CSE316

Operating Systems

Simulation Report

For

Continuous Assessment – 2

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Code Snippets:

```c
#include <stdio.h>
#include <stdlib.h>

#define MEMORY_SIZE 100
#define MAX_PROCESSES 10

int memory[MEMORY_SIZE];
int num_processes = 0;

void init_memory() {
    for (int i = 0; i < MEMORY_SIZE; i++) {
        memory[i] = 0;
    }
}

void print_memory() {
    for (int i = 0; i < MEMORY_SIZE; i++) {
        printf("%d ", memory[i]);
    }
    printf("\n");
}

int bestfit(int size) {
    int start = -1;
    int smallest = MEMORY_SIZE;
    for (int i = 0; i < MEMORY_SIZE; i++) {
        if (memory[i] == 0) {
            int j = i;
            int curr_size = 0;
            while (j < MEMORY_SIZE && memory[j] == 0) {
                curr_size++;
                j++;
            }
            if (curr_size >= size && curr_size < smallest) {
                smallest = curr_size;
                start = i;
            }
        }
    }
    return start;
}

void allocate_memory(int size) {
    int start = bestfit(size);
    if (start != -1) {
        for (int i = start; i < start + size; i++) {
            memory[i] = num_processes + 1;
        }
```

```
        printf("Process %d allocated memory starting at address %d.\n",
num_processes, start);
        num_processes++;
    } else {
        printf("Process could not be allocated memory.\n");
    }
}

void deallocate_memory(int pid) {
    for (int i = 0; i < MEMORY_SIZE; i++) {
        if (memory[i] == pid) {
            memory[i] = 0;
        }
    }
    printf("Process %d deallocated memory.\n", pid);
}

void simulate(int num_time_units) {
    int fragmentation_total = 0;
    int wasted_total = 0;
    int num_simulations = 0;
    for (int t = 0; t < num_time_units; t++) {
        printf("Time unit %d:\n", t);
        int size = rand() % 10 + 1;
        allocate_memory(size);
        size = rand() % 10 + 1;
        allocate_memory(size);
        int pid = rand() % num_processes + 1;
        deallocate_memory(pid);
        pid = rand() % num_processes + 1;
        deallocate_memory(pid);
        int fragmentation = 0;
        int wasted = 0;
        for (int i = 0; i < MEMORY_SIZE; i++) {
            if (memory[i] == 0) {
                wasted++;
                while (i < MEMORY_SIZE && memory[i] == 0) {
                    fragmentation++;
                    i++;
                }
            }
        }
        fragmentation_total += fragmentation;
        wasted_total += wasted;
        num_simulations++;
        printf("Fragmentation: %d, Wasted Memory: %d\n", fragmentation,
wasted);
    }
```

```
    float avg_fragmentation = (float) fragmentation_total / num_simulations;
    float avg_wasted = (float) wasted_total / num_simulations;
    printf("\nAverage Fragmentation: %.2f\n", avg_fragmentation);
    printf("Average Wasted Memory: %.2f\n", avg_wasted);
}

int main() {
    srand(1); // set random seed for reproducibility
    init_memory();
    simulate(5);
    return 0;
}
```

Explanation of the above code is given below:

This is a C program that simulates a memory management system using the Best-Fit algorithm. The program has the following features:

- **The memory size is fixed at 100 units, and there is a maximum of 10 processes.**
- **The memory is initialized to 0 using the init_memory() function.**
- **The print_memory() function is used to display the contents of the memory.**
- **The bestfit(int size) function finds the best fit block of memory for a process of a given size. It returns the starting index of the block if one is found, and -1 otherwise.**
- **The allocate_memory(int size) function allocates memory for a new process of a given size using the bestfit(int size) function. If a block of memory is found, the memory is marked**

as used by the process and the process ID is stored in the memory.

- **The deallocate_memory(int pid) function deallocates memory for the process with the given ID by marking the corresponding memory locations as unused (0).**
- **The simulate(int num_time_units) function simulates the memory manager for a given number of time units. In each time unit, it randomly allocates and deallocates memory for two processes and calculates the amount of fragmentation and wasted memory in the memory space. At the end of the simulation, it calculates the average fragmentation and wasted memory over all time units.**

The program runs the simulate() function for 5 time units, with a random seed of 1 for reproducibility. At the end of each time unit, it prints the amount of fragmentation and wasted memory in the memory space. Finally, it prints the average fragmentation and wasted memory over all time units.

Overall, this program demonstrates the use of the Best-Fit algorithm for memory management and provides a simple simulation of the memory manager's behavior over time.

2-This code is a simulation program that simulates a computer's memory management system using a specific memory allocation algorithm. It includes a memory manager that uses the best-fit memory allocation algorithm to allocate blocks of memory to processes. The program also includes a mechanism for deallocating memory when a process completes.

The program initializes an array of integers called "memory" with a size of 100 and sets all elements to zero using the "init_memory" function. The "print_memory" function is used to print the contents of the "memory" array.

The "bestfit" function finds the best fit memory block for a given size by searching through the "memory" array and returning the starting address of the block if found, otherwise it returns -1.

The "allocate_memory" function uses the "bestfit" function to allocate a memory block of a given size to a process. It sets the elements in the "memory" array corresponding to the allocated memory block to the process number, which is incremented by 1 after each allocation. If no suitable memory block is found, it prints a message indicating that the process could not be allocated memory.

The "deallocate_memory" function deallocates memory for a given process by setting the elements in the "memory" array corresponding to the process to 0.

The "simulate" function runs a simulation for a set number of time units, allocating and deallocating memory randomly, and recording the amount of fragmentation and wasted memory at the end of each time unit. It uses the "rand" function from the "stdlib" library to generate random integers for memory allocation and deallocation.

Finally, the "main" function initializes the "memory" array using "init_memory", sets the random seed for reproducibility using "srand", and runs the simulation for 5 time units using "simulate". The average amount of fragmentation and wasted memory are calculated and displayed at the end of the simulation.

Now let as look at the code output:

Time unit 0:

Process 0 allocated memory starting at address 98.

Process 1 allocated memory starting at address 90.

Process 1 deallocated memory.

Process 1 deallocated memory.

Fragmentation: 92, Wasted Memory: 2

Time unit 1:

Process 2 allocated memory starting at address 80.

Process 3 allocated memory starting at address 75.

Process 3 deallocated memory.

Process 3 deallocated memory.

Fragmentation: 87, Wasted Memory: 3

Time unit 2:

Process 4 allocated memory starting at address 72.

Process 5 allocated memory starting at address 67.

Process 6 deallocated memory.

Process 6 deallocated memory.

Fragmentation: 84, Wasted Memory: 3

Time unit 3:

Process 6 allocated memory starting at address 70.

Process 7 allocated memory starting at address 62.

Process 2 deallocated memory.

Process 4 deallocated memory.

Fragmentation: 87, Wasted Memory: 2

Time unit 4:

Process 8 allocated memory starting at address 56.

Process 9 allocated memory starting at address 53.

Process 8 deallocated memory.

Process 7 deallocated memory.

Fragmentation: 88, Wasted Memory: 3

Average Fragmentation: 87.60

Average Wasted Memory: 2.60

The output shows the results of simulating the memory allocation and deallocation process for 5 time units. For each time unit, the program randomly allocates and deallocates memory, and then calculates the fragmentation and wasted memory in the memory array

Explanation of outputs:

The program simulates memory allocation and deallocation in a simple memory management system. Here's what the output means:

- **The program runs for 5 time units. Each time unit represents a cycle of the simulation.**
- **For each time unit, the program performs the following actions:**
    - **It randomly selects a size between 1 and 10 and tries to allocate memory of that size using the allocate_memory() function.**
    - **It then selects another random size between 1 and 10 and tries to allocate memory of that size.**
    - **Next, it randomly selects a process ID between 1 and the current number of processes and deallocates memory**

associated with that process using the deallocate_memory() function.

- **Finally, it selects another random process ID and deallocates its memory as well.**
- **After performing these actions, the program calculates and prints the fragmentation and wasted memory in the memory system for that time unit.**

- **The program also keeps track of the total fragmentation and wasted memory across all time units, and at the end of the simulation, it calculates and prints the average fragmentation and wasted memory.**

So, looking at the output:

- **In time unit 0, the program allocated memory for two processes and deallocated memory for one of them. The fragmentation was 92 and wasted memory was 2.**
- **In time unit 1, the program allocated memory for two more processes and deallocated memory for one of them. The fragmentation was 87 and wasted memory was 3.**
- **In time unit 2, the program allocated memory for two more processes and deallocated memory for one of them. The fragmentation was 84 and wasted memory was 3.**
- **In time unit 3, the program allocated memory for two more processes and deallocated memory for two of them. The fragmentation was 87 and wasted memory was 2.**
- **In time unit 4, the program allocated memory for two more processes and deallocated memory for two of them. The fragmentation was 88 and wasted memory was 3.**

Finally, the program prints the average fragmentation and wasted memory over the entire simulation, which are 87.60 and 2.60,

respectively. These values provide an estimate of how efficiently the memory management system is working. A lower fragmentation value and wasted memory value indicate a more efficient system.

Finally a github link:

https://github.com/vtt5z/OS/tree/main