SYA14 - Neuromorphic Computing
Lab 5

1 Objective

In this lab, we will study the communication for SNN.

2 Prerequisite

The following are the prerequisites of this exercise:

- Verilog HDL

- Simulation tool: Modelsim

3 Ex 5.1: Simulation of NoC

Download the source code at: `https://web-ext.u-aizu.ac.jp/misc/neuro-eng/book/NeuromorphicComput`
`lab/SNN_NOC.zip`
Makefile is provided:
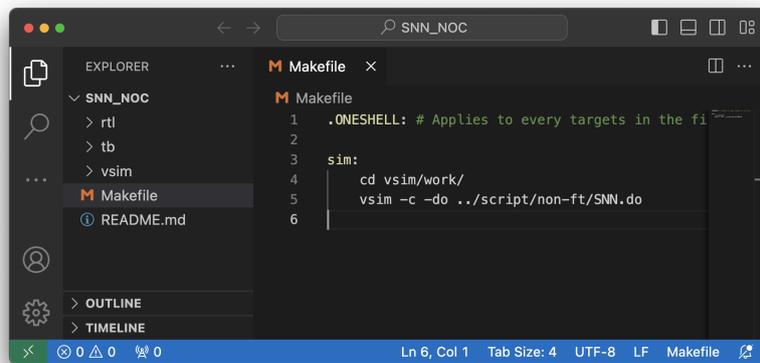
Figure 1: The context of Makefile.

3.1 Explanation of System

The configuration of the system is provided at $vsim/config/MLP\_v0/_sys.conf$:

- NoC: 1x3x3 3D NoC.

- In each part, we can see the NodeID and its address.

- In each node, there are 10 neurons and their connection table (address of connected neurons).

- Addresses are in binary format: the first 3 bits are Z address, the next 3 bits are Y address and the last 3 bits are X address.

3.2 Explanation of Configuration

Under the folder $vsim/config$, please create a folder named $new-test$. The format for configuration is

```
1  <time-step>,<number of input>,<number of output spikes>,<address of each spikes>
```

Copy all files in $vsim/config/MLP\_v0$ to in $vsim/config/new-test$ for Ex 5.1. You may remove all contents in the file $000**.conf$

Under the folder $vsim/output$, please create a folder named $new-test$. The format for output is

```
1  <time-step>,<latency in cycle>
```

The examples can be found in $vsim/config/MLP\_v0$ and $vsim/output/MLP\_v0$

3.3 Runing with the new configuration

To run with the new configuration, edit line 12 of $tb/SNN\_Simulation/defines\_SNN.v$

```
1      'define CONFIG_FOLDER  "../config/MLP_v0/"
```

to point to your new folder.

3.4 Exercise content

Run the example source code and report the result:

1. Simulate the SNN NoC using the Makefile provided (see Fig. 1).

2. Write your simulation inputs (under ./vsim/config/new-test/) and export your simulation logs (under ./vsim/output/new-test/). The new simulation is only one communication between two (2) random pairs of source and destination neurons.

3. Capture the waveform and explain the routing path from the waveform.

4 Ex 5.2: Edit NoC

With the same design in Ex 5.1, please make the following editing:

- Edit the NoC to 3D: $2x3x3$ (edit line 12-20 of $tb/SNN\_Simulation/defines\_SNN.v$) and $vsim/config/new-test/\_sys.conf$

- Edit the number of neurons per node to 8.

- Calculate the new size of SNN: input layer 32, 1 hidden layer, output layer: 8 neurons

- Generate your communication patterns

4.1   Exercise content

Run the example source code and report the result:

1. Explain your edits

2. Capture the waveform and explain the routing path from the waveform.

5   Submission format and Deadline

Your report should be prepared in English and should contain the following:

1. Your name, your ID, and the Lab #.

2. All reports

3. Submission format: soft copy.

Note: This Laboratory is designed for the book [1]

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[1]Book: Neuromorphic Computing Principles and Organization 1st, Edition, ISBN-10: 3030925242, ISBN-13: 978-3030925246, Publisher: Springer, May 2022.