

CS 1217

Memory Management Wrap, Intro to Synchronization

Logistics

Assignments (till date)	25%
Midterm Exam	25%
Endterm Exam	30%
Quizzes	15%
Synchronization Assignment	3%
Zines etc	2%
Total	100%

Page Eviction: What can go wrong?

***Thrashing** is a colloquialism normally used to describe a computer whose virtual memory subsystem is in a constant state of paging, rapidly exchanging data in memory for data on disk, to the exclusion of most application-level processing. This causes the performance of the computer to degrade or collapse.*



- Wikipedia

Swap Space

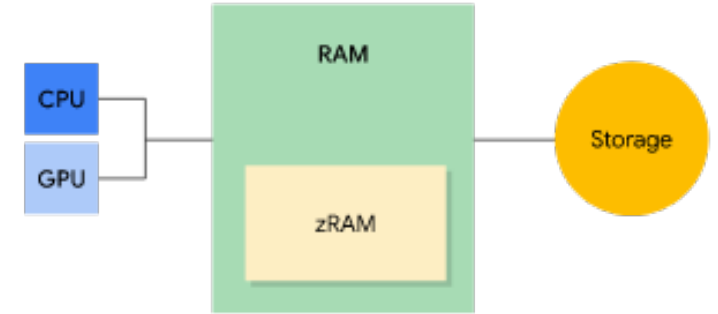
- Q: Do windows and MacOS have swap spaces? A: YES!

Change the size of virtual memory

If you receive warnings that your virtual memory is low, you'll need to increase the minimum size of your paging file. Windows sets the initial minimum size of the paging file equal to the amount of random access memory (RAM) installed on your computer, and the maximum size equal to three times the amount of RAM installed on your computer. If you see warnings at these recommended levels, then increase the minimum and maximum sizes.

1. Open System by clicking the **Start** button , right-clicking **Computer**, and then clicking **Properties**.
2. In the left pane, click **Advanced system settings** . If you're prompted for an administrator password or confirmation, type the password or provide confirmation.
3. On the **Advanced** tab, under **Performance**, click **Settings**.
4. Click the **Advanced** tab, and then, under **Virtual memory**, click **Change**.
5. Clear the **Automatically manage paging file size for all drives** check box.
6. Under Drive[**Volume Label**], click the drive that contains the paging file you want to change.
7. Click **Custom size**, type a new size in megabytes in the **Initial size (MB)** or **Maximum size (MB)** box, click **Set**, and then click **OK**.

Swapping in Android



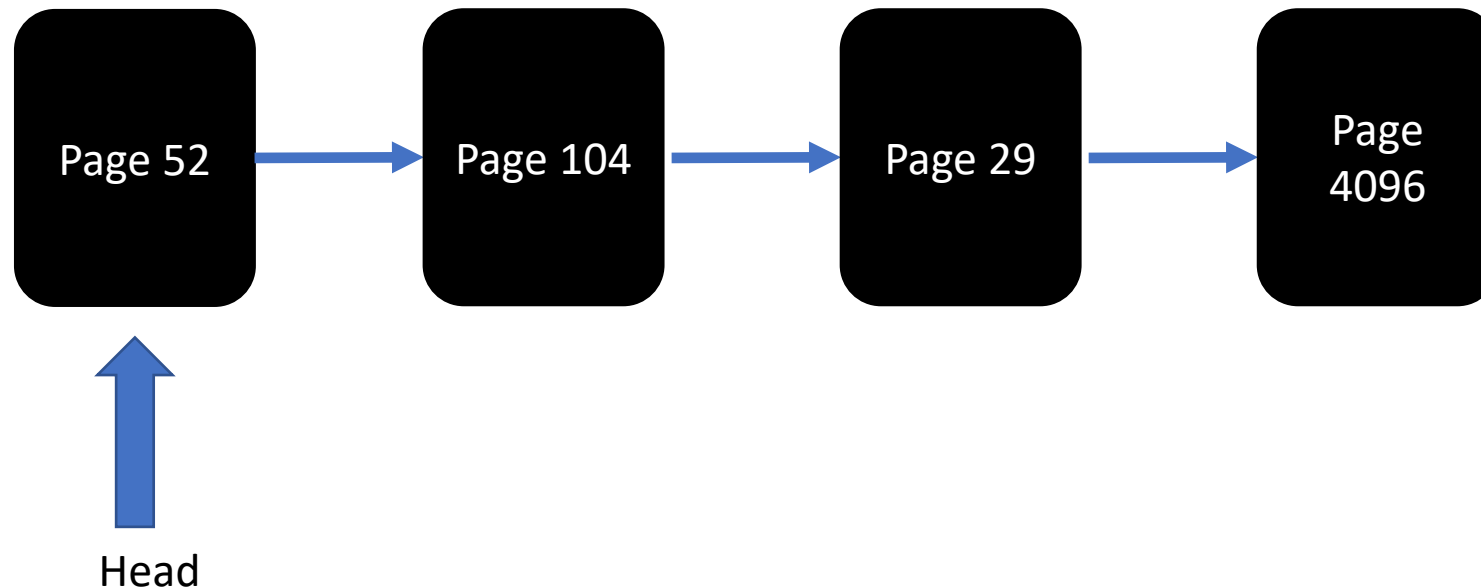
- Considerations:
- Handhelds do not have disks with moving parts : space is limited
- SSDs/Flash devices have limited lifetimes
- Handhelds do not run **a lot** of applications
- “zRAM swap can increase the amount of memory available in the system by compressing memory pages and putting them in a dynamically allocated swap area of memory.”

<https://source.android.com/devices/tech/perf/low-ram>

<https://developer.android.com/topic/performance/memory-management>

Free Space Management

- How do you decide ***which*** free page to allocate on a request?
- Kernel typically maintains a list of available free pages



Page Eviction

- Why do you need to evict pages from memory?

Page Eviction

- Swap out: Need to choose **which** page to move to disk
- Swap in: Might need to swap out a page. Which page?
- What are the tradeoffs?
 - Page being swapped-in **is** important (of course)
 - Page being swapped-out **should be** non-important
 - Moving pages between media is **not** free : benefit should be maximal

Page Evictions

- What is the absolute best page to evict, in the ideal case?
- The one that will NEVER be used again!
- Can you find such a page?

Cost Benefit Analysis

- Cost
 - A page needs to be moved from disk to memory
 - Worst case: Another one needs to be moved from memory to disk
- Benefit
 - The page moving to memory (swapped in) should be useful
 - Should be accessed **as many times as possible**

Simple Replacement Algorithms

- FIFO
- Random
- Pros:
 - Extremely simple
 - Good baseline for algorithms that try to do better
- Cons:
 - Too simple, might be bad for performance

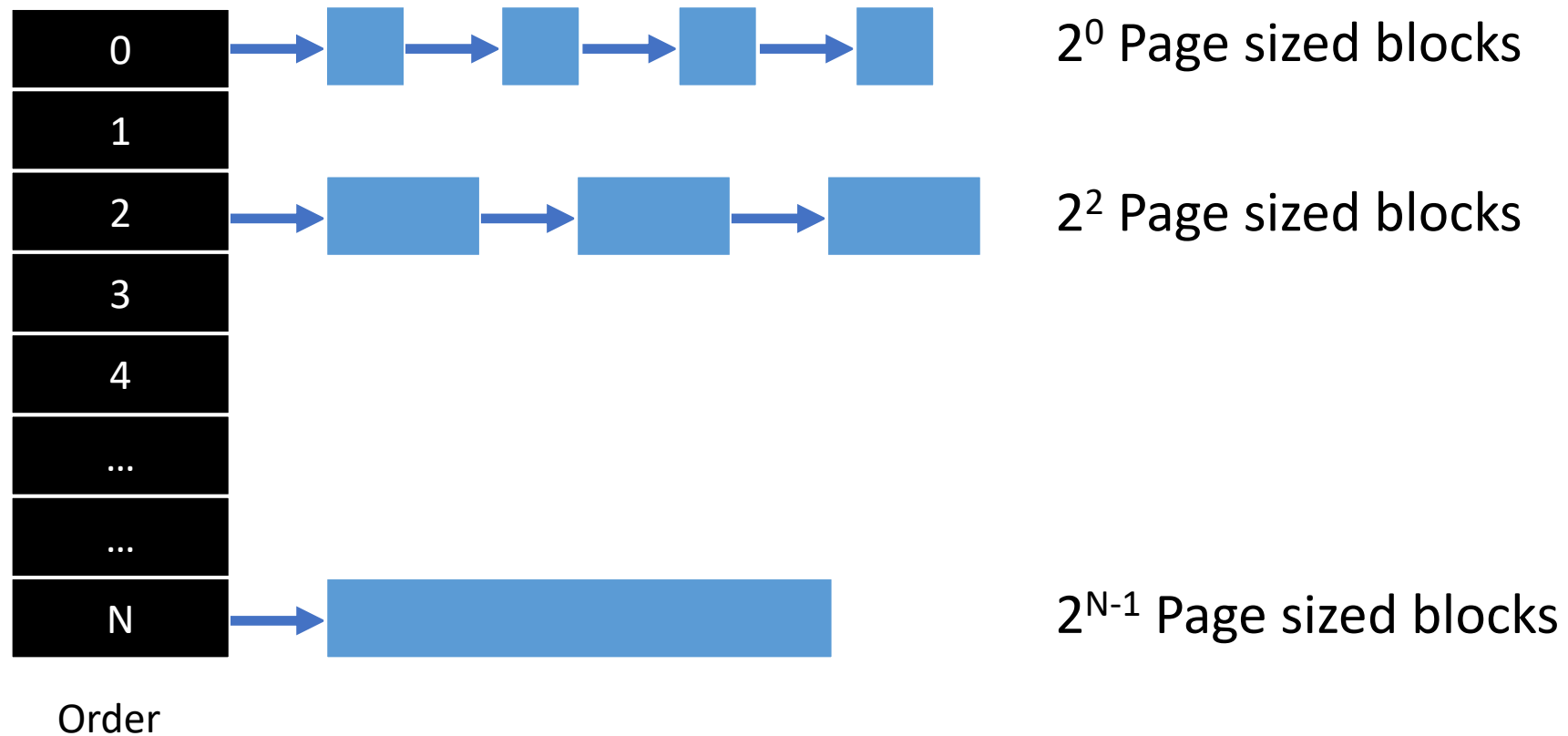
Better Replacement Algorithms

- Use past history to predict future accesses
- Least Recently Used (LRU)
- Basic intuition: If the page has not been used for the longest amount of time, it will not be used in the future (hopefully)
- Pros
 - Might help pick better candidate pages for replacement
- Cons
 - How do we **tell** how long it has been since a page has been accessed?
 - How do we **store** how long it has been since a page has been accessed?

LRU “Overheads”

- Timestamp information
- 32 bits; doubles the size of the page table entry!
- Need something more storage efficient

Buddy Allocator



End : Memory Management

Next : Synchronization