# Operating Systems

Homework 6

## Question 1

A logical address is the address where the some memory appears to reside from the perspective of a running application. The physical address is where the memory actually resides.

Each user program can reference its logical addresses, and they will be mapped to a physical address, depending on which program it came from.

## Question 2

Address binding is the operation that is performed to map a logical address to a physical address. The way this is done varies, depending on which method of memory allocation the operating system uses.

## Question 3

- Contiguous memory allocation - Each process is allocated a section of memory directly following the memory of the previous process. Each logical address is converted to a physical address by adding a base address to the logical address. This can lead to memory fragmentation since when a process terminates, it will free up a specifically sized whole in the contiguous memory, and that memory cannot be allocated to another larger process.
- Paging - The main memory is divided into many equally sized sections called frames. Each time a process begins, it is allocated a certain number of pages. A page is the same size as a frame, but the pages need not be contiguous. Each process has a table which maps each of their pages to a frame in main memory. In order to convert a logical address to a physical address, the page number is taken from the logical address and using the page table, it is converted to a frame number. Then the offset from the page number is the same as the offset from the frame number. Although this method solves the issue of fragmentation, it still has the problem that if many processes require only a small part of a page, then a lot of memory is wasted.
- Segmentation - This technique is very similar to paging, but each segment can have a different size, unlike each page that had the same size. The segment map table has to hold the base address of each segment as well as the size of each segment.

## Question 4

A logical address can be assigned to a variable when a user program creates a pointer and uses the new keyword, or when it uses the & operator in C.

## Question 5

Address binding is performed every time a program reads from memory or writes to memory, for example if a pointer is dereferenced using the * operator in C.

## Question 6

In the contiguous memory approach, whenever a new process requests a certain amount of memory, the operating system assigns it the next available piece of memory directly following the previous

allocation. When the process terminates and the memory is freed, this leaves a whole in the memory. The operating system can then assign this memory to new processes, but only if the amount the process needs is smaller than the size of the gap.

## Question 7

Logical address are assumed to begin at 0.

## Question 8

A. 30215+9223=39438
B. 30215+2302=32517
C. 30125+7044=37169

## Question 9

Physical address = A + L

## Question 10

1. 42993+104=43097
2. 42993+1755=44748
3. 3041>2031 $\Rightarrow$ out of bounds

## Question 11

If more than one partition is being used, the base register contains the address of the first byte in the partition.

## Question 12

A logical address must be checked against the bounds register before a physical address is obtained to ensure that the logical address is valid and doesn't map to a physical address that doesn't belong to the process that used it.

## Question 13

A. 42993+104=43097
B. 42993+1755=44748
C. 3041>2031 $\Rightarrow$ out of bounds

## Question 14

A.

| Operating system |
| --- |
| Process 1 |
| New process |
| Process 2 |
| Process 3 |
| Empty 52 blocks |

| Empty 100 blocks |
| --- |

B.

| Operating system |
| --- |
| Process 1 |
| Empty 60 blocks |
| Process 2 |
| Process 3 |
| New process |
| Empty 100 blocks |

C.

| Operating system |
| --- |
| Process 1 |
| Empty 60 blocks |
| Process 2 |
| Process 3 |
| Empty 52 blocks |
| New process |

# Question 15

A.

| Operating system |
| --- |
| Process 1 |
| New process |
| Empty 8 blocks |
| Process 2 |
| Process 3 |
| Empty 52 blocks |
| Empty 100 blocks |

B.

| |
|---|
| Operating system |
| Process 1 |
| Empty 60 blocks |
| Process 2 |
| Process 3 |
| New process |
| Empty 100 blocks |

C.

| |
|---|
| Operating system |
| Process 1 |
| Empty 60 blocks |
| Process 2 |
| Process 3 |
| Empty 52 blocks |
| New process |
| Empty 48 blocks |

# Question 16

In a paging memory management system, the logical address <2, 133> refers to the 133rd byte in the second page.

To convert <2, 133> into a physical address, we look up index 2 in the page table of the process. The number that is found there is the frame number. We then multiply the frame number by the frame size to get the first address of the frame. Then we add 133 to get the physical address.