

[Machine Learning Intelligent Chip Design] Homework #3

Due: 2023/05/24

Problem

The Convolution Neural Network (CNN) is a kind of neural network to do image recognition. The convolution layer of CNN is used to extract the feature of image. Please design a convolution layer with 3x3 kernel size and the stride is 1. (No padding) The convolution operation is shown in Fig.1. After the convolution operation the feature need to go through an activation function - ReLU to calculate the output. The ReLU formula is shown in Fig. 2.

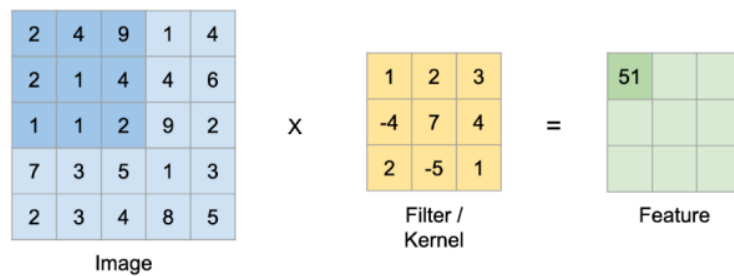
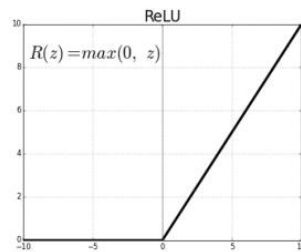


Fig. 1 Convolution operation



$$f(x) = \begin{cases} x, & x > 0 \\ 0, & x \leq 0 \end{cases}$$

Fig. 2 ReLU function

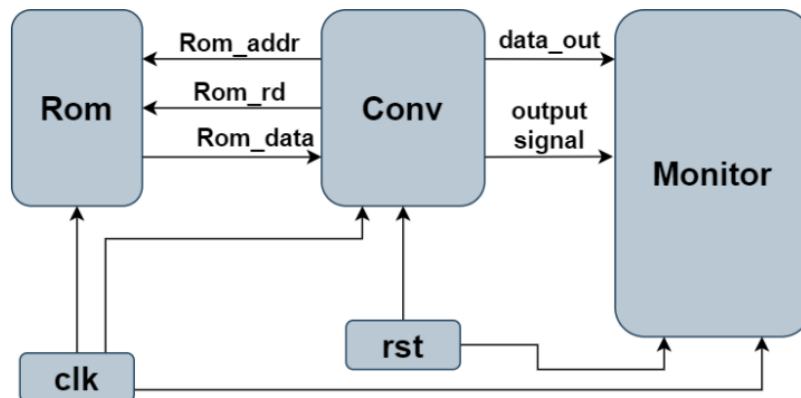


Fig. 3 Block diagram

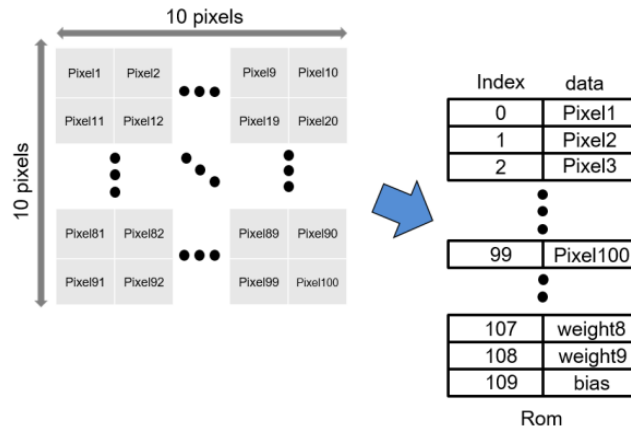


Fig. 4 ROM

Requirements

Complete the convolution block, as shown in Fig. 3. Rom_addr is the address for ROM reading, Rom_rd is the signal for ROM reading (high: valid, low: not valid), and Rom_data is the data output by ROM. Data_out is the data output by Conv, and output_signal is the output signal (high: valid, low: not valid). The ROM is used to store the input data and weight. The size of ROM is 110(10x10 input data and 10 weight data) and the specification of ROM is shown in Fig.4. The Monitor block is used to print your convolution output result on the screen, as shown in Fig. 5. Please use the Platform Architect (PA) to simulate the system and show the simulation result. **Note that you need to use Channel to interconnect each block in Fig.3.**

Result:

0	174	0	103	0	92	22	102
22	0	0	61	0	22	0	0
11	106	36	0	71	13	66	55
0	23	0	0	18	0	66	0
44	8	93	94	10	76	0	0
0	14	94	11	0	0	0	197
53	171	0	0	78	52	80	0
108	0	93	0	141	0	67	0

Fig. 5 8x8 output result (example)

Please upload the compressed file (i.e., .zip or .rar), which includes the following files, to E3@NYCU. The file name rule is Student ID_HW3.

1. Source code
2. Report (Word file Include design ideas, block diagram, and simulation result of PA and SystemC terminal)