

# Computer Architecture 2022 - Project 1

Sniper Tool Evaluation (Compiling Sniper, Running a Test Application and Configuration Setting)

Deadline: **2022/10/21 23:59**

## I. Introduction

Sniper is a generation parallel, high-speed and accurate x86 simulator. It supports multi-core, multi-threaded simulator, many kind of version Linux-OS, 3-level cache. Supports a number of pthread-based parallel application APIs, like OpenCL, OpenMP

In this project, you have to be familiar with this tool and try to adjust the arguments for some further analyses. The other requirement, you should design a simple program such as "hello world," and run it on sniper.

## II. Reference Source

You can find support for this project and future projects in the following websites:

1. Sniper IISW Tutorial:

<http://snipersim.org/documents/2013-09-22%20Sniper%20IISWC%20Tutorial.pdf>

2. The Sniper User Manual: <http://snipersim.org/documents/sniper-manual.pdf>

## III. Installation Guide

**Before you start, please check the following requirements:**

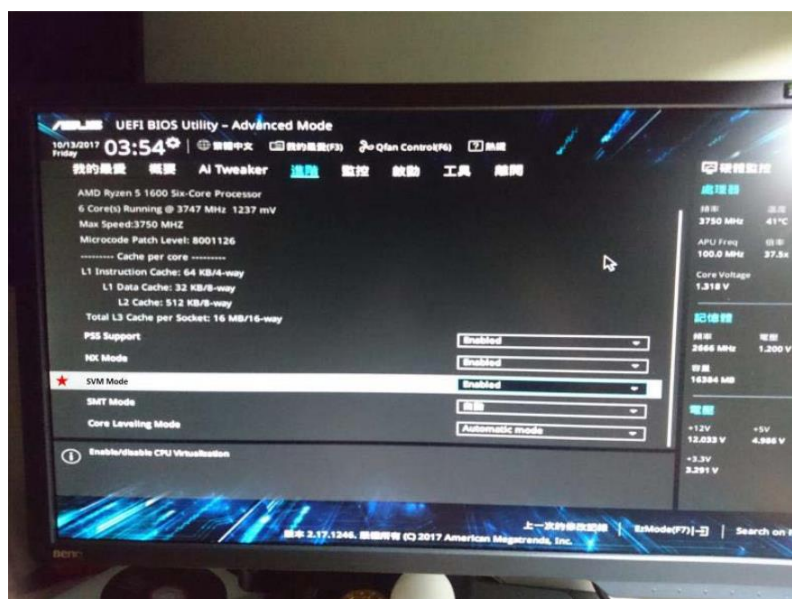
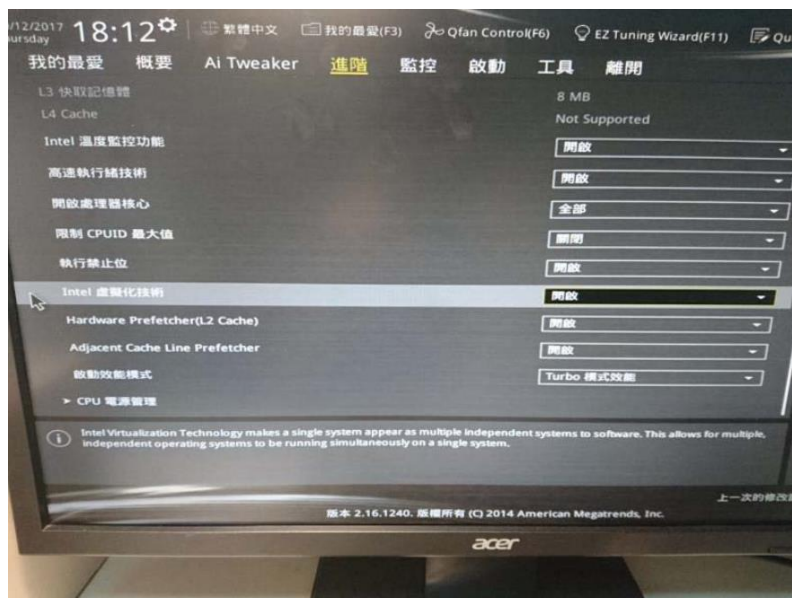
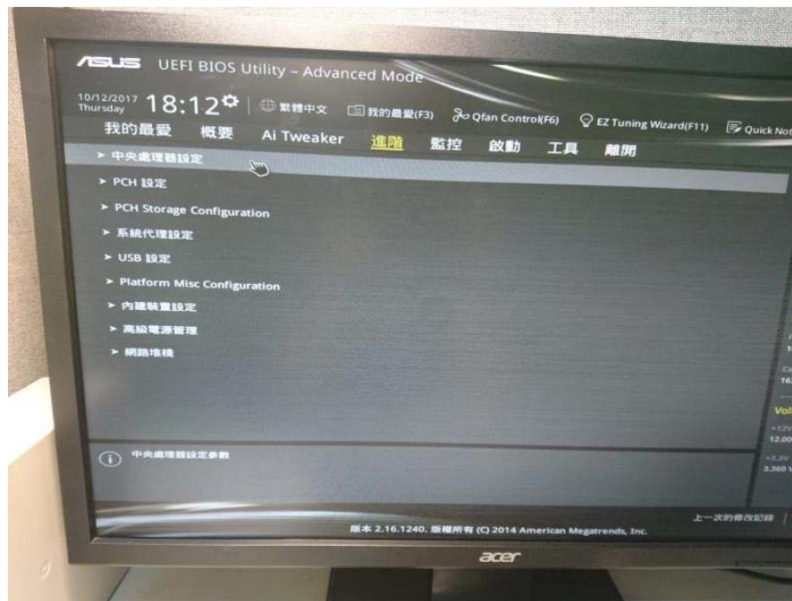
You have enough free space for a **virtual machine** (at least **60GB**)

You have enough **Ram**, **above 8GB** is recommended

✖ You have enabled VT (Intel Virtualization Technology) or SVM (AMD Secure Virtual Machine) in your computer BIOS setting, or you will not able to simulate a 64-bit environment.

To configure the VT setting: Enter BIOS setting and select the CPU Configuration (usually in advance setting category)

For example :



## Step1. Download and install Virtual Box:

Download Virtual Box for Windows Hosts



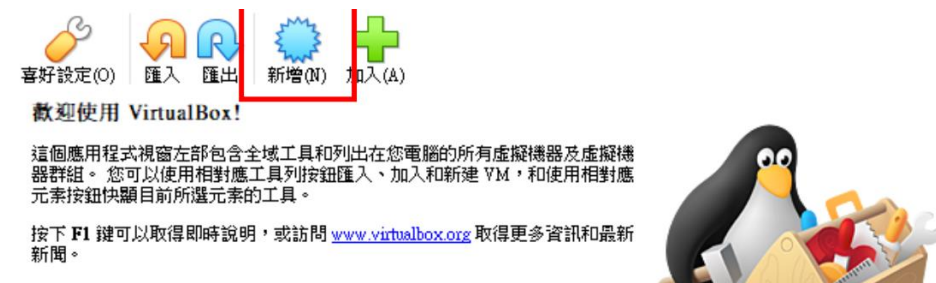
The screenshot shows the VirtualBox website's download page. The header features the VirtualBox logo and the title 'Download VirtualBox'. A sidebar on the left contains links for About, Screenshots, Downloads, Documentation, End-user docs, Technical docs, Contribute, and Community. The main content area states that users will find links to VirtualBox binaries and source code. It lists 'VirtualBox binaries' with a note about the license and links to the latest 6.0 and 5.2 builds. Below this, 'VirtualBox 6.1.38 platform packages' are listed, including Windows hosts (highlighted with a red box), Linux distributions, Solaris hosts, and Solaris 11 IPS hosts. A note mentions that binaries are released under the GPL version 2. Further down, the 'VirtualBox 6.1.38 Oracle VM VirtualBox Extension Pack' is listed, followed by the 'VirtualBox 6.1.38 Software Developer Kit (SDK)'. The 'User Manual' section is also present, with a link to the HTML version.

## Step2. Install sniper-6.0

2-1. Download and extract **sniper.rar**, website:

<https://drive.google.com/drive/folders/1psLAUZOfQzv6sPfmJ4V7ooSKg9MnvMke?usp=sharing>

2-2. Open the installation complete Virtual Box, click New addition.



The screenshot shows the VirtualBox 'New addition' button, which is highlighted with a red box. The button is labeled '新增(N)' and features a blue gear icon. Below the button, there is a section titled '歡迎使用 VirtualBox!' (Welcome to use VirtualBox!). This section contains a paragraph in Chinese explaining that the application window includes a toolbar and a list of virtual machines and virtual machine groups. It also mentions that users can use the corresponding toolbar buttons to add, delete, and create VMs, and that the F1 key can be used to get help or visit the website. To the right of the text is a cartoon penguin holding a toolbox.

2-3. Give virtual machine memory and select Linux OS system, version

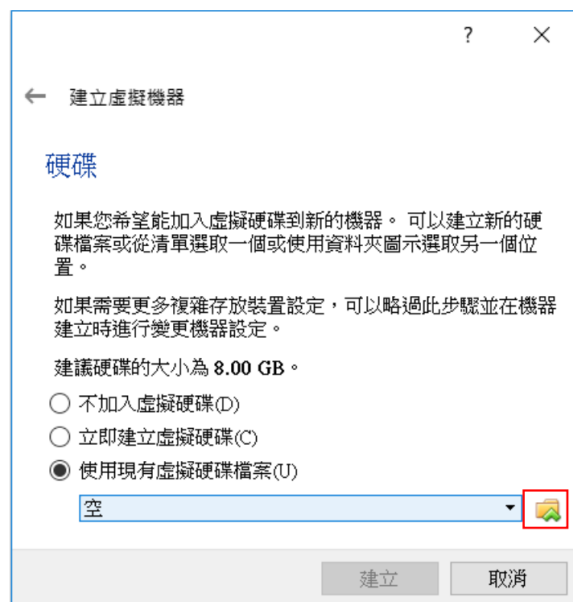


The screenshot shows the '建立虛擬機器' (Create Virtual Machine) dialog box in VirtualBox. The dialog has a title bar with a back arrow and the text '建立虛擬機器'. Below the title bar, there is a section titled '名稱和作業系統' (Name and Operating System). This section contains four fields: '名稱' (Name) with the value 'sniper', '機器資料夾' (Machine folder) with the value 'C:\Users\admin\VirtualBox VMs', '類型(T)' (Type) with the value 'Linux', and '版本(V)' (Version) with the value 'Ubuntu (64-bit)'. There is also a small icon of a Linux penguin next to the 'Linux' type field.

## 2-4. Configuration memory size (at least 16384MB)



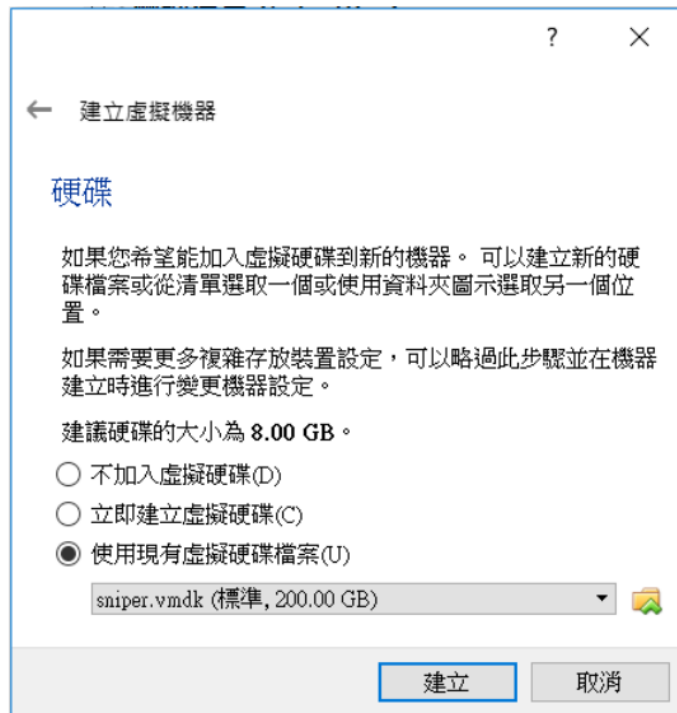
## 2-5. Use existing virtual disk file



## 2-6. Select (2-1.step) extract after generate folder → open sniper folder



## 2-7. Click set up



## 2-8. Click sniper virtual machine



## 2-9. Enter Password: **sniper**



**Step3.** Extract **sniper-6.0.tar**, file path: ~/Downloads

**Step4.** Download, extract and rename PIN folder, website:

<https://drive.google.com/drive/folders/1psLAUZOtQzv6sPfmJ4V7ooSKg9MnvMke?usp=sharing>

- Extract **pin-2.13-61206-gcc.4.4.7-linux.tar.gz**
- Rename the folder "pin-2.13-61206-gcc.4.4.7-linux" to "**pin\_kit**"
- Move "pin\_kit" folder into Downloads/sniper-6.0/

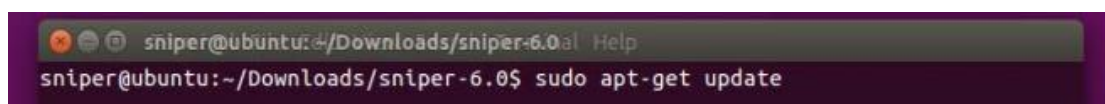
**Step5.** Download, extract boost folder, website:

<https://drive.google.com/drive/folders/1psLAUZOtQzv6sPfmJ4V7ooSKg9MnvMke?usp=sharing>

- Extract **boost\_1\_65\_1.7z**
- Move "boost\_1\_65\_1" folder into "Downloads/sniper-6.0/"

**Step6.** Update the latest package information (Open the terminal)

- Obtain a list of remote packages:





- Update Packages:

```
sniper@ubuntu: ~/Downloads/sniper-6.0
sniper@ubuntu:~/Downloads/sniper-6.0$ sudo apt-get -y dist-upgrade
```

- Clears the package:

```
sniper@ubuntu: ~/Downloads/sniper-6.0
sniper@ubuntu:~/Downloads/sniper-6.0$ sudo apt-get clean
```

#### Step7. Install sniper (Open the terminal)

```
sniper@ubuntu: ~/Downloads/sniper-6.0
sniper@ubuntu:~/Downloads/sniper-6.0$ make clean
```

```
sniper@ubuntu: ~/Downloads/sniper-6.0
sniper@ubuntu:~/Downloads/sniper-6.0$ make -j 4
```

- Verify installation:

```
sniper@ubuntu: ~/Downloads/sniper-6.0/test/fft
sniper@ubuntu:~/Downloads/sniper-6.0$ cd test/fft
sniper@ubuntu:~/Downloads/sniper-6.0/test/fft$ make run
```

#### Step8. Install benchmarks (Open the terminal)

- Extract “**sniper-benchmarks.tbz**” and move “**benchmarks**” folder into /Downloads/sniper-6.0/
- Make sure your path:

```
sniper@ubuntu: ~/Downloads/sniper-6.0
sniper@ubuntu:~/Downloads/sniper-6.0$ pwd
/home/sniper/Downloads/sniper-6.0
```

```
sniper@ubuntu: ~/Downloads/sniper-6.0/benchmarks
sniper@ubuntu:~/Downloads/sniper-6.0$ cd benchmarks/
sniper@ubuntu:~/Downloads/sniper-6.0/benchmarks$
```

```
sniper@ubuntu: ~/Downloads/sniper-6.0/benchmarks
sniper@ubuntu:~/Downloads/sniper-6.0/benchmarks$ export GRAPHITE_ROOT=/home/sniper/Downloads/sniper-6.0
```

```
sniper@ubuntu: ~/Downloads/sniper-6.0/benchmarks
sniper@ubuntu:~/Downloads/sniper-6.0/benchmarks$ export BENCHMARKS_ROOT=$(pwd)
```

```
sniper@ubuntu: ~/Downloads/sniper-6.0/benchmarks
sniper@ubuntu:~/Downloads/sniper-6.0/benchmarks$ make
```

#### Step9. Run sniper (For example: setting 2 cores)

- **Note: The number of cores must be 1, 2, 4, 8, 16....etc.**


```
sniper@ubuntu: ~/Downloads/sniper-6.0/benchmarks
sniper@ubuntu:~/Downloads/sniper-6.0/benchmarks$ ./run-sniper -p splash2-fft -i test -n 2 -c gainestown
```

- Simulation result file path: /Downloads/sniper-6.0/benchmarks/sim.out

#### Step10. Read the results

(All output picture are generated in /Downloads/sniper-6.0/benchmarks)

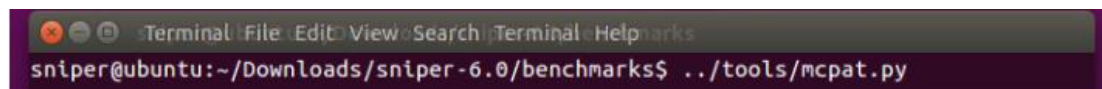
- CPI Stacks:



```
sniper@ubuntu: ~/Downloads/sniper-6.0/benchmarks
sniper@ubuntu:~/Downloads/sniper-6.0/benchmarks$ ../tools/cpistack.py
```

Output picture “**cpi-stack.png**” will be generated.

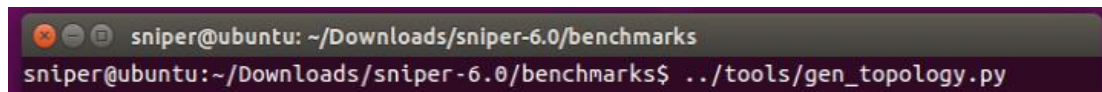
- Power Stacks:



```
sniper@ubuntu:~/Downloads/sniper-6.0/benchmarks$ ../tools/mcpat.py
```

Output picture “**power.png**” will be generated.

- Topology:



```
sniper@ubuntu: ~/Downloads/sniper-6.0/benchmarks
sniper@ubuntu:~/Downloads/sniper-6.0/benchmarks$ ../tools/gen_topology.py
```

Output file “**topo.svg**” will be generated.

## IV. Project Problem1

**Problem requirement in your report. Please put your result in the folder named Problem1.**

- Please run different core amount, save sim.out file as “**core4\_sim.out**”, “**core8\_sim.out**” respectively.
- How many instructions are committed as executing the benchmarks? (write in the word file)
- How many cycles are used? (write in the word file)
- How many total core CPI? (list core 0 CPI=?? 、 core 1 CPI=??) (write in the word file)
- List the first three components that have highest power consumption. (write in the word file)
- What kind of trouble you encountered and how did you resolve it? (write in the word file)

Problem1 folder must contain the following information:

1. Your data simulation results (core4\_sim.out, core8\_sim.out)
2. cpi-stack.png and power.png (using core4 and core8)
3. Topology (Topo.svg) (using core4 and core8)
4. The answer of b. ~ f. in Problem1 (write in the word file)

**Please move the “CA\_Problem1.doc” file in your Problem1 folder.**



## V. Configuration setting

Please reference file "The Sniper User Manual.pdf".

**6 Configuration Parameters** and **9.3 Options** used to configure the Gainestown processor.

→ The Sniper User Manual: <http://snipersim.org/documents/sniper-manual.pdf>

**Please change the L3 cache size**, configuration file path:

~/Downloads/sniper-6.0/config/gainestown.cfg

```
[perf_model/l3_cache]
perfect = false
cache_size = 8192
associativity = 10
address_hash = mask
replacement_policy = lru
data_access_time = 30 # 35 cycles total according to membench, +L1+L2 tag times
tags_access_time = 10
```

- When you're done save the file, come back ~/Downloads/sniper-6.0/benchmarks folder and run the command:

```
sniper@ubuntu: ~/Downloads/sniper-6.0/benchmarks
sniper@ubuntu:~/Downloads/sniper-6.0/benchmarks$ ./run-sniper -p splash2-fft -i
test -n 1 -c gainestown
```

- Automatically generates the topology information of the gainestown microarchitecture:

```
Terminal File Edit View Search Terminal Help
sniper@ubuntu:~/Downloads/sniper-6.0/benchmarks$ ../tools/gen_topology.py
```

## VI. Project Problem2

**Problem requirement in your report. Please put your result in the folder named Problem2.**

- Please hand out your three configurations of cache, the L3 cache size is set to **4MB**、**8MB** and **16MB**. (Submit "topo.svg" of **4MB**、**8MB** and **16MB L3 cache** under 1 core, a total of 3 "topo.svg")
- Your observation of performance analysis under different core numbers and memory levels. Please submit your "**core1\_sim.out**" and "**core2\_sim.out**" under different size of **L3 cache**, and the report should clearly explain your observation. (Submit a total of 6 "sim.out" and a report of your observation in the word file. Ex. CPI、first three Power...)

Core1 + 4MB L3 cache	Core2 + 4MB L3 cache
Core1 + 8MB L3 cache	Core2 + 8MB L3 cache
Core1 + 16MB L3 cache	Core2 + 16MB L3 cache

c. Additional requirement: please add another layer of cache (i.e. L1, L2, L3 to L1, L2, L3, L4) by revise the file `~Downloads/sniper-6.0/config/gainestown.cfg` and `nehalem.cfg`

(Submit a "topo.svg" of **64 MB L4 cache** under 1 core)

- `~/Downloads/sniper-6.0/config/nehalem.cfg`

```
shared_cores = 1

[perf_model/l3_cache] ← L3 cache
address_hash = mask
dvfs_domain = global # L1 and L2 run at core frequency (default), L3 is system frequency
prefetcher = none
writeback_time = 0
next_level_read_bandwidth=0 ← Add this line to find next level cache.
```

← Add L4 cache by imitate the format of the L3 cache.

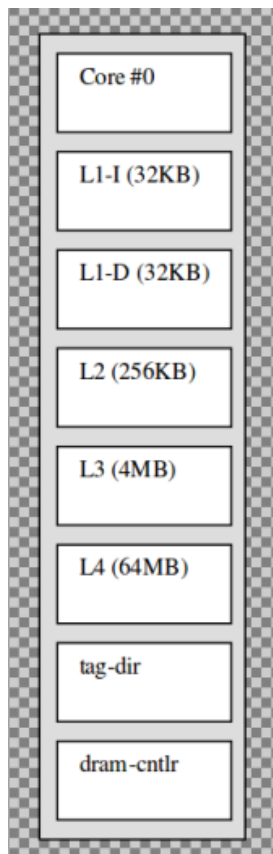
- `~/Downloads/sniper-6.0/config/gainestown.cfg`

```
[perf_model/core]
frequency = 2.66

[perf_model/l3_cache] ← L3 cache
perfect = false
cache_size = 4096
associativity = 16
address_hash = mask
replacement_policy = lru
data_access_time = 30 # 35 cycles total according to membench, +L1+L2 tag times
tags_access_time = 10
perf_model_type = parallel
writethrough = 0
shared_cores = 4
next_level_read_bandwidth = 0 ← Add this line to find next level cache.
```

← Add L4 cache by imitate the format of the L3 cache.

- **Example**



Problem2 folder must contain the following information:

1. Your data simulation results (total 6 files)
2. Topology (Topo.svg) (4 、 8 、 16MB under 1 core and 64 MB L4 cache under 1 core)
4. The answer of b. in Problem2 (write in the word file)

Please move the “**CA\_Problem2.doc**” file in your Problem2 folder.

## VII. Contact Information

If you encountered any unsolvable problem, please email me. **Pack your files as a compressed file**, the file contains Problem1 and Problem2 folder, and name the compressed file as “CAProject1\_ID\_Name” like (CAProject1\_M012345678 吳小勳) and upload it when you finished the report.

1. TA: Chen-Jung Lee 李振融
2. Lab: EC5037
3. E-mail: [andylee@cereal.cse.nsysu.edu.tw](mailto:andylee@cereal.cse.nsysu.edu.tw)