MIchip HW1 report

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Code Structure

```
├── data
│   ├── conv1_weight.txt
│   ├── conv1_bias.txt
│   ├──    .
│   ├──    .
│   ├──    .
│   ├── dog.txt
│   └── cat.txt
├── layer.h
├── layer.cpp
├── Pattern.h
├── Pattern.cpp
└── alexnet.cpp
```

Code Overview

My code presents a modular implementation of AlexNet, designed to ensure efficient input processing and accurate output generation. Below is a detailed overview of each file's role and functionality.

File Descriptions

- `layer.h` 、 `layer.cpp` : module's declaration & definition.
  including convolutional layers, fully connected layers, max pooling function, and softmax function. They encapsulate the computations needed for the network, making the architecture more structured and reusable.

- `Pattern.h` 、 `Pattern.cpp` : provide input data & evaluates the correctness of the inference results
  This files are responsible for providing input data to the network and verifying that the inference results are correct. It ensures that the model receives properly formatted inputs and evaluates the correctness of the outputs.

- `alexnet.cpp` : signal connect between layers & module create
  This file serves as the central hub for building and connecting the modules of AlexNet. It initializes and constructs the network, establishes the connections between layers.

Observation & Challenges

Observation

`sc_vector<sc_signal<double> >`

> In class, the teacher mentioned that there is no need for a space before the last `>`, but in reality, a space is required. Without it, the code will result in a compilation error.

`sc_stop()` & `exit(0)`

> Normally, sc_stop() should be used, but when I use it, the terminal doesn't exit immediately. Instead, it takes some time before the program automatically ends. To address this, I changed it to exit(0), so the inference process finishes and the code exits directly.

Challenges

`inference time`

> At first, inference for a single image took around 10 minutes. To address this, I started simplifying the design, but the improvements weren't sufficient. By chance, I decided to try using the `-O3` optimization during compilation. As expected, this significantly increased the speed. Before applying this, it took nearly 10 minutes to infer a single image. After using the `-O3`, the inference time was reduced to just 50 seconds per image.

Results

dog

```
./run dog.txt

        SystemC 2.3.3-Accellera --- Mar  4 2025 01:46:38
        Copyright (c) 1996-2018 by all Contributors,
        ALL RIGHTS RESERVED
Top 100 classes:
=================================================
  idx |      val | possibility | class name
-------------------------------------------------
  207 |    16.59 |       38.63 | golden retriever
  175 |    15.57 |       13.86 | otterhound
  220 |    15.36 |       11.26 | Sussex spaniel
  163 |    15.00 |        7.86 | bloodhound
  219 |    14.59 |        5.22 | cocker spaniel
  168 |    14.39 |        4.28 | redbone
  160 |    14.35 |        4.07 | Afghan hound
  213 |    14.18 |        3.46 | Irish setter
  291 |    14.10 |        3.19 | lion
  211 |    13.01 |        1.07 | vizsla
  244 |    12.81 |        0.88 | Tibetan mastiff
  216 |    12.69 |        0.78 | clumber
  200 |    12.46 |        0.62 | Tibetan terrier
  159 |    12.42 |        0.59 | Rhodesian ridgeback
  152 |    12.38 |        0.57 | Japanese spaniel
  167 |    12.01 |        0.39 | English foxhound
  208 |    11.65 |        0.28 | Labrador retriever
  294 |    11.63 |        0.27 | brown bear
  165 |    11.51 |        0.24 | black-and-tan coonhound
  262 |    11.46 |        0.23 | Brabancon griffon
  156 |    11.40 |        0.21 | Blenheim spaniel
  185 |    11.29 |        0.19 | Norfolk terrier
  260 |    11.11 |        0.16 | chow
  267 |    11.08 |        0.16 | standard poodle
  365 |    10.87 |        0.13 | orangutan
  154 |    10.74 |        0.11 | Pekinese
  368 |    10.70 |        0.11 | gibbon
  215 |    10.66 |        0.10 | Brittany spaniel
  161 |    10.59 |        0.10 | basset
  214 |    10.47 |        0.08 | Gordon setter
  176 |    10.39 |        0.08 | Saluki
  212 |    10.31 |        0.07 | English setter
```

cat

```
g++ -I . -I  /RAID2/COURSE/2025_Spring/mlchip/mlchipTA01/
./run cat.txt

        SystemC 2.3.3-Accellera --- Mar  4 2025 01:46:38
        Copyright (c) 1996-2018 by all Contributors,
        ALL RIGHTS RESERVED
Top 100 classes:
==================================================
  idx |       val | possibility | class name
--------------------------------------------------
  285 |     20.21 |       96.38 | Egyptian cat
  281 |     16.14 |        1.65 | tabby
  282 |     15.73 |        1.10 | tiger cat
  287 |     14.79 |        0.43 | lynx
  728 |     14.41 |        0.29 | plastic bag
  330 |     12.73 |        0.05 | wood rabbit
  331 |     12.19 |        0.03 | hare
  457 |     10.94 |        0.01 | bow tie
  335 |     10.67 |        0.01 | fox squirrel
  463 |     10.57 |        0.01 | bucket
  478 |     10.32 |        0.00 | carton
  876 |     10.29 |        0.00 | tub
  622 |     10.18 |        0.00 | lens cap
  904 |     10.01 |        0.00 | window screen
  700 |      9.56 |        0.00 | paper towel
  278 |      9.39 |        0.00 | kit fox
    8 |      9.29 |        0.00 | hen
  284 |      9.21 |        0.00 | Siamese cat
  722 |      8.80 |        0.00 | ping-pong ball
  434 |      8.77 |        0.00 | bath towel
  452 |      8.71 |        0.00 | bonnet
  289 |      8.31 |        0.00 | snow leopard
  753 |      8.30 |        0.00 | radiator
  681 |      8.11 |        0.00 | notebook
  673 |      8.04 |        0.00 | mouse
  840 |      8.03 |        0.00 | swab
  773 |      7.94 |        0.00 | saltshaker
  782 |      7.90 |        0.00 | screen
  896 |      7.71 |        0.00 | washbasin
   44 |      7.70 |        0.00 | alligator lizard
  719 |      7.69 |        0.00 | piggy bank
```

submit
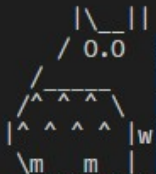
```
[Success] hw1_mlchip070.tar.gz created successfully.
11:49 mlchip070@ee25[~/hw1/09_SUBMIT]% ./01_submit
[Info] Deadline check OK ...
[Info] File check OK ...
[Info] mlchip070 SystemC start
[Info] result_cat.log Match Golden Result
[Info] result_dog.log Match Golden Result


Server_Account   mlchip070
Cat (35%)        O
Dog (35%)        O
Error_Message    No_Error
Submiss_Date     2025/03/21
Submiss_Time     12:05:43
Sim_Time (s)     50.45


[Info] Your file will be submitted to:  TA folder
[Warning]  demo has been submitted.
[Warning]  It will overwrite your original file.
[Info] Now submit hw1_mlchip070.tar.gz file to system.
[Success] Copying Sucessfully.
========================================================
                    Submit Report
========================================================
Result         :    has been submitted.
Submission time :   2025/03/21 12:05:43
========================================================
        ----------------------------
        --                    --       |\__||
        --  Congratulations !!  --      / O.O  |
        --                    --      /____    |
        --  Submission Sucessful!!--   /^ ^ ^\   |
        --                    --     |^ ^ ^ ^  |w|
        ----------------------------   \m___m__|_|
   Please remember to check your submission with ./02_check !!
   Please remember to check your submission with ./02_check !!
   Please remember to check your submission with ./02_check !!
========================================================
11:49 mlchip070@ee25[~/hw1/09_SUBMIT]% ./02_check
 hw1_mlchip070.tar.gz  has been downloaded!
 demo_result_hw1_mlchip070.csv  has been downloaded!
Server_Account,Cat (35%),Dog (35%),Error_Message,Submiss_Date,Submiss_Time,Sim_Time (s)
mlchip070,O,O,No_Error,2025/03/21,12:05:43,50.45
11:49 mlchip070@ee25[~/hw1/09_SUBMIT]%
```