**CS60038: Assignment 2**

(Handling Syscalls using LKM)

This assignment is a continuation of Assignment 1. In this assignment, you now need to develop an LKM that supports various ioctl calls to set and retrieve various configurations and internal information respectively. The following table describes the ioctl commands and their task. Here, upon insertion of this LKM, it will create a file at the path **/proc/cs60038\_a2\_<roll no>**. This path will be world-readable and writable. A userspace program will interact with the LKM through this file. A userspace program can fire an ioctl system call any time it wants.

| Command | Description |
| --- | --- |
| PB2\_SET\_CAPACITY | This command initializes the LKM with the maximum priority-queue capacity. LKM is already initialized for the current process, this command resets the LKM and reinitializes again. It expects a pointer to a 32-bit integer. The value must be in the range between 1 and 100 (both inclusive). Invalid value or inaccessible pointer causes an error and sets the error number to EINVAL. On success, it returns 0.  No other operation can be performed (including read or write) before  performing this system call. Every other system call on the LKM returns an  error (-1) with code EACCES. |
| PB2\_INSERT\_INT | This command inserts an integer into the priority-queue. It takes a  pointer to an integer as the input value. Invalid value causes an error in  LKM and sets error number to EINVAL. On success, it returns 0.  This command is followed by the PB2\_INSERT\_PRIO command at the userspace process. |
| PB2\_INSERT\_PRIO | This command inserts the priority into the priority-queue. It takes a pointer  to an integer as the input value. Invalid value causes an error in LKM and  sets error number to EINVAL. On success, this command returns 0.  If the priority-queue is full, it returns an error (-1) with code EACCES. |
| PB2\_GET\_INFO | This command returns the information about the priority-queue. PB2\_GET\_INFO command expects a pointer to a structure object of type struct obj\_info as the value.  On success, LKM returns 0 and fills the various fields of the pointer passed by the process. On error, LKM sets appropriate error no and returns -1. |
| PB2\_GET\_MIN | This extracts the element with minimum priority from the priority-queue (Element having lowest integer value as priority, should be considered as minimum priority element). This function returns 0 on success and -1 on error. |
| PB2\_GET\_MAX | This extracts the element with maximum priority from the priority-queue. This function returns 0 on success and -1 on error. |

The definition of ioctl commands are as follows:

**#define PB2\_SET\_CAPACITY #define PB2\_INSERT\_INT**

**#define PB2\_INSERT\_PRIO**

**#define PB2\_GET\_INFO**

**#define PB2\_GET\_MIN**

**#define PB2\_GET\_MAX**

**\_IOW(0x10, 0x31, int32\_t\*)**

**\_IOW(0x10, 0x32, int32\_t\*)**

**\_IOW(0x10, 0x33, int32\_t\*)**

**\_IOR(0x10, 0x34, int32\_t\*)**

**\_IOR(0x10, 0x35, int32\_t\*)**

**\_IOR(0x10, 0x36, int32\_t\*)**

The definition of structures are as follows:

struct obj\_info {

int32\_t prio\_que\_size; // current number of elements in priority-queue

int32\_t capacity; // maximum capacity of priority-queue

};

A userspace process interacts with the LKM in the following manner only.

1. It will open the file (**/proc/cs60038\_a2\_<roll no>**) in read-write mode and obtain the file descriptor.
2. Userspace process calls the ioctl system call with command PB2\_SET\_CAPACITY and appropriate value to set the maximum capacity of the priority-queue in the kernel.
3. Insert elements using the ioctl system call with commands PB2\_INSERT\_INT and PB2\_INSERT\_PRIO as many times as you want. However, there is no bound on the number of times the user program can call this insert operation. LKM verifies the arguments in the system call and inserts the input into the priority-queue. In case the priority-queue is full, an appropriate error is returned.
4. To perform read/ extract data from priority-queue, the userspace program uses ioctl system call with command PB2\_GET\_MIN or PB2\_GET\_MAX. The system call returns 0 in case of successful execution and populates the result**,** whose pointer is passed while making the call.
5. When all the operations are done, the userspace process closes the file and LKM releases all the resources allocated for the process.
6. In between the userspace program can call the ioctl system call with command PB2\_GET\_INFO to retrieve information and the current state of the priority-queue.

LKM should be able to handle concurrency and separate data from multiple processes. Also, no userspace program should be able to open the file more than once simultaneously. However, the userspace process should be able to reset the LKM (for the said process) by reopening the file.

**Submission Details:**

* Students have to submit the LKM Code and the corresponding Makefile.
* In every source code file write your Roll no in the comments at the top.
* Compress these files into a zip file and name the zip file: **ASGN2\_<ROLL\_NO>.zip.**