

## PROJECT PART 1

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Cluster Computing

## Contents

XEN INSTALLATION .....	3
hardware configuration .....	3
In addition to dom0, construction two VMs (x1 & x2).....	8
GANGLIA.....	12
1 SSH tunneling setup and add Web UI. ....	12
5%: NFS and MPICH .....	14
Swap space management:.....	15
Ganglia for Virtual Cluster Monitoring: (5%).....	16
CPU .....	17
MEMORY .....	17
DISK .....	17
NETWORK .....	18
Hadoop.....	19
Definitions: .....	19
Run WordCount(512 MB) on the two VMs and report the execution time.....	23
TeraSort(with 500 & 900 MB data) on a single machine (2%). .....	25
25%: Hadoop Installation on 8 VMs (4 machines) .....	31
– Run the WordCount (900 MB data, number_of_replicas = 2) on the 8-.....	35
VM virtual cluster. Show the largest number of “running” containers used .....	35
– Fault Tolerance .....	40
20%: TeraSort (with 1000 MB data) on the 8-VM virtual cluster .....	43
DISCUSSION BEFORE EXECUTION .....	44
TRIAL 1.....	45
TRIAL 2.....	51

## XEN INSTALLATION

I had sooo much fun!

Workshop tasks were all done using student13, student14, student1, student2 if not mentioned anything else. I did all the Project 1 individual tasks besides executing the vm-s with overlarge memory and the bonus task.

Ubuntu contains a number of tools for creating Xen guests. The easiest one is [xen-tools](#). This software suite manages the downloading and installing of guest operating systems. In this guide we are going to use xen-tools to prepare an Ubuntu para-virtualized DomU (your Dom1).

### hardware configuration

1 [Before you install xen] show the hardware configuration of the physical machine using commands: “`sudo lshw -short`” & “`sudo xl info`”; highlight the CPU model, RAM size, and # of cores in each physical machine. (2%)

A	B	C
1		
2	student13	student14
3 IP	10.42.0.57	10.42.0.60
4 CPU model	Intel(R) Core(TM) i5 CPU @ 3.0GHz	Intel(R) Core(TM) i5 CPU @ 3.0GHz
5 Memory (RAM)	16 GiB	16 GiB
6 # of Cores		4
7 Disc Storage	500 GiB	500 GiB

8 IP	student1	student2
9 CPU model	10.42.0.21	10.42.0.24
10 Memory (RAM)	Intel(R) Core(TM)2 Duo CPU @ 2.83GHz	Intel(R) Core(TM)2 Duo CPU @ 2.83GHz
11 # of Cores	4 GiB	4 GiB
12 Disc Storage		2
13	250 GiB	250 GiB
14		

Interesting notes: I used the cat /proc/cpuinfo command later when had created 3 VM-s. Even when x3 was not running, dom0 had less memory. I don't understand What Im saying here anymore.

df -h harddisk info .

sudo lshw -short - <http://www.binarytides.com/linux-lshw-command/>

<https://arstechnica.com/gadgets/2016/02/pentium-core-i5-core-i7-making-sense-of-intels-convoluted-cpu-lineup/>

```
student@student13:~$ sudo lshw -short
H/W path        Device      Class      Description
=====
          system      HP Compaq Elite 8300 SFF (QV996AV)
/0          bus            3397
/0/0        memory       64KiB BIOS
/0/4        memory      256KiB L1 cache
/0/5        memory      1MiB L2 cache
/0/6        memory      6MiB L3 cache
/0/7        memory     16GiB System Memory
/0/7/0      memory      DIMM [empty]
/0/7/1      memory     8GiB DIMM DDR3 Synchronous 1600 MHz (0.6
/0/7/2      memory      DIMM [empty]
/0/7/3      memory     8GiB DIMM DDR3 Synchronous 1600 MHz (0.6
/0/10       processor    Intel(R) Core(TM) i5-3570 CPU @ 3.40GHz
/0/100      bridge       Xeon E3-1200 v2/3rd Gen Core processor D
/0/100/2    display      Xeon E3-1200 v2/3rd Gen Core processor G
/0/100/14   bus          7 Series/C210 Series Chipset Family USB
/0/100/19   eth0        network     82579LM Gigabit Network Connection
/0/100/1a   bus          7 Series/C210 Series Chipset Family USB
/0/100/1b   multimedia  7 Series/C210 Series Chipset Family High
/0/100/1d   bus          7 Series/C210 Series Chipset Family USB
/0/100/1e   bridge       82801 PCI Bridge
/0/100/1f   bridge       Q77 Express Chipset LPC Controller
/0/100/1f.2  storage     7 Series/C210 Series Chipset Family 6-po
/0/100/1f.3  bus          7 Series/C210 Series Chipset Family SMBu
/0/1        scsi0       storage
/0/1/0.0.0  /dev/sda    disk        500GB ST500DM002-1BD14
/0/1/0.0.0/1 /dev/sda1   volume     449GiB EXT4 volume
/0/1/0.0.0/2 /dev/sda2   volume     15GiB Extended partition
/0/1/0.0.0/2/5 /dev/sda5  volume     15GiB Linux swap / Solaris partition
/0/2        scsi2       storage
/0/2/0.0.0  /dev/cdrom  disk        DVD-RAM GH80N
/1          vif1.0      network    Ethernet interface
/2          vif2.0      network    Ethernet interface
student@student13:~$
```

```
sudo xl info http://www.binarytides.com/linux-lshw-command/ - DOM infop
```

```
student@student13:~$ sudo xl info
host          : student13
release       : 3.13.0-106-generic
version       : #153-Ubuntu SMP Tue Dec 6 15:44:32 UTC 2016
machine       : x86_64
nr_cpus       : 4
max_cpu_id   : 3
nr_nodes      : 1
cores_per_socket : 4
threads_per_core : 1
cpu_mhz       : 3392
hw_caps       : bfefbf0:28100800:00000000:00007f00:77bae3ff:00000000:00000001:00000281
virt_caps     :
total_memory  : 16258
free_memory   : 345
sharing_freed_memory : 0
sharing_used_memory : 0
outstanding_claims : 0
free_cpus     : 0
xen_major     : 4
xen_minor     : 4
xen_extra     : .2
xen_version   : 4.4.2
xen_caps      : xen-3.0-x86_64 xen-3.0-x86_32p
xen_scheduler : credit
xen_pagesize  : 4096
platform_params : virt_start=0xffff800000000000
xen_changerset :
xen_commandline : placeholder
cc_compiler    : gcc (Ubuntu 4.8.4-2ubuntu1~14.04.3) 4.8.4
cc_compile_by  : stefan.bader
cc_compile_domain : canonical.com
cc_compile_date : Thu Jan 12 18:01:42 UTC 2017
xend_config_format : 4
student@student13:~$
```

`cat /proc/meminfo` [https://www.centos.org/docs/5/html/5.1/Deployment\\_Guide/s2-proc-meminfo.html](https://www.centos.org/docs/5/html/5.1/Deployment_Guide/s2-proc-meminfo.html)

About, what different Directories stand for in the UNIX filesystem  
[https://en.wikipedia.org/wiki/Unix\\_filesystem](https://en.wikipedia.org/wiki/Unix_filesystem)

About proc fileSystem and virtual files

[https://www.centos.org/docs/5/html/5.1/Deployment\\_Guide/s1-proc-virtual.html](https://www.centos.org/docs/5/html/5.1/Deployment_Guide/s1-proc-virtual.html)

I forgot to screenshot thi command before creating new XEN VM-s this is the output for dom0, where 8 GB of memory has already been given to the X1,X2

The left hand one is with 2 VM-s running, right hand with 3 VM-s running.

<pre>student@student13:~\$ cat /proc/meminfo MemTotal:      7314040 kB MemFree:       135908 kB Buffers:        151088 kB Cached:        6441480 kB SwapCached:      0 kB Active:        3629328 kB Inactive:      3052272 kB Active(anon):   39468 kB Inactive(anon): 56120 kB Active(file):  3589860 kB Inactive(file): 2996152 kB Unevictable:    36 kB Mlocked:        36 kB SwapTotal:     16646140 kB SwapFree:      16646120 kB Dirty:          3452 kB Writeback:       0 kB AnonPages:     89176 kB Mapped:         30532 kB Shmem:          6556 kB Slab:           359504 kB SReclaimable:  339812 kB SUnreclaim:    19692 kB KernelStack:    1304 kB PageTables:    10844 kB NFS_Unstable:   0 kB Bounce:          0 kB WritebackTmp:    0 kB CommitLimit:   20303160 kB Committed_AS:  662780 kB VmallocTotal:  34359738367 kB VmallocUsed:   371296 kB VmallocChunk:  34359359828 kB HardwareCorrupted: 0 kB AnonHugePages:  0 kB DirectMap4k:   16648636 kB DirectMap2M:    0 kB</pre>	<pre>student@student13-x3:~\$ student0 MemTotal:      3121068 kB MemFree:       100352 kB Buffers:        130968 kB Cached:        2362872 kB SwapCached:      0 kB Active:        1242184 kB Inactive:      1345932 kB Active(anon):   43556 kB Inactive(anon): 57308 kB Active(file):  1198628 kB Inactive(file): 1288624 kB Unevictable:    48 kB Mlocked:        48 kB SwapTotal:     16646140 kB SwapFree:      16645860 kB Dirty:          2268 kB Writeback:       0 kB AnonPages:     94112 kB Mapped:         25420 kB Shmem:          6588 kB Slab:           293396 kB SReclaimable:  273136 kB SUnreclaim:    20260 kB KernelStack:    1384 kB PageTables:    11208 kB NFS_Unstable:   0 kB Bounce:          0 kB WritebackTmp:    0 kB CommitLimit:   18206672 kB Committed_AS:  714996 kB VmallocTotal:  34359738367 kB VmallocUsed:   371568 kB VmallocChunk:  34359359304 kB HardwareCorrupted: 0 kB AnonHugePages:  0 kB DirectMap4k:   16648636 kB DirectMap2M:    0 kB</pre>
---	---

cat /proc/cpuinfo

[https://www.centos.org/docs/5/html/5.1/Deployment\\_Guide/s2-proc-cpuinfo.html](https://www.centos.org/docs/5/html/5.1/Deployment_Guide/s2-proc-cpuinfo.html)

<https://et.wikipedia.org/wiki/H%C3%BCper-hartg%C3%B6t%C3%BDtlus> –  
Tehnoloogia osa

Partial output...

```
student@student13:~$ cat /proc/cpuinfo
processor       : 0
vendor_id      : GenuineIntel
cpu family     : 6
model          : 58
model name     : Intel(R) Core(TM) i5-3570 CPU @ 3.40GHz
stepping        : 9
microcode      : 0x12
cpu MHz        : 3392.366
cache size     : 6144 KB
physical id    : 0
siblings        : 4
core id         : 0
cpu cores      : 4
apicid          : 0
initial apicid : 0
fpu             : yes
fpu_exception   : yes
cpuid level    : 13
wp              : yes
flags           : fpu de tsc msr pae mce cx8 apic sep mca cmov pat clflush acpi mmx fxsr sse sse2 ss ht syscall nx lm
constant_tsc rep_good nopl nonstop_tsc eagerfpu pni pclmulqdq monitor est ssse3 cx16 sse4_1 sse4_2 popcnt tsc_deadline_timer aes xsave avx f16c rdrand hypervisor lahf_lm ida arat epb xsaveopt pln pts dtherm fsgsbase erms
bogomips        : 6784.73
clflush size    : 64
cache_alignment : 64
address sizes   : 36 bits physical, 48 bits virtual
power management:

processor       : 1
```

In addition to dom0, construct two VMs (x1 & x2)

at your machine. Show the configuration of dom0, VM1, and VM2, including vcpu, memory size, disk size, and swap space size. (

“Sudo xl list”,

```
student@student13:~$ sudo xl list
Name                                     ID  Mem VCPUs  State   Time(s)
Domain-0                                 0   7537    4     r----- 2477433.8
student13-x1                            1   4096    1     r----- 2229936.7
student13-x2                            2   4096    1     r----- 2229897.6
student@student13:~$
```

“cat /proc/meminfo”,

```
student@student13:~$ cat /proc/meminfo
MemTotal:       7313724 kB
MemFree:        1921600 kB
Buffers:        168460 kB
Cached:         4834524 kB
SwapCached:      0 kB
Active:         1368364 kB
Inactive:       3689540 kB
Active(anon):   55460 kB
Inactive(anon): 5968 kB
Active(file):   1312904 kB
Inactive(file): 3683572 kB
Unevictable:    36 kB
Mlocked:        36 kB
SwapTotal:      16646140 kB
SwapFree:       16646140 kB
Dirty:          3632 kB
```

“cat /proc/cpuinfo”, etc.) (4%) Does not change

```
student@student13:~$ cat /proc/cpuinfo
processor       : 0
vendor_id      : GenuineIntel
cpu family     : 6
model          : 58
model name     : Intel(R) Core(TM) i5-3570 CPU @ 3.40GHz
stepping        : 9
microcode      : 0x12
cpu MHz        : 3392.366
cache size     : 6144 KB
physical id    : 0
siblings        : 4
core id        : 0
cpu cores      : 4
apicid          : 0
initial apicid : 0
fpu             : yes
fpu_exception  : yes
cpuid level    : 13
wp              : yes
flags           : fpu de tsc msr pae mce cx8 apic sep mca cmov pat clflush acpi mmx fxsr sse sse2 ss ht syscall nx lm
constant_tsc rep_good nopl nonstop_tsc eagerfpu pn1 pcimulqdq monitor est ssse3 cx16 sse4_1 sse4_2 popcnt tsc_deadli
ne_timer aes xsave avx f16c rdrand hypervisor lahf_lm ida arat epb xsaveopt pln pts dtherm fsgsbase erms
bogomips        : 6784.73
clflush size   : 64
cache_alignment : 64
address sizes   : 36 bits physical, 48 bits virtual
power management:
processor       : 1
processor       : 2
```

	dom0	x1	x2
vcpu	vcpu: 4	vcpu: 1	vcpu:1
memory	memory 7537 MB 7311692 kB	memory 4096 MB 4097820 kB	memory 4096 MB 4097820 kB
swap space	swap space 16646140 kB= 16255MB	8 GB 8388604 kB	8 GB 8388604 kB
disk size	lsblk 465 GB lshw 500 GB	50 GB	50 GB

Dom0 Has notified to have 4 vcpu-s according to xl list commad. At the same time it has 4 cores. How does this sharing between computers work ? What is considered as a vcpu ? definition kinda vague.

Question/ Claim, number oc VCPU-s is pretty much the number of CPU-s shown to the current VM ? That my hypothesis.

More about VCPU-s

<http://whatis.techtarget.com/definition/virtual-CPU-vCPU> - It is a physical processing unit that is assigned to VM . [ADDITION LATER ON]

<http://www.hardwaresecrets.com/everything-you-need-to-know-about-the-intel-virtualization-technology/2/>

<http://serverfault.com/questions/504626/best-practice-vcpus-per-physical-core> - Some recommendations about utilizing Vcpu-s

According to this article: A single physical CPU can be utilized as many vCPUs. You rarely run out of CPU resources in virtualization solutions. RAM and storage are always the limiting factors

Has my hard disk size shown for dom0 changed with the virtual disk creation ? No, checked with a 3. v.m

Check xenbridge on your machine: (brctlshow; brctlshowmacs xenbr0) (2%)

**brctl show** – it is bridging the connection between the virtual machines and dom0, which has control of the hardware.

```
student@student13:~$ brctl show
bridge name      bridge id          STP enabled    interfaces
virbr0           8000.000000000000  yes           eth0
xenbr0           8000.24be05109fdb  no            vif1.0
                                         vif2.0
student@student13:~$
```

**brctl showmacs xenbr0**, both virtual machines seem to be on the list. Shown as non-local.

00:23:ae:9b:d1:3A 10.42.0.58 student13-x1

00:23:ae:9b:d1:3B 10.42.0.59 student13-x2

```
student@student13:~$ brctl showmacs xenbr0
port no mac addr          is local?    ageing timer
  1   00:06:52:58:34:00    no          23.37
  1   00:11:bb:60:83:00    no          48.63
  1   00:11:bb:60:83:06    no          6.49
  1   00:1d:92:97:3f:f1   no          0.58
  1   00:1d:92:97:44:fe   no          4.17
  1   00:1d:92:97:57:96   no          1.97
  1   00:1d:92:97:5a:7a   no          1.57
  1   00:23:ae:9b:d0:a2   no          3.30
  2   00:23:ae:9b:d1:3a   no          0.22
  3   00:23:ae:9b:d1:3b   no          0.22
  1   00:23:ae:9b:d1:48   no          225.25
  1   00:23:ae:9b:d1:a0   no          2.18
  1   00:23:ae:9b:d1:a1   no          10.19
  1   00:23:ae:9b:d1:b5   no          3.78
  1   00:23:ae:9b:d1:b6   no          4.16
  1   00:23:ae:9b:d2:05   no          3.73
  1   00:23:ae:9b:d7:8f   no          2.08
  1   00:23:ae:9b:db:82   no          4.09
  1   00:23:ae:9b:db:93   no          0.00
  1   00:23:ae:9c:04:37   no          1.60
  1   00:23:ae:b0:9e:f9   no          0.23
  1   00:23:ae:b0:ca:84   no          0.00
  1   24:be:05:10:9f:db   yes         0.00
  1   24:be:05:15:d3:7a   no          38.41
  1   40:61:86:c4:d0:15   no          7.31
  1   40:61:86:c7:9d:a8   no          16.35
  1   5c:26:0a:bf:d5:bb   no          13.25
  1   6c:62:6d:0c:1a:8e   no          2.45
  2   fe:ff:ff:ff:ff:ff   yes         0.00
student@student13:~$
```

SSH a VM without password from two other remote vms (e.G., Studentxx-x1 ↔→ studentyy-x1, studentzz-x2). ("Ssh student@studentxx-x2") (2%)

```
* Documentation: https://help.ubuntu.com/
Last login: Mon Feb 13 17:51:50 2017 from student1-x1
student@student13-x1:~$ ssh student14-x1
Welcome to Ubuntu 14.04 LTS (GNU/Linux 3.13.0-106-generic x86_64)

* Documentation: https://help.ubuntu.com/
Last login: Mon Feb 13 12:34:49 2017 from student14
student@student14-x1:~$ ssh student13-x1
Welcome to Ubuntu 14.04.5 LTS (GNU/Linux 3.13.0-106-generic x86_64)

* Documentation: https://help.ubuntu.com/
Last login: Mon Feb 13 17:52:08 2017 from student13
student@student13-x1:~$ ssh student1-x1
Welcome to Ubuntu 14.04.5 LTS (GNU/Linux 3.13.0-106-generic x86_64)

* Documentation: https://help.ubuntu.com/
Last login: Mon Feb 13 17:50:50 2017 from student13-x1
student@student1-x1:~$ ssh student13-x2
Welcome to Ubuntu 14.04.5 LTS (GNU/Linux 3.13.0-106-generic x86_64)

* Documentation: https://help.ubuntu.com/
Last login: Fri Feb 10 15:08:21 2017 from student13
student@student13-x2:~$ █
```

## GANGLIA

### I SSH tunneling setup and add Web UI

Setup SSH tunneling to allow web access outside CBLG104 lab room. Show the GUI of your Ganglia ([http://{IP\\_Address}/ganglia/](http://{IP_Address}/ganglia/)). Should display CPU, memory, disk, network usage of your two VMs (x1 and x2) (2%)

### Short summary of process

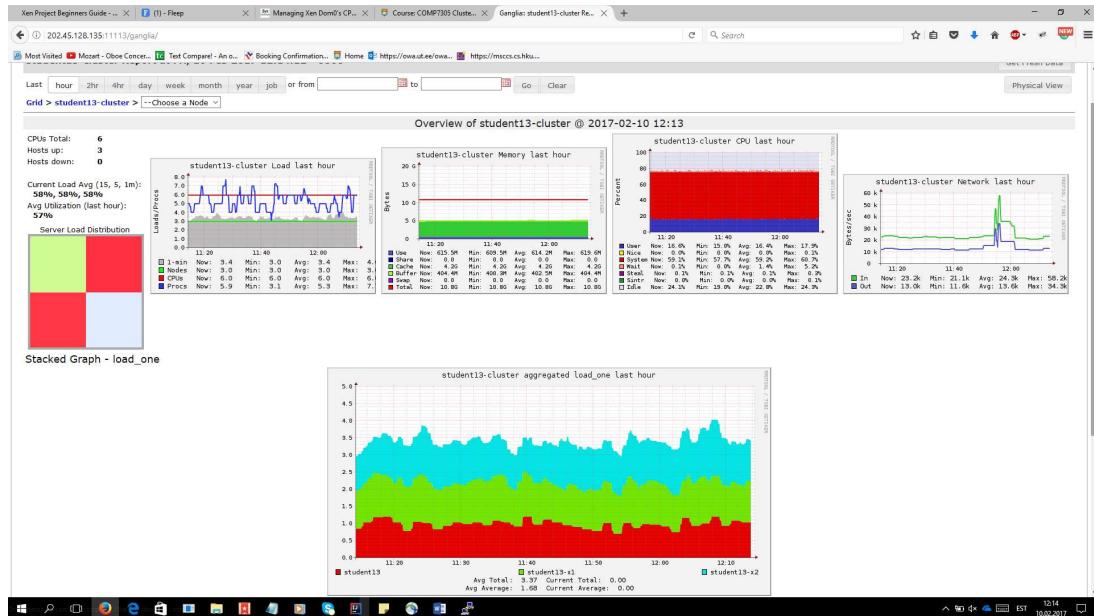
Ganglia Intro: <https://www.digitalocean.com/community/tutorials/introduction-to-ganglia-on-ubuntu-14-04>

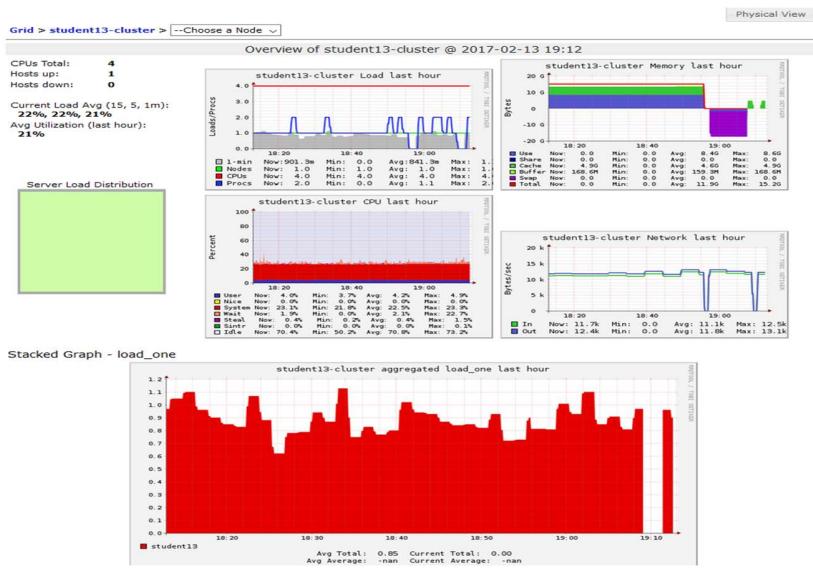
Overall process here was that we configured gmetad and gmond on dom, and gmond-s on both virtualmachines. gmond is pretty much the information provider about the system and gmetad on dom0 listens/monitors this info and gives it to another tool, which then presents this information visually on apache web-server

Dom0, VM1,VM2 Accessible at **Currently only dom0, because VM-s assigned to Cluster.**

<http://202.45.128.135:10113/ganglia>

On Bottom graph we can see dom0, x1, x2 are monitored.





## 5%: NFS and MPICH

- Create new files in your NFS folder (/mirror). Show these newly created files can be viewed ("ls") and accessed ("cat") from a remote virtual machine (NFS client) created by your groupmate. (2%)
- Execute the cpi MPI program on all 8 VMs to show the results. (3%)  
[Note: you can show the execution status using Ganglia]

```
touch: cannot touch '/mirrot/testin123': No such file or directory
student@student14-x1:~$ touch /mirror/testin123
student@student14-x1:~$
```

```
student@student13-x1:~
```

onnection to student13 closed.

```
tudent@cocserver:~$ ssh student13-x1
student@student13-x1's password:
```

```
tudent@cocserver:~$ ssh student13-x1
student@student13-x1's password:
elcome to Ubuntu 14.04.5 LTS (GNU/Linux 3.13.0-106-generic x86_64)

* Documentation: https://help.ubuntu.com/
ast login: Sun Apr  2 09:53:49 2017 from 10.42.0.1
tudent@student13-x1:~$ ls -l /mirror/
otal 10864
rw-rw-r--  1 student student      5 Mar 20 14:42 14testfile
rw-r--r--  1 student student    973 Feb 10 15:58 core-site.xml
rw-r--r--  1 student student    924 Feb 10 15:58 hdfs-site.xml
rw-rw-r--  1 student student      0 Mar 26 09:23 lamp
rw-r--r--  1 student student   1017 Feb 10 15:57 mapred-site.xml
rwxrwxr-x  6 student student   4096 Mar 19 23:32 mpich3
rwxr-xr-x 12 student student   4096 Mar 27 19:44 mpich-3.1
rw-r--r--  1 student student 11088555 Feb  1 22:48 mpich-3.1.tar.gz
rw-rw-r--  1 student student      0 Apr  2 12:36 testin123
rwxrwxr-x  2 student student   4096 Feb  1 22:40 tmp
rw-r--r--  1 student student    894 Feb 10 15:57 yarn-site.xml
student@student13-x1:~$
```

```
student@student14:~$ mpiexec -n 8 -machinefile ~/machinelist /mirror/mpich-3.1/e
xamples/mpilong
Process 0 of 8 is on student14-x1
Process 2 of 8 is on student13-x1
Process 3 of 8 is on student13-x2
Process 4 of 8 is on student1-x1
Process 7 of 8 is on student85-x2
Process 6 of 8 is on student85-x1
Process 1 of 8 is on student14-x2
Process 5 of 8 is on student1-x2
pi is approximately 3.1415926544231247, Error is 0.0000000008333316
wall clock time = 0.018821
```

## Swap space management:

(4%) Intentionally run a large MapReduce program that crashes because the system is “out of swap space”. Increase the swap space of your VMs to solve the problem. (Hint: (1). “swapoff” to turn off current swap space, (2). “dd” to increase current swap

space, (3). “mkswap” and “swapon” to turn on swap space; or something equivalent). [Note:

handle this problem after you finish most tasks in Part I ^\_^]

The screenshot shows the Hadoop Application Overview page. On the left, there's a sidebar with 'Cluster' navigation: 'About', 'Nodes', 'Applications' (with sub-options 'NEW', 'NEW SAVING', 'SUBMITTED', 'ACCEPTED', 'RUNNING', 'FINISHED', 'FAILED', 'KILLED'), 'Scheduler', and 'Tools'. The main area displays application details for 'word count' under 'MAPREDUCE'. The application status is 'FAILED'. It shows the start time as '20-Mar-2017 19:03:38' and an elapsed time of '12sec'. A 'Tracking' link is provided. The 'Diagnostics' section contains a large block of log text detailing the failure due to memory limits and container killing.

```
User: hduser
Name: word count
Application: MAPREDUCE
Type:
Application
Tags:
State: FAILED
FinalStatus: FAILED
Started: 20-Mar-2017 19:03:38
Elapsed: 12sec
Tracking: History
URL:
Diagnostics: Application application_1490005798735_0004 failed 2 times due to AM Container for appattempt_1490005798735_0004_000002 exited with exitCode: -103
For more detailed output, check application tracking page:

Without swap and with 2 gb of memory for both, the map reduce crashed in different ways.


```

Adding swap solved the issue. This can be also solved by configurin yarn to run differently, e.g with less memory if the input tasks are possible with smalle containers

## Ganglia for Virtual Cluster Monitoring (5%)

Used reports to monitor all together

CPU\_REPORT

MEMORY\_REPORT

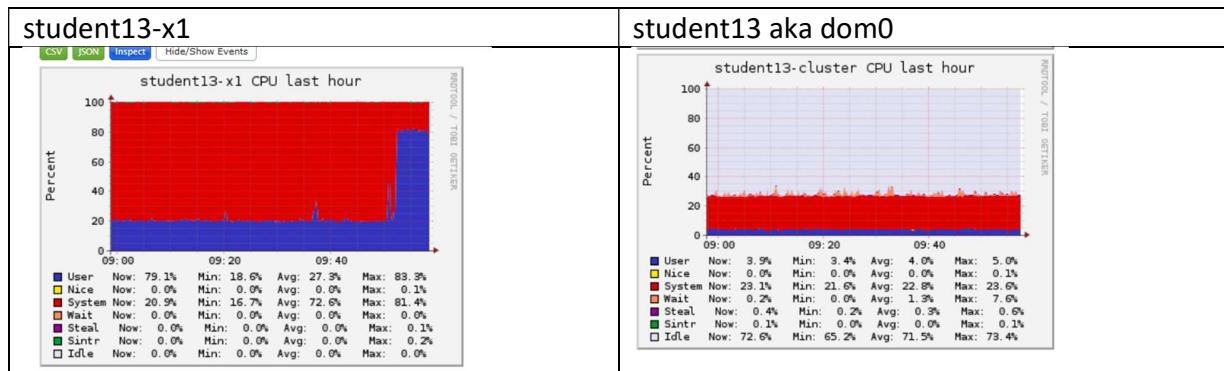
Other useful commands to test and check ganglia

top

stress --cpu 3

## WordCount (word\_input.txt 900MB) on the 8 VMs (no work to Dom0).

- For testing purposes, to see how ganglia follows cpu utilization I ran program
  - top
  - stress --cpu 3
  - Tested this on student13-x1- result

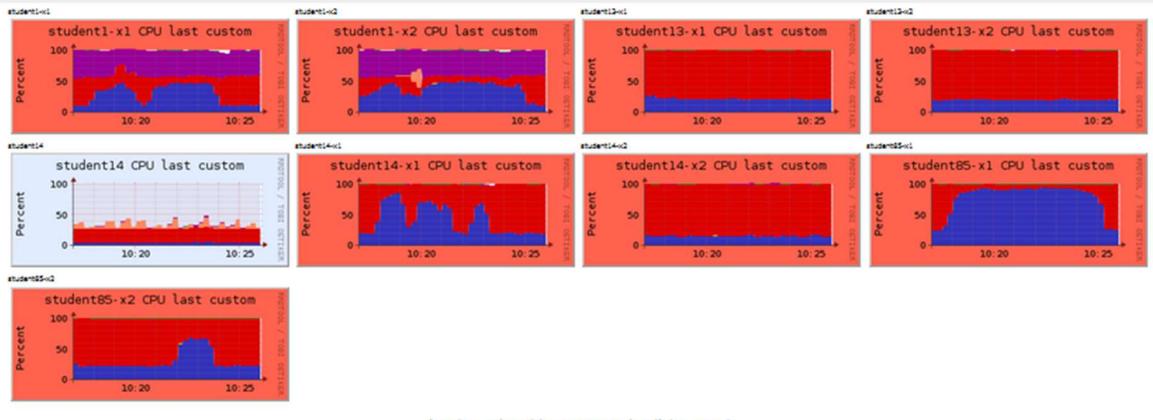


## Show the status (CPU, memory, disk, network) of the 8 VMs.

From: 10.17

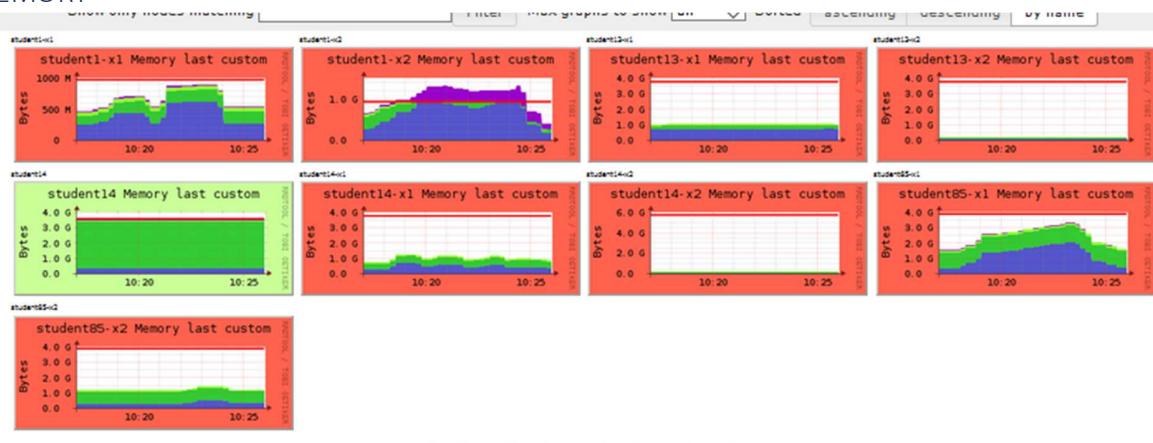
To: 10.26

CPU



(Nodes colored by 1-minute load) | Legend

MEMORY



(Nodes colored by 1-minute load) | [Legend](#)

DISK

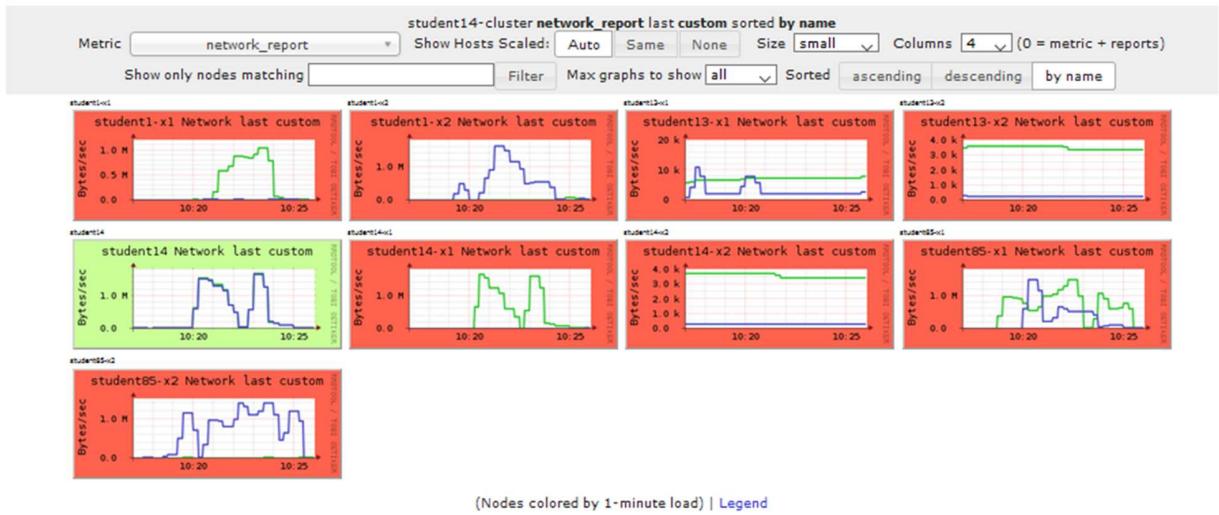
<http://eastcirclek.blogspot.hk/2015/10/monitoring-disk-throughput-using-ganglia.html>

Because I had to install some python module to read every disk separately, I only followed disk load on Student 14-x1. But its easy to assume, that Disk IO was high before map operations (reading), during sort, shuffle, merge phase (read, write) and reduce(read)

**READ** student14-x1 performed reduce



## NETWORK

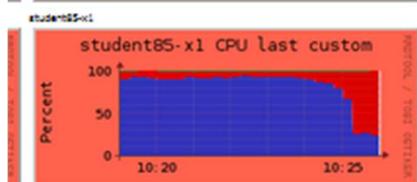


Show which VM(s) has the highest CPU load during the Reduce phase. (3%)

Reduce

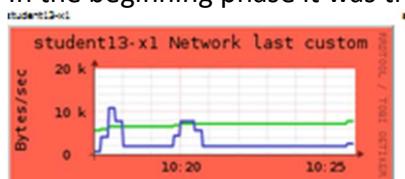
From: 10.19

To: 10.25

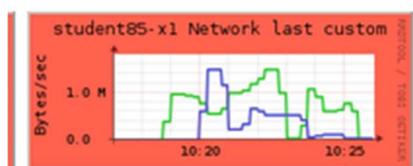


Show which VM(s) involve the largest network load/traffic. Why? (2%)

In the beginning phase it was the ResourceManager



After that it seems student85-x1 had the biggest io load. It is most likely because of misplaced datablocks.



## Hadoop

15%: Hadoop installation on a single machine with two VMs (x1 & x2): [Note: Must enable Yarn. You can choose one VM as the NameNode and let both VMs as the DataNodes. Set the replication of the input data file to 1.]

Definitions:

	MASTER	SLAVE
HDFS	NameNode	DataNode
YARN	ResourceManager	NodeManager

**job** – unit of work, the client wants to be performed

**task** – 1 map / reduce task

**input** – divided into input splits. 1 input split – 1 task

**1 container runs 1 task**

**1 CONTAINER HAS 1 TASK WHICH PROCESSES 1 INPUT UNIT**

The amount of containers running concurrently depends on memory and CPU settings.

There are multiple important parameters, when setting up a cluster

Verify the Hadoop installation: Do JPS on the two VMs respectively. (2%)

x1

```
Welcome to Ubuntu 14.04.5 LTS (GNU/Linux 3.13.0-106-generic x86_64)

 * Documentation: https://help.ubuntu.com/
Last login: Fri Feb 10 16:47:15 2017 from student14-x1
hduser@student13-x1:~$ jps
22672 DataNode
11072 SecondaryNameNode
7410 JobHistoryServer
21524 NodeManager
19880 Jps
7582 NameNode
20639 ResourceManager
hduser@student13-x1:~$
```

x2

```
FILTER := [ state TCP-STATE ] [ EXPRESSION ]
hduser@student13-x1:~$ ssh student13-x2
Welcome to Ubuntu 14.04.5 LTS (GNU/Linux 3.13.0-106-generic x86_64)

 * Documentation: https://help.ubuntu.com/
Last login: Fri Feb 10 16:56:00 2017 from student13-x1
hduser@student13-x2:~$ jps
14832 NodeManager
14902 Jps
1673 SecondaryNameNode
25418 DataNode
hduser@student13-x2:~$
```

Load a file (500 MB) to HDFS and show the overall disk usage summary ("hdfs dfsadmin -report") (2%)

<http://202.45.128.135:11113/dfshealth.html#tab-overview>

```
hduser@student13-x1:~$ hdfs dfsadmin -report
Configured Capacity: 105420939264 (98.18 GB)
Present Capacity: 91731599360 (85.43 GB)
DFS Remaining: 89826762752 (83.66 GB)
DFS Used: 1904836608 (1.77 GB)
DFS Used%: 2.08%
Under replicated blocks: 0
Blocks with corrupt replicas: 0
Missing blocks: 0

-----
Live datanodes (2):

Name: 10.42.0.59:50010 (student13-x2)
Hostname: student13-x2
Decommission Status : Normal
Configured Capacity: 52710469632 (49.09 GB)
DFS Used: 952418304 (908.30 MB)
Non DFS Used: 6270291968 (5.84 GB)
DFS Remaining: 45487759360 (42.36 GB)
DFS Used%: 1.81%
DFS Remaining%: 86.30%
Configured Cache Capacity: 0 (0 B)
Cache Used: 0 (0 B)
Cache Remaining: 0 (0 B)
Cache Used%: 100.00%
Cache Remaining%: 0.00%
Xceivers: 1
Last contact: Tue Feb 14 18:25:24 HKT 2017

Name: 10.42.0.58:50010 (student13-x1)
Hostname: student13-x1
Decommission Status : Normal
Configured Capacity: 52710469632 (49.09 GB)
DFS Used: 952418304 (908.30 MB)
Non DFS Used: 7419047936 (6.91 GB)
DFS Remaining: 44339003392 (41.29 GB)
DFS Used%: 1.81%
DFS Remaining%: 84.12%
Configured Cache Capacity: 0 (0 B)
Cache Used: 0 (0 B)
Cache Remaining: 0 (0 B)
Cache Used%: 100.00%
Cache Remaining%: 0.00%
Xceivers: 1
Last contact: Tue Feb 14 18:25:24 HKT 2017
```

# Datanode Information

---

## In operation

Node	Last contact	Admin State	Capacity	Used	Non DFS Used	Remaining	Blocks	Block pool used	Failed Volumes	Version
student13-x2 (10.42.0.59:50010)	0	In Service	49.09 GB	907.22 MB	5.84 GB	42.36 GB	15	907.22 MB (1.8%)	0	2.6.0
student13-x1 (10.42.0.58:50010)	0	In Service	49.09 GB	907.22 MB	6.91 GB	41.29 GB	15	907.22 MB (1.8%)	0	2.6.0

## Decommissioning

Node	Last contact	Under replicated blocks	Blocks with no live replicas	Under Replicated Blocks In files under construction
------	--------------	-------------------------	------------------------------	--

Hadoop, 2014.

Legacy UI

Stop and restart HDFS (stop-all.sh, start-all.sh). Verify that all DataNodes remain active after restart. (2%)

```
hduser@student13-x1:~$ start-dfs.sh
Starting namenodes on [student13-x1]
student13-x1: starting namenode, logging to /opt/hadoop-2.6.0/logs/hadoop-hduser-namenode-student13-x1.out
student13-x2: starting datanode, logging to /opt/hadoop-2.6.0/logs/hadoop-hduser-datanode-student13-x2.out
student13-x1: starting datanode, logging to /opt/hadoop-2.6.0/logs/hadoop-hduser-datanode-student13-x1.out
Starting secondary namenodes [0.0.0.0]
0.0.0.0: starting secondarynamenode, logging to /opt/hadoop-2.6.0/logs/hadoop-hduser-secondarynamenode-student13-x1.out
hduser@student13-x1:~$ jps
21908 SecondaryNameNode
19991 DataNode
2681 Jps
18911 NameNode
```

**Run WordCount(512 MB) on the two VMs and report the execution time.**

**Show the # of running containers, # of map and reduce tasks during the execution of the WordCountjob. (Note 2) (4%)**

### Example

This is running an already built file

```
hadoop jar /opt/hadoop-2.6.0/share/hadoop/mapreduce/hadoop-mapreduce-examples-2.6.0.jar wordcount /dft-single-13x1 /dft-single-13x1-output-randomString
```

This is running a .java file, that has not been previously built.

```
mkdir wordcount_classes
```

### Compilation

```
javac -cp /opt/hadoop-2.6.0/share/hadoop/mapreduce/hadoop-mapreduce-client-core-2.6.0.jar:/opt/hadoop-2.6.0/share/hadoop/common/hadoop-common-2.6.0.jar :..... -d wordcount_classes WordCount.java
```

```
-cp : classpath
```

```
-d directory
```

### Create jar

```
jar -cvf wordcount.jar -C wordcount_classes/ .
```

### Run the specific example

```
hadoop/yarn jar wordcount.jar org.myorg.WordCount/dft /dft-output-2
```

*hadoop and yarn command in this case same  
<http://stackoverflow.com/questions/22769129/differences-between-hadoop-jar-and-yarn-jar>*

### Retrieve the result

```
hdfs dfs -copyToLocal /dft-output2 ~/
```

```
# Running Containers 15
```

**Cluster Metrics**

Apps Submitted	Apps Pending	Apps Running	Apps Completed	Containers Running	Memory Used	Memory Total	Memory Reserved	VCores Used	VCores Total	VCores Reserved	Active Nodes	Decommissioned Nodes	Lost Nodes
3	0	1	2	15	16 GB	16 GB	0 B	15	16	0	2	0	0

Show 20 entries Search:

ID	User	Name	Application Type	Queue	StartTime	FinishTime	State	FinalStatus	Progress
application_1487069199374_0003	hduser	word count	MAPREDUCE	default	Tue, 14 Feb 2017 11:21:22	N/A	RUNNING	UNDEFINED	

**All Applications**

ID	User	Name	Application Type	Queue	StartTime	FinishTime	State	FinalStatus	Progress	Tracking UI
application_1487069199374_0003	hduser	word count	MAPREDUCE	default	Tue, 14 Feb 2017 11:21:22	N/A	RUNNING	UNDEFINED		ApplicationMaster
application_1487069199374_0002	hduser	word count	MAPREDUCE	default	Tue, 14 Feb 2017 10:49:43 GMT	Tue, 14 Feb 2017 10:55:30 GMT	FINISHED	SUCCEEDED		History
application_1487069199374_0001	hduser	word count	MAPREDUCE	default	Tue, 14 Feb 2017 10:47:25 GMT	Tue, 14 Feb 2017 10:51:55 GMT	FINISHED	SUCCEEDED		History

Showing 1 to 3 of 3 entries First Previous 1 Next Last

```
# Maps = 14 & Reduces = 1
```

202.45.128.135:10313/jobhistory

Most Visited Mozart - Oboe Concert... Text Compare - An o... Booking Confirmation... Home https://owa.ut.ee/owa... https://msccs.cs.hku...

Logged in as: dr.who

**JobHistory**

**Retired Jobs**

Submit Time	Start Time	Finish Time	Job ID	Name	User	Queue	State	Maps Total	Maps Completed	Reduces Total	Reduces Completed
2017.02.14 19:21:22 HKT	2017.02.14 19:21:36	2017.02.14 19:25:32 HKT	job_1487069199374_0003	word count	hduser	default	SUCCEEDED	14	14	1	1
2017.02.14 18:49:43 HKT	2017.02.14 18:51:19	2017.02.14 18:55:29 HKT	job_1487069199374_0002	word count	hduser	default	SUCCEEDED	14	14	1	1
2017.02.14 18:47:24 HKT	2017.02.14 18:47:45	2017.02.14 18:51:54 HKT	job_1487069199374_0001	word count	hduser	default	SUCCEEDED	14	14	1	1

Showing 1 to 3 of 3 entries First Previous 1 Next Last

The screenshot shows the Hadoop Cluster Nodes page. On the left, there's a sidebar with a tree view of the cluster, including sections for About, Nodes, Applications, and Scheduler. The Applications section lists stages: NEW, NEW\_SAVING, SUBMITTED, ACCEPTED, RUNNING, FINISHED, FAILED, KILLED, and Scheduler. Below this is a 'Tools' section. The main content area has a title 'Nodes of the cluster'. It includes a 'Cluster Metrics' table with columns like Apps Submitted, Apps Pending, Apps Running, Apps Completed, Containers Running, Memory Used Total, Memory Reserved, Vcores Used Total, Vcores Reserved, Active Nodes, Decommissioned Nodes, Lost Nodes, Unhealthy Nodes, and Rebooted Nodes. Below the table is a table titled 'Show 20 entries' with columns for Node Labels, Rack, Node State, Node Address, Node HTTP Address, Last health-update, Health-report, Containers, Mem Used, Mem Avail, Vcores Used, Vcores Avail, and Version. Two rows of data are shown, both for student13-x1:8042. At the bottom, it says 'Showing 1 to 2 of 2 entries' and has links for First, Previous, Next, and Last.

After Run 2. We can see, that time it took to run the program was 4 minutes. It had 15 containers running. 13 map tasks, 1 reduce task and also one AM

The screenshot shows the Hadoop Cluster Application Overview page for application\_1487069199374\_0003. The sidebar on the left is identical to the previous screenshot. The main content area is titled 'Application Overview' and displays various application details. It includes fields for User (hduser), Name (word count), Application Type (MAPREDUCE), Application Tags, State (FINISHED), FinalStatus (SUCCEEDED), Started (14-Feb-2017 19:21:22), Elapsed (4mins, 10sec), Tracking URL (History), and Diagnostics.

TeraSort(with 500 & 900 MB data) on a single machine (2%).

Show the execution time for sorting 500 MB data using 2 VMs (x1 & x2). Validate the sorted output data of TeraSort. (TeraValidate)

Generate data

```
hduser@student13-x1:/opt/hadoop-2.6.0/share/hadoop/mapreduce$ yarn jar hadoop-mapreduce-examples-2.6.0.jar teragen 500000 /terainput
```

Sort

```
Bytes Written=5000000000
hduser@student13-x1:/opt/hadoop-2.6.0/share/hadoop/mapreduce$ yarn jar hadoop-mapreduce-examples-2.6.0.jar terasort /terainput /terayoutput
17/02/15 13:13:57 INFO terasort.TeraSort: starting
```

Validate - Success

```
hduser@student13-x1:/opt/hadoop-2.6.0/share/hadoop/mapreduce$ yarn jar hadoop-mapreduce-examples-2.6.0.jar teravalidate /terayoutput /teravalidate
17/02/15 13:17:32 INFO client.RMProxy: Connecting to ResourceManager at student13-x1/10.42.0.58:8032
```

Sort time 1 min, 36 sec

MapReduce Job job\_14870691... X MapReduce Job job\_14870691... +

202.45.128.135:10313/jobhistory/job/job\_14 80% C Search

Most Visited Mozart - Oboe Concer... tc Text Compare! - An o... Booking Confirmation... Home https://owa.ut.ee/owa... https://msccs.cs.hku...

Logged in as: dr.who

 **MapReduce Job**  
**job\_1487069199374\_0011**

**Job Overview**

Job Name:	TeraSort
User Name:	hduser
Queue:	default
State:	SUCCEEDED
Uberized:	false
Submitted:	Wed Feb 15 13:14:08 HKT 2017
Started:	Wed Feb 15 13:14:21 HKT 2017
Finished:	Wed Feb 15 13:15:58 HKT 2017
Elapsed:	1mins, 36sec
Diagnostics:	
Average Map Time	46sec
Average Shuffle Time	48sec
Average Merge Time	0sec
Average Reduce Time	21sec

**ApplicationMaster**

Attempt Number	Start Time	Node	Logs
1	Wed Feb 15 13:14:12 HKT 2017	student13-x1:8042	logs

Task Type	Total	Complete
Map	8	8
Reduce	1	1

Attempt Type	Failed	Killed	Successful
Maps	0	2	8
Reduces	0	0	1

MapReduce Job job\_14870691... X MapReduce Job job\_14870691... +

202.45.128.135:10313/jobhistory/job/job\_14 80% C Search

Most Visited Mozart - Oboe Concer... tc Text Compare! - An o... Booking Confirmation... Home https://owa.ut.ee/owa... https://msccs.cs.hku...

Logged in as: dr.who

 **MapReduce Job**  
**job\_1487069199374\_0012**

**Job Overview**

Job Name:	TeraValidate
User Name:	hduser
Queue:	default
State:	SUCCEEDED
Uberized:	false
Submitted:	Wed Feb 15 13:17:36 HKT 2017
Started:	Wed Feb 15 13:17:50 HKT 2017
Finished:	Wed Feb 15 13:18:18 HKT 2017
Elapsed:	28sec
Diagnostics:	
Average Map Time	12sec
Average Shuffle Time	8sec
Average Merge Time	0sec
Average Reduce Time	1sec

**ApplicationMaster**

Attempt Number	Start Time	Node	Logs
1	Wed Feb 15 13:17:41 HKT 2017	student13-x1:8042	logs

Task Type	Total	Complete
Map	1	1
Reduce	1	1

Attempt Type	Failed	Killed	Successful
Maps	0	0	1
Reduces	0	0	1

## 900 mb data

```
Bytes Written=900000000
17/03/20 20:53:02 INFO terasort.TeraSort: done
hduser@student13-x1:~$ yarn jar /opt/hadoop-2.6.0/share/hadoop/mapreduce/hadoop-mapreduce-examples-2.6.0.jar te: 527
/terainput900-4 teraoutput900-4 18249
22340
8
17/03/20 20:55:14 INFO terasort.TeraSort: starting
17/03/20 20:55:19 ERROR terasort.TeraSort: Input path does not exist: hdfs://student13-x1:9000/terainput900-4 3942
hduser@student13-x1:~$ yarn jar /opt/hadoop-2.6.0/share/hadoop/mapreduce/hadoop-mapreduce-examples-2.6.0.jar te: 15648
/terainput900 teraoutput900-4 23185
23185
1
2
3
5
7
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
28
32
33
34
35
17/03/20 20:55:33 INFO terasort.TeraSort: starting
17/03/20 20:55:36 INFO input.FileInputFormat: Total input paths to process : 2
spent 552ms computing base-splits.
spent 7ms computing TeraScheduler splits.
Computing input splits took 573ms
Sampling 10 splits of 14
Taking 1 from 100000 sampled records
Computing partitions took 2432ms
spent 301ms computing partitions.
17/03/20 20:55:39 INFO client.RMProxy: Connecting to ResourceManager at student13-x1/10.42.0.58:8032
17/03/20 20:55:42 INFO mapreduce.JobSubmitter: number of splits:14
17/03/20 20:55:42 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_1490012227659_0006
17/03/20 20:55:43 INFO impl.YarnClientImpl: Submitted application application_1490012227659_0006
17/03/20 20:55:43 INFO mapreduce.Job: The url to track the job: http://student13-x1:8088/proxy/application_1490012227659_0006/
17/03/20 20:55:43 INFO mapreduce.Job: Running job: job_1490012227659_0006
17/03/20 20:55:58 INFO mapreduce.Job: Job job_1490012227659_0006 running in uber mode : false
17/03/20 20:55:58 INFO mapreduce.Job: map 0% reduce 0%
17/03/20 20:56:32 INFO mapreduce.Job: map 2% reduce 0%
17/03/20 20:56:33 INFO mapreduce.Job: map 6% reduce 0%
17/03/20 20:56:34 INFO mapreduce.Job: map 9% reduce 0%
17/03/20 20:56:36 INFO mapreduce.Job: map 11% reduce 0%
17/03/20 20:56:37 INFO mapreduce.Job: map 13% reduce 0%
17/03/20 20:56:39 INFO mapreduce.Job: map 16% reduce 0%
17/03/20 20:56:40 INFO mapreduce.Job: map 18% reduce 0%
17/03/20 20:56:42 INFO mapreduce.Job: map 21% reduce 0%
17/03/20 20:56:43 INFO mapreduce.Job: map 25% reduce 0%
```

```
BAD_ID=0
CONNECTION=0
IO_ERROR=0
WRONG_LENGTH=0
WRONG_MAP=0
WRONG_REDUCE=0
File Input Format Counters
    Bytes Read=900000000
File Output Format Counters
    Bytes Written=900000000
17/03/20 20:58:47 INFO terasort.TeraSort: done
hduser@student13-x1:~$
```

**MapReduce Job job\_1490012227659\_0005**

Job Overview			
Job Name:	TeraSort		
User Name:	hduser		
Queue:	default		
State:	SUCCEEDED		
Uberized:	false		
Submitted:	Mon Mar 20 20:49:11 HKT 2017		
Started:	Mon Mar 20 20:49:31 HKT 2017		
Finished:	Mon Mar 20 20:53:04 HKT 2017		
Elapsed:	3mins, 32sec		
Diagnostics:			
Average Map Time	54sec		
Average Shuffle Time	1mins, 9sec		
Average Merge Time	21sec		
Average Reduce Time	1mins, 1sec		
ApplicationMaster			
Attempt Number	Start Time	Node	Logs
1	Mon Mar 20 20:49:22 HKT 2017	student13-x2-8042	<a href="#">Logs</a>
Task Type	Total	Complete	
Map	14	14	
Reduce	1	1	
Attempt Type	Failed	Killed	Successful
Maps	5	3	14
Reduces	0	0	1

Above you can find Time to sort 900 mb

Teravalidate took 31 sec

**MapReduce Job job\_1490012227659**

Job Overview			
Job Name:	TeraValidate		
User Name:	hduser		
Queue:	default		
State:	SUCCEEDED		
Uberized:	false		
Submitted:	Mon Mar 20 21:10:14 HKT 2017		
Started:	Mon Mar 20 21:10:34 HKT 2017		
Finished:	Mon Mar 20 21:11:06 HKT 2017		
Elapsed:	31sec		
Diagnostics:			
Average Map Time	14sec		
Average Shuffle Time	2sec		
Average Merge Time	0sec		
Average Reduce Time	7sec		
ApplicationMaster			
Attempt Number	Start Time	Node	Logs
1	Mon Mar 20 21:10:24 HKT 2017	student	<a href="#">Logs</a>
Task Type	Total		
Map	1	1	
Reduce	1	1	





Because Student2 did not work (hard disk failure as it turned out) I just in case reconfigured the cluster for execution with 6 vm-s to do the assignement last Saturday. I did this to avoid time clashes later on. Our group was assigned a new computer (student85) this Thursday, but I did not do all the tasks again. Only somee. In those places I have noted that. Default is 6 vm cluster.

- [All the above tasks should be done on the machine assigned to you. We will verify the machine ID or IP address from your screen shots.]

#### 25%: Hadoop Installation on 8 VMs (4 machines)

[Reconfigure Xen and Hadoop to construct an 8-VM virtual cluster with ONE VM serves as the master node (ResourceManager + NameNode), and the other 7 VMs as slave nodes (NodeManager + DataNode). You should also create a new user account for yourself. Each member should use his/her own user account for the MapReduce job submission.]

- Show the hardware and VM configuration in one table (See a sample table at the end of this evaluation form). Indicate the role(s) of each VM in the Hadoop cluster (Master/Slave, NameNode/DataNode, ResourceManager/NodeManager). (2%)

name	student13	student14	student1	student85
ip	10.42.0.57	10.42.0.60	10.42.0.21	10.42.0.237
cpu	Intel(R) Core(TM) i-5 CPU @ 3.GHz	Intel(R) Core(TM) i-5 CPU @ 3.GHz	Intel(R) Core(TM)2 Duo CPU @ 2.83GHz	Intel(R) Core(TM) i5 CPU @ 3.33GHz
mem ory	DIMM DDR3 Synchronous 1600 MHz (0.6 ns) (16G)	DIMM DDR3 Synchronous 1600 MHz (0.6 ns) (16G)	DIMM DDR2 Synchronous 667 MHz (1.5 ns) (4G)	DIMM DDR3 Synchronous 1333 MHz (0.8 ns) (16G) , seems like only 4g allowed tho
Disk	500 GB	500 GB	250 GB	250 GB
Virtual Machines				
Name	x1	x2	x1	x2
IP	10.42.0.58	10.42.0.59	10.42.0.61	10.42.0.62
MAC	00:23:ae:9b:d1:3A	00:23:ae:9b:d1:3B	00:23:ae:9b:d1:3D	00:23:ae:9b:d1:3E
Mem ory	4	4	4	1
Storage	50	50	50	50

For all the machines x3 vm has the same specified settings.

- Set the default number of replication to 2 (number\_of\_replicas = 2).  
Load a large file (1 GB) to HDFS and show the overall disk usage summary ("hdfs dfsadmin -report"). (2%)

## 8 VM cluster

### Before adding

```
hduser@student13-x1:/opt/hadoop-2.6.0/etc/hadoop$ hdfs dfsadmin -report
Configured Capacity: 368973287424 (343.63 GB)
Present Capacity: 293570928640 (273.41 GB)
DFS Remaining: 289984102400 (270.07 GB)
DFS Used: 3586826240 (3.34 GB)
DFS Used%: 1.22%
Under replicated blocks: 2
Blocks with corrupt replicas: 0
Missing blocks: 0

-----
Live datanodes (7):

Name: 10.42.0.26:50010 (student2-x2)
Hostname: student2-x2
Decommission Status : Normal
Configured Capacity: 52710469632 (49.09 GB)
DFS Used: 746242048 (711.67 MB)
Non DFS Used: 6822391808 (6.35 GB)
DFS Remaining: 45141835776 (42.04 GB)
DFS Used%: 1.42%
DFS Remaining%: 85.64%
Configured Cache Capacity: 0 (0 B)
Cache Used: 0 (0 B)
Cache Remaining: 0 (0 B)
Cache Used%: 100.00%
Cache Remaining%: 0.00%
Xceivers: 1
Last contact: Fri Mar 24 13:12:07 HKT 2017

Name: 10.42.0.23:50010 (student1-x2)
Hostname: student1-x2
Decommission Status : Normal
```

- Check the location of data blocks of the uploaded word\_input.txt file (with 900 MB data). Show if data blocks are evenly distributed among the DataNodes. (2%)

---

---

## In operation

---

Node	Last contact	Admin State	Capacity	Used	Non DFS Used	Remaining	Blocks	Block pool used	Failed Volumes	Version
student13-x2 (10.42.0.59:50010)	2	In Service	49.09 GB	456.27 MB	6.8 GB	41.84 GB	8	456.27 MB (0.91%)	0	2.6.0
student14-x2 (10.42.0.62:50010)	2	In Service	49.09 GB	645.78 MB	8.34 GB	40.12 GB	10	645.78 MB (1.28%)	0	2.6.0
student1-x2 (10.42.0.23:50010)	1	In Service	49.09 GB	129.19 MB	5.77 GB	43.2 GB	2	129.19 MB (0.26%)	0	2.6.0
student1-x1 (10.42.0.22:50010)	2	In Service	49.09 GB	327.13 MB	26.16 GB	22.61 GB	6	327.13 MB (0.65%)	0	2.6.0
student14-x1 (10.42.0.61:50010)	2	In Service	49.09 GB	258.34 MB	9.23 GB	39.6 GB	4	258.34 MB (0.51%)	0	2.6.0

We can clearly see, that there are 30 blocks in the dfs filesystem after adding the word\_input.txt file with duplication 2. 30 blocks = (block size = 64M) = 1920MB

COMP7305@2017

4

– Stop and restart HDFS (stop-all.sh, start-all.sh). Show all DataNodes remain active and health after restart (jps). [Warning: if HDFS was not set up properly, you may find your DataNode is not starting (e.g., not shown in jps). If this happens, report how you fix the problem. Hints: You could first manually start a DataNode (“hadoop datanode”). In the worst case, you may need to reformat the NameNode: “hadoop namenode –format”. Be careful, this command will destroy all the data on the Hadoop file system.] (2%)

8VM

Script I ran

```

# My first script

stop-yarn.sh
stop-dfs.sh
mr-jobhistory-daemon.sh stop historyserver

start-dfs.sh
start-yarn.sh
mr-jobhistory-daemon.sh start historyserver

~
~
```

8VM

Result- Everything worked

```

hduser@student13-x1:~$ ./starthadoop
stopping yarn daemons
stopping resourcemanager
student14-x1: stopping nodemanager
student14-x2: stopping nodemanager
student13-x2: stopping nodemanager
student2-x1: stopping nodemanager
student2-x2: stopping nodemanager
student1-x2: stopping nodemanager
student1-x1: stopping nodemanager
student14-x2: nodemanager did not stop gracefully after 5 seconds: killing with kill -9
student14-x1: nodemanager did not stop gracefully after 5 seconds: killing with kill -9
student13-x2: nodemanager did not stop gracefully after 5 seconds: killing with kill -9
student2-x1: nodemanager did not stop gracefully after 5 seconds: killing with kill -9
student2-x2: nodemanager did not stop gracefully after 5 seconds: killing with kill -9
student1-x2: nodemanager did not stop gracefully after 5 seconds: killing with kill -9
student1-x1: nodemanager did not stop gracefully after 5 seconds: killing with kill -9
no proxyserver to stop
Stopping namenodes on [student13-x1]
student13-x1: stopping namenode
student14-x1: stopping datanode
student14-x2: stopping datanode
student13-x2: stopping datanode
student2-x2: stopping datanode
student1-x2: stopping datanode
student2-x1: stopping datanode
student1-x1: stopping datanode
Stopping secondary namenodes [0.0.0.0]
0.0.0.0: stopping secondarynamenode
stopping historyserver
Starting namenodes on [student13-x1]
student13-x1: starting namenode, logging to /opt/hadoop-2.6.0/logs/hadoop-hduser-namenode-student13-x1.out
student13-x2: starting datanode, logging to /opt/hadoop-2.6.0/logs/hadoop-hduser-datanode-student13-x2.out
student14-x2: starting datanode, logging to /opt/hadoop-2.6.0/logs/hadoop-hduser-datanode-student14-x2.out
student14-x1: starting datanode, logging to /opt/hadoop-2.6.0/logs/hadoop-hduser-datanode-student14-x1.out
student2-x2: starting datanode, logging to /opt/hadoop-2.6.0/logs/hadoop-hduser-datanode-student2-x2.out
student1-x2: starting datanode, logging to /opt/hadoop-2.6.0/logs/hadoop-hduser-datanode-student1-x2.out
student1-x1: starting datanode, logging to /opt/hadoop-2.6.0/logs/hadoop-hduser-datanode-student1-x1.out
student2-x1: starting datanode, logging to /opt/hadoop-2.6.0/logs/hadoop-hduser-datanode-student2-x1.out
Starting secondary namenodes [0.0.0.0]
0.0.0.0: starting secondarynamenode, logging to /opt/hadoop-2.6.0/logs/hadoop-hduser-secondarynamenode-student13-x1.out
starting yarn daemons
starting resourcemanager, logging to /opt/hadoop-2.6.0/logs/yarn-hduser-resourcemanager-student13-x1.out
student14-x1: starting nodemanager, logging to /opt/hadoop-2.6.0/logs/yarn-hduser-nodemanager-student14-x1.out
student14-x2: starting nodemanager, logging to /opt/hadoop-2.6.0/logs/yarn-hduser-nodemanager-student14-x2.out
student13-x2: starting nodemanager, logging to /opt/hadoop-2.6.0/logs/yarn-hduser-nodemanager-student13-x2.out
student2-x2: starting nodemanager, logging to /opt/hadoop-2.6.0/logs/yarn-hduser-nodemanager-student2-x2.out
student1-x2: starting nodemanager, logging to /opt/hadoop-2.6.0/logs/yarn-hduser-nodemanager-student1-x2.out
student2-x1: starting nodemanager, logging to /opt/hadoop-2.6.0/logs/yarn-hduser-nodemanager-student2-x1.out
student1-x1: starting nodemanager, logging to /opt/hadoop-2.6.0/logs/yarn-hduser-nodemanager-student1-x1.out
starting historyserver, logging to /opt/hadoop-2.6.0/logs/mapred-hduser-historyserver-student13-x1.out
hduser@student13-x1:~$
```

– Run the WordCount (900 MB data, number\_of\_replicas = 2) on the 8-VM virtual cluster. Show the largest number of “running” containers used during the execution. Report the total execution time, # of map, and # of Reduce. Also show which VM is running the ApplicationManager (AM).

(5%)

Cluster Metrics														
Apps Submitted	Apps Pending	Apps Running	Apps Completed	Containers Running	Memory Used	Memory Total	Memory Reserved	VCores Used	VCores Total	VCores Reserved	Active Nodes	Decommissioned Nodes	Lost Nodes	
1	0	1	0	15	16 GB	40 GB	0 B	15	40	0	5	2	0	
<b>Show 20 entries</b>														
ID	User	Name	Application Type	Queue	StartTime	FinishTime	State	FinalStatus	Progress					
application_1490506436015_0001	hduser13	word count	MAPREDUCE	default	Sun, 26 Mar 2017 06:13:11 GMT	N/A	RUNNING	UNDEFINED						
Showing 1 to 1 of 1 entries														
First														

#maps 14  
#reduces 1  
AM – on student13-x2

ApplicationMaster			
Attempt Number	Start Time	Node	Logs
1	Sun Mar 26 14:13:26 HKT 2017	student13-x2:8042	<a href="#">logs</a>

Time 4 minutes, 26 seconds

Job Overview	
Job Name:	word count
User Name:	hduser13
Queue:	default
State:	SUCCEEDED
Uberized:	false
Submitted:	Sun Mar 26 14:13:11 HKT 2017
Started:	Sun Mar 26 14:13:35 HKT 2017
Finished:	Sun Mar 26 14:18:02 HKT 2017
Elapsed:	4mins, 26sec
Diagnostics:	
Average Map Time	2mins, 57sec
Average Shuffle Time	2mins, 21sec
Average Merge Time	1sec
Average Reduce Time	0sec

#of maximum running containers 18

All Applications

Apps Submitted	Apps Pending	Apps Running	Apps Completed	Containers Running	Memory Used	Memory Total	Memory Reserved	VCores Used	VCores Total	VCores Reserved	Active Nodes
2	0	1	1	17	18 GB	40 GB	0 B	17	40	0	5

Show 20 entries

ID	User	Name	Application Type	Queue	StartTime	FinishTime	State
hduser12	hduser	MapReduce	MAPREDUCE	default	Sun Mar 26 15:46:28 HKT 2017	N/A	RUNNING

All Applications

Apps Submitted	Apps Pending	Apps Running	Apps Completed	Containers Running	Memory Used	Memory Total	Memory Reserved	VCores Used	VCores Total	VCores Reserved
2	0	1	1	18	19 GB	40 GB	0 B	18	40	0

Show 20 entries

– Increase the replication of data blocks from 2 to 3. Run the WordCount again and compare the execution time. Is it faster if the replication is increased from 2 to 3? (2%)

i assume, here is also meant that, if i increase the # of datablocks I also upload a new file word\_input.txt

MapReduce Job  
job\_1490510258937\_0003

Job Overview

Job Name:	word count
User Name:	hduser13
Queue:	default
State:	SUCCEEDED
Uberized:	false
Submitted:	Sun Mar 26 15:46:28 HKT 2017
Started:	Sun Mar 26 15:46:47 HKT 2017
Finished:	Sun Mar 26 15:56:29 HKT 2017
Elapsed:	9mins, 41sec
Diagnostics:	
Average Map Time	2mins, 45sec
Average Shuffle Time	6mins, 49sec
Average Merge Time	5sec
Average Reduce Time	9sec

ApplicationMaster

**Surprisingly It is slower, although the higher replication should allow quicker access to elements.**

– VM Migration: Run a long job (e.g., WordCount) and migrate one “active” VM during the middle of execution from one machine to another machine. Show the whole job can complete without error (i.e., WordCount result is still correct). Command to be used: `sudo xl migrate <Domain-to-be-migrated> <new host>` . (5%) [Note: after the migration, there should be 3 VMs running at the destination node.]

I migrated from student1 to student14. To make vm migration possible I had to use NFS as a shared filesystem. E.g. add student1-x1 folder to export in student 1 exports file. Then I had to mount that folder in student 14.

To make that possible I followed mainly this tutorial :

[https://www.centos.org/docs/5/html/5.2/Virtualization/sect-Virtualization-Virtualization\\_live\\_migration-An\\_example\\_of\\_a\\_configuration\\_for\\_live\\_migration.html](https://www.centos.org/docs/5/html/5.2/Virtualization/sect-Virtualization-Virtualization_live_migration-An_example_of_a_configuration_for_live_migration.html)

Also the ganglia tutorial part where mounting is specified

Also last years project about Ecommerce Business helper Accessible On Reports

## Starting the job

```
-rw-r--r-- 3 hduser13 supergroup 943890600 2017-03-26 15:36 /dft-single-13/word_input3.txt
hduser13@student13-x1:~/dft$ hadoop jar /opt/hadoop-2.6.0/share/hadoop/mapreduce/hadoop-mapreduce-examples-2.6.0.jar
wordcount /dft-single-13 /dft-13-output4
17/03/26 16:03:08 INFO client.RMProxy: Connecting to ResourceManager at student13-x1/10.42.0.58:8032
17/03/26 16:03:11 INFO input.FileInputFormat: Total input paths to process : 1
17/03/26 16:03:12 INFO mapreduce.JobSubmitter: number of splits:14
17/03/26 16:03:13 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_1490510258937_0004
17/03/26 16:03:15 INFO impl.YarnClientImpl: Submitted application application_1490510258937_0004
17/03/26 16:03:15 INFO mapreduce.Job: The url to track the job: http://student13-x1:8088/proxy/application_1490510258937_0004/
17/03/26 16:03:15 INFO mapreduce.Job: Running job: job_1490510258937_0004
17/03/26 16:05:13 INFO mapreduce.Job: Job job_1490510258937_0004 running in uber mode : false
17/03/26 16:05:13 INFO mapreduce.Job: map 0% reduce 0%
```

**MIGRATION sudo xl migrate**

```
K 17/03/26 1 student@student1: ~
/E 17/03/26 1 migration sender: libxl_domain_suspend failed (rc=-3)
/E 17/03/26 1 libxl: info: libxl_exec.c:118:libxl_report_child_exitstatus: migration target process [27444] exited
/E 17/03/26 1 rror status 3
/E 17/03/26 1 Migration failed, resuming at sender.
/E 17/03/26 1 student@student1:~$ sudo xl migrate student1-x1 student14
/E 17/03/26 1 root@student14's password:
/E 17/03/26 1 Saving to migration stream new xl format (info 0x0/0x0/860)
/E     migration target: Ready to receive domain.
/E
/E     Loading new save file <incoming migration stream> (new xl fmt info 0x0/0x0/860)
/E     Savefile contains xl domain config
/E     xc: progress: Reloading memory pages: 13312/262144    5%
/E     xc: progress: Reloading memory pages: 26624/262144   10%
/E     xc: progress: Reloading memory pages: 39936/262144   15%
/E     xc: progress: Reloading memory pages: 53248/262144   20%
/E     xc: progress: Reloading memory pages: 65536/262144   25%
/E     xc: progress: Reloading memory pages: 78848/262144   30%
/E     xc: progress: Reloading memory pages: 92160/262144   35%
/E     xc: progress: Reloading memory pages: 105472/262144  40%
```

```
migration target: Domain started successfully.
Migration successful.
student@student1:~$ sudo xl list
Name                           ID  Mem VCPUs      State   Time(s)
Domain-0                        0   800    2        r----- 563716.5
student1-x2                      22  512     1        r----- 6206.0
student@student1:~$
```

```
Run `do-release-upgrade` to upgrade to it.

Last login: Sun Mar 26 15:20:32 2017 from student13-x1
student@student14:~$ sudo xl list
[sudo] password for student:
Name                           ID  Mem VCPUs      State   Time(s)
Domain-0                        0   6467    4        r----- 4922150.1
student14-x2                      22  4096     1        r----- 503548.4
student14-x1                      23  4096     1        -----  503540.7
student1-x1                        35  1024     1        r-----   83.6
student@student14:~$
```

## Result of JOB

listLinks.html    Map Tasks for job\_14905...    FAILED Applications    HKU Moodle

202.45.128.135:11313 90%    Search: hadoop 2.6.

Most Visited: Mozart - Oboe Concerto, Text Compare! - An online tool for comparing two texts, Booking Confirmation, Home, https://owa.ut.ee/owa..., https://msccs.cs.hku...

Show 20 entries

**Task**

Name	State	Start Time	Finish Time	Elapsed Time	Start Time	Finish Time	Elapsed Time
task_1490510258937_0004_m_000009	SUCCEEDED	Sun, 26 Mar 2017 08:05:41 GMT	Sun, 26 Mar 2017 08:08:35 GMT	2mins, 53sec	Sun, 26 Mar 2017 08:05:41 GMT	Sun, 26 Mar 2017 08:08:35 GMT	2mins, 53sec
task_1490510258937_0004_m_000010	SUCCEEDED	Sun, 26 Mar 2017 08:05:41 GMT	Sun, 26 Mar 2017 08:08:39 GMT	2mins, 58sec	Sun, 26 Mar 2017 08:05:41 GMT	Sun, 26 Mar 2017 08:08:39 GMT	2mins, 58sec
task_1490510258937_0004_m_000007	SUCCEEDED	Sun, 26 Mar 2017 08:05:41 GMT	Sun, 26 Mar 2017 08:09:29 GMT	3mins, 48sec	Sun, 26 Mar 2017 08:05:41 GMT	Sun, 26 Mar 2017 08:09:29 GMT	3mins, 48sec
task_1490510258937_0004_m_000008	SUCCEEDED	Sun, 26 Mar 2017 08:05:41 GMT	Sun, 26 Mar 2017 08:09:29 GMT	3mins, 48sec	Sun, 26 Mar 2017 08:05:41 GMT	Sun, 26 Mar 2017 08:09:29 GMT	3mins, 48sec
task_1490510258937_0004_m_000013	SUCCEEDED	Sun, 26 Mar 2017 08:05:41 GMT	Sun, 26 Mar 2017 08:08:34 GMT	2mins, 53sec	Sun, 26 Mar 2017 08:05:41 GMT	Sun, 26 Mar 2017 08:08:34 GMT	2mins, 53sec
task_1490510258937_0004_m_000011	SUCCEEDED	Sun, 26 Mar 2017 08:05:41 GMT	Sun, 26 Mar 2017 08:08:39 GMT	2mins, 58sec	Sun, 26 Mar 2017 08:05:41 GMT	Sun, 26 Mar 2017 08:08:39 GMT	2mins, 58sec
task_1490510258937_0004_m_000012	SUCCEEDED	Sun, 26 Mar 2017 08:05:41 GMT	Sun, 26 Mar 2017 08:08:33 GMT	2mins, 52sec	Sun, 26 Mar 2017 08:05:41 GMT	Sun, 26 Mar 2017 08:08:33 GMT	2mins, 52sec
task_1490510258937_0004_m_000001	SUCCEEDED	Sun, 26 Mar 2017 08:05:40 GMT	Sun, 26 Mar 2017 08:09:28 GMT	3mins, 47sec	Sun, 26 Mar 2017 08:05:40 GMT	Sun, 26 Mar 2017 08:09:28 GMT	3mins, 47sec
task_1490510258937_0004_m_000002	SUCCEEDED	Sun, 26 Mar 2017 08:05:41 GMT	Sun, 26 Mar 2017 08:09:29 GMT	3mins, 48sec	Sun, 26 Mar 2017 08:05:41 GMT	Sun, 26 Mar 2017 08:09:29 GMT	3mins, 48sec
task_1490510258937_0004_m_000000	SUCCEEDED	Sun, 26 Mar 2017 08:05:41 GMT	Sun, 26 Mar 2017 08:09:32 GMT	3mins, 50sec	Sun, 26 Mar 2017 08:05:41 GMT	Sun, 26 Mar 2017 08:09:32 GMT	3mins, 50sec
task_1490510258937_0004_m_000005	SUCCEEDED	Sun, 26 Mar 2017 08:05:41 GMT	Sun, 26 Mar 2017 08:09:27 GMT	3mins, 46sec	Sun, 26 Mar 2017 08:05:41 GMT	Sun, 26 Mar 2017 08:09:27 GMT	3mins, 46sec
task_1490510258937_0004_m_000006	SUCCEEDED	Sun, 26 Mar 2017 08:05:41 GMT	Sun, 26 Mar 2017 08:08:38 GMT	2mins, 57sec	Sun, 26 Mar 2017 08:05:41 GMT	Sun, 26 Mar 2017 08:08:38 GMT	2mins, 57sec
task_1490510258937_0004_m_000003	SUCCEEDED	Sun, 26 Mar 2017 08:05:41 GMT	Sun, 26 Mar 2017 08:09:30 GMT	3mins, 49sec	Sun, 26 Mar 2017 08:05:41 GMT	Sun, 26 Mar 2017 08:09:30 GMT	3mins, 49sec
task_1490510258937_0004_m_000004	SUCCEEDED	Sun, 26 Mar 2017 08:05:41 GMT	Sun, 26 Mar 2017 08:09:27 GMT	3mins, 46sec	Sun, 26 Mar 2017 08:05:41 GMT	Sun, 26 Mar 2017 08:09:27 GMT	3mins, 46sec

ID State Start Time Finish Time Elapsed Start Time Finish Time Elapsed

Showing 1 to 14 of 14 entries First Previous 1 Next Last

### Retired JOBS

Show 20 entries

Submit Time Start Time Finish Time Job ID Name User Queue State Maps Total Maps Completed Reduces Total Reduces Completed

Submit Time	Start Time	Finish Time	Job ID	Name	User	Queue	State	Maps Total	Maps Completed	Reduces Total	Reduces Completed
2017.03.26 16:03:14 HKT	2017.03.26 16:05:32 HKT	2017.03.26 16:10:03 HKT	job_1490510258937_0004	word count	hduser13	default	SUCCEEDED	14	14	1	1
2017.03.26	2017.03.26	2017.03.26	job_1490510258937_0003	word	hduser13	default	SUCCEEDED	14	14	1	1

– Fault Tolerance: Run a long job (e.g., WordCount) on the 8-VM cluster and shutdown one VM in the middle of execution ("xm shutdown"). Show the job can still complete with correct results using only 7 VMs. (5%)

Start the job

```
drwxr-xr-x - hduser13 supergroup 0 2017-03-26 16:09 /dft-13-output4
drwxr-xr-x - hduser13 supergroup 0 2017-03-26 15:44 /dft-single-13
drwxrwx--- - hduser13 supergroup 0 2017-03-26 13:34 /tmp
hduser13@student13-x1:~/dft$ hadoop jar /opt/hadoop-2.6.0/share/hadoop/mapreduce/hadoop-mapreduce-examples-2.6.0.jar wordcount /dft-single-13 /dft-13-output5
17/03/26 16:36:04 INFO client.RMProxy: Connecting to ResourceManager at student13-x1/10.42.0.58:8032
17/03/26 16:36:08 INFO input.FileInputFormat: Total input paths to process : 1
17/03/26 16:36:08 INFO mapreduce.JobSubmitter: number of splits:14
17/03/26 16:36:09 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_1490510258937_0005
17/03/26 16:36:10 INFO impl.YarnClientImpl: Submitted application application_1490510258937_0005
17/03/26 16:36:10 INFO mapreduce.Job: The url to track the job: http://student13-x1:8088/proxy/application_1490510258937_0005/
17/03/26 16:36:10 INFO mapreduce.Job: Running job: job_1490510258937_0005
17/03/26 16:36:50 INFO mapreduce.Job: Job job_1490510258937_0005 running in uber mode : false
17/03/26 16:36:50 INFO mapreduce.Job: map 0% reduce 0%
```

Student13-x2 working

```
Run 'do-release-upgrade' to upgrade to it.

Last login: Sun Mar 26 16:08:13 2017 from student1
student@student13:~$ sudo xl list
[sudo] password for student:
Name ID Mem VCPUs State Time(s)
Domain-0 0 7048 4 r---- 1048778.1
student13-x1 2 4024 1 r---- 941136.7
student13-x2 4 4024 1 r---- 600160.4
student@student13:~$
```

Not anymore

```
student@student13:~$ sudo xl shutdown student13-x2
Shutting down domain 4
student@student13:~$ sudo xl list
Name ID Mem VCPUs State Time(s)
Domain-0 0 7048 4 r---- 1048857.1
student13-x1 2 4024 1 r---- 941206.9
student@student13:~$
```

Failures I received

```
17/03/26 16:47:27 INFO mapreduce.Job: map 95% reduce 19%
17/03/26 16:47:56 INFO mapreduce.Job: map 95% reduce 24%
17/03/26 16:47:58 INFO mapreduce.Job: Task Id : attempt_1490510258937_0005_m_000011_0, Status : FAILED
AttemptID:attempt_1490510258937_0005_m_000011_0 Timed out after 600 secs
cleanup failed for container container_1490510258937_0005_01_000007 : java.io.IOException: Failed on local exception:
java.io.IOException: java.net.SocketTimeoutException: 60000 millis timeout while waiting for channel to be ready for
read. ch : java.nio.channels.SocketChannel[connected local=/10.42.0.22:53194 remote=student1-x2/10.42.0.23:35107]; H
ost Details : local host is: "student1-x1/10.42.0.22"; destination host is: "student1-x2":35107;
        at org.apache.hadoop.net.NetUtils.wrapException(NetUtils.java:772)
        at org.apache.hadoop.ipc.Client.call(Client.java:1472)
        at org.apache.hadoop.ipc.Client.call(Client.java:1399)
        at org.apache.hadoop.ipc.ProtobufRpcEngine$Invoker.invoke(ProtobufRpcEngine.java:232)
        at com.sun.proxy.$Proxy37.stopContainers(Unknown Source)
        at org.apache.hadoop.yarn.api.impl.pb.client.ContainerManagementProtocolPBClientImpl.stopContainers(Container
ManagementProtocolPBClientImpl.java:110)
        at sun.reflect.GeneratedMethodAccessor15.invoke(Unknown Source)
```

```
R Found 7 items
drwxr-xr-x - hduser13 supergroup 0 2017-03-26 14:17 /dft-13-output
drwxr-xr-x - hduser13 supergroup 0 2017-03-26 14:52 /dft-13-output1
drwxr-xr-x - hduser13 supergroup 0 2017-03-26 15:11 /dft-13-output2
drwxr-xr-x - hduser13 supergroup 0 2017-03-26 15:56 /dft-13-output3
drwxr-xr-x - hduser13 supergroup 0 2017-03-26 16:09 /dft-13-output4
drwxr-xr-x - hduser13 supergroup 0 2017-03-26 15:44 /dft-single-13
drwxrwx--- - hduser13 supergroup 0 2017-03-26 13:34 /tmp
hduser13@student13-x1:~/dft$ hadoop jar /opt/hadoop-2.6.0/share/hadoop/mapreduce/hadoop-mapreduce-examples-2.6.0.jar
wordcount /dft-single-13 /dft-13-output5
17/03/26 16:36:04 INFO client.RMProxy: Connecting to ResourceManager at student13-x1/10.42.0.58:8032
17/03/26 16:36:08 INFO input.FileInputFormat: Total input paths to process : 1
17/03/26 16:36:08 INFO mapreduce.JobSubmitter: number of splits:14
17/03/26 16:36:09 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_1490510258937_0005
17/03/26 16:36:10 INFO impl.YarnClientImpl: Submitted application application_1490510258937_0005
17/03/26 16:36:10 INFO mapreduce.Job: The url to track the job: http://student13-x1:8088/proxy/application_1490510258937_0005/
17/03/26 16:36:10 INFO mapreduce.Job: Running job: job_1490510258937_0005
17/03/26 16:36:50 INFO mapreduce.Job: Job job_1490510258937_0005 running in uber mode : false
17/03/26 16:36:50 INFO mapreduce.Job: map 0% reduce 0%
17/03/26 16:37:13 INFO mapreduce.Job: map 2% reduce 0%
17/03/26 16:37:22 INFO mapreduce.Job: map 3% reduce 0%
17/03/26 16:37:33 INFO mapreduce.Job: map 4% reduce 0%
17/03/26 16:37:42 INFO mapreduce.Job: map 5% reduce 0%
17/03/26 16:37:46 INFO mapreduce.Job: map 6% reduce 0%
17/03/26 16:37:47 INFO mapreduce.Job: map 7% reduce 0%
```

```
17/03/26 16:42:13 INFO mapreduce.Job: map 24% reduce 0%
17/03/26 16:42:14 INFO mapreduce.Job: map 27% reduce 0%
17/03/26 16:42:23 INFO mapreduce.Job: map 29% reduce 0%
17/03/26 16:42:31 INFO mapreduce.Job: map 29% reduce 2%
17/03/26 16:42:35 INFO mapreduce.Job: map 30% reduce 2%
17/03/26 16:42:42 INFO mapreduce.Job: map 23% reduce 2%
17/03/26 16:42:42 INFO mapreduce.Job: Task Id : attempt_1490510258937_0005_m_000004_0, Status : FAILED
Container killed on request. Exit code is 137
Container exited with a non-zero exit code 137
Killed by external signal

17/03/26 16:42:52 INFO mapreduce.Job: map 26% reduce 2%
17/03/26 16:42:55 INFO mapreduce.Job: map 27% reduce 2%
```

## We can see studen13-x2 is running 0 containers

Apps submitted	Apps Pending	Apps Running	Apps Completed	Containers Running	Memory Used	Memory Total	Memory Reserved	VCores Used	VCores Total	VCores Reserved	Active Nodes	Decommissioned Nodes	Lost Nodes	Unhealthy Nodes
0	1	4	17	18 GB	40 GB	0 B	17	40	0	5	2		0	0
Now 20 entries														
Node labels	Rack	Node State	Node Address	Node HTTP Address	Last health-update	Health-report	Containers	Mem Used	Mem Avail	VCores Used	Active Nodes	Decommissioned Nodes	Lost Nodes	Unhealthy Nodes
	/default-rack	RUNNING	student1-x1:42006	student1-x1:8042	26-Mar-2017 16:40:26		5	6 GB	2 GB	5			0	3
	/default-rack	RUNNING	student13-x2:45198	student13-x2:8042	26-Mar-2017 16:37:47		0	0 B	8 GB	0			0	8
	/default-rack	RUNNING	student14-x2:51548	student14-x2:8042	26-Mar-2017 16:39:51		1	1 GB	7 GB	1			0	7
	/default-rack	RUNNING	student14-x1:39573	student14-x1:8042	26-Mar-2017 16:39:51		3	3 GB	5 GB	3			0	5
	/default-rack	RUNNING	student1-x2:35107	student1-x2:8042	26-Mar-2017 16:41:03		8	8 GB	0 B	8			0	0

Showing 1 to 5 of 5 entries

First Previous

```
17/03/26 16:49:22 INFO mapreduce.Job: map 93% reduce 29%
17/03/26 16:49:49 INFO mapreduce.Job: map 94% reduce 29%
17/03/26 16:49:59 INFO mapreduce.Job: map 95% reduce 29%
17/03/26 16:50:02 INFO mapreduce.Job: map 96% reduce 29%
17/03/26 16:50:10 INFO mapreduce.Job: map 97% reduce 29%
17/03/26 16:50:20 INFO mapreduce.Job: map 98% reduce 29%
17/03/26 16:50:23 INFO mapreduce.Job: map 100% reduce 29%
17/03/26 16:50:25 INFO mapreduce.Job: map 100% reduce 31%
17/03/26 16:51:03 INFO mapreduce.Job: map 93% reduce 31%
17/03/26 16:51:18 INFO mapreduce.Job: map 94% reduce 31%
17/03/26 16:51:26 INFO mapreduce.Job: map 95% reduce 31%
17/03/26 16:51:29 INFO mapreduce.Job: map 96% reduce 31%
17/03/26 16:51:39 INFO mapreduce.Job: map 97% reduce 31%
17/03/26 16:51:48 INFO mapreduce.Job: map 98% reduce 31%
17/03/26 16:51:57 INFO mapreduce.Job: map 100% reduce 31%
17/03/26 16:52:00 INFO mapreduce.Job: map 100% reduce 64%
17/03/26 16:52:02 INFO mapreduce.Job: map 100% reduce 100%
```

## Still success

```
7/03/26 16:54:51 INFO mapreduce.Job: Counters: 53
  File System Counters
    FILE: Number of bytes read=50770292
    FILE: Number of bytes written=62513190
    FILE: Number of read operations=0
    FILE: Number of large read operations=0
    FILE: Number of write operations=0
    HDFS: Number of bytes read=43945514
    HDFS: Number of bytes written=644076
    HDFS: Number of read operations=45
    HDFS: Number of large read operations=0
    HDFS: Number of write operations=2
  Job Counters
    Failed map tasks=5
    Killed map tasks=13
    Launched map tasks=32
    Launched reduce tasks=1
    Other local map tasks=4
    Data-local map tasks=24
    Rack-local map tasks=4
    Total time spent by all maps in occupied slots (ms)=9926994
    Total time spent by all reduces in occupied slots (ms)=951502
    Total time spent by all map tasks (ms)=9926994
    Total time spent by all reduce tasks (ms)=951502
    Total vcore-seconds taken by all map tasks=9926994
    Total vcore-seconds taken by all reduce tasks=951502
    Total megabyte-seconds taken by all map tasks=1985398800
    Total megabyte-seconds taken by all reduce tasks=285450600
  Map-Reduce Framework
    Map input records=19833000
    Map output records=160785600
    Map output bytes=1561130397
    Map output materialized bytes=10154074
    Input split bytes=1666
    Combine input records=163591536
    Combine output records=3507420
    Reduce input groups=50106
    Reduce shuffle bytes=10154074
    Reduce input records=701484
    Reduce output records=50106
    Spilled Records=4208904
    Shuffled Maps =14
    Failed Shuffles=5
    Merged Map outputs=14
    GC time elapsed (ms)=34941
    CPU time spent (ms)=350310
    Physical memory (bytes) snapshot=3075588096
    Virtual memory (bytes) snapshot=28203290624
    Total committed heap usage (bytes)=2228527104
  Shuffle Errors
    BAD_ID=0
    CONNECTION=0
    IO_ERROR=5
    WRONG_LENGTH=0
    WRONG_MAP=0
    WRONG_REDUCE=0
  File Input Format Counters
    Bytes Read=943943848
  File Output Format Counters
    Bytes Written=644076
duser13@student13-x1:~/dfr$
```

## 20%: TeraSort (with 1000 MB data) on the 8-VM virtual cluster

– Show the best execution time using 8 VMs at the 4 machines assigned to your group. For fair comparison, the total number of VMs should be fixed at 8, 2 per machine; with one master node and 7 slave nodes. Dom0 should not be used to run any MapReduce task. The sorted results must be validated.] (**Note 3**)

- Show the configurations of Dom0, x1, and x2 that achieved the best results for the 4GB or 16 GB machine respectively. (2%)
- Show the configuration of Hadoop (yarn-site.xml and mapredsite.xml) or the configuration options you specified in the "hadoop jar -D" command that achieved the best results. (Note: You are allowed to change the default Block size.) (2%) (**Note 4**)
- Show the (largest) # of running containers, # of map and reduce tasks during the execution of the TeraSort job. Check if the # of running containers is changing during the execution. (2%)
- Increase/decrease mapreduce.task.io.sort.mb (default 100 MB) and/or mapreduce.reduce.shuffle.parallelcopies (default=5) and

COMP7305@2017

5

see if the performance gets improved? (4%)

– Write a short summary explaining your optimization strategy with evidences from your observations (e.g., CPU utilization at each VM at different phases, network traffic during shuffle phase, memory utilization, etc.) – Ganglia may help! (10%)

– [Note: We will compare the best execution time submitted by all students to give marks on this part. Fastest: 18-20; Good: 14-17; Slow: <

14]

## DISCUSSION BEFORE EXECUTION

### yarn

yarn.nodemanager.resource.memory-mb Default 8192 *Amount of physical memory, in MB, that can be allocated for containers*

- Leave room for the Operating system
- Leave room for datanode -> very little
- Leave room for Nodemanager

yarn.app.mapreduce.am.resource.mb default = 1536 *The amount of memory the MR AppMaster needs*

- Our application master definitely does not need so much memory as specified in the default– its not a big job at all . In original settigns: mapreduce.reduce.memory.mb is 1024 =>  $1.5 * \text{map}$  could be a good size for this.

### mapreduce

mapreduce.map.memory.mb

- This is pretty hard. I think just try with big and small. Do a hill climb search 😊 I guess it also depends on the datablock size. My intuition says bigger is good in the sense of reading bigger. This setting Should be multiplication of 64 or 128 I also think this setting is very much related with hdfs block size setting specified down below. Continue reading in hdfs part

mapreduce.reduce.memory.mb

- $1.5 * \text{map}$  I would guess
- 

mapreduce.map.cpu.vcores

mapreduce.reduce.cpu.vcores

I think these are good if they are 1. Sorting is Cpu Intensive.

1. <https://www.scribd.com/document/23046928/Hadoop-Performance-Tuning>
2. <http://www.idryman.org/blog/2014/03/05/hadoop-performance-tuning-best-practices/>

mapred.compress.map.output -> change it to true -> less to write to memory

### hdfs

dfs.block.size -> affects the number of maps needed to be done. In my eyes bigger is better. This is also recommended by the article (1) REASON being „in smaller cluster task creation is also a considerable overhead“ <= **larger blocksize, larger maps, larger reduces**

## TRIAL 1

**Student1, Student2, Student13, Student14**

### RESULT 1.38

**Max # Containers running the same time: 9**

**Number of maps: 8**

**Number of reduces:7**

*I avoided using student2, because of its memory limits. It slowed down the execution with 128 mb blocksize. I rather tried to use less large size containers, because there were only 8 few tasks. I avoided using 64 mb with so few machines because of the task overhead being very big.*

### VM SPECIFICATIONS

#### **Student 13**

Yarn has a gigabyte of space to spare

dom0 3 gb

student13-x1 4 gb

student13-x2 8 gb

#### **Student 14**

Yarn has actually less memory than needed 7096

dom0 4 gb

student13-x1 6.5 gb

student13-x2 6.5 gb

#### **Student 1**

dom0 0.8 gb

student13-x1 1.5 gb

student13-x2 1 gb

### MAPRED

mapreduce.map.memory.mb 1500

mapreduce.reduce.memory.mb 2000

mapreduce.task.io.sort.factor 100

mapreduce.map.output.compress false

mapreduce.job.reduces 7  
mapreduce.task.io.sort.mb 450  
mapreduce.reduce.shuffle.parallelcopies 8  
mapreduce.map.java.opts -Xmx800  
mapreduce.reduce.java.opts -Xmx1000m

#### **HDFS**

dfs.replication 7  
dfs.blocksize 128

#### **YARN**

yarn.scheduler.minimum-allocation-mb  
yarn.scheduler.maximum-allocation-mb  
yarn.scheduler.minimum-allocation-mb  
yarn.scheduler.maximum-allocation-vcores

These are for every separate container.

yarn.nodemanager.resource.memory-mb Amount of physical memory, in MB, that can be allocated for containers

mapreduce.reduce.java.opts - it seems the default is not specified, on some places its also 1024 -> maybe specify this the same as map

mapreduce.map.java.opts -- it seems the default is not specified, on some places its also 1024 -> maybe specify this the same as reduce



Logged in as: dr.who

## MapReduce Job job\_1490880455212\_0002

› Application
› Job
<a href="#">Overview</a>
<a href="#">Counters</a>
<a href="#">Configuration</a>
<a href="#">Map tasks</a>
<a href="#">Reduce tasks</a>

› Tools
---------

Job Overview			
Job Name:	TeraSort	User Name:	hduser13
Queue:	default	State:	SUCCEEDED
Uberized:	false	Submitted:	Thu Mar 30 21:31:29 HKT 2017
Started:	Thu Mar 30 21:31:35 HKT 2017	Finished:	Thu Mar 30 21:33:13 HKT 2017
Elapsed:	1mins, 38sec	Diagnostics:	
Average Map Time	38sec	Average Shuffle Time	49sec
Average Merge Time	5sec	Average Reduce Time	6sec
ApplicationMaster			
Attempt Number	Start Time	Node	Logs
1	Thu Mar 30 21:31:17 HKT 2017	student85-x1:8042	<a href="#">logs</a>
Task Type		Total	Complete
<a href="#">Map</a>		8	8
<a href="#">Reduce</a>		7	7
Attempt Type		Failed	Killed
<a href="#">Maps</a>		0	1
<a href="#">Reduces</a>		0	7
Successful			

```
7/03/30 21:33:35 INFO mapreduce.Job: Job: job_1150888133212_0002 completed successfully
7/03/30 21:33:35 INFO mapreduce.Job: Counters: 51
   File System Counters
      FILE: Number of bytes read=1040000570
      FILE: Number of bytes written=2081607690
      FILE: Number of read operations=0
      FILE: Number of large read operations=0
      FILE: Number of write operations=0
      HDFS: Number of bytes read=1000000896
      HDFS: Number of bytes written=1000000000
      HDFS: Number of read operations=45
      HDFS: Number of large read operations=0
      HDFS: Number of write operations=14
   Job Counters
      Killed map tasks=1
      Launched map tasks=9
      Launched reduce tasks=7
      Data-local map tasks=8
      Rack-local map tasks=1
      Total time spent by all maps in occupied slots (ms)=689098
      Total time spent by all reduces in occupied slots (ms)=862074
      Total time spent by all map tasks (ms)=344549
      Total time spent by all reduce tasks (ms)=431037
      Total vcore-seconds taken by all map tasks=344549
      Total vcore-seconds taken by all reduce tasks=431037
      Total megabyte-seconds taken by all map tasks=516823500
      Total megabyte-seconds taken by all reduce tasks=862074000
   Map-Reduce Framework
      Map input records=10000000
      Map output records=10000000
      Map output bytes=1020000000
      Map output materialized bytes=1040000336
      Input split bytes=896
      Combine input records=0
      Combine output records=0
      Reduce input groups=10000000
      Reduce shuffle bytes=1040000336
      Reduce input records=10000000
      Reduce output records=10000000
      Spilled Records=20000000
      Shuffled Maps =56
      Failed Shuffles=0
      Merged Map outputs=56
      GC time elapsed (ms)=9667
      CPU time spent (ms)=106660
      Physical memory (bytes) snapshot=6871793664
      Virtual memory (bytes) snapshot=39148986368
      Total committed heap usage (bytes)=6457741312
   Shuffle Errors
      BAD_ID=0
      CONNECTION=0
      IO_ERROR=0
      WRONG_LENGTH=0
      WRONG_MAP=0
      WRONG_REDUCE=0
   File Input Format Counters
      Bytes Read=1000000000
   File Output Format Counters
      Bytes Written=1000000000
7/03/30 21:33:35 INFO terasort.TeraSort: done
duser13@student13-x1:~$
```

```

      Bytes Read=10000000000
      File Output Format Counters
      Bytes Written=10000000000
17/03/30 21:30:51 INFO terasort.TeraSort: done
hduser13@student13-x1:~$ yarn jar /opt/hadoop-2.6.0/share/hadoop/mapreduce/hadoop-mapreduce-examples-2.6.0.jar terasort /terainput /teraoutputAndres
17/03/30 21:31:13 INFO terasort.TeraSort: starting
17/03/30 21:31:17 INFO input.FileInputFormat: Total input paths to process : 2
Spent 503ms computing base-splits.
Spent 6ms computing TeraScheduler splits.
Computing input splits took 512ms
Sampling 8 splits of 8
Making 7 from 100000 sampled records
Computing partitions took 3743ms
Spent 4260ms computing partitions.
17/03/30 21:31:21 INFO client.RMProxy: Connecting to ResourceManager at student13-x1/10.42.0.58:8032
17/03/30 21:31:26 INFO mapreduce.JobSubmitter: number of splits:8
17/03/30 21:31:28 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_1490880455212_0002
17/03/30 21:31:29 INFO impl.YarnClientImpl: Submitted application application_1490880455212_0002
17/03/30 21:31:29 INFO mapreduce.Job: The url to track the job: http://student13-x1:8088/proxy/application_1490880455212_0002/
17/03/30 21:31:29 INFO mapreduce.Job: Running job: job_1490880455212_0002
17/03/30 21:31:56 INFO mapreduce.Job: Job job_1490880455212_0002 running in uber mode : false
17/03/30 21:31:56 INFO mapreduce.Job: map 0% reduce 0%
17/03/30 21:32:14 INFO mapreduce.Job: map 8% reduce 0%
17/03/30 21:32:17 INFO mapreduce.Job: map 25% reduce 0%
17/03/30 21:32:18 INFO mapreduce.Job: map 29% reduce 0%
17/03/30 21:32:19 INFO mapreduce.Job: map 36% reduce 0%
17/03/30 21:32:20 INFO mapreduce.Job: map 42% reduce 0%

```

Max Number containers running at the same time = 9

Retired Jobs											
Show 20 entries											Search:
Submit Time	Start Time	Finish Time	Job ID	Name	User	Queue	State	Maps Total	Maps Completed		
2017.03.30 21:42:03 HKT	2017.03.30 21:42:09 HKT	2017.03.30 21:42:53 HKT	job_1490880455212_0003	TeraValidate	hduser13	default	SUCCEEDED	7	7		
2017.03.30 21:31:29 HKT	2017.03.30 21:31:35 HKT	2017.03.30 21:33:13 HKT	job_1490880455212_0002	TeraSort	hduser13	default	SUCCEEDED	8	8		

```

sudo: dfs: command not found
hduser13@student13-x1:~$ hdfs dfs -ls /teravalidateAndres
Found 2 items
-rw-r--r-- 7 hduser13 supergroup          0 2017-03-30 21:43 /teravalidateAndres/_SUCCESS
-rw-r--r-- 7 hduser13 supergroup        24 2017-03-30 21:43 /teravalidateAndres/part-r-00000
hduser13@student13-x1:~$ 

```

```
Computing partitions took 3743ms
Spent 4260ms computing partitions.
17/03/30 21:31:21 INFO client.RMProxy: Connecting to ResourceManager at student13-x1/10.42.0.58:8032
17/03/30 21:31:26 INFO mapreduce.JobSubmitter: number of splits:8
17/03/30 21:31:28 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_1490880455212_0002
17/03/30 21:31:29 INFO impl.YarnClientImpl: Submitted application application_1490880455212_0002
17/03/30 21:31:29 INFO mapreduce.Job: The url to track the job: http://student13-x1:8088/proxy/application_1490880455
212_0002/
17/03/30 21:31:29 INFO mapreduce.Job: Running job: job_1490880455212_0002
17/03/30 21:31:56 INFO mapreduce.Job: Job job_1490880455212_0002 running in uber mode : false
17/03/30 21:31:56 INFO mapreduce.Job: map 0% reduce 0%
17/03/30 21:32:14 INFO mapreduce.Job: map 8% reduce 0%
17/03/30 21:32:17 INFO mapreduce.Job: map 25% reduce 0%
17/03/30 21:32:18 INFO mapreduce.Job: map 29% reduce 0%
17/03/30 21:32:19 INFO mapreduce.Job: map 36% reduce 0%
17/03/30 21:32:20 INFO mapreduce.Job: map 42% reduce 0%
17/03/30 21:32:22 INFO mapreduce.Job: map 48% reduce 0%
17/03/30 21:32:23 INFO mapreduce.Job: map 65% reduce 0%
17/03/30 21:32:26 INFO mapreduce.Job: map 71% reduce 0%
17/03/30 21:32:30 INFO mapreduce.Job: map 79% reduce 0%
17/03/30 21:32:39 INFO mapreduce.Job: map 79% reduce 1%
17/03/30 21:32:40 INFO mapreduce.Job: map 79% reduce 4%
17/03/30 21:32:41 INFO mapreduce.Job: map 88% reduce 4%
17/03/30 21:32:42 INFO mapreduce.Job: map 88% reduce 5%
17/03/30 21:32:43 INFO mapreduce.Job: map 88% reduce 6%
17/03/30 21:32:45 INFO mapreduce.Job: map 92% reduce 7%
17/03/30 21:32:46 INFO mapreduce.Job: map 92% reduce 8%
17/03/30 21:32:49 INFO mapreduce.Job: map 92% reduce 13%
17/03/30 21:32:50 INFO mapreduce.Job: map 96% reduce 13%
17/03/30 21:32:52 INFO mapreduce.Job: map 96% reduce 15%
17/03/30 21:32:54 INFO mapreduce.Job: map 96% reduce 18%
17/03/30 21:32:55 INFO mapreduce.Job: map 100% reduce 21%
17/03/30 21:32:57 INFO mapreduce.Job: map 100% reduce 24%
17/03/30 21:32:59 INFO mapreduce.Job: map 100% reduce 29%
17/03/30 21:33:01 INFO mapreduce.Job: map 100% reduce 34%
17/03/30 21:33:02 INFO mapreduce.Job: map 100% reduce 45%
17/03/30 21:33:03 INFO mapreduce.Job: map 100% reduce 46%
17/03/30 21:33:04 INFO mapreduce.Job: map 100% reduce 49%
17/03/30 21:33:05 INFO mapreduce.Job: map 100% reduce 56%
17/03/30 21:33:07 INFO mapreduce.Job: map 100% reduce 63%
17/03/30 21:33:08 INFO mapreduce.Job: map 100% reduce 75%
17/03/30 21:33:10 INFO mapreduce.Job: map 100% reduce 76%
17/03/30 21:33:11 INFO mapreduce.Job: map 100% reduce 78%
17/03/30 21:33:13 INFO mapreduce.Job: map 100% reduce 80%
17/03/30 21:33:14 INFO mapreduce.Job: map 100% reduce 83%
17/03/30 21:33:16 INFO mapreduce.Job: map 100% reduce 87%
17/03/30 21:33:17 INFO mapreduce.Job: map 100% reduce 89%
17/03/30 21:33:19 INFO mapreduce.Job: map 100% reduce 91%
17/03/30 21:33:21 INFO mapreduce.Job: map 100% reduce 92%
17/03/30 21:33:22 INFO mapreduce.Job: map 100% reduce 93%
17/03/30 21:33:23 INFO mapreduce.Job: map 100% reduce 94%
17/03/30 21:33:24 INFO mapreduce.Job: map 100% reduce 95%
17/03/30 21:33:26 INFO mapreduce.Job: map 100% reduce 96%
17/03/30 21:33:27 INFO mapreduce.Job: map 100% reduce 97%
17/03/30 21:33:29 INFO mapreduce.Job: map 100% reduce 98%
17/03/30 21:33:30 INFO mapreduce.Job: map 100% reduce 99%
```

## TRIAL 2

Student1, Student85, Student13, Student14

BEST RESULT 1.32

# CONTAINERS CONCURRENTLY RUNNING 20

*Although the HW improved a lot, the results did not. Its a shame. But I did not have too much time to test out new hardware. At the same time, Parallelism increased significantly. I used almost all the available memory, which is a possible cause for not getting even better result. Maximum number of running containers was 14.*

### VM

- a. Student13
  - i. Domain 2
  - ii. x1 3
  - iii. x2 11
- b. Student14
  - i. Domain 2
  - ii. x1 7
  - iii. x2 7
- c. Student1
  - i. Domain 1
  - ii. x1 3
- d. Student85
  - i. Domain 2
  - ii. x1 7
  - iii. x2

### MAPRED

```
mapreduce.map.memory.mb 1500  
mapreduce.reduce.memory.mb 2000  
mapreduce.task.io.sort.factor 100  
mapreduce.map.output.compress false  
mapreduce.job.reduces 12  
mapreduce.task.io.sort.mb 450  
mapreduce.reduce.shuffle.parallelcopies 8  
mapreduce.map.java.opts -Xmx800
```

mapreduce.reduce.java.opts -Xmx1000m

**HDFS**

dfs.replication 3

dfs.blocksize 128

**YARN**

yarn.scheduler.minimum-allocation-mb

yarn.scheduler.maximum-allocation-mb

yarn.scheduler.minimum-allocation-mb

yarn.scheduler.maximum-allocation-vcores

These are for every separate container.

yarn.nodemanager.resource.memory-mb Amount of physical memory, in MB, that can be allocated for containers

```
hdfs-site.xml
hduser13@student13-x1:~$ yarn jar /opt/hadoop-2.6.0/share/hadoop/mapreduce/hadoop-mapred
rt /terainput128 /terasortAndres2
17/04/02 21:05:17 INFO terasort.TeraSort: starting
17/04/02 21:05:20 INFO input.FileInputFormat: Total input paths to process : 2
Spent 494ms computing base-splits.
Spent 15ms computing TeraScheduler splits.
Computing input splits took 510ms
Sampling 8 splits of 8
Making 11 from 100000 sampled records
Computing partitions took 5060ms
Spent 5574ms computing partitions.
17/04/02 21:05:26 INFO client.RMProxy: Connecting to ResourceManager at student13-x1/10.
17/04/02 21:05:31 INFO mapreduce.JobSubmitter: number of splits:8
17/04/02 21:05:32 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_1491137204100_0004
17/04/02 21:05:33 INFO yarn.ClientImpl: Submitted application application_1491137204100_0004
17/04/02 21:05:33 INFO mapreduce.Job: The url to track the job: http://student13-x1:18088
17/04/02 21:05:33 INFO mapreduce.Job: Running job: job_1491137204100_0004
17/04/02 21:05:48 INFO mapreduce.Job: Job job_1491137204100_0004 running in uber mode :
17/04/02 21:05:48 INFO mapreduce.Job: map 0% reduce 0%
17/04/02 21:06:03 INFO mapreduce.Job: map 8% reduce 0%
17/04/02 21:06:07 INFO mapreduce.Job: map 25% reduce 0%
17/04/02 21:06:08 INFO mapreduce.Job: map 46% reduce 0%
17/04/02 21:06:13 INFO mapreduce.Job: map 47% reduce 0%
17/04/02 21:06:15 INFO mapreduce.Job: map 51% reduce 0%
17/04/02 21:06:16 INFO mapreduce.Job: map 58% reduce 0%
17/04/02 21:06:20 INFO mapreduce.Job: map 67% reduce 0%
17/04/02 21:06:21 INFO mapreduce.Job: map 80% reduce 0%
17/04/02 21:06:23 INFO mapreduce.Job: map 84% reduce 0%
17/04/02 21:06:24 INFO mapreduce.Job: map 88% reduce 0%
17/04/02 21:06:28 INFO mapreduce.Job: map 92% reduce 0%
17/04/02 21:06:29 INFO mapreduce.Job: map 92% reduce 2%
17/04/02 21:06:30 INFO mapreduce.Job: map 92% reduce 5%
17/04/02 21:06:34 INFO mapreduce.Job: map 92% reduce 6%
17/04/02 21:06:35 INFO mapreduce.Job: map 92% reduce 9%
17/04/02 21:06:38 INFO mapreduce.Job: map 92% reduce 17%
17/04/02 21:06:42 INFO mapreduce.Job: map 92% reduce 18%
17/04/02 21:06:44 INFO mapreduce.Job: map 92% reduce 21%
17/04/02 21:06:45 INFO mapreduce.Job: map 92% reduce 22%
17/04/02 21:06:51 INFO mapreduce.Job: map 92% reduce 23%
17/04/02 21:06:52 INFO mapreduce.Job: map 100% reduce 23%
17/04/02 21:06:55 INFO mapreduce.Job: map 100% reduce 26%
17/04/02 21:06:56 INFO mapreduce.Job: map 100% reduce 29%
17/04/02 21:06:57 INFO mapreduce.Job: map 100% reduce 30%
17/04/02 21:06:58 INFO mapreduce.Job: map 100% reduce 36%
17/04/02 21:06:59 INFO mapreduce.Job: map 100% reduce 40%
17/04/02 21:07:00 INFO mapreduce.Job: map 100% reduce 49%
```

The screenshot shows the Hadoop MapReduce Job Overview page. The top navigation bar includes links for 'listLinks.html', 'MapRedu...', 'All Application...', 'MapReduce J...', 'MapReduce J...', 'MapReduce J...', 'MapReduce J...', and 'MapReduce J...'. The browser status bar shows the URL '202.45.128.135:11313' and a battery level of '60%'. The main content area features a yellow elephant icon and the word 'hadoop'. The title 'MapReduce Job job\_1491137204100\_0002' is displayed. On the left, a sidebar menu under 'Job' lists 'Overview', 'Counters', 'Configuration', 'Map tasks', 'Reduce tasks', and 'Tools'. The 'Job Overview' section contains detailed information about the job, including its name ('TeraSort'), user ('hduser13'), queue ('default'), state ('SUCCEEDED'), submission time ('Sun Apr 02 20:51:16 HKT 2017'), start time ('Sun Apr 02 20:51:30 HKT 2017'), finish time ('Sun Apr 02 20:53:03 HKT 2017'), and elapsed time ('1mins, 32sec'). It also includes a 'Diagnostics' section with average times for map, shuffle, merge, and reduce tasks. Below this is the 'ApplicationMaster' section, which lists the attempt number (1), start time ('Sun Apr 02 20:51:21 HKT 2017'), node ('student13-x2:8042'), and log file ('logs'). The 'Logs' table provides a breakdown of task types (Map, Reduce) and attempt types (Maps, Reduces) with their counts of Failed, Killed, and Successful attempts.

Task Type	Failed	Killed	Successful
Maps	0	1	8
Reduces	0	1	12

Apps Completed	Containers Running	Memory Used	Memory Total	Mem Reset
20	28 GB	33.44	0 B	GB
<hr/>				

### **Some useful commands**

```
hdfs fsck /tmp/test.txt -files -blocks - CHECK blocksize of a file
```