

COMP 3430

Operating Systems

July 10th, 2019

Goals

By the end of today's lecture, you should be able to:

- Describe the concept of paging (chapter 18, in-class)
- Describe how paging solves problems with memory management (chapter 18)
- Compare and contrast data structures for implementing paging (chapters 19,20, in-class)
- Evaluate TLB entry replacement policies (in-class)



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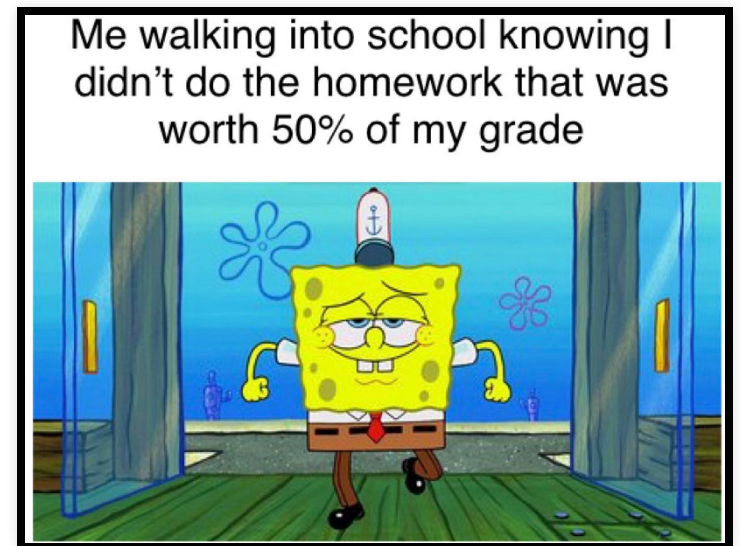
Assignment 4

For example, you would give it a path to the file as:

path/to/filename.txt

Now, with shorthand names, it would look like this: PATH/TO/FILENA~1TXT

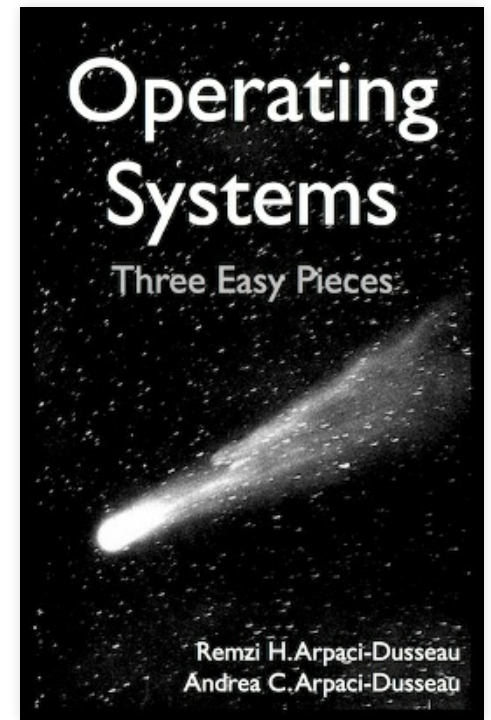
So my question is, can we implement the get method to use with shorthand names?



OSTEP Q 'n A

Chapters for this week:

- Chapter 18
- Chapter 19
- Chapter 20



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Kahoot

How do these things fit together?

- We want to compare and contrast page tables, TLB, and page directories.
- The book describes each concept in excruciating detail.
 - ... but it doesn't give us the **big picture**.
- Let's draw out what this looks like.



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Compare and contrast

- We want to compare and contrast page tables with and without a TLB.

Let's answer some questions:

1. Who or what is responsible for *implementing* them?
2. Where does a page table *live*? Where does a TLB *live*?
3. Who or what is responsible for *doing* translations?
4. What happens during a translation with a TLB and without?
5. When is a page table with a TLB *faster* or *slower* than without?



309.06633, indeed. Pixabay License

TLB Replacement policies

There are 2 hard problems in computer science: cache invalidation, naming things, and off-by-1 errors. Leon

Bambrick



What kind of a maniac takes *that* piece???

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TLB Replacement policies

- The TLB is a **cache**.
 - When we need more space, **which entry** do we *evict*?
- Two possible strategies:
 1. Least recently used (LRU)
 2. Random

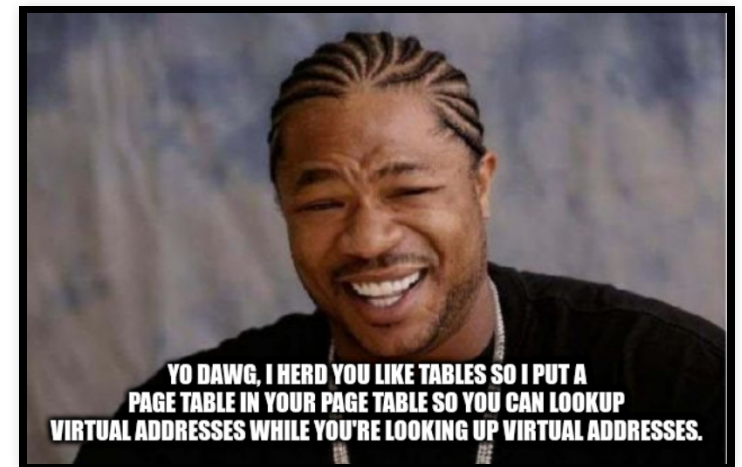
Evaluating replacement policies

- How do we decide which one has the best performance characteristics?
- Let's look at a **small** piece of code

```
int sum =  
    0;  
for (int i = 0; i < 10;  
    i++)  
    sum +=  
    a[i];
```

Page directories

- A page directory is an *alternative* implementation for address translation lookups.
- We want to compare and contrast **page tables** and **page directories**.



Page directories.

Tables vs directories

Let's answer some questions:

1. What is the **main difference** between the two?
2. What **data structures** can be used to implement each?
3. What **trade offs** are we making when choosing tables or directories?
4. How much **hardware support** does each require?
5. Can you use a TLB with *both*?

Paging

- Paging and segmentation solve the same problem.
 - How do I make processes *think* they have an entire address space by mapping virtual addresses to physical addresses?
- Paging avoids external fragmentation, but suffers from speed and size issues.
 - Speed issues are addressed with a TLB (cache)
 - Size issues *can* be addressed with different data structures.
 - ... at the cost of speed/performance.



Yeesh. (Pixabay License)

Next week

Let's take a look at the schedule.

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500
1000



256
512
1024