CS553 Project:
Understanding the Cost of Computing in the Cloud

Instructions:

- ***Due date: 11:59PM on Wednesday, 04/06/16***
- ***Maximum Points: 100%***
- *This programming assignment must be done individually.*
- *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; please submit your report in PDF format to BB.*
- *Name your file as this rule: "PROG#_LASTNAME_FIRSTNAME.pdf". E.g. "Proj_Raicu_Ioan.pdf".*
- *Late submission will be penalized at 10% per day (beyond the 7-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 concensus that a cloud computing software stack at the layer of IaaS will be used, but its 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 for the following instance types: t2.small, m3.large, c3.8xlarge, g2.2xlarge, r3.4xlarge, i2.8xlarge, and d2.8xlarge. These instance types are 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 Newegg.com (http://www.newegg.com/) as a good source for low cost and large variety of 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 shoping cart in your final writeup report for this assignment; include this as an appendix at the end of your report.

Table 1: Instance Types Matrix

Instance Type	vCPU	Memory (GiB)	Storage (GB)	Networking Performance	Physical Processor	Clock Speed (GHz)	Price
m4.10xlarge	40	160	EBS Only	10Gbps	Intel Xeon E5-2676 v3	2.4	$2.394
m3.large	2	7.5	1 x 32 SSD	Moderate (500Mbps)	Intel Xeon E5-2670 v2	2.5	$0.133
m3.2xlarge	8	30	2 x 80 SSD	High (1Gbps)	Intel Xeon E5-2670 v2	2.5	$0.532
c3.8xlarge	32	60	2 x 320 SSD	10Gbps	Intel Xeon E5-2680 v2	2.8	$1.680
g2.2xlarge	8	15	1 x 60 SSD	High (1Gbps)	Intel Xeon E5-2670	2.6	$0.650
r3.4xlarge	16	122	1 x 320 SSD	High (1Gbps)	Intel Xeon E5-2670 v2	2.5	$1.33
i2.8xlarge	32	244	8 x 800 SSD	10Gbps	Intel Xeon E5-2670 v2	2.5	$6.82
d2.8xlarge	36	244	24 x 2,000	10Gbps	Intel Xeon E5-2676 v3	2.4	$5.52

Each vCPU is a hyper-thread of an Intel Xeon core for M3, M4, C3, R3, D2, G2, and I2.

2. What you will submit?

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

- Plot the cost of a compute cloud from 1GFlop to 1PFlop (1M GFlops)
- Compare the costs of 8 different instance types: m4.10xlarge, m3.large, m3.2xlarge, c3.8xlarge, g2.2xlarge, r3.4xlarge, i2.8xlarge, and d2.8xlarge

- Compute the private cloud cost equivalents to the 8 different Amazon EC2 Instance Types: m4.10xlarge.private, m3.large.private, m3.2xlarge.prinvate, c3.8xlarge.private, g2.2xlarge.private, r3.4xlarge.private, i2.8xlarge.private, and d2.8xlarge.private
    - 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)
    - show a separate table with the costs of each of the 8 different types, broken down by components (e.g. CPU, memory, motherboard, case, power supply, disk, network card, cooling, power, administration, etc)
- Plot (#1) the cost (in $) per **flop** per hour, for the 8 Amazon EC2 instance types, vs. the 8 private cloud equivalent instance types, from 1GFlop to 1PFlop
- Plot (#2) the needed utilization of the private cloud from 1GFlop to 1PFlop for the different instance types in order to break even cost wise
- Explain in words the two plots, and anything interesting you might have found

Hint: Since CPUs and GPUs can deliver different amounts of single precision and double precision floating point operations/sec, it is important to clearly state which types of floating point operations/sec you are measuring. Also, plot #2 comes from the same data collected for Plot #1, its just a different way to look at the same data.

Since your report will have 7 tables and 2 figures, its likely that your final report will be 3~6 pages long (not including the appendix with the printout of your shoping cart). A similar study looking to understand the cost of cloud storage was done previously; its writeup can be found at http://datasys.cs.iit.edu/projects/CloudStorage_summary12.pdf. This 1-page summary is a good example of what some of your graphs might look like, except that you are not scaling up the storage system in GB, but the compute capacity in GFlops. You are to make a PDF of your project writeup, and submit it on BB, with the fo llowing filename "Proj_LASTNAME-FIRSTNAME.pdf". Please ask questions on Piazza if there are any doubts about assumptions you need to make.