

# CS553 Project:

## Understanding the Cost of Computing in the Cloud

---

### Instructions:

- **Due date: 11:59PM on Tuesday, 11/21/17**
- **Maximum Points: 100%**
- *This assignment can be done in groups of up to 3 students*
- *Please post your questions to the Piazza forum.*
- *Only a softcopy submission is required; it must be submitted to "Digital Drop Box" on Blackboard.*
- *For all assignments, please submit just the softcopy; submit your report in PDF format to BB.*
- *Name your file as this rule: "PROG#\_LASTNAME1\_LASTNAME2\_LASTNAME3.tgz". E.g. "Proj2\_Raicu\_Peng\_Mathew.tgz".*
- *Late submission will be penalized at 20% per day (beyond the 4-day late pass).*

### 1. Introduction

You are hired by a startup company who is considering to use cloud computing instead of building its own infrastructure. There is consensus that a cloud computing software stack at the layer of IaaS will be used, but it's not clear whether the computing resources should be rented from a public cloud on-demand, or whether a private cloud should be purchased. You are tasked to find the cost breakdown of a private cloud, and compare that to what Amazon would charge. You can find many instance types defined at <http://aws.amazon.com/ec2/instance-types/>, and their prices are set at <http://aws.amazon.com/ec2/pricing/>. For pricing purposes, please stick to Linux on-demand pricing.

Since you have to estimate the cost of the hardware when building a private cloud, you can use hardware prices found at Dell (<http://www.dell.com/p/enterprise-products.aspx?c=ae&l=en&s=bsd&~ck=mn>), AcmeMicro (<http://www.acmemicro.com>), or Pogolinux (<http://www.pogolinux.com>) as good sources for server hardware. If you cannot find some particular hardware here, please cite whatever site you find where you obtained the pricing information. You must include a printout of your shopping cart in your final writeup report for this assignment; include this as an appendix at the end of your report.

You are to estimate the cost of different configurations for 3 different sets of requirements:

- Configuration 1: Hadoop/Spark Cluster with 32K-cores, 256TB memory, 50PB HDD, and 10Gb/s Ethernet Fat-Tree network (each VM should be equivalent to the d2.8xlarge instance); in addition to the compute resources, a 100PB distributed storage shared across the entire cloud should be procured, with enough capacity for 100GB/sec throughput (for pricing comparison, see S3)
- Configuration 2: Support 1 million virtual machines (VM) where each VM requires 2-core, 15GB RAM, 32GB SSD storage, and 1Gb/s Fat-Tree network (each VM should be equivalent to the r3.large instances); in addition to the compute resources, a 10PB distributed storage shared across the entire cloud should be procured, with enough capacity for 10GB/sec throughput (for pricing comparison, see S3)
- Configuration 3: Support deep learning with 1 exaflop of mixed precision performance (hint: each VM should be equivalent to p3.16xlarge instances; you will want to use the NVIDIA V100 GPUs (8 GPUs per node), and allocate 8-cores per GPU (64-cores per node) with 8GB of memory per core (512GB per node); the network to use is at least 10Gb/s per GPU (100Gb/s should work), and should be organized in a Fat-Tree network; in addition to the compute resources, a 1PB distributed storage shared across the entire cloud should be procured, with enough capacity for 10GB/sec throughput (for pricing comparison, see S3)

## 2. What you will submit?

Your deliverables for this project are to be written in a report, which will include the following:

- Compare the costs of the 3 different configurations between the public cloud (Amazon AWS) and the private cloud
  - you may assume a 5 year amortization cost
  - you will have to factor in things other than hardware, such as cooling, power, administration costs, network infrastructure (e.g. switches); you can assume 1 system administrator is needed for every 1000 servers
  - show your data in three different tables with the costs of each of the 3 configurations, broken down by components (e.g. servers, network switches, cables, racks, cooling, power, administration, etc)
  - summarize your data in a 4<sup>th</sup> table, comparing the public cloud cost to the private cloud cost
- Explain in words if it is better to rent or buy. If it is better to buy, what utilization must you maintain over the 5 year lifetime of the private cloud in order to break even on the investment?

*Table 1: Table summarizing each of the three configurations; please include 1 table per configuration, for a total of 3 tables*

	Description	Price per Item	Quantity	Total Price
Compute Servers				
Network Switches				
Network Cables				
Racks				
Storage Servers				
Electric Power				
Cooling				
Administration				
TOTAL	N/A	N/A	N/A	

*Table 2: Summary table comparing the 3 configurations between the public and private cloud; your cost of power, cooling, and administration should be to cover 5 years of costs*

	Configuration 1	Configuration 2	Configuration 3
Public Cloud (including EC2 and S3) Cost over 5 years, 24/7 operation, with 100% usage			
Private Cloud cost over 5 years, 24/7 operation, with 100% usage			
What utilization must be achieved with the private cloud to make the private cloud option more attractive than the public cloud?			

You are to make a PDF of your project writeup. At the end of your PDF, include a printout of your shopping cart showing the hardware you would need to purchase. Submit a single PDF file on BB, with the following filename "Proj\_LASTNAME1\_LASTNAME2.pdf". Please ask questions on Piazza if there are any doubts about assumptions you need to make.