Operating Systems Memory Review

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Questions?

- List and describe the four memory allocation algorithms covered in lectures.

- **First-Fit** – in the linked list of available memory addresses, we place the data in the first entry that will fit its data. Its aim is to minimize the amount of searching, but leads to external fragmentation later on.
- **Next-Fit** – similar to first fit, but instead of searching from the beginning each time, it searches from the last successful allocation. Greatly reduces the amount of searching but leaves external fragmentation at the beginning of memory.
- **Worst-Fit** – traverses the memory and gives the partitions as large spaces as possible – to leave usable fragments left over. Needs to search the complete list and such is a poor performer.
- **Best-Fit** – carefully scours the memory for spaces that perfectly fit the RAM we want. However, the search is likely to take a very long time.

Questions?

- What is the basic function of paging?
  - Paging is a memory management scheme that permits **the physical-address space of a process to be noncontiguous**. It avoids the considerable problem of having to **fit varied sized memory chunks onto the backing store**.

Questions?

- One of the design decisions in OS memory management is the choice between swapping and paging. Define each of these terms, and clarify their respective roles in OS memory management.

  - swapping: **copies entire process image between memory and disk.** Assumes contiguous allocation, entire process needed for execution. Used to limit multiprogramming level and avoid thrashing.
  - paging: **divides** logical address space of process into **fixed-size pieces**; process can execute with only a **subset** of these pages being resident in memory at a time. Provides flexible and efficient memory management, with lots of processes active at a time.

Questions?

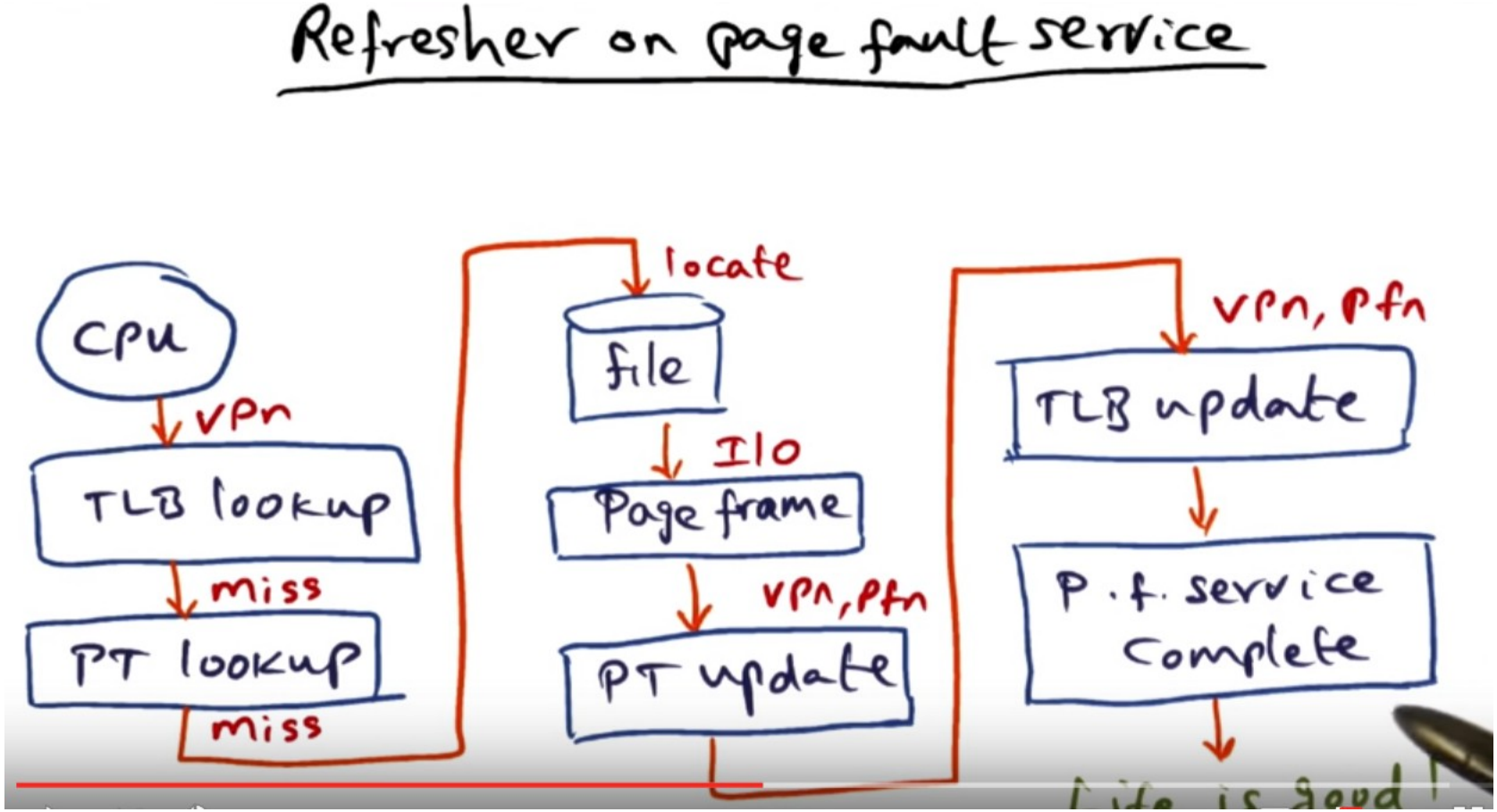
- Describe page-based virtual memory. You should consider pages, frames, page tables, and Memory Management Units in your answer.
  - Page based virtual memory ensures that every process has **its own address space**. It allows processes access up to 2^(system bits) bytes of address space, and **allows programs requiring more RAM to use only what it needs to at any one point**. Physical memory need not be contiguous. **No external fragmentation**. Minimal internal fragmentation. **Allows sharing** (you can map several pages to the same frame)

Questions?

- What is a translation look-aside buffer? What is contained in each entry it contains?
  - A **translation look-aside buffer (TLB)** is a high speed **cache** for **page table entries** (that can either be virtual or part of the physical MMU) containing those that are recently used. It consists of two different entries, EntryLo and EntryHi. EntryHi contains **a virtual address**. EntryLo contains **a corresponding physical address and a number of bits signifying whether the address is 'dirty', 'empty' or otherwise**.

Questions?

- Describe how OS deals with a page fault?



Questions?

- Enumerate some pros and cons for increasing the page size.
  - Pros:
    - **Reduce total page table size**, freeing some memory
    - **Increase TLB coverage** - Increase swapping I/O throughput
  - Cons:
    - **Increase page fault latency** (more page to search through)
    - **Increase internal fragmentation of pages**

Questions?

- What is the working set of a process?
  - The working set of a process is the **allocated pages/segments at any one time window** (delta), consisting of all pages accessed during that time. Includes **current top of stack, areas of the heap, current code segment and shared libraries**.

Questions?

- How does page size of a particular architecture affect working set size?
  - Page size of a particular architecture affects working set size because **the larger the pages, the more memory that can be wasted on irrelevant data**, vastly increasing the working set size for no good reason. If they're smaller, the pages accurately reflect current memory usage.

Questions?

- In pure on-demand paging, a page replacement policy is used to manage system resources. Suppose that a newly-created process has 3 page frames allocated to it, and then generates the page references indicated below.

Questions?

- (i) How many page faults would occur with FIFO page replacement?

- **11**
  - **A B C B A D A B C D A B A C B D**
  - **A B C B A D A B C D A B A C B D**

Questions?

- (ii) How many page faults would occur with LRU page replacement?

- **10**
- **A B C** B A **D** A B **C D A B** A **C** B **D**