

Simple Storage Manager Implementation

Cmpe321 - Introduction to Database System

Semester: 3 (Summer Class)

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1.Introduction

This is the second part of the project which implementation takes apart. After designin the database, near %35 of the design is changed as expected. Yet, designing before implementing was really helpful, only some names and values are changed, plan is still same.

In this project i have implemented a simple database management system in JAVA programming language. This program creates a file if there is no exist, else read and write on that specific file. It holds only 1 file with the storage capacity 1MB. This storage manager also makes these 7 operations successfully.

DDL Operations:

1. Create a type
2. Delete a type
3. List all types

DML Operations:

1. Create a record
2. Delete a record
3. Search for a record (by primary key)
4. List all records of a type

2. Changes From Initial Design

2.1) Assumptions & Constraints

This is where the changes are shown from the initial design. Red characters represents the old design. Red character = "it is deleted!!" ... Blue character = "Created new!!"

- Page size : **1KB** - **1240 Bytes** per each
- Type header includes; **name of types**, primaryKey, **numberOfPages**, **numberOfRecords**, pointer to next type, **isEmpty** and **newType<ID>**
- Page header includes; pageID, isEmpty, **numberOfRecords**, pointerToNextPage and **newPage**
- Record header includes; recordID, **pageID**, **isEmpty**, **pointerToNextRecord**, primaryKey and **newRecord<ID>**
- Max number of fields a type can have: 9 fields for each record.
- Max length of a type name: 10 bytes

- Max length of a field name: 10 bytes
- These assumptions mean $9 \times 10 + 10 + 20 =$ approximately 120bytes for each record and maximum record number in each page is 10. $120 \times 10 =$ approximately 1200Bytes + 40Bytes for page Header = 1240 Bytes per page as default.
- Fixed number of fields. 9 for each record starting with null.
- Max number of type that DBMS or SystemCatalog can have 10 types. 1 type has 75 pages with approximately 100KB. Because storage manager can have 1MB max. $1000/100 = 10$ type maximum.
- System Catalog includes, Number of pages, types and records. Besides that it also keep the record of Storage information and type names that created. Sys Catalog keeps 210Bytes.

2.3) Data Structures

2.3.1 System Catalog

System Catalog is a file to store meta data inside of it including type names, type numbers, page numbers and record Numbers. It also keeps pages are empty or not to decide and operate fast. System Catalog also keeps the records of Storage information to decide it exceed 1MB or not.

2.3.2 Type Structure

This part where the types are differ in each other and locates under that file. Number of fields are fixed to 9 it doesn't need to keep that record. Beside of that every type has its own primary key and ID to keep and fill records easily. It also keeps how many records and pages are in that type. Also pointer to next type to operate fast. It also has newType<ID> to determine exact location of the database to be able to do Read&Write. There is also field at footer which is called "endRecord<ID> to decide if the type is finished or not.

2.3.3 Page Structure

Pages are under types and maximum size of 1240 per each. 1 page will has approximately 10 at most 9 records at most if we count 120bytes for each record. Page header will have its own "pageID", look if this page is empty or not by checking "isEmpty" and it will help to operate fast in this structure, keeps "numberOfRecords", and has a pointer to go fast to next page "pointerToNextPage". newPage<ID> to decide position.

2.3.4 Record Structure

The data will come records' fields. First it will look for the records capacity by checking isEmpty. If it's still empty than the data record goes one of the "Null" Fields and replace with it. Every record has its own primary Key and ID to track it easily. With primary key, records have also newRecord<ID> to check double to find exact location. With combination of PK and ID, surely the keyword can be found.

Type Header

- Name of type
- Primary Key
- Pointer to next type
- Number of pages
- Number of Records
- newType<ID>

Page Header

- pageID
- numberOfRecords
- pointerToNextPage
- isEmpty
- newPage<ID>

Record Header

- ```
- recordID -pageID -isEmpty
- primaryKey - *toNextRec -newRec<ID>
```

Field #1

Field #2

Field #3

Field #4

...

Field #9

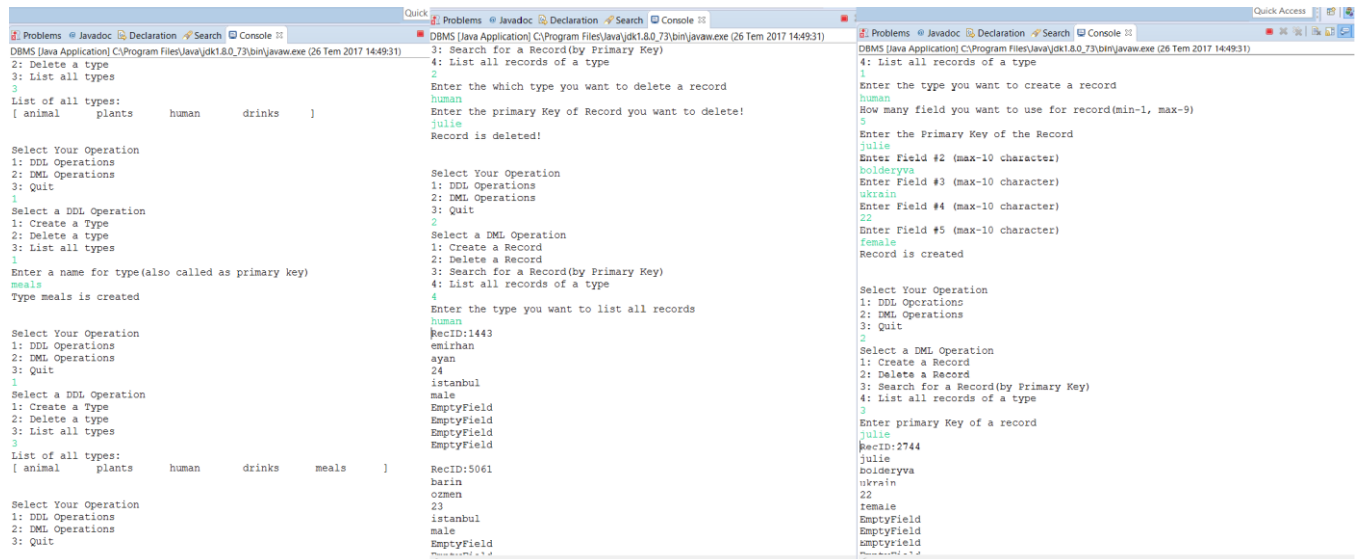


## Type Footer

- endType<ID>

### 3. Sample Output

Here are some operation outputs of the program. It creates type, list the types, deletes a record, list all records and creates a record starting from the beginning in the first picture.



```
DBMS [Java Application] C:\Program Files\Java\jdk1.8.0_73\bin\javaw.exe (26 Tem 2017 14:49:31)
2: Delete a type
3: List all types
3
List of all types:
{ animal plants human drinks }

Select Your Operation
1: DDL Operations
2: DML Operations
3: Quit
1
Select a DDL Operation
1: Create a Type
2: Delete a type
3: List all types
1
Enter a name for type(also called as primary key)
meals
Type meals is created

Select Your Operation
1: DDL Operations
2: DML Operations
3: Quit
2
Select a DML Operation
1: Create a Record
2: Delete a Record
3: Search for a Record(by Primary Key)
4: List all records of a type
1
Enter the which type you want to delete a record
human
Enter the primary Key of Record you want to delete!
julie
Record is deleted!

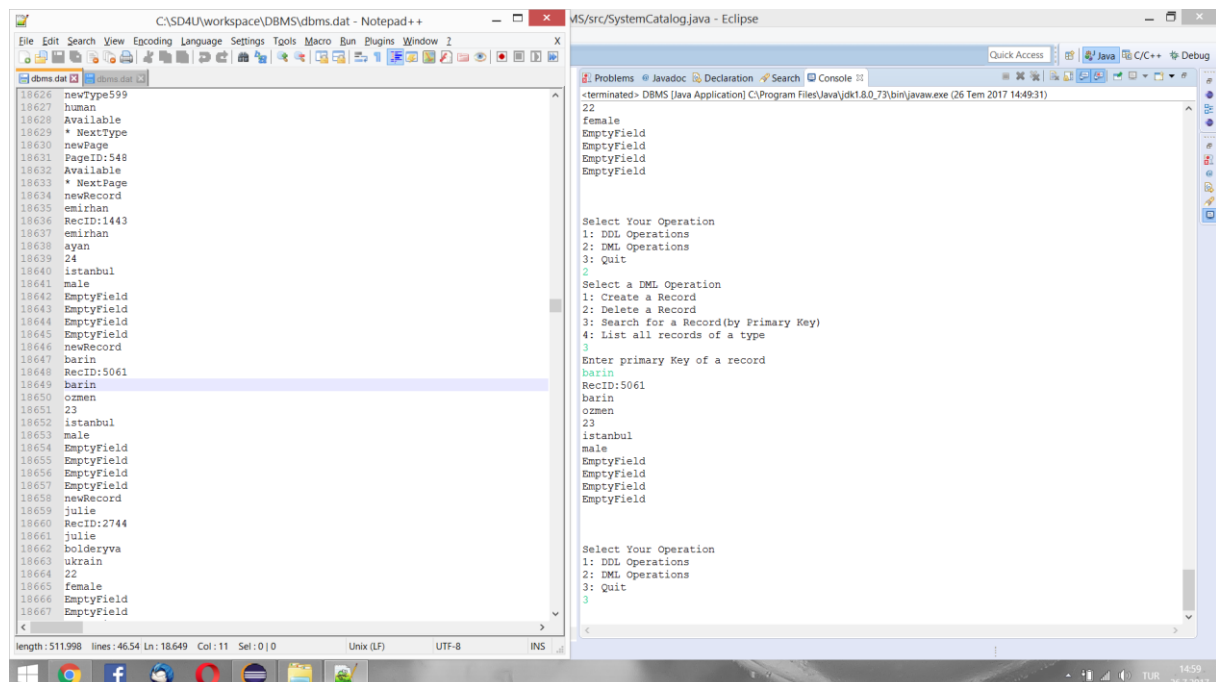
Select Your Operation
1: DDL Operations
2: DML Operations
3: Quit
2
Select a DML Operation
1: Create a Record
2: Delete a Record
3: Search for a Record(by Primary Key)
4: List all records of a type
4
Enter the type you want to list all records
human
RecID:1443
emirhan
ayan
24
istanbul
male
EmptyField
EmptyField
EmptyField
EmptyField

RecID:5061
barin
ozmen
23
istanbul
male
EmptyField

DBMS [Java Application] C:\Program Files\Java\jdk1.8.0_73\bin\javaw.exe (26 Tem 2017 14:49:31)
4: List all records of a type
3
Enter the type you want to create a record
human
How many field you want to use for record(min-1, max-9)
5
Enter the Primary Key of the Record
julie
Enter Field #2 (max-10 character)
bolderyva
Enter Field #3 (max-10 character)
ukrain
Enter Field #4 (max-10 character)
22
Enter Field #5 (max-10 character)
female
Record is created

Select Your Operation
1: DDL Operations
2: DML Operations
3: Quit
2
Select a DML Operation
1: Create a Record
2: Delete a Record
3: Search for a Record(by Primary Key)
4: List all records of a type
3
Enter primary Key of a record
julie
RecID:2744
julie
bolderyva
ukrain
22
femaile
EmptyField
EmptyField
EmptyField
```

Search an operation for the specific primary key of a record. And also shown in the database file (dbms.dat) line by line.



```
C:\SD4U\workspace\DBMS\dbms.dat - Notepad++
18626 newType599
18627 human
18628 Available
18629 * NextType
18630 newPage
18631 PageID:548
18632 Available
18633 * NextPage
18634 newRecord
18635 emirhan
18636 RecID:1443
18637 emirhan
18638 ayan
18639 24
18640 istanbul
18641 male
18642 EmptyField
18643 EmptyField
18644 EmptyField
18645 EmptyField
18646 newRecord
18647 barin
18648 RecID:5061
18649 barin
18650 ozmen
18651 23
18652 istanbul
18653 male
18654 EmptyField
18655 EmptyField
18656 EmptyField
18657 EmptyField
18658 newRecord
18659 julie
18660 RecID:2744
18661 julie
18662 bolderyva
18663 ukrain
18664 22
18665 female
18666 EmptyField
18667 EmptyField

length:511998 lines:4654 Ln:18649 Col:11 Sel:0|0 Unix (LF) UTF-8 INS

MS/src/SystemCatalog.java - Eclipse
-terminated> DBMS [Java Application] C:\Program Files\Java\jdk1.8.0_73\bin\javaw.exe (26 Tem 2017 14:49:31)
22
female
EmptyField
EmptyField
EmptyField
EmptyField

Select Your Operation
1: DDL Operations
2: DML Operations
3: Quit
2
Select a DML Operation
1: Create a Record
2: Delete a Record
3: Search for a Record(by Primary Key)
4: List all records of a type
3
Enter primary Key of a record
barin
RecID:5061
barin
ozmen
23
istanbul
male
EmptyField
EmptyField
EmptyField
EmptyField

Select Your Operation
1: DDL Operations
2: DML Operations
3: Quit
3
```

The last picture is about deleting a type and how it affects to database file.

```
DBMS [Java Application] C:\Program Files\Java\jdk1.8.0_73\bin\java.exe (26 Tem 2017 14:49:31)
2: Delete a type
3: List all types
3
List of all types:
[animal plants human drinks meals]

Select Your Operation
1: DDL Operations
2: DML Operations
3: Quit
1
Select a DDL Operation
1: Create a Type
2: Delete a type
3: List all types
2
Enter name(primary key) of the type
plants
Type plants is deleted from the DataBase

Select Your Operation
1: DDL Operations
2: DML Operations
3: Quit
1
Select a DDL Operation
1: Create a Type
2: Delete a type
3: List all types
3
List of all types:
[animal human drinks meals]

Select Your Operation
1: DDL Operations
2: DML Operations
3: Quit

dbms.dat
1 Number Of Types: 4
2 Number of Pages: 300
3 Number of Records: 9
4 Storage Info: 1MB/511998
5 TypeName
6 animal
7
8 human
9 drinks
10 meals
11
12
13
14
15
16 newType989
17 animal
18 Available
19 * NextType
20 newPage
21 PageID:306
22 Available
23 * NextPage
24 newRecord
25 bird
26 RecID:2235
27 bird
28 joe
29 jackson
30 male
31 EmptyField
32 EmptyField
33 EmptyField
34 EmptyField
35 EmptyField
36
37
38
39
40
41
42
length: 511.998 lines: 46.54 Ln: 18.649 Col: 6 Sel: 5 | 1 Unix (LF) UTF-8 INS
```

## 4. Conclusion and Assessment

In this project, i learn how a database management systems' alghoritms work. From the beginning of it with designing and implementing onto a java code, most of the database concepts are learned well not only the techniques of it but also as a real time experiance. Whole system works well unless the user doesn't write wrong inputs. Yet, sentece written in the project description block that situation which is "Assume user always inputs valid data."