VIRTUALIZATION AND CLOUD PLATFORMS

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Module 1
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UC San Diego

ATTRIBUTION

- These slides incorporate material from:
  - Michael Freedman and Kyle Jamieson, Princeton University (also under a CC BY-NC-SA 3.0 Creative Commons license)
  - Andrew Moore, Univ. of Cambridge
  - The Datacenter as a Computer: An Introduction to the Design of Warehouse-Scale Machines, 2nd ed., by Barroso, Clidaras, and Hölzle

IBM CP/40: FIRST VIRTUAL MACHINE SYSTEM

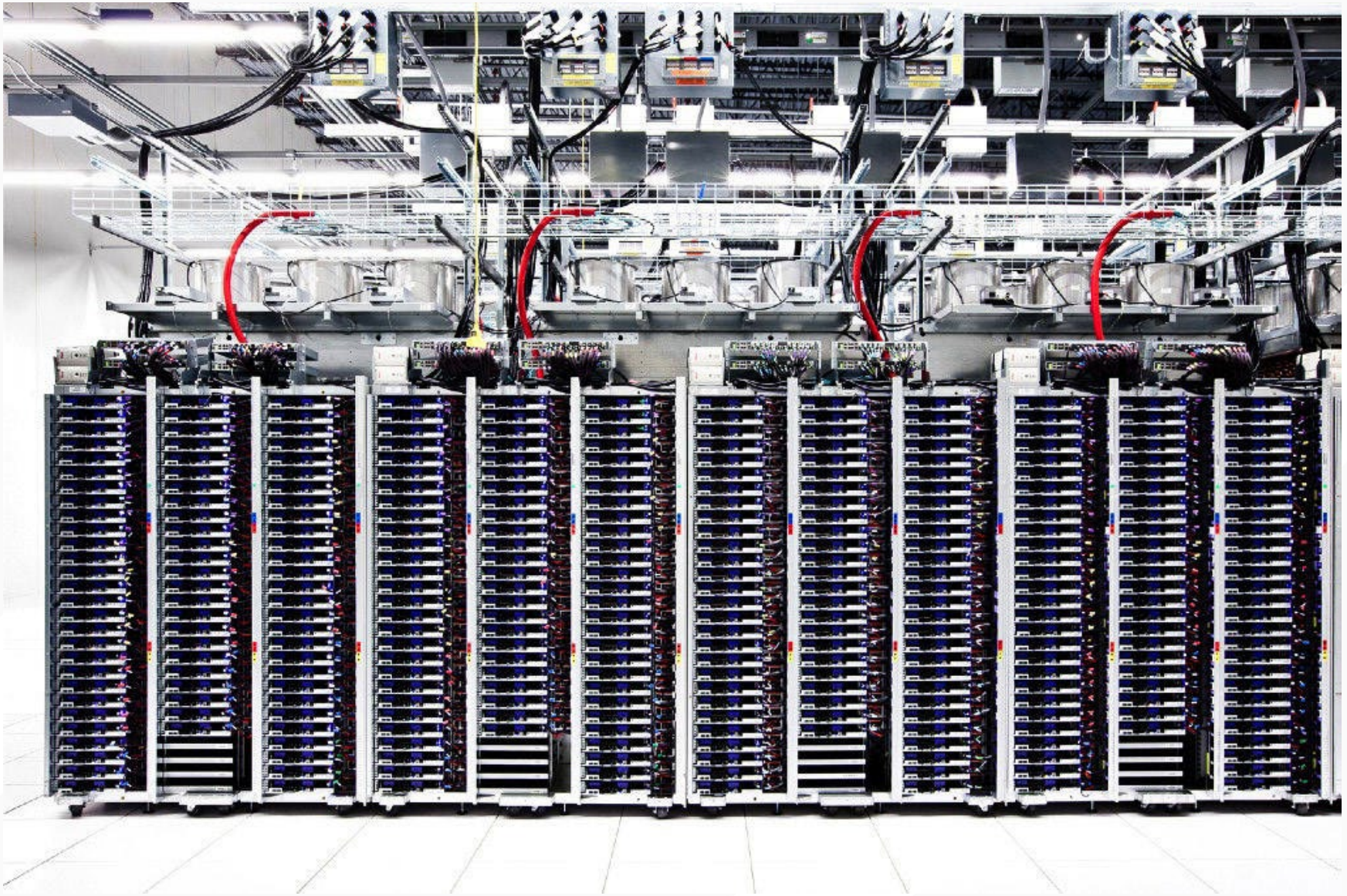
IBM S/370 – 1ST COMMERCIAL "CLOUD COMPUTING"

DATACENTERS ARE NOT EXACTLY NEW…

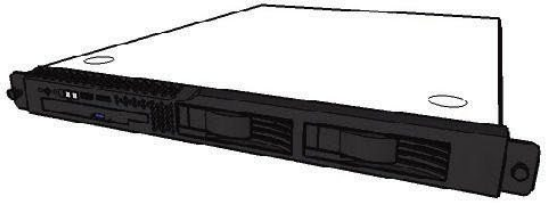
EDSAC, 1949

“ROWS” OF SERVERS IN A DATACENTER

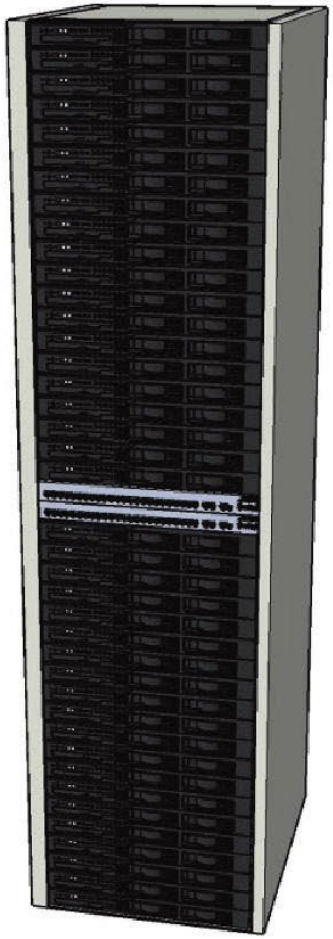
“RACKS” MAKING UP ONE ROW



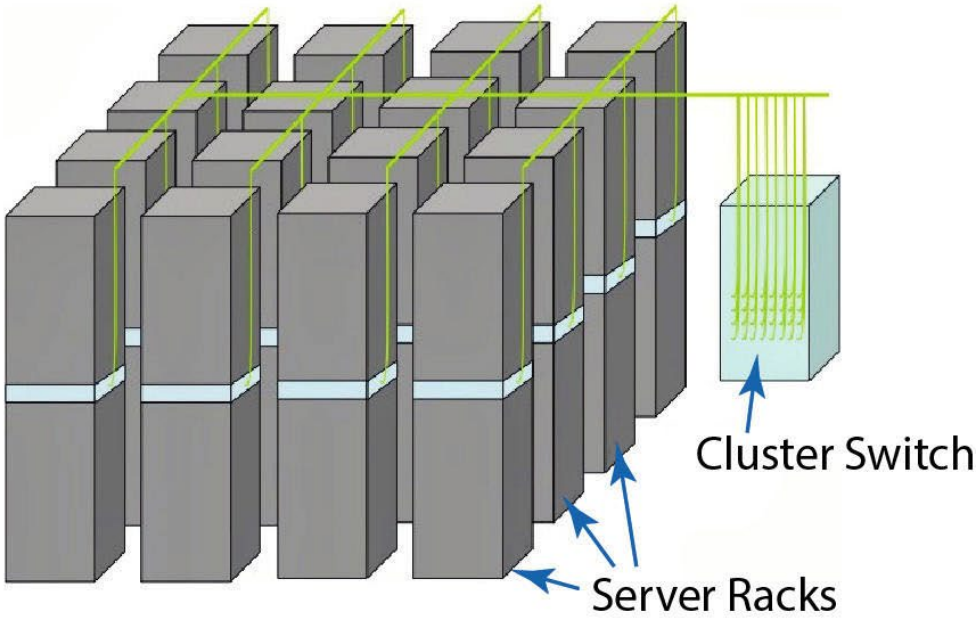
BUILDING BLOCKS OF MODERN DATA CENTERS



Network switch

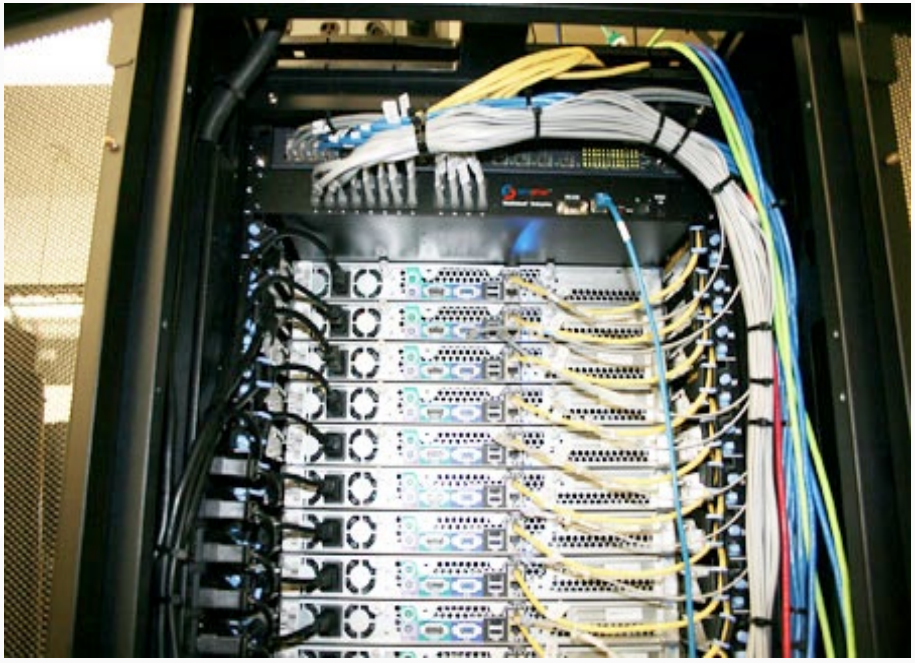


Rack



A SINGLE RACK

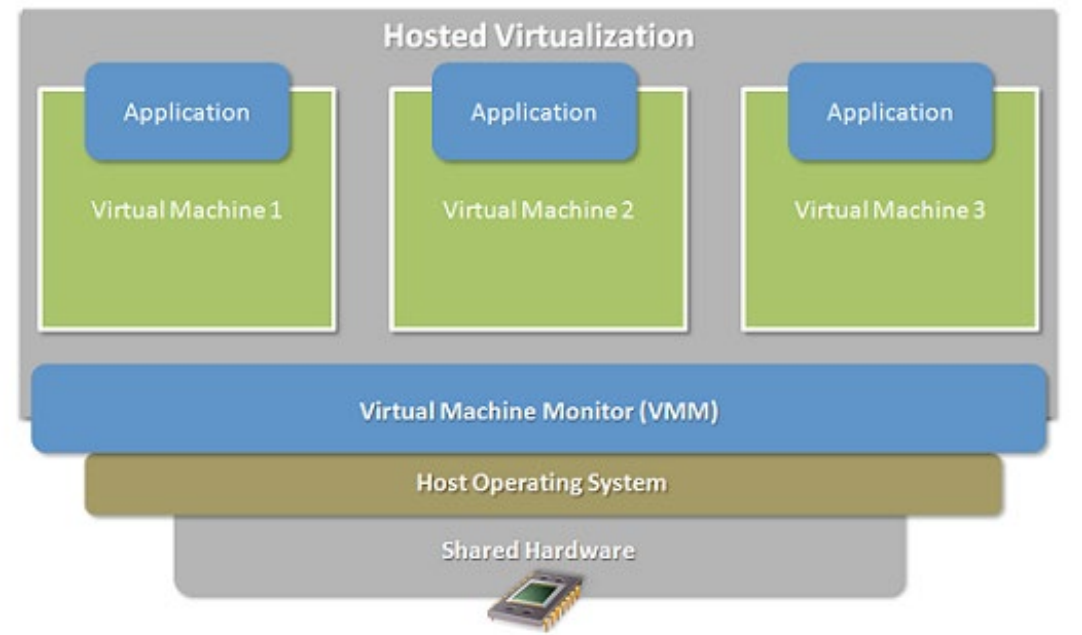
- 20-40 “pizza box” servers per rack
- Each rack has a “top of rack” network switch that connects it to the rest of the datacenter network



WHAT IS A VIRTUAL MACHINE?

- Depends on what you are virtualizing
- VirtualBox/VMWare/XEN/etc
  - X86 instruction set
- Java JVM
  - A fictitious “java virtual machine”
- Amazon EC2
  - Linux “servers” hosted in the Amazon cloud
  - Many “VMs” run on a single physical server

HOST VIRTUALIZATION



- Multiple virtual machines on one physical machine
- Applications run unmodified as on real machine
- VM can migrate from one computer to another

Julia Evans
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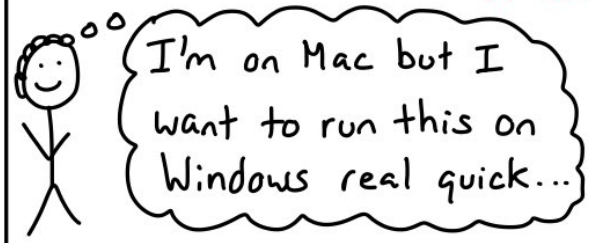
virtual machines

Virtual machines let you run many operating systems at the same time

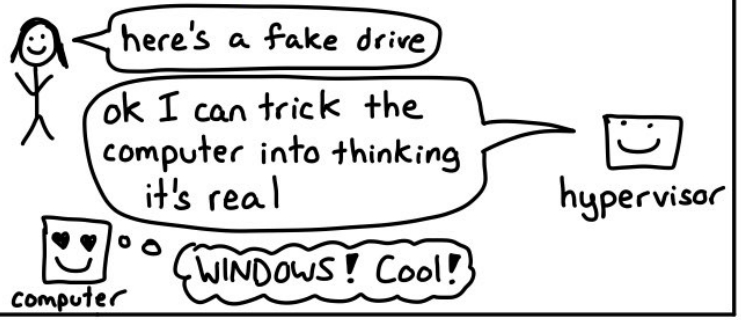


how VMs work (EXTREMELY condensed)

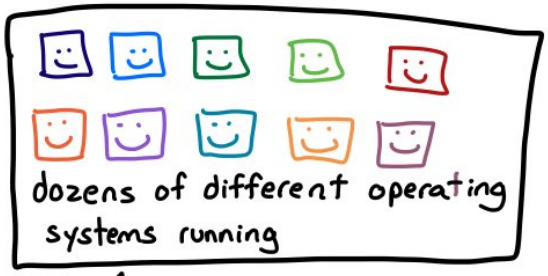
step 1: make a fake hard drive

5GB file that's an exact copy of a drive with Windows installed

step 2: tell your computer to pretend it's a real HD

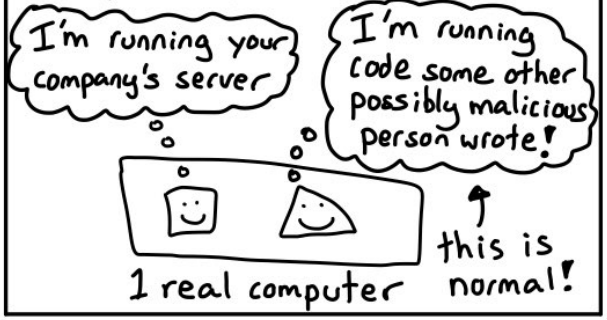


the "cloud" is made of virtual machines



1 real computer

virtual machines are totally isolated from each other



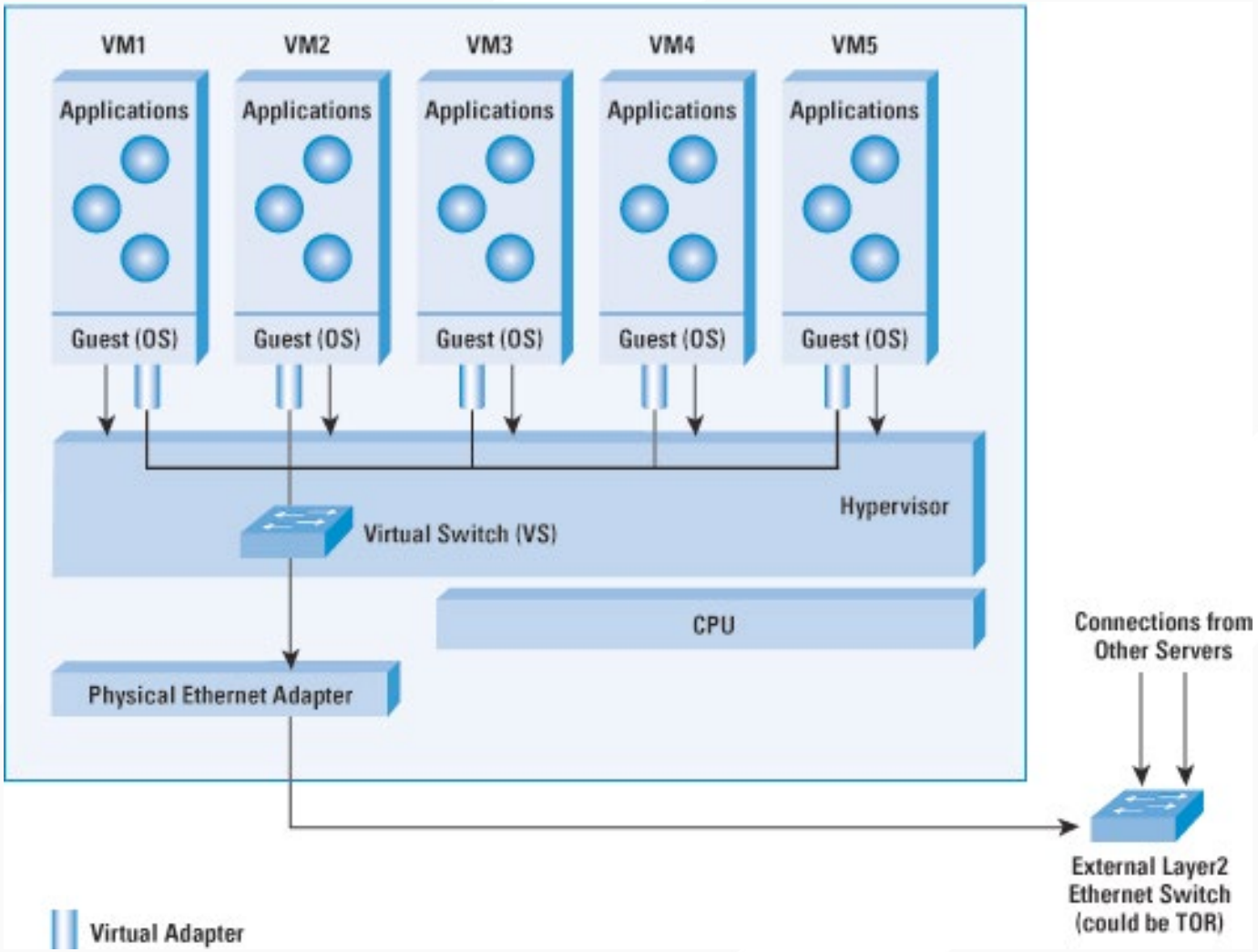
1 real computer

a hypervisor manages all the virtual machines

it:

- makes fake network devices
- gives each VM the right amount of RAM
- controls access to the hard drive and other hardware
- makes sure each VM gets its turn on the CPU

VMM VIRTUAL SWITCHES



MANY TYPES OF VMS

Family	Type	vCPUs	Memory (GiB)	Instance Storage (GB)	EBS-Optimized Available	Network Performance	IPv6 Support
General purpose	t2.nano	1	0.5	EBS only	-	Low to Moderate	Yes
General purpose	t2.micro Free tier eligible	1	1	EBS only	-	Low to Moderate	Yes
General purpose	t2.small	1	2	EBS only	-	Low to Moderate	Yes
General purpose	t2.medium	2	4	EBS only	-	Low to Moderate	Yes
General purpose	t2.large	2	8	EBS only	-	Low to Moderate	Yes
General purpose	t2.xlarge	4	16	EBS only	-	Moderate	Yes
General purpose	t2.2xlarge	8	32	EBS only	-	Moderate	Yes
General purpose	t3a.nano	2	0.5	EBS only	Yes	Up to 5 Gigabit	Yes
General purpose	t3a.micro	2	1	EBS only	Yes	Up to 5 Gigabit	Yes
General purpose	t3a.small	2	2	EBS only	Yes	Up to 5 Gigabit	Yes
General purpose	t3a.medium	2	4	EBS only	Yes	Up to 5 Gigabit	Yes
General purpose	t3a.large	2	8	EBS only	Yes	Up to 5 Gigabit	Yes
General purpose	t3a.xlarge	4	16	EBS only	Yes	Up to 5 Gigabit	Yes
General purpose	t3a.2xlarge	8	32	EBS only	Yes	Up to 5 Gigabit	Yes
General purpose	t3.nano	2	0.5	EBS only	Yes	Up to 5 Gigabit	Yes
General purpose	t3.micro	2	1	EBS only	Yes	Up to 5 Gigabit	Yes
General purpose	t3.small	2	2	EBS only	Yes	Up to 5 Gigabit	Yes
General purpose	t3.medium	2	4	EBS only	Yes	Up to 5 Gigabit	Yes
General purpose	t3.large	2	8	EBS only	Yes	Up to 5 Gigabit	Yes
General purpose	t3.xlarge	4	16	EBS only	Yes	Up to 5 Gigabit	Yes
General purpose	t3.2xlarge	8	32	EBS only	Yes	Up to 5 Gigabit	Yes
General purpose	t4g.nano	2	0.5	EBS only	Yes	Up to 5 Gigabit	Yes

SOME REALLY POWERFUL!

	Family	Type	vCPUs	Memory (GiB)
☐	Memory optimized	x1e.32xlarge	128	3904
☐	Memory optimized	x1e.16xlarge	64	1952
☐	Memory optimized	x1.32xlarge	128	1952
☐	Memory optimized	x1e.8xlarge	32	976
☐	Memory optimized	x1.16xlarge	64	976
☐	Memory optimized	r5.metal	96	768
☐	Memory optimized	r5.24xlarge	96	768

- Can include GPUs as well for machine learning workloads

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