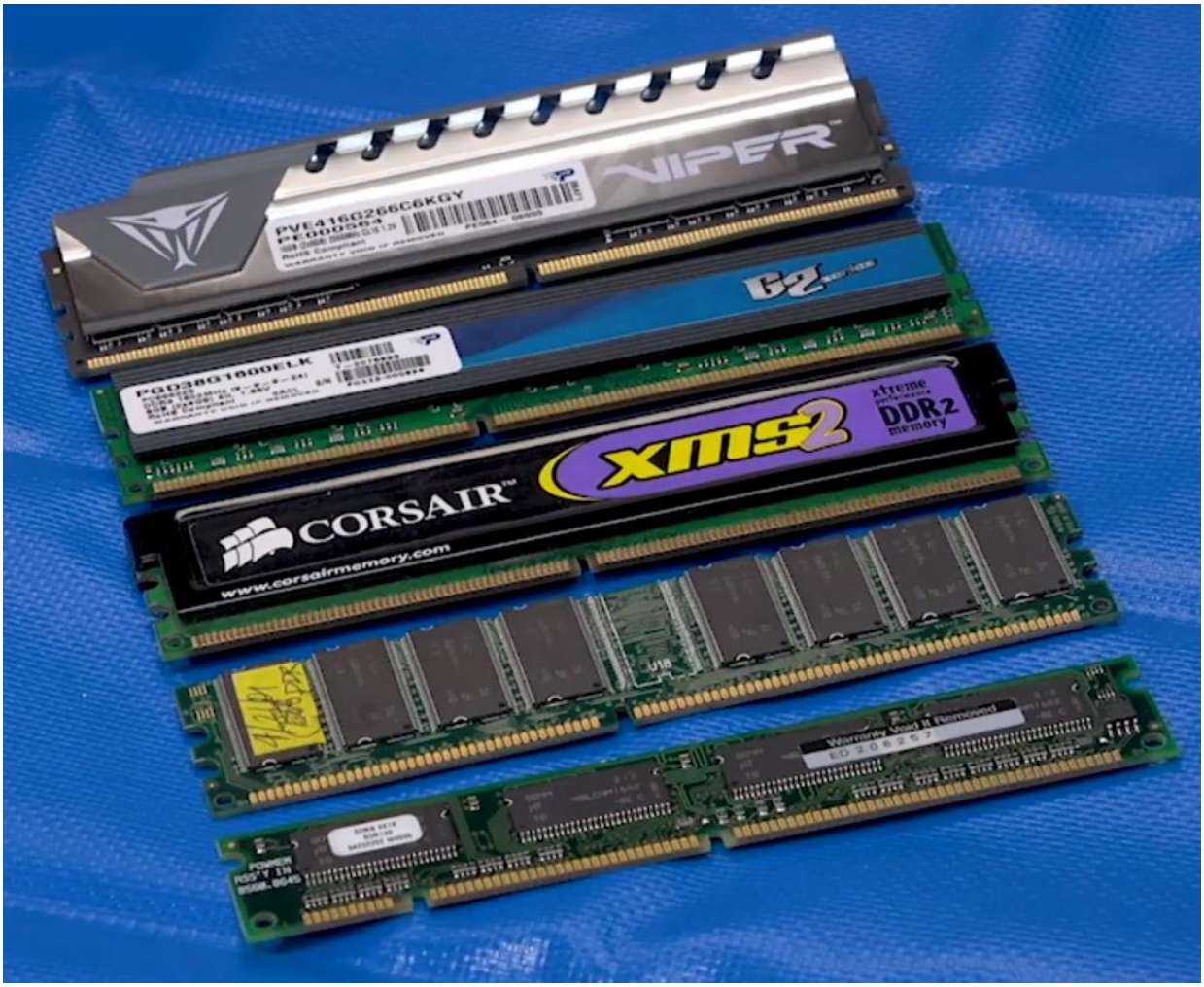
RAM Technology

- Different motherboards support a specific RAM technology
- The technologies on the exam are DDR, DDR2, DDR3 and DDR4
- We measure RAM speeds using DDR or PC ratings
- Multiply a DDR speed by eight to get the PC speed



SDRAM - 168 Pins - SDRAM is the ONLY RAM stick with 2 Notches
Ran at Base Speed (aka Motherboard Speed; Core Speed) in MHz

ClockSpeed	DDR Speed Rating	PC Speed Rating
100 MHz	DDR-200	PC-1600
133 MHz	DDR-266	PC-2100
166 MHz	DDR-333	PC-2700
200 MHz	DDR-400	PC-3200
217 MHz	DDR-433	PC-3500
233 MHz	DDR-466	PC-3700
250 MHz	DDR-500	PC-4000
275 MHz	DDR-550	PC-4400
300 MHz	DDR-600	PC-4800
	x8	

DDR SDRAM (Double Data Rate, or DDR RAM) - 184 Pins - 1 Notch

For any given click of the clock, it gave us 2 bits of information.

Huge Breakthrough & sped RAM up a lot

Core RAM Clock Speed	DDR I/O Speed	DDR2 Speed Rating	PC Speed Rating
100 MHz	200 MHz	DDR2-400	PC2-3200
133 MHz	266 MHz	DDR2-533	PC2-4200
166 MHz	333 MHz	DDR2-667	PC2-5300
200 MHz	400 MHz	DDR2-800	PC2-6400
266 MHz	533 MHz	DDR2-1066	PC2-8500
	x2	x2	x8

DDR2 - 240 Pin - 1 Notch

Always multiply Speed Rating by 8 for the PC Speed Rating

PC-XXXX - DDR PC2-XXXX - DDR2

Core RAM Clock Speed	DDR I/O Speed	DDR3 Speed Rating	PC Speed Rating
100 MHz	400 MHz	DDR3-800	PC3-6400
133 MHz	533 MHz	DDR3-1066	PC3-8500
166 MHz	667 MHz	DDR3-1333	PC3-10667
200 MHz	800 MHz	DDR3-1600	PC3-12800
233 MHz	933 MHz	DDR3-1866	PC3-14900
266 MHz	1066 MHz	DDR3-2133	PC3-17000
300 MHz	1200 MHz	DDR3-2400	PC3-19200
	x4	x2	x8

DDR3 - 240 Pin - 1 Notch

PC3-XXXX - DDR3

Clock Speed	Bandwidth	DDR4 Speed Rating	PC Speed Rating
200 MHz	1600 MT/s	DDR4-1600	PC4-12800
266 MHz	2133 MT/s	DDR4-2133	PC4-17000
300 MHz	2400 MT/s	DDR4-2400	PC4-19200
400 MHz	3200 MT/s	DDR4-3200	PC4-25600

DDR4 - 288 Pin Fastest & Most Common

PC4-XXXX - DDR4

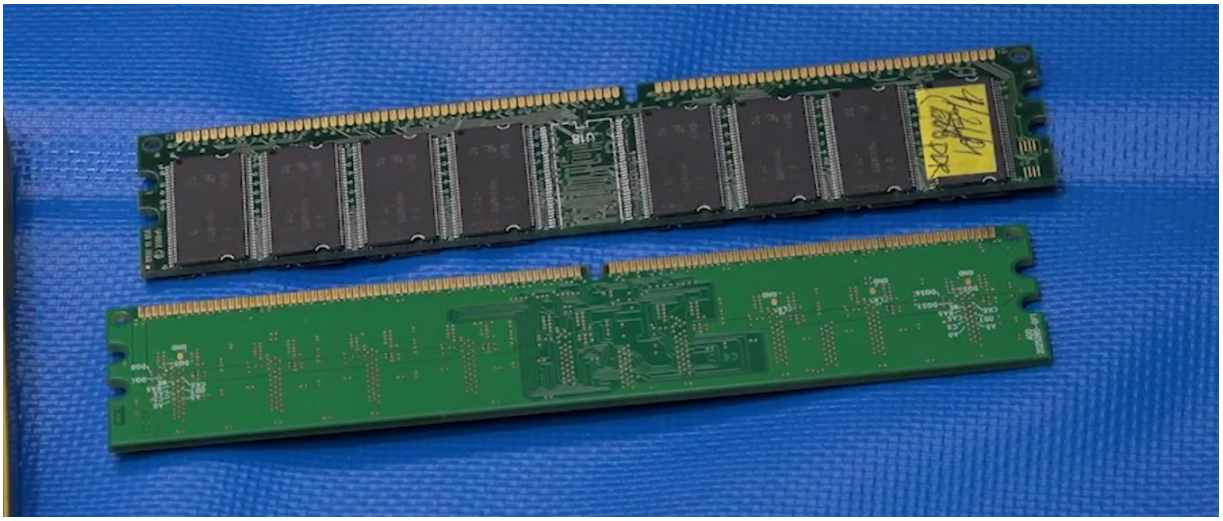
SDRAM; DDR; DDR2; DDR3; DDR4 - really is just referring to the SPEED of the RAM stick, NOT the Capacity!!!!

RAM Capacity

- Every Stick of RAM has a specific capacity
- RAM comes in single- and double-sided versions
- Motherboards offer multichannel memory
- RAM should be identical in the same channel

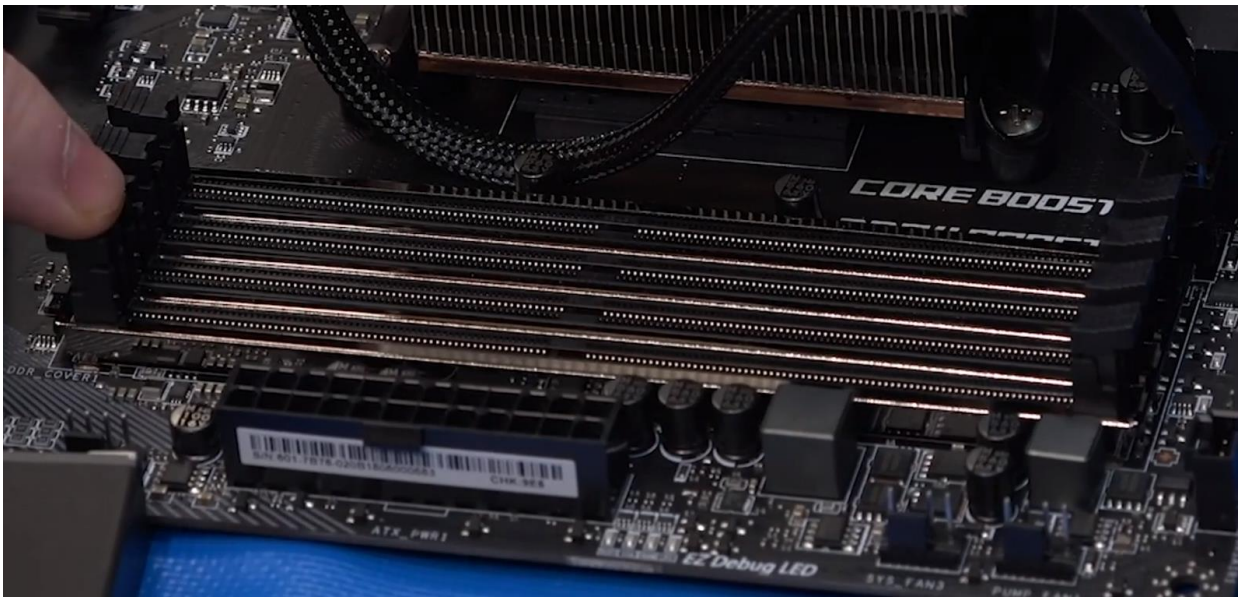
The way the internal organization is in RAM is based on a Square
When the manufacturers make a bigger chip, they *double each side* of this square

Doubling each side of a 256MB square stick of RAM will make it *4x bigger*! (1GB)
Next increase is 4GB, then 16GB



Single-sided RAM - chips on 1 side of the stick

Double-sided RAM - Doubles this amount of RAM (chips on both sides of the stick)
Make sure your Motherboard is compatible with this style of RAM!



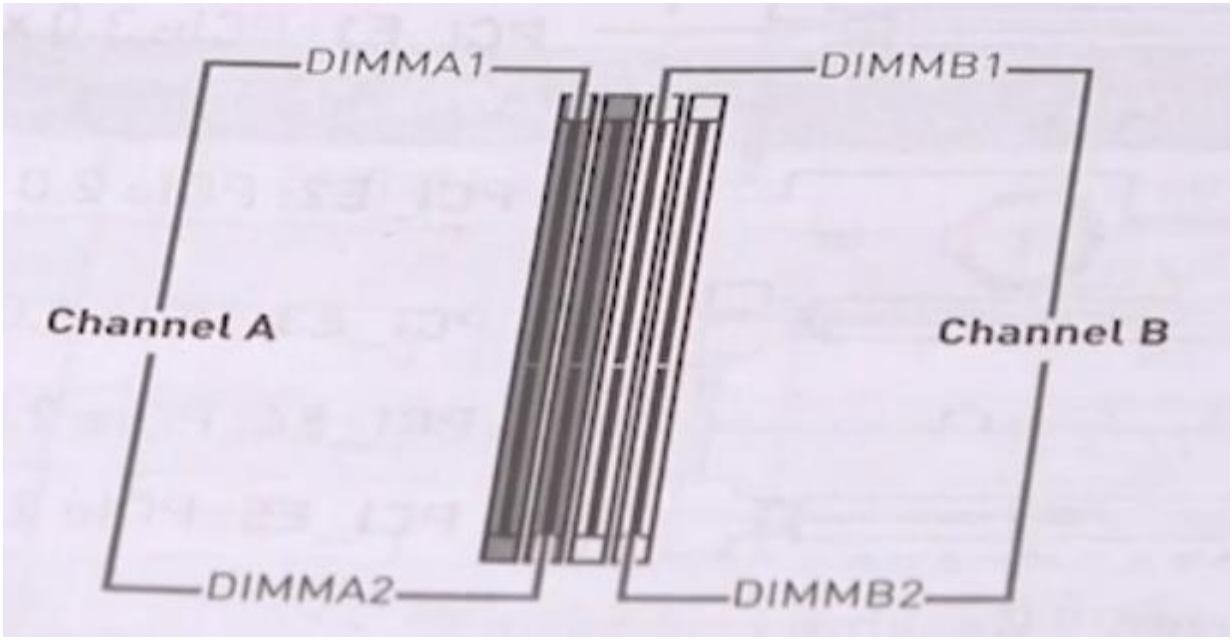
4 Slots where we can snap in RAM sticks on the Motherboard

Some Motherboards will only have 2, 8, or 16 Slots!

(2) 8GB sticks, this system has 16GB of RAM

(4) 8GB sticks, this system has 32GB of RAM

RAM sticks are almost always sold in pairs, because of Motherboards using Channels

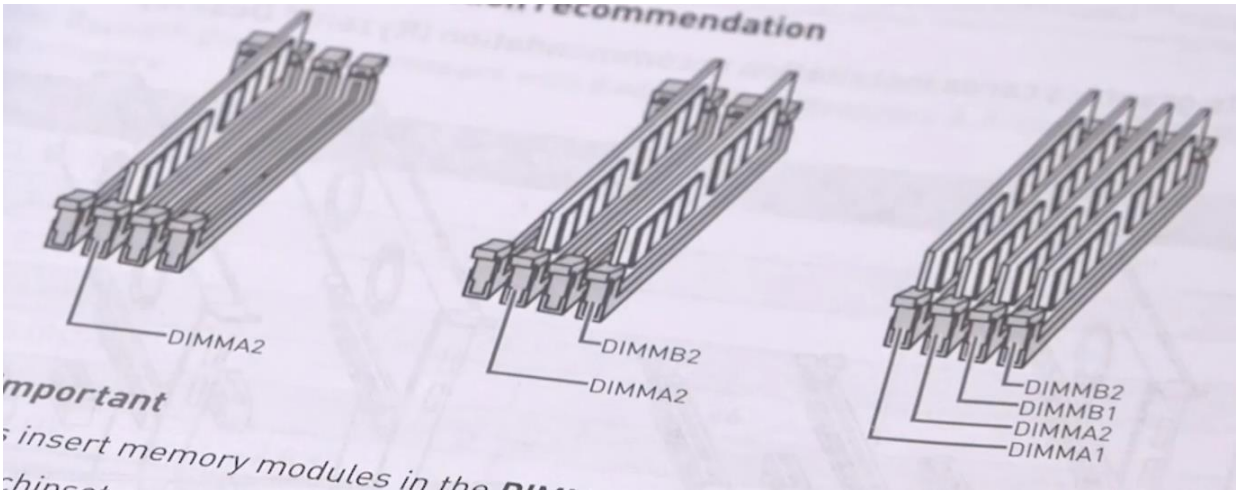


Channels - Image above is showing 4 slots (Dual-Channel Memory)

We have to put the same RAM sticks of the same Size & Speed in specific slots.

Check the Motherboard book to see which slots are for which Channels

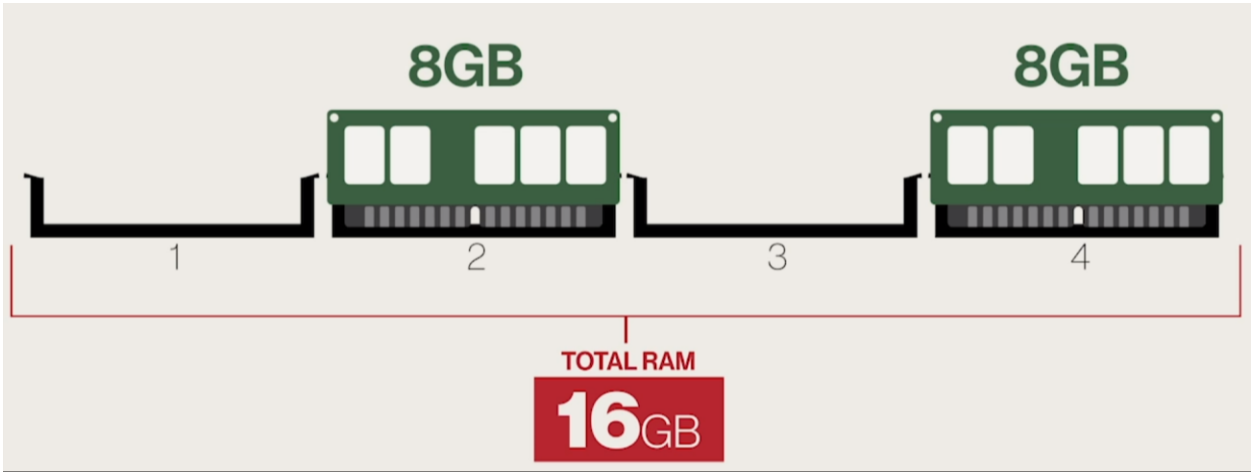
(2 Slots = 1 Channel)

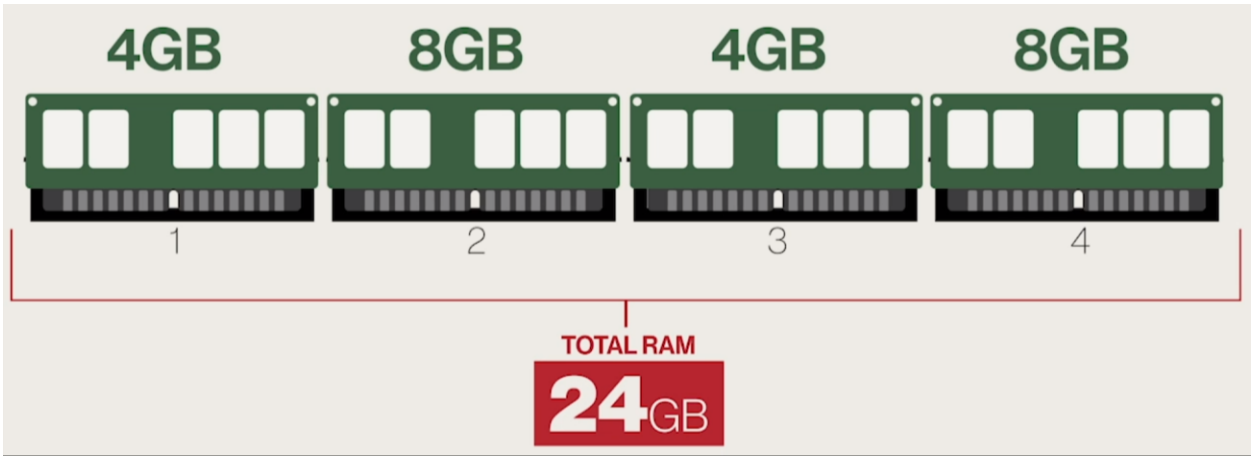


2nd Pic is saying...

For 2 Sticks, have 1 Stick in Channel A & the other in Channel B for this Motherboard.

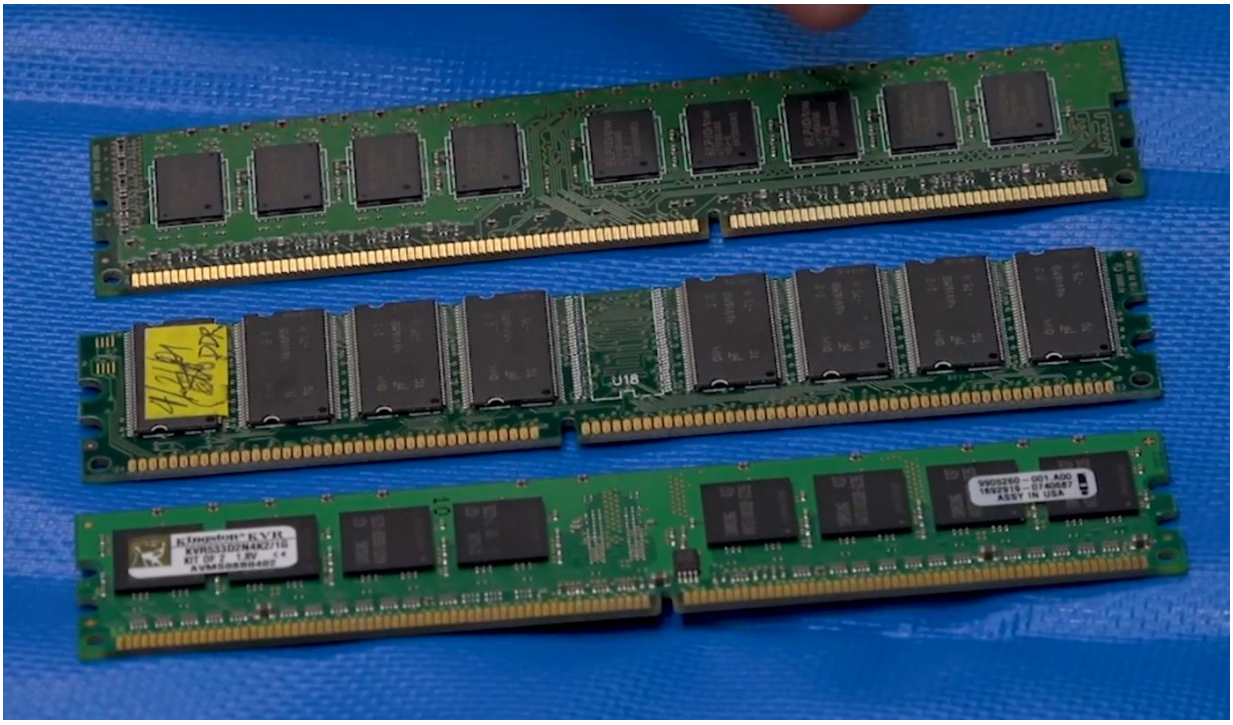
4 Sticks is easy. Just fill them all up!





RAM Features

- Parity and ECC RAM contain extra chips to check for RAM errors
- ECC RAM is only for motherboards that support it
- SO-DIMMS are for smaller spaces
- Almost all RAM has an SPD chip that stores information about the RAM stick
- Tools like CPU-Z read SPD information



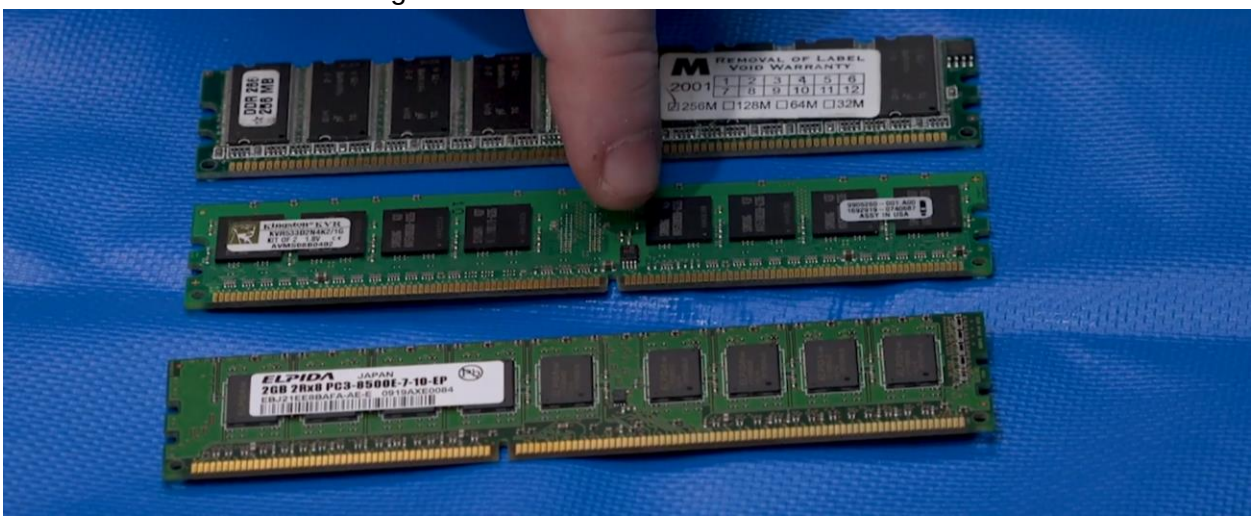
RAM sticks will have 8 chips (or 9 chips)

Parity/ECC (Error Correction Code) RAM - Additional chip, called a Parity Chip
With Parity RAM, we could have 1 bad chip
ECC RAM, we can have 2 bad chips (expensive & motherboard needs to be compatible)
and the RAM stick will still work!! (ECC more common in Servers)

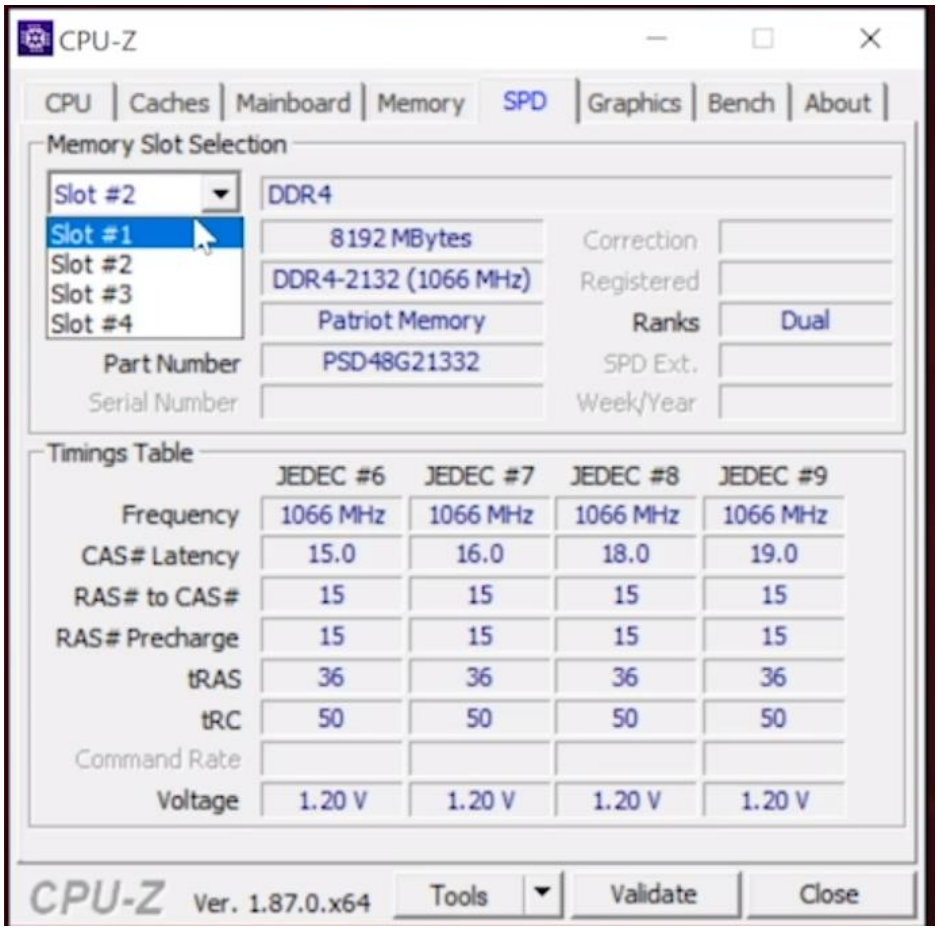
SO-DIMMS - used where Long Sticks aren't compatible, like in a Laptop

Everything else about these sticks are the same as the other ones.

Still will use channelling



SPD Chip (Serial Presence Detect) - Allows your system to query the RAM Chip (what's your capacity?; how fast are you?; what technology are you?; etc)



You can see how many slots you have,

and if you have empty slots through this software!!

Virtual Memory

- Virtual memory is a portion of mass storage that acts as memory
- Should only be used when physical memory is exhausted
- All operating systems have tools to adjust virtual memory use
- In most cases we just let the OS automatically control virtual memory use

As we load more programs, we approach using all the Memory.
If we use all the Memory, we'll get an error "Out of Memory" -Computer is pretty much stalled

Virtual Memory (Swap File) - Part of the Mass Storage that acts like RAM
We don't want to have to use Virtual Memory -we want to have enough RAM!!

"Automatically manage *paging file* size for all drives" -Virtual Memory

Installing RAM

- Use the motherboard book to make sure you're installing the right RAM capacity and speed
- Line up the notch and drop the RAM straight into the slot
- Watch when the system boots to verify the system sees the installed RAM
- Make sure RAM is fully installed and channels are properly filled

For installing RAM, you need to look at the *Motherboard book* to make sure you have the right kind of RAM. It will say something like,

"4x DDR4 Memory Slots, support upto 64GB" -this is quoted from the Specifications pg

(16GB x 4 = 64GB)

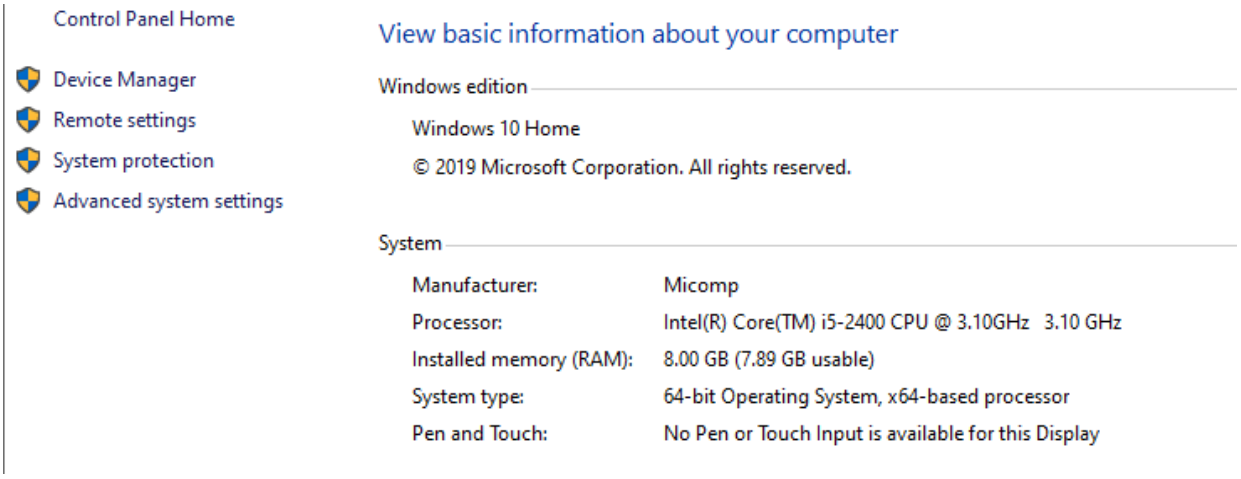
Also, remember to consider the Channels when installing RAM!

Boot up the system, and check CPU-Z to see that every stick is being detected

If this is not the case, open the system up and see if it was installed correctly!

(Dropped Down Correctly, or Check the Channels!)

Use Anti-Static Wrist Straps during the Installation (and Anti-Static Mat)



Control Panel -> System Notice the 8GB RAM