Sreepathy Jayanand
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Device Drivers
Quiz-2

1. List atleast 3 messages that kernel writes in log when system hangs

ANS: i. Out_Of_Memory : kill process pid1, pid2 ..
ii. Kernel Panic - not syncing : Fatal machine check on current CPU.
iii. Wait status failed
iii. Thermal thermal_zone 0 : Critical temperature reached.
(High temperature can cause kernel to hang)

2. ____ is for support for mouse devices in virtual consoles in Linux

ANS: A daemon called GPM (General purpose mouse) helps to configure and run mouse support in virtual machine.
It provides all features like cut, paste, copy etc.

3. The ____ field is used to manage the locking of module load and unloading. It is obviously important that a module is not ____ while in ____.

ANS: The lock field is used to manage the locking of module loading and unloading. It is obviously important that a module is not unloaded while it is in execution.

4. 3 Differences between loopback interface and SNULL.

ANS: i. Loopback interface sends packet to same channel where it received without modification. SNULL on the other hand changes the message (so as to create illusion that it is comming from somewhere else.

ii. Loopback sends the packet to the same channel, whereas SNULL sends the packet to a different channel.

iii. Loopback is used to test the whole channel and also the network program, whereas SNULL is used to ~~simulate~~ simulate a packet coming from other networks.

5. Explain init.d

ANS: It is the first process to be executed by the kernel during the boot. It always runs in background. It is the parent of all other processes. If the init is unable to start a kernel panic occurs.

6. What is MSS, how is it related to network device driver? What is its impact?

ANS: MSS → Maximum segment size is a field in the header indicating the maximum segment size that the computer can send/receive. The network device driver constructs the TCP headers and hence it is the job of the network device driver to assign values to MSS. Based on the size of MSS, we can change the amount of data shared per segment and this field help to tune the efficiency of the transmission.

7. Explain NUMA.

ANS: NUMA stands for non-uniform memory access.

The philosophy is that it is easier to access elements closer to you (spatial locality).

So if the page allocator is NUMA aware, basically means the allocator is given information about physical location of memory, it can allocate memory from the same memory node as the requestor.

8. Explain atleast ~~3 differences between~~ 4 cases of concurrency which gives raise to racing.

ANS:

i. Interrupts: When an interrupt is called that routine might modify a memory location another application was holding. When the application resumes the value could be different from where it left off.

ii. Kernel pre-emption: A pre-emtive kernel can start & stop a thread anytime. So if ~~thread~~ threads don't carefully allocate resources racing can occur with other threads.
This is because even an instruction like "x++" is broken as

```
read x
add 1
write x
```

At any given point in between the kernel can pre-empt

iii. Symmetrical Multiprocessing: If 2 CPUs are running 2 threads that share some memory racing can occur as before 1 thread commits the other may modify it.

iv. Softirq and Tasklet: Softirqs are high priority routines of kernel and the current process maybe preempted by the softirqs. Similarly for tasklets also. Again this preemption can cause racing.

9. Explain contention w.r.t lock

Ans: Ans. To implement critical sections in codes we have to implement locks. So a process obtains a lock if the resources is available or waits if some other process has it. Contention is when 2 process want to acquire same locks so they can execute once the resources are allocated.

10. True/False. Some hardware devices can perform DMA to certain addresses.

Ans: True. This is because memory is divided into zones.

There are 4 types, DMA, DMA_32, Normal, high mem. Since one zone is physically different from others it is made sure that some hardware devices can perform DMA to certain ZONES and not to all zones.

11. How many pages will there be in 8 GiB RAM with page size is 64 KB

ANS: $\#\text{Pages} = \frac{\text{Total size}}{\text{Size of page}} = \frac{2^3 \cdot 2^{30} \text{ Bytes}}{2^6 \cdot 2^{10} \text{ Bytes}} = 2^{17} \text{ pages}$

$= 131072$ pages

12. Explain "Interrupt handlers need not be reentrant!"

ANS: When an interrupt is being serviced, the corresponding interrupt line for that interrupt is made invalid on all processors so another interrupt from the same line is not serviced. All others ~~are enabled~~ ~~enabled~~ interrupt lines are enabled and hence are servisable by the processor.

13. _____ is handled by wait queues.

ANS: Threads are ~~wanted~~ handled by wait queues. The state of the waiting threads can be either interruptible or uninterruptible based on the thread functionality. The definitions are given in /include/linux/wait.h.

14. The top difference between kernel threads and normal threads is that kernel threads do not have ____

ANS. The major difference is that kernel threads do not have a process address space and hence doesn't have associated memory descriptor. They also only operate in kernel space, whereas normal threads operate in user-space and use syscall() ~~to~~ for kernel functionalities.

15. Explain top halves & bottom halves w.r.t device drivers.

ANS: The top half is what ~~usually~~ helps the external device to communicate with memory for exchange and is usually written by producer of the particular hardware.

Eg: In case of Network card chip, the top half takes care of com writting contents of buffer to RAM.

The bottom half is what helps deliver the packets (written to memory by top half) to other locations, which are communicated by the bottom half to the user application to which the data has to be eventually transferred.

Eg: In case of Network card chip, the bottom half takes the packets put in ram by top half and writes in user application readable locations and also gives information to applications on where exactly in memory are the contents written.