Available commands

```
Available Commands:
init memory <size>              - Initialize physical memory
init virtual <vmem> <pmem> <page> - Initialize virtual memory
init cache <1|2>                - Initialize L1 or L2 cache
set allocator <first|best|worst> - Set memory allocation strategy
malloc <size>                    - Allocate memory
free <id>                        - Free memory by ID
read <address>                   - Read from memory (cache simulation)
translate <virtual_addr>         - Translate virtual to physical address
dump                             - Show memory layout
stats                            - Show memory statistics
cache stats                      - Show cache statistics
help                             - Show this help message
exit                             - Exit simulator
```

Running sequential allocation txt file

```
> memory of size 1024 created
> Allocator set
> Memory allocated with ID: 1 using first-fit
> Memory allocated with ID: 2 using first-fit
> Memory allocated with ID: 3 using first-fit
> Memory allocated with ID: 4 using first-fit
> Memory allocated with ID: 5 using first-fit
> Memory alloted from: 0 to: 49 to user with ID: 1
Memory alloted from: 50 to: 124 to user with ID: 2
Memory alloted from: 125 to: 224 to user with ID: 3
Memory alloted from: 225 to: 349 to user with ID: 4
Memory alloted from: 350 to: 499 to user with ID: 5
Free memory from: 500 to: 1023
> Total memory 1024
Free memory 524
Allocated memory 500
External Fragmentation 0%
```

Fragmentation Test - Deallocation Behavior

```
> memory of size 800 created
> Allocator set
> Memory allocated with ID: 1 using first-fit
> Memory allocated with ID: 2 using first-fit
> Memory allocated with ID: 3 using first-fit
> Memory allocated with ID: 4 using first-fit
> Memory alloted from: 0 to: 99 to user with ID: 1
Memory alloted from: 100 to: 179 to user with ID: 2
Memory alloted from: 180 to: 299 to user with ID: 3
Memory alloted from: 300 to: 359 to user with ID: 4
Free memory from: 360 to: 799
> Total memory 800
Free memory 440
Allocated memory 360
External Fragmentation 0%
> Memory with ID 2 freed successfully
> Memory with ID 4 freed successfully
> Memory alloted from: 0 to: 99 to user with ID: 1
Free memory from: 100 to: 179
Memory alloted from: 180 to: 299 to user with ID: 3
Free memory from: 300 to: 799
> Total memory 800
Free memory 580
Allocated memory 220
External Fragmentation 13.7931%
```

```
> Memory allocated with ID: 5 using first-fit
> Memory allocated with ID: 6 using first-fit
> Memory alloted from: 0 to: 99 to user with ID: 1
Memory alloted from: 100 to: 149 to user with ID: 5
Free memory from: 150 to: 179
Memory alloted from: 180 to: 299 to user with ID: 3
Memory alloted from: 300 to: 339 to user with ID: 6
Free memory from: 340 to: 799
> Total memory 800
Free memory 490
Allocated memory 310
External Fragmentation 6.12245%
```

Running multilevel cache test.txt file

```
PS C:\Users\khush\OneDrive\Desktop\Memory\memory-simulator> Get-Content tests\mu
ltilevel_cache_test.txt | .\memory_simulator.exe
Memory Management Simulator
Type 'help' for available commands
> memory of size 4096 created
> Enter Cache size
Enter Block Size
Enter associativity
> Enter Cache size
Enter Block Size
Enter associativity
> Found in main memory
> Found in main memory
> Found in L1 cache
> Found in main memory
> Found in L1 cache
> Found in main memory
> Found in L1 cache
> L1 Cache - Hits: 3, Misses: 4, Hit Ratio: 0.428571
L2 Cache - Hits: 0, Misses: 4, Hit Ratio: 0
L1 Cache - Hits: 3, Misses: 4, Hit Ratio: 0.428571
L2 Cache - Hits: 0, Misses: 4, Hit Ratio: 0
> End
```

LRU Replacement Test

```
PS C:\Users\khush\OneDrive\Desktop\Memory\memory-simulator> cd "c:\Users\khush\OneDrive\De
sktop\Memory\memory-simulator"; Get-Content tests\lru_replacement_test.txt | .\memory_simu
lator.exe
Memory Management Simulator
Type 'help' for available commands
> memory of size 2048 created
> Enter Cache size
Enter Block Size
Enter associativity
> > Found in main memory
> Found in L1 cache
> > > Found in main memory
> Found in L1 cache
> Found in L1 cache
> > > Found in main memory
> Found in L1 cache
> > L1 Cache - Hits: 4, Misses: 3, Hit Ratio: 0.571429
L1 Cache - Hits: 4, Misses: 3, Hit Ratio: 0.571429
> End
```

Basic Translation Test – Page Faults

```
PS C:\Users\khush\OneDrive\Desktop\Memory\memory-simulator> Get-Content tests\ba
sic_translation_test.txt | .\memory_simulator.exe
Memory Management Simulator
Type 'help' for available commands
> memory of size 1024 created
> Virtual memory initialized: 2048 virtual, 1024 physical, page size 256
Virtual memory initialized: 2048 virtual, 1024 physical, page size 256
> Virtual address 0 -> Physical address 768
Virtual address 0 -> Physical address 768
> Virtual address 100 -> Physical address 868
Virtual address 100 -> Physical address 868
> Virtual address 256 -> Physical address 512
Virtual address 256 -> Physical address 512
> Virtual address 500 -> Physical address 756
Virtual address 500 -> Physical address 756
> Virtual address 1000 -> Physical address 488
Virtual address 1000 -> Physical address 488
> Virtual address 1500 -> Physical address 220
Virtual address 1500 -> Physical address 220
```

Page Fault Test -LRU

```
PS C:\Users\khush\OneDrive\Desktop\Memory\memory-simulator> Get-Content tests\pa
ge_fault_test.txt | .\memory_simulator.exe
Memory Management Simulator
Type 'help' for available commands
> Virtual memory initialized: 2048 virtual, 512 physical, page size 256
Virtual memory initialized: 2048 virtual, 512 physical, page size 256
> Virtual address 0 -> Physical address 256
Virtual address 0 -> Physical address 256
> Virtual address 256 -> Physical address 0
Virtual address 256 -> Physical address 0
> Virtual address 512 -> Physical address 256
Virtual address 512 -> Physical address 256
> Virtual address 0 -> Physical address 0
Virtual address 0 -> Physical address 0
> Virtual address 768 -> Physical address 256
Virtual address 768 -> Physical address 256
> Virtual address 256 -> Physical address 0
Virtual address 256 -> Physical address 0
```

Allocators Comparision

```
> memory of size 1000 created
> Allocator set
> Memory allocated with ID: 1 using first-fit
> Memory allocated with ID: 2 using first-fit
> Memory allocated with ID: 3 using first-fit
> Memory allocated with ID: 4 using first-fit
> Memory allocated with ID: 5 using first-fit
> Memory alloted from: 0 to: 99 to user with ID: 1
Memory alloted from: 100 to: 299 to user with ID: 2
Memory alloted from: 300 to: 399 to user with ID: 3
Memory alloted from: 400 to: 549 to user with ID: 4
Memory alloted from: 550 to: 649 to user with ID: 5
Free memory from: 650 to: 999
> Total memory 1000
Free memory 350
Allocated memory 650
External Fragmentation 0%
> Memory with ID 2 freed successfully
> Memory with ID 4 freed successfully
> Memory alloted from: 0 to: 99 to user with ID: 1
Free memory from: 100 to: 299
Memory alloted from: 300 to: 399 to user with ID: 3
Free memory from: 400 to: 549
Memory alloted from: 550 to: 649 to user with ID: 5
Free memory from: 650 to: 999
> Total memory 1000
Free memory 700
Allocated memory 300
External Fragmentation 50%
```

```
> Memory allocated with ID: 6 using first-fit
> Memory allocated with ID: 7 using first-fit
> Memory alloted from: 0 to: 99 to user with ID: 1
Memory alloted from: 100 to: 179 to user with ID: 6
Memory alloted from: 180 to: 239 to user with ID: 7
Free memory from: 240 to: 299
Memory alloted from: 300 to: 399 to user with ID: 3
Free memory from: 400 to: 549
Memory alloted from: 550 to: 649 to user with ID: 5
Free memory from: 650 to: 999
> Total memory 1000
Free memory 560
Allocated memory 440
External Fragmentation 37.5%
> memory of size 1000 created
> Allocator set
> Memory allocated with ID: 1 using best-fit
> Memory allocated with ID: 2 using best-fit
> Memory allocated with ID: 3 using best-fit
> Memory allocated with ID: 4 using best-fit
> Memory allocated with ID: 5 using best-fit
> Memory alloted from: 0 to: 99 to user with ID: 1
Memory alloted from: 100 to: 299 to user with ID: 2
Memory alloted from: 300 to: 399 to user with ID: 3
Memory alloted from: 400 to: 549 to user with ID: 4
Memory alloted from: 550 to: 649 to user with ID: 5
Free memory from: 650 to: 999
> Total memory 1000
Free memory 350
Allocated memory 650
External Fragmentation 0%
```

```
> Memory with ID 2 freed successfully
> Memory with ID 4 freed successfully
> Memory alloted from: 0 to: 99 to user with ID: 1
Free memory from: 100 to: 299
Memory alloted from: 300 to: 399 to user with ID: 3
Free memory from: 400 to: 549
Memory alloted from: 550 to: 649 to user with ID: 5
Free memory from: 650 to: 999
> Total memory 1000
Free memory 700
Allocated memory 300
External Fragmentation 50%
> Memory allocated with ID: 6 using best-fit
> Memory allocated with ID: 7 using best-fit
> Memory alloted from: 0 to: 99 to user with ID: 1
Free memory from: 100 to: 299
Memory alloted from: 300 to: 399 to user with ID: 3
Memory alloted from: 400 to: 479 to user with ID: 6
Memory alloted from: 480 to: 539 to user with ID: 7
Free memory from: 540 to: 549
Memory alloted from: 550 to: 649 to user with ID: 5
Free memory from: 650 to: 999
> Total memory 1000
Free memory 560
Allocated memory 440
External Fragmentation 37.5%
> memory of size 1000 created
> Allocator set
> Memory allocated with ID: 1 using worst-fit
> Memory allocated with ID: 2 using worst-fit
> Memory allocated with ID: 3 using worst-fit
> Memory allocated with ID: 4 using worst-fit
```

```
> Memory allocated with ID: 5 using worst-fit
> Memory alloted from: 0 to: 99 to user with ID: 1
Memory alloted from: 100 to: 299 to user with ID: 2
Memory alloted from: 300 to: 399 to user with ID: 3
Memory alloted from: 400 to: 549 to user with ID: 4
Memory alloted from: 550 to: 649 to user with ID: 5
Free memory from: 650 to: 999
> Total memory 1000
Free memory 350
Allocated memory 650
External Fragmentation 0%
> Memory with ID 2 freed successfully
> Memory with ID 4 freed successfully
> Memory alloted from: 0 to: 99 to user with ID: 1
Free memory from: 100 to: 299
Memory alloted from: 300 to: 399 to user with ID: 3
Free memory from: 400 to: 549
Memory alloted from: 550 to: 649 to user with ID: 5
Free memory from: 650 to: 999
> Total memory 1000
Free memory 700
Allocated memory 300
External Fragmentation 50%
> Memory allocated with ID: 6 using worst-fit
> Memory allocated with ID: 7 using worst-fit
> Memory alloted from: 0 to: 99 to user with ID: 1
Free memory from: 100 to: 299
Memory alloted from: 300 to: 399 to user with ID: 3
Free memory from: 400 to: 549
Memory alloted from: 550 to: 649 to user with ID: 5
Memory alloted from: 650 to: 729 to user with ID: 6
```

```
Memory alloted from: 730 to: 789 to user with ID: 7
Free memory from: 790 to: 999
> Total memory 1000
Free memory 560
Allocated memory 440
External Fragmentation 62.5%
```

Full System Integration Test

```
ll_system_test.txt | .\memory_simulator.exe
Memory Management Simulator
Type 'help' for available commands
> memory of size 2048 created
> Allocator set
> Enter Cache size
Enter Block Size
Enter associativity
> Enter Cache size
Enter Block Size
Enter associativity
> Virtual memory initialized: 4096 virtual, 2048 physical, page size 256
Virtual memory initialized: 4096 virtual, 2048 physical, page size 256
> Memory allocated with ID: 1 using best-fit
> Found in main memory
> Virtual address 500 -> Physical address 2036
Virtual address 500 -> Physical address 2036
> Memory allocated with ID: 2 using best-fit
> Found in main memory
> Virtual address 1000 -> Physical address 1768
Virtual address 1000 -> Physical address 1768
> Memory with ID 1 freed successfully
> Found in L1 cache
> Virtual address 1500 -> Physical address 1500
Virtual address 1500 -> Physical address 1500
> Free memory from: 0 to: 199
Memory alloted from: 200 to: 349 to user with ID: 2
Free memory from: 350 to: 2047
> Total memory 2048
Free memory 1898
Allocated memory 150
External Fragmentation 10.5374%
```

```
> L1 Cache - Hits: 1, Misses: 2, Hit Ratio: 0.333333
L2 Cache - Hits: 0, Misses: 2, Hit Ratio: 0
L1 Cache - Hits: 1, Misses: 2, Hit Ratio: 0.333333
L2 Cache - Hits: 0, Misses: 2, Hit Ratio: 0
```