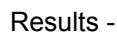
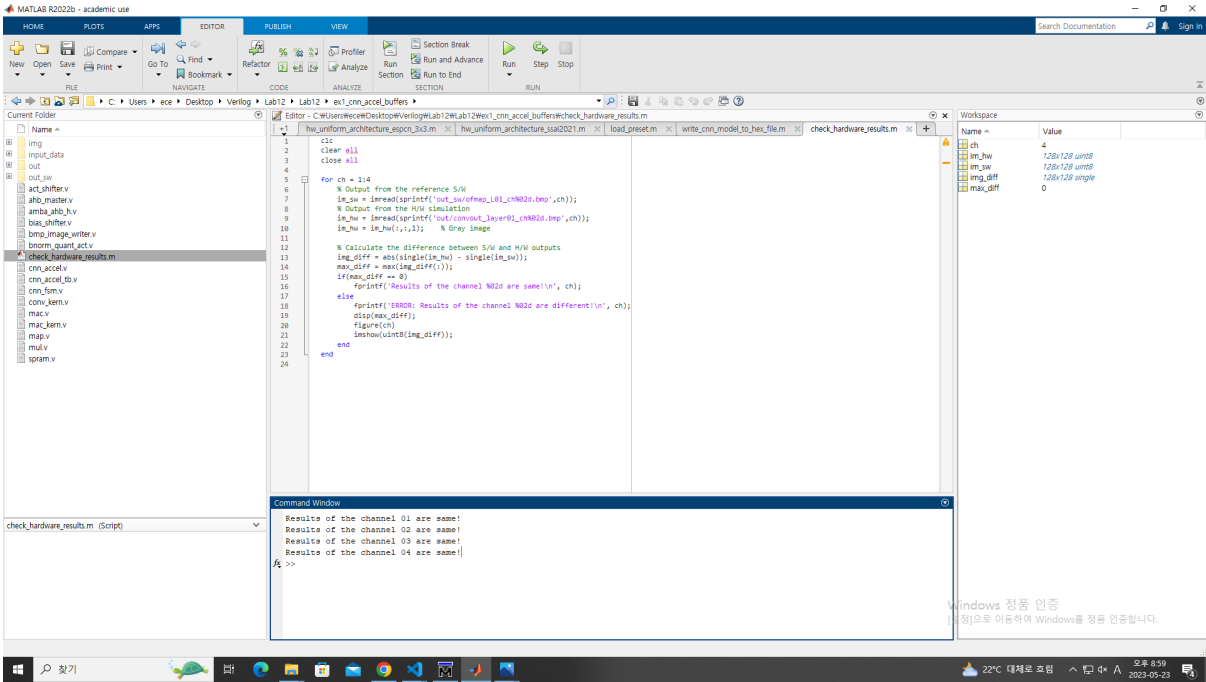

Waveform -

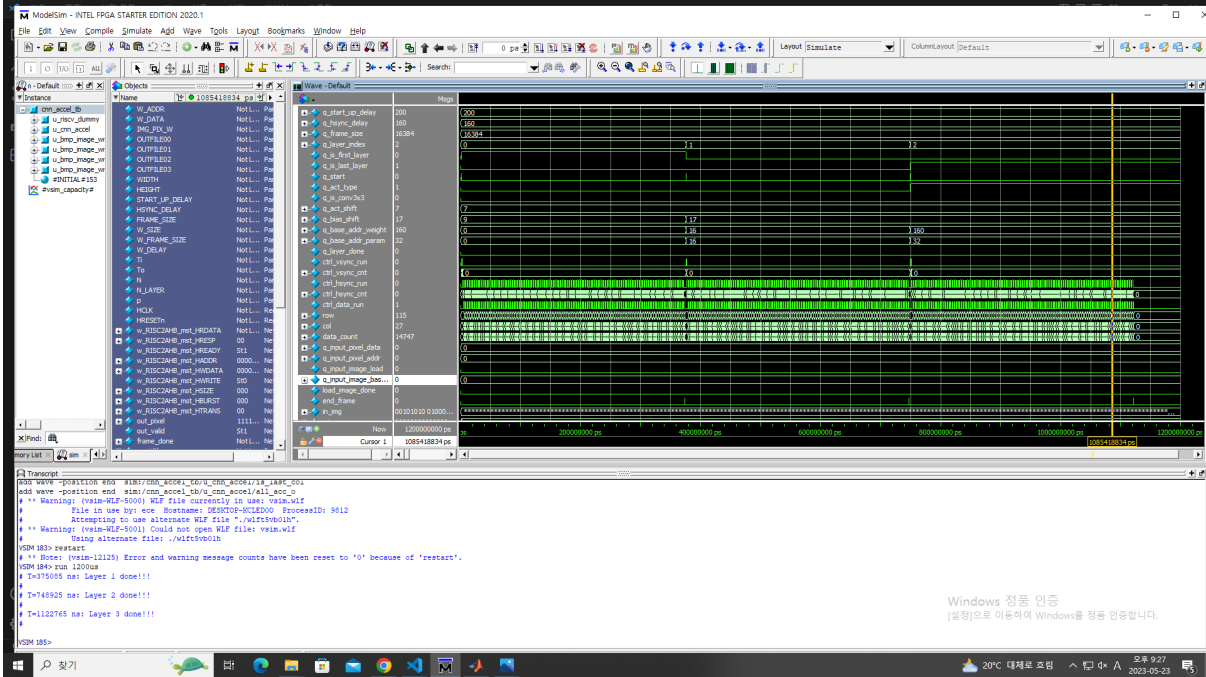


AI Hardware System Design Project (2023-1_M3238.000400/M3500.001500)



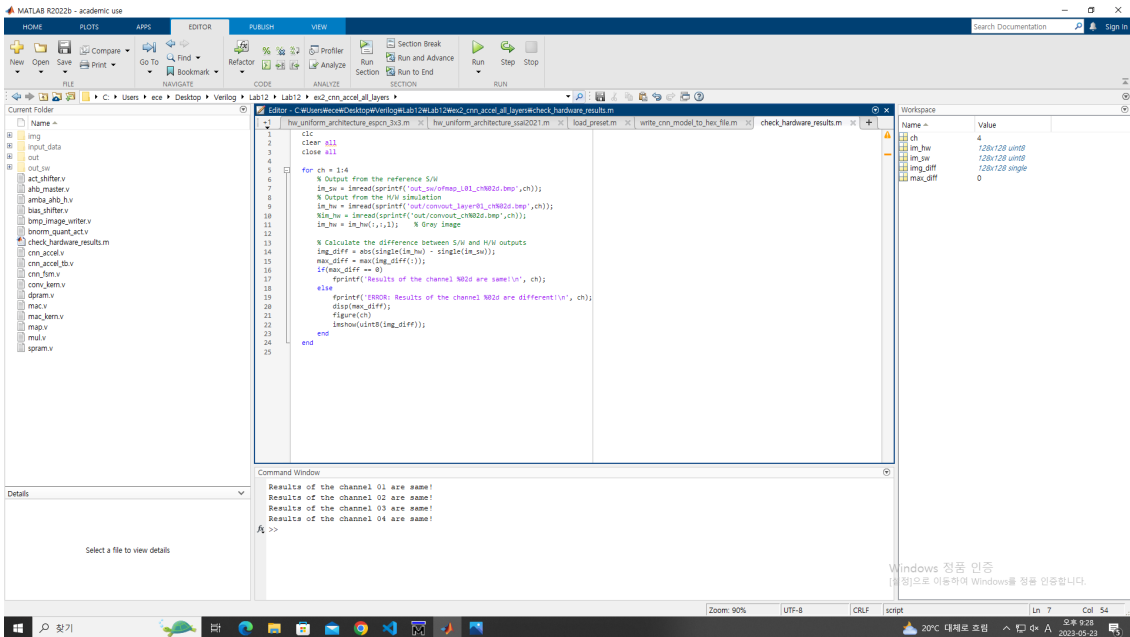
Problem 2 (10p): Output buffers and execute three layers

Waveform -



AI Hardware System Design Project (2023-1_M3238.000400/M3500.001500)

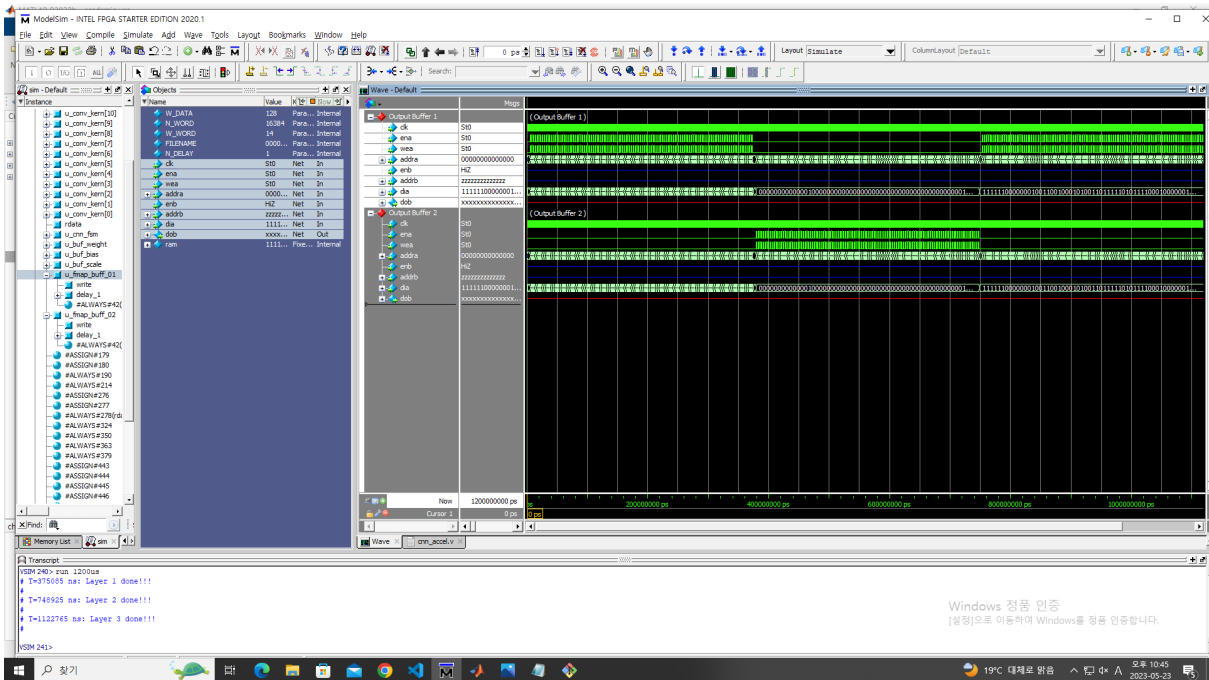
Results -



- a. The CNN accelerator uses dual buffers to store the feature maps. Do a simulation and capture the waveform of dual buffers. Explain the motivation to use dual buffers.

Using a dual buffer allows reading and writing at the same time so it makes the process faster and saves time.

Waveform -



Results -

The image shows the MATLAB R2022b - academic use interface. The main window displays a script named 'check_hardware_results.m' with the following code:

```

1  clc
2  clear all
3  close all
4
5  for ch = 1:4
6      % Output from the reference S/W
7      in_sw = fread(sprintf('out_sw_ofmap_L01_ch%02d.bmp',ch));
8      % Output from the H/W simulation
9      in_hw = fread(sprintf('out/comout_layer01_ch%02d.bmp',ch));
10     in_hw = fread(sprintf('out/comout_ch%02d.bmp',ch));
11     in_hw = in_hw(:,:); % Gray Image
12
13     % Calculate the difference between S/W and H/W outputs
14     img_diff = abs(single(in_hw) - single(in_sw));
15     max_diff = max(img_diff(:));
16     if(max_diff == 0)
17         fprintf('Results of the channel %02d are same!\n', ch);
18     else
19         fprintf('ERROR: Results of the channel %02d are different!\n', ch);
20         disp(max_diff);
21         figure(ch);
22         imshow(uint8(img_diff));
23     end
24
25

```

The Command Window shows the following output:

```

Results of the channel 01 are same!
Results of the channel 02 are same!
Results of the channel 03 are same!
Results of the channel 04 are same!
>>

```

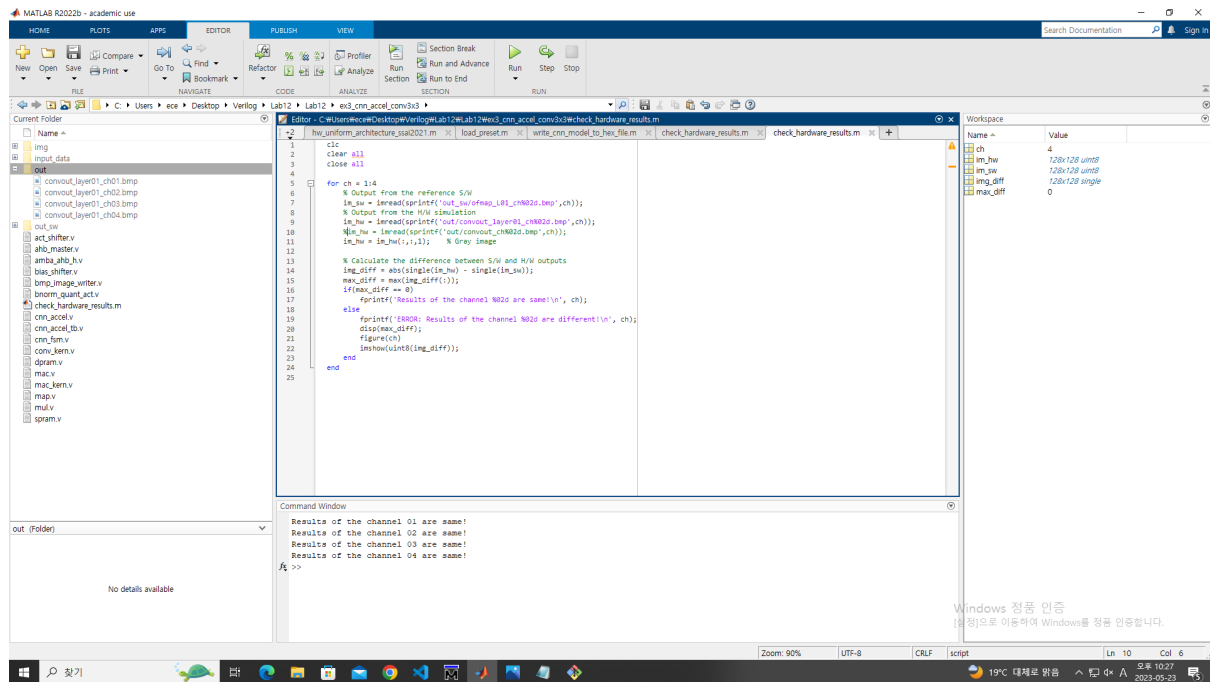
The Workspace shows the following variables:

Name	Value
ch	4
in_hw	128x128 uint8
in_sw	128x128 uint8
img_diff	128x128 single
max_diff	0

Windows 제품 인증 (정)으로 이동하여 Windows를 제품 인증합니다.

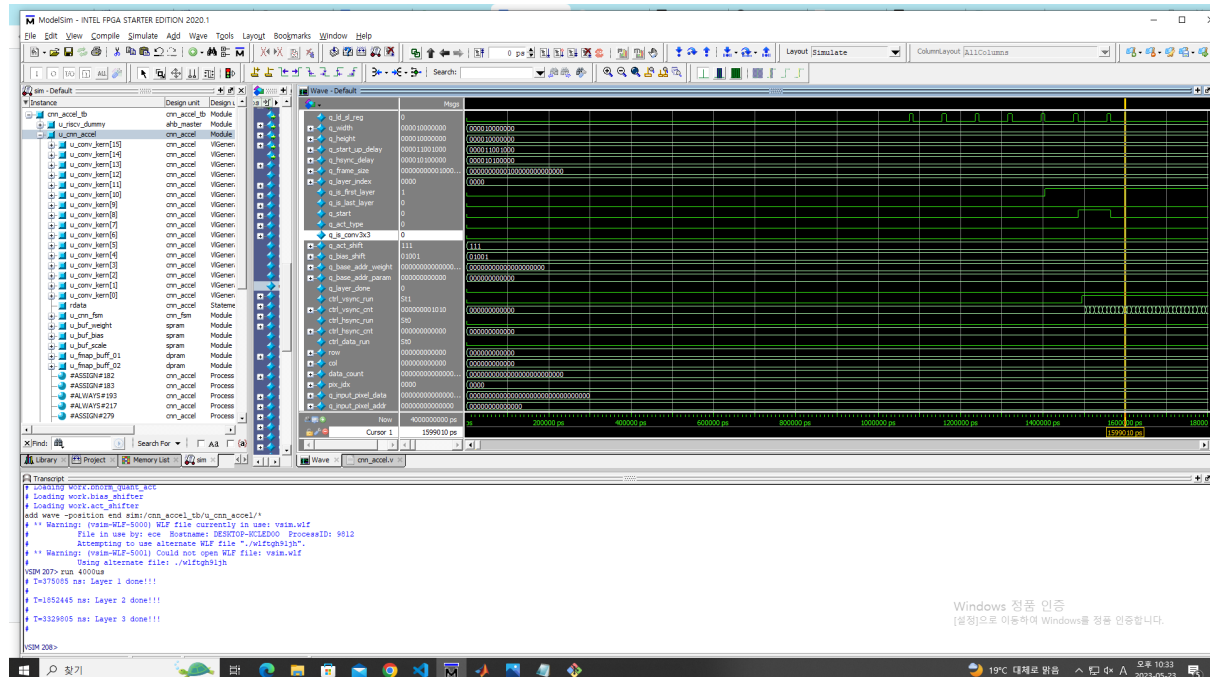
Problem 3 (10p): Convolution 3x3

Results -

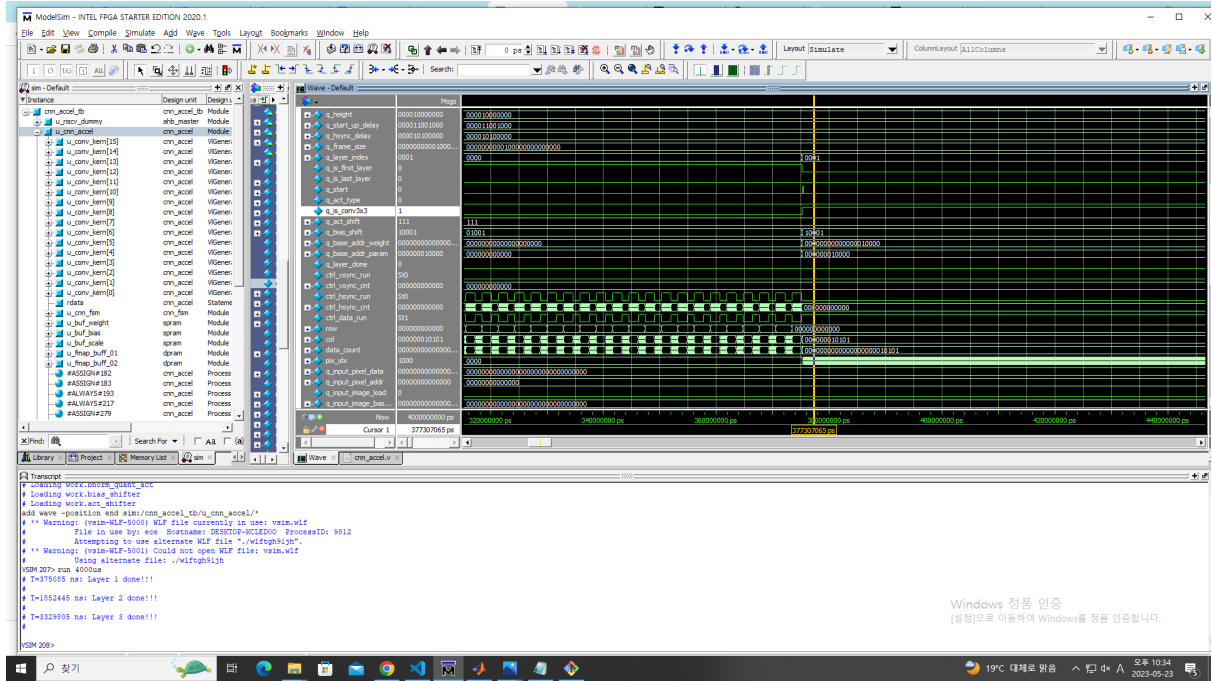


Waveform -

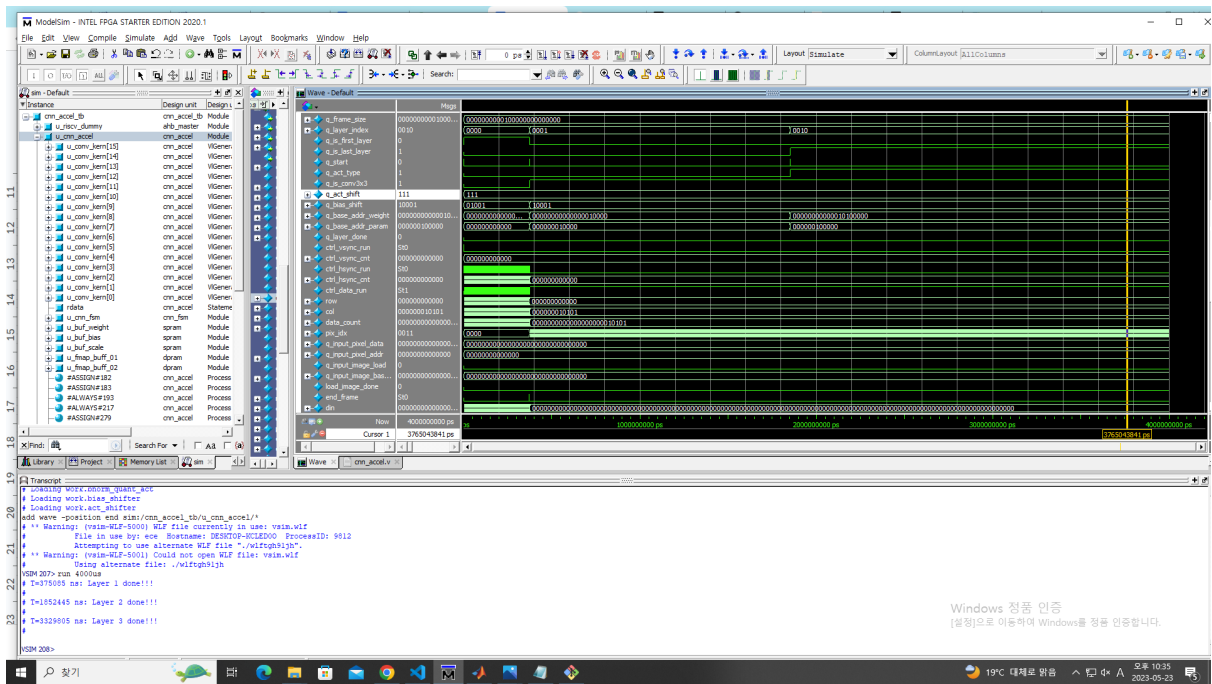
1. A captured waveform of FSM for conv1x1.



2. A captured waveform of FSM for conv3x3.



3. Simulation results.



Problem 4: (Optional) (2p)

Code -

```
dpram #(.W_DATA(To*ACT_BITS), .W_WORD(FRAME_SIZE_W),.N_WORD(FRAME_SIZE))
u_fmap_buff_01(
    .clk (clk ),
    .ena ((!out_buff_sel) & vld_o[0]),
    .wea ((!out_buff_sel) & vld_o[0]),
    .addra (pixel_count ),
    .enb ((out_buff_sel) & vld_o[0]),
    .addrb (data_count ),
    .dia (all_acc_o),
    .dob (*OPEN*/ )
);
```

```
dpram #(.W_DATA(To*ACT_BITS), .W_WORD(FRAME_SIZE_W),.N_WORD(FRAME_SIZE))
u_fmap_buff_02(
    .clk (clk ),
    .ena (out_buff_sel & vld_o[0]),
    .wea (out_buff_sel & vld_o[0]),
    .addra (pixel_count ),
    .enb ((!out_buff_sel) & vld_o[0] ),
    .addrb (data_count ),
    .dia (all_acc_o),
    .dob (*OPEN*/ )
);
```