Advances in Operating Systems Design (CS60038)

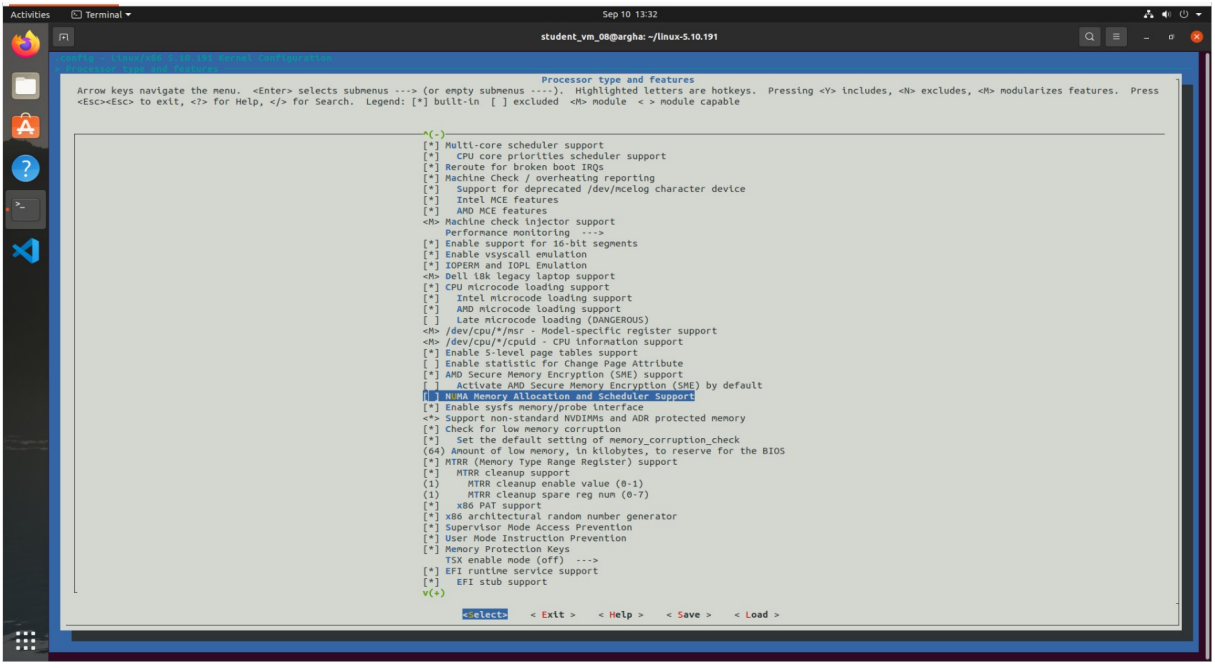
Assignment 1 – Part A (Configuring and building Linux kernel)

Anand Parikh – 20CS10007
Divyansh Vijayvergia – 20CS30016

- **Remove NUMA memory allocation, scheduler, and emulation**

NUMA memory allocation, scheduler and emulation suppport was removed by using the menuconfig option for Linux kernel version 5.10.191

Go to: *Processor type and features -> NUMA Memory Allocation and Scheduler support*



Before removing NUMA

1) In .config file – NUMA is enabled

```
student_vm_08@argha:~/Downloads/linux-5.10.191$ cat .config | grep NUMA
CONFIG_ARCH_SUPPORTS_NUMA_BALANCING=y
CONFIG_NUMA_BALANCING=y
CONFIG_NUMA_BALANCING_DEFAULT_ENABLED=y
CONFIG_X86_NUMACHIP=y
CONFIG_NUMA=y
CONFIG_AMD_NUMA=y
CONFIG_X86_64_ACPI_NUMA=y
CONFIG_NUMA_EMU=y
CONFIG_USE_PERCPU_NUMA_NODE_ID=y
CONFIG_ACPI_NUMA=y
CONFIG_NUMA_KEEP_MEMINFO=y
```

2) List of nodes using NUMA – NUMA is in use

```
student_vm_08@argha:~/Downloads/linux-5.10.191$ numactl --hardware
available: 1 nodes (0)
node 0 cpus: 0 1 2 3
node 0 size: 3911 MB
node 0 free: 1035 MB
node distances:
node   0
  0:  10
```

After removing NUMA

1) In .config file – NUMA is disabled

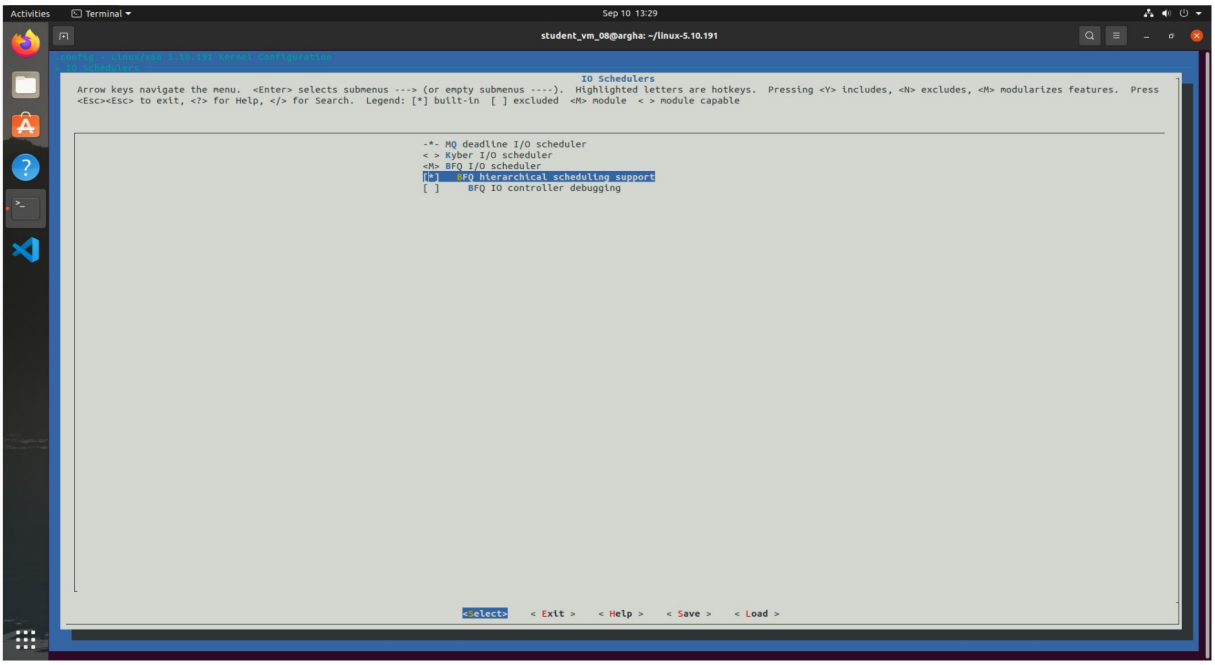
```
student_vm_08@argha:~/linux-5.10.191$ cat .config | grep NUMA
CONFIG_ARCH_SUPPORTS_NUMA_BALANCING=y
# CONFIG_NUMA is not set
```

2) List of nodes using NUMA – NUMA is not in use

```
student_vm_08@argha:~$ numactl --hardware
No NUMA available on this system
student_vm_08@argha:~$
```

- **Remove Kyber I/O Scheduler**

Kyber I/O shceduler is unselected in the menuconfig option for Linux kernel version 5.10.191
Go to: *IO scheduler->Kyber I/O scheduler* and disable it



Before removing Kyber

1) In .config file – KYBER is enabled

```
student_vm_08@argha:~/Downloads/linux-5.10.191$ cat .config | grep KYBER
CONFIG_MQ_IOSCHED_KYBER=m
```

2) Check kernel module (in /lib/modules/<kernel version>/kernel/block/) - KYBER is present

```
student_vm_08@argha:/lib/modules/5.10.191/kernel/block$ ls
bfq.ko  kyber-iosched.ko
```

After removing Kyber

1) In .config file – KYBER is disabled

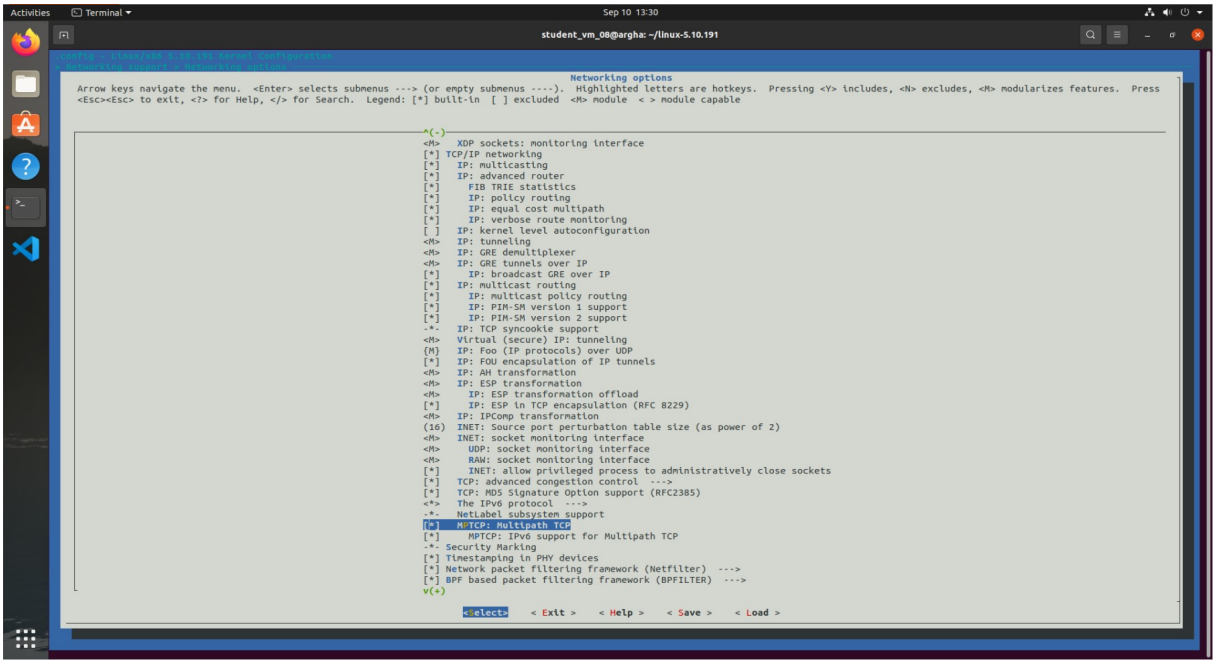
```
student_vm_08@argha:~/linux-5.10.191$ cat .config | grep KYBER
# CONFIG_MQ_IOSCHED_KYBER is not set
```

2) Check kernel module (in /lib/modules/<your kernel version>/kernel/block/) -KYBER not present

```
student_vm_08@argha:~/linux-5.10.191$ ls /lib/modules/5.10.191/kernel/block/
bfq.ko
```

- **Include multipath TCP (MPTCP)**

MPTCP is by default enabled in Kernel version 5.10.191 which can be browed in menuconfig option as follows:
Networking support->Networking options->TCP/IP networking->MPTCP: Multipath TCP



<u>After enabling MPTCP (enabled by default)</u>

1) In .config file – MPTCP is enabled

```
student_vm_08@argha:~/linux-5.10.191$ cat .config | grep MPTCP
CONFIG_MPTCP=y
CONFIG_INET_MPTCP_DIAG=m
CONFIG_MPTCP_IPV6=y
```

2) Using dmesg – MPTCP in action

```
student_vm_08@argha:~$ dmesg | grep MPTCP
[    0.468619] MPTCP token hash table entries: 4096 (order: 4, 98304 bytes, linear)
```