

TCCS 422: OPERATING SYSTEMS

Memory Virtualization III: Introduction to Paging, Translation Lookaside Buffer (TLB), Smaller Tables

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 University of Washington - Tacoma



March 5, 2026
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OBJECTIVES – 3/5

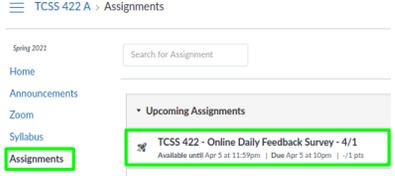
- **Questions from 3/3**
- Assignment 2 - March 12 AOE
- Quiz 3 – Synchronized Array - Mar 10 AOE
- Tutorial 2 – Pthread/locks/conditions tutorial 3/5 AOE
- Assignment 3 (as a Tutorial) - March 20 AOE
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ONLINE DAILY FEEDBACK SURVEY

- Daily Feedback Quiz in Canvas – Available After Each Class
- Extra credit available for completing surveys **ON TIME**
- Tuesday surveys: due by ~ Wed @ 11:59p
- Thursday surveys: due ~ Mon @ 11:59p



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TCCS 422 - Online Daily Feedback Survey - 4/1

Quiz Instructions

Question 1 0.5 pts

On a scale of 1 to 10, please classify your perspective on material covered in today's class:

1	2	3	4	5	6	7	8	9	10
Mostly Review to Me			Equal New and Review				Mostly New to Me		

Question 2 0.5 pts

Please rate the pace of today's class:

1	2	3	4	5	6	7	8	9	10
slow			Just right				fast		

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MATERIAL / PACE

- Please classify your perspective on material covered in today's class (31 of 46 respondents (7 online) – 67.39%):
- 1-mostly review, 5-equal new/review, 10-mostly new
- **Average – 6.87 (↑ - previous 6.52)**
- Please rate the pace of today's class:
- 1-slow, 5-just right, 10-fast
- **Average – 5.55 (↑ - previous 5.48)**

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FEEDBACK FROM 3/3

- **What is the difference between defragmentation and compaction?**
- These terms are similar, but not the same
- **Defragmentation:** largely refers to traditional magnetic hard disk drives (HDDs)
 - Data was physically stored across cylinders, tracks, and sectors
 - Reorganized large data files so all data was written contiguously would improve read/write speeds
 - >>The disk heads do not need to jump and reposition as often
- **Coalescing** – merge adjacent free blocks to create a larger single free block (no moving just merging free blocks)
- **Compaction** – move live memory blocks (in use) to make them contiguous, to free large contiguous block elsewhere

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FEEDBACK - 2

- **Are the entries in a page table always 4 bytes? Or just in the examples shown?**
 - They do not have to be 4 bytes. The examples we've seen are mostly for indexing a 32-bit address space. (4 GB computer)
- **What purpose does the page offset bits serve?**
 - Offset bits index (point to) the specific memory you want to access on the page
 - Code (an assembly instruction)
 - Variable (a variable on the heap, stack, or data segment)
 - If a variable is at address 100 (11000100), the offset bits in the virtual address are the same as the physical address
 - Offset bits are not translated, only virtual page numbers (VPNs) to page frame numbers (PFNs) are
- **Are there multi-level page tables?**
 - Yes, these are discussed in Chapter 20

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FEEDBACK - 3

- **How do you find the offset bits of the page table?**
 - Offset bits come directly from the virtual address
 - A virtual address consists of:
 - The virtual page number (VPN)
 - Offset bits that refer to specific code or data
 - Offset bits are not stored in the page table
 - Status bits are stored in the page table
 - They provide various management bits for read/write state, etc.
- **What is the worst-case scenario for the 'next fit' memory allocation strategy if the only usable chunk is right before the current pointer location?**
 - This sounds like n comparisons, where n is the size of the list

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CATCH UP FROM LECTURE 14/15

- Switch to Lecture 14 Slides
- Slides L14.90 to L14.103
(Chapter 18 – Introduction to Paging)
- Switch to Lecture 15 Slides
- Slides L15.33 to L15.81
(Chapter 19 – Translation Lookaside Buffer - TLB)
(Chapter 20 – Paging – Smaller Tables)

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QUIZ 2

- In Class Today, March 5, 2026

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QUESTIONS



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