CS 162 Final Review

Brought to you by your smilin' TAs:

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Paging

- Know paging
  - I.e. how to get address widths, what the levels are, etc.
- Two level paging
  - Including 2 level page tables and segmenting with paging.
  - How do we divide up the address?
  - How do we know how big the page tables are?
- What is the typical layout of a Page Table Entry (PTE), and what is each bit for?

Translation Lookaside Buffer

- What is a TLB?
- How fast are they?
- How big are they?
- How are entries searched?
- Where does a TLB fits into the paging scheme?
  - Why do we use them?
- What extra overhead does the TLB add to context switches?

Translation Lookaside Buffer

- Why don't we make the TLB really big?
- What is the effective access time of a cache?
  - How to we calculate it?
- What is a. . .
  - Compulsory miss?
  - Capacity miss?
  - Conflict miss?
  - Policy miss?

Translation Lookaside Buffer II

- What is the principle of. . .
  - Temporal Locality?
  - Spatial Locality?
- How can we leverage locality?
  - Is there something the user could do when writing programs to minimize page faults?
- When does caching break down?
  - Will a cache always help?

Page Faults & Demand Paging

- What is a core map?
  - Why do we need one?
- What size should pages be?
  - What are some pros/cons of large pages?
  - Can we page the operating system?
- After a page fault, can a process be restarted directly?
  - How many page faults can occur in one instruction?

Page Faults & Demand Paging III

- What is a page replacement algorithm?
  - When is it called?
  - How does it work?
- What is demand paging?
  - What support is needed for this?
  - Why is it used?
  - How does it work?
- How do we determine the performance of a page replacement algorithm?

Page Replacement Algorithms

- Random
  - What is this?
  - Why isn't it used?
- FIFO
  - What are its limitations?
  - Does giving this algorithm more pages always improve its performance? (Belady's Anomaly)
    - Example: consider the following string of references with 3 vs. 4 page frames and FIFO replacement: 3 2 1 0 3 2 4 3 2 1 0 4 2 3 2 1 0 4

Page Replacement Algorithms II

- LRU
  - What is this?
  - What are some limitations in implementing it?
  - How do we approximate it?
- FINUFO/Clock/Nth Chance
  - What aspect of PTE layout does this algorithm take advantage of?
  - How does it work? Drawbacks?
  - Do we need hardware support to implement this at all?

Page Replacement Algorithms III

- MIN/OPT
  - What is the exact definition of an optimal page replacement algorithm?
  - Why can't we implement it?
- Be able to draw a flowchart of. . .
  - How paging works with page replacement
  - Where the TLB fits in
  - This working with any flavor of multi-level paging.
- How do we evaluate paging algorithms?

Thrashing and Working Sets

- What is thrashing?
- How do we fix this problem?
  - There are several solutions!
- What is a working set?
  - Why is it useful?
  - When is it useful?
- What is the Working Set paging algorithm?
  - How is it implemented?
- What is the difference between global and local replacement?

Disk Structure

- What is a platter?
  - How many are there?
- What is a track?
  - How many are there?
- What is a cylinder?
  - How many are there per track?
- What is a sector?
- What is a block?

I/O Optimization

- What are some of the trends in disk design?
  - How can disks fail?
- How do we make file operations fast?
  - What is the importance of block size?
- What characteristics of disk hardware most effect performance?
  - Know all of these!
- What if there is more than one outstanding disk request?
  - How should we schedule them?

I/O Optimization II

- FCFS
- SSTF
- SCAN
- C-SCAN
- Know the differences, pros, and cons of each one of these
- Are they all fair?
- Are any of them optimal?

I/O Optimization III

- What is rotational scheduling?
- What are some problems we can run into when reading specific blocks?
  - What is a solution to some of these?
- How can we minimize seek distance?
- What is a disk cache for?
  - How does it help performance?
  - What are some of the drawbacks of a disk cache?

I/O Optimization IV

- What can we do at the file system level to increase performance?
  - Any way caching can help?
- How are files accessed?
  - Understand various methods
- What is RAID?
- What is a file?
  - How are the blocks of a file laid out on disk?

File System Structure

- Contiguous allocation
  - Pros/Cons?
- Linked List allocation
  - Pros/Cons?
- Indexed Files allocation
  - Pros/Cons?
- Multilevel Indexed allocation
  - Pros/Cons?

File System Structure III

- What are the primary issues file systems should address?
- What are the usual operating characteristics of a file system?
  - Most files large or small?
  - More reads or writes?
  - What kind of file IO is most prevalent?

File System Structure IV

- How do we find the blocks of a file?
  - What is a File Descriptor? (iNode)
    - What is recorded here?
    - What is it used for?
    - Where should the iNodes be placed on disk?
  - What is NOT in a File Descriptor?

File System Structure V

- How do we allocate a new block for a file?
  - How do we find the block?
  - How do we allocate it?
- What if file sectors get corrupted?
  - Can we recover? How?
- What is a directory?
  - What's stored in a directory?
  - How does a disk transverse /one/two/three/four?

File Access Control

- What is an Access Control Matrix/List?
  - What are the rows and columns?
  - Where is this stored?
- What is a Capability?
  - Where are they stored?
- What are the disadvantages/advantages between the two?
  - Can we combine them?

Networks and Communication

- What is a Broadcast Network?
  - What are some of the issues that must be overcome for these to work well?
  - What are some examples of this type of network?
- What is a Point-to-Point Network?
  - What do these offer that Broadcast doesn't?
  - What are some examples of Point-to-Point Networks?

Networks and Communication II

- What is latency?
  - Transmission versus Set-up
- What is bandwidth?
- What is the bandwidth-delay product?
  - What does it tell us? Why is it useful?

Networks and Communication III

- What are the seven ISO layers?
- What about network links makes them inherently unreliable?
  - Dropped packets
  - Network congestion
- How is a packet routed through the internet?
  - What protocol is used?
  - Is the internet reliable? Why/why not?

Networks and Communication IV

- Ethernet
  - How does it work?
  - Does it add anything to packets?
  - Is it reliable?
  - What is a MAC address?
- IP
  - Defining characteristics?
  - What's in the header?
  - Is it reliable?
  - How is routed?

Networks and Communication V

- TCP
  - What does this offer that IP doesn't?
  - How does it go about offering it?
  - Is it slower/faster to transmit data than UDP?
  - How does TCP control congestion?
- UDP
  - Defining characteristics?
  - Why would you ever want to use this on top of TCP?
  - Why use this at all, instead of straight IP?

Distributed Systems

- What is a distributed system?
  - What are some of the goals in their design?
- Why are they useful?
- What is the General's Paradox?
- What is Two Phase Commit?
  - Why is it used?
  - Why is it NOT used?

Distributed Systems II

- What is Remote Procedure Call?
  - How is this different from local procedure call?
  - Why do we want to use RPC?
  - What are the issues that must be addressed in order to get this to work?
  - What is 'marshalling'?
  - What are some problems with RPC?

Distributed Systems III

- What is a distributed file system?
- How is caching used in a distributed file system?
- What if we made a system with no caching?
  - How would this work?
  - What would be the issues?
  - What problems would this solve?

Distributed Systems IV

- What is NFS?
  - What are the key characteristics of NFS?
  - What is really nice about NFS?
  - What are the problems with it?
- What is AFS?
  - What are the key characteristics of AFS?
  - What's nice about it?
  - What are its problems?

Protection and Security

- What is the goal of protection?
- What are the three aspects to a protection mechanism?
  - Authentication
    - Passwords
      - Long or short?
      - Salt
  - Authorization determination
    - Access lists versus capabilities
  - Access enforcement

Protection and Security II

- What are some common weaknesses?
  - Abuse of valid privileges
  - Imposter or Trojan Horse
  - Listener / Eavesdropping
  - Trap doors
- What are some countermeasures?
  - Logging
  - Minimum privilege
  - Correctness proofs
  - Callbacks
  - Consistency / Plausibility Checks

Encryption

- What are challenges of implementation in practice?
  - Key distribution
  - True randomness
- What are examples of crypto systems in use?
  - DES
  - RSA
  - PGP
  - AES
- How does public/private key encryption work?
  - How do we go about establishing secure communications with a server?

Internet Security

- What is a computer virus?
- What is a computer worm?
  - How different from a virus?
- How would one go about writing one of these?
- What is TCP Connection hijacking?
- How do we improve security in general?
  - What are the major problems here?