**Operating System Principles: Assignment 3 Report**

Jordan – S3902159

**Introduction**

For the experiments, I decided to implement the time it took to run the memory allocator in milliseconds, and the percentages and bytes for both internal fragmentation and external fragmentation, the percentages being (total bytes wasted/total free memory) \*100 and the bytes the total amount for memory being wasted.

**Performance Discussion**

In terms of speed, we can see from the results that the first fit implementation is generally faster than the best fit method in terms of time to run in milliseconds. This is in line with what we already know about first fit and best fit, and makes sense, as first fit doesn’t need to search all memory chunks.

Internal fragmentation is what happens when a block being allocated is larger than requested, leading to memory being wasted. The results show that both first fit and best fit implementations show similar percentages and bytes, indicating that the two different methods still result in roughly the same amounts internal fragmentation.

External fragmentation occurs when there is enough memory to satisfy a request, but the memory is not contiguous, so the allocated memory is scattered into smaller blocks. From the data, we can see that overall, the best fit implementation results in less external fragmentation, in one test case, it even achieved 0% external fragmentation. This is because it searches for the smallest block which can accommodate a process.

In short, in this scenario the best fit allocator has less external fragmentation and is slower, while the first fit allocator

**Performance Improvement and Allocation Strategies**

This first performance improvement which would reduce overall fragmentation would be a garbage collection system, which would periodically identify and free unused blocks of memory. Another improvement which could be made is using a tagging system for processes, where for smaller allocations, the first fit strategy is used for speed, and best fit is used for larger processes where efficiency is more important than speed.

An allocation strategy which was not used in this assignment is worst fit, which works by counteracting best fit. In this case, the processes are allocated to the largest block of memory available. Some advantages are that since the largest block is chosen, more processes can be assigned the remaining partition. Like best-fit, worst fit is also slower, as it needed to traverse the entire list to find the largest block of memory.

Another allocation strategy is next fit, which is like first fit, but it starts its searching from the location of the last allocation. Like first fit, next fit has a fast allocation time, since it becomes faster than next fit over time, however for larger applications, the number fragmentations increase over time.

Across all four allocation strategies, first fit prioritises speed, best fit reduces external fragmentation, worst fit is suitable for maximising the use of large blocks, and next fit provides a balance of speed and efficiency. It is important to apply different strategies to different use cases to provide maximum efficiency in differing scenarios.

Time to run - ms

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | 50 | 100 | 500 | 1000 | 5000 | 10000 |
| ./firstfit | 1.439 | 0.997 | 2.133 | 3.262 | 11.728 | 22.44 |
| ./bestfit | 0.911 | 1.0761 | 2.148 | 3.410 | 14.056 | 16.0235 |

Internal Fragmentation - Percentage

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | 50 | 100 | 500 | 1000 | 5000 | 10000 |
| ./firstfit | 9.98% | 18.20% | 22.88% | 25.57% | 23.99% | 24.40% |
| ./bestfit | 10.35% | 17.61% | 22.74 | 25.91% | 24.04% | 24.60% |

Internal Fragmentation - Bytes

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | 50 | 100 | 500 | 1000 | 5000 | 10000 |
| ./firstfit | 709 | 2447 | 16647 | 31680 | 142780 | 288935 |
| ./bestfit | 709 | 2209 | 16433 | 31278 | 142191 | 287648 |

External Fragmentation - Percentage

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | 50 | 100 | 500 | 1000 | 5000 | 10000 |
| ./firstfit | 54.05% | 25% | 4.84% | 0.67% | 5.36% | 3.46% |
| ./bestfit | 54.05% | 21.68% | 5.67% | 0% | 5.19% | 2.55% |

External Fragmentation - Bytes

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | 50 | 100 | 500 | 1000 | 5000 | 10000 |
| ./firstfit | 3840 | 3360 | 3520 | 832 | 31872 | 41056 |
| ./bestfit | 52.33 | 2720 | 4096 | 0 | 30688 | 29920 |