Project Report

Understanding the Cost of Computing in the Cloud

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Public Cloud Cost Computation

Instance Type	vCPU	Memory (GB)	Storage (GB)	Storage Type	Networking Performance (Gb/s)	Physical Processor	Clock Speed (GHz)	Price	No. of Cores / Processor	No. of hardware threads / core	IPC	Theoretical GFLOPS/ instance
m4.10xlarge	40	160	EBS only	EBS	10	Intel Xeon E5- 2676 v3	2.4	\$2.39	12	2	16	768
m3.large	2	7.5	1 x 32	SSD	0.5	Intel Xeon E5- 2670 v2	2.5	\$0.13	10	2	8	20
m3.2xlarge	8	30	2 x 80	SSD	1	Intel Xeon E5- 2670 v2	2.5	\$0.53	10	2	8	80
c3.8xlarge	32	60	2 x 320	SSD	10	Intel Xeon E5- 2680 v2	2.8	\$1.68	10	2	8	358.4
g2.2xlarge	8	15	1 x 60	SSD	1	Intel Xeon E5- 2670	2.6	\$0.65	8	2	8	2531.6
r3.4xlarge	16	122	1 x 320	SSD	1	Intel Xeon E5- 2670 v2	2.5	\$1.33	10	2	8	160
i2.8xlarge	32	244	8 x 800	SSD	10	Intel Xeon E5- 2670 v2	2.5	\$6.82	10	2	8	320
d2.8xlarge	36	244	24 x 2000	HDD	10	Intel Xeon E5- 2676 v3	2.4	\$5.52	12	2	16	691.2

This table shows specifications of Amazon Web Services (AWS) instances and also its cost per hour. All instances use intel Xeon processors Family E5.

Here, m3.large is the cheapest instance with lowest GFLOPs: 80, whereas g2.2xlarge is the most expensive instance, which is used for rendering, machine learning, game streaming, and transcoding jobs that require massive amounts of parallel processing power, followed by d2.8xlarge, c3.8xlarge, i2.8xlarge, m3.2xlarge and m3.large.

In terms of best hardware, m4.10xlarge has the best specifications. It has 12 core with 2.4 GHz clock speed, 160 GB RAM and 10 Gb/sec network. Whereas d2.8xlarge has 48 TB of disk space with 244 GB RAM.

Private Cloud Cost Computation

1. m4.10xlarge.private

Cost:

Description	Details	Quantity	Cost per Unit	Final Cost
Case	NORCO RPC-170 Black 1U Rackmount Server Chassis 1 External 5.25" Drive Bays [7]	1	96.84	96.84
Processor	Intel Xeon E5-2640 V4 2.4 GHz 25MB L3 Cache LGA 2011 90W BX80660E52640V4 Server Processor [9]	2	990	1980
Memory	Kingston 16GB 288-Pin DDR4 SDRAM ECC Registered DDR4 2133 (PC4 17000) Server Memory Model KVR21R15D4/16 [14]	10	92	920
Motherboard	GIGABYTE MD80-TM0 E-ATX / SSI EEB Server Motherboard Dual LGA 2011-3 Intel C612 [8]	1	660	660
HDD	Kingston SSD Now mS200 mSATA 30GB SATA III Internal Solid State Drive (SSD) SMS200S3/30G [17]	1	30.29	30.29
Rack	APC AR3300 42U NetShelter SX 600mm Wide x 1200mm Deep Enclosure [3]	Depends on no of machines	1660	
Network Switch	NETGEAR ProSAFE XS728T 28-Port 10-Gigabit Ethernet Smart Managed Switch (XS728T) - Lifetime Warranty [4]	Depends on no of machines	2854	
System Admin	1 year system admin salary [6]	Depends on no of machines	105290	526450
Power	Power needed to run and cool system [5]		0.153	

GFLOPS	No. of machines	No of instances	Hardware cost	Network Switches Quantity	Network cost	Network Power cost	No. of System Admin(s)	Administration cost	System & Cooling Power cost	Rack Quantity	Rack cost	Rack Power cost	Total Cost	Cost / hour	Cost / hour / GFLOPS
1	1	1	3687.13	1	2854	335.2536	1	526450	3888.94176	1	1654.73	1341.0144	540211.0698	12.32683164	0.01605056
10	1	1	3687.13	1	2854	335.2536	1	526450	3888.94176	1	1654.73	1341.0144	540211.0698	12.32683164	0.01605056
100	1	1	3687.13	1	2854	335.2536	1	526450	3888.94176	1	1654.73	1341.0144	540211.0698	12.32683164	0.01605056
1000	2	2	7374.26	1	2854	335.2536	1	526450	7777.88352	1	1654.73	1341.0144	547787.1415	12.49970659	0.00813783
10000	14	14	51619.82	1	2854	335.2536	1	526450	54445.18464	1	1654.73	1341.0144	638700.0026	14.57420597	0.00135549
100000	131	131	483014.03	6	17124	2011.5216	1	526450	509451.3706	4	6618.92	5364.0576	1550033.9	35.36952126	0.00035156
1000000	1303	1303	4804330.39	86	245444	28831.8096	2	1052900	5067291.113	32	52951.36	42912.4608	11294661.13	257.727755	0.00025755

2. m3.large.private

Cost:

Description	Details	Quantity	Cost per Unit	Final Cost
Case	NORCO RPC-170 Black 1U Rackmount Server Chassis 1 External 5.25" Drive Bays [7]	1	96.84	96.84
Processor	Intel Xeon E5-2680 v3 Haswell 2.5 GHz LGA 2011-3 120W BX80644E52680V3 Server Processor [10]	2	1720	3440
Memory	Kingston 16GB 288-Pin DDR4 SDRAM ECC Registered DDR4 2133 (PC4 17000) Server Memory Model KVR21R15D4/16 [14]	23	92	2116
Motherboard	GIGABYTE MD80-TM0 E-ATX / SSI EEB Server Motherboard Dual LGA 2011-3 Intel C612 [8]	1	660	660
HDD	SanDisk SD8SB8U-1T00-1122 X400 SATA 2.5" 1TB Internal SSD [18]	2	275	550
Network Adapter	Lenovo Think Server I350-T4 AnyFabric 1 Gb 4-port Base-T Ethernet Adapter by Intel [20]	1	96.76	96.76
Rack	APC AR3300 42U NetShelter SX 600mm Wide x 1200mm Deep Enclosure [3]	Depends on no of machines	1660	
Network Switch	NETGEAR ProSAFE XS728T 28-Port 10-Gigabit Ethernet Smart Managed Switch (XS728T) - Lifetime Warranty [4]	Depends on no of machines	2854	
System Admin	1 year system admin salary [6]	Depends on no of machines	105290	526450
Power	Power needed to run and cool system [5]		0.153	

GFLOPS	No. of machines	No of instances	Hardware cost	Network Switches Quantity	Network cost	Network Power cost	No. of System Admin(s)	Administration cost	System & Cooling Power cost	Rack Quantity	Rack cost	Rack Power cost	Total Cost	Cost / hour	Cost / hour / GFLOPS
1	1	1	6959.6	1	2854	335.2536	1	526450	5967.51408	1	1654.73	1341.0144	545562.1121	12.44893465	0.62244673
10	1	1	6959.6	1	2854	335.2536	1	526450	5967.51408	1	1654.73	1341.0144	545562.1121	12.44893465	0.62244673
100	1	5	6959.6	1	2854	335.2536	1	526450	5967.51408	1	1654.73	1341.0144	545562.1121	12.44893465	0.12448935
1000	2	50	13919.2	1	2854	335.2536	1	526450	11935.02816	1	1654.73	1341.0144	558489.2262	12.74391261	0.01274391
10000	11	500	76555.6	2	2854	670.5072	1	526450	65642.65488	1	1654.73	1341.0144	675168.5065	15.40636424	0.00154064
100000	105	5000	730758	14	2854	4693.5504	1	526450	626588.9784	3	4964.19	4023.0432	1900331.762	43.36280947	0.00043363
1000000	1042	50000	7251903.2	334	2854	111974.7024	2	1052900	6218149.671	25	41368.25	33525.36	14712675.18	335.7218689	0.00033572

3. m3.2xlarge.private

Cost:

Description	Details	Quantity	Cost per Unit	Final Cost
Case	NORCO RPC-170 Black 1U Rackmount Server Chassis 1 External 5.25" Drive Bays [7]	1	96.84	96.84
Processor	Intel Xeon E5-2680 v3 Haswell 2.5 GHz LGA 2011-3 120W BX80644E52680V3 Server Processor [10]	2	1720	3440
Memory	Kingston 16GB 288-Pin DDR4 SDRAM ECC Registered DDR4 2133 (PC4 17000) Server Memory Model KVR21R15D4/16 [14]	23	92	2116
Motherboard	GIGABYTE MD80-TM0 E-ATX / SSI EEB Server Motherboard Dual LGA 2011-3 Intel C612 [8]	1	660	660
HDD	SanDisk SD8SB8U-1T00-1122 X400 SATA 2.5" 1TB Internal SSD [18]	2	275	550
Rack	APC AR3300 42U NetShelter SX 600mm Wide x 1200mm Deep Enclosure [3]	Depends on no of machines	1660	
Network Switch	NETGEAR ProSAFE XS728T 28-Port 10-Gigabit Ethernet Smart Managed Switch (XS728T) - Lifetime Warranty [4]	Depends on no of machines	2854	
System Admin	1 year system admin salary [6]	Depends on no of machines	105290	526450
Power	Power needed to run and cool system [5]		0.153	

GFLOPS	No. of machines	No of instances	Hardware cost	Network Switches Quantity	Network cost	Network Power cost	No. of System Admin(s)	Administration cost	System & Cooling Power cost	Rack Quantity	Rack cost	Rack Power cost	Total Cost	Cost / hour	Cost / hour / GFLOPS
1	1	1	6862.84	1	2854	335.2536	1	526450	5900.46336	1	1654.73	1341.0144	545398.3014	12.44519673	0.15556496
10	1	1	6862.84	1	2854	335.2536	1	526450	5900.46336	1	1654.73	1341.0144	545398.3014	12.44519673	0.15556496
100	1	2	6862.84	1	2854	335.2536	1	526450	5900.46336	1	1654.73	1341.0144	545398.3014	12.44519673	0.07778248
1000	2	13	13725.68	1	2854	335.2536	1	526450	11800.92672	1	1654.73	1341.0144	558161.6047	12.73643676	0.01224657
10000	11	125	75491.24	1	2854	335.2536	1	526450	64905.09696	1	1654.73	1341.0144	673031.335	15.35759709	0.00153576
100000	105	1250	720598.2	9	2854	3017.2824	1	526450	619548.6528	3	4964.19	4023.0432	1881455.368	42.93207759	0.00042932
1000000	1042	12500	7151079.28	174	2854	58334.1264	2	1052900	6148282.821	25	41368.25	33525.36	14488343.84	330.6029536	0.00033060

4. c3.8xlarge.private

Cost:

Description	Details	Quantity	Cost per Unit	Final Cost
Case	NORCO RPC-170 Black 1U Rackmount Server Chassis 1 External 5.25" Drive Bays [7]	1	96.84	96.84
Processor	Intel Xeon E5-2680 v2 Ivy Bridge-EP 2.8 GHz 25MB L3 Cache LGA 2011 115W BX80635E52680V2 Server Processor [11]	2	1770	3540
Memory	Kingston ValueRAM 64GB (4 x 16GB) 288-Pin DDR4 SDRAM ECC Registered DDR4 2133 (PC4 17000) Server Memory Model KVR21R15D4K4/64I [15]	1	412.75	412.75
Motherboard	GIGABYTE MD80-TM0 E-ATX / SSI EEB Server Motherboard Dual LGA 2011-3 Intel C612 [8]	1	660	660
HDD	SanDisk SD8SB8U-1T00-1122 X400 SATA 2.5" 1TB Internal SSD [18]	1	275	275
Rack	APC AR3300 42U NetShelter SX 600mm Wide x 1200mm Deep Enclosure [3]	Depends on no of machines	1660	
Network Switch	NETGEAR ProSAFE XS728T 28-Port 10-Gigabit Ethernet Smart Managed Switch (XS728T) - Lifetime Warranty [4]	Depends on no of machines	2854	
System Admin	1 year system admin salary [6]	Depends on no of machines	105290	526450
Power	Power needed to run and cool system [5]		0.153	

GFLOPS	No. of machines	No of instances	Hardware cost	Network Switches Quantity	Network cost	Network Power cost	No. of System Admin(s)	Administration cost	System & Cooling Power cost	Rack Quantity	Rack cost	Rack Power cost	Total Cost	Cost / hour	Cost / hour / GFLOPS
1	1	1	4984.59	1	2854	335.2536	1	526450	4157.14464	1	1654.73	1341.0144	541776.7326	12.36255779	0.034493744
10	1	1	4984.59	1	2854	335.2536	1	526450	4157.14464	1	1654.73	1341.0144	541776.7326	12.36255779	0.034493744
100	1	1	4984.59	1	2854	335.2536	1	526450	4157.14464	1	1654.73	1341.0144	541776.7326	12.36255779	0.034493744
1000	3	3	14953.77	1	2854	335.2536	1	526450	12471.43392	1	1654.73	1341.0144	560060.2019	12.77975999	0.011885937
10000	28	28	139568.52	2	2854	670.5072	1	526450	116400.0499	1	1654.73	1341.0144	788938.8215	18.00243751	0.001793929
100000	280	280	1395685.2	12	2854	4023.0432	1	526450	1164000.499	7	11583.11	9387.1008	3113982.953	71.05656611	0.000708073
1000000	2791	2791	13911990.69	277	2854	92865.2472	3	1579350	11602590.69	67	110866.91	89847.9648	27390365.5	625.0083402	0.000624824

5. g2.2xlarge.private

Cost:

Description	Details	Quantity	Cost per Unit	Final Cost
Case	NORCO RPC-170 Black 1U Rackmount Server Chassis 1 External 5.25" Drive Bays [7]	1	96.84	96.84
Processor	Intel Xeon E5-2690 v3 Haswell 2.6 GHz 12 x 256KB L2 Cache 30 MB L3 Cache LGA 2011-3 135W BX80644E52690V3 Server Processor [12]	2	2150	4300
Memory	Kingston ValueRAM 64GB (4 x 16GB) 288-Pin DDR4 SDRAM ECC Registered DDR4 2133 (PC4 17000) Server Memory Model KVR21R15D4K4/64I [15]	2	412.75	825.5
Motherboard	GIGABYTE MD80-TM0 E-ATX / SSI EEB Server Motherboard Dual LGA 2011-3 Intel C612 [8]	1	660	660
HDD	SanDisk SD8SB8U-1T00-1122 X400 SATA 2.5" 1TB Internal SSD [18]	1	275	275
GPU	Nvidia GRID K520 8GB PCle x16 Cloud Gaming GPU Graphics Card 900-12055-0020-000 [22]	3	1799	5397
Rack	APC AR3300 42U NetShelter SX 600mm Wide x 1200mm Deep Enclosure [3]	Depends on no of machines	1660	
Network Switch	NETGEAR ProSAFE XS728T 28-Port 10-Gigabit Ethernet Smart Managed Switch (XS728T) - Lifetime Warranty [4]	Depends on no of machines	2854	
System Admin	1 year system admin salary [6]	Depends on no of machines	105290	526450
Power	Power needed to run and cool system [5]		0.153	

GFLOPS	No. of machines	No of instances	Hardware cost	Network Switches Quantity	Network cost	Network Power cost	No. of System Admin(s)	Administration cost	System & Cooling Power cost	Rack Quantity	Rack cost	Rack Power cost	Total Cost	Cost / hour	Cost / hour / GFLOPS
1	1	1	11554.34	1	2854	335.2536	1	526450	14013.60048	1	1654.73	1341.0144	558202.9385	12.73737994	0.005031356
10	1	1	11554.34	1	2854	335.2536	1	526450	14013.60048	1	1654.73	1341.0144	558202.9385	12.73737994	0.005031356
100	1	1	11554.34	1	2854	335.2536	1	526450	14013.60048	1	1654.73	1341.0144	558202.9385	12.73737994	0.005031356
1000	1	1	11554.34	1	2854	335.2536	1	526450	14013.60048	1	1654.73	1341.0144	558202.9385	12.73737994	0.005031356
10000	1	4	11554.34	1	2854	335.2536	1	526450	14013.60048	1	1654.73	1341.0144	558202.9385	12.73737994	0.001257839
100000	7	40	80880.38	1	2854	335.2536	1	526450	98095.20336	1	1654.73	1341.0144	711610.5814	16.23791944	0.000160352
1000000	66	396	762586.44	3	2854	1005.7608	1	526450	924897.6317	2	3309.46	2682.0288	2223785.321	50.74354968	5.06163E-05

6. r3.4xlarge.private

Cost:

Description	Details	Quantity	Cost per Unit	Final Cost
Case	NORCO RPC-170 Black 1U Rackmount Server Chassis 1 External 5.25" Drive Bays [7]	1	96.84	96.84
Processor	Intel Xeon E5-2680 v3 Haswell 2.5 GHz LGA 2011-3 120W BX80644E52680V3 Server Processor [10]	2	1720	3440
Memory	SAMSUNG 32GB 288-Pin DDR4 SDRAM DDR4 2133 (PC4 17000) Server Memory Model M386A4G40DM0-CPB [16]	23	214.89	4942.47
Motherboard	GIGABYTE MD80-TM0 E-ATX / SSI EEB Server Motherboard Dual LGA 2011-3 Intel C612 [8]	1	660	660
HDD	SanDisk SD8SB8U-1T00-1122 X400 SATA 2.5" 1TB Internal SSD [18]	2	275	550
Rack	APC AR3300 42U NetShelter SX 600mm Wide x 1200mm Deep Enclosure [3]	Depends on no of machines	1660	
Network Switch	NETGEAR ProSAFE XS728T 28-Port 10-Gigabit Ethernet Smart Managed Switch (XS728T) - Lifetime Warranty [4]	Depends on no of machines	2854	
System Admin	1 year system admin salary [6]	Depends on no of machines	105290	526450
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GFLOPS	No. of machines	No of instances	Hardware cost	Network Switches Quantity	Network cost	Network Power cost	No. of System Admin(s)	Administration cost	System & Cooling Power cost	Rack Quantity	Rack cost	Rack Power cost	Total Cost	Cost / hour	Cost / hour / GFLOPS
1	1	1	9689.31	1	2854	335.2536	1	526450	5900.46336	1	1654.73	1341.0144	548224.7714	12.50969267	0.078185579
10	1	1	9689.31	1	2854	335.2536	1	526450	5900.46336	1	1654.73	1341.0144	548224.7714	12.50969267	0.078185579
100	1	1	9689.31	1	2854	335.2536	1	526450	5900.46336	1	1654.73	1341.0144	548224.7714	12.50969267	0.078185579
1000	2	7	19378.62	1	2854	335.2536	1	526450	11800.92672	1	1654.73	1341.0144	563814.5447	12.86542864	0.01148699
10000	11	63	106582.41	1	2854	335.2536	1	526450	64905.09696	1	1654.73	1341.0144	704122.505	16.06705241	0.001593954
100000	105	625	1017377.55	4	2854	1341.0144	1	526450	619548.6528	3	4964.19	4023.0432	2176558.45	49.66590111	0.000496659
1000000	1042	6250	10096261.02	63	2854	21120.9768	2	1052900	6148282.821	25	41368.25	33525.36	17396312.43	396.9585713	0.000396959

7. i2.8xlarge.private

Cost:

Description	Details	Quantity	Cost per Unit	Final Cost
Case	NORCO RPC-170 Black 1U Rackmount Server Chassis 1 External 5.25" Drive Bays [7]	1	96.84	96.84
Processor	Intel Xeon E5-2680 v3 Haswell 2.5 GHz LGA 2011-3 120W BX80644E52680V3 Server Processor [10]	2	1720	3440
Memory	SAMSUNG 32GB 288-Pin DDR4 SDRAM DDR4 2133 (PC4 17000) Server Memory Model M386A4G40DM0-CPB [16]	23	214.89	4942.47
Motherboard	GIGABYTE MD80-TM0 E-ATX / SSI EEB Server Motherboard Dual LGA 2011-3 Intel C612 [8]	1	660	660
HDD	CUK Cyclone 2TB 7mm 2.5-Inch SATA III Internal Solid State Drive (SSD) [19]	10	500	5000
Network Adapter	Lenovo ThinkServer I350-T4 AnyFabric 1 Gb 4-port Base-T Ethernet Adapter by Intel [20]	1	96.76	96.76
Rack	APC AR3300 42U NetShelter SX 600mm Wide x 1200mm Deep Enclosure [3]	Depends on no of machines	1660	
Network Switch	NETGEAR ProSAFE XS728T 28-Port 10-Gigabit Ethernet Smart Managed Switch (XS728T) - Lifetime Warranty [4]	Depends on no of machines	2854	
System Admin	1 year system admin salary [6]	Depends on no of machines	105290	526450
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GFLOPS	No. of machines	No of instances	Hardware cost	Network Switches Quantity	Network cost	Network Power cost	No. of System Admin(s)	Administration cost	System & Cooling Power cost	Rack Quantity	Rack cost	Rack Power cost	Total Cost	Cost / hour	Cost / hour / GFLOPS
1	1	1	14236.07	1	2854	335.2536	1	526450	8649.54288	1	1654.73	1341.0144	555520.6109	12.67617312	0.039613041
10	1	1	14236.07	1	2854	335.2536	1	526450	8649.54288	1	1654.73	1341.0144	555520.6109	12.67617312	0.039613041
100	1	1	14236.07	1	2854	335.2536	1	526450	8649.54288	1	1654.73	1341.0144	555520.6109	12.67617312	0.039613041
1000	2	4	28472.14	1	2854	335.2536	1	526450	17299.08576	1	1654.73	1341.0144	578406.2238	13.19838955	0.010311242
10000	11	32	156596.77	2	2854	670.5072	1	526450	95144.97168	1	1654.73	1341.0144	784711.9933	17.90598743	0.001748632
100000	105	313	1494787.35	14	2854	4693.5504	1	526450	908202.0024	3	4964.19	4023.0432	2945974.136	67.22284903	0.000671155
1000000	1042	3125	14833984.94	334	2854	111974.7024	2	1052900	9012823.681	25	41368.25	33525.36	25089430.93	572.5043568	0.000572504

8. d2.8xlarge.private

Cost:

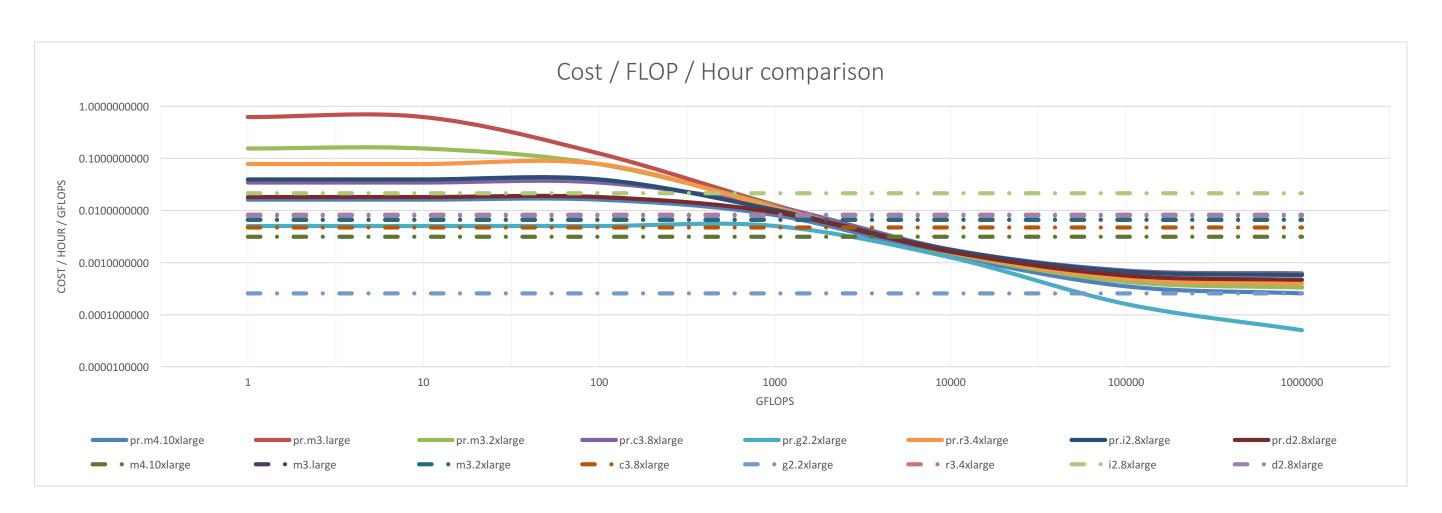
Description	Details	Quantity	Cost per Unit	Final Cost
Case	NORCO RPC-170 Black 1U Rackmount Server Chassis 1 External 5.25" Drive Bays [7]	1	96.84	96.84
Processor	Intel Xeon E5-2640 V4 2.4 GHz 25MB L3 Cache LGA 2011 90W BX80660E52640V4 Server Processor [13]	2	990	1980
Memory	Kingston ValueRAM 64GB (4 x 16GB) 288-Pin DDR4 SDRAM ECC Registered DDR4 2133 (PC4 17000) Server Memory Model KVR21R15D4K4/64I [15]	4	412.75	1651
Motherboard	GIGABYTE MD80-TM0 E-ATX / SSI EEB Server Motherboard Dual LGA 2011-3 Intel C612 [8]	1	660	660
HDD	Seagate Archive HDD v2 ST8000AS0002 8TB 128MB Cache SATA 6.0Gb/s 3.5" Internal Hard Drive Bare Drive [21]	6	215	1290
Rack	APC AR3300 42U NetShelter SX 600mm Wide x 1200mm Deep Enclosure [3]	Depends on no of machines	1660	
Network Switch	NETGEAR ProSAFE XS728T 28-Port 10-Gigabit Ethernet Smart Managed Switch (XS728T) - Lifetime Warranty [4]	Depends on no of machines	2854	
System Admin	1 year system admin salary [6]	Depends on no of machines	105290	526450
Power	Power needed to run and cool system [5]		0.153	

GFLOPS	No. of machines	No of instances	Hardware cost	Network Switches Quantity	Network cost	Network Power cost	No. of System Admin(s)	Administration cost	System & Cooling Power cost	Rack Quantity	Rack cost	Rack Power cost	Total Cost	Cost / hour	Cost / hour / GFLOPS
1	1	1	7387.84	1	2854	335.2536	1	526450	5967.51408	1	1654.73	1341.0144	545990.3521	12.45870646	0.018024749
10	1	1	7387.84	1	2854	335.2536	1	526450	5967.51408	1	1654.73	1341.0144	545990.3521	12.45870646	0.018024749
100	1	1	7387.84	1	2854	335.2536	1	526450	5967.51408	1	1654.73	1341.0144	545990.3521	12.45870646	0.018024749
1000	2	2	14775.68	1	2854	335.2536	1	526450	11935.02816	1	1654.73	1341.0144	559345.7062	12.76345624	0.009232824
10000	15	15	110817.6	1	2854	335.2536	1	526450	89512.7112	1	1654.73	1341.0144	732965.3092	16.72520329	0.001613156
100000	145	145	1071236.8	6	2854	2011.5216	1	526450	865289.5416	4	6618.92	5364.0576	2479824.841	56.58599947	0.000564595
1000000	1447	1447	10690204.48	100	2854	33525.36	2	1052900	8634992.874	35	57915.55	46935.504	20519327.77	468.2212433	0.000468143

Cost Comparison of Public Cloud (Amazon) vs. Private Cloud

1. Plot 1

GFLOPS	m4.10xlarge	m3.large	m3.2xlarge	c3.8xlarge	g2.2xlarge	r3.4xlarge	i2.8xlarge	d2.8xlarge	m4.10xlarge	m3.large.pri	m3.2xlarge.	c3.8xlarge.p	2xlarge.priv	r3.4xlarge.p	i2.8xlarge.pr	d2.8xlarge.
GFLOFS	1114.10xlarge	iii5.iaige	iii5.2xiaige	cs.oxidige	gz.zxiaige	15.4xlarge		uz.oxiaige	.private	vate	private	rivate	ate	rivate	ivate	private
1	0.00311719	0.00665000	0.00665000	0.00468750	0.00025675	0.00831250	0.02131250	0.00798611	0.01605056	0.62244673	0.15556496	0.03449374	0.00503136	0.07818558	0.03961304	0.01802475
10	0.00311719	0.00665000	0.00665000	0.00468750	0.00025675	0.00831250	0.02131250	0.00798611	0.01605056	0.62244673	0.15556496	0.03449374	0.00503136	0.07818558	0.03961304	0.01802475
100	0.00311719	0.00665000	0.00665000	0.00468750	0.00025675	0.00831250	0.02131250	0.00798611	0.01605056	0.12448935	0.07778248	0.03449374	0.00503136	0.07818558	0.03961304	0.01802475
1000	0.00311719	0.00665000	0.00665000	0.00468750	0.00025675	0.00831250	0.02131250	0.00798611	0.00813783	0.01274391	0.01224657	0.01188594	0.00503136	0.01148699	0.01031124	0.00923282
10000	0.00311719	0.00665000	0.00665000	0.00468750	0.00025675	0.00831250	0.02131250	0.00798611	0.00135549	0.00154064	0.00153576	0.00179393	0.00125784	0.00159395	0.00174863	0.00161316
100000	0.00311719	0.00665000	0.00665000	0.00468750	0.00025675	0.00831250	0.02131250	0.00798611	0.00035156	0.00043363	0.00042932	0.00070807	0.00016035	0.00049666	0.00067115	0.00056460
1000000	0.00311719	0.00665000	0.00665000	0.00468750	0.00025675	0.00831250	0.02131250	0.00798611	0.00025755	0.00033572	0.00033060	0.00062482	0.00005062	0.00039696	0.00057250	0.00046814



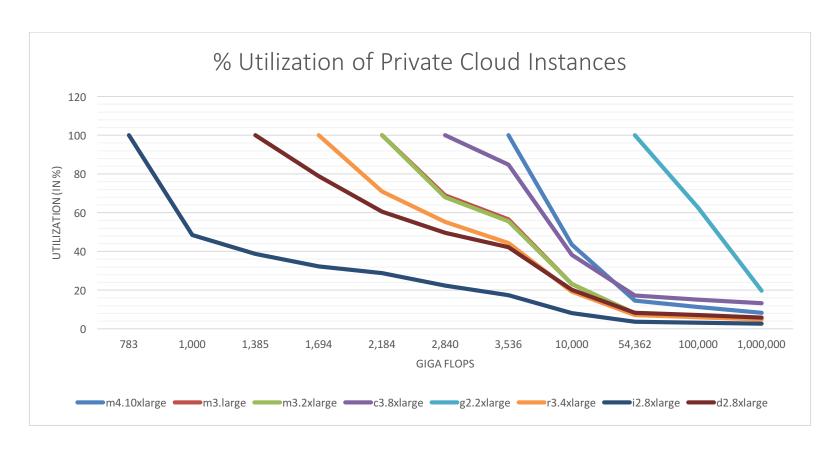
The above graph shows the cost per hour per FLOP in dollars for each of the eight amazon instances, viz., m4.10xlarge, m3.2xlarge, m3.2xlarge, g2.2xlarge, r3.4xlarge, i2.8xlarge, and d2.8xlarge and the private cloud across 1 GFLOP to 1 PFLOP. All private instances are cost effective if the required GFLOPS is more than 1000 GFLOPs.

It is observed that as -

- 1. the compute capacity is scaled from 1 GFLOP to 1 PFLOP, the cost per hour per FLOP decreases gradually, as the initial administration costs, house rental costs and other fixed costs are amortized.
- 2. For low computation power, private clouds are expensive as the infrastructure is much more expensive than the cost of public cloud.
- 3. Use of public cloud is profitable if there is GFLOP requirement is low, whereas whenever there is high requirement private clod s are profitable.

2. Plot 2

GFLOPS	m4.10xlarge	m3.large	m3.2xlarge	c3.8xlarge	g2.2xlarge	r3.4xlarge	i2.8xlarge	d2.8xlarge
783							100	
1000							48.38119338	
1385							38.7049547	100
1694						100	32.25412892	78.91428751
2184		100	100			71.00518053	28.74027227	60.56592294
2840		69.03997971	68.02253968	100		55.22625152	22.3535451	49.5569042
3536	100	56.64104552	55.63457325	84.76171249		44.38346057	17.4032532	42.21755837
10000	43.48432383	23.16746502	23.09413097	38.27048791		19.1753818	8.204722981	20.19952089
54362	14.49750248	8.041976648	7.975894877	17.27155765	100	7.190306455	3.62554354	8.327106802
100000	11.27804284	6.520723228	6.455951518	15.10556252	62.45353629	5.974845247	3.149112694	7.069715076
1000000	8.262141506	5.048449157	4.971472986	13.32958703	19.71388877	4.775441459	2.686237451	5.861968833

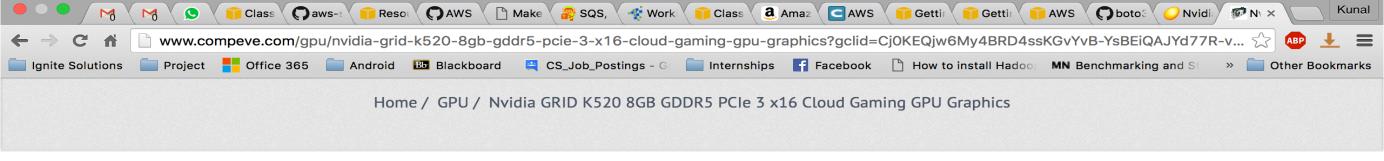


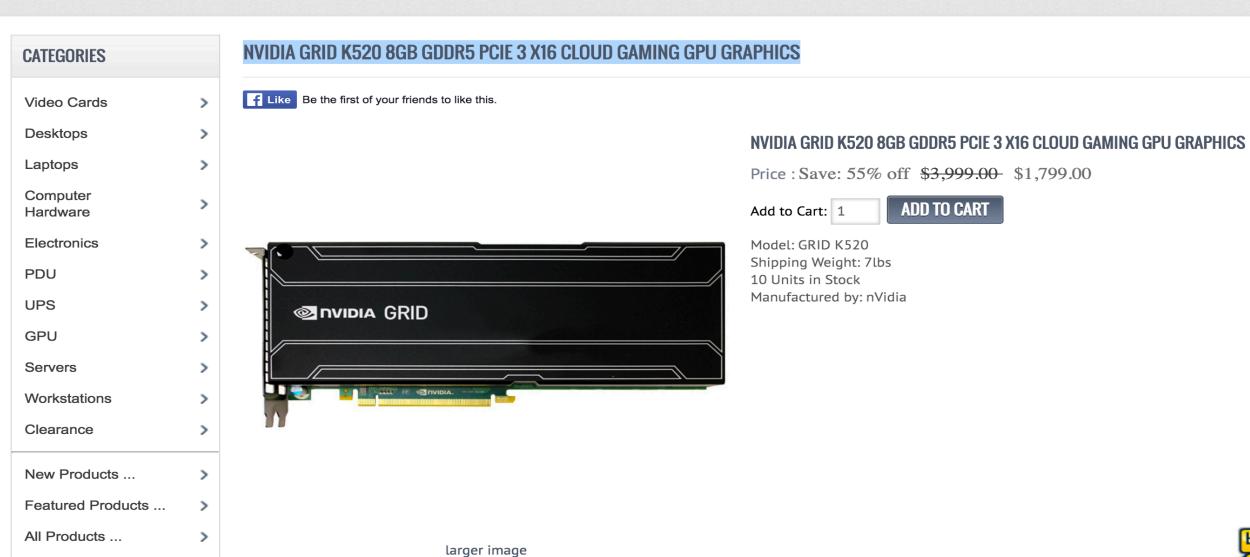
As per above plot, we can define that for the private cloud cost utilization remains infinite up to when it cross cost of equivalent public cloud instance. At the point of intersection in plot 1, utilization becomes 100%. After whenever private instance's cost become lower it's utilization % also become less. Wherever computing power is in PFLOP, then for all instances utilization is less than 20%. Thus, we can conclude that with high computational requirement, private clouds are much more affordable than public clouds.

Assumptions

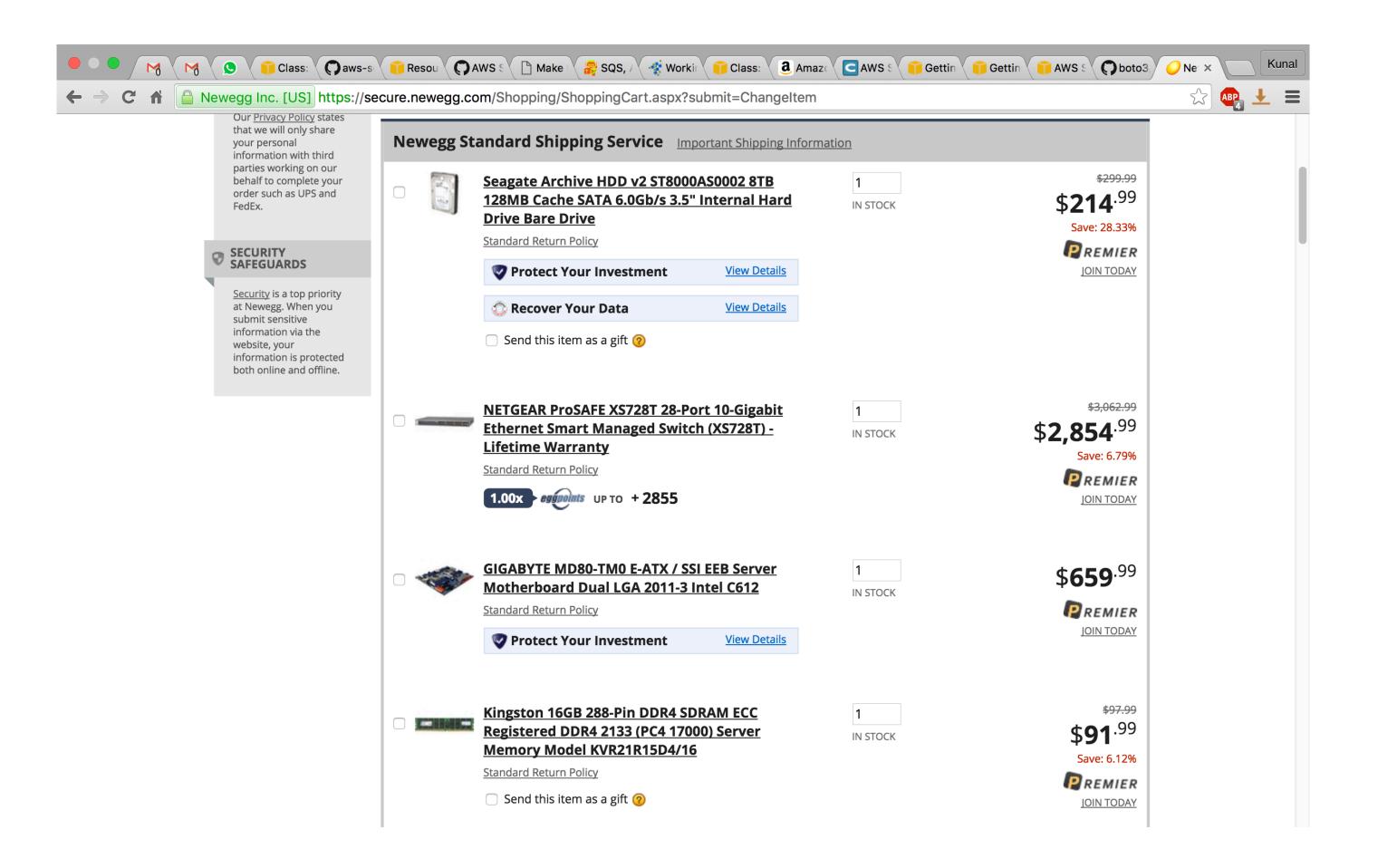
- 1. System Power consumption is assumed same as Cooling Power.
- 2. GPU's Double Precision G-Flops are considered for g2.2xlarge G-Flops computation
- 3. It is assumed that one System Admin is able to handle 1000 physical nodes
- 4. It is assumed that data is center is power backed up by generator.
- 5. It is assumed that the Data Center will be setup in Chicago; hence the Power charges are considered accordingly as on Feb 2016

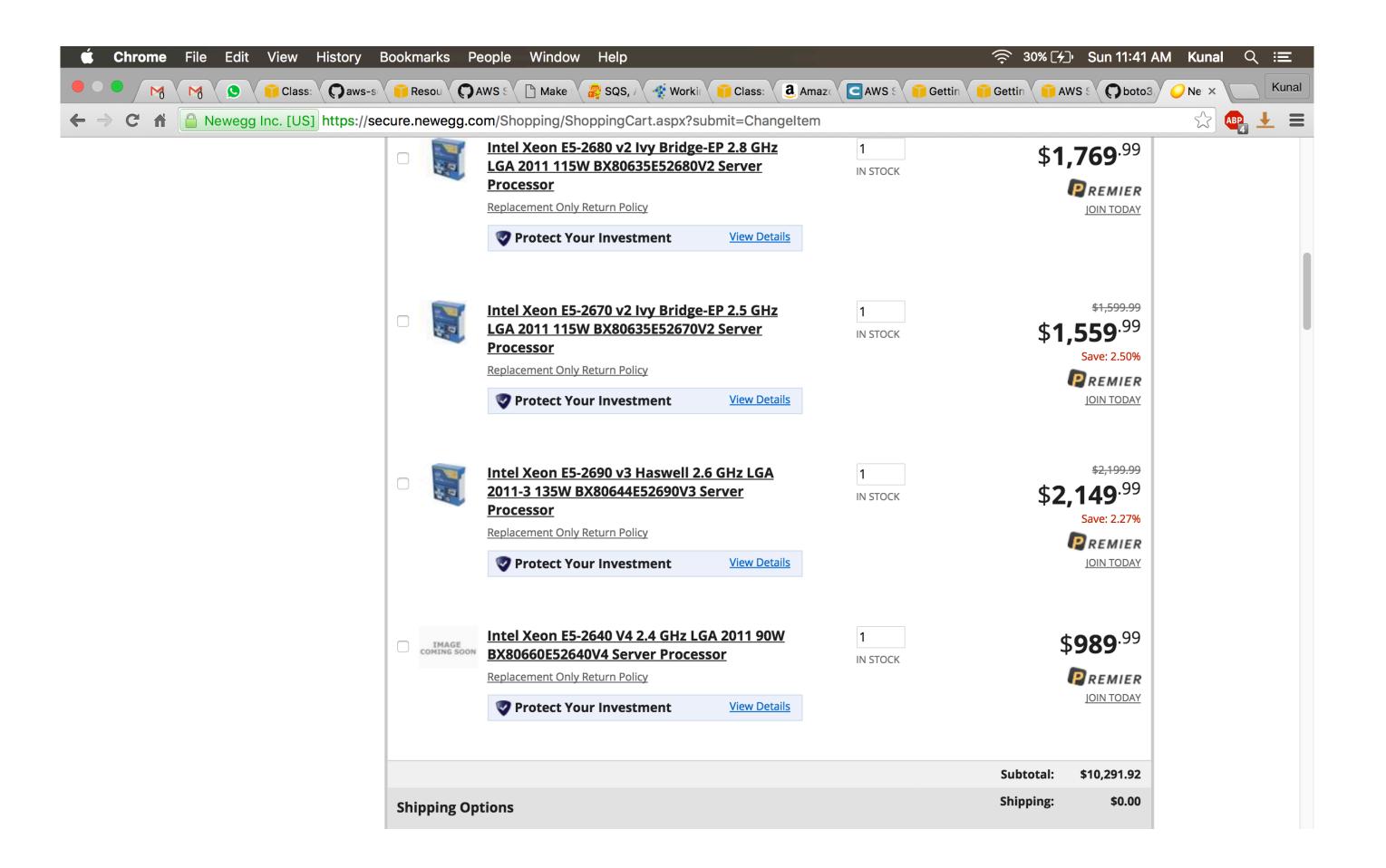
Shopping Cart Screen Shots

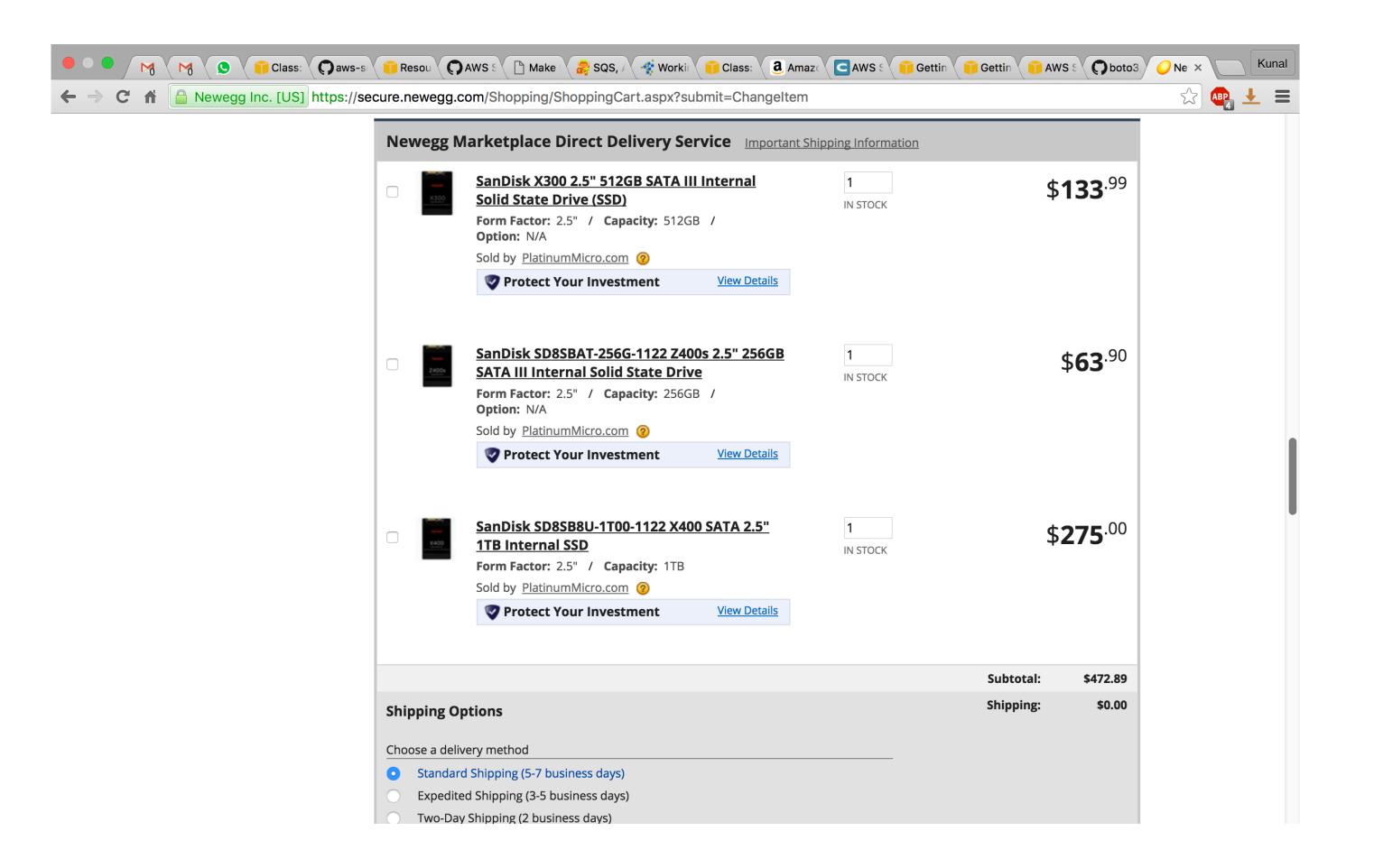


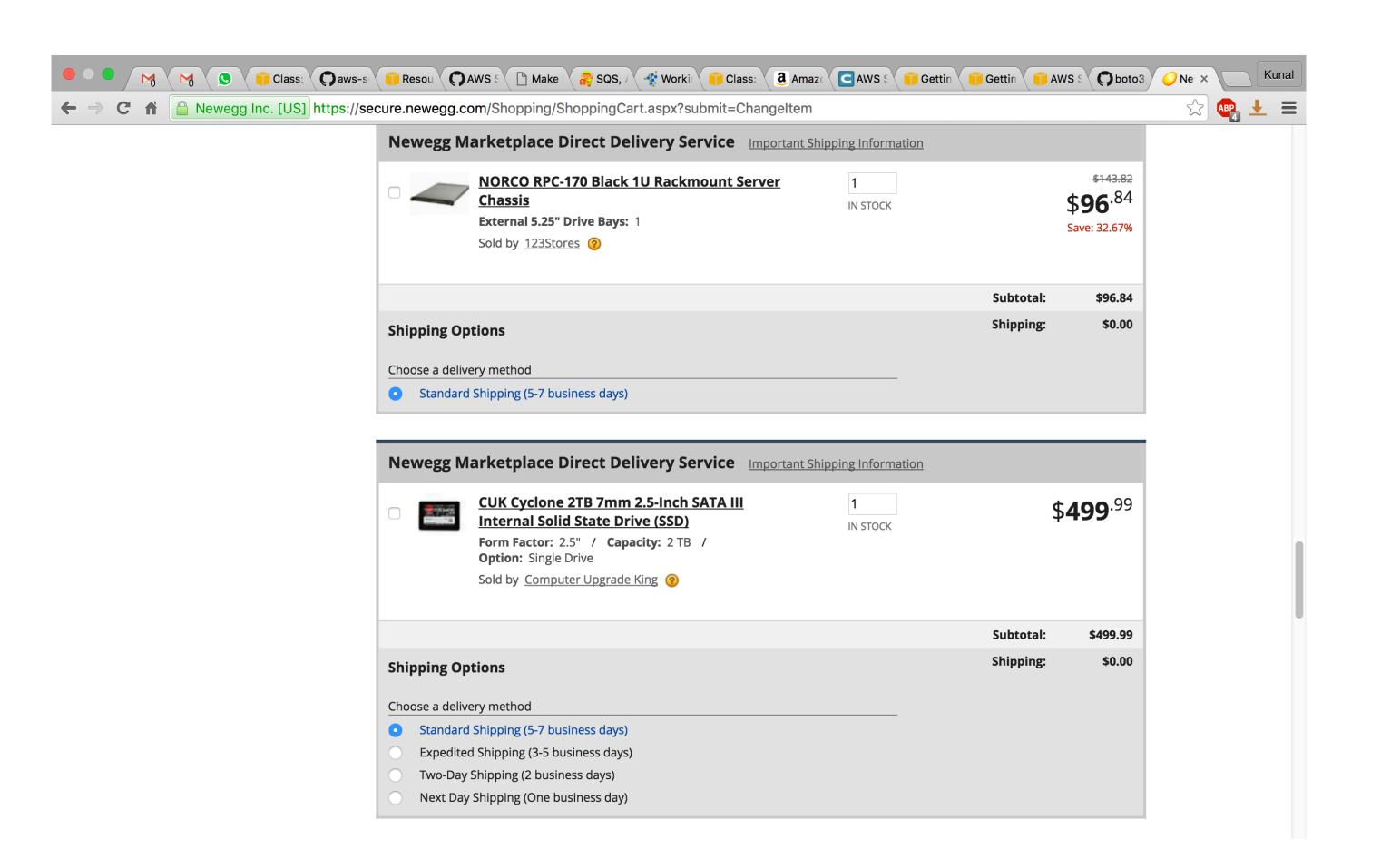


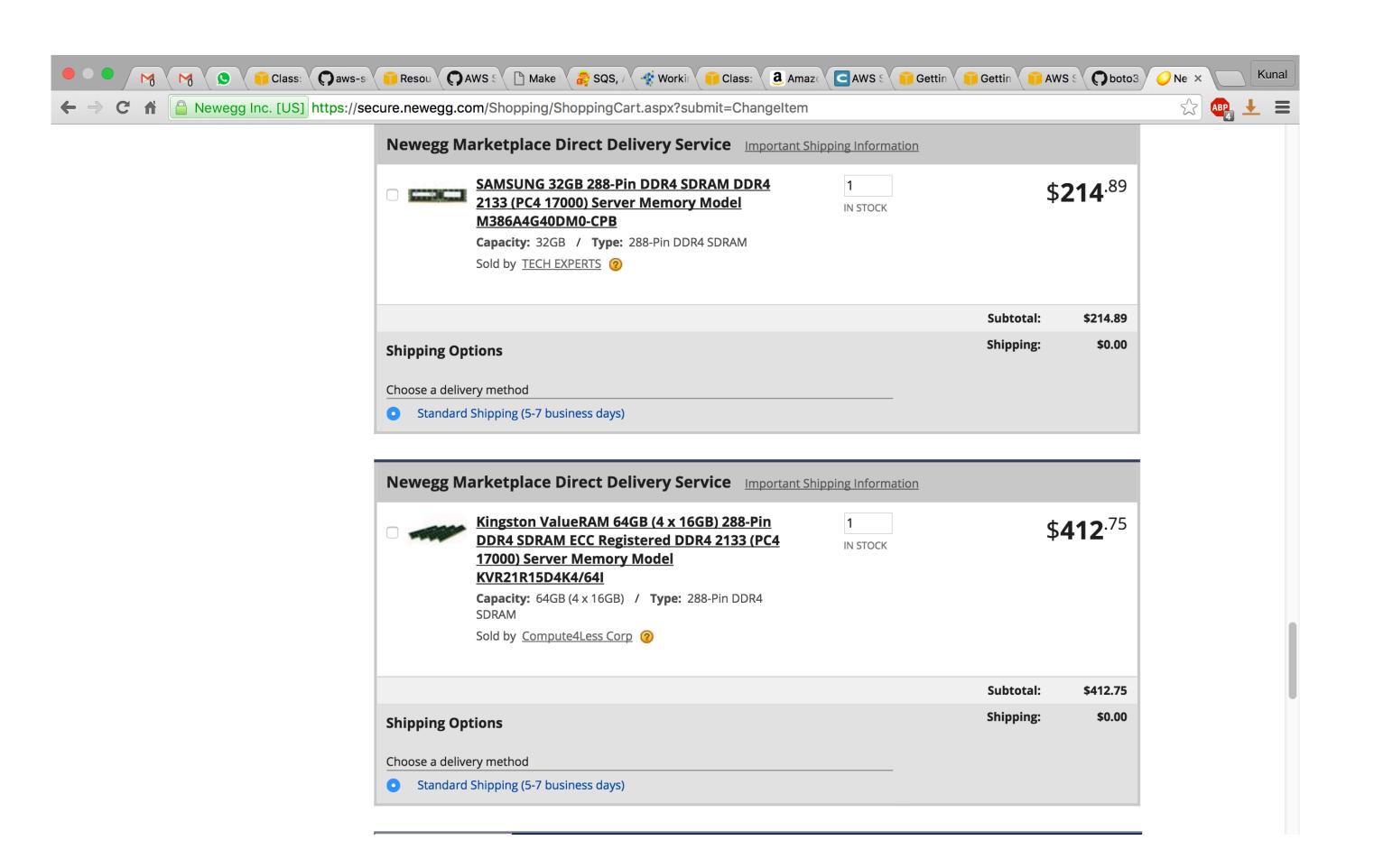












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