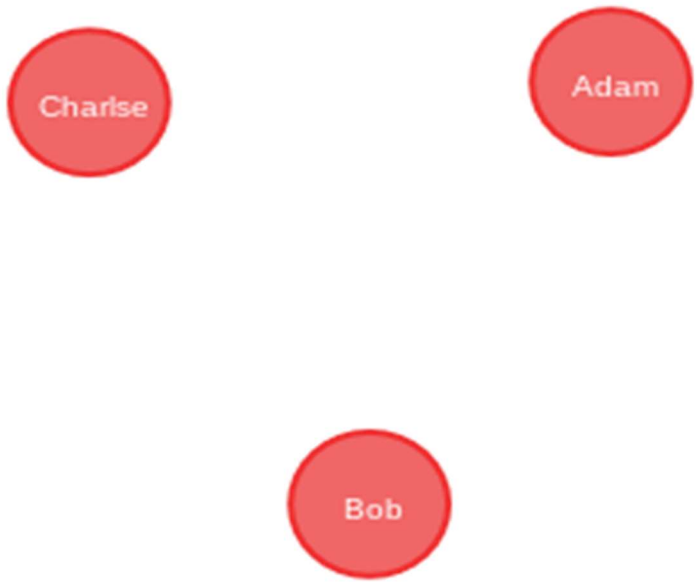
User cases using cypher

1) **List of customers who live in Bournemouth.**

match (c:Customer)

where c.rcity = "Bournemouth"

return c



2) **Return the books borrowed by Adam**

MATCH (Customer {rfirstname:'Adam' })-->(Book) RETURN Book.title

Book.title
"Mechanical Harry"
null

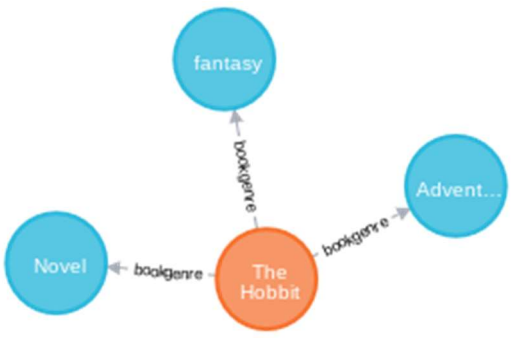
3) **Genre of book The Hobbit**

match n=

(Book)-[:bookgenre]->(genre)

where Book.title="The Hobbit"

return n



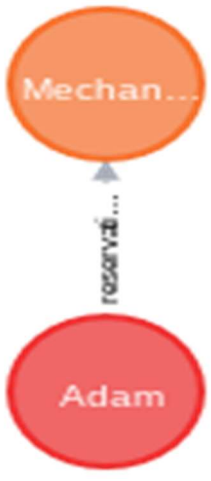
4) **Show the reservation list of Adam**

match

n=(p:Customer)-[f:reservationlist]->(:Book)

where p.rfirstname= "Adam"

return n,f.reservationdate



5) **List of ebooks that are in fiction genre**

match

w=(:Ebook)-[:ebookgenre]->(s:Genre)<-[:bookgenre]-(:Book)

where s.genre1="fiction"

return w

6) **List of all customers and number of items borrowed in descending order**

match

(c:Customer)

return c.num_item,c.rfirstname

order by c.num_item desc

c.num_item	c.rfirstname
4	"Bob"
3	"Christ"
2	"Charlse"
1	"John"
0	"Adam"

7) **To see the author name starts with J**

match

(a:Author)

where a.firstname starts with "J"

return a.firstname,a.lastname,a.surname

a.firstname	a.lastname	a.surname
"J"	"R. R."	"Tolkien"
"John"	""	"Green"

MongoDB

To make data types more efficient and supportive more MongoDB was developed as a NoSQL database an Open Source, Document Database (MongoDB 2008) which delivers data modelling and data management at high performance and scalability with enormous sets of data in a company application. MongoDB also features Auto-Scaling. Also, MongoDB can be installed across different platforms like Windows, Linux etcetera because it is a cross platform database.

Key Features of MongoDB

1. MongoDB provides high performance. Due to support of embedded documents (data models), input and output operations in MongoDB are significantly less than relational databases and MongoDB also supports faster queries.
2. Sharding is also one of the major features of MongoDB. Horizontal Scalability is workable due to sharding(Kristina 2013).
3. Schema-less database is the very basic feature of MongoDB. No schema migrations are needed anymore. Since, MongoDB is free from schema albeit, your code defines your schema and proves to be very handy feature.
4. Very hands-down to scale.
5. Due to its nature of employing the internal memory for the storage it permits faster access of the data.
6. It is a well-known that alteration of RDBMS in table creates a high chance of getting database locked which results in huge performance degradation. Therefore, in MongoDB adding new fields will not produce any issue because it is a schema less database system.

MongoDB consists of a set of databases. Each set of databases again consists of Collections in which data is stored. The below figure depicts the typical database structure in MongoDB (Cyrus 2016).

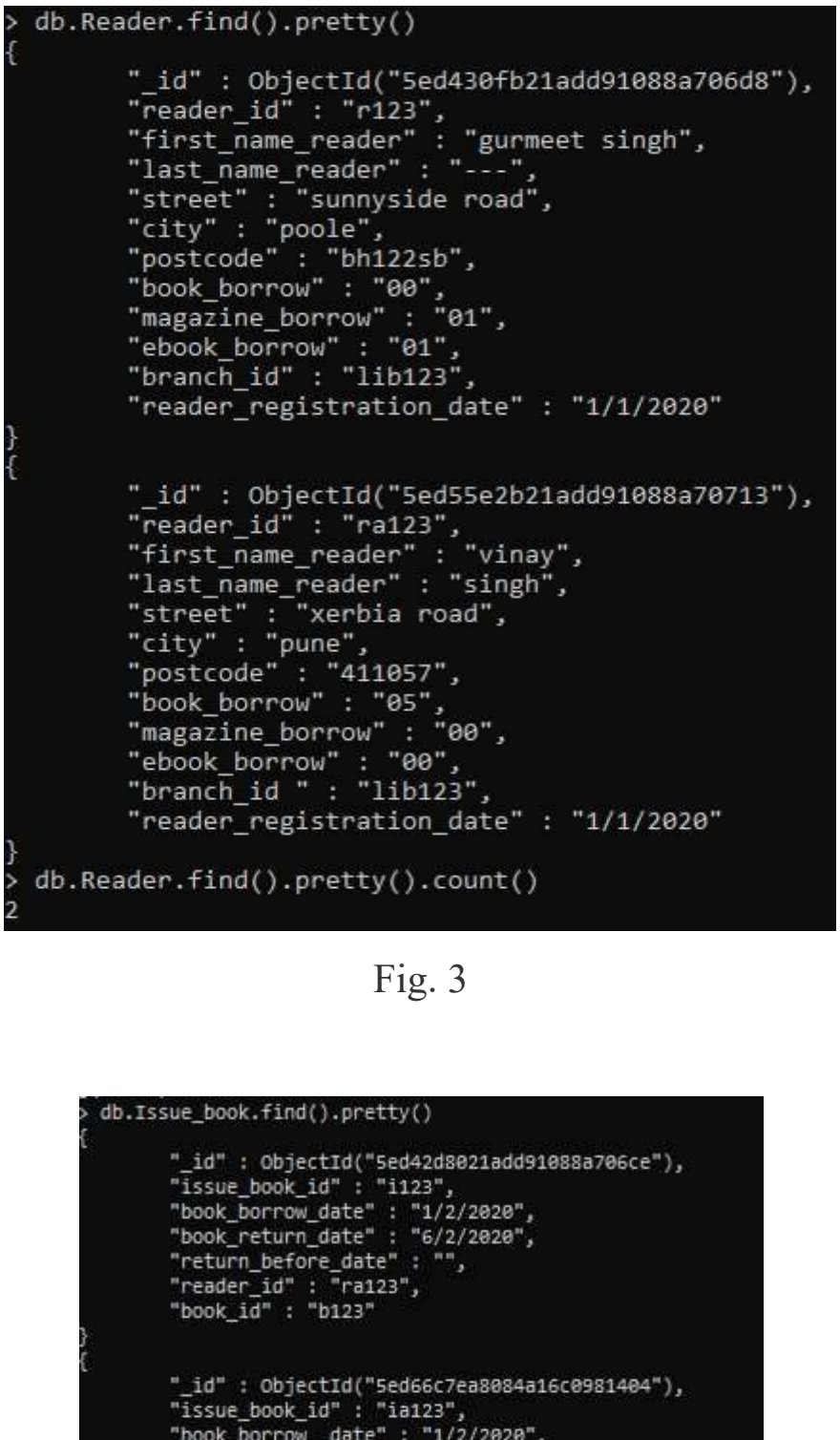
Samples of data

```
db.Reader.find( {"city":"poole"} ).pretty()

        "_id" : ObjectId("5ed430fb21add91088a706d8"),
        "reader_id" : "r123",
        "first_name_reader" : "gurmeet singh",
        "last_name_reader" : "---",
        "street" : "sunnyside road",
        "city" : "poole",
        "postcode" : "bh122sb",
        "book_borrow" : "00",
        "magazine_borrow" : "01",
        "ebook_borrow" : "01",
        "branch_id" : "lib123",
        "reader_registration_date" : "1/1/2020"
```

Fig. 1

```
> db.Book_book_genre.find( {"book_genre":"academic"} ).pretty()
{
        "_id" : ObjectId("5ed5577621add91088a70706"),
        "book_genre" : "academic",
        "book_id " : "ba123"
}
{
        "_id" : ObjectId("5ed6cf7ca8084a16c0981416"),
        "book_genre" : "academic",
        "book_id: " : "bb123"
}
{
        "_id" : ObjectId("5ed6cf88a8084a16c0981417"),
        "book_genre" : "academic",
        "book_id: " : "bc123"
}
{
        "_id" : ObjectId("5ed6cf90a8084a16c0981418"),
        "book_genre" : "academic",
        "book_id: " : "bd123"
}
```

Fig. 2



```
> db.Reader.find().pretty()
{
        "_id" : ObjectId("5ed430fb21add91088a706d8"),
        "reader_id" : "r123",
        "first_name_reader" : "gurmeet singh",
        "last_name_reader" : "---",
        "street" : "sunnyside road",
        "city" : "poole",
        "postcode" : "bh122sb",
        "book_borrow" : "00",
        "magazine_borrow" : "01",
        "ebook_borrow" : "01",
        "branch_id" : "lib123",
        "reader_registration_date" : "1/1/2020"
}
{
        "_id" : ObjectId("5ed55e2b21add91088a70713"),
        "reader_id" : "ra123",
        "first_name_reader" : "vinay",
        "last_name_reader" : "singh",
        "street" : "xerbia road",
        "city" : "pune",
        "postcode" : "411057",
        "book_borrow" : "05",
        "magazine_borrow" : "00",
        "ebook_borrow" : "00",
        "branch_id " : "lib123",
        "reader_registration_date" : "1/1/2020"
}
> db.Reader.find().pretty().count()
2
```


Fig. 3

```
> db.Issue_book.find().pretty()
{
        "_id" : ObjectId("5ed42d8021add91088a706ce"),
        "issue_book_id" : "i123",
        "book_borrow_date" : "1/2/2020",
        "book_return_date" : "6/2/2020",
        "return_before_date" : "",
        "reader_id" : "ra123",
        "book_id" : "b123"
}
{
        "_id" : ObjectId("5ed66c7ea8084a16c0981404"),
        "issue_book_id" : "ia123",
        "book_borrow_ date" : "1/2/2020",
        "book_return_date" : "6/2/2020",
        "return_before_date" : "",
        "reader_id" : "ra123",
        "book_id" : "ba123"
}
{
        "_id" : ObjectId("5ed66c9ba8084a16c0981405"),
        "issue_book_id" : "ib123",
        "book_borrow_date" : "1/2/2020",
        "book_return_date" : "6/2/2020",
        "return_before_date" : "",
        "reader_id" : "ra123",
        "book_id" : "bb123"
}
{
        "_id" : ObjectId("5ed66cb6a8084a16c0981406"),
        "issue_book_id" : "ic123",
        "book_borrow_date" : "1/2/2020",
        "book_return_date" : "6/2/2020",
        "return_before_date" : "",
        "reader_id" : "ra123",
        "book_id" : "bc123"
}
{
        "_id" : ObjectId("5ed66ccfa8084a16c0981407"),
        "issue_book_id" : "id123",
        "book_borrow_date" : "1/2/2020",
        "book_return_date" : "6/2/2020",
        "return_before_date" : "",
        "reader_id" : "ra123",
        "book_id" : "bd123"
}
> db.Issue_book.find().pretty().count()
5
```


Fig. 4

The ability to derive a document-based data model is one of reason in selecting the collections in MongoDB (David 2020). Because the way it stores the data in the form of Binary JSON, ruby hashes etcetera, helps to store the data in a very rich way while being capable of holding arrays and other documents which capable it to accept as many collections also it is a non-relational DBM system (MongoDB 2008).

Use cases

1. How many readers have borrowed more than 2 books

```
> db.Reader.find( {"book_borrow": {$gt: 02} } ).pretty()
{
        "_id" : ObjectId("5ed55e2b21add91088a70713"),
        "reader_id" : "ra123",
        "first_name_reader" : "vinay",
        "last_name_reader" : "singh",
        "street" : "xerbia road",
        "city" : "pune",
        "postcode" : "411057",
        "book_borrow" : 5,
        "magazine_borrow" : 0,
        "ebook_borrow" : 0,
        "branch_id " : "lib123",
        "reader_registration_date" : ISODate("2020-01-01T00:00:00Z")
}
> db.Reader.find( {"book_borrow": {$gt: 02} } ).pretty().count()
1
```

2. Retrieving publisher's emails and contact numbers (John 2017).

```
> db.Publisher_phone_numbers.aggregate([{$lookup: { from:"Publisher_emails", localField: "pub_phone_number", foreignField: "Pub_email", as: "Publisher_emails"}} ]).pret
ty()
{
        "_id" : ObjectId("5ed4e86221add91088a706f0"),
        "pub_phone_number" : "987654321",
        "pub_id" : "p123",
        "Publisher_emails" : [ ]
}
{
        "_id" : ObjectId("5ed6affda8084a16c0981411"),
        "pub_phone_number" : "887654321",
        "pub_id" : "pa123",
        "Publisher_emails" : [ ]
}
{
        "_id" : ObjectId("5ed6b00ba8084a16c0981412"),
        "pub_phone_number" : "787654321",
        "pub_id" : "pb123",
        "Publisher_emails" : [ ]
}
{
        "_id" : ObjectId("5ed6b02da8084a16c0981413"),
        "pub_phone_number" : "687654321",
        "pub_id" : "pc123",
        "Publisher_emails" : [ ]
}
{
        "_id" : ObjectId("5ed6b038a8084a16c0981414"),
        "pub_phone_number" : "587654321",
        "pub_id" : "pd123",
        "Publisher_emails" : [ ]
}
```

3. Total number of books available in library.

```
> db.Book.aggregate([{ $lookup: { from: "Magazine", localField: "branch_id", foreignField: "branch_id", as:"Book" } }]).pretty()
{
        "_id" : ObjectId("5ed4265521add91088a706c4"),
        "book_id" : "b123",
        "book_tittle" : "think and grow rich",
        "book_year" : 1983,
        "book_page_numbers" : 580,
        "available_copies" : 4,
        "total_copies" : 5,
        "pub_id" : "p123",
        "branch_id" : "lib123",
        "Book" : [
                {
                        "_id" : ObjectId("5ed42c6021add91088a706c9"),
                        "magazine_id" : "m123",
                        "mag_tittle" : "mabc",
                        "mag_issue_number" : "000",
                        "total_copies" : 5,
                        "available_copies" : 4,
                        "pub_id" : "p123",
                        "branch_id" : "lib123"
                },
                {
                        "_id" : ObjectId("5ed55bb721add91088a7070e"),
                        "magazine_id" : "ma123",
                        "mag_tittle" : "mabcd",
                        "mag_issue_number" : "000",
                        "total_copies" : 5,
                        "available_copies" : 5,
                        "pub_id" : "p123",
                        "branch_id" : "lib123"
                }
        ]
```

4. Total number of books available to issue.

```
> db.Reader.aggregate([   {       $match: {       book_borrow: {                  $lt: 6       }       }   }, {       $group: {       _id: null,      total: {        $
sum: "$book_borrow"       }     }   } ]);
{ "_id" : null, "total" : 5 }
>
```

5. Details of employees of a library (John 2017).

```
> db.Employee.aggregate([ {$lookup: {from:"Library",localField:"branch_id",foreignField:"branch_id",as:"Library"}} ]).pretty()
{
        "_id" : ObjectId("5ed4e31721add91088a706e0"),
        "employee_id" : "e123",
        "first_name " : "manjeet singh",
        "last_name" : "---",
        "position" : "owner",
        "branch_id" : "lib123",
        "Library" : [
                {
                        "_id" : ObjectId("5ed4edd621add91088a706fa"),
                        "branch_id" : "lib123",
                        "lib_street" : "talbot",
                        "lib_city" : "bournemouth",
                        "lib_postcode" : "bh125bb"
                }
        ]
}
{
        "_id" : ObjectId("5ed5598221add91088a7070b"),
        "employee_id" : "ea123",
        "first_name " : "gurmeet singh",
        "last_name" : "---",
        "position" : "manager",
        "branch_id" : "lib123",
        "Library" : [
                {
                        "_id" : ObjectId("5ed4edd621add91088a706fa"),
                        "branch_id" : "lib123",
                        "lib_street" : "talbot",
                        "lib_city" : "bournemouth",
                        "lib_postcode" : "bh125bb"
                }
        ]
}
```

PART – B

1. Introduction

Machine learning is an artificial intelligence (AI) application which provides systems with the ability to learn and improve automatically from experience without explicit programming. The focus of machine learning is on developing computer programmes that can access data and use it to learn for themselves (Expert System Team, 2020). Classical algorithms to complete a task are given exact and complete rules. Machine learning algorithms, along with data, are given general guidelines which define the model. This data will include the necessary details that the model requires in order to complete the process. So, when the model has been adjusted with respect to the data, a machine learning algorithm can perform its task (Rocca 2019). Machine learning algorithms are often classified as supervised or unsupervised.

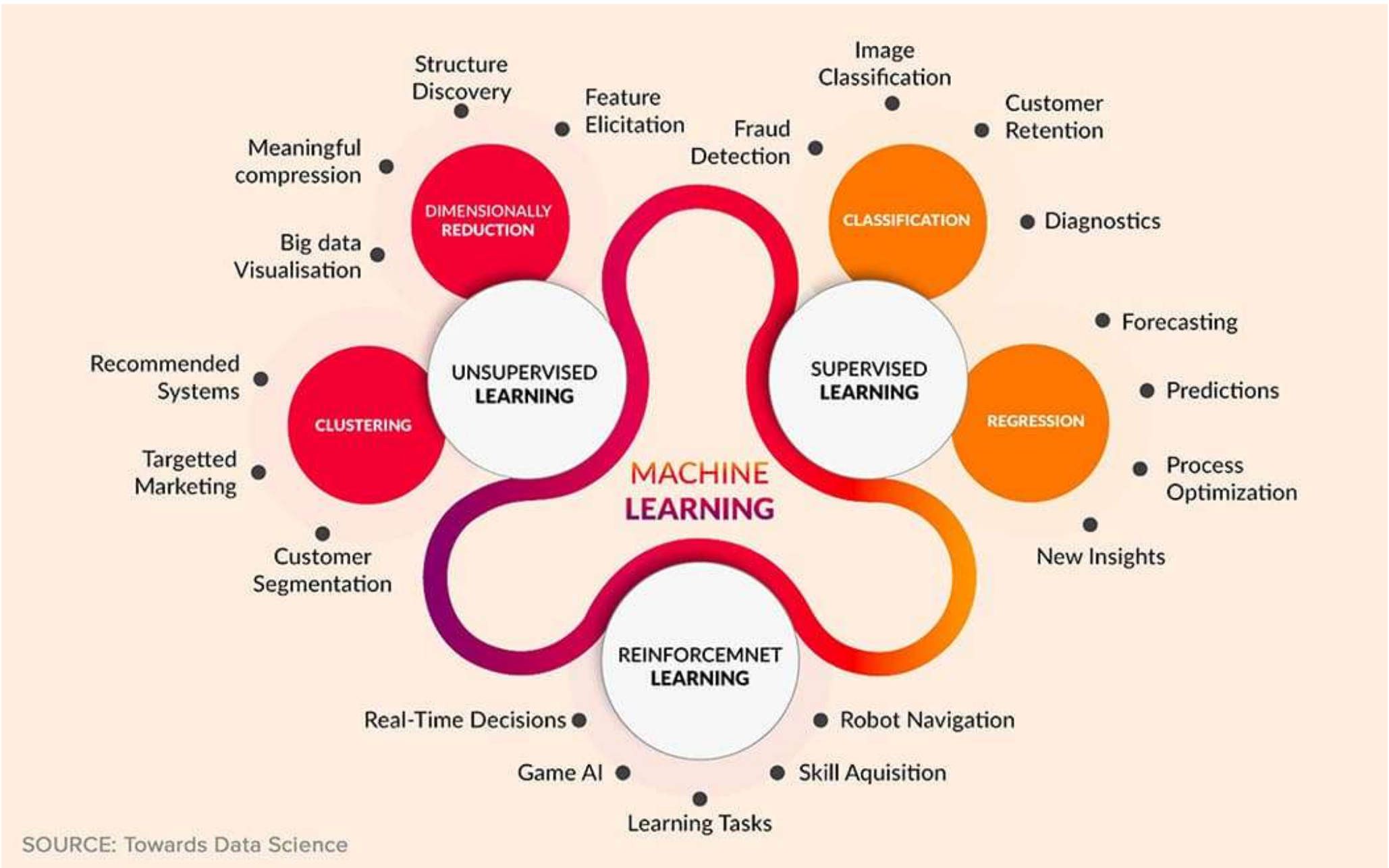


Figure 65 Machine Learning (Cygnis Media Editor 2020)

This project dealt with **supervised machine learning;** we want to get a model in supervised learning to predict the label of data based on its features. To learn how to map between features and labels (**classification**), the model must be fitted with their related labels on given examples of features (Rocca 2019).

2. Classification Algorithms

In this project we used 2 algorithms,

2.1 Support-vector machine

"The objective of the support vector machine algorithm is to find a hyperplane in an N-dimensional space (N - the number of features) that distinctly classifies the data points" (Gandhi 2018).

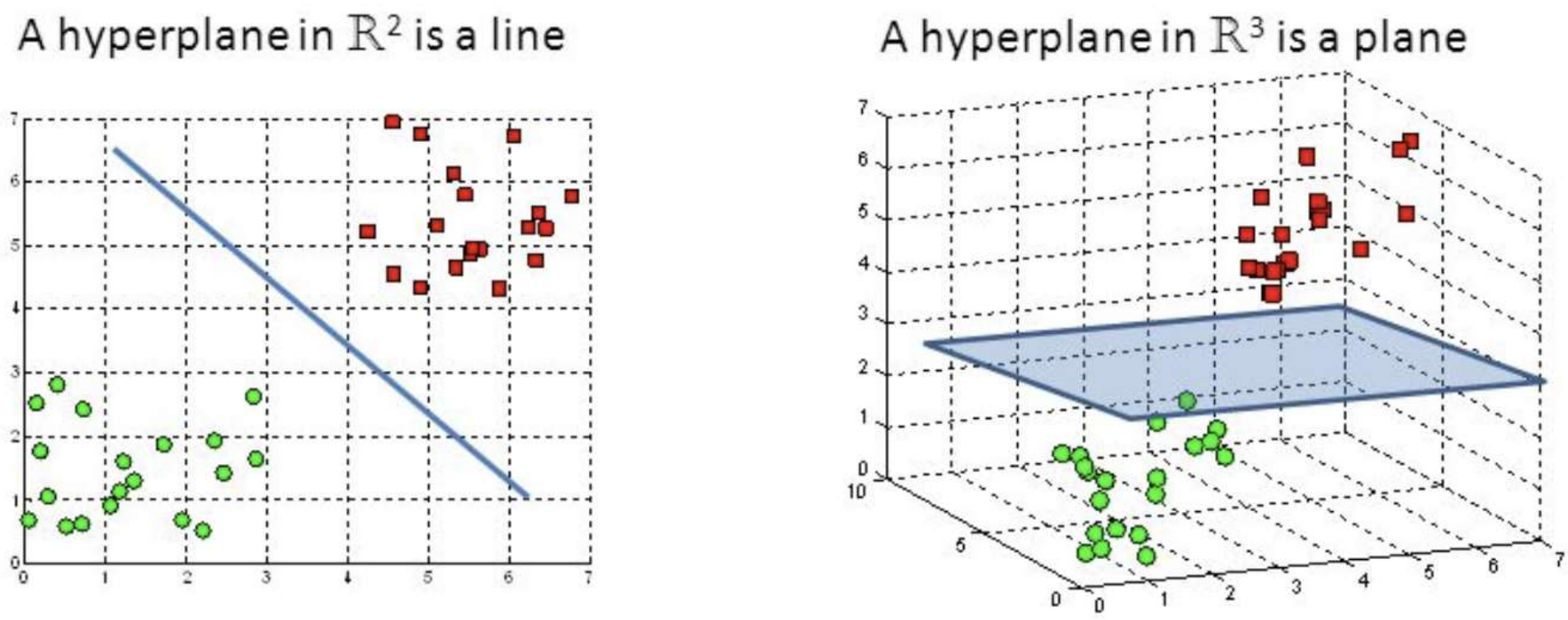


Figure 66 SVM hyperplane (Gandhi 2018).

Hyperplanes are boundaries for decision taking and help to distinguish data points. Data points which fall on either side of the hyperplane can be attributed to various classes. Also, the hyperplane dimension depends on how many features. When the number of input characteristics is 2, then the hyperplane becomes a line only. If the number of features of the input is 3 then the hyperplane will become a two-dimensional plane (Gandhi 2018).

Types of kernels:

2.1.1 Linear kernel

2.1.2 Polynomial kernel

2.1.3 **Radial basis function kernel (RBF)/ Gaussian Kernel** is a function the value of which depends on the distance from the origin or any other point. RBF kernel is considered to be the most power full among the 3 kernels, so RBF kernel is chosen for the project.

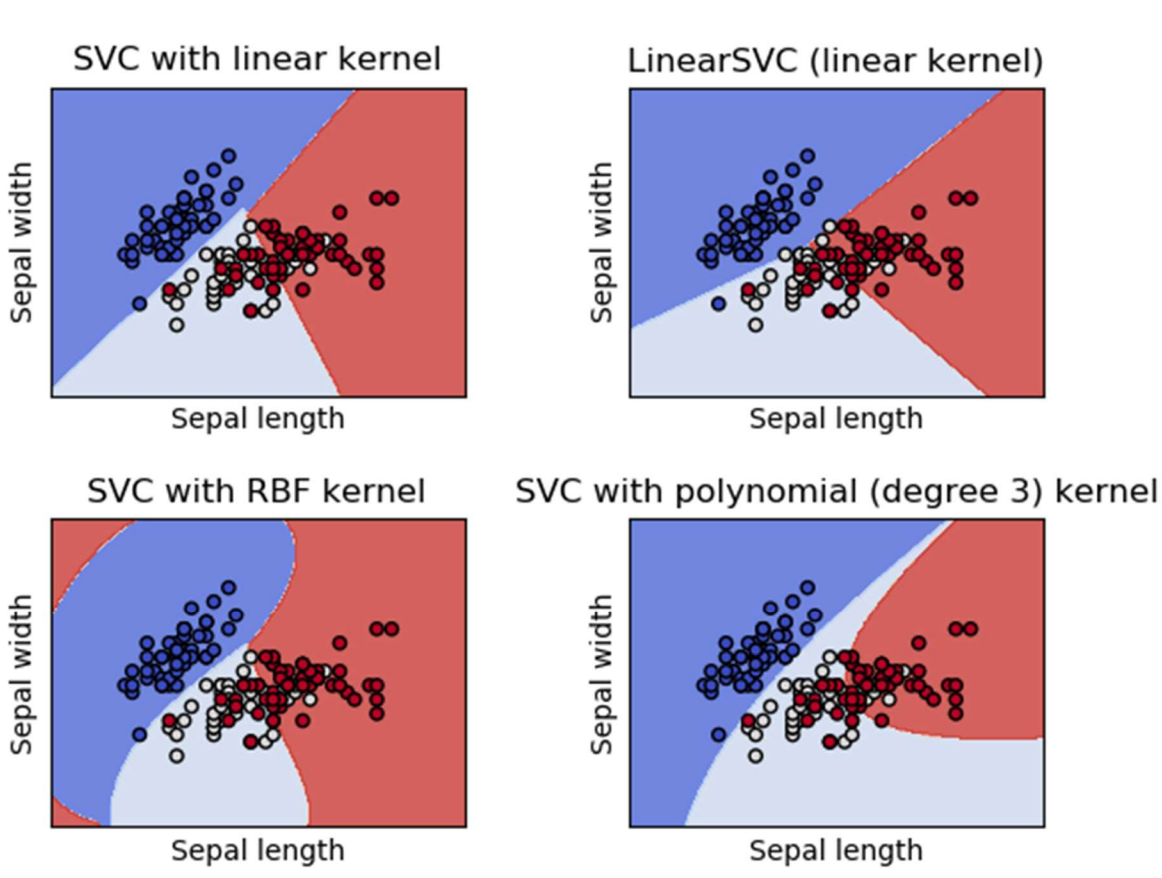


Figure 67Types of Kernal (Pedregosa, 2011)

2.2 k-nearest neighbours

"k-NN is a type of instance-based learning, or lazy learning, where the function is only approximated locally and all computation is deferred until function evaluation" (Wikipedia 2019). k value can be any integer value preferably odd numbers. If k=1 instance is classified as the nearest neighbour or if k=3 then instance is classified as the majority class in the 3 nearest class and so on.

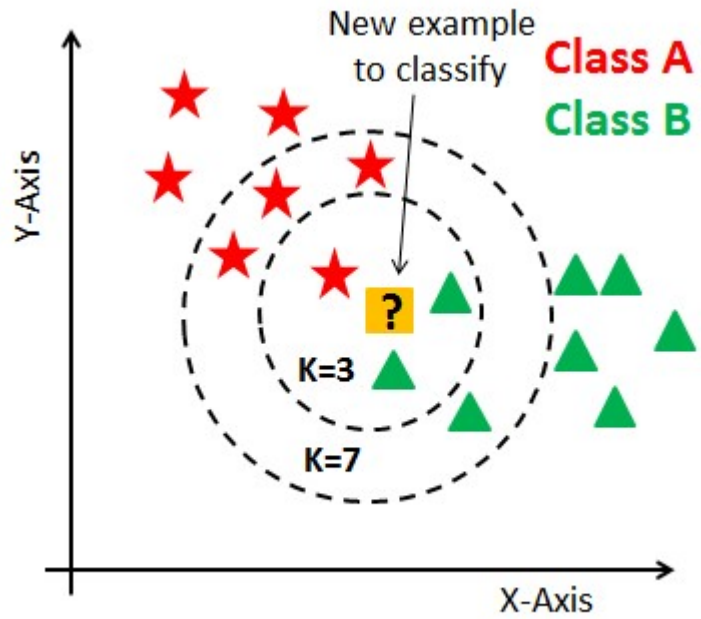


Figure 68 KNN (Navlani, 2018)

3. Dataset Description

- Dataset contains 5 folders each containing 100 files; therefore, dataset have a total of 500 files.
- Each file represents each person which contains 23.5 seconds of brain recording.
- These 23.5 seconds corresponds to 4097 data points.
- 4097 datapoints are divided into 23 chunks with 178 data points inside.
- 178 data points correspond to 1 second.
- Therefore 500 persons has 500 files which means 23 x 500 chunk files and as a result a total of 11500 row are created.
- Each row (chunks) contains 178 columns for datapoints of 1 second and 1 column for label
- 179 columns containing X1,X2,……X177,X178 and y
- Even though the dataset contains 5 labels, it is changed into a binary dataset containing seizure and non-seizure classification.

4. Evaluation techniques

4.1 Confusion Matrix

Confusion matrix is matrix containing 4 categories of predications, which are:

- True Positives (TP): Instances where the label is yes, and output predicted as yes
- True Negatives (TN): Instances where the label is no, and output predicted as no
- False Positives (FP): Instances where the label is no, and output predicted as yes
- False Negative (FN): Instances where the label is yes, and output predicted as no

(Brownlee, 2014)

	Positive	**Negative**
Positive	True Positive	False Positive
Negative	False Negative	True Negative

4.2 Classification Accuracy

Classification accuracy is often referred as accuracy, which is number of correct predictions divided by total number of predictions made by model (Kostoulas 2020). It can be obtained from confusion matrix by

Accuracy = **(TP + TN) / (TP + TN + FP +FN)**

4.3 Balanced Accuracy

Accuracy doesn't not always give correct evaluation of the performance especially when the class are unbalanced, in that case we use balanced accuracy (Kostoulas 2020).

Balanced Accuracy = **[(TP/ (TP + FP)) + (TN/ (TN + FN))] / 2**

4.4 Precision

Precision is the correct positive samples divided by total number of positive cases predicted by classifier (Kostoulas 2020).

Precision = **TP / (TP + FP)**

4.5 Recall

Recall is the correct positive samples divided by all samples those should be predicted as positive (Kostoulas 2020).

Recall = **TP / (TP + FN)**

4.6 Area Under Curve

A graph is plotted between true positive rate vs false positive rate or **sensitivity** vs **1-specificity** at different thresholds of the algorithms. Different thresholds correspond to different working points of the system which means different confusion matrix therefore different value for sensitivity or specificity (Kostoulas 2020).

Sensitivity = **TP / (TP + FN)**
Specificity = **TN / (TN + FP)**

Important points to observe in the graph are (0,0), (0,1), (1,1) and diagonal.
As the graph is closer to the top left corner (0,1)

- 1-specificity is closer to 0 which means specificity is closer to 1 which implies False positive is closer to 0.
- Sensitivity closer to 1 which implies False negative closer to 0.

False positive and false negative is closer to 0 means **number of false predictions is less and true predictions is high**, which should be the property of a good algorithm (Kostoulas 2020).

4.7 Significance Test

Significance test was used to evaluate the performance of the test set (Kostoulas 2020). Confidence interval method was selected, the formula for finding confidence interval is:

$$error \pm Z \sqrt{error \,.\frac{1 - error}{n}}$$

5. Dimensionality Reduction and Principal Component Analysis

A dataset contains multiple number of variables and these variables has too many relations with one another. This increases the probability of overfitting the model, therefore it is essential to focus on the important variables rather than considering the whole dataset. This process of reducing the dimensionality of the can be achieved by 2 processes:

5.1 Feature Elimination is the process in which only certain variables are kept and rest of them are eliminated. This will cause loss of information from the eliminated variables, which may or may not be useful to the model.

5.2 Feature Extraction is the process by which the n number of independent variables in the dataset is converted in 'new' n independent variables and each new variable is a combination of all n old variable. These new independent variables are created in such a way that it is ordered in how it predicts the dependent variable. So even if some variables are eliminated, the most important features are kept from all the variables.

Principal Component Analysis (PCA) uses feature extraction technique. So PCA combines input variables into new independent variables and new variables are created preserving the important features from all the old variables and ordered according to the importance. Still least important variables can be dropped without losing valuable information (Brems 2017).

6. Feature selection

Feature selection and dimension reduction are often confused. Feature selection is the process by which the number of attributes is changed without changing the attributes, only attributes are included or excluded. Whereas in dimensionality reduction actual attributes are converted into new attributes. Feature selection increases accuracy by removing unwanted or redundant data and thus reducing the complexity of the model and helping to train the model with less time (Brownlee 2014).
Feature selection algorithms are divided into 3 types:

6.1 Filter methods

Each feature gets applied a statistical scoring, and these scoring is used to determine whether attribute is kept or removed. Examples of these methods are correlation coefficient scores, information gain and Chi squared test.

6.2 Wrapper methods

This is mainly used in search problems, where multiple combinations are created, evaluated and compared with each other. An example for wrapper method is recursive feature elimination algorithm.

6.3 Embedded method

While the model is getting created embedded methods learn the best features contributing to the accuracy. Regularisation methods are the common embedded methods for feature selection.

7. Working Environment

Waikato Environment for Knowledge Analysis (**WEKA**) is an open source machine learning software developed at the University of Waikato, New Zealand, which can be accessed using graphical user interface. "Weka can be used to build machine learning pipelines, train classifiers, and run evaluations without having to write a single line of code" (Machine Learning Group, University of Waikato 2019).

Assignment Tasks

1. Task 1 - Training and Testing set of the Dataset

The whole dataset is split into 3 fragments. Primarily dataset is divided into 2 fragments of **80%** and **20%.** This was done using Microsoft Excel where the top 80% of data is kept in the same file and bottom 20% was copied to another excel file, this part is done manually. The larger split is used as **Training and Validation** data and later is the **Test data.** Training and validation split can be done using 2 methods (Percentage split or cross validation). As the dataset is relatively larger cross validation take much more time to train the model, so **percentage split** of 80/20 was selected for both algorithms. Percentage split will split the data 80% for training and 20% validation similar to what was done for the test data although percentage split is done by the algorithm. **Total data of 11500 is divided into 80/20 split for training and testing, which gives 9200 for training and 2300 for testing.**

2. Task 2 - Applying two classification algorithms

2.1. Establishing the Baseline

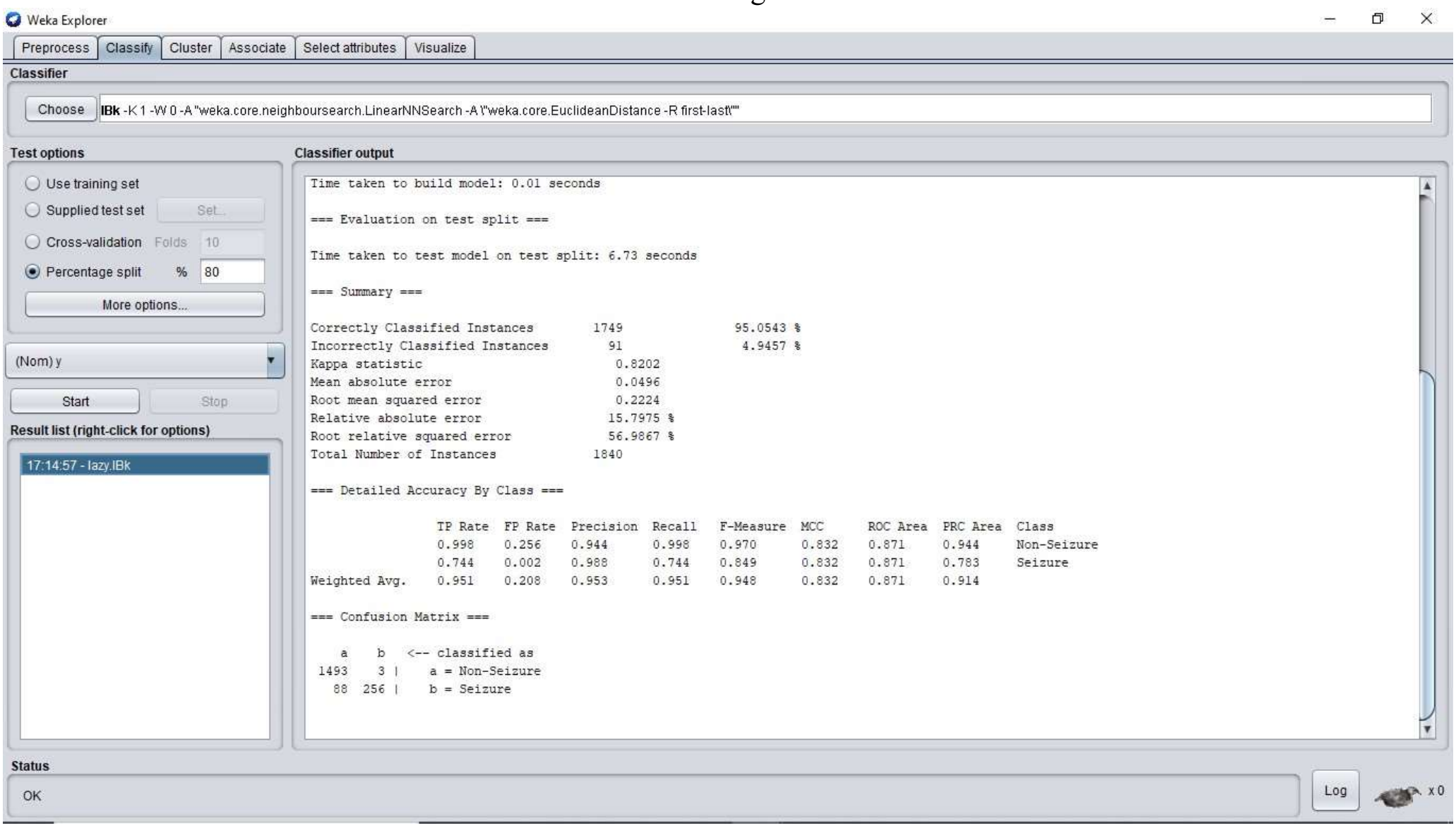
```
=== Summary ===

Correctly Classified Instances        1496               81.3043 %
Incorrectly Classified Instances       344               18.6957 %
Kappa statistic                          0
Mean absolute error                      0.3138
Root mean squared error                  0.3902
Relative absolute error                100      %
Root relative squared error            100      %
Total Number of Instances             1840

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area  Class
                 1.000    1.000    0.813      1.000    0.897      0.000    0.500     0.813     Non-Seizure
                 0.000    0.000    0.000      0.000    0.000      0.000    0.500     0.187     Seizure
Weighted Avg.    0.813    0.813    0.661      0.813    0.729      0.000    0.500     0.696

=== Confusion Matrix ===

    a    b   <-- classified as
 1496    0 |    a = Non-Seizure
  344    0 |    b = Seizure
```

Baseline for comparing the results is established by taking the metrics of a classifier which classifies every class into the majority class. Here the majority class is Non-seizure having 1496 over Seizure having only 344 for validation. Here the ZeroR predicts everything as Non-seizure which gives an accuracy of 81.3%. **AUC of 0.5 is the baseline for comparing all further algorithms.**

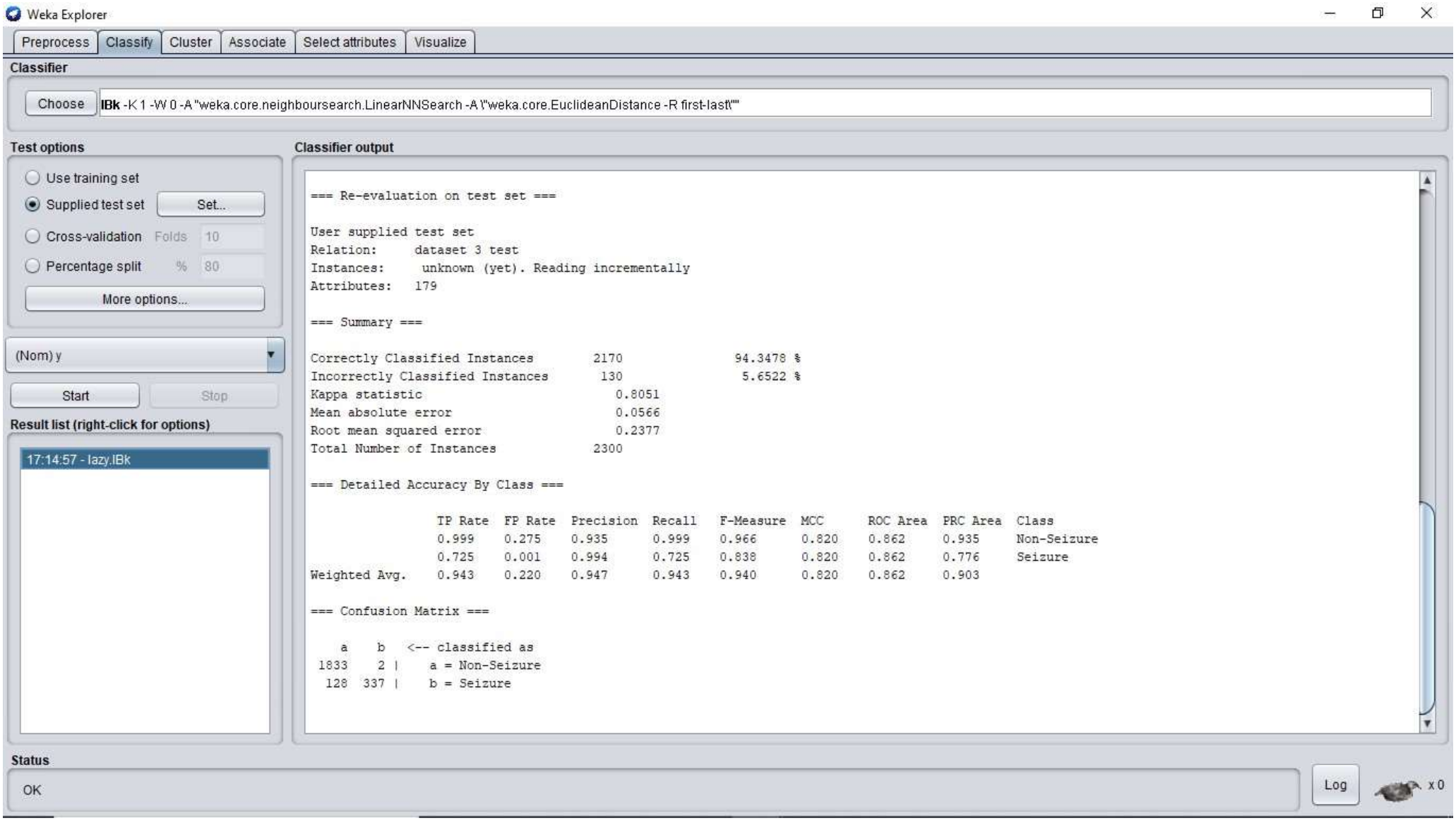
2.2. KNN algorithm

2.2.1. The training dataset was split using percentage split of 80% for training and 20% for validation.

2.2.2. Dataset was trained and validated on KNN algorithm and results are shown below.



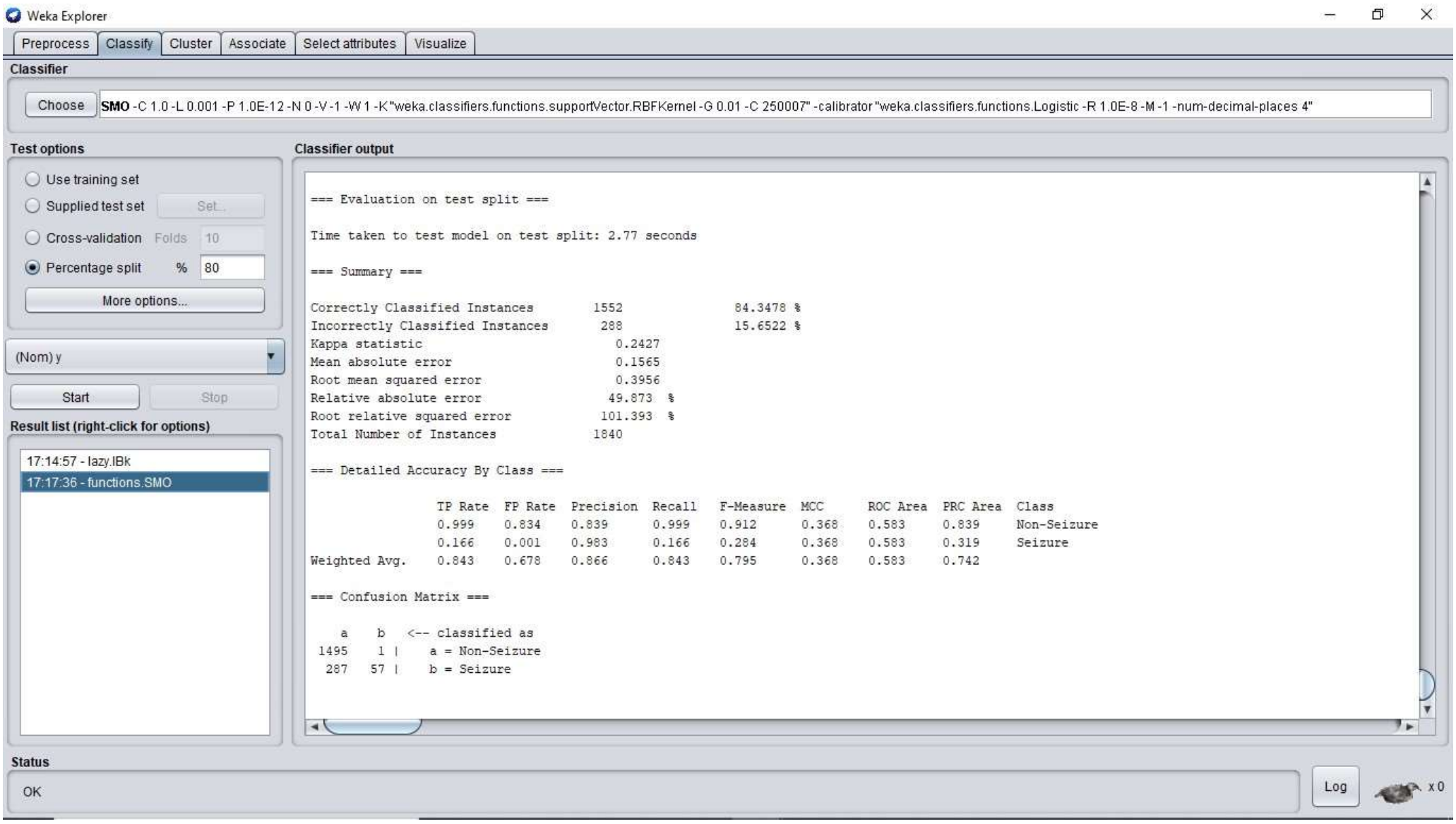
2.2.3. Trained model was tested using the test split and results are given below



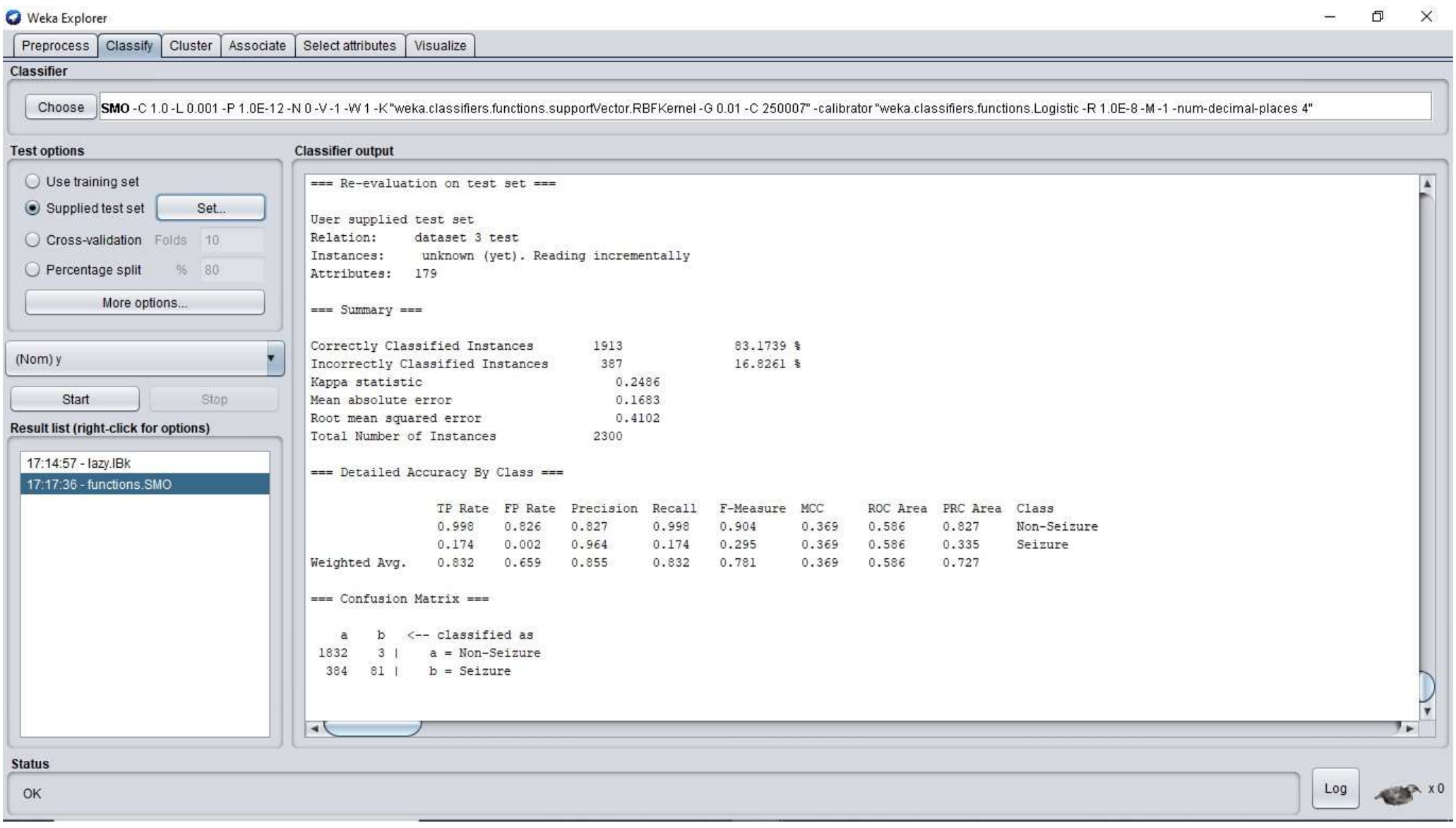
2.3. SVM with RBF kernel

2.3.1. The training dataset was split using percentage split of 80% for training and 20% for validation.

2.3.2. Dataset was trained and validated on SVM algorithm with RBF kernel and results are shown below.



2.3.3. Trained model was tested using the test split and results are given below



2.4. Comparing the performances of both model

2.4.1. Training set

	KNN	SVM	Baseline
Accuracy	95.05	84.34	81.3
Balanced Accuracy	87.1	58.25	50
Precision	95.3	86.6	66.1
Recall	95.1	84.3	81.3
AUC	**87.1**	**58.3**	**50**

We have 5 metrics here for comparing the performance of the algorithms, but we used AUC. KNN shows 87.1 but SVM generates only 58.3, whereas the baseline is only 50. In this case KNN is clearly outperforming SVM by almost 30% difference. This is because KNN is trying to predict both classes but SVM is really biased toward the majority class as seen in the confusion matrix. So false negatives increase in SVM and sensitivity decreases so AUC also decreases. **So KNN is performing well with low False Negatives of 88 over SVM which has 287 False Negatives. Both algorithms perform better than the baseline.**

2.4.2. Test set

	KNN	SVM
Accuracy	94.34	83.17
Balanced Accuracy	86.18	58.62
Precision	94.7	85.5
Recall	94.3	83.2
AUC	**86.2**	**58.6**

Obviously, test set predictions are not different from the training set. KNN is having better AUC of 86.2 as compared to SVM with 58.6. Even though KNN almost have a 1% reduction from the training AUC, it is still performing well considering the fact that test data was unseen by the algorithm. But SVM is still struggling to recognize the minority class. SVM has an AUC of only 58.6 as SVM is only trying to predict non- seizure or the majority class, this really increasing the false negatives just like what happened with validation AUC. And as a result, sensitivity decreases, and AUC also decreases.

Significant Test using confidence interval

Significant test was performed on AUC results of both KNN and SVM algorithms. Confidence interval of 95% is chosen for the test,

i. Confidence interval for KNN.

AUC / Error = 0.862
Z for 95% = 1.96
Number of samples (n) = 2300

$$error \pm Z \sqrt{error\ .\frac{1-error}{n}}$$

$$=0.862 \pm 1.96\sqrt{0.862.\frac{1-0.862}{2300}}$$

$$=\mathbf{0.862 \pm 0.014}$$

ii. Confidence interval for SVM.

AUC / Error = 0.586
Z for 95% = 1.96
Number of samples (n) = 2300

$$error \pm Z \sqrt{error\ .\frac{1-error}{n}}$$

$$= 0.586 \pm 1.96\sqrt{0.586.\frac{1-0.586}{2300}}$$

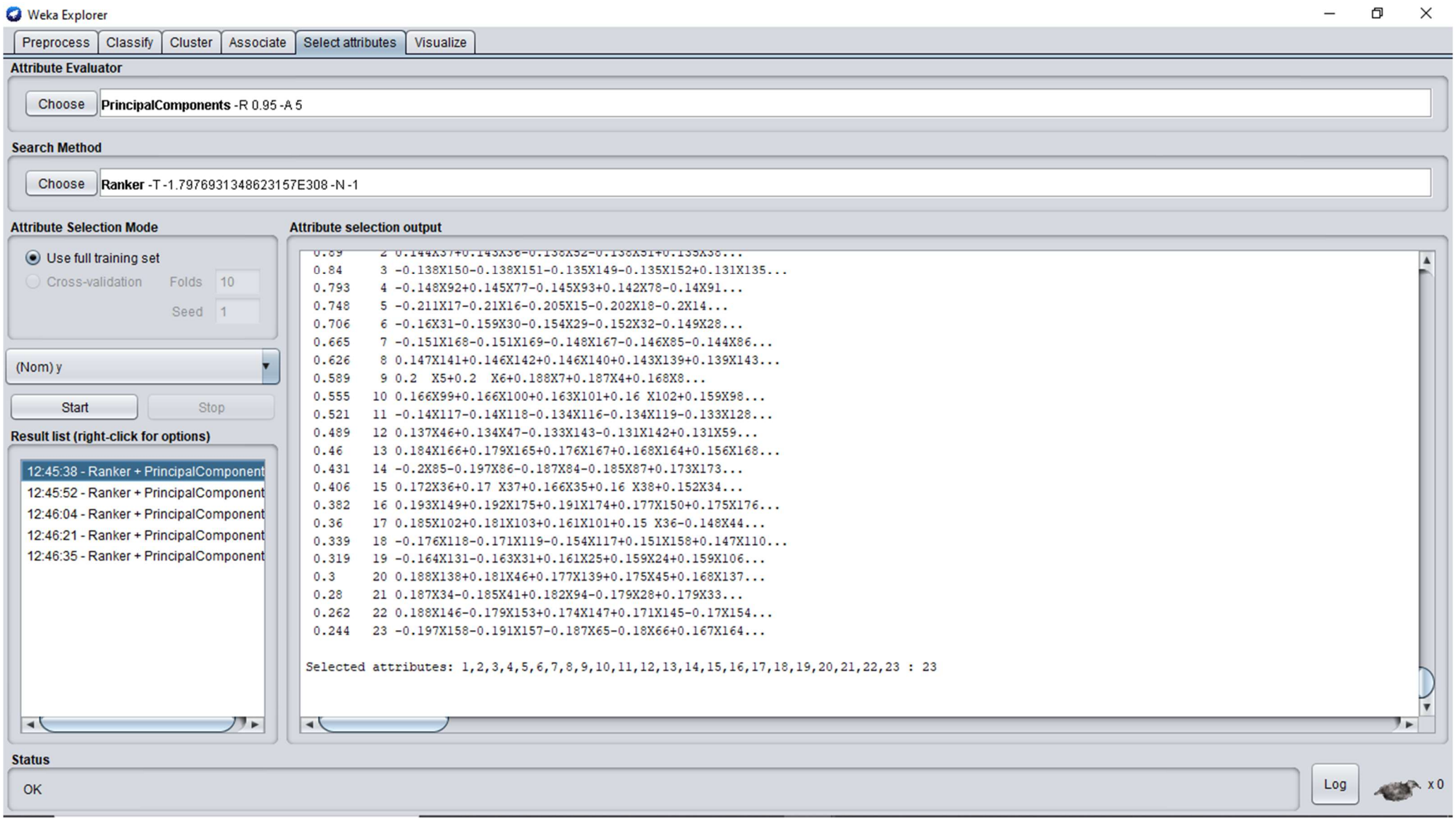
$$= \mathbf{0.586 \pm 0.0303}$$

Significant test shows a figure of 0.862 ± 0.014 for KNN and 0.586 ± 0.0303 SVM at 95% confidence interval. This clearly signifies that the KNN algorithm is far more accurate in seizure vs non-seizure classification than SVM algorithm.

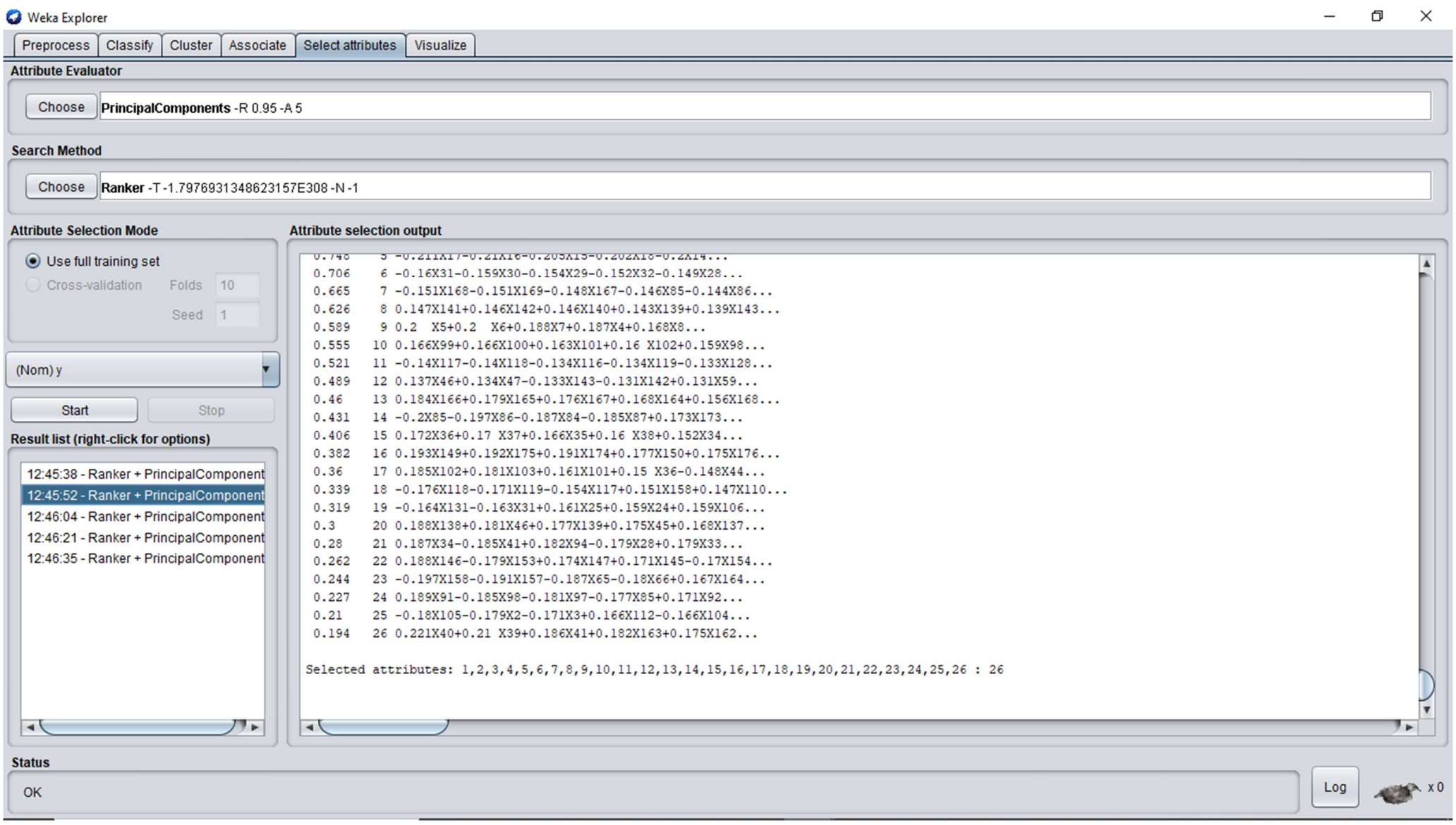
3. Task 3– Applying Principal Component Analysis

PCA was applied to the train data set and variance covered was given 5 different values to study the relationship between number of principal component and percentage of variance covered. Variance was set at 0.75, 0.8, 0.85, 0.9 and 0.95 and number of principal components increased as variance increased.

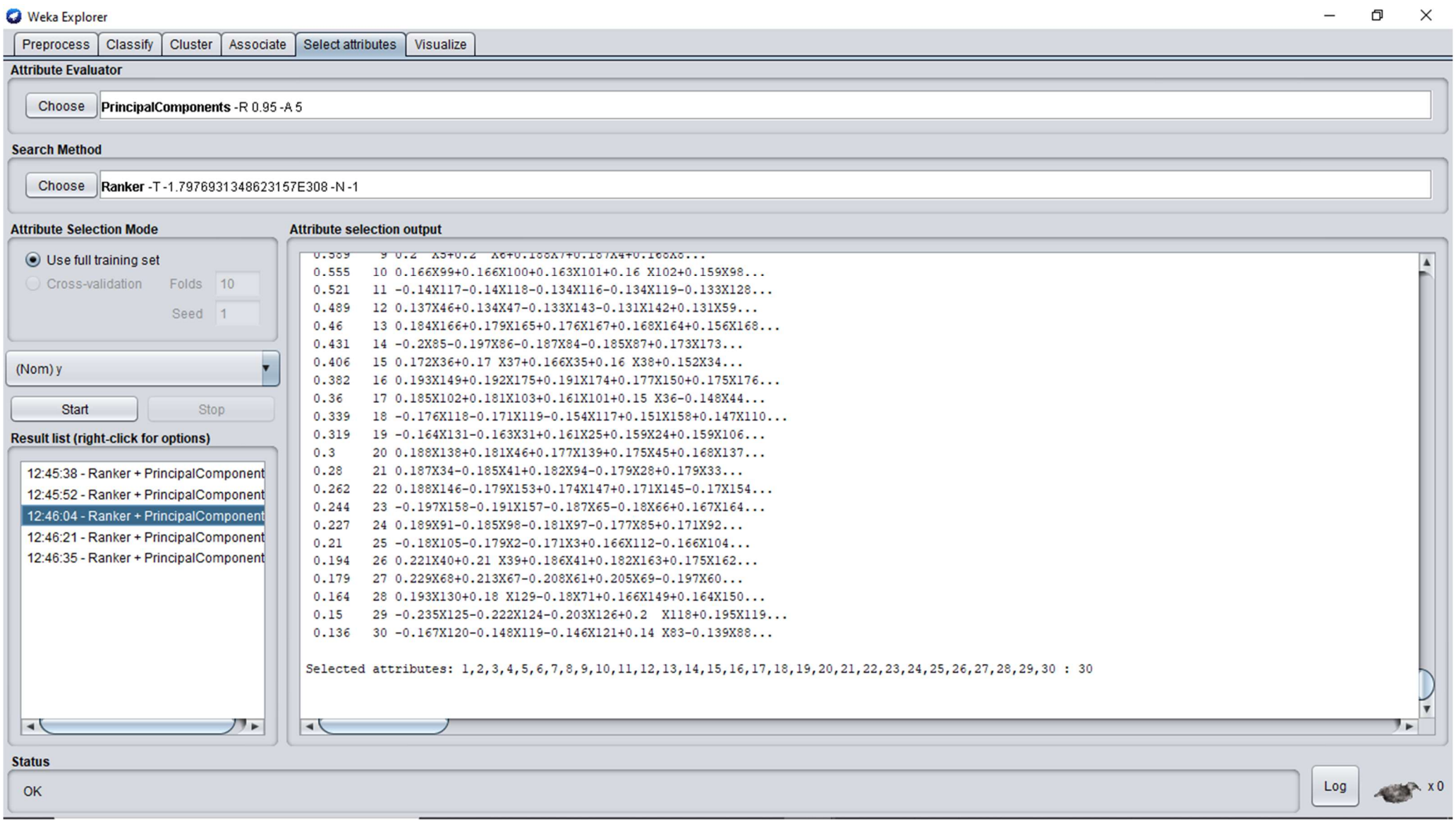
3.1. Variance set to 0.75



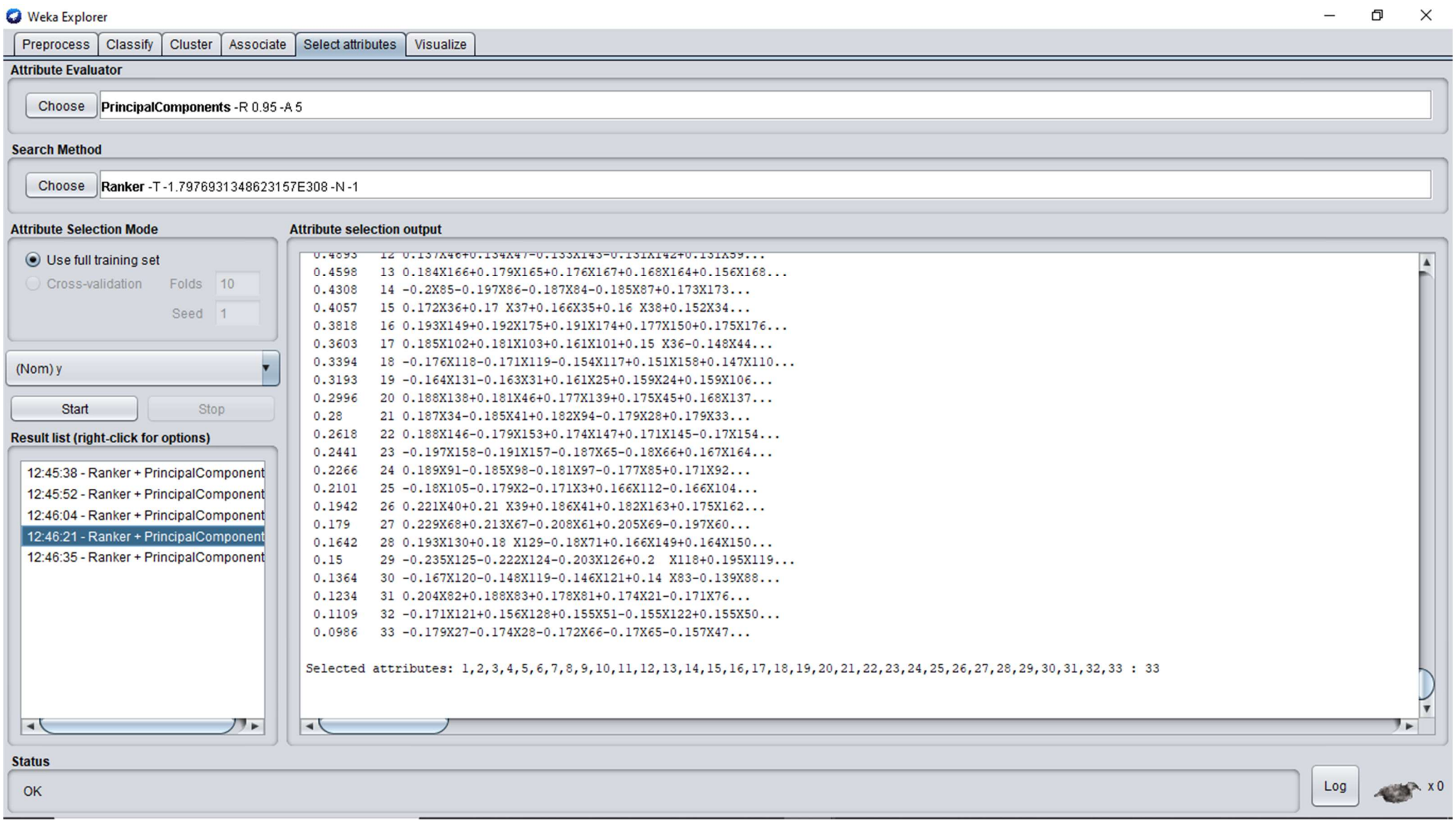
3.2. Variance set to 0.80



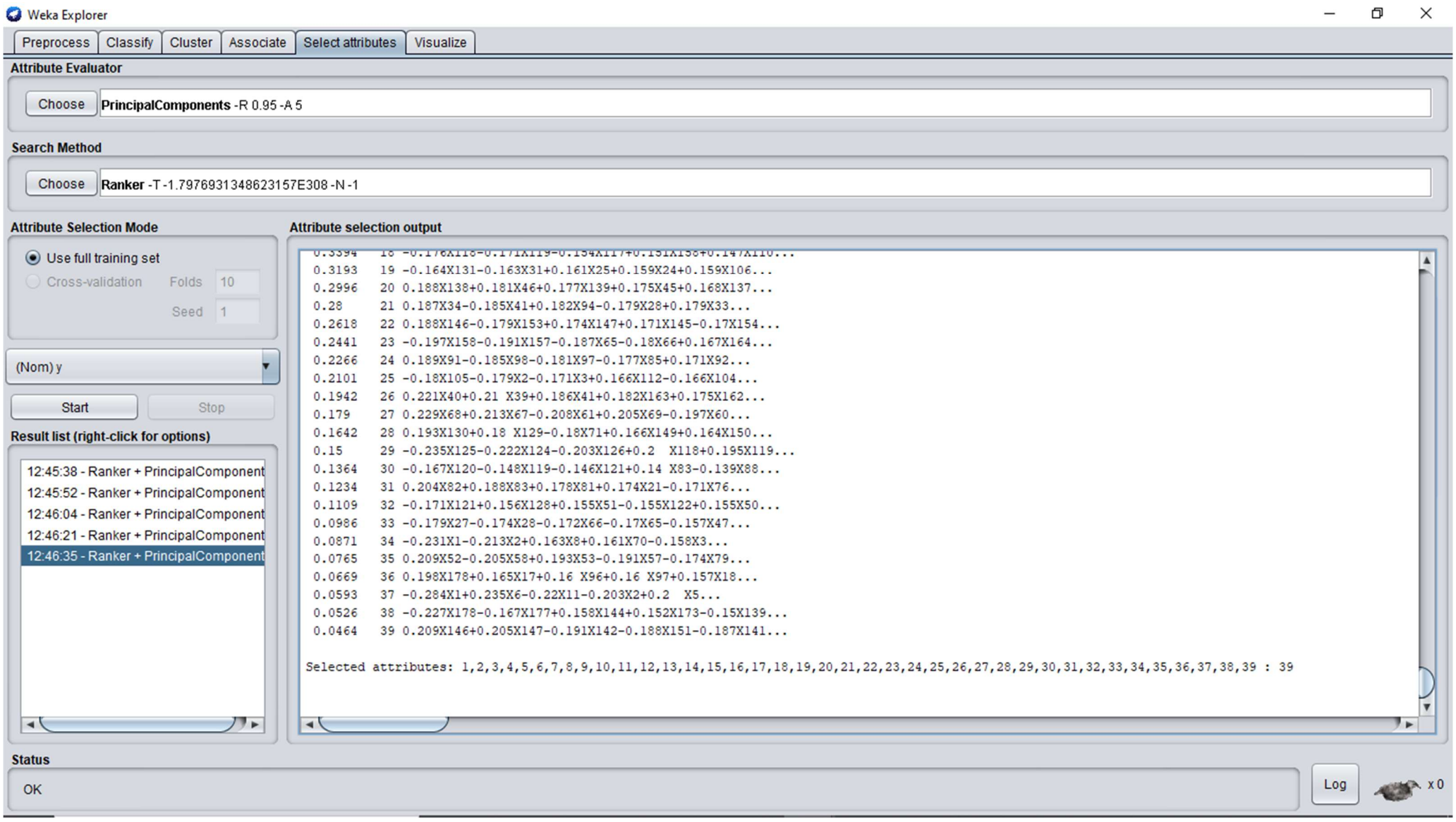
3.3. Variance set to 0.85



3.4. Variance set to 0.90



3.5. Variance set to 0.95



	No. of Principal Components	Variance Covered	AUC (KNN)
1	39	0.95	85.7
2	33	0.9	85.3
3	30	0.85	85.5
4	26	0.8	86.6
5	23	0.75	87.5

A total of 178 variables were present before applying PCA. These 178 variables were reduced to just 23 principal components when the variance was set at 75%. Then variance was increased to 80%, which increased the principal component to 26. Again, variance was increased to 85%, where the principal component rose by 4 units, to 30 in total. Furthermore, principal components were 33 when the variance were increased by 5%. Finally, the variance was set to 95% to get the highest number of principal components, which is 39. **To conclude, as the number of principal components increased accordingly the variance also increased.**

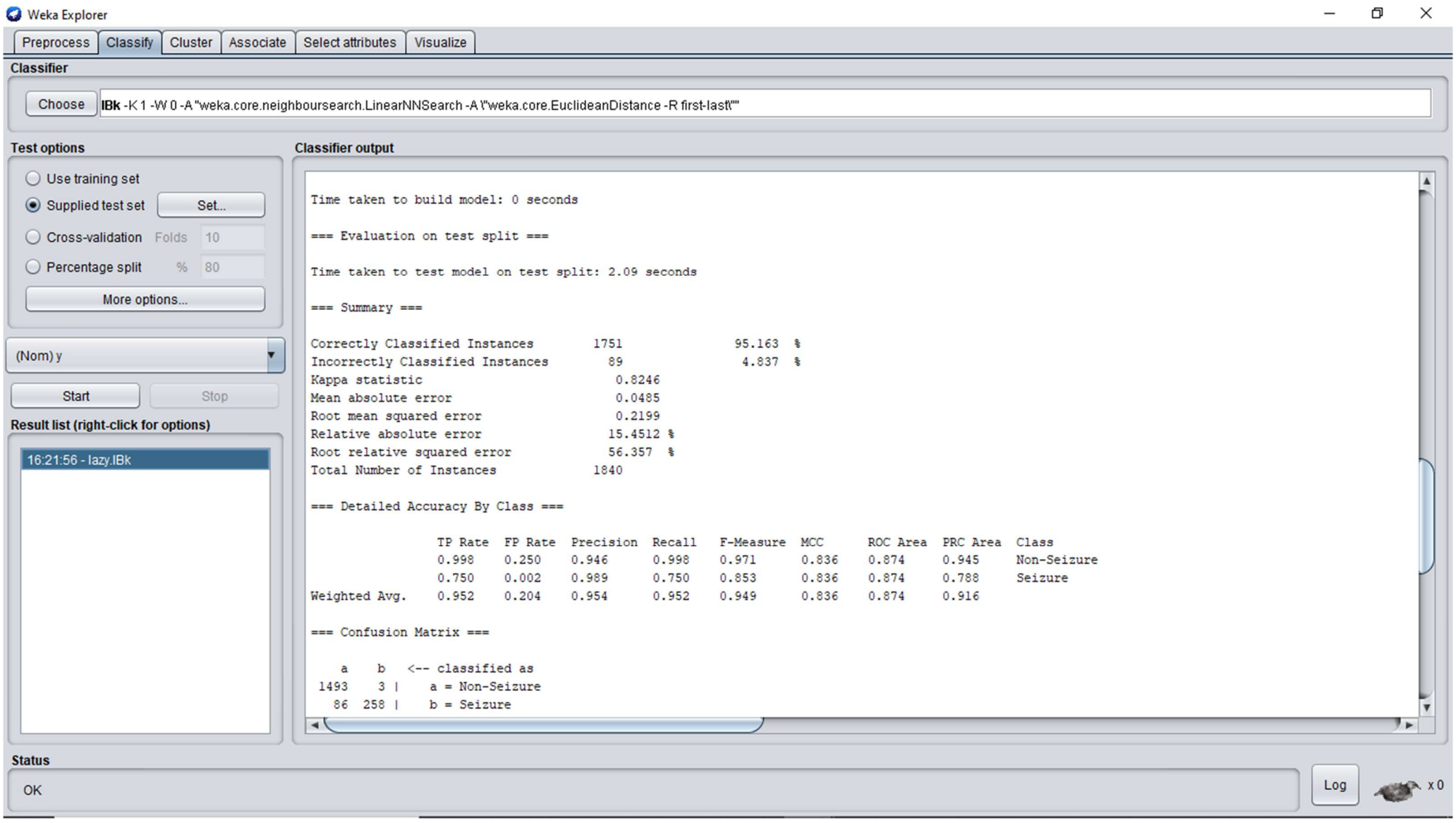
A total of 178 variables were present before applying PCA, where the AUC is 87.1. These 178 variables were reduced to 39 principal components when the variance was set at 95%. Even after there is a reduction of 139 variables AUC is 85.7. Then variance was decreased to 90%, which decreased the principal component to 33 and AUC was also reduced slightly to 85.3. Again, variance was decreased to 85%, where the principal component dipped by 3 units, to 30 in total, but AUC was increased to 85.5. Then principal components were 26 when the variance was decreased by 5% and AUC was at 86.6. Finally, the variance was set to 75% to get the least number of principal components, which is 23. But the important thing is with only 23 principal components AUC of 87.5 was achieved which is greater than the AUC with 178 variables. **To conclude, as the number of principal components decreased accordingly the variance also decreased and at 75% variance algorithm was able to predict with better AUC with just 23 variables rather than 178.**

4. Task 4– Feature selection

The dataset contains 178 attributes contributing to the accuracy of the model and **Cfs subset algorithm** was implemented to reduce the number of attributes. As a result 178 attributes was reduced to 55 attributes, (1,4,6,9,13,16,19,23,26,30,32,36,38,41,46,51,55,61,64,69,74,77,79,85,89,91,94,97,98,101,104,106,111, 113,115,118,122,125,127,128,131,138,140,142,143,146,153,156,161,164,167,168,173,174,178) are the selected attributes.

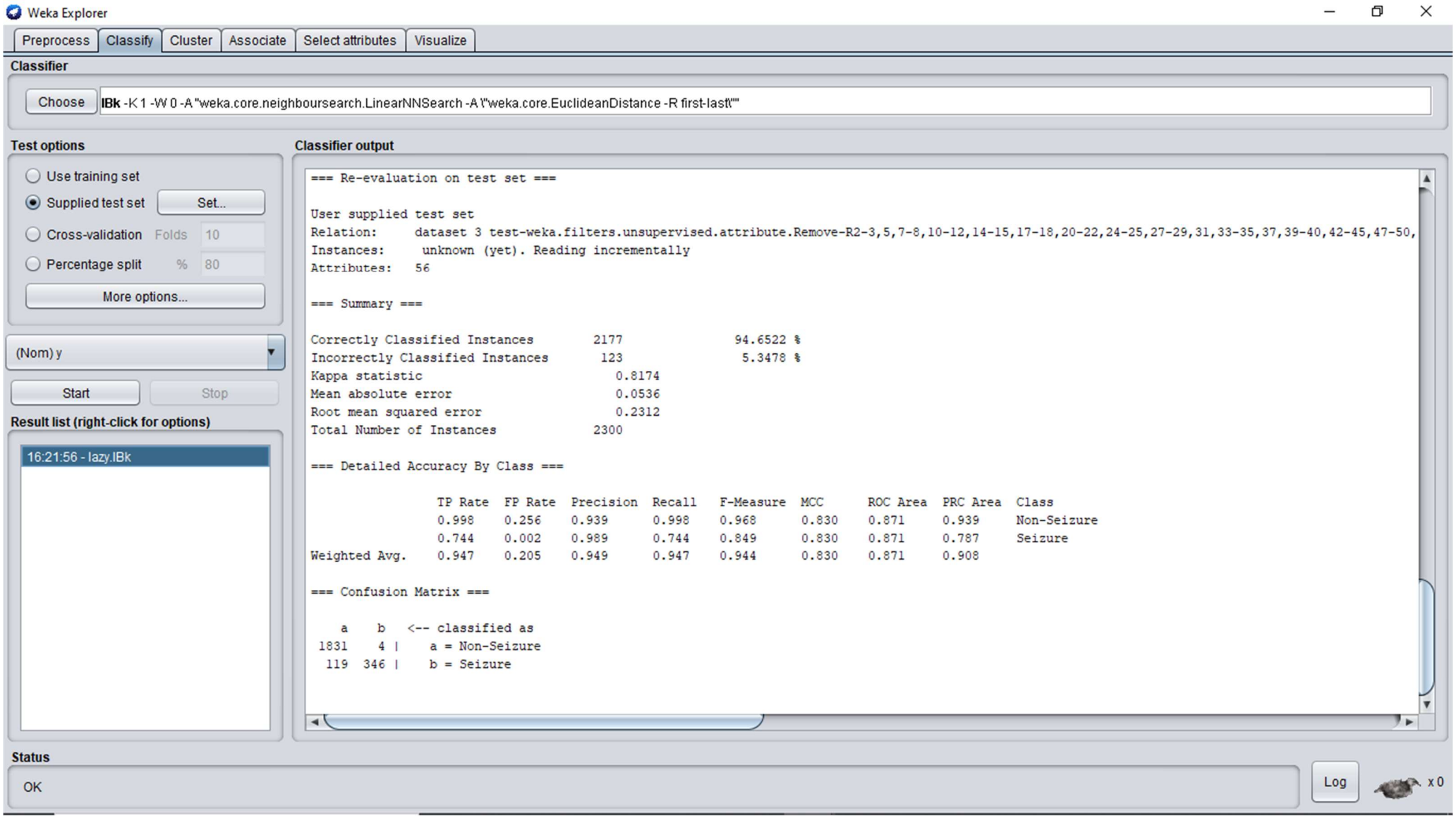
4.1. Training the KNN model with feature selected dataset.

KNN algorithm is used again for training the model and unprocessed dataset is replaced with feature selected and reduced dataset.



4.2. Testing the model

The test dataset was manually modified to become similar like the train dataset.



4.3. Comparing the performances of both dataset

4.3.1. Training performance

	Unprocessed Dataset	Feature selected	Baseline
Accuracy	95.05	95.16	81.3
Balanced Accuracy	87.1	87.4	50
Precision	95.3	95.4	66.1
Recall	95.1	95.2	81.3
AUC	**87.1**	**87.4**	**50**

As the table illustrates every parameter increased when the feature selected dataset was used. AUC increased from 87.1 in the primitive dataset to 87.4 in the feature selected dataset. This is because False Negatives decreased by 2 units and True Negative increased the same. Even though the number is increment is relatively low, but the algorithm is moving in the right direction.

4.3.2. Test-set performance

	Unprocessed Dataset	Feature selected
Accuracy	94.34	94.65
Balanced Accuracy	86.18	87.09
Precision	94.7	94.9
Recall	94.3	94.7
AUC	**86.2**	**87.1**

Table shows a similar trend as shown in the train comparison, the feature selected model is producing better numbers in all the performance measuring criteria. The AUC increased from 86.2 to 87.1 in the later model. This is due to the increase in True Negatives from 337 to 346 and decrease of False Negatives from 128 to 119.

Significant Test using confidence interval

Significant test was performed on AUC results of feature selected dataset is calculated. Since we have already calculated the value for unprocessed data set, which is **0.862 ± 0.014.** Confidence interval of 95% is chosen for the test,

i. Confidence interval for KNN.

AUC / Error = 0.871
Z for 95% = 1.96
Number of samples (n) = 2300

$$error \pm Z \sqrt{error \,.\frac{1-error}{n}}$$

$$=0.871 \pm 1.96\sqrt{0.871.\frac{1-0.871}{2300}}$$

$$=\mathbf{0.871 \pm 0.0136}$$

Significance test clearly shows the difference in performance, unprocessed dataset had **0.862 ± 0.014** and feature selected dataset improves to **0.871 ± 0.0136** at 95% confidence.

After comparing the results, feature selection improves the model when compared to un-processed dataset.

5. Task 5– Time required to build the models.

	KNN	SVM
Un-processed	0.01	306.26s
Feature Extracted	0	79.25 s

As KNN is a lazy algorithm it doesn't require much time to build a model, still there is a difference small difference between un-processed having 0.01s and feature extracted having 0s to build the model. This difference can be exploited when using a larger dataset than what we are using now. There is a 6s delay when validating on the un-processed dataset, but it was reduced to 2s in the later stage. When using algorithms like SVM there is a significant difference between the time taken to create the model. SVM takes 306.26s to create a model using the un-processed dataset but only takes 79.25s to create using feature selected dataset. **This implies feature selected method is 4-5 times faster than un-processed dataset.**

References

Brems, M., 2017. A One-Stop Shop for Principal Component Analysis. [Online]
Available at: https://towardsdatascience.com/a-one-stop-shop-for-principal-component-analysis-5582fb7e0a9c
[Accessed: 29 May 2020].

Brownlee, J., 2014. An Introduction to Feature Selection. [Online]
Available at: https://machinelearningmastery.com/an-introduction-to-feature-selection/ [Accessed: 29 May 2020].

Brownlee, J., 2014. Classification Accuracy is Not Enough: More Performance Measures You Can Use. [Online]
Available at: https://machinelearningmastery.com/classification-accuracy-is-not-enough-more-performance-measures-you-can-use/ [Accessed: 30 May 2020].

Cygnis Media Editor, 2020. How Machine Learning can be used in Ecommerce. [Online]
Available at: https://www.cygnismedia.com/blog/machine-learning-in-ecommerce/ [Accessed: 20 May 2020].

Cyrus, D., 2016. Create and Drop Database in MongoDB [Online]. Available from:
http://sd.blackball.lv/library/MongoDB_Cookbook_2nd_Edition_(2016).pdf [Accessed: 02 June 2020].

David, G., 2020. MongoDB: Examples [Online]. [MongoDB, Inc.]. Available from:
https://metacpan.org/pod/MongoDB::Examples#DATABASE-COMMANDS [Accessed:03 June 2020].

Expert System Team, 2020. What is machine learning. [Online]
Available at: https://expertsystem.com/machine-learning-definition/ [Accessed: 25 May 2020].

Gandhi, R., 2018. Support Vector Machine — Introduction to Machine Learning Algorithms. [Online]
Available at: https://towardsdatascience.com/support-vector-machine-introduction-to-machine-learning-algorithms-934a444fca47 [Accessed: 25 May 2020].

Gilmore, J. Neo4j Query Examples. [Online]. Github. Available at:
https://gist.github.com/wjgilmore/8ba5f31ef1435dc04c52 [Accessed: 29 May 2020].

John, O., 2017. Complex queries [Online]. [COMPOSE.]. Available from:
https://www.compose.com/articles/aggregations-in-mongodb-by-example/ [Accessed:02 June 2020].

Kristina, C., 2013. MongoDB, The Definitive Guide [Online]. [O'REILLY]. Available from:
https://usuaris.tinet.cat/bertolin/pdfs/mongodb_%20the%20definitive%20guide%20-%20kristina%20chodorow_1401.pdf [Accessed on: 02 June 2020].

Kyle, B., 2012. MongoDB in action [Online]. [MANNING]. Available from: https://pepa.holla.cz/wp-content/uploads/2016/07/MongoDB-in-Action-2nd-Edition.pdf [Accessed:04 June 2020].

Machine Learning Group, University of Waikato., 2019. WEKA. [Online]
Available at: https://www.cs.waikato.ac.nz/ml/weka/ [Accessed: 27 May 2020].

Melendez, S., 2019. [Online]
Available at: https://www.techwalla.com/articles/what-is-relational-database-schema [Accessed: 12 May 2020].

MongoDB, 2008. MongoDB operations [Online]. Available from: https://docs.mongodb.com/manual/aggregation/ [Accessed : 04 June 2020].

Navlani, A., 2018. KNN Classification using Scikit-learn. [Online]
Available at: https://www.datacamp.com/community/tutorials/k-nearest-neighbor-classification-scikit-learn [Accessed: 25 May 2020].

Pedregosa, F., 2011. Support Vector Machines. [Online]
Available at: https://scikit-learn.org/stable/modules/svm.html [Accessed: 25 May 2020].

Reif, J., 2018a. How Do You Know If a Graph Database Solves the Problem? [Online]. Available at:
https://medium.com/neo4j/how-do-you-know-if-a-graph-database-solves-the-problem-a7da10393f5 [Accessed: 29 May 2020].

Reif, J., 2018b. How Do You Know If a Graph Database Solves the Problem? [Online]. Available at:
https://medium.com/neo4j/how-do-you-know-if-a-graph-database-solves-the-problem-a7da10393f5 [Accessed: 29 May 2020].

Relational Databases vs. Graph Databases: A Comparison [Online]. Available at: https://neo4j.com/developer/graph-db-vs-rdbms/ [Accessed: 29 May 2020a].

Relational Databases vs. Graph Databases: A Comparison [Online]. Available at: https://neo4j.com/developer/graph-db-vs-rdbms/ [Accessed: 29 May 2020b].

Robinson, I., Webber, J. and Eifrem, E., 2013. Graph Databases. OReilly Media. Inc. , Sebastopol, United States.

Rocca, J., 2019. A simple introduction to Machine Learning. [Online]
Available at: https://towardsdatascience.com/introduction-to-machine-learning-f41aabc55264 [Accessed: 20 May 2020].

SINGH, C., 2020 Entity Relationship Diagram – ER Diagram in DBMS. [Online]
Available at: https://beginnersbook.com/2015/04/e-r-model-in-dbms/ [Accessed: 06 May 2020].

The 5 Best Science Magazines - by Magazine.co.uk, 2019. [Online]. Available at: https://www.magazine.co.uk/the-hub/the-5-best-science-magazines [Accessed: 29 May 2020].

Upadhyay, M., 2020a Second normal form. [Online]
Available at: https://www.geeksforgeeks.org/second-normal-form-2nf/ [Accessed: 13 May 2020].

Upadhyay, M., 2020b Third Normal Form (3NF). [Online]
Available at: https://www.geeksforgeeks.org/third-normal-form-3nf/ [Accessed: 15 May 2020].

W3 Schools, 2020 SQL intro. [Online]
Available at: https://www.w3schools.com/sql/sql_intro.asp [Accessed: 16 May 2020].

Wikipedia, 2020 Database normalization. [Online]
Available at: https://en.wikipedia.org/wiki/Database_normalization [Accessed: 18 May 2020].

Wikipedia, 2019. k-nearest neighbors algorithm. [Online]
Available at: https://en.wikipedia.org/wiki/K-nearest_neighbors_algorithm [Accessed: 25 May 2020].

Bakirov, R., 2020a. Lecture 2: Relational Data Model. [Online]. Unpublished.

Bakirov, R., 2020b. Lecture 3: SQL. [Online]. Unpublished.

Kostoulas, T., 2020. ML-Evaluation and significance. [Online]. Unpublished.