CS302:

Assignment8 Report

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1 Answer of Question 1

(1) **Pros and cons of polling and interrupt-based I/O**

- Polling:

Pros: This basic protocol works simple by just asking what is going on once a while.

Cons: Inefficient and inconvenient. Since polling executes until the device finished its I/O, it wastes a great deal of CPU time just waiting for the potentially slow device.

- Interrupt-based:

Pros: It saves CPU time since when a process is operating with I/O it will be put to sleep and context switch to another process. The use of disk is also utilized during the middle stretch of time and can inform the OS to wake up once after the disk request is finished.

Cons: If a device performs quickly and polling can immediately finds its completion, interrupt-based still needs to perform context switch, interrupt handling which is time consuming and slows down the system.

(2) **Differences between PIO and DMA**

PIO and DMA are both methods helping data to move between memory and disk. PIO involves CPU to move data. But DMA bypass CPU and the OS program the DMA engine to transfer the data. A DMA engine is a very specific device that can organize transfers between devices and main memory without much CPU intervention.

(3) **Memory-mapped I/O and explicit I/O instructions protection**

1. Ensure these instructions are privileged, the OS should be the only entity allowed to directly communicate with them.

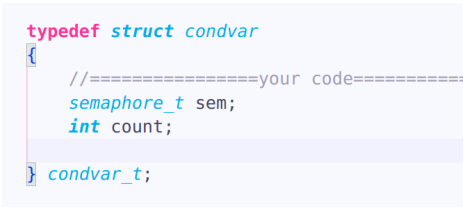
2 Answer of Question 2

The condition variable structure has two members: one semaphore and one counter value to record the waiting threads. At the very beginning, initialize the condition variable by initialize its semaphore and set the counter to 0.

For the `cond_signal` function, it is called when the waiting is over and mom or sister needs to buy milk to fill the fridge. Therefore, if the waiting threads are larger than 0, then wake up and unlock one thread in the waiting queue of the semaphore.

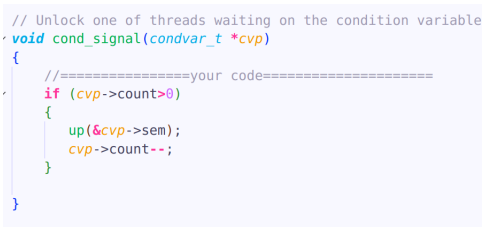
For the `cond_wait` function, it releases lock, put thread to sleep until condition is signaled. When thread wakes up again, it will reacquire the lock.

The following codes are the detailed implementations.



(a) Struct

(b) Init function



(c) Signal function

(d) Wait function

Fig. 1: Condition Variable Implementation

The results are shown below. Me and dad first consumed 100 milk by eating 20 a time. When mom and sister checked the fridge in this process, there were milk left so they went to wait until the next time dad signaled them to buy the milk.

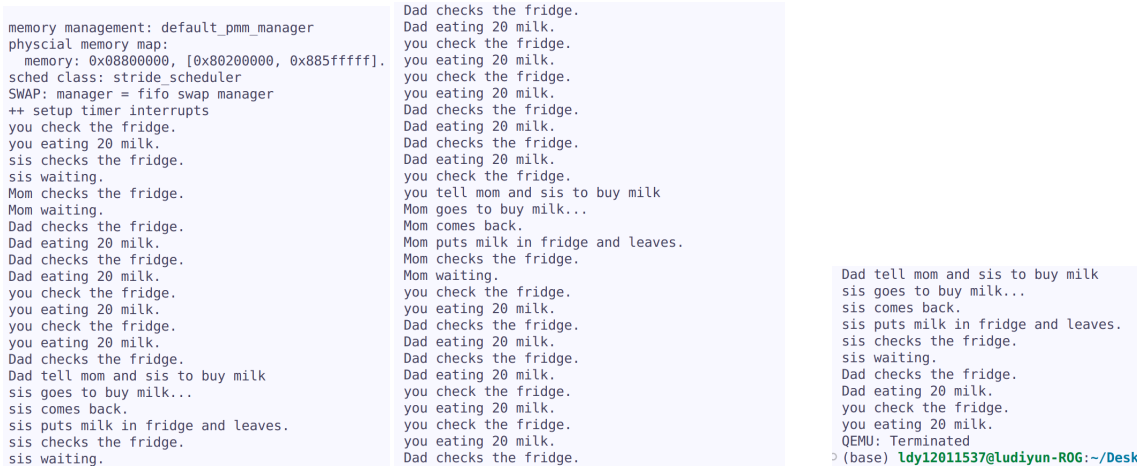


Fig. 2: Final Results