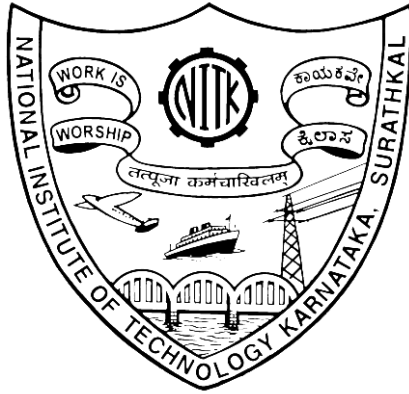


# **National Institute of Technology Karnataka, Surathkal**



## **DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING**

### **GEM5 FULL SYSTEM MODE(FS) REPORT**

SUBMITTED BY

**VIKAS B**

**11CO100**

## **CONTENTS:**

In this report, assuming gem5 is installed and various architectures such as arm, alpha and x86 are built ,I have explained the steps to run gem5 in full system mode for various architectures such as arm, alpha and x86.First, steps to run gem5 in full system mode using default disk image is shown and screenshots are attached to further aid the process.

Next, steps are shown to run gem5 in full system mode for various architectures such as arm, alpha and x86 by specifying the disk image specified for that particular architecture. Relevant screenshots are attached to further aid the process. Once gem5 can be run on full system mode we can run programs in full system mode.

## GEM5 FULL SIMULATION :

Assuming GEM5 Simulator has been installed following are the steps to setup GEM5 Full simulation mode.

### STEPS FOR ARM:

1. Open the terminal and make a new directory called full\_system\_images
2. Change the directory to full\_system\_images
3. Download Arm package from gem5 or paste arm package downloaded manually to folder full\_system\_images
4. Type `tar -xzf arm64-system-02-2014.tgz` or `tar jxf arm-system-2011-08.tar.bz2` depending upon the package you have downloaded.
5. Add M5\_PATH into .bashrc file to tell the system where the image is. Point the M5\_PATH to full\_system\_images to bashrc
6. type command `M5_PATH="/home/vikas/full_system_images/"` >> `./bashrc`
7. To check whether successful type `echo $M5_PATH` if it shows as follows then successful `=/home/vikas/full_system_images/`
8. Path can also be changed by the following method
  - Open gem5->configs->common-SysPath.py file
  - Then under def system paste the path where you have extracted the downloaded images
  - Eg: `path = [ '/dist/m5/system', '/home/vikas/full_system_images' ]`

### RUNNING A PROGRAM :

By default, the fs.py script boots Default Linux and starts a shell on the system console. To keep console traffic separate from simulator input and output, this simulated console is associated with a TCP port. To interact with the console, you must connect to the port using a program such as telnet

1. Set the directory to gem5 and Type the command `./ build/ARMgem5.opt configs/example/fs.py -mem-size=256MB`. Specify Memory size for arm as default gem5 arm build does not support more than 256 MB. Default Linux Image at binaries in full\_system\_images folder will be loaded

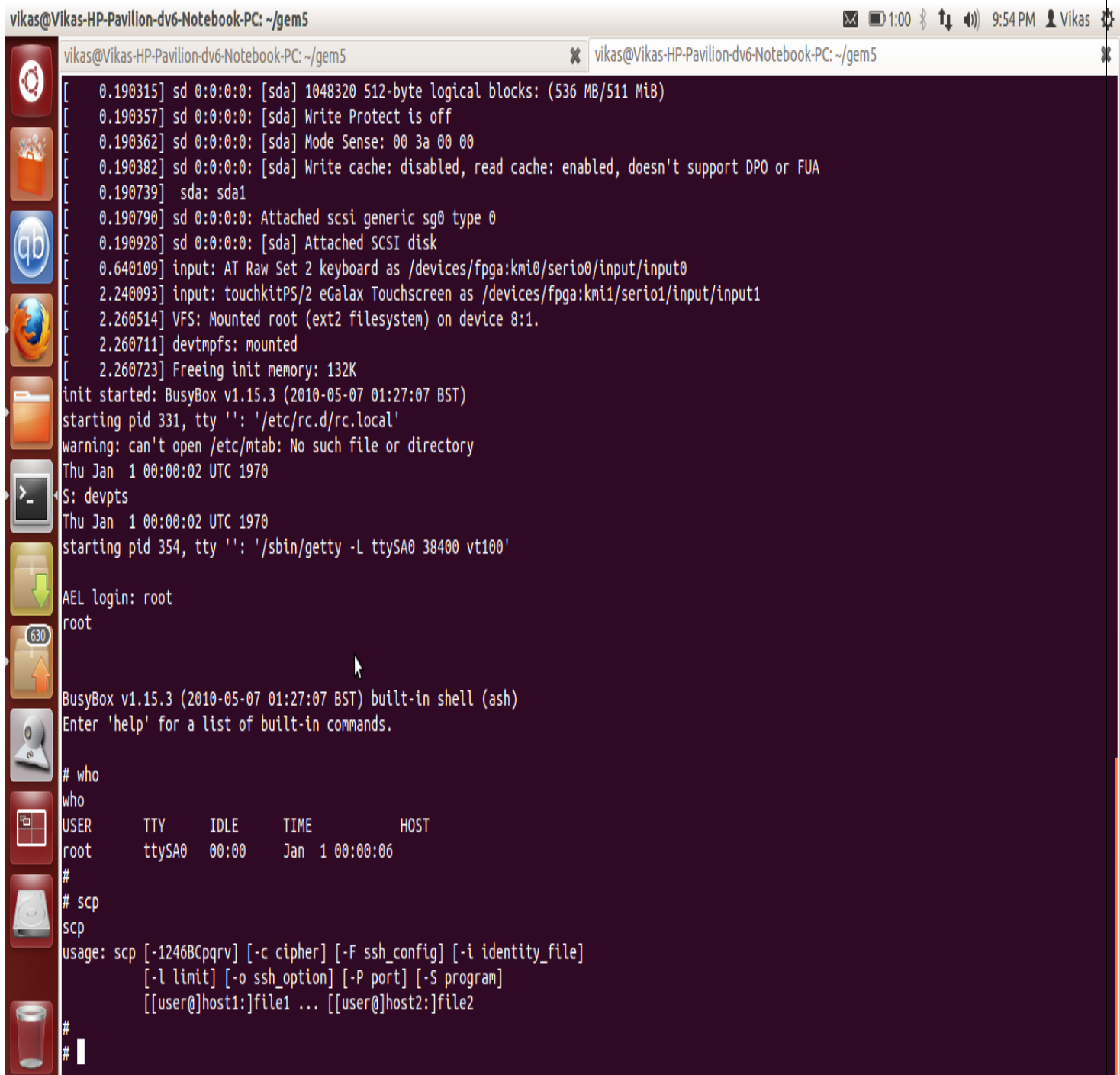
```
vikas@Vikas-HP-Pavillion-dv6-Notebook-PC: ~/gem5
gem5 is copyrighted software; use the --copyright option for details.

gem5 compiled Jun  9 2014 18:58:01
gem5 started Jun 16 2014 21:50:34
gem5 executing on Vikas-HP-Pavillion-dv6-Notebook-PC
command line: ./build/ARM/gem5.opt configs/example/fs.py --mem-size=256MB
Global frequency set at 1000000000 ticks per second
info: kernel located at: /home/vikas/full_system_images/binaries/vmlinux.arm.smp.fb.2.6.38.8
Listening for system connection on port 5901
Listening for system connection on port 3457
  0: system.cpu.isa: ISA system set to: 0xdc0e500 0xdc0e500
0: system.remote_gdb.listener: listening for remote gdb #0 on port 7001
info: Using bootloader at address 0x80000000
info: Using kernel entry physical address at 0x8000
**** REAL SIMULATION ****
info: Entering event queue @ 0. Starting simulation...
warn: The clidr register always reports 0 caches.
warn: clidr LoUIS field of 0b001 to match current ARM implementations.
warn: The csselr register isn't implemented.
warn: The ccsidr register isn't implemented and always reads as 0.
warn: instruction 'mcr bpiallis' unimplemented
warn: instruction 'mcr icialluis' unimplemented
warn: instruction 'mcr dccimvac' unimplemented
warn: instruction 'mcr dccmvau' unimplemented
warn: instruction 'mcr icimvau' unimplemented
```

2. Now open a new terminal tab by typing `ctr +shift +t` and type `telnet 127.0.0.1 3456`. Now you will be logged on to on the simulated system

```
vikas@Vikas-HP-Pavillion-dv6-Notebook-PC: ~/gem5
vikas@Vikas-HP-Pavillion-dv6-Notebook-PC: ~/gem5$ telnet 127.0.0.1 3456
Trying 127.0.0.1...
Connected to 127.0.0.1.
Escape character is '^J'.
==== m5 slave terminal: Terminal 0 ====
[ 0.000000] Linux version 2.6.38.8-gem5 (saidi@zeep) (gcc version 4.5.2 (Sourcery G++ Lite 2011.03-41) ) #1 SMP Mon Aug 15 21:18:38 EDT 2011
[ 0.000000] CPU: ARMv7 Processor [410fc0f0] revision 0 (ARMv7), cr=10c53c7f
[ 0.000000] CPU: VIPT nonaliasing data cache, VIPT nonaliasing instruction cache
[ 0.000000] Machine: ARM-RealView PBX
[ 0.000000] Ignoring unrecognised tag 0x00000000
[ 0.000000] bootconsole [earlycon0] enabled
[ 0.000000] Memory policy: ECC disabled, Data cache writealloc
[ 0.000000] On node 0 totalpages: 65536
[ 0.000000] DMA zone: 512 pages used for memmap
[ 0.000000] DMA zone: 0 pages reserved
[ 0.000000] DMA zone: 65024 pages, LIFO batch:15
[ 0.000000] PERCPU: Embedded 7 pages/cpu @c0556000 s6272 r8192 d14208 u32768
[ 0.000000] pcpu-alloc: s6272 r8192 d14208 u32768 alloc=8*4096
[ 0.000000] pcpu-alloc: [0] 0
[ 0.000000] Built 1 zonelists in Zone order, mobility grouping on. Total pages: 65024
[ 0.000000] Kernel command line: earlyprintk=pl011,0x1c090000 console=ttyAMA0 lpj=19988480 norandmaps rw loglevel=8 mem=256MB root=/dev/sda1
[ 0.000000] PID hash table entries: 1024 (order: 0, 4096 bytes)
[ 0.000000] Dentry cache hash table entries: 32768 (order: 5, 131072 bytes)
[ 0.000000] Inode-cache hash table entries: 16384 (order: 4, 65536 bytes)
[ 0.000000] Memory: 256MB = 256MB total
[ 0.000000] Memory: 256384k/256384k available, 5760k reserved, 0K highmem
[ 0.000000] Virtual kernel memory layout:
[ 0.000000] vector : 0xffff0000 - 0xffff1000 ( 4 kB)
[ 0.000000] fixmap : 0xffff0000 - 0xfffe0000 ( 896 kB)
[ 0.000000] DMA : 0xfffc0000 - 0xffe00000 ( 2 MB)
[ 0.000000] vmalloc : 0xd0800000 - 0xf8000000 ( 632 MB)
[ 0.000000] lowmem : 0xc0000000 - 0xd0000000 ( 256 MB)
[ 0.000000] modules : 0xbf000000 - 0xc0000000 ( 16 MB)
[ 0.000000] .init : 0xc0008000 - 0xc0029000 ( 132 kB)
[ 0.000000] .text : 0xc0029000 - 0xc031c044 (3021 kB)
[ 0.000000] .data : 0xc031e000 - 0xc0336b40 ( 99 kB)
[ 0.000000] Hierarchical RCU implementation.
[ 0.000000] RCU-based detection of stalled CPUs is disabled.
[ 0.000000] NR_IRQS:128
```

3. Type root as login to begin with. Output when commands who and scp is typed is shown below. We get the output of the commands in the simulated GEM5 System.



```
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC: ~/gem5
[ 0.190315] sd 0:0:0:0: [sda] 1048320 512-byte logical blocks: (536 MB/511 MiB)
[ 0.190357] sd 0:0:0:0: [sda] Write Protect is off
[ 0.190362] sd 0:0:0:0: [sda] Mode Sense: 00 3a 00 00
[ 0.190382] sd 0:0:0:0: [sda] Write cache: disabled, read cache: enabled, doesn't support DPO or FUA
[ 0.190739] sda: sda1
[ 0.190790] sd 0:0:0:0: Attached scsi generic sg0 type 0
[ 0.190928] sd 0:0:0:0: [sda] Attached SCSI disk
[ 0.640109] input: AT Raw Set 2 keyboard as /devices/fpga:kmi0/serio0/input/input0
[ 2.240093] input: touchkitPS/2 eGalax Touchscreen as /devices/fpga:kmi1/serio1/input/input1
[ 2.260514] VFS: Mounted root (ext2 filesystem) on device 8:1.
[ 2.260711] devtmpfs: mounted
[ 2.260723] Freeing init memory: 132K
init started: BusyBox v1.15.3 (2010-05-07 01:27:07 BST)
starting pid 331, tty '': '/etc/rc.d/rc.local'
warning: can't open /etc/mtab: No such file or directory
Thu Jan 1 00:00:02 UTC 1970
S: devpts
Thu Jan 1 00:00:02 UTC 1970
starting pid 354, tty '': '/sbin/getty -L ttySA0 38400 vt100'
AEL login: root
root
BusyBox v1.15.3 (2010-05-07 01:27:07 BST) built-in shell (ash)
Enter 'help' for a list of built-in commands.
# who
who
USER      TTY      IDLE      TIME      HOST
root      ttySA0   00:00     Jan 1 00:00:06
#
# scp
scp
usage: scp [-1246BCpqrv] [-c cipher] [-F ssh_config] [-i identity_file]
          [-l limit] [-o ssh_option] [-P port] [-S program]
          [[user@]host1:]file1 ... [[user@]host2:]file2
#
#
```

To run arm full system with more than 256 MB install PCIe express machine and pass that to command line for the full system run

NOW WE RUN FULL SIMULATION BY SPECIFYING THE DISK IMAGE.  
STEPS IN ARM:

1. Open the terminal and change the directory to gem5
2. Type the command `build/ARM/gem5.opt configs/example/fs.py --disk-image=/home/vikas/full_system_images/disks/arm-ubuntu-natty-headless.img --mem-size=256MB`. We get the information about the system and os we are booting. (/home/vikas....is path to the disk image).

```
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC: ~/gem5
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC: ~/gem5
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC:~$ cd gem5
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC:~/gem5$ ./build/ARM/gem5.opt configs/example/fs.py --disk-image=/home/vikas/full_system_images/disks/arm-ubuntu-natty-headless.img
gem5 Simulator System. http://gem5.org
gem5 is copyrighted software; use the --copyright option for details.

gem5 compiled Jun  9 2014 18:58:01
gem5 started Jun 15 2014 03:05:13
gem5 executing on Vikas-HP-Pavilion-dv6-Notebook-PC
command line: ./build/ARM/gem5.opt configs/example/fs.py --disk-image=/home/vikas/full_system_images/disks/arm-ubuntu-natty-headless.img
The currently selected ARM platforms doesn't support
the amount of DRAM you've selected. Please try
another platform
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC:~/gem5$ ./build/ARM/gem5.opt configs/example/fs.py --disk-image=/home/vikas/full_system_images/disks/arm-ubuntu-natty-headless.img --mem-size=256MB
gem5 Simulator System. http://gem5.org
gem5 is copyrighted software; use the --copyright option for details.

gem5 compiled Jun  9 2014 18:58:01
gem5 started Jun 15 2014 03:05:21
gem5 executing on Vikas-HP-Pavilion-dv6-Notebook-PC
command line: ./build/ARM/gem5.opt configs/example/fs.py --disk-image=/home/vikas/full_system_images/disks/arm-ubuntu-natty-headless.img --mem-size=256MB
Global frequency set at 1000000000 ticks per second
info: kernel located at: /home/vikas/full_system_images/binaries/vmlinux.arm.smp.fb.2.6.38.8
Listening for system connection on port 5900
Listening for system connection on port 3456
  0: system.cpu.isa: ISA system set to: 0xc9a4500 0xc9a4500
  0: system.remote_gdb.listener: listening for remote gdb #0 on port 7000
info: Using bootloader at address 0x80000000
info: Using kernel entry physical address at 0x8000
**** REAL SIMULATION ****
info: Entering event queue @ 0. Starting simulation...
warn: The clidr register always reports 0 caches.
warn: clidr LOUIS field of 0b001 to match current ARM implementations.
warn: The csselr register isn't implemented.
warn: The ccsidr register isn't implemented and always reads as 0.
warn: instruction 'mcr bpiallis' unimplemented
warn: instruction 'mcr icialluis' unimplemented
```

```
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC: ~/gem5
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC: ~/gem5
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC: ~/gem5$ telnet 127.0.0.1 3456
Trying 127.0.0.1...
Connected to 127.0.0.1.
Escape character is '^]'.
==== m5 slave terminal: Terminal 0 ====
[ 0.000000] Linux version 2.6.38.8-gem5 (saidi@zeep) (gcc version 4.5.2 (Sourcery G++ Lite 2011.03-41) ) #1 SMP Mon Aug 15 21:18:38 EDT 2011
[ 0.000000] CPU: ARMv7 Processor [410fc0f0] revision 0 (ARMv7), cr=10c53c7f
[ 0.000000] CPU: VIPT nonaliasing data cache, VIPT nonaliasing instruction cache
[ 0.000000] Machine: ARM-RealView PBX
[ 0.000000] Ignoring unrecognised tag 0x00000000
[ 0.000000] bootconsole [earlycon0] enabled
[ 0.000000] Memory policy: ECC disabled, Data cache writealloc
[ 0.000000] On node 0 totalpages: 65536
[ 0.000000]   DMA zone: 512 pages used for memmap
[ 0.000000]   DMA zone: 0 pages reserved
[ 0.000000]   DMA zone: 65024 pages, LIFO batch:15
[ 0.000000] PERCPU: Embedded 7 pages/cpu @c0556000 s6272 r8192 d14208 u32768
[ 0.000000] pcpu-alloc: s6272 r8192 d14208 u32768 alloc=8*4096
[ 0.000000] pcpu-alloc: [0] 0
[ 0.000000] Built 1 zonelists in Zone order, mobility grouping on. Total pages: 65024
[ 0.000000] Kernel command line: earlyprintk=pl011,0x1c090000 console=ttyAMA0 lpj=19988480 norandmaps rw loglevel=8 mem=256MB root=/dev/sda1
[ 0.000000] PID hash table entries: 1024 (order: 0, 4096 bytes)
[ 0.000000] Dentry cache hash table entries: 32768 (order: 5, 131072 bytes)
[ 0.000000] Inode-cache hash table entries: 16384 (order: 4, 65536 bytes)
[ 0.000000] Memory: 256MB = 256MB total
[ 0.000000] Memory: 256384k/256384k available, 5760k reserved, 0K highmem
[ 0.000000] Virtual kernel memory layout:
[ 0.000000]   vector : 0xffff0000 - 0xffff1000   ( 4 kB)
[ 0.000000]   fixmap : 0xffff0000 - 0xfffe0000   ( 896 kB)
[ 0.000000]   DMA    : 0xffc00000 - 0xffe00000   ( 2 MB)
[ 0.000000]   vmalloc : 0xd0800000 - 0xf8000000   ( 632 MB)
[ 0.000000]   lowmem : 0xc0000000 - 0xd0000000   ( 256 MB)
[ 0.000000]   modules : 0xbf000000 - 0xc0000000   ( 16 MB)
[ 0.000000]   .init : 0xc0008000 - 0xc0029000   ( 132 kB)
[ 0.000000]   .text : 0xc0029000 - 0xc031c044   (3021 kB)
[ 0.000000]   .data : 0xc031e000 - 0xc0336b40   ( 99 kB)
[ 0.000000] Hierarchical RCU implementation.
[ 0.000000] RCU-based detection of stalled CPUs is disabled.
[ 0.000000] NR_IRQS:128
```

3. Now Press ctrl +shift +t to open new terminal tab and type telnet 127.0.0.1 3456 to connect with the simulated system. We get information about simulated system.Output



```
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC: ~/gem5
[ 0.190931] sd 0:0:0:0: [sda] Attached SCSI disk
[ 0.640109] input: AT Raw Set 2 keyboard as /devices/fpga:kmi0/serio0/input/input0
[ 2.240093] input: touchkitPS/2 eGalax Touchscreen as /devices/fpga:kmi1/serio1/input/input1
[ 2.241629] EXT3-fs: barriers not enabled
[ 2.241732] kjournald starting. Commit interval 5 seconds
[ 2.241982] EXT3-fs (sda1): using internal journal
[ 2.241986] EXT3-fs (sda1): mounted filesystem with writeback data mode
[ 2.241993] VFS: Mounted root (ext3 filesystem) on device 8:1.
[ 2.242192] devtmpfs: mounted
[ 2.242204] Freeing init memory: 132K

Ubuntu 11.04 gem5sim ttySA0

gem5sim login: vikas
vikas
^[[APasswoliverpool

Login incorrect
gem5sim login:
Login timed out after 60 seconds.
init: tty main process ended, respawning

Ubuntu 11.04 gem5sim ttySA0

gem5sim login:

Ubuntu 11.04 gem5sim ttySA0

gem5sim login:
Ubuntu 11.04 gem5sim ttySA0

gem5sim login:

```

4. Wait for 30 minutes for the image to bootup. The image we used here is arm-ubuntu-natty-headless.img .Type root to login and type command who ,scp to test the running of simulated image

5. Output when commands scp and who are typed

```
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC: ~/gem5
root@gem5sim:~#
root@gem5sim:~# scp
scp
usage: scp [-12346BCqrv] [-c cipher] [-F ssh_config] [-i identity_file]
          [-l limit] [-o ssh_option] [-P port] [-S program]
          [[user@]host1:]file1 ... [[user@]host2:]file2
root@gem5sim:~#
root@gem5sim:~# who
who
root    ttyAMA0      1969-12-31 18:09
root@gem5sim:~#
root@gem5sim:~#
```



### STEPS FOR ALPHA:

1. Open the terminal. We have already created full\_system\_images directory
2. Change the directory to full\_system\_images
3. Download ALPHA( M5 system package) from gem5 website or paste ALPHA package downloaded manually to folder full\_system\_images
4. Type `tar jxf M5_system_2.0b3.tar.bz2` depending upon the package you have downloaded.
5. Since we already changed the M5\_Path we need not do it again. If not set then do the following
6. Add M5\_PATH into .bashrc file to tell the system where the image is  
.Point the M5\_PATH to full\_system\_images to bashrc
7. type command `M5_PATH="/home/vikas/full_system_images/"` >>  
`./bashrc`
8. To check whether successful type `echo $M5_PATH` if it shows as follows then successful `=/home/vikas/full_system_images/`
9. Path can also be changed by the following method
  - Open `gem5->configs->common-SysPath.py` file
  - Then under `def system` paste the path where you have extracted the downloaded images
  - Eg: `path = [ '/dist/m5/system', '/home/vikas/full_system_images' ]`

### RUNNING ALPHA IN FS :

By default, the fs.py script boots Linux and starts a shell on the system console. To keep console traffic separate from simulator input and output, this simulated console is associated with a TCP port. To interact with the console, you must connect to the port using a program such as telnet

1. Type the command `.build/ALPHA/gem5.opt / configs/example/fs.py` .  
Default Linux image at full\_system\_images folder will be loaded.

```
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC: ~/gem5
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC: ~/gem5
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC:~$ cd gem5
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC:~/gem5$ ./build/ALPHA/gem5.opt configs/example/fs.py --mem-size=256MB
gem5 Simulator System. http://gem5.org
gem5 is copyrighted software; use the --copyright option for details.

gem5 compiled Jun 16 2014 23:51:13
gem5 started Jun 19 2014 17:58:16
gem5 executing on Vikas-HP-Pavilion-dv6-Notebook-PC
command line: ./build/ALPHA/gem5.opt configs/example/fs.py --mem-size=256MB
Global frequency set at 100000000000 ticks per second
info: kernel located at: /home/vikas/full_system_images/binaries/vmlinux
Listening for system connection on port 3456
0: system.tsunami.io.rtc: Real-time clock set to Thu Jan 1 00:00:00 2009
0: system.remote_gdb.listener: listening for remote gdb #0 on port 7000
**** REAL SIMULATION ****
info: Entering event queue @ 0. Starting simulation...
warn: Prefetch instructions in Alpha do not do anything
warn: Prefetch instructions in Alpha do not do anything
1821258803500: system.terminal: attach terminal 0
```

2. Now open a new terminal tab by typing `ctr +shift +t` and type `telnet 127.0.0.1 3456`. Wait for a bit. Now you will be logged on to on the simulated system linux version and you can type commands you want.

```
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC: ~/gem5
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC: ~/gem5
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC:~/gem5$ telnet 127.0.0.1 3456
Trying 127.0.0.1...
Connected to 127.0.0.1.
Escape character is '^]'.
==== m5 slave terminal: Terminal 0 ====
M5 console: m5AlphaAccess @ 0xFFFFFD0200000000
Got Configuration 623
memsize 10000000 pages 8000
First free page after ROM 0xFFFFFC0000018000
HWRPB 0xFFFFFC0000018000 l1pt 0xFFFFFC0000040000 l2pt 0xFFFFFC0000042000 l3pt_rpb 0xFFFFFC0000044000 l3pt_kernel 0xFFFFFC0000048000 l2reserv 0xFFFFFC0000046000
kstart = 0xFFFFFC00000310000, kend = 0xFFFFFC0000085898, kentry = 0xFFFFFC00000310000, numCPUs = 0x1
CPU Clock at 2000 MHz IntrClockFrequency=1024
Booting with 1 processor(s)
KSP: 0x20043FE8 PTBR 0x20
Console Callback at 0x0, fixup at 0x0, crb offset: 0x510
Memory cluster 0 [0 - 392]
Memory cluster 1 [392 - 32376]
Initializing mdt_bitmap addr 0xFFFFFC0000038000 mem_pages 8000
ConsoleDispatch at virt 10000658 phys 18658 val FFFFFFFC00000100A8
unix_boot_mem ends at FFFFFFFC0000070000
k_argc = 0
jumping to kernel at 0xFFFFFC00000310000, (PCBB 0xFFFFFC0000018180 pfn 1067)
CallbackFixup 0 18000, t7=FFFFFFC000070C000
Linux version 2.6.13 (hsul@zed.eecs.umich.edu) (gcc version 3.4.3) #1 SMP Sun Oct 8 19:52:07 EDT 2006
Booting GENERIC on Tsunami variation DP264 using machine vector DP264 from SRM
Major Options: SMP LEGACY_START VERBOSE_MCHECK
Command line: root=/dev/hda1 console=ttyS0
memcluster 0, usage 1, start 0, end 392
memcluster 1, usage 0, start 392, end 32768
freeing pages 1069:32768
reserving pages 1069:1070
SMP: 1 CPUs probed -- cpu_present_mask = 1
Built 1 zonelists
Kernel command line: root=/dev/hda1 console=ttyS0
PID hash table entries: 2048 (order: 11, 65536 bytes)
Using epoch = 1900
Console: colour dummy device 80x25
Dentry cache hash table entries: 65536 (order: 6, 524288 bytes)
```

```
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC: ~/gem5
hdb: 4177920 sectors (2139 MB), CHS=4144/16/63, UDMA(33)
hdb: cache flushes not supported
hdb: unknown partition table
mice: PS/2 mouse device common for all mice
NET: Registered protocol family 2
IP route cache hash table entries: 8192 (order: 3, 65536 bytes)
TCP established hash table entries: 32768 (order: 6, 524288 bytes)
TCP bind hash table entries: 32768 (order: 6, 524288 bytes)
TCP: Hash tables configured (established 32768 bind 32768)
TCP reno registered
ip_conntrack version 2.1 (1024 buckets, 8192 max) - 296 bytes per conntrack
ip_tables: (C) 2000-2002 Netfilter core team
arp_tables: (C) 2002 David S. Miller
TCP brc registered
Initializing IPsec netlink socket
NET: Registered protocol family 1
NET: Registered protocol family 17
NET: Registered protocol family 15
Bridge firewalling registered
802.1Q VLAN Support v1.8 Ben Greear <greearb@candelatech.com>
All bugs added by David S. Miller <davem@redhat.com>
VFS: Mounted root (ext2 filesystem) readonly.
Freeing unused kernel memory: 224k freed
init started: BusyBox v1.1.0 (2007.03.04-01:07+0000) multi-call binary
mounting filesystems...
EXT2-fs warning: checktime reached, running e2fsck is recommended
loading script...
Script from M5 readfile is empty, starting bash shell...
# who
serial8250: too much work for irq4
who
bash: who: command not found
# # help
serial8250: too much work for irq4
help
bash: help: command not found
# #
```

NOW WE RUN FULL SIMULATION BY SPECIFYING THE DISK IMAGE.

STEPS IN ALPHA:

1. Open the terminal and change the directory to gem5
2. Type the command `./build/ALPHA/gem5.opt configs/example/fs.py --disk-image=/home/vikas/full_system_images/disks/linux-latest.img --mem-size=256MB`. (Gem5 ALPHA build Supports memory size till 2047 MB) We get the information about the system and os we are booting.

```
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC: ~/gem5$ ./build/ALPHA/gem5.opt configs/example/fs.py --disk-image=/home/vikas/full_system_images/disks/linux-latest.img --mem-size=256MB
gem5 Simulator System. http://gem5.org
gem5 is copyrighted software; use the --copyright option for details.

gem5 compiled Jun 16 2014 23:51:13
gem5 started Jun 19 2014 18:18:43
gem5 executing on Vikas-HP-Pavilion-dv6-Notebook-PC
command line: ./build/ALPHA/gem5.opt configs/example/fs.py --disk-image=/home/vikas/full_system_images/disks/linux-latest.img --mem-size=256MB
Global frequency set at 1000000000 ticks per second
info: kernel located at: /home/vikas/full_system_images/binaries/vmlinux
Listening for system connection on port 3456
0: system.tsunami.io.rtc: Real-time clock set to Thu Jan 1 00:00:00 2009
0: system.remote_gdb.listener: listening for remote gdb #0 on port 7000
**** REAL SIMULATION ****
info: Entering event queue @ 0. Starting simulation...
```

- Now Press ctrl +shift +t to open new terminal tab and type telnet 127.0.0.1 3456 to connect with the simulated system. We get information about simulated system

```
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC: ~/gem5
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC: ~/gem5$ telnet 127.0.0.1 3456
Trying 127.0.0.1...
Connected to 127.0.0.1.
Escape character is '^]'.
==== m5 slave terminal: Terminal 0 ====
M5 console: m5AlphaAccess @ 0xFFFFFD0200000000
Got Configuration 623
memsize 10000000 pages 8000
First free page after ROM 0xFFFFFC000018000
HWRPB 0xFFFFFC000018000 l1pt 0xFFFFFC000040000 l2pt 0xFFFFFC000042000 l3pt_rpb 0xFFFFFC000044000 l3pt_kernel 0xFFFFFC000048000 l2reserv 0xFFFFFC000046000
kstart = 0xFFFFFC0000310000, kend = 0xFFFFFC0000855898, kentry = 0xFFFFFC0000310000, numCPUs = 0x1
CPU Clock at 2000 MHz IntrClockFrequency=1024
Booting with 1 processor(s)
KSP: 0x20043FE8 PTBR 0x20
Console Callback at 0x0, fixup at 0x0, crb offset: 0x510
Memory cluster 0 [0 - 392]
Memory cluster 1 [392 - 32376]
Initializing mdt_bitmap addr 0xFFFFFC000038000 mem_pages 8000
ConsoleDispatch at virt 10000658 phys 18658 val FFFFFC0000100A8
unix_boot_mem ends at FFFFFC000076000
k_argc = 0
jumping to kernel at 0xFFFFFC0000310000, (PCBB 0xFFFFFC0000018180 pfn 1067)
CallbackFixup 0 18000, t7=FFFFFFC000070C000
Linux version 2.6.13 (hsul@zed.eecs.umich.edu) (gcc version 3.4.3) #1 SMP Sun Oct 8 19:52:07 EDT 2006
Booting GENERIC on Tsunami variation DP264 using machine vector DP264 from SRM
Major Options: SMP LEGACY_START VERBOSE_MCHECK
Command line: root=/dev/hda1 console=ttyS0
memcluster 0, usage 1, start 0, end 392
memcluster 1, usage 0, start 392, end 32768
freeing pages 1069:32768
reserving pages 1069:1070
SMP: 1 CPUs probed -- cpu_present_mask = 1
Built 1 zonelists
Kernel command line: root=/dev/hda1 console=ttyS0
PID hash table entries: 2048 (order: 11, 65536 bytes)
Using epoch = 1900
Console: colour dummy device 80x25
Dentry cache hash table entries: 65536 (order: 6, 524288 bytes)
```

- Wait for the image to boot to type in the commands you want

```
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC: ~/gem5
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC: ~/gem5$
hdb: 4177920 sectors (2139 MB), CHS=4144/16/63, UDMA(33)
hdb: cache flushes not supported
hdb: unknown partition table
mice: PS/2 mouse device common for all mice
NET: Registered protocol family 2
IP route cache hash table entries: 8192 (order: 3, 65536 bytes)
TCP established hash table entries: 32768 (order: 6, 524288 bytes)
TCP bind hash table entries: 32768 (order: 6, 524288 bytes)
TCP: Hash tables configured (established 32768 bind 32768)
TCP reno registered
ip_conntrack version 2.1 (1024 buckets, 8192 max) - 296 bytes per conntrack
ip_tables: (C) 2000-2002 Netfilter core team
arp_tables: (C) 2002 David S. Miller
TCP bic registered
Initializing IPsec netlink socket
NET: Registered protocol family 1
NET: Registered protocol family 17
NET: Registered protocol family 15
Bridge firewalling registered
802.1Q VLAN Support v1.8 Ben Greear <greearb@candelatech.com>
All bugs added by David S. Miller <davem@redhat.com>
VFS: Mounted root (ext2 filesystem) readonly.
Freeing unused kernel memory: 224k freed
init started: BusyBox v1.1.0 (2007.03.04-01:07:0000) multi-call binary
mounting filesystems...
EXT2-fs warning: checktime reached, running e2fsck is recommended
loading script...
Script from M5 readfile is empty, starting bash shell...
# who
serial8250: too much work for irq4
who
bash: who: command not found
# # help
serial8250: too much work for irq4
help
bash: help: command not found
# #
```

## STEPS FOR X86:

10. Open the terminal. We have already created full\_system\_images directory
11. Change the directory to full\_system\_images
12. Download X86 from gem5 website or paste X86 package downloaded manually to folder full\_system\_images. Also download M5 system package to the same folder
13. Type `tar jxf M5_system_2.0b3.tar.bz2` and depending upon the package you have downloaded.
14. Since we already changed the M5\_Path we need not do it again. If not set then do the following
15. Add M5\_PATH into .bashrc file to tell the system where the image is  
.Point the M5\_PATH to full\_system\_images to bashrc
16. type command `M5_PATH="/home/vikas/full_system_images/" >> ./bashrc`
17. To check whether successful type `echo $M5_PATH` if it shows as follows then successful `=/home/vikas/full_system_images/`
18. Path can also be changed by the following method
  - Open gem5->configs->common-SysPath.py file
  - Then under def system paste the path where you have extracted the downloaded images
  - Eg: `path = [ '/dist/m5/system', '/home/vikas/full_system_images' ]`

## RUNNING IN FULL SYSTEM MODE :

By default, the fs.py script boots Linux and starts a shell on the system console. To keep console traffic separate from simulator input and output, this simulated console is associated with a TCP port. To interact with the console, you must connect to the port using a program such as telnet

1. Type the command `.build/ALPHA/gem5.opt / configs/example/fs.py .`  
Default Linux binaries in full\_system\_images folder will be loaded.

NOW WE RUN FULL SIMULATION BY SPECIFYING THE DISK IMAGE.

STEPS IN X86:

1. Open the terminal and change the directory to gem5
2. Type the command `./build/X86/gem5.opt configs/example/fs.py --disk-image=/home/vikas/full_system_images/disks/linux-x86.img --mem-size=256MB.`(Gem5 ALPHA build Supports memory size till 2047 MB) We get the information

```
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC: ~/gem5
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC:~/gem5$ ./build/X86/gem5.opt configs/example/fs.py --disk-image=/home/vikas/full_system_images/disks/linux-x86.img --mem-size=256MB
gem5 Simulator System. http://gem5.org
gem5 is copyrighted software; use the --copyright option for details.

gem5 compiled Jun  9 2014 19:23:45
gem5 started Jun 19 2014 18:20:36
gem5 executing on Vikas-HP-Pavilion-dv6-Notebook-PC
command line: ./build/X86/gem5.opt configs/example/fs.py --disk-image=/home/vikas/full_system_images/disks/linux-x86.img --mem-size=256MB
Global frequency set at 1000000000000 ticks per second
info: kernel located at: /home/vikas/full_system_images/binaries/x86_64-vmLinux-2.6.22.9
0: rtc: Real-time clock set to Sun Jan  1 00:00:00 2012
Listening for com_1 connection on port 3456
warn: Reading current count from inactive timer.
0: system.remote_gdb.listener: listening for remote gdb #0 on port 7000
**** REAL SIMULATION ****
info: Entering event queue @ 0. Starting simulation...
warn: Don't know what interrupt to clear for console.
```

about the system and as we are booting.

3. Now Press `ctrl +shift +t` to open new terminal tab and type `telnet 127.0.0.1 3456` to connect with the simulated system. We get information about simulated system



```
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC: ~/gem5
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC: ~/gem5
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC:~/gem5$ telnet 127.0.0.1 3456
Trying 127.0.0.1...
Connected to 127.0.0.1.
Escape character is '^J'.
==== m5 slave terminal: Terminal 0 ====
Linux version 2.6.22.9 (blackga@nacho) (gcc version 4.1.2 (Gentoo 4.1.2)) #2 Mon Oct 8 13:13:00 PDT 2007
Command line: earlyprintk=ttyS0 console=ttyS0 lpj=7999923 root=/dev/hda1
BIOS-provided physical RAM map:
 BIOS-e820: 0000000000000000 - 0000000000009fc00 (usable)
 BIOS-e820: 0000000000009fc00 - 00000000000100000 (reserved)
 BIOS-e820: 00000000000100000 - 000000000001000000 (usable)
 BIOS-e820: 000000000001000000 - 00000000000100000000 (reserved)
end_pfn_map = 1048576
kernel direct mapping tables up to 100000000 @ 8000-d000
DMI 2.5 present.
Zone PFN ranges:
 DMA             0 ->      4096
 DMA32          4096 ->   1048576
 Normal       1048576 ->   1048576
early_node_map[2] active PFN ranges
0:             0 ->      159
0:          256 ->   65536
Intel MultiProcessor Specification v1.4
MPTABLE: OEM ID: MPTABLE: Product ID: MPTABLE: APIC at: 0xFEE00000
Processor #0 (Bootup-CPU)
I/O APIC #1 at 0xFEC00000.
Setting APIC routing to flat
Processors: 1
swsusp: Registered nosave memory region: 0000000000009f000 - 00000000000a0000
swsusp: Registered nosave memory region: 00000000000a0000 - 00000000000100000
Allocating PCI resources starting at 20000000 (gap: 10000000:ffff0000)
Built 1 zonelists. Total pages: 62932
Kernel command line: earlyprintk=ttyS0 console=ttyS0 lpj=7999923 root=/dev/hda1
Initializing CPU#0
PID hash table entries: 1024 (order: 10, 8192 bytes)
time.c: Detected 1999.998 MHz processor.
Console: colour dummy device 80x25
console handover: boot [earlyser0] -> real [ttyS0]
Dentry cache hash table entries: 32768 (order: 6, 262144 bytes)
```

4. Wait for the image to boot to start typing the commands you want

```
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC: ~/gem5
vikas@Vikas-HP-Pavilion-dv6-Notebook-PC: ~/gem5
hdb: 4177920 sectors (2139 MB), CHS=4144/16/63, UDMA(33)
hdb: unknown partition table
megaraid cmm: 2.20.2.7 (Release Date: Sun Jul 16 00:01:03 EST 2006)
megaraid: 2.20.5.1 (Release Date: Thu Nov 16 15:32:35 EST 2006)
megasas: 00.00.03.10-rc5 Thu May 17 10:09:32 PDT 2007
Fusion MPT base driver 3.04.04
Copyright (c) 1999-2007 LSI Logic Corporation
Fusion MPT SPI Host driver 3.04.04
Fusion MPT SAS Host driver 3.04.04
ieee1394: raw1394: /dev/raw1394 device initialized
USB Universal Host Controller Interface driver v3.0
usbcore: registered new interface driver usb_lpc
drivers/usb/class/usb_lpc.c: v0.13: USB Printer Device Class driver
Initializing USB Mass Storage driver...
usbcore: registered new interface driver usb-storage
USB Mass Storage support registered.
PNP: No PS/2 controller found. Probing ports directly.
serio: i8042 KBD port at 0x60,0x64 irq 1
serio: i8042 AUX port at 0x60,0x64 irq 12
mice: PS/2 mouse device common for all mice
input: AT Translated Set 2 keyboard as /class/input/input0
device-mapper: ioctl: 4.11.0-ioctl (2006-10-12) initialised: dm-devel@redhat.com
input: PS/2 Generic Mouse as /class/input/input1
usbcore: registered new interface driver usbhid
drivers/hid/usbhid/hid-core.c: v2.6:USB HID core driver
oprofile: using timer interrupt.
TCP cubic registered
NET: Registered protocol family 1
NET: Registered protocol family 10
IPv6 over IPv4 tunneling driver
NET: Registered protocol family 17
EXT2-fs warning: mounting unchecked fs, running e2fsck is recommended
VFS: Mounted root (ext2 filesystem).
Freeing unused kernel memory: 232k freed
INIT: version 2.86 booting
mounting filesystems...
loading script...
Script from M5 readfile is empty, starting bash shell...
(none) / #
```



