ECE 592: OS Design - Project 4 Report

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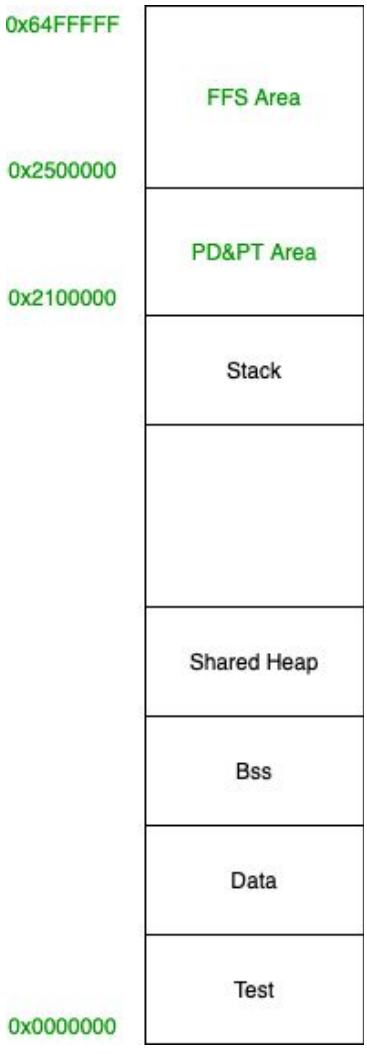
Additions and changes to Design Document:

Physical memory layout

- Layout of XINU memory:

In the design document we mentioned that the start address of the XINU area was 0x100000 but it was 0x000000. The updated memory map is shown below with the changes highlighted in green.



- Another change to note is that we switched the mapping of the PDPT Area and FFS area to conveniently map the XINU area and PDPT area when creating system processes. The changes are shown on the left in green.

System Initialization

1. Switching to 'Kernel mode':

- Since the project specification states that all the system calls are run in Kernel mode, we deduced that the Kernel has to have the view of the entire XINU physical memory map from text to FFS area to be able to do this.
- So when paging is enabled, the kernel needs to have it's own paging structures with the entire physical memory mapped in Kernel's page tables and the CR3 should contain the Kernel's PDBR when system calls are running.
- Hence in our implementation of paging, we allocated page directory and page tables to the Kernel and mapped the entire XINU physical memory to the Kernel's page tables.
- We also have a global Kernel PDBR and which is written to CR3 when entering kernel code like vmalloc, free or kill. This successfully enabled the OS to run system calls in Kernel mode.
- All system processes like nullproc, main, startup, etc. have another privileged mode called system mode which maps the xinu area and the PD-PT area.

2. Valid bits of the page table entries.

- In order to avoid freeing the XINU area when killing a user process and only free FFS frames, we set pt_avail to 2 when initializing a PTE for an FFS frame in vmalloc and 1 when mapping XINU area.

First fit policy details

- While calling vmalloc, we first check if the page tables have enough space to allocate the requested memory. If not, return error and stop trying to allocate pages.
- If the number of bytes to be allocated is greater than PAGE_SIZE*MAX_PT_SIZE, initializes the remaining page table entries in the current page table and rolls over to the next page directory entries until the number of virtual pages allocated is equal to nbytes>>12.
- The freelist handling function of xinu's shared heap is modified to take care of the PD-PT area free list and the FFS area free list. This handles the freeing and allocation of memory in accordance to first fit policy.

Context Switch

- The new processes' PDBR is a function argument to the ctxsw function so that the CR3 can be updated. Hence only one extra argument is passed to the ctxsw function unlike what has been described in the project 4 design document.

Working of the code:

- All the testcases are running as expected and match with the output files.