

**DiamondDogs**

Operating System

CS 450 MPX

# Programmers Manual

Version 6.0

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## i. MPX Project Overview:

The MPX Project is designed to implement various functions of an operating system. This module includes our first version of the command menu, allowing the user to interact with the OS through the terminal. The user will use the keyboard to send input and whenever a system response is generated, it will display on the terminal window.

## ii. Operating System Functions:

### I. `run_ch()`

#### i. Functionality:

This function initiates the control switching to our command handler. This module prints the OS specifications, the menu and determines what command to execute based on the user's input.

#### ii. Input Parameters:

None

#### iii. Returns:

None

### II. `run_startup()`

#### i. Functionality:

This module builds and outputs the startup design and system details.

#### ii. Parameters:

None

#### iii. Returns:

None

### III. `run_getdate()`

#### i. Functionality:

Getdate uses the *outb* function to access the register value for each of the 3 parts of date, and then converts them in order to be able to output the correct system response.

#### ii. Parameters:

- None
- iii. Returns:
  - None

#### IV. `run_gettime()`

- i. Functionality:

Gettime utilizes the same logic as `getdate` in order to access the individual registers corresponding to each piece of the time.
- ii. Parameters:
  - None
- iii. Returns:
  - Int

#### V. `run_help()`

- i. Functionality:

The help function takes in the user input buffer where it parses the command to determine the menu option to include. If nothing follows the initial help command, it outputs the main menu of the system.
- ii. Parameters:
  - `char* commandBuff` - buffer holding UI command.
  - `int bufferSize` - size of corresponding buffer.
- iii. Returns:
  - Int

#### VI. `run_version()`

- i. Functionality:

This module writes the current system version to the terminal.
- ii. Parameters:
  - None
- iii. Returns:
  - Int

#### VII. `run_settime()`

- i. Functionality:

Settime allocates memory in character arrays for the hours, minutes and seconds declaration. The function parses through the commandBuff to read in the three values for hour, minute, and second. Those values are run through the 'atoi' function which are then converted to BCD to be placed into the registers

- ii. Parameters:  
char \* commandBuff - buffer holding UI command.
- iii. Returns:  
Int

#### VIII. run\_setdate()

- i. Functionality:  
Settime allocates memory in character arrays for the month, day, and year declaration. The function parses through commandBuff to read in the three values for month, day, and year. Those values are converted to integers with the 'atoi' function and then converted to BCD to be placed into the registers
- ii. Parameters:  
char \* commandBuff - buffer holding UI command.
- iii. Returns:  
Int

#### IX. run\_shutdown()

- i. Functionality:  
Shutdown confirms with the user with a yes or no option on whether they want to shut down the program or not. If yes is entered, then it returns, 1, indicating shutdown, if no is entered, a 0 is returned and the program keeps running
- ii. Parameters:  
char\* buffer - Used to read confirmation input  
Int size - size of buffer
- iii. Returns:  
Int - 1 tells command handler to shutdown, 0 keeps the program running

## X. `get_command()`

### i. Functionality:

The function starts at the 0 index of `commandBuff` and searches for the first ' ' character or a null terminator and places those characters in a command array. From there we `strcmp` the command array to different commands to determine what command was typed. Once determined, that command is run.

### ii. Parameters:

`Char * commandBuff` - buffer holding UI command

`Int bufferSize` - size of `commandBuff`

### iii. Returns:

`Int`

## XI. `keycap()`

### i. Functionality:

Called from within polling to handle keyboard logic. Through a series of if statements, the key capture can determine what letter or number is pressed, as well as special characters like backspace, delete, and enter.

### ii. Parameters:

`char* buffer` - A buffer that inputted characters are placed into and removed from.

`Int location` - Keeps track of what position the cursor is on after each keystroke

`Int length` - Keeps track of the length of the buffer

### iii. Returns:

`Int location` - Returns the location of the cursor so that it can be tracked, and sent back to `keyCap`. If -1 is returned, enter has been pressed and causes a break to happen in polling, stopping user input.

## XII. `itoa()`

### i. Functionality:

Convert an integer to a string

### ii. Parameters:

`Int num` - integer to be converted



char\* str - char\* for the string to be placed into

iii. Returns:

char\* str - returns string with converted integer

### XIII. `polling()`

i. Functionality:

To check for ready byte that indicates that the user has pressed the keyboard. From there `keyCap` is called to handle what was pressed.

ii. Parameters:

char\* buffer - buffer to place char values into

int\* count - size of buffer

iii. Returns:

int\* count - returns the size of the buffer

#### XIV. setupPCB()

i. Functionality:

To create a new pcb and fill its contents with the user inputted name, class, and priority. Checks to make sure that a pcb with the same name is not already in one of the queues and allocates space for pcb.

ii. Parameters:

char\* name - user inputted name of process

Int class - integer value of class

Int priority - integer value of user inputted priority

iii. Returns:

PCB\* newPCB - returns the pcb it just created

#### XV. findPCB()

i. Functionality:

Searches through the four queues and compares the names to every pcb to check to see if there is a pcb with the same name inside the queues.

ii. Parameters:

char\* name - user inputted name to search for.

iii. Returns:

PCB\* current - returns NULL pointer if one does not exist or the pcb with the same name if it does exist.

#### XVI. allocatePCB()

i. Functionality:

Allocates a section in memory for the PCB

ii. Parameters:

None

iii. Returns:

PCB\* temp - PCB that was just allocated

#### XVII. freePCB()

i. Functionality:

Free's the PCB from memory

ii. Parameters:

PCB\* pcb

- iii. Returns:  
void

#### XVIII. removePCB()

- i. Functionality:  
Is called by deletePCB() to remove the pcb from whatever queue it is inside
- ii. Parameters:  
PCB\* pcb
- iii. Returns:  
Int - Returns 1 if the removal is successful

#### XIX. insertPCB()

- i. Functionality:  
Determines what queue the pcb needs to be placed into, and adds the pcb to the queue in the correct place, depending on if the queue is priority or fifo.
- ii. Parameters:  
PCB\* pcb
- iii. Returns:  
PCB\* pcb - Returns the pcb that was just inserted

#### XX. get\_pcb\_data()

- i. Functionality:  
This function calls get\_name, get\_class, and get\_prio to gather the information needed to create the PCB. It then checks to make sure a pcb with the same name does not exist, then calls setupPCB to create it
- ii. Parameters:  
Char\* commandBuff - command buffer
- iii. Returns:  
Int - returns 1 for success, another number for error

#### XXI. blockPCB()

- i. Functionality:

Moves a pcb out of the ready or suspended ready into the blocked or suspended blocked queue

- ii. Parameters:  
char\* commandBuff - command buffer
- iii. Returns:  
PCB\* pcb - returns pcb that it just blocked

#### XXII. unblockPCB()

- i. Functionality:  
Returns the pcb to the ready or suspended ready from the blocked or suspended blocked queue.
- ii. Parameters:  
char\* commandBuff - command buffer
- iii. Returns:  
PCB\* pcb - returns pcb that it just unblocked

#### XXIII. suspendPCB()

- i. Functionality:  
Moves pcb from ready or blocked queue to suspended ready or suspended blocked queue
- ii. Parameters:  
char\* commandBuff - command buffer
- iii. Returns:  
PCB\* pcb -returns pcb that was just suspended

#### XXIV. resumePCB()

- i. Functionality:  
Returns pcb from the suspended ready or blocked ready to the ready or blocked queue
- ii. Parameters:  
char\* commandBuff - command buffer
- iii. Returns:  
PCB\* pcb - returns pcb that it just resumed

#### XXV. setPriority()

- i. Functionality:

Changes priority of user inputted pcb to user inputted priority

- ii. Parameters:  
char\* commandBuff -
- iii. Returns:  
Int - returns 1 for success

#### XXVI. showPCB()

- i. Functionality:  
Shows contents of pcb
- ii. Parameters:  
char\* commandBuff - command buffer
- iii. Returns:  
void

#### XXVII. printReady()

- i. Functionality:  
Print current ready queue
- ii. Parameters:  
none
- iii. Returns:  
none

#### XXVIII. printBlocked()

- i. Functionality:  
Prints all the pcb's in the blocked queue.
- ii. Parameters:  
none
- iii. Returns:  
none

#### XXIX. printAll()

- i. Functionality:  
Shows all the pcb's in every queue.
- ii. Parameters:  
none
- iii. Returns:

none

### XXX. `get_name()`

- i. **Functionality:**  
Called in `get_pcb_data()` to parse the command buffer and get the inputted name
- ii. **Parameters:**  
`char* commandBuff` - command buffer
- iii. **Returns:**  
`char* name_ptr` - copied name

### XXXI. `get_class()`

- i. **Functionality:**  
Called in `get_pcb_data()` to parse the command buffer and get the inputted class number
- ii. **Parameters:**  
`char* commandBuff` - command buffer
- iii. **Returns:**  
`char* class_ptr`

### XXXII. `get_prio()`

- i. **Functionality:**  
Called in `get_pcb_data()` to parse the command buffer and get the inputted priority number
- ii. **Parameters:**  
`char* commandBuff` - command buffer
- iii. **Returns:**  
`prio_ptr`

### XXXIII. `print()`

- i. **Functionality:**  
Called by `printReady`, `printBlocked`, and `printAll`, to print the individual pcb and the contents within it
- ii. **Parameters:**  
`PCB* pcb` - current pcb that needs to be printed

- iii. Returns:  
none

#### XXXIV. `initQueues()`

- i. Functionality:  
Initializes the four queues.
- ii. Parameters:  
none
- iii. Returns:  
none

#### XXXV. `deletePCB()`

- i. Functionality:  
Delete specified PCB from queue.
- ii. Parameters:  
PCB\* pcb - current pcb that needs to be deleted
- iii. Returns:  
none

#### XXXVI. `deleteAll()`

- i. Functionality:  
Deletes all processes from every queue in order to allow for shutdown.
- ii. Parameters:  
none
- iii. Returns:  
none

#### XXXVII. `resumeAll()`

- i. Functionality:  
Resumes all processes in the suspended ready queue.
- ii. Parameters:  
none
- iii. Returns:  
none

#### XXXVIII. `alarm()`

**i.** Functionality:

Checks to see if an alarm PCB is inside of the ready queue and adds one if it isn't inside. Handles all user input for the message and the user imputed time. Calls `add_alarm` to add alarm to the system.

**ii.** Parameters:

`char* buffer` - Command buffer from command handler

**iii.** Returns:

none

#### XXXIX. `add_alarm()`

**i.** Functionality:

Retrieves alarm data to add into the system.

**ii.** Parameters:

`char* hr` - Pointer variable representing hours

`char* min` - Pointer variable representing min

`char* sec` - Variable representing seconds

`char message[50]` - input buffer

**iii.** Returns:

none

#### XL. `check_alarm()`

**i.** Functionality:

Function called by the alarm PCB to check the alarm times versus the current time of the system. If an alarm needs to be triggered, the function prints the message the user imputed.

**ii.** Parameters:

none

**iii.** Returns:

none



XLII. `get_current_time()`

- i. **Functionality:**  
Get the current time of the system.
- ii. **Parameters:**  
none
- iii. **Returns:**  
Char\* getTime - Char\* of the hours, minutes, and seconds concatenated together to compare against alarm times.

XLIII. `loadr3()`

- i. **Functionality:**  
This function loads all described processes into the system and places them into their correct queue.
- ii. **Parameters:**  
none
- iii. **Returns:**  
none

XLIV. `sys_call_isr()`

- i. **Functionality:**  
Pushes and pops all the CPU registers and calls the sys\_call function.
- ii. **Parameters:**  
none
- iii. **Returns:**  
none

XLV. `sys_call()`

- i. **Functionality:**  
Gets operating processes context data and changes the currently operating process based on what processes are inside of the ready queue.
- ii. **Parameters:**  
context\* registers - pointer to processes context
- iii. **Returns:**  
unsigned pointer to context of process.

XLV. `create_infinite()`

- i. **Functionality:**  
Initializes a process to run continuously.
- ii. **Parameters:**  
none
- iii. **Returns:**  
none

XLVI. `initHeap()`

- i. **Functionality:**  
Initializes the heap for the system. Creates a free block of memory with size 50,000.
- ii. **Parameters:**  
none
- iii. **Returns:**  
none

XLVII. `initLists()`

- i. **Functionality:**  
Initializes the linked list for keeping track of the memory control blocks.
- ii. **Parameters:**  
none
- iii. **Returns:**  
none

XLVIII. `allocateMem()`

- i. **Functionality:**  
Allocates memory inside of the heap
- ii. **Parameters:**  
U32int size - size of process that needs to be allocated
- iii. **Returns:**  
U32int address - Address in memory for the allocated process.

#### XLIX. `freeMem()`

- i. **Functionality:**  
Free's a memory control block
- ii. **Parameters:**  
void\* location - Location in memory of memory control block that needs to be freed.
- iii. **Returns:**  
Int 0 if successfully freed

#### L. `findMCB()`

- i. **Functionality:**  
Called by `freeMem` to search the list to find the MCB at the address provided.
- ii. **Parameters:**  
U32int address - address of MCB
- iii. **Returns:**  
MCB\* mcb - MCB at provided address

#### LI. `updateList()`

- i. **Functionality:**  
Called by `freeMem` to update the list after every free action, combining free MCB's that are next to each other in location.
- ii. **Parameters:**  
none
- iii. **Returns:**  
none

#### LII. `findSpace()`

- i. **Functionality:**  
Called by `allocateMem` to find an MCB inside of the heap with enough space to accommodate the process
- ii. **Parameters:**  
Int size - size needed for process
- iii. **Returns:**  
MCB\* curr - MCB with enough space for the process  
MCB\* null - returns null if there isn't a MCB with enough space

#### LIII. isEmpty()

- i. Functionality:  
Searches through the heap to see if the heap is empty.
- ii. Parameters:  
none
- iii. Returns:  
Int 0 - Not empty  
Int 1 - empty

#### LIV. showFree()

- i. Functionality:  
Traverses the heap list and prints only the free MCB's size, location, and type.
- ii. Parameters:  
none
- iii. Returns:  
none

#### LV. showAlloc()

- i. Functionality:  
Traverses the heap list and prints only the allocated MCB's size, location, and type.
- ii. Parameters:  
none
- iii. Returns:  
none

#### LVI. printNodes()

- i. Functionality:  
Test function to print every MCB inside of the heap list.
- ii. Parameters:  
none
- iii. Returns:  
none

#### LVII. `set_int()`

- i. **Functionality:**  
Handles disabling correct interrupts.
- ii. **Parameters:**  
int bit - bit to place.  
int on - boolean value to determine whether its on or off
- iii. **Returns:**  
none.

#### LVIII. `top_handle()`

- i. **Functionality:**  
The handler determines what the specific interrupt is and calls the corresponding function to handle it.
- ii. **Parameters:**  
none.
- iii. **Returns:**  
none.

#### LIX. `com_open()`

- i. **Functionality:**  
Initializing the serial port to be used for I/O communication.
- ii. **Parameters:**  
int baud\_rate - baud rate for module.
- iii. **Returns:**  
int - 0 for completion, no error.  
otherwise - specific error code.

#### LX. `com_close()`

- i. **Functionality:**  
This function executes after the completion of an I/O session to update the port properties.
- ii. **Parameters:**  
void
- iii. **Returns:**  
int - 0 for completion, no error.  
otherwise 201 - open port error code.

#### LXI. `com_read()`

- i. **Functionality:**  
Places characters from port input into specific buffer.
- ii. **Parameters:**  
char\* buffer - address for the beginning of the requestors buffer that holds the characters from input.  
int\* count - value representing the total number of characters that are to be read through port.
- iii. **Returns:**  
int - 0 for completion, no error.  
otherwise specific error code.

#### LXII. `com_write()`

- i. **Functionality:**  
Begins execution of data transfer via specified serial port.
- ii. **Parameters:**  
char\* buffer - address for the beginning of buffer containing values to be sent.  
int\* count pointer? - integer value representing total number of characters that should be transferred.
- Returns:**  
int - 0 for completion, no error.  
otherwise specific error code.

#### LXIII. `initIOCBQueue()`

- i. **Functionality:**  
Creation of interrupt requests.
- ii. **Parameters:**  
none.
- iii. **Returns:**  
none.

#### LXIV. `createIOCB()`

- i. **Functionality:**  
Creates IOCB structure using parameters taken in.
- ii. **Parameters:**

u32int address - ?

char\* buffer - buffer corresponding to the IOCB

int buffer\_length - length of buffer for function.

int operation - specifies the request type.

- iii. Returns:  
none.

#### LXV. insertIOCB()

- i. Functionality:  
Place input/output interrupt structure in the corresponding system queue.
- ii. Parameters:  
struct IOCB\* new - takes in IOCB to be added.
- iii. Returns:  
none.

#### LXVI. IOCBScheduler()

- i. Functionality:  
The scheduler checks for whether an interrupt has occurred and reads it's current status in order to call the correct function for service.
- ii. Parameters:  
none.
- iii. Returns:  
none.

#### LXVII. read\_interrupt()

- i. Functionality:  
Retrieves input character and places in appropriate buffer
- ii. Parameters:  
none.
- iii. Returns:  
none.

#### LXVIII. write\_interrupt()

- i. Functionality:

The write function outputs the characters inside the requestors buffer.

- ii. Parameters:  
none.
- iii. Returns:  
none.

#### LXIX.

- i. Functionality:
- ii. Parameters:  
none.
- iii. Returns:  
none.

#### LXX.

- i. Functionality:
- ii. Parameters:
- iii. Returns: