

# Weekly Report

Wangwon Lee, 2019/03/16

## This week

- **Server status**
  - To check the server status in realtime
  - Made with google-spreadsheet-api
- **Audio Classification**
  - Fine tuning in previous work
  - Tune dropout rate in best case
  - Visualize filter

## Next week

- **Audio Classification**
  - To visualize 1D-CNN
  - Understanding 1D-CNN model.
  - Mapping our brain data
  - To investigate 1D model more specific

## Interesting and new finding

- Fine Tuning
- Filter in DSP (Digital Signal Processing)

## The aim of this month / Discussion

- **The aim of this month:** To study the brain and GLM, To investigate about CNN.

# Server status

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Few days ago...

# Server status

- When the server take a break, then my heart also break.
  - “Ah... A lot of money take a break.....”

Server and GPU usage - Google X

https://docs.google.com/spreadsheets/d/1E34/edit#gid=0

Server and GPU usage

파일 수정 보기 삽입 서식 데이터 도구 부

50% \$ % .0 .00 123

| Server  | GPU | Usage   | Owner                       |
|---------|-----|---------|-----------------------------|
| hcbbsp  | 0   | Changha | Changha's personal computer |
| ganbsp  | 0   | Juhyeon | Juhyeon's personal computer |
| tribsp  | 0   | Niv     | Niv's personal computer     |
| glbbsp  | 0   | Niv     | Niv's personal computer     |
| ecbsp   | 0   | Niv     | Niv's personal computer     |
| lstmbsp | 0   | Niv     | Niv's personal computer     |
| relbsp  | 0   | Niv     | Niv's personal computer     |
| dribsp  | 1   | Niv     | Niv's personal computer     |
| mlbsp   | 1   | Niv     | Niv's personal computer     |
| annbsp  | 2   | Niv     | Niv's personal computer     |
| sigbsp  | 3   | Niv     | Niv's personal computer     |
| grubsp  | 4   | Niv     | Niv's personal computer     |
| fcbsp   | 5   | Niv     | Niv's personal computer     |
| dfcbbsp | 6   | Niv     | Niv's personal computer     |

Sheet1



# Server status

- So I try the experiment as much as possible.
- A lot of experiment was tried.

Server and GPU usage - Google X

https://docs.google.com/spreadsheets/d/1E34/edit#gid=0

Server and GPU usage

파일 수정 보기 삽입 서식 데이터 도구 부가

50% \$ % .0 .00 123 Ari

| Server  | GPU | Usage   | Owner                         |
|---------|-----|---------|-------------------------------|
| hcbbsp  | 0   | Changha | Changha's personal computer   |
| ganbsp  | 0   | Juhyeon | Juhyeon's personal computer   |
| tribsp  | 0   | Niv     | Niv's personal computer       |
| glpbsp  | 0   | Niv     | Niv's personal computer       |
| ecbsp   | 0   | khc     | Dong-You's personal computer  |
| lstmbsp | 0   | khc     | Hyun-Chul's personal computer |
| relbsp  | 0   | jmy     | Han's personal computer       |
| dribsp  | 0   | jmy     |                               |
|         | 1   | jmy     |                               |
| mlbsp   | 0   | Niv     |                               |
|         | 1   | Niv     |                               |
|         | 2   | Niv     |                               |
| annbsp  | 0   | lww     |                               |
|         | 1   | lww     |                               |
|         | 2   | lww     |                               |
|         | 0   | Niv     |                               |
| sigbsp  | 1   | Niv     |                               |
|         | 2   | Niv     |                               |
|         | 3   | Niv     |                               |
|         | 0   | lww     |                               |
|         | 1   | lww     |                               |
|         | 2   | lww     |                               |
|         | 3   | lww     |                               |
|         | 5   | lww     |                               |
|         | 6   | lww     |                               |
|         | 7   | lww     |                               |
|         | 0   | lww     |                               |
|         | 1   | lww     |                               |
|         | 2   | lww     |                               |
|         | 3   | lww     |                               |
|         | 4   | lww     |                               |
|         | 5   | lww     |                               |
|         | 6   | lww     |                               |
|         | 7   | lww     |                               |
| fcbsp   | 0   | LJHyen  |                               |
|         | 1   | LJHyen  |                               |
|         | 2   | LJHyen  |                               |
|         | 3   | LJHyen  |                               |
|         | 4   | LJHyen  |                               |
|         | 5   | Niv     |                               |
| dfcbsp  | 0   | LJHyen  |                               |
|         | 1   | LJHyen  |                               |
|         | 2   | LJHyen  |                               |
|         | 3   | LJHyen  |                               |
|         | 4   | LJHyen  |                               |
|         | 5   | Niv     |                               |

장되었습니다.

→

→



# Server status

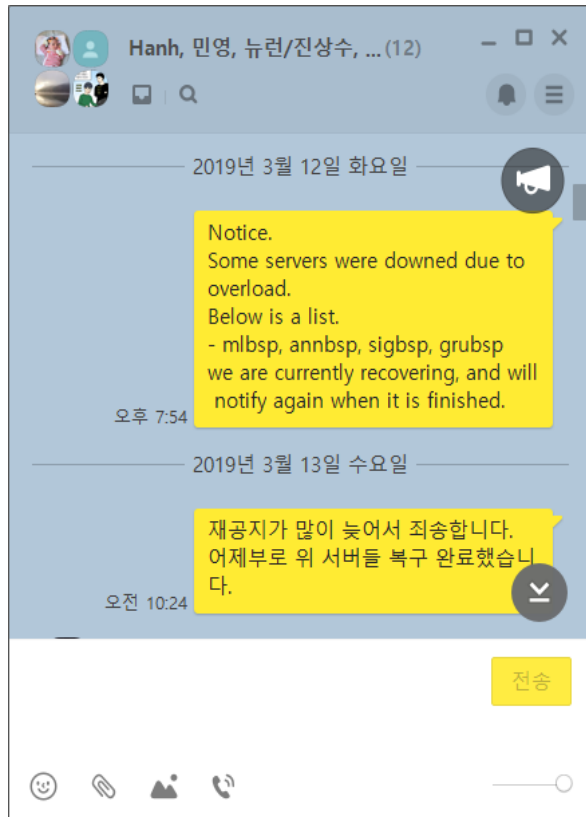
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And few hours later.....



# Server status

- Some server were downed due to overload.
- I say “Don’t take a break”, But he understand only “~~Don’t take a break~~”
- So, I felt the need to monitor the server status in real time.



# Server status

- Frankly, many people are afraid of new things.
- So if we develop new things, Do not make new one, improve the old one.

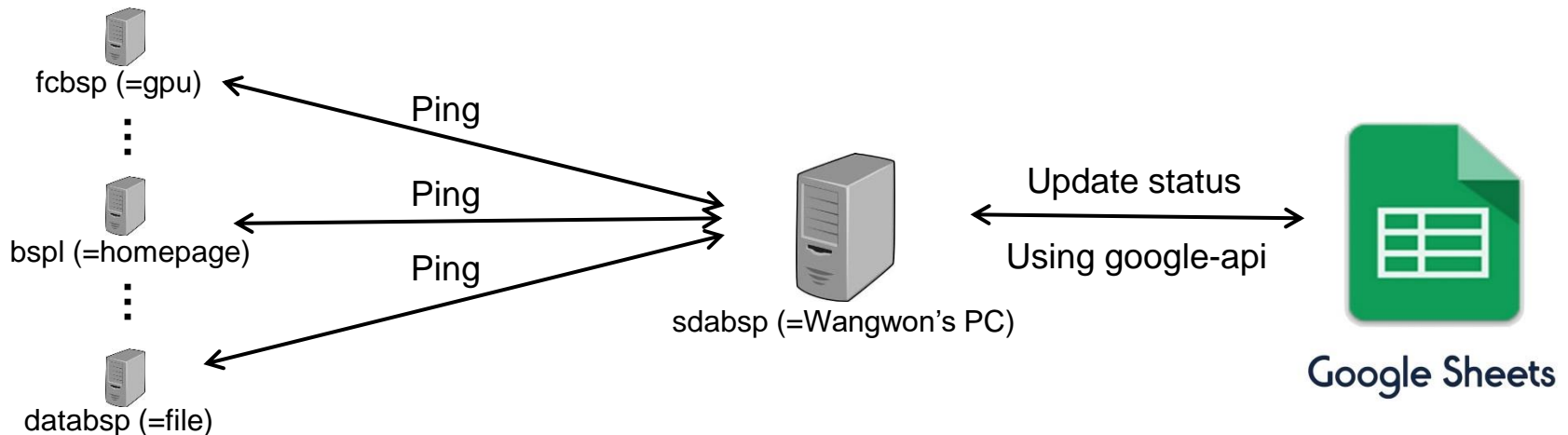
A. What is the old one?

→ We always check google-spreadsheets for using server

B. What do we need?

→ Check server status in realtime

- So I add new feature to check server status in realtime in google-sheet.



# Server status

- Now we can check server status in realtime 😊

Server and GPU usage - Google Sheets

https://docs.google.com/spreadsheets/d/1q4JKDHPubUlub8XbGVShh9ZTCfkOyZnIX0Vlb41j2xM/edit#gid=0

Server and GPU usage

파일 수정 보기 삽입 서식 데이터 도구 부가기능 도움말 드라이브에서 모든 변경사항이 저장되었습니다.

100% \$ % .0 .00 123 Arial 14 B I S A

Changha's personal computer

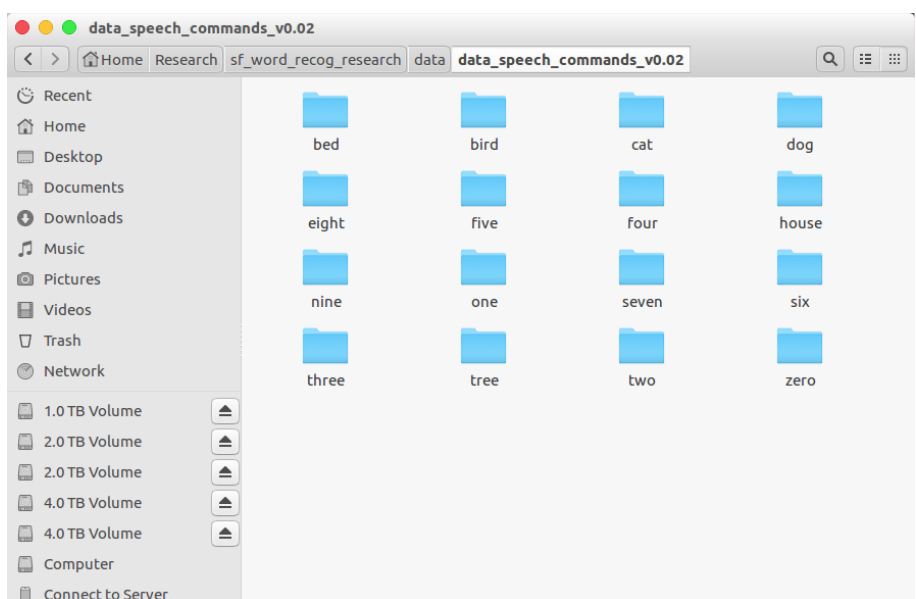
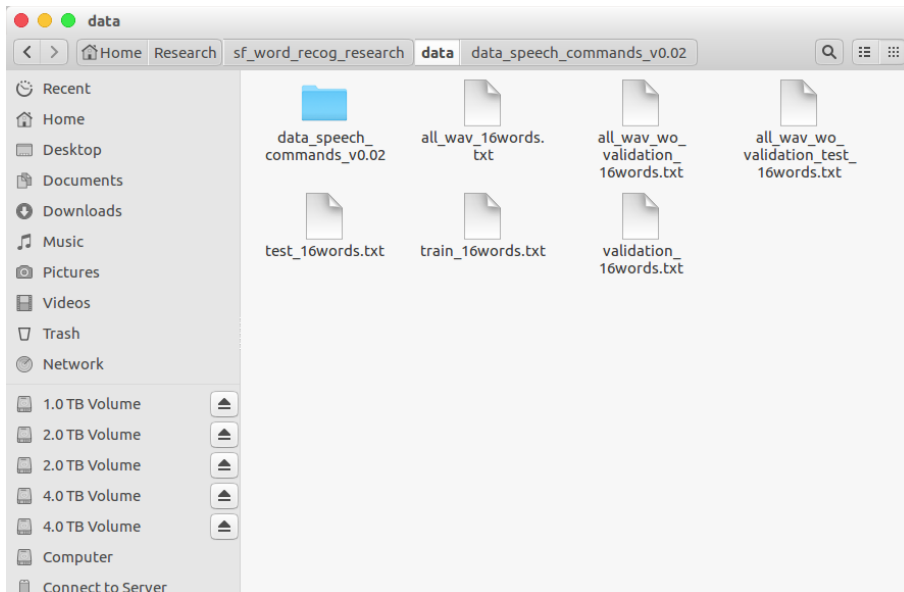
|    | A        | B | C       | D | E                             | F              | G  | H                   |
|----|----------|---|---------|---|-------------------------------|----------------|----|---------------------|
| 8  | hcpbsp   | 0 | Changha |   | Changha's personal computer   | 163.152.29.178 | ON | 2019-03-14 15:26:45 |
| 9  | ganbsp   | 0 | Juhyeon |   | JuHyeon's personal computer   | 163.152.29.179 | ON | 2019-03-14 15:26:49 |
| 10 | trlbsp   | 0 |         |   | Niv using CPU                 | 163.152.29.180 | ON | 2019-03-14 15:26:35 |
| 11 | glpbsp   | 0 | Niv     |   | Niv's personal computer       | 163.152.29.207 | ON | 2019-03-14 15:26:40 |
| 12 | ecbsp    | 0 |         |   | Dong-Youl's personal computer | 163.152.29.205 | ON | 2019-03-14 15:26:45 |
| 13 | lstmbbsp | 0 | khc     |   | Hyun-Chul's personal computer | 163.152.29.206 | ON | 2019-03-14 15:26:49 |
| 14 | relbsp   | 0 | jmy     |   | Hanh's personal computer      | 163.152.29.181 | ON | 2019-03-14 15:26:35 |
| 15 | drlbsp   | 0 | jmy     |   |                               | 163.152.29.182 | ON | 2019-03-14 15:26:40 |
| 16 |          | 1 | jmy     |   |                               |                |    |                     |
| 17 | mlbsp    | 0 | Niv     |   |                               | 163.152.29.188 | ON | 2019-03-14 15:26:45 |
| 18 |          | 1 | Niv     |   |                               |                |    |                     |
| 19 |          | 2 | Niv     |   |                               |                |    |                     |
| 20 | annbsp   | 0 | lww     |   |                               | 163.152.29.189 | ON | 2019-03-14 15:26:49 |
| 21 |          | 1 | lww     |   |                               |                |    |                     |
| 22 |          | 2 | lww     |   |                               |                |    |                     |
| 23 | sigbsp   | 0 | Niv     |   |                               | 163.152.29.190 | ON | 2019-03-14 15:26:54 |
| 24 |          | 1 | Niv     |   |                               |                |    |                     |
| 25 |          | 2 | Niv     |   |                               |                |    |                     |
| 26 |          | 3 | Niv     |   |                               |                |    |                     |
| 27 |          | 0 | lww     |   |                               |                |    |                     |

Sheet1



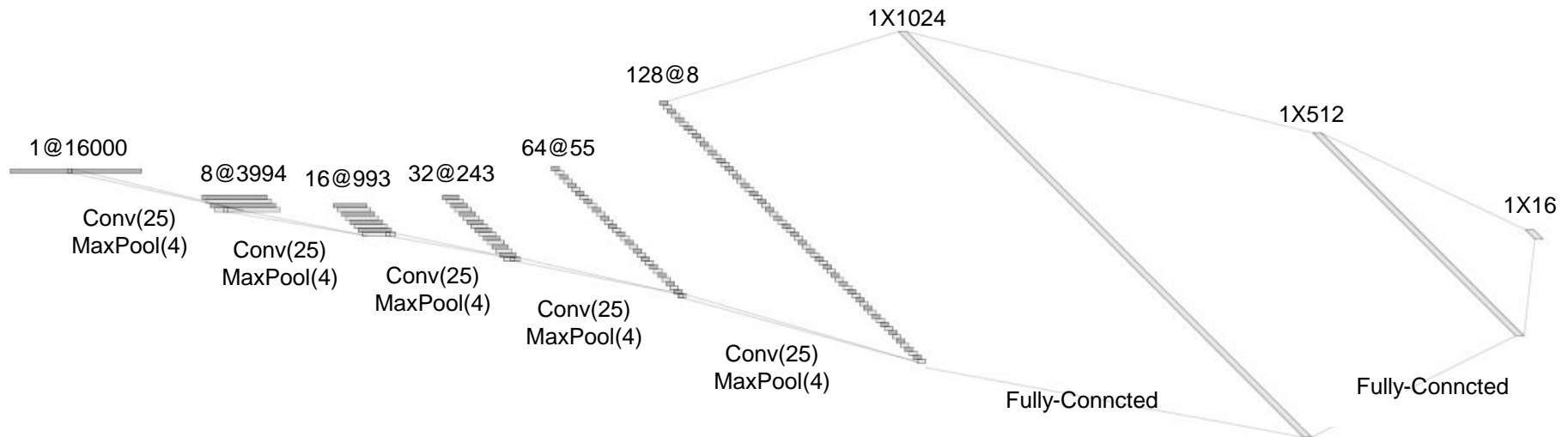
# Audio Classification

- Data is low-waveform.
  - sec: 1, sampling rate: 16000, type: float32, channel: mono
- 16 class data.
  - 'zero', 'one', 'two', 'three', 'four', 'five', 'six', 'seven', 'eight', 'nine', 'bed', 'bird', 'tree', 'cat', 'house', 'dog'
- Train: 40851( $\div 80\%$ ), Validation: 4796( $\div 10\%$ ), Test: 5297( $\div 10\%$ )



# Audio Classification

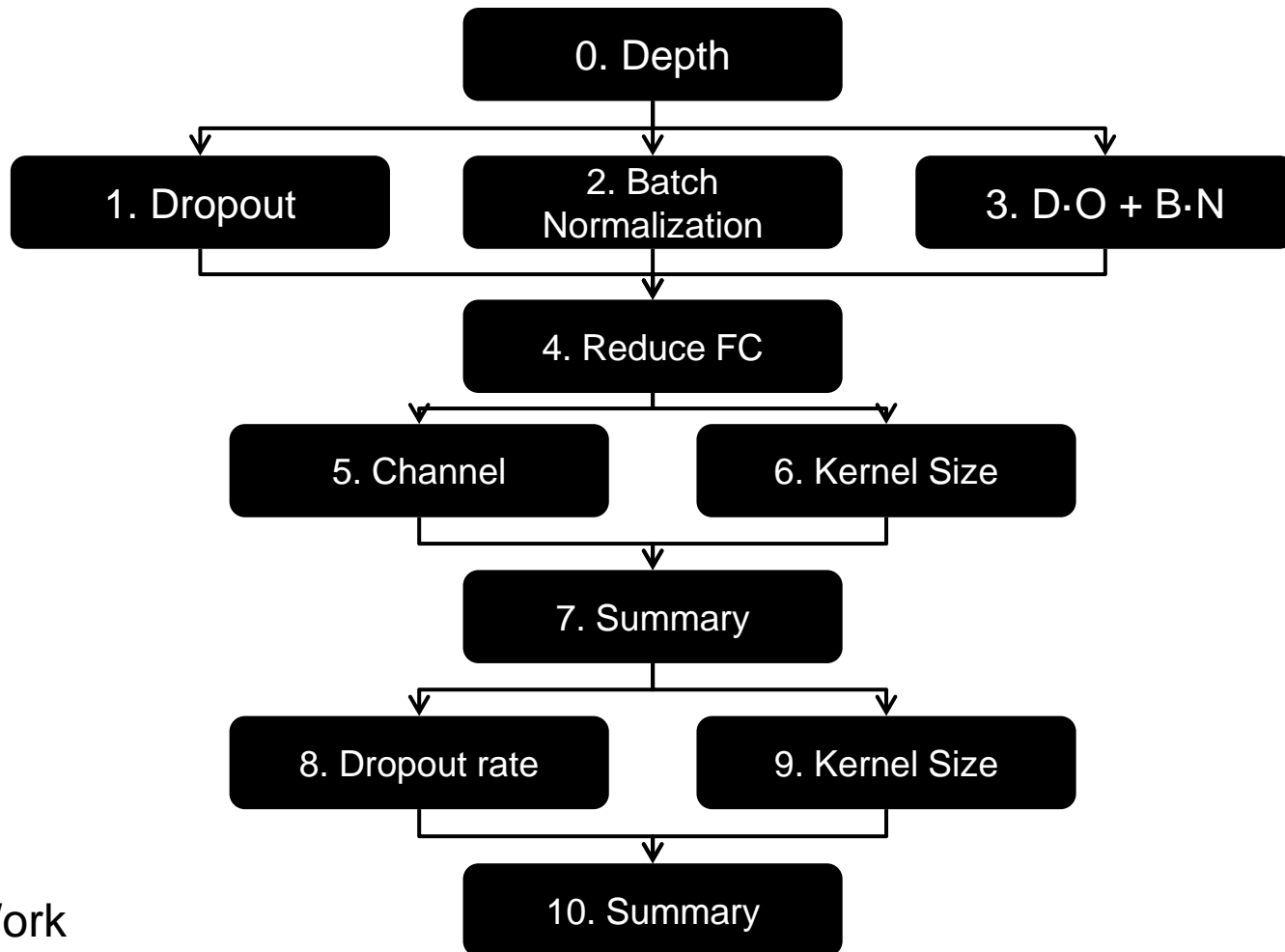
- For example, '5Conv, 2FC' baseline model's detail.
  - It just flatten 2D model. (5X5 filter->1X25 filter, 2X2 stride->1X4 stride)
  - Input: 16000X1 low waveform.
  - Output: 1x16 labeled one hot vector. ('zero', ..., 'eight', ..., 'house', 'dog')
  - Loss: cross entropy loss
  - Optimizer: Adam
- 



[ Baseline Architecture ]

# Audio Classification

- Fine tuning task in 1D-CNN



Previous Work

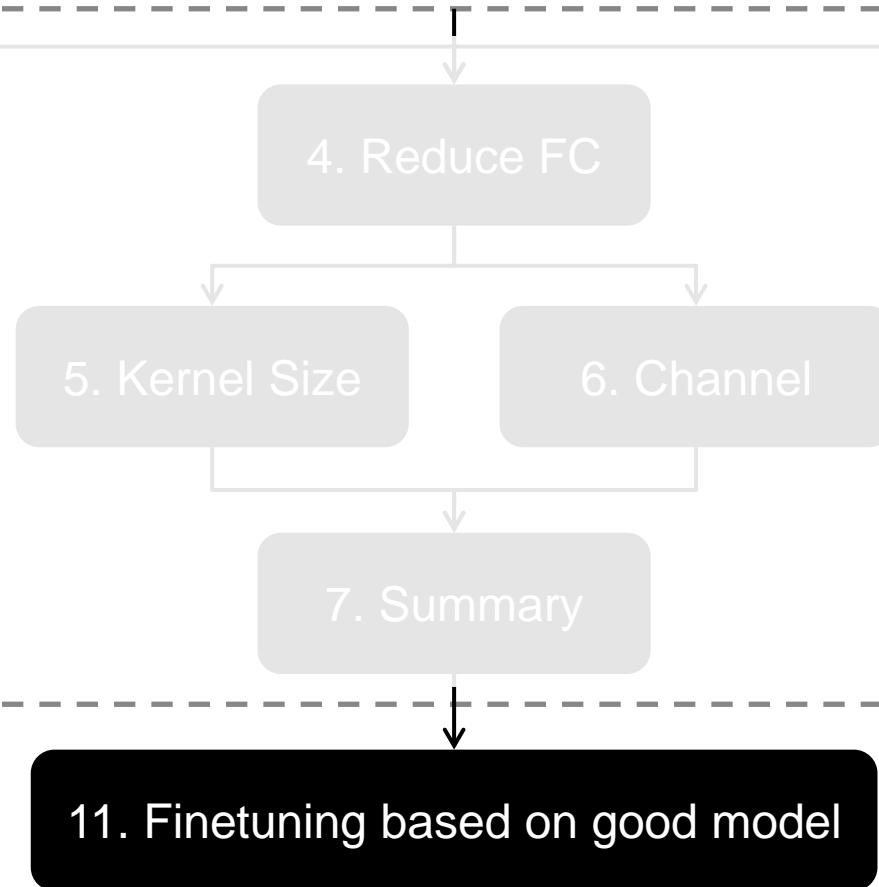
# Audio Classification

- This is SOTA(State Of The Art) in previous research.

|  | Architecture (i = 0,1,2...)                 | 1D DO(0.5) | 1D BN  | 1D DO+BN | Params    |
|--|---|------------|--------|----------|-----------|
| base model   | baseline                                    |            |        |          |           |
|  | 5 Conv(25, $8 \cdot 2^i$ ), 5 Pool(4), 2 FC | 0.9090     | 0.9072 | 0.9240   | 1,855,056 |
|  | Accuracy and Number of parameters           |            |        |          |           |
| Custom<br>channel 32<br>Custom<br>channel 64<br>DO(0.75) | 8 CONV(5, 64)                               | 0.9477     | 0.9285 | 0.9391   | 94,768    |
|  | 8 CONV(5, 128)                              | 0.9589     | X      | 0.9497   | 363,600   |
|  | 16 CONV(3, 128) , 8 Pool                    | 0.9620     | 0.9423 | 0.9136   | 470,736   |
| Custom<br>channel 128                                    | Only Accuracy                               |            |        |          |           |
|  | 9 CONV(5, 512)                              | 0.9396     | 0.9632 | 0.9674   | 2,071,184 |
|  |   |            |        |          |           |

# Audio Classification

- Fine tuning task in 1D-CNN



Added Work

# Audio Classification

- I tune the dropout's rate in 'custom ch32' model
- The accuracy was exceeded 0.95

| Architecture   | DO(0.25) | DO(0.25)+BN | DO(0.75) | DO(0.75)+BN |
|----------------|----------|-------------|----------|-------------|
| 1 CONV(5, 32)  | X        | X           | X        | X           |
| 2 CONV(5, 32)  | X        | X           | X        | X           |
| 3 CONV(5, 32)  | 0.5034   | 0.5277      | 0.6260   | 0.6816      |
| 4 CONV(5, 32)  | 0.6395   | 0.6712      | 0.7983   | 0.8019      |
| 5 CONV(5, 64)  | 0.7248   | 0.7458      | 0.8432   | 0.8461      |
| 6 CONV(5, 64)  | 0.8650   | 0.8536      | 0.9101   | 0.8951      |
| 7 CONV(5, 64)  | 0.9267   | 0.9215      | 0.9425   | 0.9252      |
| 8 CONV(5, 64)  | 0.9452   | 0.9369      | 0.9533   | 0.9458      |
| 9 CONV(5, 128) | 0.9362   | 0.9385      | 0.9506   | 0.9491      |



# Audio Classification

- This is SOTA(State Of The Art) in current research.
- Despite less than 100,000 parameters, it was exceeded 0.95.

|                                   | Architecture (i = 0,1,2...)                 | 1D DO(0.5) | 1D BN  | 1D DO+BN | Params    |
|-----------------------------------|---|------------|--------|----------|-----------|
| baseline                          |   |            |        |          |           |
| base model                        | 5 Conv(25, $8 \cdot 2^i$ ), 5 Pool(4), 2 FC | 0.9090     | 0.9072 | 0.9240   | 1,855,056 |
| Accuracy and Number of parameters |   |            |        |          |           |
| Custom channel 32                 | 8 CONV(5, 64)                               | 0.9477     | 0.9285 | 0.9391   | 94,768    |
| Custom channel 64 DO(0.75)        | 8 CONV(5, 128)                              | 0.9589     | X      | 0.9497   | 363,600   |
| Custom VGG style DO(0.75)         | 16 CONV(3, 128) , 8 Pool                    | 0.9620     | 0.9423 | 0.9136   | 470,736   |
| Only Accuracy                     |   |            |        |          |           |
| Custom channel 128                | 9 CONV(5, 512)                              | 0.9396     | 0.9632 | 0.9674   | 2,071,184 |
| And, here is new challenger       |   |            |        |          |           |
| Custom channel 32 DO(0.75)        | 8 CONV(5, 64)                               | 0.9533     | X      | 0.9458   | 94,768    |

# Audio Classification

- Confusion matrix
- Compare 'baseline' and this model
- In 'Three' and 'Tree' case, it is around two times better.

| Predict Class            | Actual class |     |     |       |      |      |     |       |       |      |     |      |     |     |       |      | Actual class                             |     |     |       |      |      |     |       |       |      |     |      |     |     |       |      |  |
|--------------------------|--------------|-----|-----|-------|------|------|-----|-------|-------|------|-----|------|-----|-----|-------|------|--|-----|-----|-------|------|------|-----|-------|-------|------|-----|------|-----|-----|-------|------|--|
|                          | Zero         | One | Two | Three | Fore | Five | Six | Seven | Eight | Nine | Bed | Bird | Cat | Dog | House | Tree | Zero                                     | One | Two | Three | Fore | Five | Six | Seven | Eight | Nine | Bed | Bird | Cat | Dog | House | Tree |  |
| Zero                     | 367          | 0   | 8   | 0     | 5    | 0    | 0   | 0     | 1     | 1    | 1   | 1    | 0   | 0   | 0     | 1    | 369                                      | 0   | 5   | 1     | 3    | 0    | 1   | 4     | 0     | 1    | 0   | 0    | 1   | 0   | 0     | 0    |  |
| One                      | 1            | 344 | 0   | 0     | 3    | 7    | 0   | 1     | 0     | 6    | 1   | 0    | 0   | 0   | 0     | 1    | 1  | 347 | 0   | 0     | 4    | 1    | 1   | 0     | 0     | 7    | 2   | 0    | 0   | 1   | 0     | 0    |  |
| Two                      | 5            | 0   | 359 | 0     | 7    | 0    | 0   | 2     | 1     | 1    | 1   | 1    | 1   | 4   | 1     | 1    | 8  | 0   | 369 | 2     | 0    | 0    | 0   | 0     | 1     | 0    | 0   | 0    | 2   | 2   | 0     | 0    |  |
| Three                    | 1            | 0   | 5   | 333   | 0    | 4    | 2   | 3     | 5     | 1    | 1   | 2    | 0   | 0   | 0     | 20   | 1  | 0   | 2   | 356   | 0    | 1    | 1   | 2     | 6     | 0    | 0   | 0    | 0   | 0   | 0     | 8    |  |
| Fore                     | 3            | 2   | 3   | 2     | 344  | 3    | 0   | 2     | 0     | 0    | 2   | 1    | 0   | 6   | 0     | 0    | 2  | 2   | 1   | 1     | 359  | 2    | 0   | 0     | 0     | 0    | 0   | 1    | 0   | 0   | 0     | 0    |  |
| Five                     | 1            | 4   | 0   | 4     | 0    | 388  | 1   | 0     | 1     | 4    | 0   | 1    | 1   | 2   | 1     | 0    | 0  | 6   | 0   | 3     | 4    | 386  | 0   | 2     | 1     | 3    | 0   | 1    | 2   | 0   | 0     | 0    |  |
| Six                      | 0            | 0   | 0   | 1     | 0    | 1    | 367 | 1     | 2     | 1    | 0   | 0    | 1   | 0   | 0     | 0    | 0  | 0   | 3   | 1     | 0    | 366  | 1   | 2     | 0     | 1    | 0   | 0    | 0   | 0   | 0     | 0    |  |
| Seven                    | 4            | 1   | 0   | 1     | 1    | 0    | 5   | 355   | 0     | 4    | 0   | 1    | 4   | 0   | 0     | 0    | 3  | 0   | 0   | 0     | 1    | 0    | 2   | 367   | 0     | 0    | 3   | 0    | 0   | 0   | 0     | 0    |  |
| Eight                    | 0            | 1   | 0   | 5     | 2    | 1    | 3   | 1     | 349   | 4    | 5   | 2    | 3   | 0   | 0     | 0    | 1  | 0   | 1   | 2     | 1    | 0    | 0   | 0     | 367   | 0    | 2   | 0    | 1   | 0   | 0     | 1    |  |
| Nine                     | 0            | 2   | 0   | 1     | 0    | 3    | 0   | 0     | 0     | 364  | 2   | 1    | 0   | 4   | 0     | 0    | 0  | 6   | 0   | 0     | 0    | 3    | 0   | 0     | 0     | 364  | 3   | 1    | 0   | 0   | 0     | 0    |  |
| Bed                      | 2            | 3   | 1   | 1     | 0    | 1    | 4   | 3     | 4     | 0    | 153 | 3    | 8   | 0   | 0     | 0    | 1  | 0   | 2   | 0     | 0    | 0    | 0   | 0     | 6     | 0    | 166 | 5    | 2   | 1   | 0     | 0    |  |
| Bird                     | 1            | 2   | 0   | 2     | 1    | 3    | 0   | 0     | 0     | 5    | 4   | 133  | 1   | 0   | 0     | 1    | 0  | 1   | 1   | 0     | 0    | 2    | 0   | 0     | 2     | 7    | 137 | 0    | 2   | 0   | 0     | 0    |  |
| Cat                      | 0            | 0   | 3   | 0     | 1    | 1    | 0   | 1     | 0     | 1    | 1   | 0    | 157 | 1   | 2     | 0    | 0  | 0   | 0   | 0     | 0    | 0    | 1   | 0     | 0     | 1    | 0   | 161  | 4   | 1   | 0     | 0    |  |
| Dog                      | 1            | 1   | 2   | 0     | 0    | 1    | 0   | 0     | 1     | 4    | 1   | 5    | 0   | 176 | 0     | 0    | 0  | 1   | 5   | 0     | 0    | 0    | 0   | 0     | 1     | 1    | 0   | 2    | 182 | 0   | 0     | 0    |  |
| House                    | 0            | 0   | 0   | 0     | 0    | 2    | 1   | 0     | 0     | 1    | 0   | 0    | 3   | 0   | 159   | 1    | 0  | 0   | 2   | 0     | 0    | 1    | 1   | 0     | 0     | 1    | 0   | 0    | 5   | 1   | 156   | 0    |  |
| Tree                     | 1            | 0   | 4   | 32    | 0    | 0    | 0   | 0     | 3     | 1    | 0   | 0    | 0   | 0   | 0     | 122  | 2  | 0   | 2   | 15    | 0    | 0    | 1   | 0     | 4     | 1    | 0   | 0    | 0   | 0   | 0     | 138  |  |
| base model (Acc: 0.9090) |              |     |     |       |      |      |     |       |       |      |     |      |     |     |       |      | Custom channel 32 DO(0.75) (Acc: 0.9533) |     |     |       |      |      |     |       |       |      |     |      |     |     |       |      |  |

base model (Acc: 0.9090)

Custom  
channel 32 (Acc: 0.9533)  
DO(0.75)

# Audio Classification

- I tune the dropout's rate in 'custom ch128' model
- 0.97.....!?

| Architecture   | DO(0.25) | DO(0.25)+BN | DO(0.75) | DO(0.75)+BN |
|----------------|----------|-------------|----------|-------------|
| 1 CONV(5, 128) | X        | X           | X        | X           |
| 2 CONV(5, 128) | X        | X           | X        | X           |
| 3 CONV(5, 128) | 0.5522   | 0.5124      | 0.6476   | 0.6457      |
| 4 CONV(5, 128) | 0.6768   | 0.6866      | 0.7803   | 0.7867      |
| 5 CONV(5, 256) | 0.7601   | 0.7445      | 0.8386   | 0.8449      |
| 6 CONV(5, 256) | 0.8906   | 0.8789      | 0.9130   | 0.8970      |
| 7 CONV(5, 256) | 0.9369   | 0.9171      | 0.9576   | 0.9302      |
| 8 CONV(5, 256) | 0.9570   | 0.9547      | 0.9618   | 0.9580      |
| 9 CONV(5, 512) | 0.9535   | 0.9701      | 0.9645   | 0.9595      |

# Audio Classification

- This is SOTA(State Of The Art) in current research.
- The accuracy achieve 0.97

|                                | Architecture (i = 0,1,2...)                 | 1D DO(0.5) | 1D BN  | 1D DO+BN | Params    |
|--------------------------------|---|------------|--------|----------|-----------|
| base model                     | baseline                                    |            |        |          |           |
|                                | 5 Conv(25, $8 \cdot 2^i$ ), 5 Pool(4), 2 FC | 0.9090     | 0.9072 | 0.9240   | 1,855,056 |
|                                | Accuracy and Number of parameters           |            |        |          |           |
|                                | 8 CONV(5, 64)                               | 0.9533     | 0.9285 | 0.9391   | 94,768    |
| Custom channel 32 DO(0.75)     | 8 CONV(5, 128)                              | 0.9589     | X      | 0.9497   | 363,600   |
| Custom channel 64 DO(0.75)     | 16 CONV(3, 128) , 8 Pool                    | 0.9620     | 0.9423 | 0.9136   | 470,736   |
| Custom VGG style DO(0.75)      | Only Accuracy                               |            |        |          |           |
| Custom channel 128             | 9 CONV(5, 512)                              | 0.9396     | 0.9632 | 0.9674   | 2,071,184 |
|                                | And, here is new challenger                 |            |        |          |           |
| Custom channel 128 DO(0.25)+BN | 9 CONV(5, 512)                              | 0.9535     | X      | 0.9701   | 2,071,184 |

# Audio Classification

- Confusion matrix
- Compare 'baseline' and this model
- In 'Three' and 'Tree' case, it is around two or three times better.

Actual class

Actual class

Predict  
Class

|       |                                       |  |
|-------|---------------------------------------|--|
| Zero  | [[367 0 8 0 5 0 0 0 1 1 1 1 0 0 0 1]  | [[375 0 3 0 2 0 0 3 0 1 0 0 0 0 0 1]   |
| One   | [ 1 344 0 0 3 7 0 1 0 6 1 0 0 0 0 1]  | [ 0 348 0 0 4 1 0 1 1 6 1 0 0 0 1 1]   |
| Two   | [ 5 0 359 0 7 0 0 2 1 1 1 1 1 4 1 1]  | [ 1 0 375 2 1 0 0 0 0 0 0 0 0 0 2 1 2] |
| Three | [ 1 0 5 333 0 4 2 3 5 1 1 2 0 0 0 20] | [ 1 0 5 356 0 0 2 3 1 0 1 0 0 0 0 8]   |
| Fore  | [ 3 2 3 2 344 3 0 2 0 0 2 1 0 6 0 0]  | [ 0 0 0 0 364 1 0 0 0 0 0 1 1 0 0 1]   |
| Five  | [ 1 4 0 4 0 388 1 0 1 4 0 1 1 2 1 0]  | [ 0 0 0 0 5 399 0 0 1 2 0 0 1 0 0 0]   |
| Six   | [ 0 0 0 1 0 1 367 1 2 1 0 0 1 0 0 0]  | [ 0 0 0 1 0 0 371 1 0 0 1 0 0 0 0 0]   |
| Seven | [ 4 1 0 1 1 0 5 355 0 4 0 1 4 0 0 0]  | [ 1 0 0 0 0 0 1 373 1 0 0 0 0 0 0 0]   |
| Eight | [ 0 1 0 5 2 1 3 1 349 4 5 2 3 0 0 0]  | [ 0 0 4 2 0 0 0 0 362 4 0 2 1 0 0 1]   |
| Nine  | [ 0 2 0 1 0 3 0 0 0 364 2 1 0 4 0 0]  | [ 0 5 0 0 0 3 0 1 0 363 2 3 0 0 0 0]   |
| Bed   | [ 2 3 1 1 0 1 4 3 4 0 153 3 8 0 0 0]  | [ 0 0 1 0 0 0 1 0 1 0 178 1 0 0 0 1]   |
| Bird  | [ 1 2 0 2 1 3 0 0 0 5 4 133 1 0 0 1]  | [ 0 0 0 0 0 0 0 0 0 1 3 147 0 1 0 1]   |
| Cat   | [ 0 0 3 0 1 1 0 1 0 1 1 0 157 1 2 0]  | [ 0 0 0 0 0 0 0 0 0 0 0 0 166 1 1 0]   |
| Dog   | [ 1 1 2 0 0 1 0 0 1 4 1 5 0 176 0 0]  | [ 0 0 2 0 0 0 0 0 0 0 1 1 0 186 0 2]   |
| House | [ 0 0 0 0 0 2 1 0 0 1 0 0 3 0 159 1]  | [ 0 0 0 0 0 0 0 0 2 0 0 1 3 0 161 0]   |
| Tree  | [ 1 0 4 32 0 0 0 0 3 1 0 0 0 0 122]   | [ 0 0 10 0 0 0 0 4 1 0 0 0 0 0 147]    |

base model (Acc: 0.9090)

Custom  
channel 128 (Acc: 0.9701)  
DO(0.25)+BN

# Audio Classification

- Confusion matrix
- Compare two best model.
- Not much different, but the right model is a little better.

Actual class

Actual class

Predict  
Class

|       |   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |    |
|-------|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|
| Zero  | [ | 369 | 0   | 5   | 1   | 3   | 0   | 1   | 4   | 0   | 1   | 0   | 0   | 1   | 0   | 0   | 0] |
| One   | [ | 1   | 347 | 0   | 0   | 4   | 1   | 1   | 0   | 0   | 7   | 2   | 0   | 0   | 1   | 0   | 0] |
| Two   | [ | 8   | 0   | 369 | 2   | 0   | 0   | 0   | 0   | 1   | 0   | 0   | 0   | 2   | 2   | 0   | 0] |
| Three | [ | 1   | 0   | 2   | 356 | 0   | 1   | 1   | 2   | 6   | 0   | 0   | 0   | 0   | 0   | 0   | 8] |
| Fore  | [ | 2   | 2   | 1   | 1   | 359 | 2   | 0   | 0   | 0   | 0   | 0   | 0   | 1   | 0   | 0   | 0] |
| Five  | [ | 0   | 6   | 0   | 3   | 4   | 386 | 0   | 2   | 1   | 3   | 0   | 1   | 2   | 0   | 0   | 0] |
| Six   | [ | 0   | 0   | 0   | 3   | 1   | 0   | 366 | 1   | 2   | 0   | 1   | 0   | 0   | 0   | 0   | 0] |
| Seven | [ | 3   | 0   | 0   | 0   | 1   | 0   | 2   | 367 | 0   | 0   | 3   | 0   | 0   | 0   | 0   | 0] |
| Eight | [ | 1   | 0   | 1   | 2   | 1   | 0   | 0   | 0   | 367 | 0   | 2   | 0   | 1   | 0   | 0   | 1] |
| Nine  | [ | 0   | 6   | 0   | 0   | 0   | 3   | 0   | 0   | 0   | 364 | 3   | 1   | 0   | 0   | 0   | 0] |
| Bed   | [ | 1   | 0   | 2   | 0   | 0   | 0   | 0   | 0   | 6   | 0   | 166 | 5   | 2   | 1   | 0   | 0] |
| Bird  | [ | 0   | 1   | 1   | 1   | 0   | 0   | 2   | 0   | 0   | 2   | 7   | 137 | 0   | 2   | 0   | 0] |
| Cat   | [ | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 1   | 0   | 0   | 1   | 0   | 161 | 4   | 1   | 0] |
| Dog   | [ | 0   | 1   | 5   | 0   | 0   | 0   | 0   | 0   | 0   | 1   | 1   | 0   | 2   | 182 | 0   | 0] |
| House | [ | 0   | 0   | 2   | 0   | 0   | 1   | 1   | 0   | 0   | 1   | 0   | 0   | 5   | 1   | 156 | 0] |
| Tree  | [ | 2   | 0   | 2   | 15  | 0   | 0   | 1   | 0   | 4   | 1   | 0   | 0   | 0   | 0   | 138 | ]] |

Custom  
channel 32 (Acc: 0.9533)  
DO(0.75)

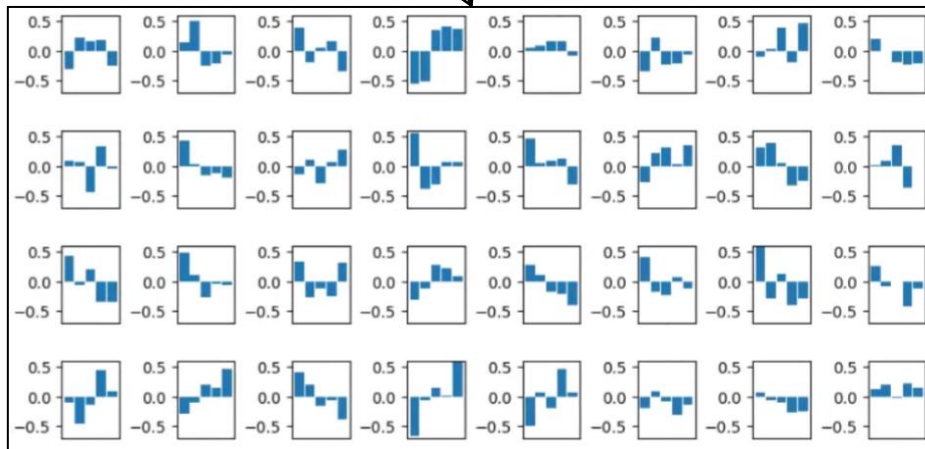
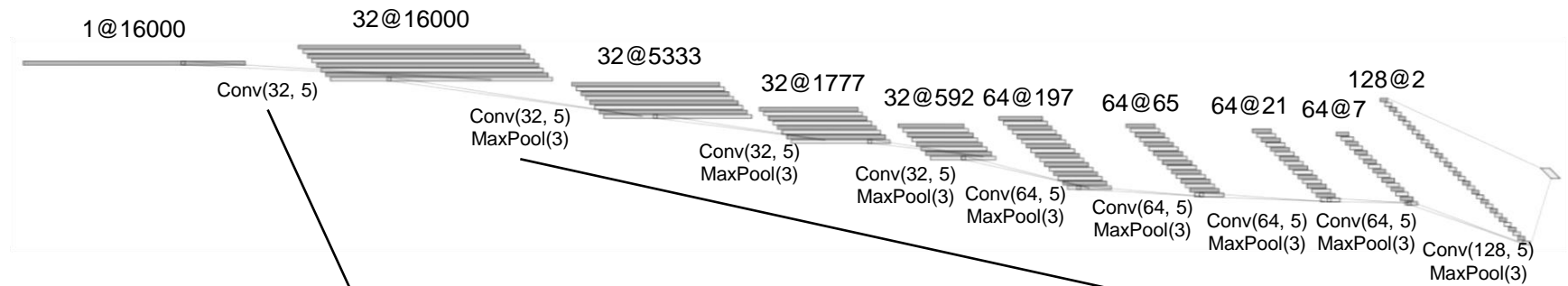
|       |   |     |     |     |     |     |     |     |     |     |     |     |   |     |     |     |       |
|-------|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|---|-----|-----|-----|-------|
| Zero  | [ | 375 | 0   | 3   | 0   | 2   | 0   | 0   | 3   | 0   | 1   | 0   | 0 | 0   | 0   | 0   | 1]    |
| One   | [ | 0   | 348 | 0   | 0   | 4   | 1   | 0   | 1   | 1   | 6   | 1   | 0 | 0   | 0   | 1   | 1]    |
| Two   | [ | 1   | 0   | 375 | 2   | 1   | 0   | 0   | 0   | 0   | 0   | 0   | 0 | 0   | 2   | 1   | 2]    |
| Three | [ | 1   | 0   | 5   | 356 | 0   | 0   | 2   | 3   | 1   | 0   | 1   | 0 | 0   | 0   | 0   | 8]    |
| Fore  | [ | 0   | 0   | 0   | 0   | 364 | 1   | 0   | 0   | 0   | 0   | 0   | 1 | 1   | 0   | 0   | 1]    |
| Five  | [ | 0   | 0   | 0   | 0   | 5   | 399 | 0   | 0   | 1   | 2   | 0   | 0 | 1   | 0   | 0   | 0]    |
| Six   | [ | 0   | 0   | 0   | 1   | 0   | 0   | 371 | 1   | 0   | 0   | 1   | 0 | 0   | 0   | 0   | 0]    |
| Seven | [ | 1   | 0   | 0   | 0   | 0   | 0   | 1   | 373 | 1   | 0   | 0   | 0 | 0   | 0   | 0   | 0]    |
| Eight | [ | 0   | 0   | 4   | 2   | 0   | 0   | 0   | 0   | 362 | 4   | 0   | 2 | 1   | 0   | 0   | 1]    |
| Nine  | [ | 0   | 5   | 0   | 0   | 0   | 3   | 0   | 1   | 0   | 363 | 2   | 3 | 0   | 0   | 0   | 0]    |
| Bed   | [ | 0   | 0   | 1   | 0   | 0   | 0   | 1   | 0   | 1   | 0   | 178 | 1 | 0   | 0   | 0   | 1]    |
| Bird  | [ | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 1   | 3 | 147 | 0   | 1   | 0]    |
| Cat   | [ | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0 | 166 | 1   | 1   | 0]    |
| Dog   | [ | 0   | 0   | 2   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 1   | 1 | 0   | 186 | 0   | 2]    |
| House | [ | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 2   | 0   | 0   | 1 | 3   | 0   | 161 | 0]    |
| Tree  | [ | 0   | 0   | 1   | 10  | 0   | 0   | 0   | 0   | 4   | 1   | 0   | 0 | 0   | 0   | 0   | 147]] |

Custom  
channel 128 (Acc: 0.9701)  
DO(0.25)+BN

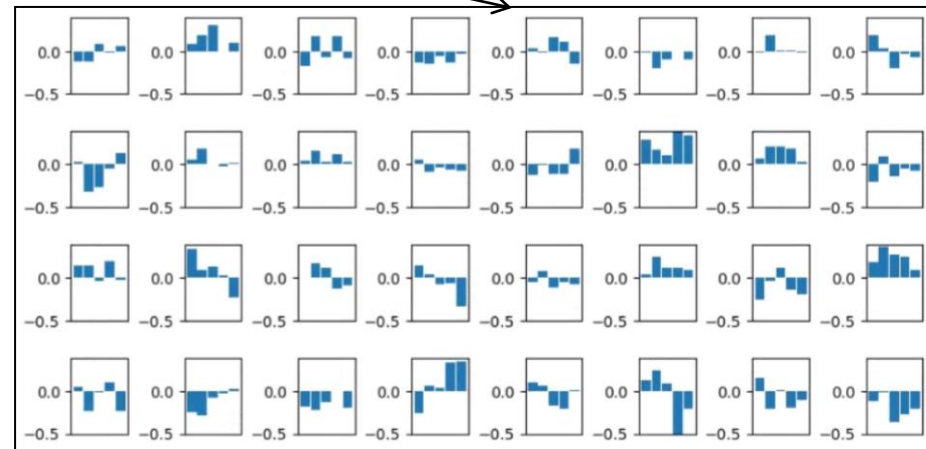


# Audio Classification

- Visualize the filter map. (Custom channel 32 DO(0.75) Model)
- Of course, Small number of parameters is easy to analyze
- There was a shape to know, but most of the shape was hard to understand.
- Next time, I will prepare the feature map and analyze it more detail.



First layer's filter



Second layer's filter

# Any Question?

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# Thank you