

# پاسخ تمرین شماره ۵ درس معماری کامپیوتر

## نصب و راه اندازی gem5

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### نصب پیش نیاز ها

چون از قبل این پیش نیازها نصب شده است نتیجه دستورات به صورت زیر است :

```
asay@ubuntu:~$ sudo apt-get install build-essential
Reading package lists... Done
Building dependency tree
Reading state information... Done
build-essential is already the newest version (12.1ubuntu2).
0 upgraded, 0 newly installed, 0 to remove and 538 not upgraded.

asay@ubuntu:~$ sudo apt-get install git
Reading package lists... Done
Building dependency tree
Reading state information... Done
git is already the newest version (1:2.7.4-0ubuntu1.6).
0 upgraded, 0 newly installed, 0 to remove and 538 not upgraded.

asay@ubuntu:~$ sudo apt-get install libgoogle-perftools-dev
Reading package lists... Done
Building dependency tree
Reading state information... Done
libgoogle-perftools-dev is already the newest version (2.4-0ubuntu5.16.04.1).
0 upgraded, 0 newly installed, 0 to remove and 538 not upgraded.

asay@ubuntu:~$ sudo apt-get install protobuf-compiler
Reading package lists... Done
Building dependency tree
Reading state information... Done
protobuf-compiler is already the newest version (2.6.1-1.3).
0 upgraded, 0 newly installed, 0 to remove and 538 not upgraded.

asay@ubuntu:~$ sudo apt-get install libprotobuf-dev
Reading package lists... Done
Building dependency tree
Reading state information... Done
libprotobuf-dev is already the newest version (2.6.1-1.3).
0 upgraded, 0 newly installed, 0 to remove and 538 not upgraded.
```

```
0 upgraded, 0 newly installed, 0 to remove and 538 not upgraded.  
asay@ubuntu:~$ sudo apt-get install m4  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
m4 is already the newest version (1.4.17-5).  
m4 set to manually installed.  
0 upgraded, 0 newly installed, 0 to remove and 538 not upgraded.  
asay@ubuntu:~$ sudo apt-get install python  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
python is already the newest version (2.7.12-1~16.04).  
0 upgraded, 0 newly installed, 0 to remove and 538 not upgraded.  
asay@ubuntu:~$ sudo apt-get install python-dev  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
python-dev is already the newest version (2.7.12-1~16.04).  
python-dev set to manually installed.  
0 upgraded, 0 newly installed, 0 to remove and 538 not upgraded.  
asay@ubuntu:~$ sudo apt-get install scons  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
scons is already the newest version (2.4.1-1).  
0 upgraded, 0 newly installed, 0 to remove and 538 not upgraded.  
asay@ubuntu:~$ sudo apt-get install zlib1g  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
zlib1g is already the newest version (1:1.2.8.dfsg-2ubuntu4.1).  
0 upgraded, 0 newly installed, 0 to remove and 538 not upgraded.  
asay@ubuntu:~$ sudo apt-get install zlib1g-dev  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
zlib1g-dev is already the newest version (1:1.2.8.dfsg-2ubuntu4.1).  
zlib1g-dev set to manually installed.  
0 upgraded, 0 newly installed, 0 to remove and 538 not upgraded.
```

## مشروع نصب

### GIT CLONE

```
asay@ubuntu:~$ git clone https://gem5.googlesource.com/public/gem5  
Cloning into 'gem5'...  
remote: Sending approximately 170.80 MiB ...  
remote: Counting objects: 16, done  
remote: Finding sources: 100% (16/16)  
remote: Total 195298 (delta 149853), reused 195295 (delta 149853)  
Receiving objects: 100% (195298/195298), 170.82 MiB | 705.00 KiB/s, done.  
Resolving deltas: 100% (149853/149853), done.  
Checking connectivity... done.
```

## BUILD

```
asay@ubuntu:~/gem5$ scans build/x86/gem5.opt -j5
scans: Reading Scons script files...
Info: Using Python config: /usr/bin/python2.7-config
      support incremental linking and lto at the same time, so lto is being disabled. To force lto on anyway, use the --force-lto option. That will disable partial linking.
      Checking for C library python.h... (cached) yes
      Checking for C library python2.7... (cached) yes
      Checking for C library pthread... (cached) yes
      Checking for C library dl... (cached) yes
      Checking for C library util... (cached) yes
      Checking for accept(0,0) in C++ library None... (cached) yes
      Checking for zlibVersion() in C++ library z... (cached) yes
      Checking for GOOGLE_PROTOBUF_VERIFY_VERSION in c++ library protobuf... (cached) yes
      Checking for C header file valgrind/valgrind.h... (cached) no
      Checking for C header file kvm.h... (cached) yes
      Checking for C header file kvm_xsane... (cached) yes
      Checking whether _i386_ is declared... (cached) yes
      Checking whether __i386__ is declared... (cached) yes
      Checking whether __x86_64__ is declared... (cached) yes
      Building in /home/asay/gem5/build/X86
Using saved variables file /home/asay/gem5/build/variables/X86
scans: Building targets ...
[  CX ] X86/python/_m5/param_Gem5ToTlmBridge32.cc --> .
[  CX ] X86/python/_m5/param_Gem5ToTlmBridge64.cc --> .
[  CX ] X86/python/_m5/param_Gem5ToTlmBridgeBase.cc --> .
[SO PyBind] HMCController --> X86/python/_m5/param_HMCController.cc
[SO PyBind] HelloObject --> X86/python/_m5/param_HelloObject.cc
[SO PARAM] HMCController --> X86/params/HMCController.hh
[SO PARAM] HelloObject --> X86/params/HelloObject.hh
[  CX ] X86/python/_m5/param_I2CDevice.cc --> .
[  CX ] X86/python/_m5/param_I2CBus.cc --> .
[  CX ] X86/python/_m5/param_I2CBusBase.cc --> .
[SO PyBind] I2CDevice --> X86/python/_m5/param_I2CDevice.cc
[SO PyBind] I2CBus --> X86/python/_m5/param_I2CBus.cc
[SO PyBind] I2CBusBase --> X86/python/_m5/param_I2CBusBase.cc
[SO PARAM] I2CDevice --> X86/params/I2CDevice.hh
[  CX ] X86/python/_m5/param_I2CBus.cc --> .
[SO PyBind] I2CDevice --> X86/python/_m5/param_I2CDevice.cc
[  CX ] X86/python/_m5/param_I2CDevice.cc --> .
[SO PyBind] I8042 --> X86/python/_m5/param_I8042.cc
[SO PARAM] I8042 --> X86/params/I8042.hh
[SO PARAM] PS2Device --> X86/params/PS2Device.hh
[  CX ] X86/python/_m5/param_I8042.cc --> .
[SO PyBind] I82094AA --> X86/python/_m5/param_I82094AA.cc
[SO PARAM] I82094AA --> X86/params/I82094AA.hh
[SO PARAM] I8259 --> X86/params/I8259.hh
[  CX ] X86/python/_m5/param_I82894AA.cc --> .
[SO PyBind] I8237 --> X86/python/_m5/param_I8237.cc
[SO PARAM] I8237 --> X86/params/I8237.hh
[  CX ] X86/python/_m5/param_I8237.cc --> .
[SO PyBind] I8254 --> X86/python/_m5/param_I8254.cc
[SO PARAM] I8254 --> X86/params/I8254.hh
[ TRACING ] --> X86/debug/IntelI8254Timer.hh
[  CX ] X86/python/_m5/param_I8254.cc --> .
[SO PyBind] I8259 --> X86/python/_m5/param_I8259.cc
[  CX ] X86/python/_m5/param_I8259.cc --> .
[SO PyBind] IGbE --> X86/python/_m5/param_IGbE.cc
[SO PARAM] IGbE --> X86/params/IGbE.hh
[ TRACING ] --> X86/debug/EthernetDesc.hh
[ TRACING ] --> X86/debug/EthernetIntr.hh

asay@ubuntu:~/gem5$
```

```

asay@ubuntu:~/gem5$ [  CXN] X86/cpu/cpuevent.cc -> .o
[  CXN] X86/cpu/exetrace.cc -> .o
[  CXN] X86/cpu/exec_context.cc -> .o
[  CXN] X86/cpu/func_unit.cc -> .o
[  CXN] X86/cpu/inteltrace.cc -> .o
[  TRACING] -> X86/debug/ExecAll.hh
[  CXN] X86/cpu/intr_control.cc -> .o
[  TRACING] -> X86/debug/IntrControl.hh
[  CXN] X86/cpu/nativetrace.cc -> .o
[  CXN] X86/cpu/pc_event.cc -> .o
[  CXN] X86/cpu/profile.cc -> .o
[  CXN] X86/cpu/quiesce_event.cc -> .o
[  CXN] X86/cpu/reg_class.cc -> .o
[  CXN] X86/cpu/static_inst.cc -> .o
[  CXN] X86/cpu/simple_thread.cc -> .o
[  TRACING] -> X86/debug/Context.hh
[  CXN] X86/cpu/thread_context.cc -> .o
[  CXN] X86/cpu/thread_state.cc -> .o
[  CXN] X86/cpu/timing_expr.cc -> .o
[  CXN] X86/cpu/checker/cpu.cc -> .o
[  CXN] X86/cpu/dummy_checker.cc -> .o
[  TRACING] -> X86/debug/DirectedTest.hh
[  CXN] X86/cpu/testers/directedtest/RubyDirectedTester.cc -> .o
[  LINK] -> X86/mem/cache/lib.o.partial
[  CXN] X86/cpu/testers/directedtest/DirectedGenerator.cc -> .o
[  CXN] X86/cpu/testers/directedtest/SeriesRequestGenerator.cc -> .o
[  CXN] X86/cpu/testers/directedtest/InvalidateGenerator.cc -> .o
[  TRACING] -> X86/debug/MemTest.hh
[  CXN] X86/cpu/testers/memtest/memtest.cc -> .o
[  CXN] X86/arch/generic/decode_cache.cc -> .o
[  LINK] -> X86/cpu/testers/directedtest/lib.o.partial
[  CXN] X86/arch/generic/mmapped_lpr.cc -> .o
[  CXN] X86/arch/generic/tlb.cc -> .o
[  LINK] -> X86/cpu/lib.o.partial
[  CXN] X86/arch/generic/pseudo_inst.cc -> .o
[  TRACING] -> X86/debug/TrafficGen.hh
[  CXN] X86/cpu/testers/traffic_gen/base.cc -> .o
[  CXN] X86/cpu/testers/traffic_gen/base_gen.cc -> .o
[  CXN] X86/cpu/testers/traffic_gen/dram_gen.cc -> .o
[  LINK] -> X86/arch/generic/lib.o.partial
[  CXN] X86/cpu/testers/traffic_gen/dram_rot_gen.cc -> .o
[  LINK] -> X86/cpu/testers/memtest/lib.o.partial
[  CXN] X86/cpu/testers/traffic_gen/exit_gen.cc -> .o
[  CXN] X86/cpu/testers/traffic_gen/idle_gen.cc -> .o
[  CXN] X86/cpu/testers/traffic_gen/linear_gen.cc -> .o
[  CXN] X86/cpu/testers/traffic_gen/random_gen.cc -> .o
[  CXN] X86/cpu/testers/traffic_gen/stream_gen.cc -> .o
[  CXN] X86/cpu/testers/traffic_gen/pygen.cc -> .o
[  CXN] X86/cpu/testers/traffic_gen/trace_gen.cc -> .o
[  CXN] X86/cpu/testers/traffic_gen/traffic_gen.cc -> .o
[  CXN] X86/mem/ruby/network/fault_model/FaultModel.cc -> .o
[  CXN] X86/cpu/simple/probes/simpoint.cc -> .o
[  LINK] -> X86/mem/ruby/network/fault_model/lib.o.partial
[  CXN] X86/mem/ruby/network/BasicLink.cc -> .o
[  CXN] X86/mem/ruby/network/BasicRouter.cc -> .o
[  CXN] X86/mem/ruby/network/MessageBuffer.cc -> .o
[  CXN] X86/mem/ruby/network/Network.cc -> .o
[  CXN] X86/mem/ruby/network/Topology.cc -> .o
[  LINK] -> X86/cpu/simple/probes/lib.o.partial
[  TRACING] -> X86/debug/ProbeVerbose.hh
[  CXN] X86/sim/probe/probe.cc -> .o
[  LINK] -> X86/cpu/testers/traffic_gen/lib.o.partial
[  LINK] -> X86/sim/probe/lib.o.partial
[  LINK] -> X86/mem/ruby/network/lib.o.partial
[  CXN] X86/base/date.cc -> .o
[  LINK] -> X86/gem5.opt
scons: done building targets.

```

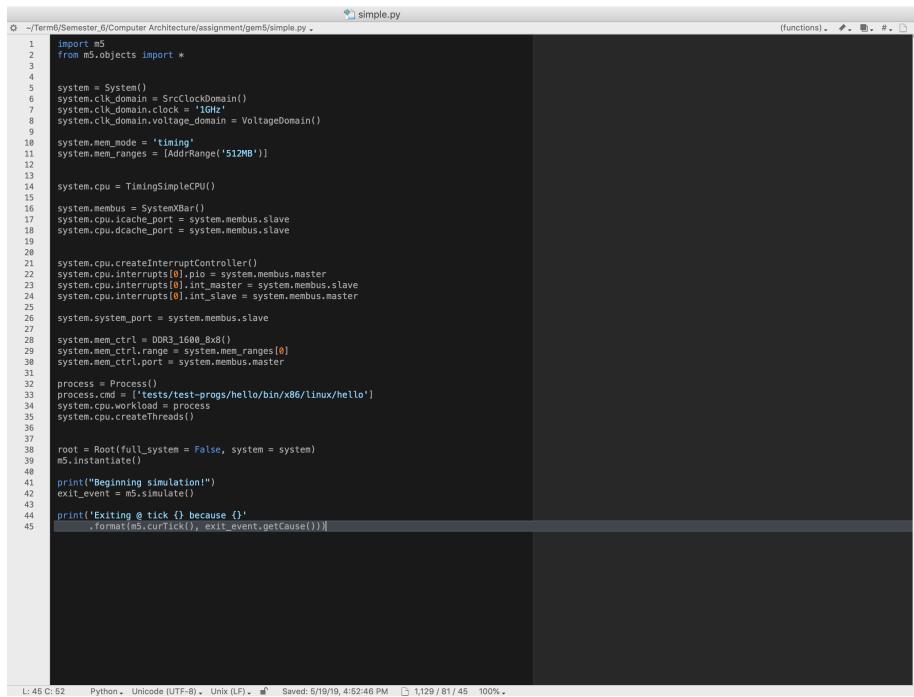
به علت حجم زیاد خروجی ، عکس ها آورده نشده است ولی در فایل zip ارسالی موجود می باشد .

## ساخت یک فایل Config

با استفاده از دستورات زیر در پوشه configs یک فایل به نام simple.py به وجود می آوریم و بعد فایل toturial را که فایل config میباشد را به وجود می آوریم که محتوای آن هم به صورت فایل و هم عکس در فایل گزارش موجود است.

```
touch configs/toturial/simple.py mkdir configs/toturial
```

که محتوای فایل simple.py به صورت زیر می باشد :



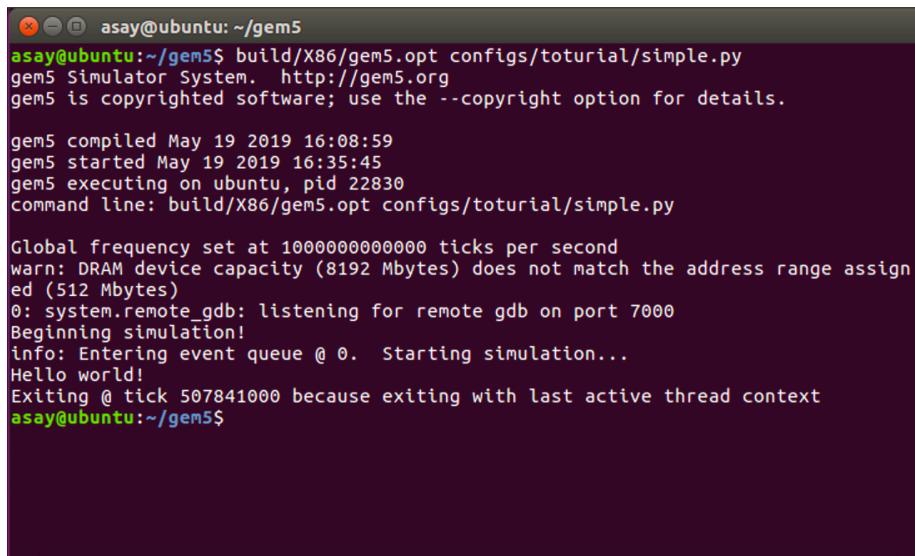
```
simple.py
1 import m5
2 from m5.objects import *
3
4 system = System()
5 system.clk_domain = SrcClockDomain()
6 system.clk_domain.clock = '1GHz'
7 system.clk_domain.voltage_domain = VoltageDomain()
8
9 system.mem_mode = 'timing'
10 system.mem_ranges = [AddrRange('512MB')]
11
12
13 system.cpu = TimingSimpleCPU()
14
15
16 system.membus = SystemXBar()
17 system.cpu.icache_port = system.membus.slave
18 system.cpu.dcache_port = system.membus.slave
19
20
21 system.cpu.createInterruptController()
22 system.cpu.interrupts[0].pio = system.membus.master
23 system.cpu.interrupts[0].int_master = system.membus.slave
24 system.cpu.interrupts[0].in_slave = system.membus.master
25
26 system.system_port = system.membus.slave
27
28 system.mem_ctrl = DDR3_1600_0x8()
29 system.mem_ctrl.range = system.mem_ranges[0]
30 system.mem_ctrl.port = system.membus.master
31
32 process = Process()
33 process.cmd = ['tests/test-progs/hello/bin/x86/linux/hello']
34 system.cpu.workload = process
35 system.cpu.createThreads()
36
37
38 root = Root(full_system = False, system = system)
39 m5.instantiate()
40
41 print("Beginning simulation!")
42 exit_event = m5.simulate()
43
44 print("Exiting @ tick {} because {}".format(m5.curTick(), exit_event.getCause()))
```

این فایل نیز به پیوست ارسال شده است.

و بعد با استفاده از دستور

build/X86/gem5.opt configs/toturial/simple.py

که نتیجه آن به شرح زیر می باشد :



```
asay@ubuntu:~/gem5$ build/X86/gem5.opt configs/toturial/simple.py
gem5 Simulator System. http://gem5.org
gem5 is copyrighted software; use the --copyright option for details.

gem5 compiled May 19 2019 16:08:59
gem5 started May 19 2019 16:35:45
gem5 executing on ubuntu, pid 22830
command line: build/X86/gem5.opt configs/toturial/simple.py

Global frequency set at 100000000000 ticks per second
warn: DRAM device capacity (8192 Mbytes) does not match the address range assigned (512 Mbytes)
0: system.remote_gdb: listening for remote gdb on port 7000
Beginning simulation!
info: Entering event queue @ 0. Starting simulation...
Hello world!
Exiting @ tick 507841000 because exiting with last active thread context
asay@ubuntu:~/gem5$
```