

# Key PC Components

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# Why You Need to Care

- Because someday you'll have to:
  - Repair a PC
  - Plan a purchase of computer equipment that meets a specific requirement
    - Graphics ability, storage sizes, network interface count, USB data transfer speeds, CPU computation speed (serial and/or parallel), etc.
  - Compare form factors and standards to make decisions
  - Understand new technology as the market (rapidly) changes



# Computer Hardware Overview

- All computers consist of the following major components:
  - Enclosure/case
  - Motherboard (MOBO or board)
  - Central Processing Unit (CPU)
  - Random Access Memory (RAM)
  - Power Supply Unit (PSU)
  - Input/Output methods such as a mounted drive
- Our goal isn't to talk about the theoretical workings of these components (that's for other classes), but to talk about usage, selection criteria, identification, and other practical considerations



# Personal Computer (PC) Hardware Overview

- All general purpose Personal Computers consist of some or all of the following major components:
  - Enclosure, Case, or Frame
  - Motherboard (MOBO or board)
  - Central Processing Unit (CPU)
  - Random Access Memory (RAM)
  - Power Supply Unit (PSU)
  - Drives (HDD, SSD, Optical)
  - Cooling systems (CPU and case)
  - Graphics Processing Unit (GPU)
  - Network Interface Controller (NIC)
  - Peripherals (input devices, speakers, monitors, etc.)

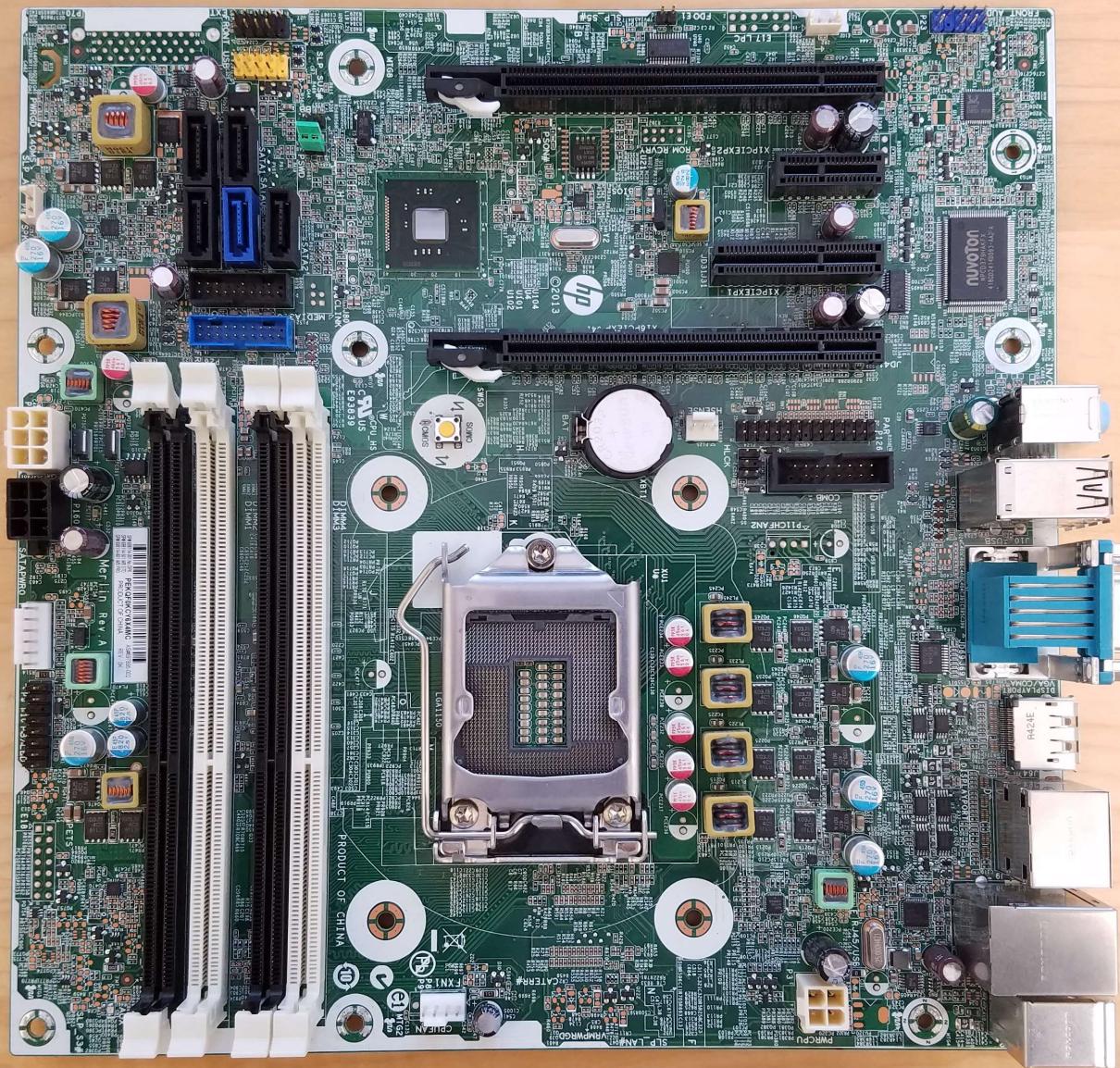


# PC Standards: AT and ATX

- AT comes from the name of IBM's second-generation PC, the IBM PC/AT, where AT stands for "Advanced Technology"
- The ATX standard is the extended, modern version of the AT standard
- ATX specifies:
  - Motherboard size (many form factors: Standard ATX, Micro-ATX, Mini-ITX, etc.)
  - Manufacturer-defined connector block on back of system
  - Power supply voltages: +12V, +5V, +3.3V, and low-power -12V, +5V<sub>SB</sub>
  - PSU dimensions
  - Power connector: 24-pin + 4-pin
  - Power switch: PSU controlled by OS and front-panel switch
- Let's look at our MOBO for this class's Labs!



# HP Z230 Motherboard



# Motherboard Specifications

- Modern PC hardware is developed to match a set of motherboard specifications
- Old, de facto specification: AT
  - De facto because other clones simply copied the form factor of the IBM AT
- Current specification: ATX
- Newer but un-loved spec: BTX



# Motherboard Busses

- An internal computer bus (short for omnibus) connects all the computer components together, providing a way for data to get to and from the CPU, RAM, and I/O devices
  - The connection between CPU and RAM is tightly coupled, and runs independently from other components
- An external bus connects peripherals to the computer. Today, this is typically accomplished with USB



# Motherboard Busses

- Old-school parallel busses reached their limit in terms of speed because of the difficulties of crosstalk, timing skew, EMI, and power consumption
- Serial busses don't have those problems, and have been able to achieve much faster speeds, which is a bit counter-intuitive
- Intel CPUs, for example, use a specific chipset on the MOBO that includes the physical, electrical, and logical connections for the busses
  - E.g., Intel's Coffee Lake-series CPUs use the Z370 chipset



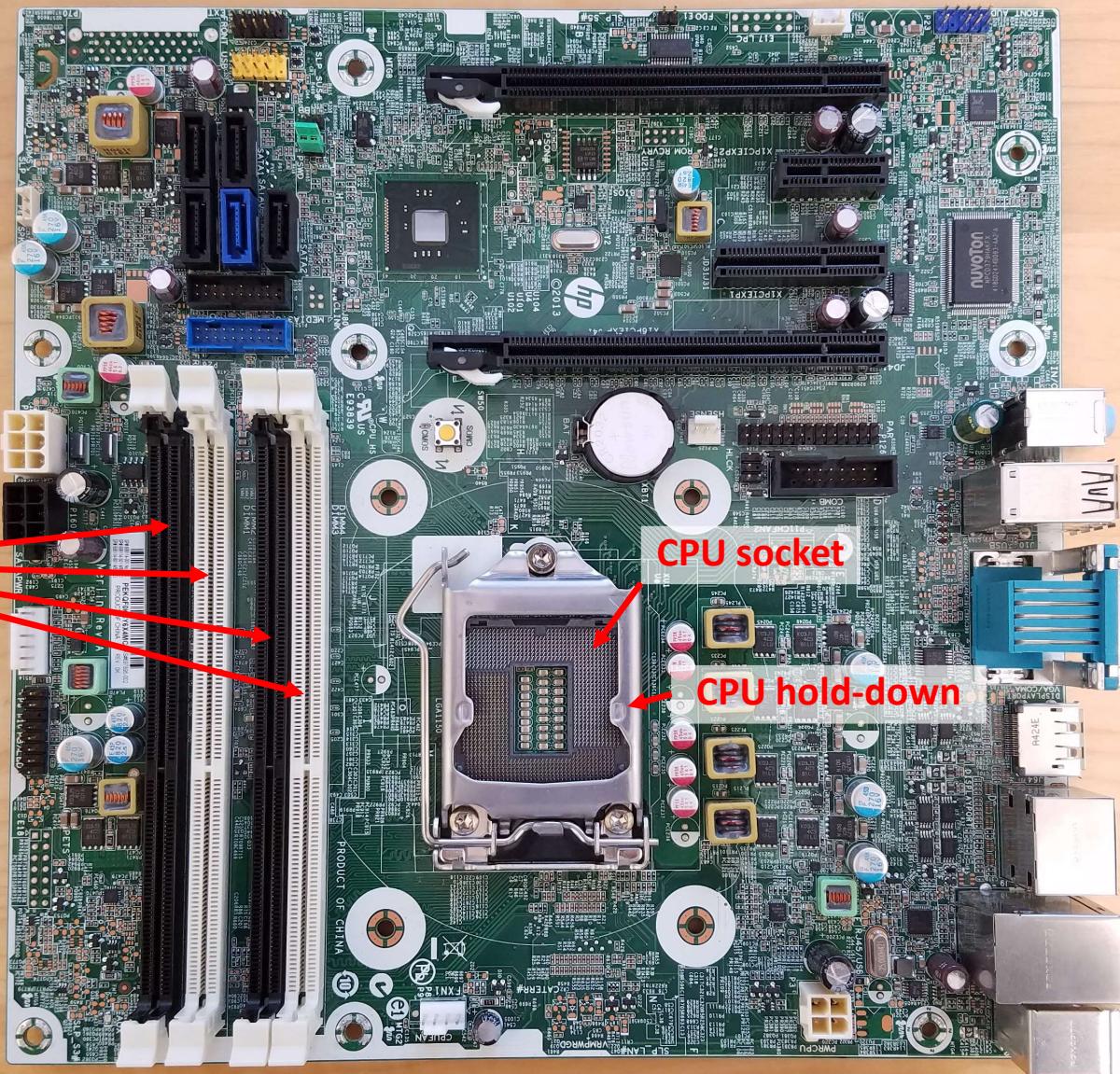
## HP Z230 Motherboard

Let's identify  
some parts  
together...

RAM Slots

CPU socket

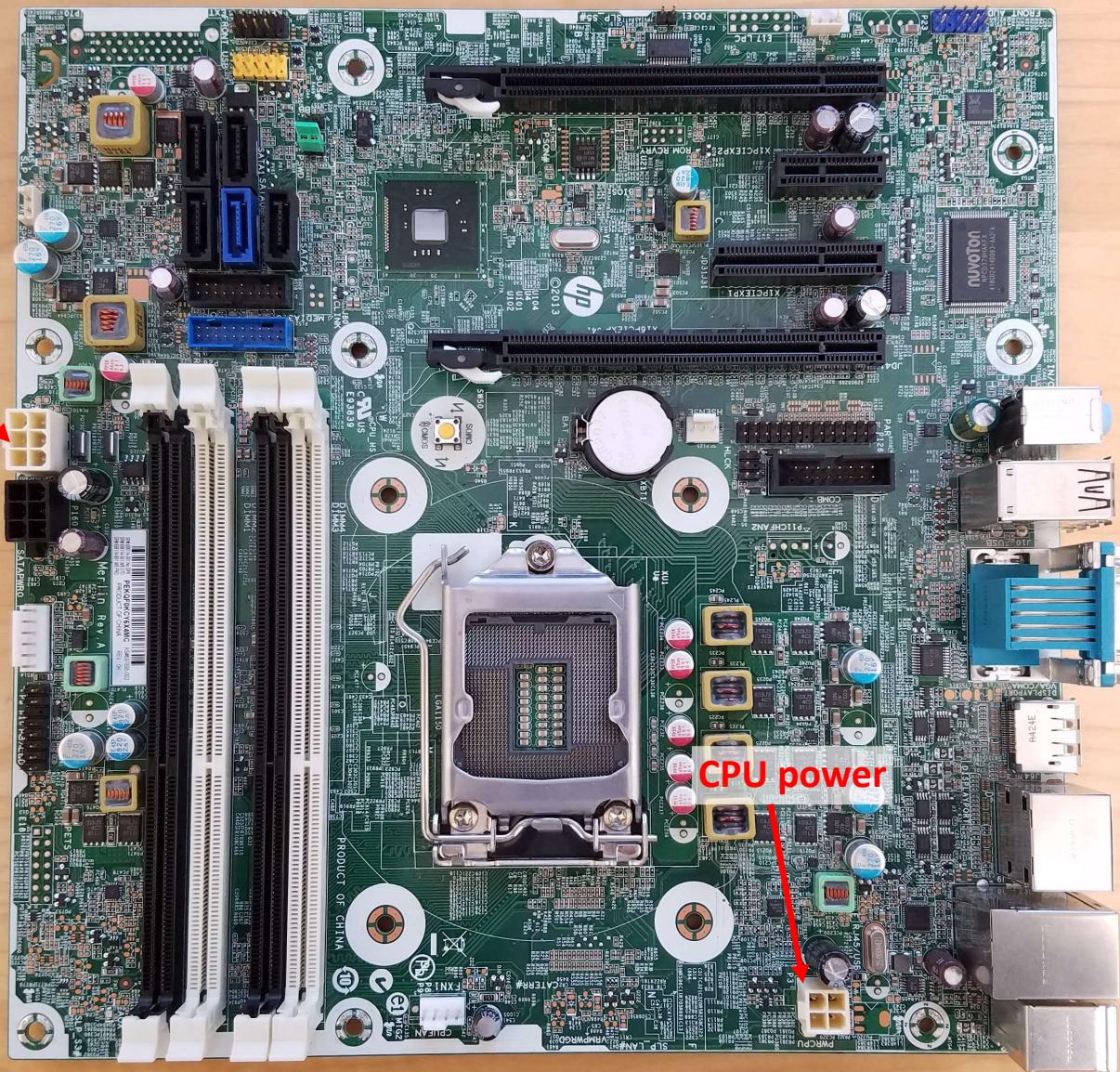
CPU hold-down



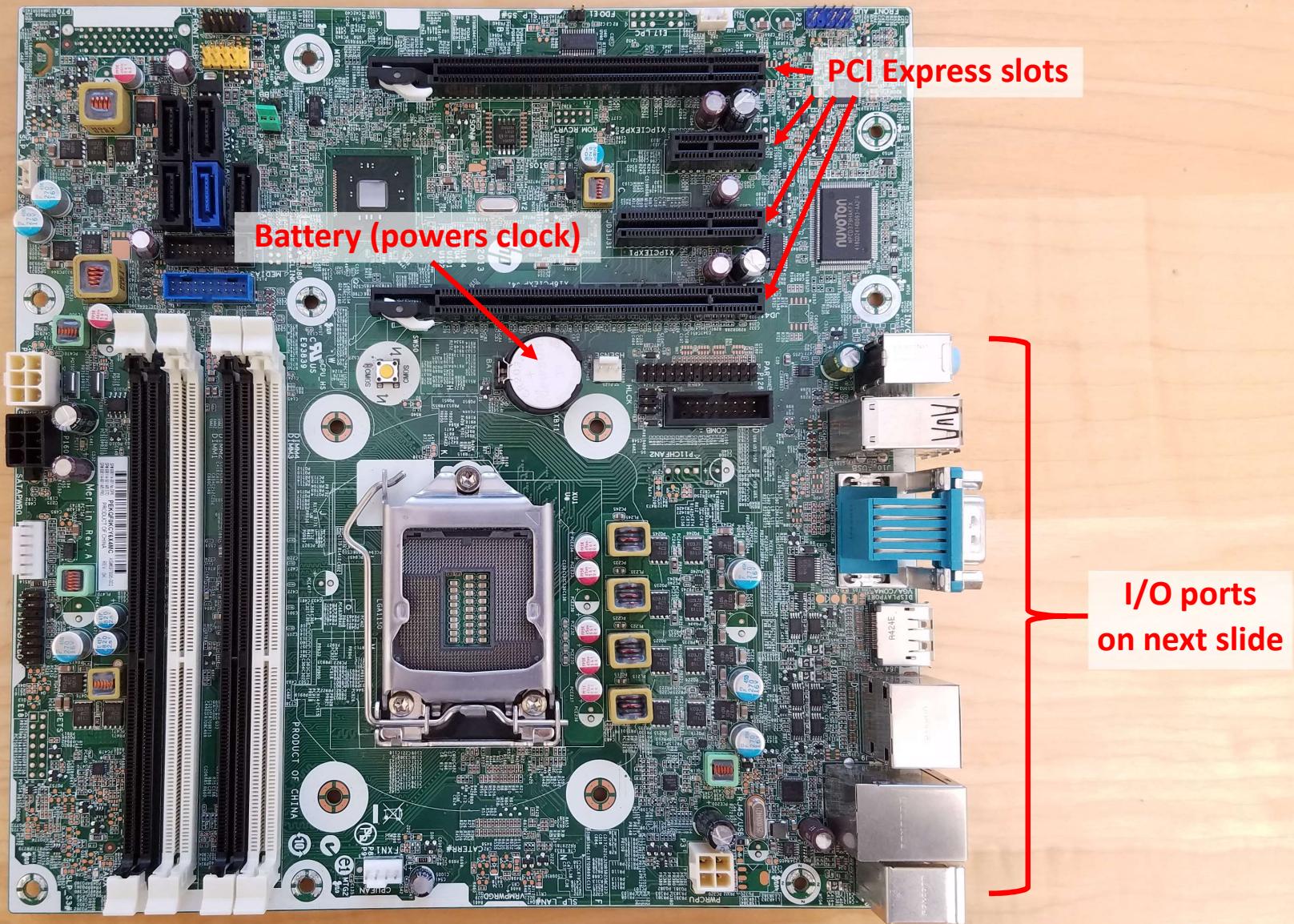
# HP Z230 Motherboard

Non-standard  
MOBO power

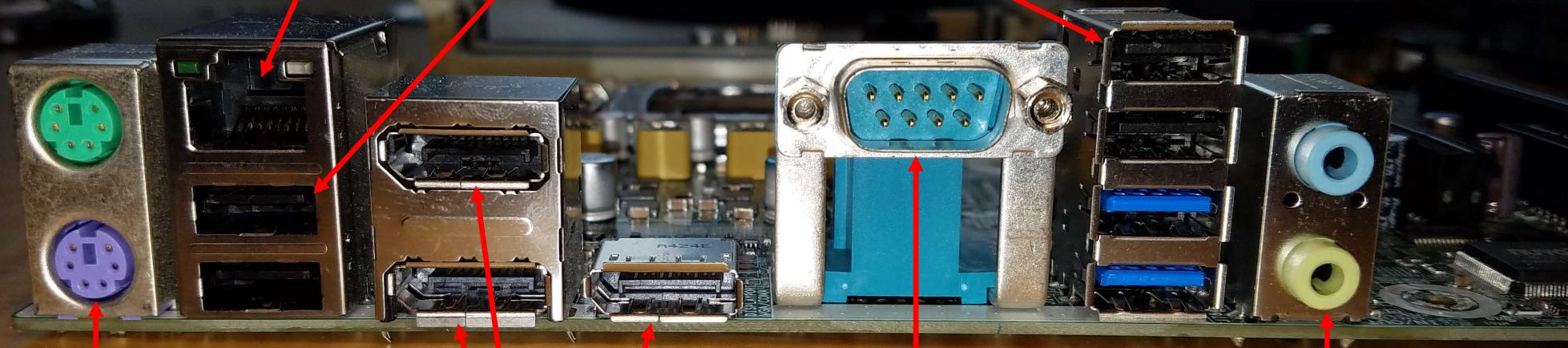
CPU power



# HP Z230 Motherboard



HP Z230  
Motherboard



PS/2 mouse (top),  
keyboard

Network,  
8P8C connector

4x USB 2  
2x USB 3

DisplayPort

RS-232 aka Serial

3.5mm analog Audio  
line-in (top), line-out

## HP Z230 Motherboard

SATA Ports

Primary oscillator

Header for front  
panel lights and  
switches

Case USB block  
headers

Looks similar to this:



By Altzone at English Wikipedia [Public domain], via Wikimedia Commons

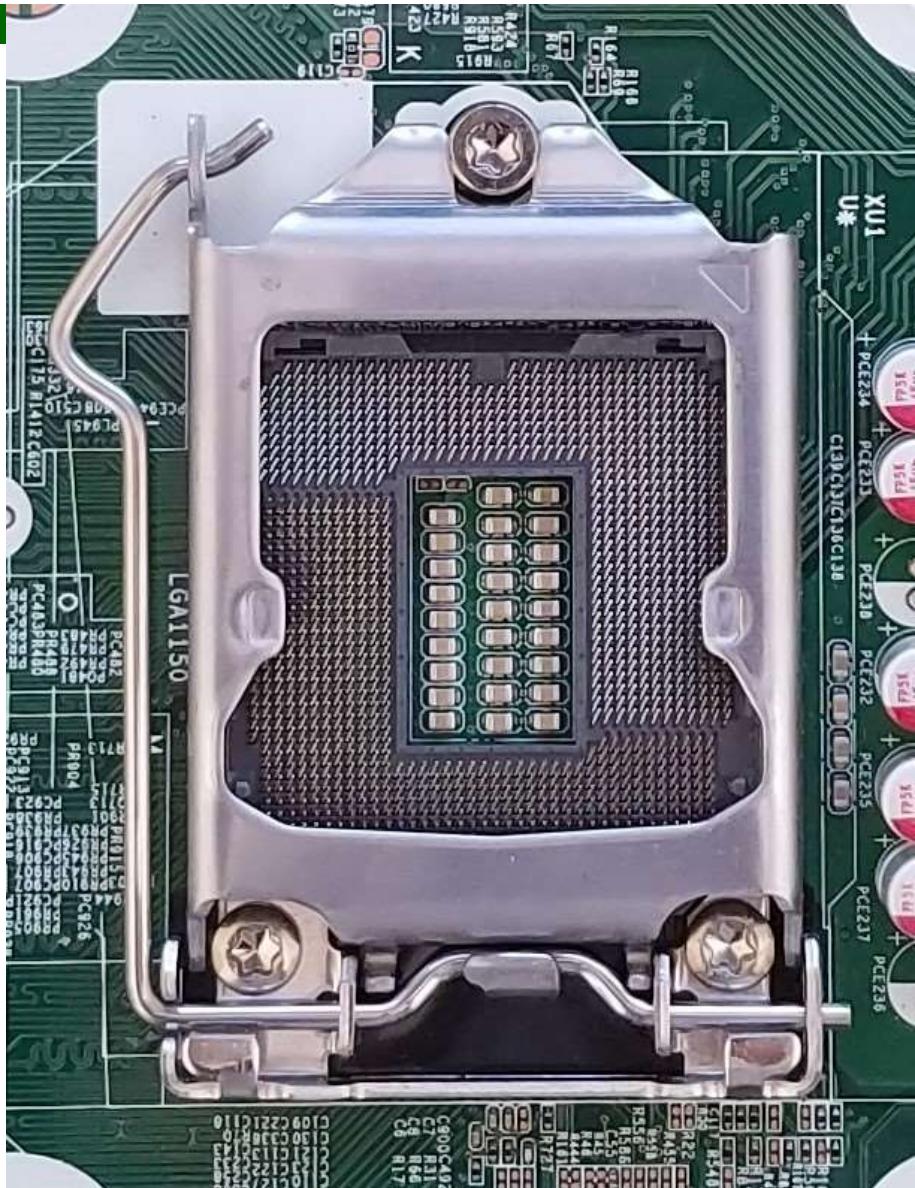
# CPU

- The Central Processing Unit handles most of the processing of program instructions done in the computer
- Other processing units in a computer include:
  - Motherboard chipset, which handles basic input and output
  - Graphics Processing Unit (GPU), which is nearly a mini-computer all by itself
- From the perspective of a sysadmin, you'll select CPUs based on the proper intersection of price and features for a specific use



# CPU Sockets

- The CPU socket on a motherboard only supports a certain class of CPUs.
- This HP Z230 socket is for LGA1150 CPUs only.
  - LGA stands for Land Grid Array, and refers to the fact that the pins are on the socket, while the CPU remains flat
  - 1150 refers to the 1150 pins/pads
- CPU features and specs dictate the shape of sockets



# RAM

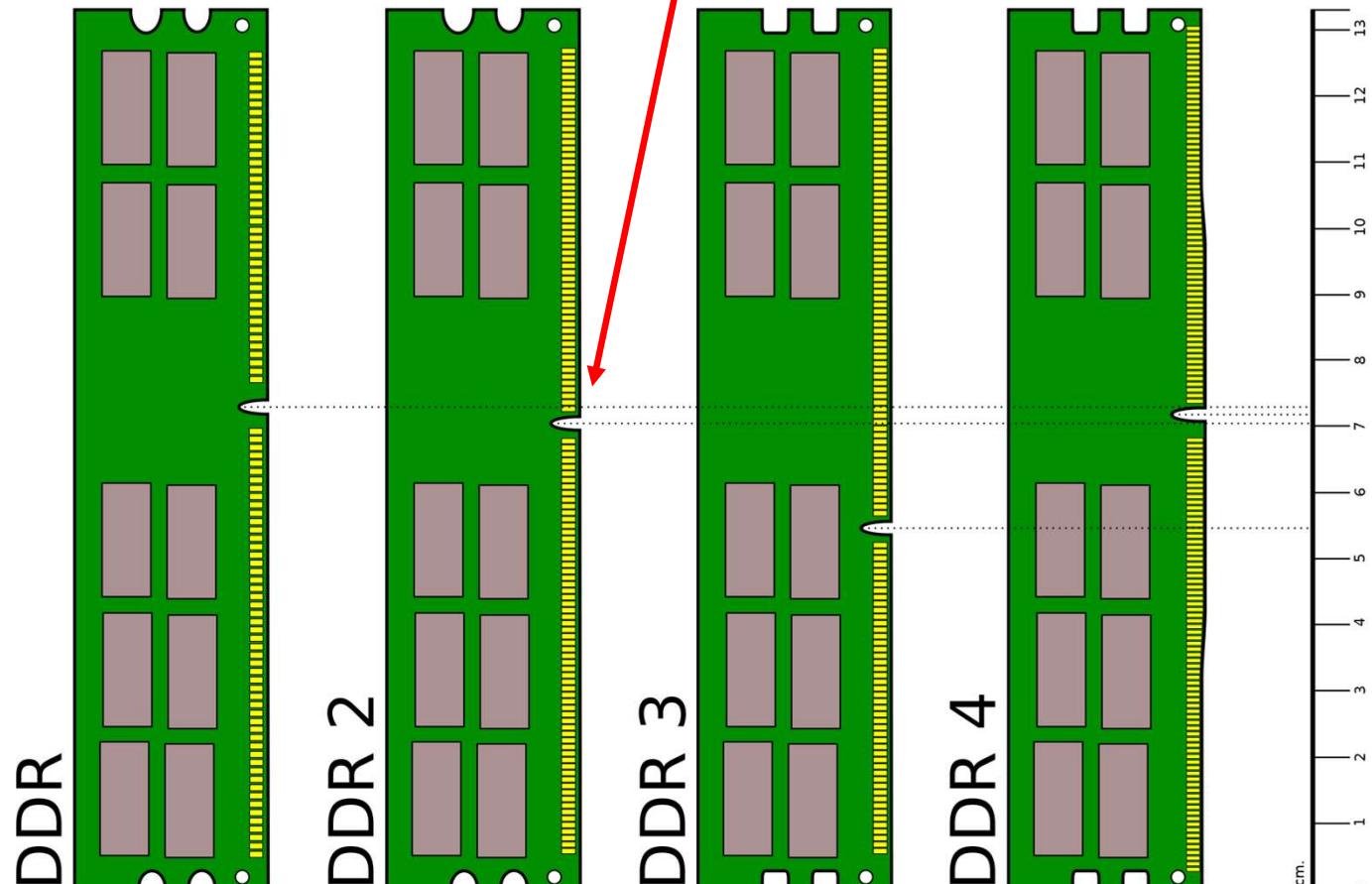
- Random Access Memory modules come in lots of speeds, sizes, shapes, and technologies, some with heatsinks, some read two at a time (dual channel)
- This is the 4GB OEM module in our HP Z230 PC. It's type is PC3-12800U, which uses DDR3-1600 DRAM chips in an unbuffered (faster, but perhaps less reliable) configuration running at 12.8 GHz total across the entire module



# RAM - DDR

- Double Data Rate RAM differs from Single Data Rate RAM in that it transfers data on both the rising and falling edges of the oscillator-generated clock signal

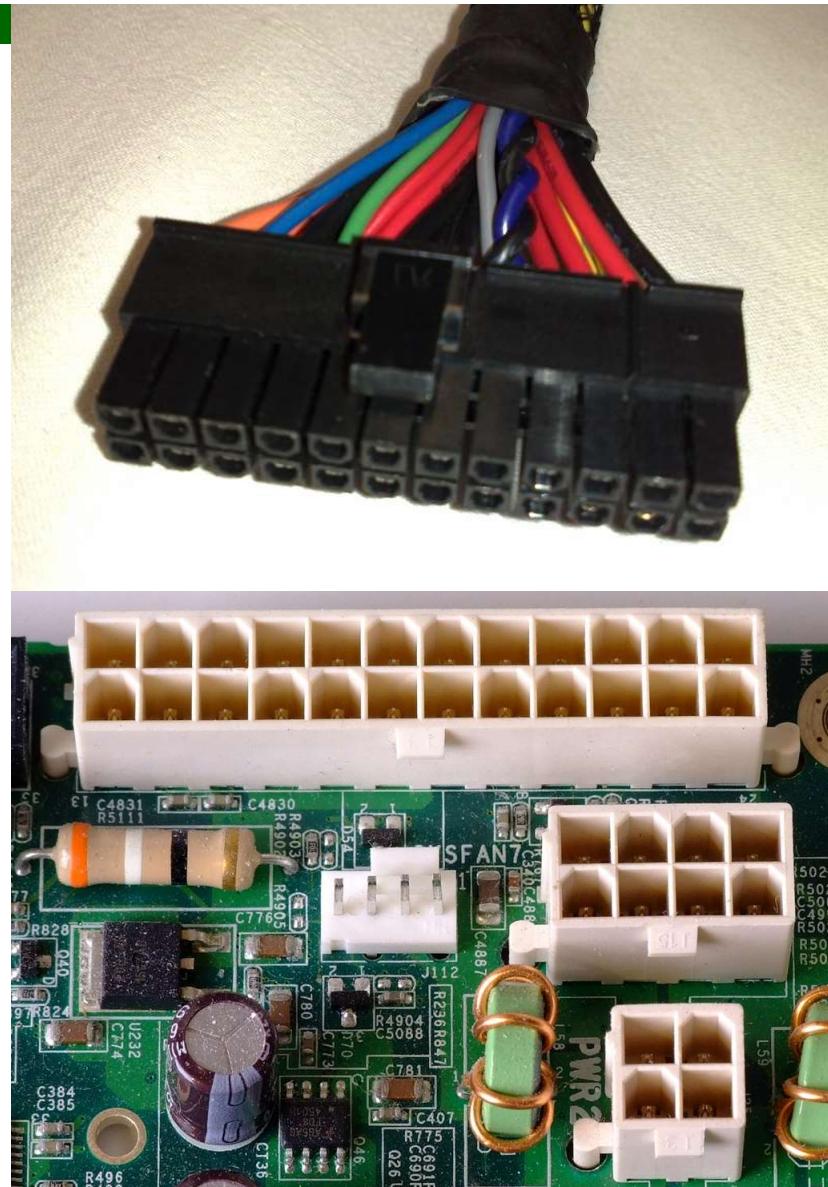
Differentiate generations by notch (aka key) position



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# Power

- Power Supply Units provide several DC voltages for the components of a computer, adapting it from main supply (120V AC)
- ATX specifies:
  - Voltages: +12V, +5V, +3.3V, and low-power -12V, +5V<sub>SB</sub>
  - PSU dimensions
  - Primary 24-pin MOBO connector
  - Power switch: PSU controlled by OS and front-panel switch



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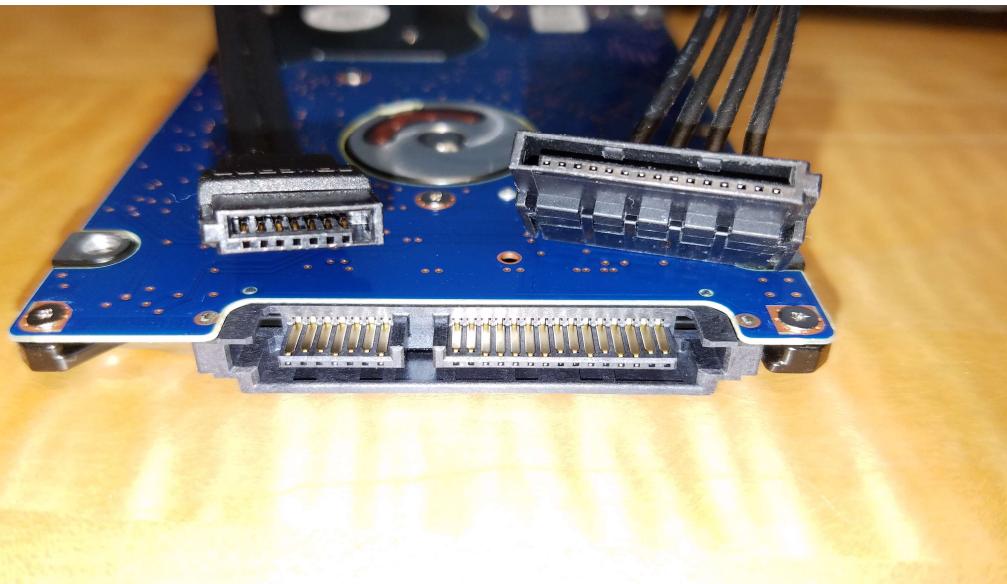
# Power

- This is a non-standard form factor PSU for the HPZ230:



# Interfaces - SATA

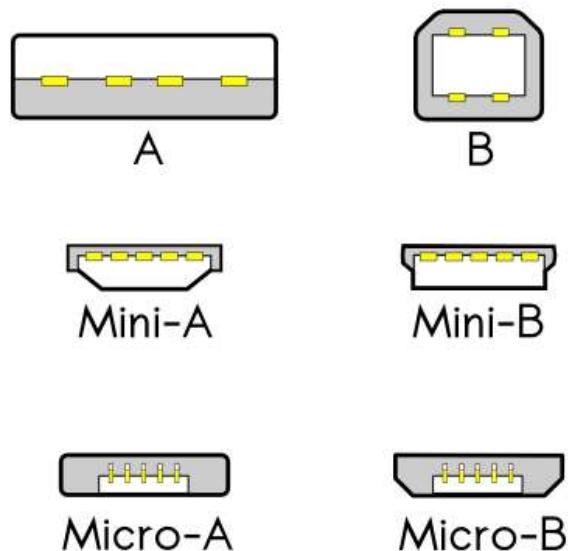
- SATA stands for “Serial AT Attachment”
- Replace the ol’ ribbon cable Parallel ATA standard
- Consists of both data cable and power cable standards



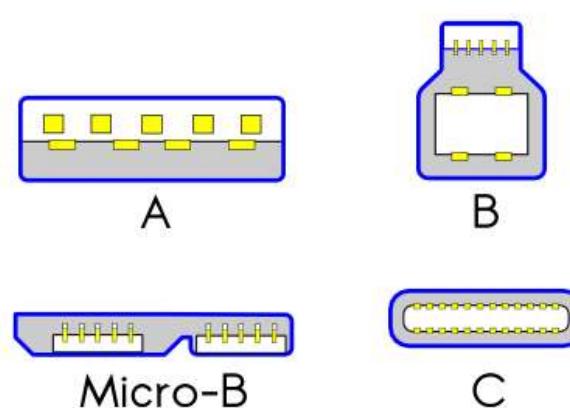
# Interfaces - USB

- Universal Serial Bus is the prevalent peripheral bus used today
- There are lots of different plugs:

USB 1.0 - 2.0



USB 3.0 - 3.1

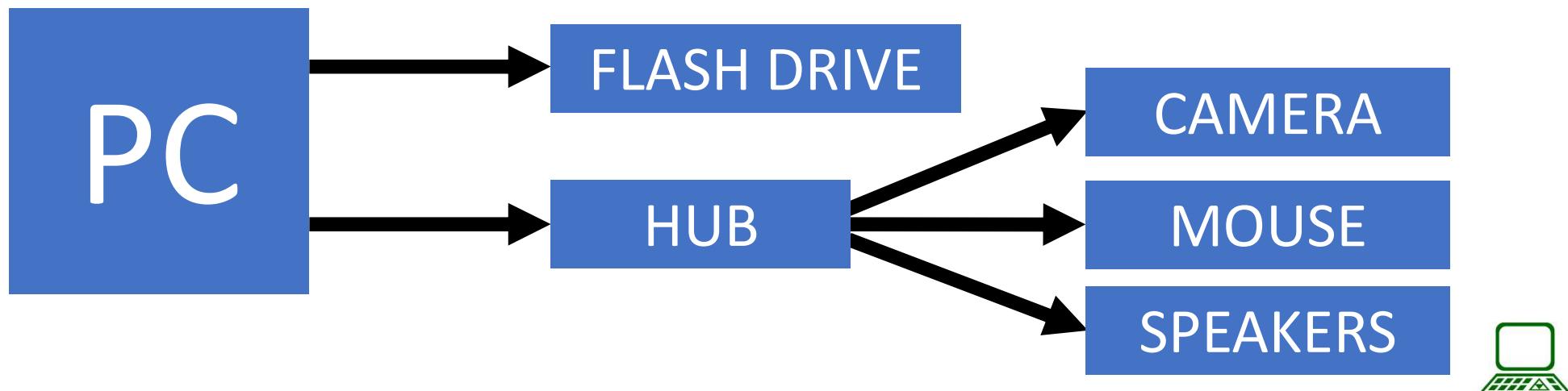


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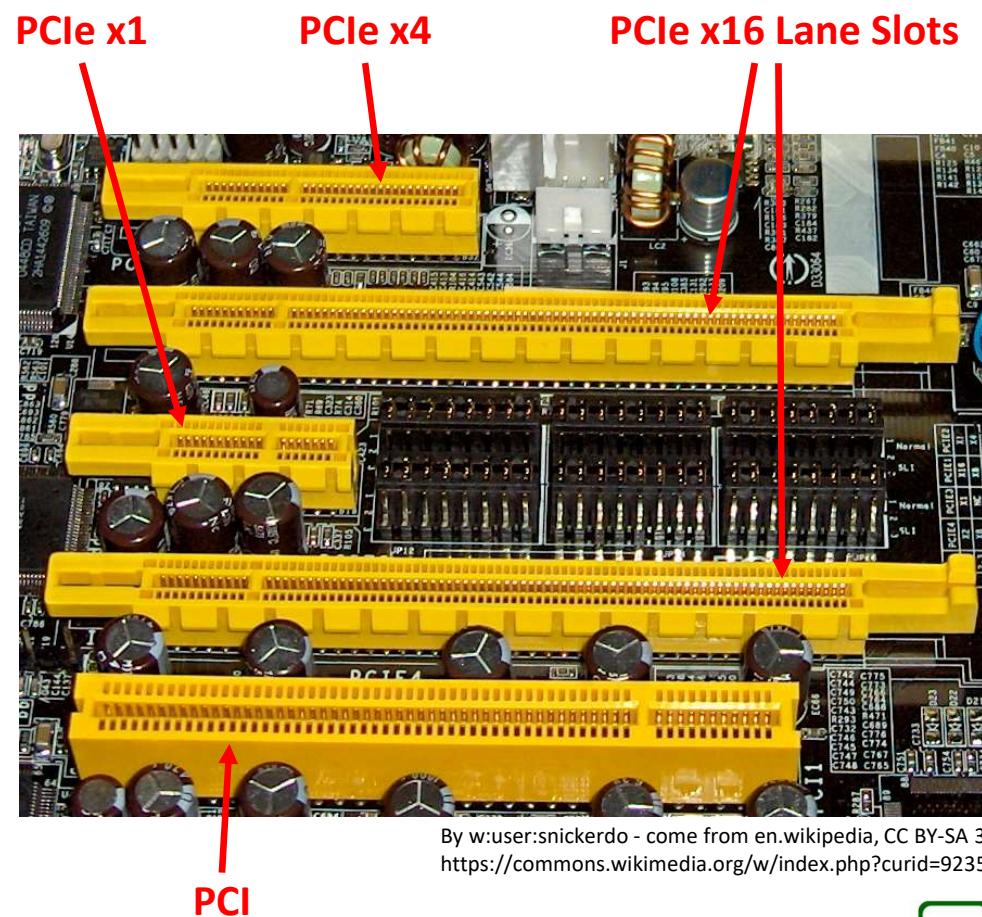
# Interfaces - USB

- USB connections are directed, such that one host device is all the way upstream, while other devices connect in a tree graph
- Power is provided via USB and can only flow downstream: peripherals cannot power the host or upstream devices
- Powered Hubs can often provide more power than the host can



# Interfaces - PCI

- ISA gave way to PCI, which has given way to PCI Express (PCIe)
- PCIe is a serial computer expansion bus standard used in all modern PCs to connect devices requiring high speed data transfer
  - Some flash-based hard drives
  - Video cards
  - High-speed network adaptors (10Gb)
- Organized as a serial hierarchical network like USB(!)

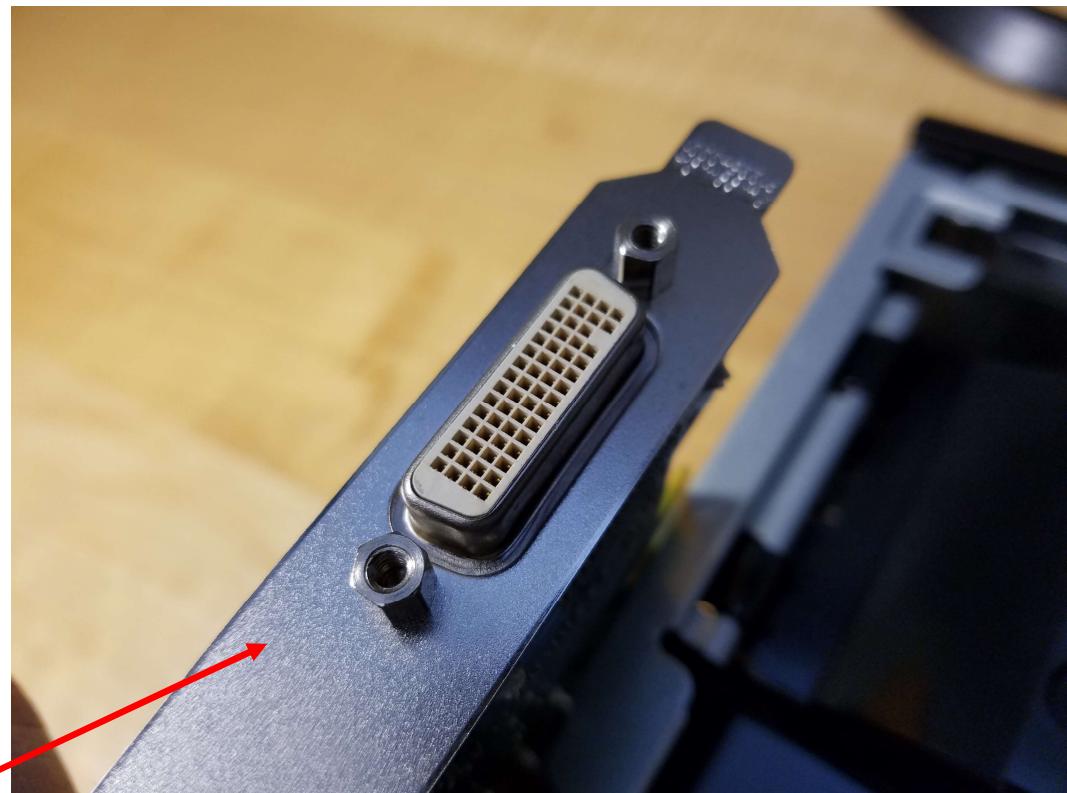


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# Interfaces - Video

- Video interface connectors change frequently! The current common jacks are HDMI, DVI, and VGA
- Ubiquitous digital HDMI supports up to  $10240 \times 4320 @ 120\text{Hz}$ , while DVI supports up to  $2560 \times 1600 @ 60\text{Hz}$
- Old-school analog VGA supports up to  $2048 \times 1536 @ 85\text{Hz}$
- Our HP Z230 uses a connector called DMS-59, which uses an adapter cable to split off and provide two DVI-I interface jacks at once

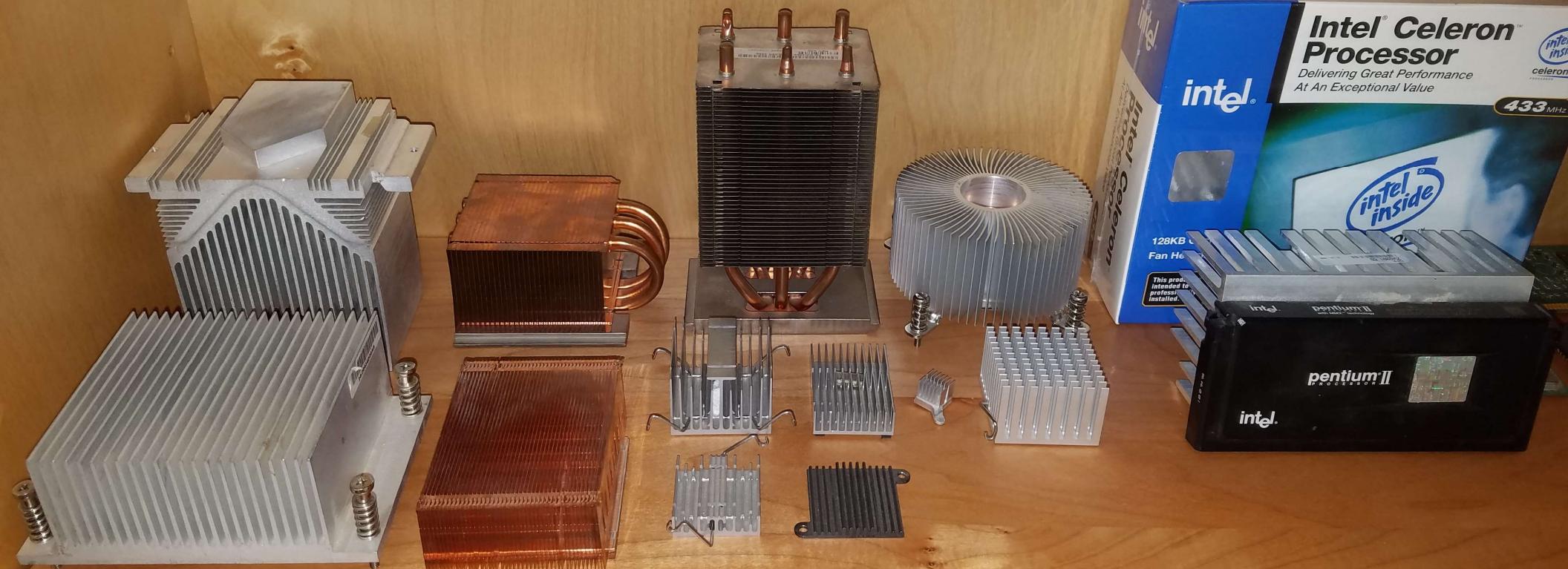


# Cooling Systems

- Computer components must have a way to dispose of waste heat, or they will burn up
- Active cooling fans pull air across the fins of heatsinks attached directly to hot components such as the CPU, PSU, GPU, drives, and MOBO chipset
- Heat may also be transferred via heatpipes, liquid cooling, and even submersion



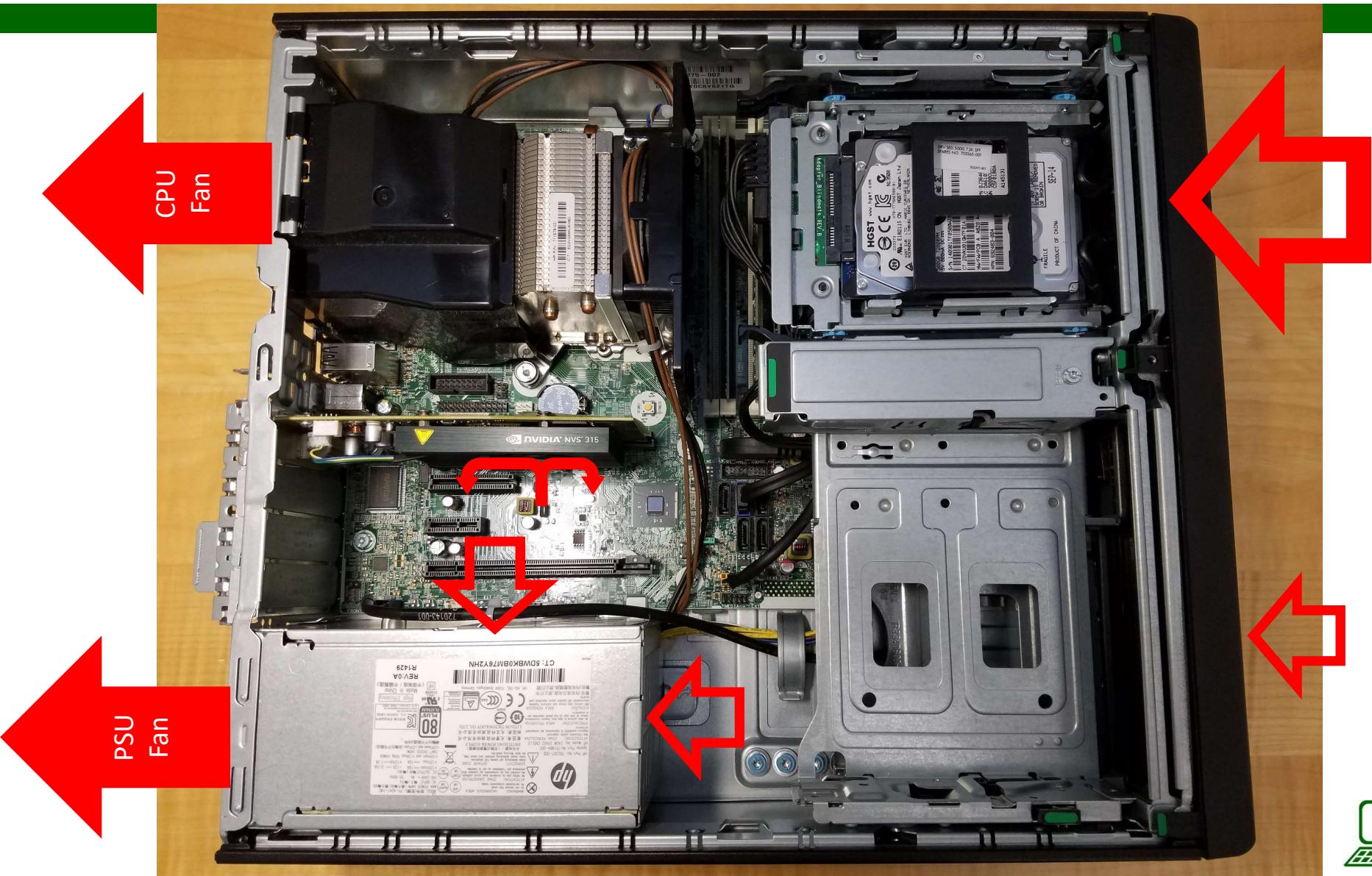
# HEATSINKS



HEATSINKS

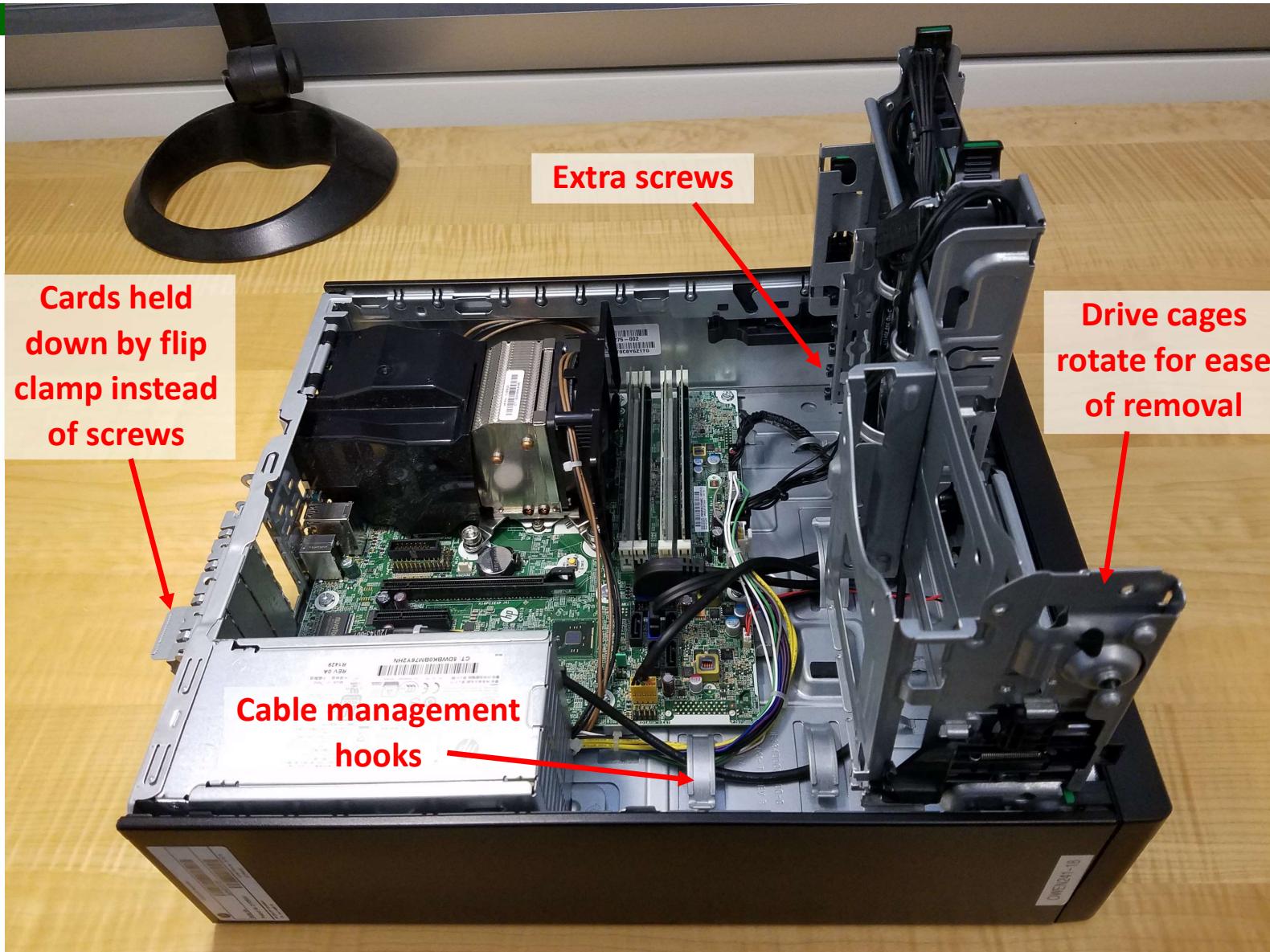


# Airflow in HP Z230



# Cases

- A good case holds all the components safely, facilitates cooling, and provides for easy maintenance
- The HP Z230 is a Small Form Factor (SFF) case



# Conclusion

- Computer parts are always changing
- New components have a high extra margin of cost on them compared to the previous generation
- Identifying different types of components comes with exposure and experience
- Check out <https://pcpartpicker.com/>
  - It's awesome

