Lecture 15 — CS695

- A2 marks / eval on moodle.
- A3 is available (28th March 2024)
- 3b. will be added shortly.
- & A4

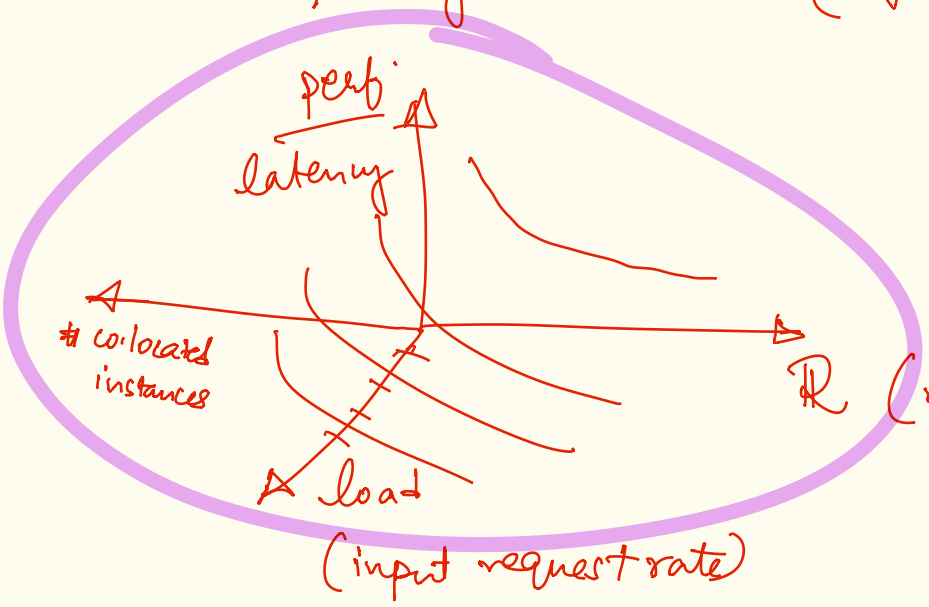
* resource mgmt. mechanisms + policies
orchestration

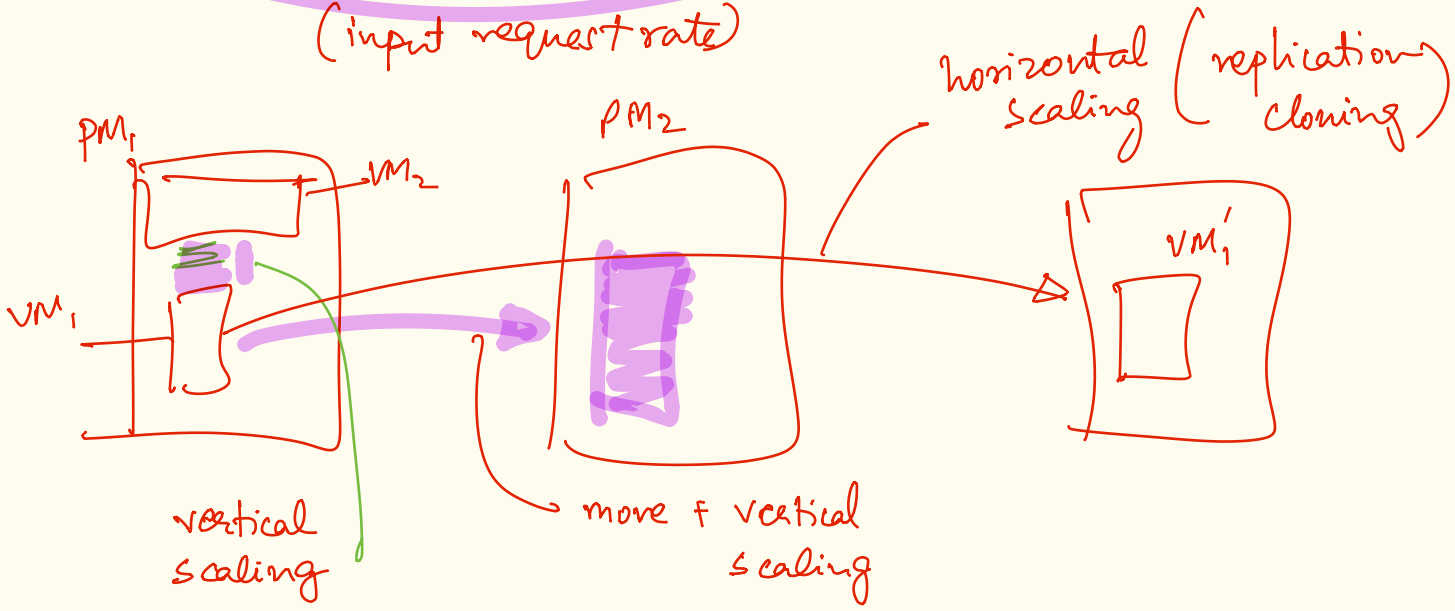
[mem mgmt]
[sandpiper]

- ballooning
- migration

[live migration]
[remus]
[snowflock]

manage cluster resources to meet SLAs w/ dynamic workloads (dynamic resource requirements)





sandpiper

(i) measurements & profiling

(ii) hotspot detection

(iii) resolution via migration
ballooning &

black box vs gray box

⇒ work-conserving

→ if work & if resource do work.!

gray-box.

$\lambda_{cap} \propto \frac{1}{\mu}$ ← service time

$\lambda_{peak} > 2 * \lambda_{cap}$

↑ 1 cpu

2 cpus

Q. how much resources to add/change?

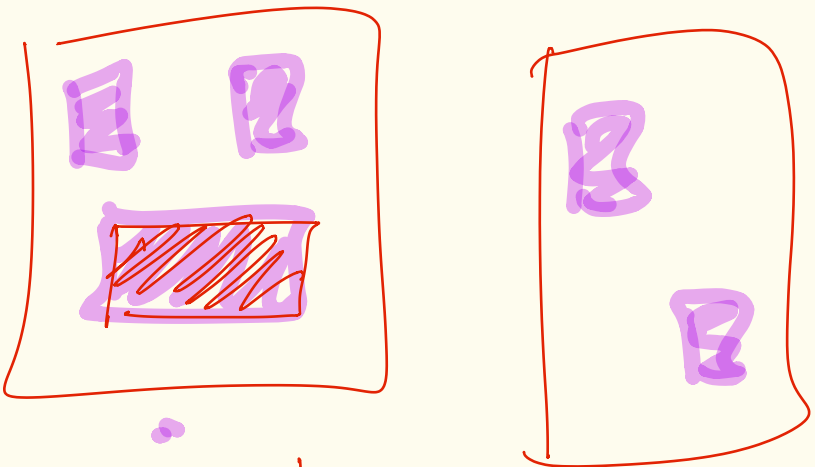
- feedback control loop
- lookup perf. to resource profile table (measurement)
- performance models

$\phi = f(\mathbb{R}, \mathbb{C})$

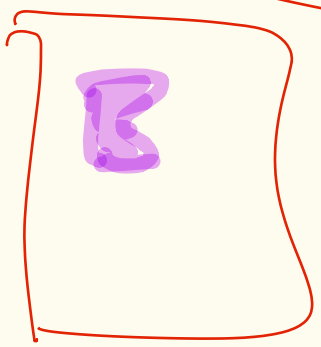
↓

resources, configurations, load levels

Q. which VM to migrate?
where to migrate?



$$Vol = \frac{1}{1-cpu} \times \frac{1}{1-mem} \times \frac{1}{1-nw\ util.}$$



volume to size ratio

heuristic:
move VM with highest VSR to least loaded PM.

(*) where to migrate / ? where to place?

⇒ the placement problem (generalized version).

— Knapsack / bin-packing (multi-dimensional).

$V = \{v_i\}$ v_i — v_m. # i

$v_i = \{r_{ij}\}$ r_{ij} — resource req. of vm_i on res. j.

$\mathcal{C} = \{c_i\}$ — capacity of i^{th} PM.

place V on $\mathcal{C}$ s.t. some objective fn. is met.

- least physical machines used
- highest slack
- balanced load / allocation

(*) NP-Hard

Exponential search space.

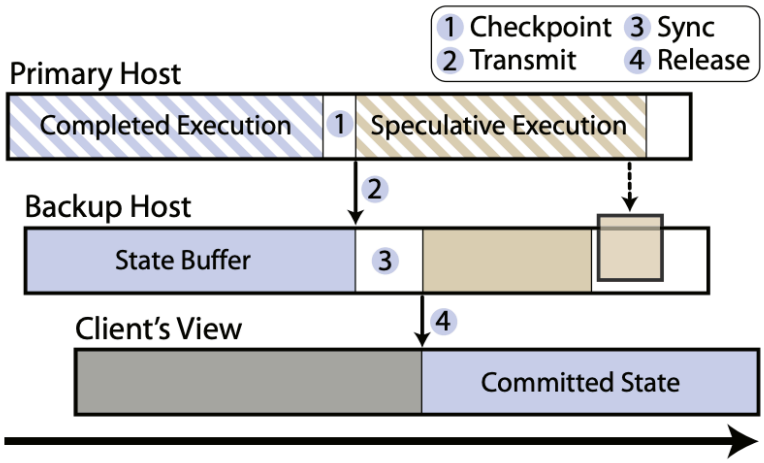


Figure 1: Speculative execution and asynchronous replication in Remus.

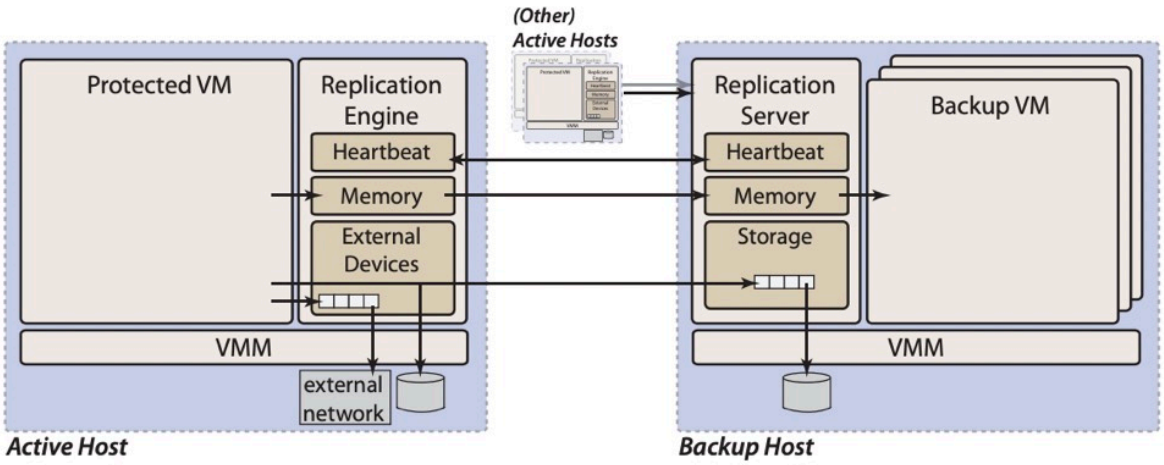


Figure 2: Remus: High-Level Architecture

[remus] — ~~Replication~~ High Availability via Asynchronous VM Replication.

NSDI 2008

HA — high availability (2009?)

- failure handling (HA as a service / HA for the masses)
- ⇒ appl'n service is "available" for service
  - ⇒ at all / most times