Why should I take this course?

①

Why should I care about cloud?

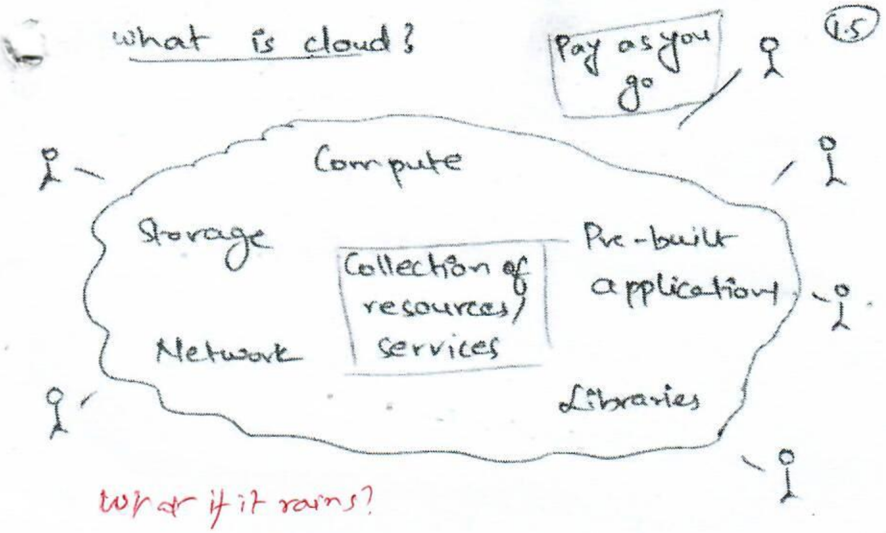
virtualization?

rust?

1

what is cloud?

1.5



what if it rains?

why cloud?

①

Don't want to manage resources

∴ Hardware faults are common

Assume your laptop crashes after 5 years ≈ 1800 days

If you've 200 of them, one is crashing 9 days

Why cloud? Elasticity 2m

- My ~~blog~~ memes app today got very popular

  100 → 100,000 users

- laptop crashed. my chance of becoming popular is missed.

- Solution: use 1,000 laptops. · High upfront cost

Why cloud? Provides fault tolerance 3m

- Doesn't lose data even when individual disks might fail

- Moves your computation to other machine if CPU overheats and dies.

→ AWS SLA ←

1

- Downtime is expensive > $1M/hour
  - Crashed server
  - Disconnected wifi/electricity
  - Tornado / Earthquake
- Loss of trust
  - Bank lost last 100 transactions

Why cloud? Proximity 1m

My memes app is getting popular in Canada.

- Ping time ≈ 300 ms
- Every 100 ms delay drops 7% users
- Rent a VM next door to user ≈ 20ms

→ Region-wise ping times ←

Virtualization ①

What?
- Act of "virtualizing" physical resources

Why?
relavance to cloud

Challenges?

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③

Investment

$\xrightarrow{\text{20yrs}}$ sell

- Management, security overhead

Buy virtual gold: Gold bonds

GOLD 10g
Govt INDIA

back to VMs ②

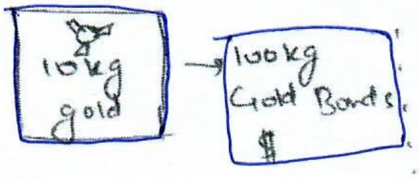
Why? (Buyer)

- No management
- Little upfront cost
- Elasticity
- Trusted

- DDos attac
- Power outage
- Earthquak
- SW update

Why? (Seller) ②

- Overprovision

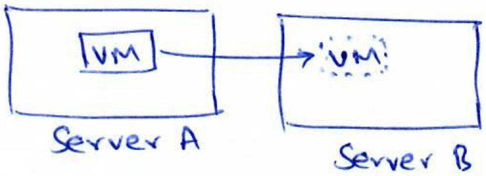


- Anyways buyi physical resources for self
  - Amazon, Google
- Rent unused.
- Incremental mgmt overhea

Virtualization supports cloud (1) ②

- Live migration / checkpoint-restore

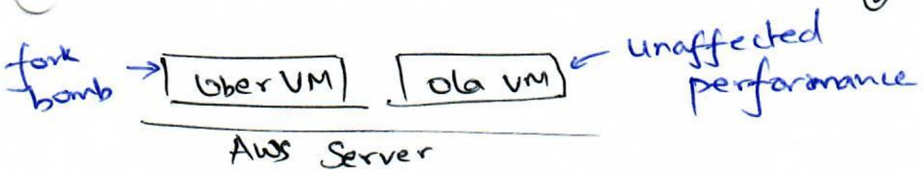
zero downtime



- Load balancing
- Management: restart/upgrade server A
- Proximity. (supercomputers)

- * Strong Isolation (even performance)

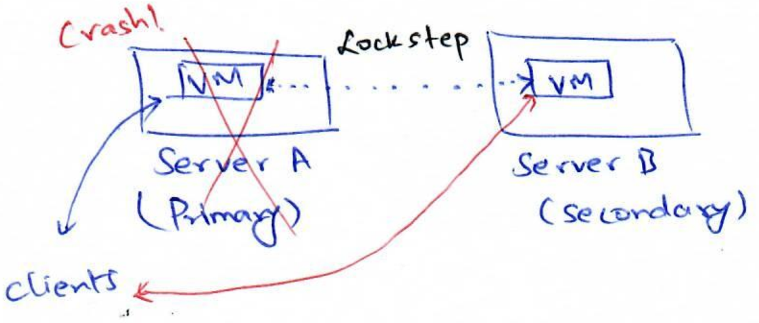
②



- * Auditting/monitoring/intrusion analysis
  - What all did the VM do?

②

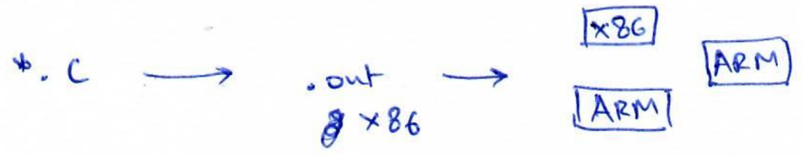
State machine replication



Fault tolerance!

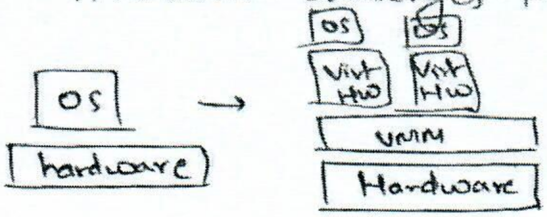
②

- Binary from one architecture can run on another



- Diversified placement
- Support legacy software

Virtualization challenges: Feasability ②



- Zero/minimal modification to OS, apps (OS thinks it owns H/W
- Performance

What's new? ⑫

Traditional. IaaS - Rent VMs

1 How many VM?

Dropping requests — Idle ⇒ losing money

Too few ⟷ Too many

Sophisticated capacity planning, elasticity

New cloud. ①

FaaS: specify functions, triggers

: Auto scaling

: Do not pay when function is not running

>AWS Pricing<

New challenges: fast boot, dynamic provisioning, sharing data, etc

Pricing comparison

③

* FaaS. Mobile application backend

$2.33

* IaaS. a1.medium → 0.0255/hr * 24*30

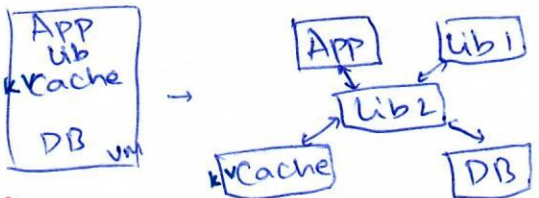
= $18.36

* Ignoring data transfer/storage costs

What's new (2)

②

Monolithic → Microservices



Can we improve performance?
Specialize for one workload?

- Scale independently
- Different fault tolerance properties ⇒ crash lib, can't crash DB

Why take this course?

1.5

1 You'll work with cloud

- Startup: using cloud infra
- (Personal projects)
- AWS / Google / Azure: Managing
- ML experiments
- Research: interesting problems

2. Hands on virtualization: beautiful history

3. Study real systems → firecracker

Highly collaborative project ①

- Collaboration is hard
⇒ GIT, CI/CD, PRs, unit tests

- Design is hard ⇒ Interfaces/abstraction
  but fun

- Real end-to-end product

Why rust? ②

- Fastest growing language "most-loved" according to stack overflow
- Fast. Systems language C/C++
- Automatic memory management Java/Python/Go without GC
- Modern paradigms: Iterators, closures
- Safe: no null pointers, no double mutation, no pointer arithmetic