CSI 402 – Spring 2012

Programming Assignment III

Administrative Information

- **Deadline:** 11 PM, Friday, Mar. 23, 2012.

  Cutoff: 11 PM, Friday, Mar. 25, 2011.

  Note: **The due dates mentioned in the handout are incorrect**. Please correct them. (Correct dates appear in the online version of the handout.)

- The program must have two or more C source files.

- All the files (C source files, header files and the `makefile`) must be submitted together using the `turnin-csi402` command.

- README file

  `~csi402/public/prog3/prog3.README`

  will be available by 10 PM on Saturday, Mar. 10, 2012.

- The `README` file will contain information regarding `turnin-csi402` and additional specifications for the `makefile`.

Project Description

Goal: To implement a relational database system that supports simple retrieval queries.

Weightage: 10%

Total Points: 100 (Correctness: 85, Str. & doc: 15).

Relational Databases:

- Data stored as relations (tables).
- The database may have many relations.

Relational Databases (continued)

Example: Relation `Roster`.

Name	Major	Totcr	Majcr
Smith, Bob	PSY	57	30
Woods, Jane	CSI	64	39
Baker, Norma	PSY	57	48

Notes:

- `Name`, `Major`, `Totcr`, `Majcr`: Attributes.
- Each row of data: Tuple.

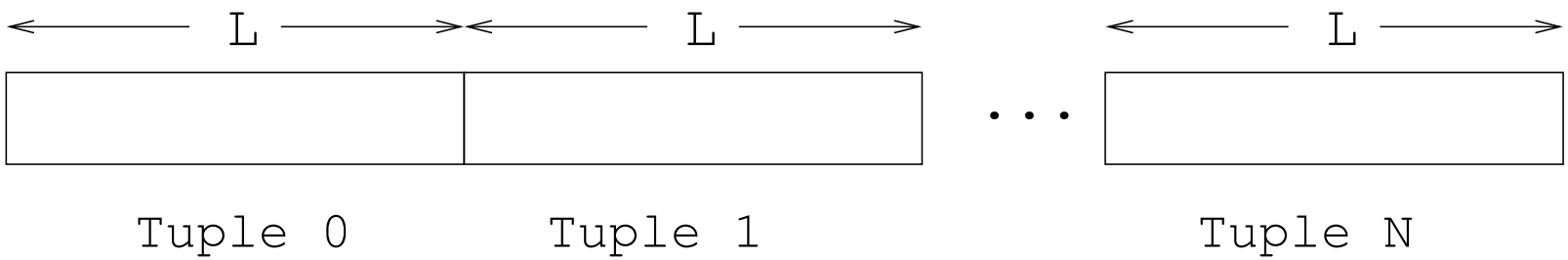
Relational Databases (continued)

- The **schema** for each relation gives:
  - Name of each attribute.
  - Type of each attribute (`'I'` or `'S'`).
  - Length (in bytes) for each attribute.
- Length of each tuple (in bytes) = Sum of the lengths of the attributes.

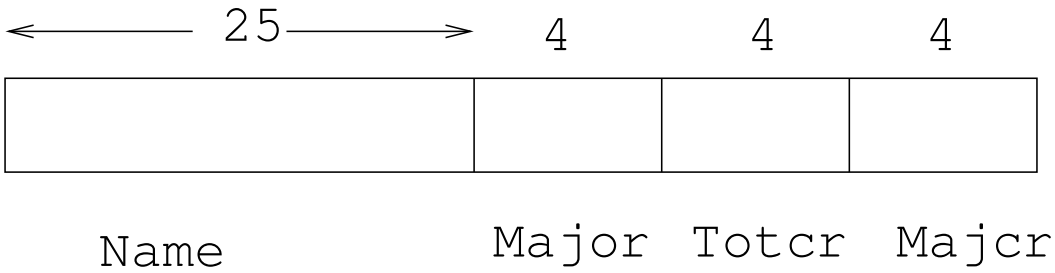
Relational Databases (continued)

How tuples are stored:

- In a binary file.
- Each tuple is of the same length (which can be determined from the schema information).



Example – Tuple for the `Roster` Relation:



Length of each tuple = 37 bytes.

Notes:

- Length of each integer attribute = 4 bytes.
- Length of each string attribute includes the byte for `'\0'`.

Operations on Relations

(a) Number of attributes of a relation:

Example Query:

```
nattr    Roster
```

Result:

```
4
```

(b) Length of each tuple of a relation:

Example Query:

```
tuplen    Roster
```

Result:

```
37
```

Operations on Relations (continued)

(c) Information about an attribute of a relation:

Example Query I:

```
infattr    Roster    Majcr
```

Result:

```
Attribute type   :  Integer
Attribute length :  4
```

Example Query II:

```
infattr    Roster    Name
```

Result:

```
Attribute type   :  String
Attribute length :  25
```

Operations on Relations (continued)

(d) Counting the number of tuples:

Example Query:

```
count    Roster
```

Result:

```
3
```

(e) Projection on an attribute:

- Outputs the values found in the specified column.
- Duplicates must be removed.

Operations on Relations (continued)

Example I:

```
project   Roster   Major
```

Result:

```
PSY
CSI
```

Example II:

```
project   Roster   Totcr
```

Result:

```
57
64
```

Operations on Relations (continued)

(f) Selection under a condition:

- Outputs each tuple that satisfies the condition.

Example I:

```
select  Roster  Major == "PSY"
```

Result:

```
Smith, Bob    PSY     57    30
Baker, Norma  PSY     57    48
```

Operations on Relations (continued)

Selection under a condition (continued)

Example II:

```
select   Roster   Totcr  >  60
```

Result:

```
Woods, Jane   CSI     64    39
```

Unix Command Line Details

% `p3` *configfile* *queryfile*

- `p3`: Executable version of your program.
- *configfile*:
  - Specifies the name of a text file (called the **configuration** file).
  - First line: No. of relations in the database.
  - Each subsequent line: Name of one relation.
  - Implicitly specifies the name of the schema file and the data file for each relation.

Note: For an example of a configuration file, see page 5 of the handout.

Unix Command Line Details (continued)

- *queryfile*:
  - Also a text file.
  - Each line has exactly one command. (In addition to `nattr`, `infattr`, `tuplen`, `count`, `project` and `select`, there is also the `quit` command.)

Assumptions:

- The configuration, schema and data files won't contain any errors.
- Each command in the query file will be one of `nattr`, `tuplen`, `infattr`, `count`, `project`, `select` or `quit`.
- Each command will have the correct number of arguments.

Errors to be Detected

- Errors to be detected for each command in the query file are discussed in the handout.
- When a command in the query file contains an error, your program should print an appropriate error message to `stdout` and process the next command. The program should stop only when the `quit` command is seen.
- Unix command line errors (e.g. wrong number of command line arguments, one of the specified files can't be opened) should be written to `stderr` and the program should stop right away.

Important Notes

- All responses to queries (including errors detected in queries) are written to `stdout`. Be sure to use be sure to use `fflush(stdout)` after each call to `printf`.
- Binary (data) files made available on `itsunix` may **not** work on other machines.

Watch Out!!

Your program processes a sequence of commands. If it exits abnormally (due to an error such as a segmentation fault) in the middle of the command sequence, you won't get any credit for the remaining commands in that sequence.

Additional Suggestions

- Implement one command at a time.
- For processing each command (except `quit`) have a separate C source file that contains all the functions needed to process that command.
- Review the use of standard C functions such as `fgets`, `strcmp`, `strtok` and `fseek`. (You will also be using `fread`.)