# Simple Database

In the Simple Database problem, you'll implement an in-memory database similar to Redis. For simplicity's sake, instead of dealing with multiple clients and communicating over the network, your program will receive commands via standard input (stdin), and should write appropriate responses to standard output (stdout).

## Guidelines

- We recommend that you use a high-level language, like Python, Go, Haskell, Ruby, or Java. We're much more interested in seeing clean code and good *algorithmic*performance than raw throughput.
- It is very helpful to the engineers who grade these challenges if you reduce external dependencies, make compiling your code as simple as possible, and include instructions for compiling and/or running your code directly from the command line, without the use of an IDE.
- Your submission must comply with the input/output formats and performance requirements specified below.

## Data Commands

Your database should accept the following commands:

- `SET` *`name`* *`value`* – Set the variable *name* to the value *value*. Neither variable names nor values will contain spaces.
- `GET` *`name`* – Print out the value of the variable *name*, or `NULL` if that variable is not set.
- `UNSET` *`name`* – Unset the variable *name*, making it just like that variable was never set.
- `NUMEQUALTO` *`value`* – Print out the number of variables that are currently set to*value*. If no variables equal that value, print `0`.
- `END` – Exit the program. Your program will always receive this as its last command.

Commands will be fed to your program one at a time, with each command on its own line. Any output that your program generates should end with a newline character. Here are some example command sequences:

| INPUT | OUTPUT |
|---|---|
| SET ex 10 | |
| GET ex | 10 |
| UNSET ex | |
| GET ex | NULL |
| END | |

| INPUT | OUTPUT |
|---|---|
| SET a 10 | |
| SET b 10 | |
| NUMEQUALTO 10 | 2 |
| NUMEQUALTO 20 | 0 |
| SET b 30 | |
| NUMEQUALTO 10 | 1 |
| END | |

## Transaction Commands

In addition to the above data commands, your program should also support database transactions by also implementing these commands:

- `BEGIN` – Open a new transaction block. Transaction blocks can be nested; a`BEGIN` can be issued inside of an existing block.
- `ROLLBACK` – Undo all of the commands issued in the *most recent* transaction block, and close the block. Print nothing if successful, or print `NO TRANSACTION` if no transaction is in progress.
- `COMMIT` – Close *all* open transaction blocks, permanently applying the changes made in them. Print nothing if successful, or print `NO TRANSACTION` if no transaction is in progress.

Any data command that is run outside of a transaction block should commit immediately. Here are some example command sequences:

```
  INPUT    OUTPUT
BEGIN
SET a 10
GET a      10
BEGIN
SET a 20
GET a      20
ROLLBACK
GET a      10
ROLLBACK
GET a      NULL
END
```

```
  INPUT         OUTPUT
BEGIN
SET a 30
BEGIN
SET a 40
COMMIT
GET a      40
ROLLBACK   NO TRANSACTION
COMMIT     NO TRANSACTION
END
```

```
  INPUT    OUTPUT
SET a 50
BEGIN
GET a      50
SET a 60
BEGIN
UNSET a
GET a      NULL
ROLLBACK
GET a      60
COMMIT
GET a      60
```

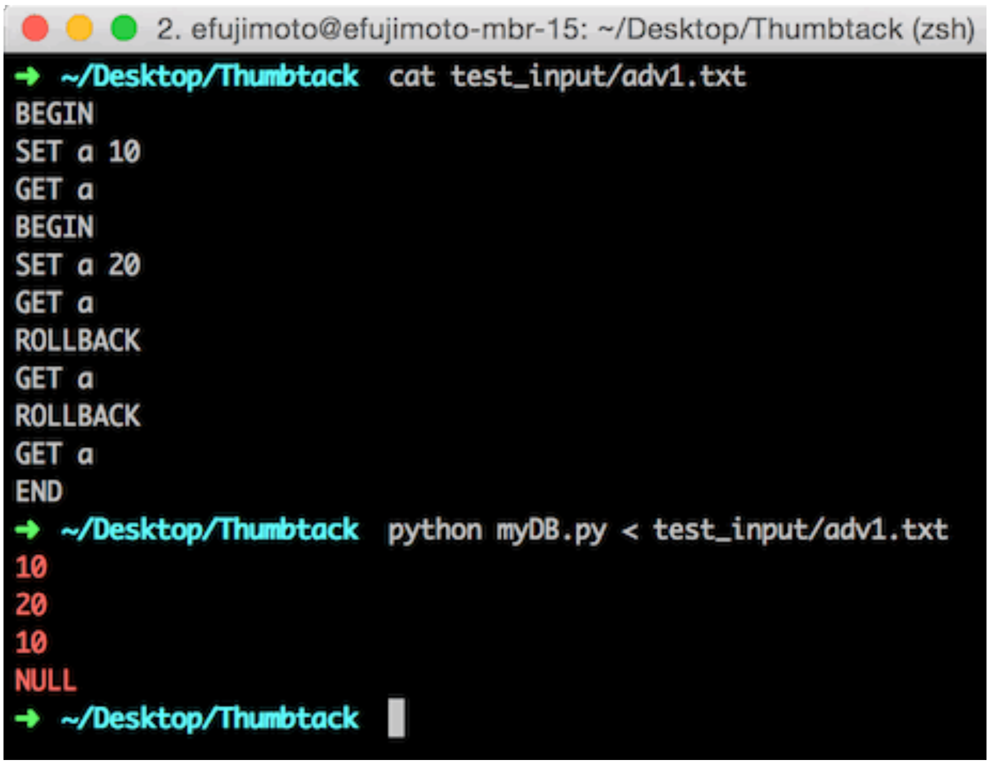
END

| **INPUT** | **OUTPUT** |
|---|---|
| SET a 10 | |
| BEGIN | |
| NUMEQUALTO 10 | 1 |
| BEGIN | |
| UNSET a | |
| NUMEQUALTO 10 | 0 |
| ROLLBACK | |
| NUMEQUALTO 10 | 1 |
| COMMIT | |
| END | |

### Input and Output Format

Your program should expect input from standard input (stdin) and handle EOF. Below are two examples of ways we might test your program.

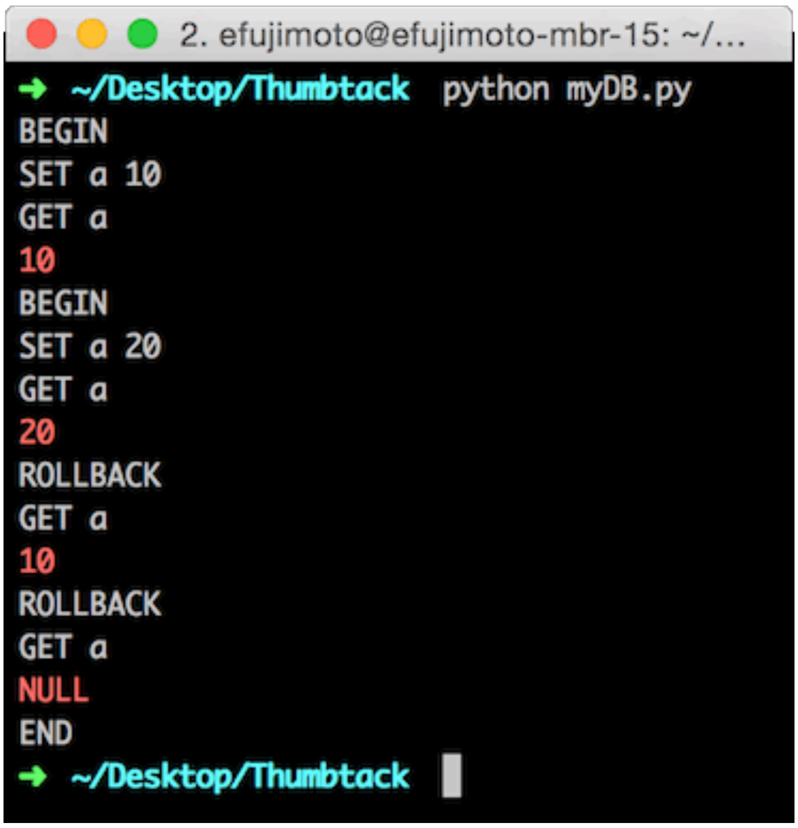
- Pass a file of commands to standard input:



2. efujimoto@efujimoto-mbr-15: ~/Desktop/Thumbtack (zsh)

```
➜  ~/Desktop/Thumbtack  cat test_input/adv1.txt
BEGIN
SET a 10
GET a
BEGIN
SET a 20
GET a
ROLLBACK
GET a
ROLLBACK
GET a
END
➜  ~/Desktop/Thumbtack  python myDB.py < test_input/adv1.txt
10
20
10
NULL
➜  ~/Desktop/Thumbtack  
```

- Run the program interactively:



```
➜  ~/Desktop/Thumbtack  python myDB.py
BEGIN
SET a 10
GET a
10
BEGIN
SET a 20
GET a
20
ROLLBACK
GET a
10
ROLLBACK
GET a
NULL
END
➜  ~/Desktop/Thumbtack
```

The gray text is what we've typed in to the program and the red text is the program output. Please note that you do *not* need to implement any sort of text coloring. The different colors shown here are merely to help you distinguish between input and output.

## Performance Requirements

- All of the following commands `BEGIN`, `GET`, `SET`, `UNSET`, and `NUMEQUALTO`should have an average-case runtime of *O(log N)* or better, where *N* is the total number of variables stored in the database.

  The runtime of these commands should not depend on the number of transactions, *T*, initiated by the input. (Certain inputs may have *T* >> *N*.)

- The vast majority of transactions will only update a small number of variables *M* (*M*<< *N*). Accordingly, each transaction should consume at most *O(M)* additional memory.

## How We Review Your Submission

- Functionality: Does the solution satisfy all the logic requirements described above? Does it handle all edge cases properly and is it sufficiently tested?

- Algorithmic performance: Does the solution satisfy both the runtime and memory usage requirements outlined above?

- Code style: How readable is the code? Does it have a clear structure with abstraction and encapsulation that fit this problem? Is the solution overly-complex and over-engineered?