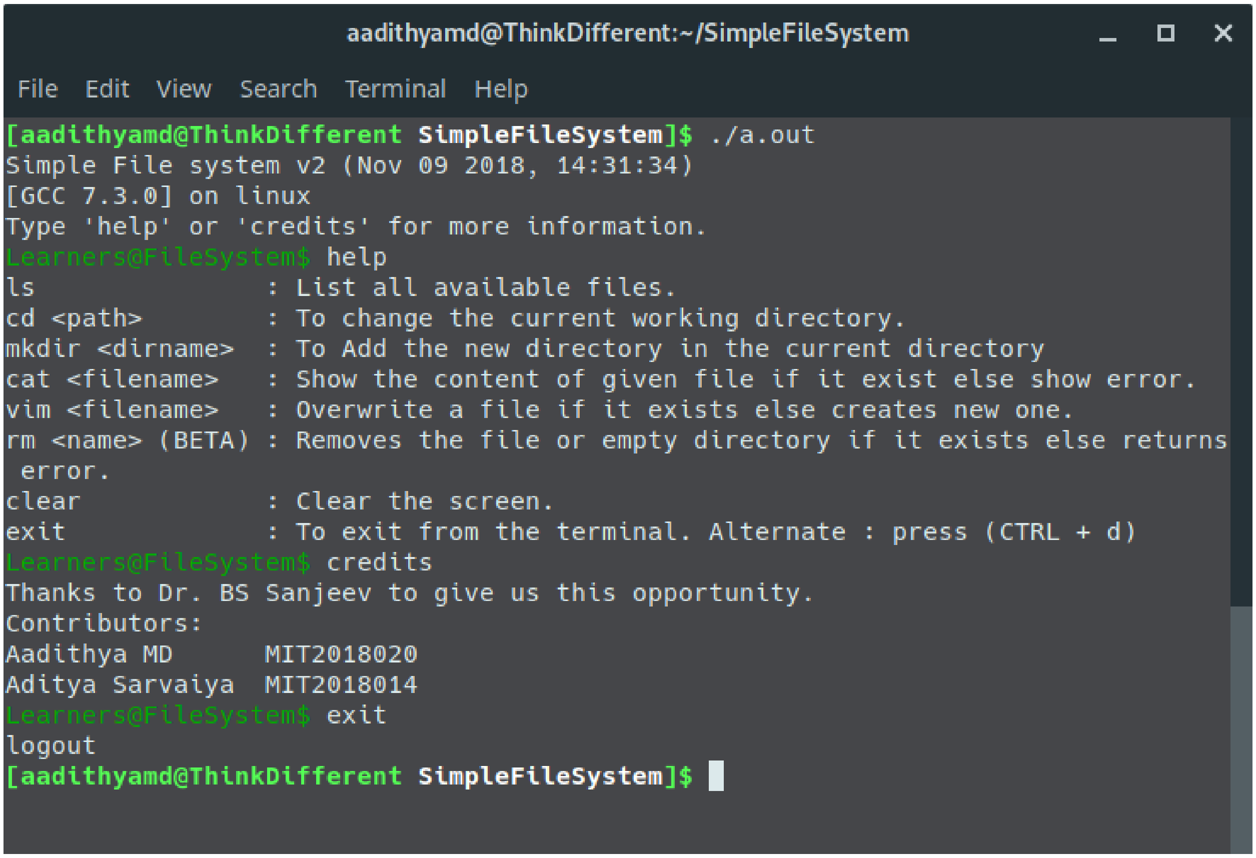
Simple File System

Group : Learners



aadithyamd@ThinkDifferent:~/SimpleFileSystem
File Edit View Search Terminal Help

```
[aadithyamd@ThinkDifferent SimpleFileSystem]$ ./a.out
Simple File system v2 (Nov 09 2018, 14:31:34)
[GCC 7.3.0] on linux
Type 'help' or 'credits' for more information.
Learners@FileSystem$ help
ls                 : List all available files.
cd <path>          : To change the current working directory.
mkdir <dirname>    : To Add the new directory in the current directory
cat <filename>     : Show the content of given file if it exist else show error.
vim <filename>     : Overwrite a file if it exists else creates new one.
rm <name> (BETA) : Removes the file or empty directory if it exists else returns
 error.
clear              : Clear the screen.
exit               : To exit from the terminal. Alternate : press (CTRL + d)
Learners@FileSystem$ credits
Thanks to Dr. BS Sanjeev to give us this opportunity.
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Learners@FileSystem$ exit
logout
[aadithyamd@ThinkDifferent SimpleFileSystem]$
```

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PPR Project

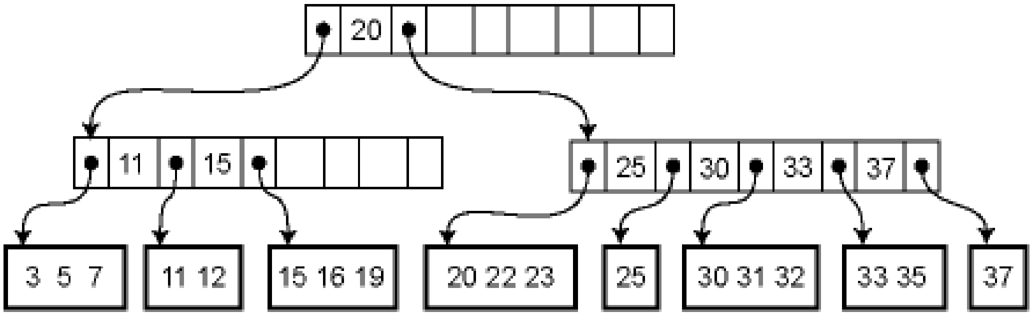
INTRODUCTION

It’s a simple file system made using BTree. A BTree is a tree data structure that keeps data sorted and allows searches, sequential access, insertion, and deletion in logarithmic time. A BTree is a generalization of a binary search tree in a way that a node may have more than two children depending on its degree.

Why BTree?

There are many data structures available which we can use. Then why BTree? What is so special about it? Answer to this question can be justified by the following points:

- As BTree is self balancing tree, it takes logarithmic time (O(log n) or O(h) to be precise) for most of the operations.
- Disk operations are costly so, it is desirable to minimise it. Since BTree reduces the no of disk access required by reducing the height of the tree, it is preferred.
- Deleting or Inserting a record from/to a table with a million records or more in it could be an expensive operation if the table has to be completely rewritten. If sequential access to the underlying table is handled through the B-Tree or if the entire file is stored in the nodes of the B-Tree, deletion or insertion of a row or record in the table gets much simpler.



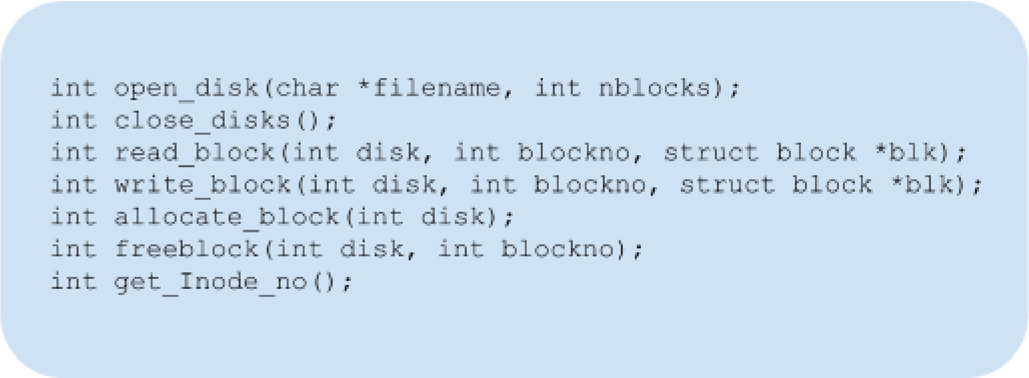
1.1 Simple BTree structure

STAGES

Stage 1 : Disk Library

Designing a simple disk library that reads and writes disk blocks. Our file system will be built on top of this interface.

The disk interface is as follows:

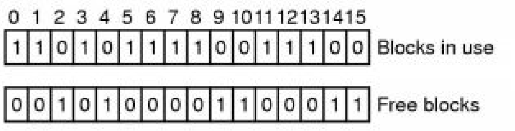


```
int open_disk(char *filename, int nblocks);
int close_disks();
int read_block(int disk, int blockno, struct block *blk);
int write_block(int disk, int blockno, struct block *blk);
int allocate_block(int disk);
int freeblock(int disk, int blockno);
int get_Inode_no();
```

1.2 Disk Interface

The calls return an error if the underlying Unix system calls fail.

A disk block freelist. This is a simple data structure (for instance, a bitmap) that tracks what blocks on the disk have been allocated. This data structure is, for obvious reasons, persistent (i.e., on disk).

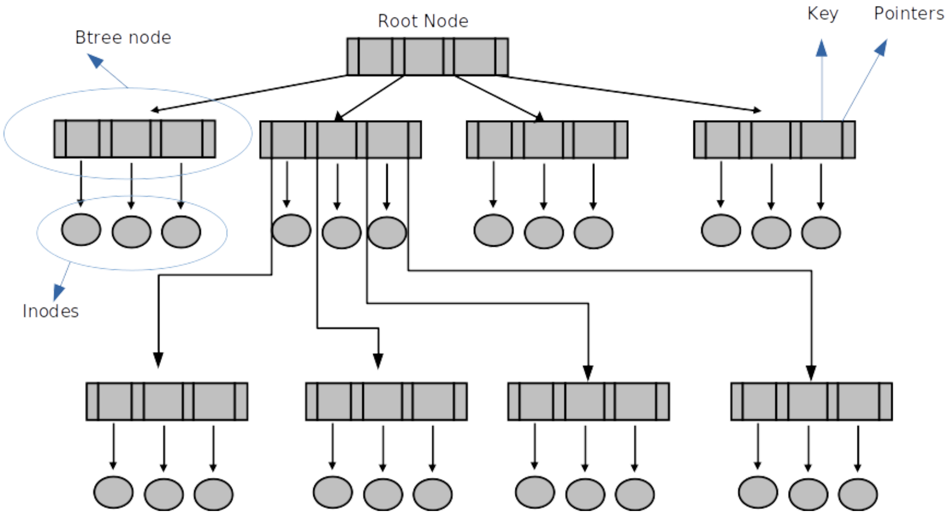


0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1	1	0	1	0	1	1	1	1	0	0	1	1	1	0	0	Blocks in use
0	0	1	0	1	0	0	0	0	1	1	0	0	0	1	1	Free blocks

1.3 Disk Block Freelist

Stage 2 : BTree Implementation

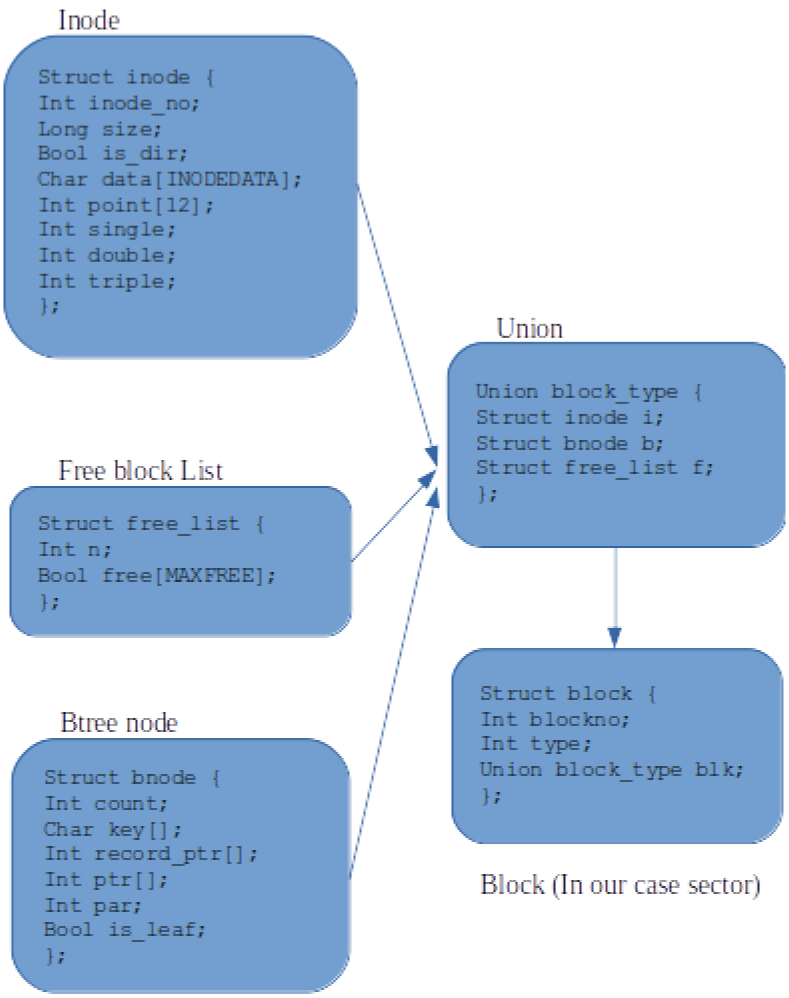
BTree. It is a fat height balanced search tree. BTree achieves significant reduction in number of disk accesses compared to other data structures by height reduction.



Inodes. An inode is persistent memory that contains pointers to disk blocks. Inodes are used to map a file to the disk representation of a file: each file has its own inode, the inode has pointers to all disk blocks that make up that file.

inode_no
size
is_dir
hash
data
point
single
double

1.4 Inode Structure



```
Struct inode {
Int inode_no;
Long size;
Bool is_dir;
Char data[INODEDATA];
Int point[12];
Int single;
Int double;
Int triple;
};
```

```
Union block_type {
Struct inode i;
Struct bnode b;
Struct free_list f;
};
```

```
Struct free_list {
Int n;
Bool free[MAXFREE];
};
```

```
Struct block {
Int blockno;
Int type;
Union block_type blk;
};
```

```
Struct bnode {
Int count;
Char key[];
Int record_ptr[];
Int ptr[];
Int par;
Bool is_leaf;
};
```

Basic Architecture of Structure Block

Stage 3 : Command Line Interface

Function name and Argument	Description
help	Overview of all the available commands
ls	List all available files in that directory
cd <path>	To change the current working directory
mkdir <dirname>	To Add the new directory in the current directory
cat <filename>	Show the content of given file if it exist else show error
vim <filename>	Overwrite a file if it exists else creates new one
(BETA) rm <filename> rm <dirname>	Removes the given file or empty directory if it exists else gives an error
clear	Clear the terminal screen
exit	To exit from the terminal. Alternate : press (CTRL + d)

Link to code : https://github.com/aadithyamd/SimpleFileSystem

REFERENCES

1. **Book - “Introduction to algorithms” by Cormen, Leiserson, Rivest and Stein**
2. **MIT lab assignment on a file system:**

   http://web.mit.edu/6.033/1997/handouts/html/04sfs.html

3. **Stack overflow :**

   https://stackoverflow.com/questions/4714056/how-to-implement-a-very-simple-filesystem

4. **University of Illinois at Chicago:**

   https://www.cs.uic.edu/~jbell/CourseNotes/OperatingSystems/11_FileSystemImplementation.html