Computer Operating Systems, Practice Session 11

Linux Message Queues

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Today

Computer Operating Systems, PS 11

Message Queues

Usage

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Message Queues

- Message queues are used for **ASYNCHRONOUS** communication among processes.
- Message queues are kept by the OS.
- A message placed into the queue is kept in the queue until it is read by the receiver.
- Many processes/threads may access the queue at the same time (not the same instance).
- Queue keeps its existence independent of the lifecycle of the processes/threads using the queue.

Some Useful IPC Commands

Two commonly used commands, related to inter-process communication, defined by Linux operating system:

ipcs : provides information on IPC resources currently used by the OS.

ipcrm : can be used for deleting IPC resources currently used by the OS.

- **-m** to remove a shared memory location
- **-s** to remove a semaphore
- **-q** to remove a message queue

E.g:

- With the `ipcs -q` command, the message queues currently been kept by OS can be seen.
- `ipcrm -q 123` command deletes the message queue with identifier 123.

Creating a Message Queue

```c
#include <stdio.h>
#include <stdlib.h>
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/msg.h>
#define KEYMQ 500 // key

void main(){
   // create a message queue
   int msqid = msgget(KEYMQ,IPC_CREAT|0777);
   msqid>0 ?
   printf("Queue %d is created.\n", msqid) :
   printf("Queue creation failed.\n");
}
```

Creating a Message Queue - Output

```
musty@musty-VirtualBox:/media/sf_virtualbox_shared_folder$ gcc cr.c
musty@musty-VirtualBox:/media/sf_virtualbox_shared_folder$ ipcs -q

------ Message Queues --------
key        msqid      owner      perms      used-bytes   messages
0x0000d903 0          musty      777        0            0

musty@musty-VirtualBox:/media/sf_virtualbox_shared_folder$ ./a.out
Queue 32769 is created.
musty@musty-VirtualBox:/media/sf_virtualbox_shared_folder$ ipcs -q

------ Message Queues --------
key        msqid      owner      perms      used-bytes   messages
0x0000d903 0          musty      777        0            0
0x0000000a 32769      musty      777        0            0
```

Sending a Message

```c
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/msg.h>
#define msgsz 256 // message size

struct msgbuf{ // message buffer
  long mtype; // message type
  char mtext[msgsz]; // message
};
void main(int argc, char **argv){
  // convert input argument to long integer(id of the message queue)
  int msqid = strtol(argv[1],NULL,10);
  struct msgbuf msgp; // create a message buffer
  // convert input argument to long integer (message type)
  msgp.mtype = strtol(argv[2],NULL,10);
  strcpy(msgp.mtext, argv[3]); // read message from console
  // send message from message queue
  msgsnd(msqid, &msgp, msgsz, 0) == 0 ?
  printf("Sent.\n") : printf("Cannot send.\n");
}
```

Sending a Message - Output

```
musty@musty-VirtualBox:/media/sf_virtualbox_shared_folder$ gcc snd.c
musty@musty-VirtualBox:/media/sf_virtualbox_shared_folder$ ipcs -q

------ Message Queues --------
key        msqid      owner      perms      used-bytes   messages
0x0000d903 0          musty      777        0            0
0x0000000a 131073     musty      777        0            0

musty@musty-VirtualBox:/media/sf_virtualbox_shared_folder$ ./a.out 131073 10 "Message 1, Type 10"
Sent.
musty@musty-VirtualBox:/media/sf_virtualbox_shared_folder$ ./a.out 131073 20 "Message 2, Type 20"
Sent.
musty@musty-VirtualBox:/media/sf_virtualbox_shared_folder$ ./a.out 131073 30 "Message 3, Type 30"
Sent.
musty@musty-VirtualBox:/media/sf_virtualbox_shared_folder$ ./a.out 131073 40 "Message 4, Type 40"
Sent.
musty@musty-VirtualBox:/media/sf_virtualbox_shared_folder$ ipcs -q

------ Message Queues --------
key        msqid      owner      perms      used-bytes   messages
0x0000d903 0          musty      777        0            0
0x0000000a 131073     musty      777        1024         4
```

Reading a Message

```c
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/msg.h>
#define msgsz 256 // message size
// return immediately if no message of the requested type is in the queue
#define msgflg IPC_NOWAIT

struct msgbuf{ // message buffer
  long mtype; // message type
  char mtext[msgsz]; // message
};
void main(int argc, char **argv){
  // convert input argument to long integer(id of the message queue)
  int msqid = strtol(argv[1],NULL,10);
  // convert input argument to long integer (message type)
  long msgtyp = strtol(argv[2],NULL,10);
  struct msgbuf msgp; // create a message buffer
  // read the message
  msgrcv(msqid, &msgp, msgsz, msgtyp, msgflg) >0 ?
  printf("Received: \"%s\" of type=%ld.\n", msgp.mtext, msgp.mtype) :
  printf("Cannot receive anything.\n");
}
```

Reading a Message

- If `msgtyp` is 0, then the first message in the queue is read.
- If `msgtyp` is greater than 0, then the first message in the queue of type `msgtyp` is read.
- If `msgtyp` is less than 0, then the first message in the queue with the lowest type less than or equal to the absolute value of `msgtyp` will be read.

Reading a Message - Output

```
musty@musty-VirtualBox:/media/sf_virtualbox_shared_folder$ gcc rcv.c
musty@musty-VirtualBox:/media/sf_virtualbox_shared_folder$ ./a.out 131073 0
Received: "Message 1, Type 10" of type=10.
musty@musty-VirtualBox:/media/sf_virtualbox_shared_folder$ ./a.out 131073 30
Received: "Message 3, Type 30" of type=30.
musty@musty-VirtualBox:/media/sf_virtualbox_shared_folder$ ./a.out 131073 -10
Cannot receive anything.
musty@musty-VirtualBox:/media/sf_virtualbox_shared_folder$ ./a.out 131073 -20
Received: "Message 2, Type 20" of type=20.
musty@musty-VirtualBox:/media/sf_virtualbox_shared_folder$ ./a.out 131073 40
Received: "Message 4, Type 40" of type=40.
musty@musty-VirtualBox:/media/sf_virtualbox_shared_folder$ ipcs -q

------ Message Queues --------
key        msqid      owner      perms      used-bytes   messages
0x0000d903 0          musty      777        0            0
0x0000000a 131073     musty      777        0            0
```

Deleting a Message Queue

```c
#include <stdio.h>
#include <stdlib.h>
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/msg.h>

void main(int argc, char **argv){
  // convert input argument to long integer (id of the queue)
  int msqid=strtol(argv[1], NULL, 10);
  // remove the message queue
  printf("Queue %d remov%s.\n", msqid, msgctl(msqid,IPC_RMID,0) ==0?
      "ed successfully":"al failed");
}
```

Deleting a Message Queue - Output

```
musty@musty-VirtualBox:/media/sf_virtualbox_shared_folder$ ipcs -q

------ Message Queues --------
key        msqid      owner      perms      used-bytes   messages
0x0000d903 0          musty      777        0            0
0x0000000a 32769      musty      777        0            0

musty@musty-VirtualBox:/media/sf_virtualbox_shared_folder$ gcc rm.c
musty@musty-VirtualBox:/media/sf_virtualbox_shared_folder$ ./a.out 10
Queue 10 removal failed.
musty@musty-VirtualBox:/media/sf_virtualbox_shared_folder$ ./a.out 32769
Queue 32769 removed successfully.
musty@musty-VirtualBox:/media/sf_virtualbox_shared_folder$ ipcs -q

------ Message Queues --------
key        msqid      owner      perms      used-bytes   messages
0x0000d903 0          musty      777        0            0
```