



BILKENT UNIVERSITY

ENGINEERING FACULTY

DEPARTMENT OF COMPUTER ENGINEERING

CS 342 Project 3 Report

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Description and RunTime Table

Project Description

In this Project, we were asked to implement a thread-safe memory management library(static library) which will be used by a multithreaded application to allocate memory dynamically.

This Project has been done by pair. Mehmet Ege Acican and Berk Türk.

The Project uses synchronization. Since it is a multithreaded program. The Project uses Mutex locks to allow synchronization.

For Dynamic Memory Allocation, 3 methods were asked to implement: First fit, Best fit and Worst Fit:

- 1. First Fit:** In the first fit, the partition is allocated which is first sufficient block.
- 2. Best Fit** Allocate the process to the partition which is the first smallest sufficient block.
- 3. Worst Fit** Allocate the process to the partition which is the largest sufficient block.

The user creates a chunk that he/she adjusts the size of and all of the methods(Allocation, freeing)is being done on this chunk. If there are no available chunksize left for allocation, the commanded allocation won't happen. The program only allocates if there is enough space for it.

Minimum chunk size is 32 KB and maximum chunk size is 32 MB

Minimum request size (size requested for allocation) is 128 bytes and maximum request size is 2048 KB.

Runtime Table and Project Outputs

For different variables, the runtime has been calculated by clock() functions and the runtime results have been recorded. Below are the tables for the runtime results for different variables.

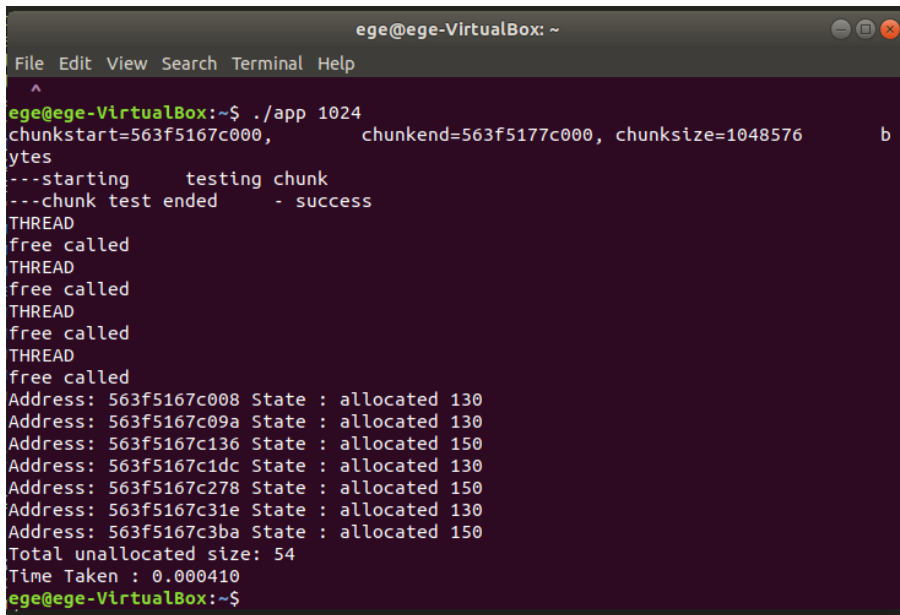
Runtime Table and Outputs for Allocation Algorithms

Below are the output results for First fit, Best Fit and Worst Fit algorithms. The thread size has been held constant as 4. While testing, the typical allocation request sizes were chosen as 130,140 and 150.

Algorithm	Runtime(s)
First Fit	0.000410
Best Fit	0.000207
Worst Fit	0.000205

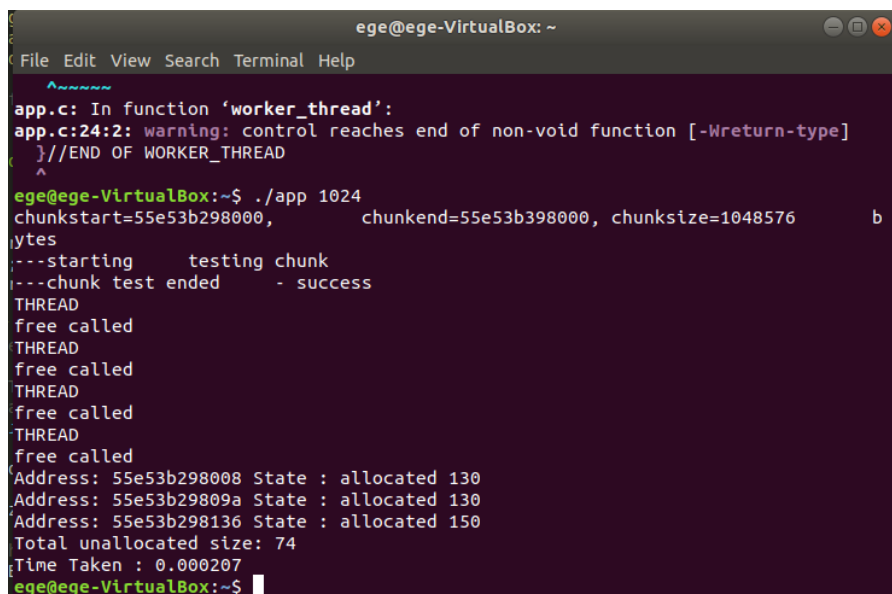
Note: (s) indicates seconds

Conclusion: Best Fit and Worst Fit Algorithms seems to work more efficient than first fit algorithms.



```
ege@ege-VirtualBox: ~
File Edit View Search Terminal Help
^
ege@ege-VirtualBox:~$ ./app 1024
chunkstart=563f5167c000,      chunkend=563f5177c000, chunksize=1048576      b
ytes
---starting      testing chunk
---chunk test ended      - success
THREAD
free called
THREAD
free called
THREAD
free called
THREAD
free called
Address: 563f5167c008 State : allocated 130
Address: 563f5167c09a State : allocated 130
Address: 563f5167c136 State : allocated 150
Address: 563f5167c1dc State : allocated 130
Address: 563f5167c278 State : allocated 150
Address: 563f5167c31e State : allocated 130
Address: 563f5167c3ba State : allocated 150
Total unallocated size: 54
Time Taken : 0.000410
ege@ege-VirtualBox:~$
```

Figure 1: Output of the First Fit



```
ege@ege-VirtualBox: ~
File Edit View Search Terminal Help
^
app.c: In function 'worker_thread':
app.c:24:2: warning: control reaches end of non-void function [-Wreturn-type]
} //END OF WORKER_THREAD
^
ege@ege-VirtualBox:~$ ./app 1024
chunkstart=55e53b298000,      chunkend=55e53b398000, chunksize=1048576      b
ytes
---starting      testing chunk
---chunk test ended      - success
THREAD
free called
THREAD
free called
THREAD
free called
THREAD
free called
Address: 55e53b298008 State : allocated 130
Address: 55e53b29809a State : allocated 130
Address: 55e53b298136 State : allocated 150
Total unallocated size: 74
Time Taken : 0.000207
ege@ege-VirtualBox:~$
```

Figure 2: Output of the best fit

```

ege@ege-VirtualBox: ~
File Edit View Search Terminal Help
ege@ege-VirtualBox:~$ ./app 1024
chunkstart=5612c4071000, chunkend=5612c4171000, chunksize=1048576 bytes
---starting testing chunk
---chunk test ended - success
THREAD
free called
THREAD
free called
THREAD
free called
THREAD
free called
Address: 5612c4071008 State : allocated 130
Address: 5612c407109a State : free 0
Address: 5612c4071136 State : allocated 150
Address: 5612c40711dc State : allocated 130
Address: 5612c407126e State : free 0
Address: 5612c407130a State : allocated 150
Address: 5612c40713b0 State : allocated 130
Address: 5612c4071442 State : free 0
Address: 5612c40714de State : allocated 150
Address: 5612c4071584 State : allocated 130
Total unallocated size: 54
Time Taken : 0.000205
ege@ege-VirtualBox:~$

```

Figure 3: Output of the Worst Fit

Runtime Table and Outputs for Thread size

Below are the output results and runtimes for different thread sizes(N = 1 to N = 4). The allocation algorithm used is First fit and it is constant. The request sizes has been taken as 130, 140 and 150.

Thread Number	Runtime(s)
1	0..000125
2	0.000164
3	0.000189
4	0.000293

Note: (s) indicates seconds

Conclusion: The thread number and run time are linearly dependent.

```

ege@ege-VirtualBox: ~
File Edit View Search Terminal Help
app.c: In function 'worker_thread':
app.c:24:2: warning: control reaches end of non-void function [-Wreturn-type]
} //END OF WORKER_THREAD
^
ege@ege-VirtualBox:~$ ./app 1024
chunkstart=55de5984c000, chunkend=55de5994c000, chunksize=1048576 bytes
---starting testing chunk
---chunk test ended - success
THREAD
free called
Address: 55de5984c008 State : allocated 130
Address: 55de5984c09a State : free 0
Address: 55de5984c136 State : allocated 150
Total unallocated size: 744
Time Taken : 0.000125
ege@ege-VirtualBox:~$

```

Figure 1: Output for thread number = 1

```
ege@ege-VirtualBox: ~  
File Edit View Search Terminal Help  
^  
ege@ege-VirtualBox:~$ ./app 1024  
chunkstart=563c8420d000, chunkend=563c8430d000, chunksize=1048576 bytes  
---starting testing chunk  
---chunk test ended - success  
THREAD  
free called  
THREAD  
free called  
Address: 563c8420d008 State : allocated 130  
Address: 563c8420d09a State : allocated 130  
Address: 563c8420d136 State : allocated 150  
Address: 563c8420d1dc State : free 0  
Address: 563c8420d278 State : allocated 150  
Total unallocated size: 464  
Time Taken : 0.000164  
ege@ege-VirtualBox:~$
```

Figure 2: Output for Thread Number = 2

```
ege@ege-VirtualBox: ~  
File Edit View Search Terminal Help  
---chunk test ended - success  
THREAD  
free called  
THREAD  
free called  
THREAD  
free called  
Address: 5583f31ae008 State : allocated 130  
Address: 5583f31ae09a State : allocated 130  
Address: 5583f31ae136 State : allocated 150  
Address: 5583f31ae1dc State : allocated 130  
Address: 5583f31ae278 State : allocated 150  
Address: 5583f31ae31e State : free 0  
Address: 5583f31ae3ba State : allocated 150  
Total unallocated size: 184  
Time Taken : 0.000189  
ege@ege-VirtualBox:~$
```

Figure 3: Output for Thread Number = 3

```
ege@ege-VirtualBox: ~  
File Edit View Search Terminal Help  
free called  
THREAD  
free called  
THREAD  
free called  
THREAD  
free called  
Address: 558538184008 State : allocated 130  
Address: 55853818409a State : allocated 130  
Address: 558538184136 State : allocated 150  
Address: 5585381841dc State : allocated 130  
Address: 558538184278 State : allocated 150  
Address: 55853818431e State : allocated 130  
Address: 5585381843ba State : allocated 150  
Total unallocated size: 54  
Time Taken : 0.000293  
ege@ege-VirtualBox:~$
```

Figure 4: Output for Thread Number = 4