Data Parallelism – Part 2

Comprehensive Review

DSC 208R – Parallel Data Processing and the Cloud

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1 Motivation

Large scale data applications often rent compute in the cloud. The slides note that fixed bundles of CPUs, memory, and storage can waste resources when an application needs only some of them. The industry answer is newer renting paradigms such as serverless Function as a Service (FaaS).:contentReference[oaicite:0]index=0

2 Serverless Paradigm

- User uploads a function plus a resource hint (CPU and DRAM).
- Cloud provider hides all provisioning and autoscaling.
- Reported cost savings can reach 10x compared to spot instances.:contentReference[oaicite:1]index=

Serverless keeps the shared nothing mindset: each function call is isolated, pulls data as needed, and scales horizontally.

Car Analogy

The slides compare serverless to ride sharing: no need to buy or maintain a car; pay only for miles driven. Similarly, serverless users pay only for milliseconds of compute.

3 Example Services

1. **AWS Athena** – serverless SQL querying over S3 (schema on read).:contentReference[oaicite:2]ind
2. **AWS SageMaker plus Data Lake** – serverless ML training and prediction.:contentReference[oaicite:3]index=3
3. **AWS IoT stack** – edge devices stream data to a serverless pipeline that does inference with SageMaker Neo.:contentReference[oaicite:4]index=4

4 Resource Disaggregation

Future clouds may fully disaggregate compute, memory, and storage: every resource is network attached and can be added or removed on demand. The slides show a diagram where new memory and CPUs are hot plugged to speed up ongoing jobs. Research aims to make such elasticity low latency.:contentReference[oaicite:5]index=5

Figure 1: All resources network attached and elastic.

5 Is All This Complexity Worth It?

Cloud advantages: manageability, pay as you go cost, rapid elasticity. Cloud disadvantages listed in the slides:contentReference[oaicite:6]index=6

- API and license complexity; need for dedicated CloudOps teams.
- Long term cost may exceed on premise clusters.
- Easy to waste money accidentally by leaving services running.
- Vendor lock in, privacy, security, and governance risks.
- Dependence on public internet and provider uptime (example 2015 AWS outage).

Hybrid clouds remain common in enterprises, health care, and academia.

6 Cloud Adoption Surveys

Flexera State of the Cloud surveys indicate the following trends:contentReference[oaicite:7]index=7

- Public cloud spend continues to rise year over year.
- Many organizations use multi cloud strategies.
- Top challenges: controlling cost and managing cloud spend.

7 Pros and Cons Summary

- **Pros**
  - Pay only for what you use.
  - No cluster maintenance.
  - Rapid scale up and down.
- **Cons**
  - Complex API landscape.
  - Potentially higher long term cost.
  - Risk of lock in and outages.

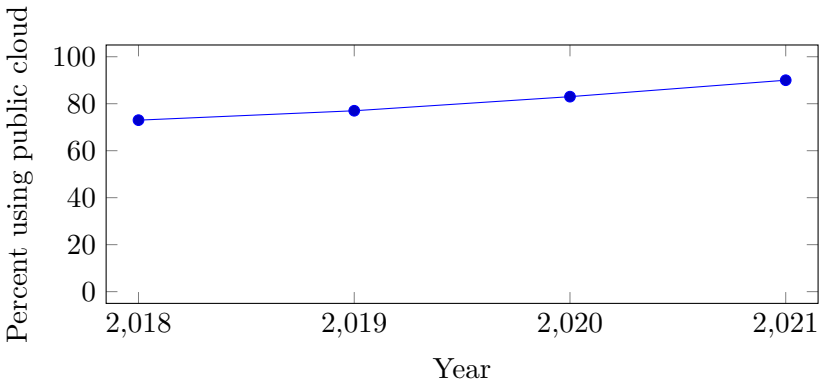

Figure 2: Survey trend of public cloud adoption (illustrative).

8 Future Directions

- Fully disaggregated clouds with sub second elasticity.
- Better cost observability and automatic budget guards.
- Cross vendor orchestration to ease lock in concerns.

Conclusion

Data parallel workloads drive demand for flexible cloud resources. Serverless and emerging disaggregation promise fine grained scaling and cost savings, but add complexity and new failure modes. Understanding the trade offs is key when choosing between on premise, hybrid, and cloud native architectures.:contentReference[oaicite:8]index=8