SYA14 - Neuromorphic Computing

Lab 6

1 Objective

In this lab, we will design the AER protocol.

2 Prerequisite

The following are the prerequisites of this exercise:

- Verilog HDL
- Simulation tool: Modelsim

3 Ex 6.1: AER generator in Python

Write the conversion code from spike vectors:

- 256 inputs
- binary format
- randomly generated
- 1000 time-steps
- both encoder and decoder
- compare the results: input and output

3.1 Input content

The input content is a 2D matrix of 1000× 256 where 1000 is the number of time-step and 256 is the spike vector format. Please save it into the 'input.csv' file where each row of the file is one timestep and each column is for one input. Items are separated by commas (,).

Note: please randomly generate this file with a predefined seed for replications.

3.2 Output content

The output content is a 2D matrix of 1000× N (N is the maximum number of spikes per time-step across all time steps). Please save it into the 'output.csv' file where each row of the file is one timestep and each column is for one output.

3.3 Example content

For instance, with 10 time steps and 8 inputs, we have the following 'input.csv' file:

```
0, 0, 0, 0, 1, 0, 0, 0
0, 0, 0, 0, 0, 0, 0, 0
1, 0, 0, 0, 0, 0, 0, 0
0, 0, 1, 0, 0, 0, 0, 0
0, 0, 0, 0, 0, 0, 0, 0
0, 0, 0, 1, 1, 0, 0, 0
0, 0, 0, 0, 0, 0, 0, 0
0, 0, 0, 0, 0, 0, 0, 0
0, 0, 0, 0, 0, 1, 1, 1
0, 0, 1, 0, 0, 0, 0, 0
```

The 'output.csv' is as follows:

```
4

0
2

3,4


5, 6, 7
2
```

3.4 Exercise content

Write the Python code and report the result.

4 Ex 6.2: AER generator in Verilog HDL

Similar to the Ex 6.1, we write RTL code to generate AER protocol with the same inputs and configuration

4.1 Exercise content

1. Write the RTL equivalence (in Verilog HDL) of the Python code.
2. Generate the AER
3. Compare the differences between RTL and Python.

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]

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