

1. a) Trap instruction is run in user mode, and privileged operation is run in kernel mode

Notes

- **Privileged Instructions**

- Is the instruction that can run only in **kernel mode**
- Attempt at execution in **user mode** → treated as an illegal operation & will not run.

- **Trap**

- Is a special hardware instruction
- Is a software generated interrupt ^[4]
- Is a type of synchronous interrupt ^[1]
- Is caused by an exceptional condition ^[1]
 1. Division by zero ^[1]
 2. Invalid memory access (segmentation fault) ^[1]
 3. Privileged instruction by **user mode** code ^[2]
- Usually results in a switch to **kernel mode** → Operating system performs action → Returns control to original process

- **Trap Instruction**

- Is executed when a user wants to invoke a service from the operating system (i.e. reading hard drive) in **user mode**

- **User Mode**

- Executing code has no ability to *directly* access hardware or reference memory ^[3]
- Crashes are always recoverable ^[3]
- Is where most of the code on our computer are executed ^[3]

- **Kernel Mode**

- Executing code has complete and unrestricted access to the underlying hardware ^[3]
- Is generally reserved for the lowest-level, most trusted functions of the operating system ^[3]
- Is fatal to crash; it will halt the entire PC (i.e the blue screen of death) ^[3]

References

- 1) Wikipedia, Trap (computing), link
- 2) University of Utah, CS5460: Operating Systems Lecture 3 - OS Organization, link
- 3) Coding Horror, Understanding User and Kernel Mode, link
- 4) ETH Zurich, Programming in Systems, link

- b) Notes

- **Locks**
 - Is very primitive, and has minimal semantics
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- **Semaphore**
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