(whttps://eduassistpro.github.

axgopala@imperial.ac.uk

Add WeChat edu_assist_pr

Shar

https://eduassistpro.github.

directories and intrager entor data edu_assist_production and intrager edu_assist_production and intrager entor data edu_assist_production and intrager entor data edu_assist_production and intrager edu_assist_produc

File: Named collection of data of arbitrary size

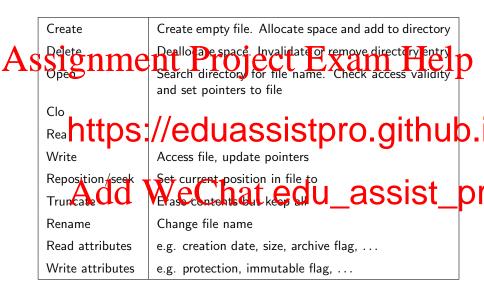
File Naming
Typical file extensions

As sile gynemetals in rojection Exam Help

executable	exe, com, bin	read to run machine-language pro-	
obj https	:://edua	assistpro.githฃ	b.
source code	c, cc, java,	sour	
batchAdd	but seCh	at edu_assist_	pr
		prete]

https://eduassistpro.github.

File User Functions



Unix/Linux: File System calls

```
Assignment Projecto Exam Help
    open (file, how, ...)
                        Open a file for reading/writing
    c1
    re https://eduassistpro.github.
    write (fd, buf, nbytes)
                        Write
                 ceChatedu_assist_pr
                        File locking and other operations
    fnctl (fd, cmd, ...)
```

File System Support Functions

Logical name to physical disk address translation

sile. /homes/axgopala/vimrc → disk 2, block 399 sile. memorisk are project Exam Help

https://eduassistpro.github.

Caching and buffering

Protected dans to State Chat edu_assist_pr

Back-up and restore

Security

Protection against unauthorised access

File Attributes I

Basic information

Assignment, Pintry Jeache, Lirexa, m Help

file o

file https://eduassistpro.github.

Address information

size allocated

start addresses size used

weight addresses cyl, head, sect, LBA

disk drive partition edu_assist_properties of the cyl, head, sect, LBA

cyl, head, sect, LBA

File Attributes II

Access control information

access activity counts

Assignment Project Examine Help

per

Usaghttps://eduassistpro.github.

last read date and time last read date and time

Assignment Project Exam Help

https://eduassistpro.github.

Add WeChat edu_assist_pr

Assignment Project Exam Help

https://eduassistpro.github.

Add WeChat edu_assist_pr

Assignment Project Exam Help

https://eduassistpro.github.

Add WeChat edu_assist_pr

Assignment Project Exam Help

https://eduassistpro.github.

Add WeChat edu_assist_pr

Assignment Project Exam Help

https://eduassistpro.github.

Add WeChat edu_assist_pr

Unix/Linux stat System Call

File attributes can be accessed using system call stat(2) (man 2 stat)

```
ssignment Project Exam Help
 struct stat {
  de
  https://eduassistpro.github.
                        /* user ID of owner */
  uid_t
           st_uid;
                        /* group ID of owner */
                           total size. <del>in</del> bytes */
  struct timespec st_atim; /* time of last access */
  struct timespec st_mtim; /* time of last modification */
  struct timespec st_ctim; /* time of last status change */
```

};

File size naturally variable

Assignments Project 81 Extam Help Choosing block size

- https://eduassistpro.github.
 - More memory needed for buffer space
- Block size too small wastes spa A Governed Cerm Natha Colu_assist_pr
 - High file transfer time: seek time greater t

Which allocation works the best?

https://eduassistpro.github.

Index Alodd WeChat edu_assist_pr

Contiguous File Allocation I

Place file data at contiguous addresses on storage device

Assignment Project Exam Help Successive logical records typically physically adjacent

https://eduassistpro.github.

- Poor performance if files grow and shrink ov
- Fix graved be will be considered that seed u_assist_pr
 - Must be transferred to new area of adequate size
 - Leads to additional I/O operations

Add WeChat edu_assist_pr

https://eduassistpro.github.

- (a) Contiguous allocation of disk space for seven files
- (b) The state of the disk after files D and F have been removed

Imperial College

Block Linkage (Chaining) I

Place file data by linking them together \Rightarrow insertion/deletion by modifying pointer in previous block

Assignment Project Exam Help

https://eduassistpro.github.

Block Linkage (Chaining) II

Disadvantages

Assignment Project Exam Help

https://eduassistpro.github.

Block-to-block seeks occur

wastandspWieChat edu_assist_pr

Block Allocation Table I

Store pointers to file blocks

Assignmented properties block of file

Assignmented properties block

Determines location of next block

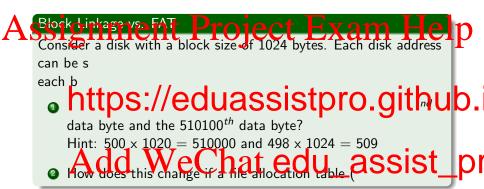
File Anttps://eduassistpro.github.

- Stored on disk but cached in memory for perf
 Add WeChat edu assist_pr
 Reduces number of lengthy seeks to access given re
 - But files become fragmented → periodic defragmentation
 - Table can get very large

https://eduassistpro.github.

Add WeChat edu_assist_pr

Example Problem



Answer: Block Linkage

There are 1020 data bytes per block. The 1022nd byte is resident Assing nick block Projective Exam Help

https://eduassistpro.github.

The 510100th data byte is resident in the 501 01

reads Ac required WeChat edu_assist_properties.

Example Problem

Answer: FAT

There are 1024 data bytes per block. Each block of the FAT can series are 1024 data bytes per block. Each block of the FAT can series are 1024 data bytes per block. Each block of the FAT can series are 1024 data bytes per block. Each block of the FAT can series are 1024 data bytes per block. Each block of the FAT can series are 1024 data bytes per block. Each block of the FAT can series are 1024 data bytes per block. Each block of the FAT can series are 1024 data bytes per block.

- 1 The 1020th byte is on the 1st block and requires 1 read for the
- https://eduassistpro.github.
 - At best, all of the first 499 blocks of the file can be represented in 2 FAT blocks

Addst.WeChateedu_assist_pr

Either case requires 1 extra read for the data. H

- Best case requires 3 reads
- Worst case requires 500 reads

Answer: FAT

Assignment Project Exam Help https://eduassistpro.github.

Example Problem

Answer: FAT

Assignment Project Exam Help

https://eduassistpro.github.
Add WeChat edu_assist_pr

How can we improve?

Index Blocks I

Each file has one (or more) index blocks

https://eduassistpro.github.

- Searching may take place in index blocks the
 Place of the place o
- access to data
- Can cache index blocks in memory for faster access

https://eduassistpro.github.

Unix/Linux: Inodes

Index blocks called inodes (index nodes) in UNIX/Linux nodes) in UNIX/Linux Project UE Kam Help inode entry created in memory

clu https://eduassistpro.github. Direct pointer

- Disk device number
- Add we have been been edu_assist_
 - file
- Major/minor device number

inode

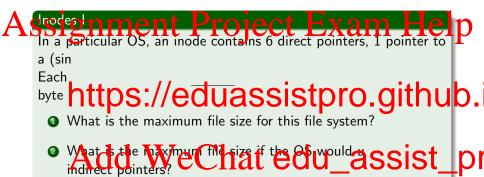
Type and access control

Group ID

Indirect pointer Double indirect pointer Triple indirect pointer

https://eduassistpro.github.

Example Problem



Answer: Inodes I Assignment (details) is: Assignment (details) is: $+ 128 \times 1024$ (data referenced by single indirect) https://eduassistpro.github. 2 (data directly indexed) (data referenced by double in assist_pr $128^2 \times 1024$ $+ 128^3 \times 1024$ (data referenced by triple indirect) = 2.02 GB

Example Problem

A special to the local contact point of point of

Example Problem

Our favourite numbers ©

A smalpstdiants in note to har collect points in points to a doubly indirect block.

Each
byte https://eduassistpro.github.

the 1020th data byte?

the 1020th varathe? hat edu_assist_pro.github.

Assignment Project Exam Help

https://eduassistpro.github.

Assignment Project Exam Help

https://eduassistpro.github.

Add WeChat edu_assist_pro.github.

Summary: File Allocation Examples

Assignment Project Exam Help

Byt https://eduassistpro.github.

Byt worst case

Add WeChat edu_assist_pro.github.

How do we manage a storage device's free space? Assert grick receipted to be proposed to the proposed to the

Use fr

- https://eduassistpro.github.
- Newly-freed blocks appended to end of list

Low Add Nore Chatine Cub_assist_pr

Files likely to be allocated in noncontiguous blocks \rightarrow increases file access time

https://eduassistpro.github.

Assignment Project Exam Help Disk b Num https://eduassistpro.github. Hard drive size: 500 GB Numb Action ks We lio hat edu_assist_ Number of blocks required to store all addresses: 1.

Bitmap I

Assignment black rosect Exam Help • ith bit corresponds to ith block on disk

* https://eduassistpro.github.

Disady Antered We Chat edu_assist_properties May need to search entire bitmap to find free b

 May need to search entire bitmap to find free to in execution overhead

https://eduassistpro.github.

Assing nment Project Exam Help
Block size: 1 KB

Hard

https://eduassistpro.github.

Number of bits required: 488 million

A possible file system layout

Assignment Project Exam Help

Add WeChat edu_assist_pr

https://eduassistpro.github.

File System Layout II

Fixed disk layout (with inodes)

boot block

Assignment Project Exam Help

- https://eduassistpro.github.
 - no of inodes
 - nA of class by eChat edu_assist_pressure of inode & free space bitmap
 - first data block
 - block size
 - maximum file size, . . .

File System Directories

Directory

• Maps symbolic file names to logical disk locations (e.g.

Assignment organization et al. (LBA)) Assignment organization et al. (LBA)) Assignment of the control of the

• Ensures uniqueness of names

https://eduassistpro.github.

https://eduassistpro.github.

FS often performs linear search of directory to locate file

• Leads to poor performance

Add WeChat edu_assist_pr

Little flexibility in terms of file organisation

MultiLevel (Tree) Directory Structure

Hierarchical file system

- UNIX, Linux, Windows, Mac, . . .
- Assignment on disk root directory begins

 Assignment of the declared and Help

 Each of which contains entries for its files

https://eduassistpro.github.

Pathnames

Pathnames

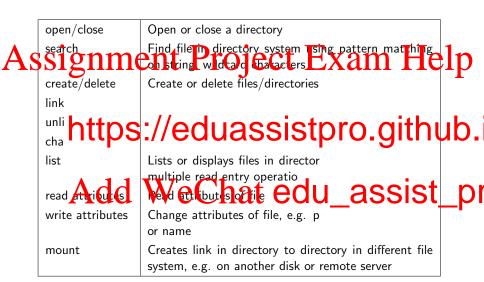
• File names usually given as path from root directory to file

Assignment Project Exam Help

- https://eduassistpro.github.
 - Relative to working (or current) directory

 and dang double calculate COU_assist_pi
 - Displayed with pwd
 - Current directory: .
 - Parent directory: ..

Directory Operations



Unix/Linux: Directory System Calls

```
System Call
                          Description
ssignment. Project Examp Help
                          Remove directory
  s = rmdir (path)
 s https://eduassistpro.github.
   = chdir (path)
 dir Addir We Chat edu_assist
   = closedir (dir)
 dirent = readdir (dir)
                          Read one entry from directory
                          Rewind directory to re-read
 rewinddir (dir)
```

Unix/Linux: Looking Up File Names

Steps in looking up /usr/ast/mbox

Assignment Project Exam Help

Add WeChat edu_assist_pr

https://eduassistpro.github.

Links

Link: Reference to directory/file in another part of FS

• Allows alternative names (and different locations in tree)

Assignment Project Exam Help

Only supported for files in Unix

https://eduassistpro.github.

Problems dd We Chat edu assist pr

- Leave links and cause exception when used (symbolic links)
- Keep $\underline{\mathsf{link}}\ \mathsf{count}\ \mathsf{with}\ \mathsf{file} \to \mathsf{delete}\ \mathsf{file}\ \mathsf{when}\ \mathsf{count} = \mathsf{0}\ \mathsf{(hard}\ \mathsf{links)}$
- Looping: directory traversal algorithms may loop

https://eduassistpro.github.

Add WeChat edu_assist_pr

Imperial College London

51/59

Mounting I

Mount operation

Assignment on site perfect X an Help

Support for soft-links to files in mounted FSs but not

мыhttps://eduassistpro.github.

• Directory in native FS assigned to root of mou

FSs maded www.cchat edu_assist_pr

- Information about location of mount poin
- When native FS encounters mount point, use mount table to determine device and type of mounted FS

https://eduassistpro.github.

Assignment Project Exam Help Goal: high-performance, robust F3 with support for advanced featu

Typi https://eduassistpro.github.

Safety mechanism: 5% of blocks reserved for root

• Avoid process Continue tentiler assist process consumes all FS disk space

ext2fs Inode

Represents files and directories in ext2 FS

Stores information relevant to single file/directory ightarrow e.g. time

Assignment Project Exam Help

- https://eduassistpro.github.
- 14th pointer is a doubly-indirect pointer

Adds Wedichateedu_assist_pr

- 15th pointer is triply-indirect pointer
 - · Locates block of doubly indirect pointers

Provides fast access to small files, while supporting very large files

ext2fs Block Groups I

Block groups

Clusters of contiguous blocks

Assissance of the store plated data in same block group Help

Bloc

https://eduassistpro.github.

FS was mounted, ...

ext2fs Block Groups II

Inode table: Contains entry for each inode in block group

Inode allocation bitmap: Inodes used within block group

A Service in the property of t

- https://eduassistpro.github.
- block allocation bitmap
- Add WeChat edu_assist_properties | Properties | Propertie
 - Directory information stored in directory entries
 - Each directory entry is composed of: inode number, directory entry length, file name length, file type, file name

https://eduassistpro.github.

Add WeChat edu_assist_pro.github.

Assignment Projectex xam File Atricke WG 32 19812 edu_assist_te)pr