2GA3 Tutorial #11

DATE: December 3rd, 2021

TA: Jatin Chowdhary

T02

- Might need to end today's tutorial a bit early
  - I need to be somewhere else
    - i.e. Appointment
- Hard stop at 11:10 AM

Black Friday

- I hope y'all took advantage of this
  - I know I did
- Deals were pretty darn good this time
  - Last year was horrible
- Anyways, it's time to get back to work
  - 2GA3 Exam is on December 20th, 2021
    - A little over 2 weeks…
      - Crunch time starts now

Content

- **Question:** “Where are the slides?”
  - Asked by: *Literally everyone*
- **Answer:** Coming
  - I’m gonna *finish* my courses this Saturday
    - I got about 2 (tedious) assignments left
    - I figured it’s better to wrap it up now, and then jump to 2GA3
      - By Saturday, I’m done my stuff

Course Evals

- If you put something done w.r.t to me, make sure it's funny
  - I need a good laugh
- Jokes aside, try to be as honest as possible
  - But nothing to explicit
    - I don't know if they are truly anonymous
- *"Are course evals relevant?"*
  - Kind of – this is a tricky question

Listen Carefully

Life Lessons

- On multiple occasions, I've said, ''Don't be afraid to participate and ask questions'', it's because:
  - Get rid of your shyness and improve your communication skills – this is the key to colossal success
    - i.e. Getting a job, loan, money, etc.
      - This is why I force participation
- In the beginning I said, ''It's important that you respect each other'', it's because:
  - If somebody here gets a job at FAANG, then the rest of us can use him as a way in or as a reference
  - If you end up working together on something big, mutual respect is key

Expectations

- Everyone here should be able to land a six-figure CO-OP
  - Thanks to Corona it's an employees market
    - More demand; less supply
  - You don't need to know anything; just apply
    - All you gotta do is dress professionally and sound smart/confident
      - i.e. Nick B. (GTC-OAT)
  - When I say six-figures, I mean $100,000 a year
    - Easier to get a $5 million dollar loan than a $5 loan

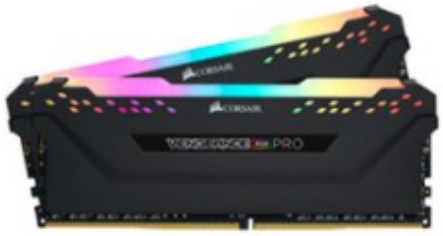
Get Better

- Don’t accept complacency or mediocrity
- Keep moving
  - I don’t care if it’s up or down
    - Just keep moving
      - Don’t stay in the same place
- Do something you wouldn’t normally do
  - Better yet, do something to scare yourself (daily)
    - *i.e. 190.MP4*
      - *But not this*

Questions?
Comments?
Concerns?

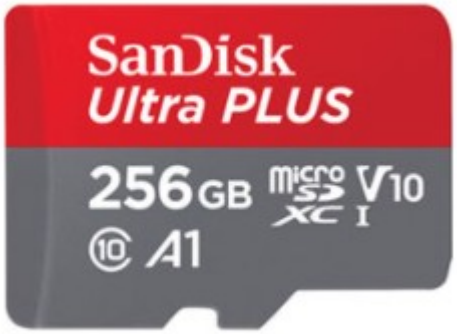
Clarification

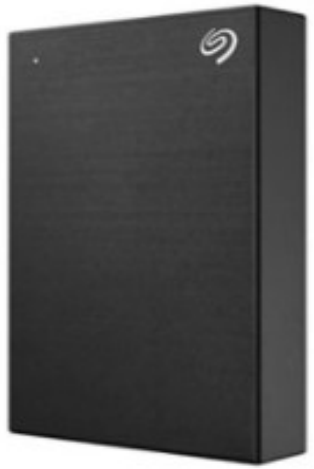
- Bytes Vs. Bits
  - Bytes are represented with a **BIG B**
    - *i.e. 4GB, 8GB, 16GB, etc.*
  - Bits are represented with a <u>small b</u>
    - *i.e. 150Mbps, 100 Mbps, 1024 Gb, etc.*



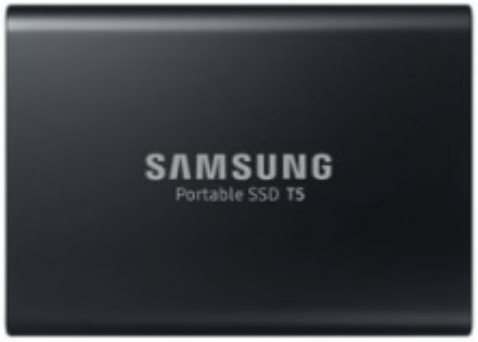
Corsair Vengeance RGB Pro 32GB (2 x 16GB) DDR4 3600MHz Desktop Memory (CMW32GX4M2D3600C18)

Corsair Vengeance LPX 16GB (2 x 8GB) DDR4 3600MHz Desktop Memory (CMK16GX4M2D3600C18)





Seagate One Touch 5TB USB 3.0 Portable External Hard Drive (STKC5000400) - Black



Samsung T5 1TB USB External Solid State Drive (MU-PA1T0B/AM)

Clarification

- Bytes Vs. Bits
  - Bytes are represented with a **BIG B**
    - *i.e. 4GB, 8GB, 16GB, etc.*
  - Bits are represented with a <u>small b</u>
    - *i.e. 150Mbps, 100 Mbps, 1024 Gb, etc.*

Download speed up to **150** Mbps[1]

Upload speed up to **15** Mbps

Buy online and we'll waive the $39 Ignite Express Setup fee!

Ignite Internet 500u

Connect up to 16 devices

Unlimited
Usage

500 Mbps [1]
Download speed up to

Ignite SmartStream
Add for $5/mo·

See details

FOR LIGHT INTERNET USAGE

Fibe Internet

10 Mbps
Max download speed to your Home Hub

0.93 Mbps
Max upload speed to your Home Hub

100 GB
Monthly usage

Review Question #1

- **Question:** From the options given, which memory is the fastest?
- **Options:**
  - A) L1 Cache
  - B) Solid State Drive
  - C) USB Port
  - D) Hard Drive
  - E) L2 Cache
  - F) Registers
  - G) None Of The Above
- **Answer:**

Review Question #2

- **Question:** From the options given, which memory is the slowest?
- **Options:**
  - A) L1 Cache
  - B) Solid State Drive
  - C) RAM
  - D) Hard Drive
  - E) L2 Cache
  - F) Registers
  - G) None Of The Above
- **Answer:**

Review Question #3

- **Question:** The Miss Penalty for L1 cache is:
- **Options:**
  - A) $AMAT_{L2}$
  - B) HT_{L2}
  - C) MP_{L2}
  - D) $AMAT_{L3}$
  - E) HT_{L3}
  - F) MP_{L3}
  - G) None Of The Above
- **Answer:**

Review Question #4

- **Question:** If the CPU requests memory, in which order are the checks made? Assume each check results in a miss.
- **Options:**
  - A) L1 » L2 » L3 » HDD » RAM » SSD
  - B) L3 » L2 » L1 » RAM » HDD
  - C) L1 » L2 » L3 » HDD » RAM
  - D) L1 » L2 » L3 » RAM » HDD
  - E) L1 » L2 » L3 » SSD » HDD
  - F) L3 » L2 » L1 » HDD » RAM
  - G) None Of The Above
- **Answer:**

Review Question #5

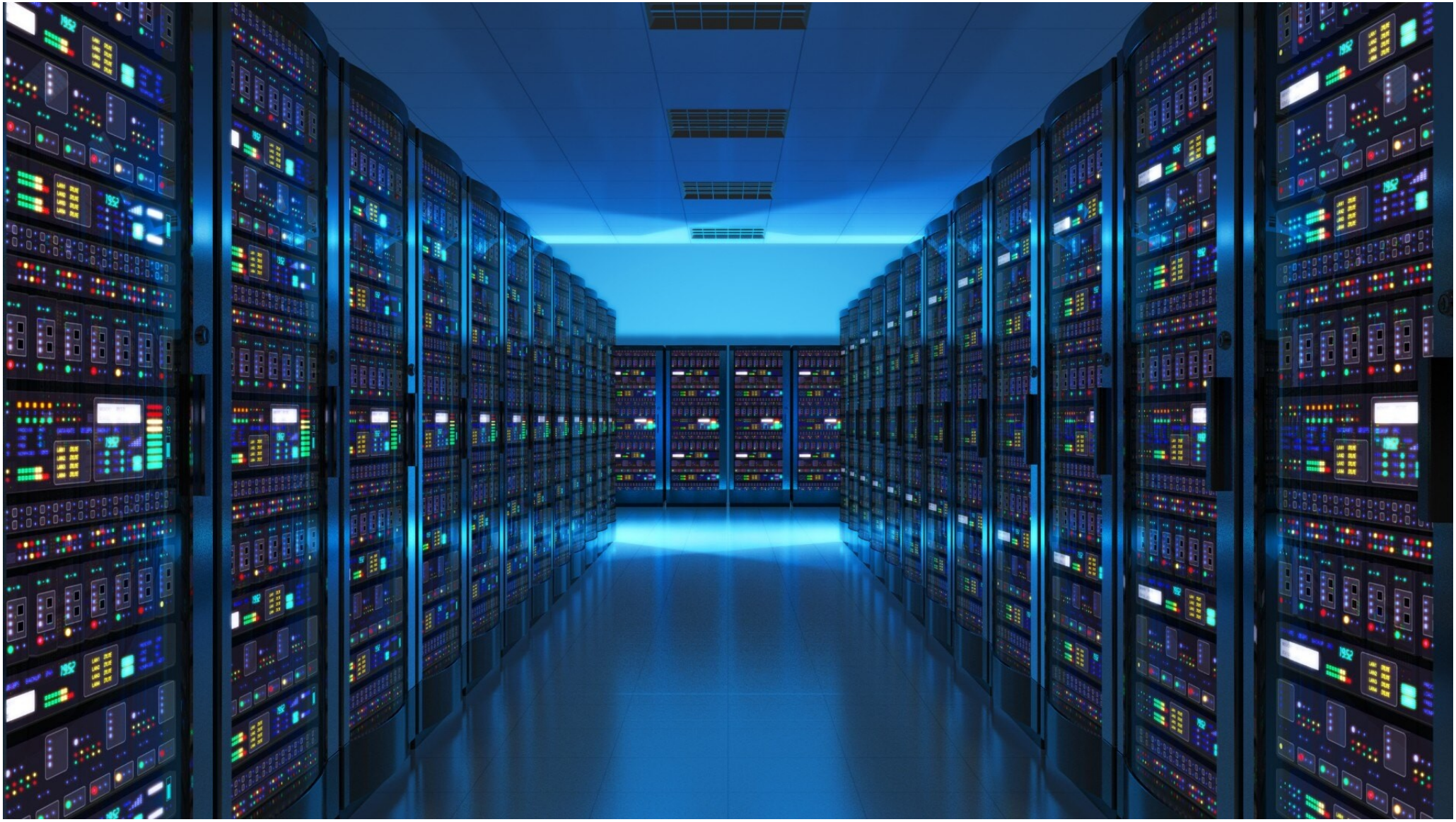
- **Question:** Rank the memories from slowest to fastest
- **Options:**
  - A) Registers » Cache » RAM » HDD » Magnetic Tape
  - B) Cache » Registers » RAM » HDD » Magnetic Tape
  - C) Ram » Cache » Registers » HDD » Magnetic Tape
  - D) Magnetic Tape « HDD « SSD « RAM « Registers « Cache
  - E) Magnetic Tape « HDD « SSD « RAM « Cache « Registers
  - F) Magnetic Tape « SSD « HDD « RAM « Cache « Registers
  - G) None Of The Above
- **Answer:**

Questions?
Comments?
Concerns?

Learning Time

(Straighten Up)

Precursor For Question #1



Precursor For Question #1

Precursor For Question #1

- What you just saw are pictures of massive servers
  - Servers require lots of hard disks to store information
    - Every single tech company uses servers
    - The server is the ‘‘cloud’’
- All those hard drives connected together is called: RAID
  - RAID = Redundant Array of Inexpensive Disks
  - RAID = Redundant Array Of Indepedent Disks

What Is RAID?

- According to Wikipedia, ‘‘data storage virtualization technology that combines multiple physical disk drive components into one or more logical units for the purposes of data redundancy, performance improvement, or both.’’
  - Basically, we combine HDDs (or SSDs) to achieve data redundancy, performance, greater storage, etc.
    - Data redundancy: If one drive fails, we can *easily* recover the lost data from another drive. Since the data is redundant, it isn’t really lost

RAID

- There are different kinds of RAID levels
  - Raid 0
  - Raid 1
  - Raid 2
  - Raid 3
  - Raid 4
  - Raid 5
  - Raid 6
- Each RAID level has its own use
  - i.e. Reliability, availability, performance, and capacity.

RAID Recap

- RAID stands for *Redundant Array Of Inexpensive Disks*
  - We use RAID to improve things like:
    - Reliability, availability, performance, and capacity
- In a server farm, reliability and availability are **very** important
  - Why?
    - Because servers need 99.9999% uptime. If a drive goes offline or crashes, it needs to be replaced ASAP!

Tutorial Question #1

- **Question:** Mean time between failures (MTBF), mean time to replacement (MTTR), and mean time to failure (MTTF) are useful metrics for evaluating the reliability and availability of a storage resource. Explore these concepts by answering the questions about a device with the following metrics:
  - A) Calculate the MTBF for such a device.
  - B) Calculate the availability for such a device.
  - C) What happens to availability as the MTTR approaches 0? Is this a realistic situation?
  - D) What happens to availability as the MTTR gets very high, i.e., a device is difficult to repair? Does this imply the device has low availability?

MTT* Explained

- MTTF = Mean Time To Failure
  - How long will the drive last before it crashes?
- MTTR = Mean Time To Replacement
  - How long does it take to replace the drive AFTER it crashes?
    - This has to do with copying the data over to the new drive
      - More redundancy = Lower replacement time
      - Less redundancy = Greater replacement time
- MTBF = MTTF + MTTR
  - Used to determine availability

Tutorial Answer #1

- A) Calculate the MTBF for such a device.
  - MTBF = MTTF + MTTR

    MTBF = 3 years + 1 day

    MTBF = 1095 + 1

    MTBF = 1096

Tutorial Answer #1

- B) Calculate the availability for such a device
  - Availability = (MTTF / MTBF)

    Availability = (1095 / 1096)

    Availability = 0.999087591240876

    Availability = 99.91%
- We want availability to be as large as possible
  - High availability = Less crashes and less service interruptions

Tutorial Answer #1

- C) What happens to availability as the MTTR approaches 0? Is this a realistic situation?
  - Availability = (MTTF / MTBF)
  - Availability = (MTTF / (MTTF + MTTR))
    - If MTTR = 0, Then:
  - Availability = (MTTF / (MTTF + 0))
  - Availability = 1.0
    - Rather, availability approaches 1.0

Tutorial Answer #1

- C) Is it possible to have an MTTR to be 0, or nearly 0?
  - Not entirely 0, but it is possible to be nearly 0 as drives get more and more inexpensive
    - But, replacing file systems and data on a drive can take significant time
      - Note: Manufacturers will not include this time in their statistics, even though this time is part of replacing a disk. Similar to how ISPs give the speed in Mbps – they want to make their numbers look marketable

Tutorial Answer #1

- D) What happens to availability as the MTTR gets very high? (i.e. The drive is difficult to repair). Does this imply the device has low availability?
  - If we look back to the availability equation:

    Availability = (MTTF / (MTTF + MTTR))
  - If MTTR increases, and MTTF remains the same, then availability decreases
    - Because MTTR dictates how long it takes to repair a broken drive. Repair time eats into availability
  - If MTTR and MTTF increase proportionally, then availability is unaffected
    - i.e. Samsung's new SSDs last longer, but repairing them also takes longer

SS

Tutorial Question #2

- **Question:** This exercise examines the single error correcting, double error detecting (SEC/DED) Hamming code.
  - What is the minimum number of parity bits required to protect a 128-bit word using the SEC/DED code?
  - Consider a SEC code that protects 8 bit words with 4 parity bits. If we read the value 0x375, is there an error? If so, correct the error.

Tutorial Answer #2

- What is the minimum number of parity bits required to protect a 128-bit word using the SEC/DED code?
  - For SEC, we need to find minimum p such that

    $2p >= p + d + 1$ (and then add one)

    That gives us $p = 8$.

    We then need to add one more bit for SEC/DED.

Tutorial Question #2

- **Question:** This exercise examines the single error correcting, double error detecting (SEC/DED) Hamming code.
  - Consider a SEC code that protects 8 bit words with 4 parity bits. If we read the value 0x375, is there an error? If so, correct the error.
    - Convert 0x375 to binary

THE END