CLOUD COMPUTING APPLICATIONS

CLOUDONOMICS: PART 2

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Cloudonomics: Part 2

Economics necessitates Cloud Computing:

- Part 1: Utility Pricing
- Part 2: Benefits Common Infrastructure

See other details and benefits in

“Cloudonomics: A Rigorous Approach to Cloud Benefit Quantification,” Joe Weinman

https://www.csiac.org/sites/default/files/journal_files/stn14_4.pdf

The Value of Common Infrastructure

- For infrastructure built to peak requirements: Multiplexing demand → higher utilization
  - Lower cost per delivered resource than unconsolidated workloads
- For infrastructure built to less than peak: Multiplexing demand → reduce the unserved demand
  - Lower loss of revenue or a Service-Level agreement violation payout

A Useful Measure of “Smoothness”

The coefficient of variation:

$$C_v = \frac{\text{standard deviation } \sigma}{\text{mean } |\mu|}$$

C_v is a measure of smoothness

- small is smooth!
- large mean and/or smaller standard deviation

Implications of “Smoothness”

- A fixed-asset facility servicing highly variable jobs yields low utilization
- Same facility servicing smooth jobs yields high utilization
- **Multiplexing jobs with different distributions may reduce the coefficient of variation C_V**

Case Study of C_V for Independent Jobs

- X_1, X_n,…, X_n independent jobs with standard variation σ and mean μ
- Aggregated jobs
  - Mean → sum of means: $n.\ \mu$
  - Variance → sum of variances: $n.\sigma^2$
  - Aggregate C_v→ $\frac{\sqrt{n}.\sigma}{n.\mu} = \frac{\sigma}{\sqrt{n}.\mu} = \frac{1}{\sqrt{n}} C_v$

Case Study of C_V for Independent Jobs

Adding *n* independent jobs reduces C_v by $1/\sqrt{n}$

- Penalty of insufficient/excess resources grows smaller
- Aggregating 100 workloads brings the penalty to 10%

Case Study of C_V for Correlated Jobs

- Best Case: Negative correlation
  - Optimal packing of customer jobs
  - X and 1-X → Sum is 1, $C_v = 0$
  - Optimally smooth, best CPU utilization

- Worst Case: Positive correlation
  - Mean: n.μ(X), standard deviation: n.σ(X)
  - Aggregate $C_v = C_v(X) = \frac{\sigma(X)}{\mu(X)}$
  - Which isn't smoother!

Results from Theory

- Negative-correlated jobs
  - Private, mid-size, and large-size providers can experience similar statistics of scale
- Independent jobs
  - Mid-size providers can achieve similar statistical economies to an infinitely large provider

Common Infrastructure in Real World

- Available data on economy of scale for large providers is mixed
  - Use the same COTS computers and components
  - Locate near cheap power supplies → everyone can do that
  - Early entrant automation tools → 3rd parties take care of it
- Takeaway lesson: you don’t need to be as large as Amazon.com to compete! ☺
  - At least according to “Value of Common Infrastructure”