Assignment 3

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1. Solutions

1.1 Solution 1

Dynamic loading is using the operating system resources smartly and not loading all the program data every time. Dynamic loading helps only loading the data and routines which are required currently and save the rest on a secondary drive. whenever some data or routine is required by the primary disk, the operating system gives that routine power and moves it to the main memory. Dynamic loading is designed in such a way the programmers can implement the functionality in the routines which require no additional work on the OS level. One of the main advantages of Dynamic loading is that it helps make routine's fast and utilize memory space more efficiently. Operating system only loads the essential data on the disk and keeps relocating the non-essential data to another disk.

1.2 Solution 2

Paging is similar to segmentation when it comes to memory management. it allows the physical address of a process/task to not adjoin each other. One of the main advantages of Paging is is avoiding external fragmentation. In the process of Paging, logical memory is divided into blocks of equal size which are referred to as pages. It also requires frames which are made from equal size blocks of memory. Once the operating system has pages and frames then it loads the frame into any available pages on the main physical memory.

Getting corrupt and loss of data is very common if done incorrectly, Pagination avoids this by mapping page number and page offset. Using the correct page number with a correct frame number from the page table makes sure that each logical address maps directly to the right physical address.

1.3 Solution 3

Paging is a memory management scheme which allows processes to be non-contiguous which is very similar to segmentation. Segmentation enables memory allocation to be a replica of the user's point of view of memory allocation. Where pagination uses pages and frames, segmentation is made up of segments which are further made up of base and length. One of the main differences between segmentation and pagination is that segmentation makes segments which replicates the user's point of view of the memory. Physical is formulated using the base and length given by the user when accessing memory or memory segments.

This process is very different in pagination where the user only provides one address and pagination automatically finds out page number and offset. Segmentation provided some back-end information to the programmer on how it's allocating and deallocating the memory whereas paginations completely keeps it abstract from the programmer.

1.4 Solution 4

Demand paging system and a paging system with swapping are both part of the pagination memory management scheme. Demand paging system , as the name states, only loads the pages/offset which are demanded by the process or the block of memory. where as on the other hand, Pagination with swapping swaps out the entire process/memory block from the secondary to the main.

The demand paging system only loads the essential pages which allow other users to access the pages which the current process is not using. Swapping on the other hand takes the whole process or block memory even when all the data is not necessary. this stops other users from accessing the data from the same memory or page.

1.5 Solution 5

Page replacement algorithm as the name might suggest replaces the pages from the main memory to the secondary memory when space for a new page is required and the one that's already there needs to go. FIFO algorithm is a queue based algorithm which uses first in first out implementation. when a new frame needs to come into the memory, the frame that is currently in the system from the longest time is kicked out to make space for the new frame.

Second-chance algorithm is very similar to FIFO and is an advanced version where Second chance algorithms look at all the frames and check if they have been recently used by their reference bit which is marked 1 for yes and 0 for no. If a frame has been recently used then it's not kicked out. This algorithm focuses on kicking out the frame which has not been used the longest.

1.6 Solution 6

Copy-on-write used to the pages as copy-on writes when a child process makes a change to page copied from the parent process. This is a memory management technique used in windows xp and many more to save time and space when a child process is created. On creation of the child process from the parent process, copy-on-write stops it from copying all the pages from the parent process as they all won't be used. Whenever a child process makes a change to a page which has been copied from the parent process then it has to make a copy of the page it's changing and cannot make a direct change in the parent process page.

This means that copying all the pages from the parent process is not efficient as they might not be used. This copy-on-write allows the child process to only make the copy of the pages which are going to be changed or edited.

1.7 Solution 7

The six basic operations to implement for handling files in operating system are as following : Create file - while this implementation, none of the other functions will be much of use unless files were imported.

Read file - one of the essential functions to allow processes to be able to open and read a file

Write file - write file is key function to ensure processes can also make changes in the file when necessary

Delete file - this will allow deleting the files by using their address. important to be able to use memory efficiently

Truncate file - truncating a file is important when we don't want to delete the file but delete the content

Move file - move file will allow operating system to re-arrange, copy files in the system

1.8 Solution 8

In general, to create a file, we will need the name of the file. Space needs to be found in the current file structure for the new file when it is created. On creating the fie, the file name and attributes also need to be added to the file directory.

When creating a new file, we need to save the name of the file and find space in the current file structure for the new file. this can be done by allocating a file block system in the logical file system after the request of new file. The file directory then gets updated with the new name and new file system block which is ultimately written back to the disk. The allocation of file control blocks is dependent on the file system and it can be either done initially or when required.

1.9 Solution 9

Hash table is superior to linear list structure as it is faster. Both linear and hash table functions are part of the data structures family where linear structure as the name suggests is linear in design. The simple creates some problems when introduced to scalability as it gets slower and slower with bigger data size. The linear data structure requires a lot of data searches to be able to perform any functionality. For example, to add a new file, a linear search is performed to make sure another file with the same name doesn't already exist. Similarly, the same linear search is required when updating or deleting a file.

This problem was solved by Hash tables where they store the name of the file as integer hash value which is then mapped to the name of the file. This makes it a lot faster to perform the same functionality. One of the major issues in hash table implementation is Collisions. Depending on the algorithm, it may be possible that two different files may get hashed to the same integer key which results in corrupt data.

1.10 Solution 10

When selecting a disk-scheduling algorithm, Scalability and request type are the most influencing factors. Most of the time, an operating system uses multiple disk scheduling algorithms at the same time to produce maximum efficiency. The difference between dif-

ferent types of disk scheduling algorithms is marginal when a sample size of request is very small but this difference changes quickly as the number of requests increases. The type of request is similarly very important as different types of data may produce different efficiency from the same algorithms. If data is linked together than disk head will perform multiple head moments else it's not required. Many operating systems use different types of disk-scheduling algorithms for different types of data at the same time.

1.11 Solution 11

SSTF is one of the disk scheduling algorithms which determines which job will be selected to run from the work queue. SSTF stands for shortest seek time first. There are many disadvantages of using SSTF where one of them is process starvation and issues caused by the algorithm when changing disk head. SSTF chooses the request based on the shortest seek time which means if the current request is 80 and the next request is at 100 and 70 then it will choose 70 to be the next request. The way this can lead to starvation is if a process is very far from the current header then it may never get it's turn unless all the other shortest processes are dealt with first.

1.12 Solution 12

The concept of bus is based upon communication between devices locally. This means that all the connected devices like keyboards and printers require a way to communicate with each other and buses are used to fulfil these requirements. PCI bus and expansion bus are the two types of buses used where PCI is used for fast communication devices and expansion bus is used for slow communication devices. Most of the devices in the bus system are connected by a wire and it's very commonly used. Daisy chain is a concept of communication as well where all the devices are connected together in a series with the help of cables and ports. The intersection between Bus and daisy chains is communication of devices and how they talk to each other. Daisy chain is prefered when a series of devices communicating keeps expanding as it's very easy to scale as compared to busses.

1.13 Solution 13

Buffering works as a bridge between two devices or two networks which makes sure the sending party is able to send all the data to the receiving party properly. The different reasons to use buffering are :

Different speed between sending and receiving clients. When data is transferred across different devices, many times the bandwidth is different, buffering works as a container which holds all the data and then gives it to the client in correct order to avoid multiple writes.

Difference is data transfer size between client and server specially when on a network requires buffering as to make up for the bandwidth difference

To ensure data Integrity, Buffering plays an important role to make sure data received is the same as the data sent. Operating system uses kernel buffers to ensure correct data is being copied.

1.14 Solution 14

Mechanism of protection usually implies the way we can protect whereas the policies of protection implies what needs to be done.

It is important to distinguish between mechanisms of protection and policies as the separation of these two provide flexibility in the system. If these are well separated then changes in one only affect few changes in the other whereas if they are vaguely defined then it requires a lot more work to make changes and identify regression defects. Mechanisms can be nontechnical, such as requiring proof of identity before changing a password; in fact, policies often require some procedural mechanisms that technology cannot enforce. Policies on the other hand may be presented mathematically, as a list of allowed secure and nonsecure states.

1.15 Solution 15

Access Matrix is used for the implementation of the Protection model in operating systems. To implement access control using an access control matrix, we look at a large sparse matrix as most of the users will have null access. This can be represented by using either column matrix or row matrix. Each entry in the matrix consists of a set of access rights. The entry access (i,j) defines the set of operations that a process executing in a domain Di can invoke an object of Oj. It must be ensured that a process executing in domain Di can access only these objects specified to the row i. Here rows work with domain under user, process and procedure and columns work with objects under resources.

1.16 Solution 16

Worms differ from viruses as they rely on computer networks to spread whereas viruses use executables. Worms are standalone programs which can travel from one machine to other but virus requires host program or human help. Being a stand alone application help worm self-propagate from an infected user's computer to other computers. Virus does not use computer networks and rely on copying or installation from executables. Being on the network allows worms to spread more aggressively as compared to a virus.

1.17 Solution 17

Symmetric encryption is a type of encryption where only one key is used to encrypt and decrypt. the same key which encrypts the data is then sent to the other party to decrypt it. Asymmetric encryption is a type of encryption where keys are used in pairs as public and private keys. The public key is used to encrypt data and the private key is used to decrypt data. Symmetric encryption is an old technique also referred to as DES which is not used anymore because it's easily decrypted whereas AES is widely used at the moment and a relatively new algorithm. Asymmetric encryption was introduced to complement the inherent problem of the need to share the key in a symmetric encryption model, eliminating the need to share the key by using a pair of public-private keys. Hence, the extra complication and security makes Asymmetric encryption take relatively more time than the symmetric encryption.

1.18 Solution 17

Keyed hashing method for message authentication. HMAC is used with an iterative cryptographic hash function, such as MD5 or SHA-1, in combination with a secret shared key. The cryptographic strength of HMAC depends on the properties of the underlying hash function.