ASSIGNMENT 3

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1. mems_init():

- This function sets up an initial memory block and creates a free list.
- mmap() is called to request a block of memory from the operating system and is assigned to start representing the starting address of the MeMS virtual address space.
  - NULL - systems chooses a suitable address.
  - PAGE_SIZE - memory of the block to be allocated
  - PROT_READ | PROT_WRITE - allocated memory can be written and read
  - MAP_PRIVATE | MAP_ANONYMOUS - indicating the memory should be private to the process
  - -1 - specifies that no specific file descriptor is associated.
  - 0 - offset within the file
- total size of the MeMS virtual address space is set to the value of PAGE_SIZE.
- memsheap.freelist is initialized to point to the same address as memsheap.start. the memory allocated stores block structures.
- memsheap.freelist block is set to the remaining size of the memory block.

2. mem_finish():

- The purpose of the mems_finish function is to be called at the end of the MeMS system to deallocate and release all the memory that was previously allocated by the MeMS.
- pointer current_block is initialized to the head of the memsheap.freelist.
- the function enters a while loop to iterate through the linked lists of memory blocks until current_block is not NULL.
- munmap is called to deallocate memory associated with the current block using the size of the block to be unmapped (current_size + block_size).
- current_block pointer is updated to the next block in freelist.

3. mem_print_stats():

- The purpose of this function is to print statistics about the MeMS System(number of pages utilized and how much memory is unused).
- calculates the number of mapped pages using memsheap.mem_size and PAGE_SIZE (memsheap.mem_size / PAGE_SIZE).
- a pointer current_block is initialized to the head of the freelist and continues to traverse through the while loop until current_block is NOT NULL.
- the size of the current_block is added to the unused memory variable

4. mem_free():

- The purpose of mems_free is to free up memory pointed by the MeMS virtual address and add it back to the freelist.

- after ensuring v_ptr is not a null pointer, to obtain the address of the block structure it is cast to a block* pointer and decremented by 1.
- current_block is initialized to the head of the freelist by inserting it to the beginning of the freelist.
- memsheap.freelist is updated to point at current_block.

```
------- Allocated virtual addresses [mems_malloc] -------
Virtual address: 139777965105168
Virtual address: 139777965106184
Virtual address: 139777965107200
Virtual address: 139777965108216
Virtual address: 139777964867600
Virtual address: 139777964868616
Virtual address: 139777964869632
Virtual address: 139777964870648
Virtual address: 139777964859408
Virtual address: 139777964860424

------ Assigning value to Virtual address [mems_get] -----
Virtual address: 139777965105168        Physical Address: 139777965105168
Value written: 200

--------- Printing Stats [mems_print_stats] --------
Block size : 6144 bytes
Unused memory : 6144 bytes

---------- Freeing up the memory [mems_free] --------
Block size : 1032 bytes
Block size : 6144 bytes
Unused memory : 7176 bytes
Block size : 6144 bytes
Unused memory : 6144 bytes

---------- Unmapping all memory [mems_finish] --------
```

```
------- Allocated virtual addresses [mems_malloc] -------
Virtual address: 140334360809488
Virtual address: 140334360810504
Virtual address: 140334360811520
Virtual address: 140334360812536
Virtual address: 140334360571920
Virtual address: 140334360572936
Virtual address: 140334360573952
Virtual address: 140334360574968
Virtual address: 140334360563728
Virtual address: 140334360564744

------ Assigning value to Virtual address [mems_get] -----
Virtual address: 140334360809488        Physical Address: 140334360809488
Value written: 200

--------- Printing Stats [mems_print_stats] --------
Block size : 6144 bytes
Unused memory : 6144 bytes

---------- Freeing up the memory [mems_free] --------
Block size : 1032 bytes
Block size : 6144 bytes
Unused memory : 7176 bytes
Block size : 6144 bytes
Unused memory : 6144 bytes

---------- Unmapping all memory [mems_finish] --------
```