Use cost sensitive learning(1:10) for binary classification(0:others)

Drop some files out for test. No shuffle and split the rest data as 80% for training and 20% for validation.

Model consists of three parallel structure. All take raw data. One can get the envelope of the data and feed them to a conv1d network. One can process FFT on the data and feed the output to a conv1d network. The other can process discrete wavelet transform on the data and feed the output to a conv1d network. Then concatenate these three structures output.

## Drop Files[6,30,31,32,33,34,35]:

Class 0 : others

Train (acc 0.989)

|  |  |  |
| --- | --- | --- |
|  | Predicted 0 | Predicted others |
| Actual 0 | 5792 | 66 |
| Actual others | 0 | 562 |

Valid (acc 0.976)

|  |  |  |
| --- | --- | --- |
|  | Predicted 0 | Predicted others |
| Actual 0 | 1508 | 36 |
| Actual others | 4 | 149 |

Test (acc 0.925)

|  |  |  |
| --- | --- | --- |
|  | Predicted 0 | Predicted others |
| Actual 0 | 288 | 38 |
| Actual others | 1 | 200 |

Class 1 : 2 : 6

Train (acc 0.857)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Predicted 1 | Predicted 2 | Predicted 6 |
| Actual 1 | 71 | 10 | 39 |
| Actual 2 | 21 | 249 | 8 |
| Actual 6 | 1 | 1 | 162 |

Valid (acc 0.736)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Predicted 1 | Predicted 2 | Predicted 6 |
| Actual 1 | 5 | 10 | 18 |
| Actual 2 | 2 | 70 | 5 |
| Actual 6 | 0 | 5 | 37 |

Test (acc 0.656)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Predicted 1 | Predicted 2 | Predicted 6 |
| Actual 1 | 30 | 7 | 15 |
| Actual 2 | 37 | 19 | 1 |
| Actual 6 | 9 | 0 | 83 |

Class 2 : 6

Train (acc 0.970)

|  |  |  |
| --- | --- | --- |
|  | Predicted 2 | Predicted 6 |
| Actual 2 | 265 | 13 |
| Actual 6 | 0 | 164 |

Valid (acc 0.907)

|  |  |  |
| --- | --- | --- |
|  | Predicted 2 | Predicted 6 |
| Actual 2 | 71 | 6 |
| Actual 6 | 5 | 37 |

Test (acc 0.946)

|  |  |  |
| --- | --- | --- |
|  | Predicted 2 | Predicted 6 |
| Actual 2 | 52 | 5 |
| Actual 6 | 3 | 89 |

Class 1 : 6

Train (acc 0.996)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 6 |
| Actual 1 | 119 | 1 |
| Actual 6 | 0 | 164 |

Valid (acc 0.880)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 6 |
| Actual 1 | 26 | 7 |
| Actual 6 | 2 | 40 |

Test (acc 0.798)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 6 |
| Actual 1 | 48 | 4 |
| Actual 6 | 25 | 67 |

Class 1 : 2

Train (acc 0.907)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 2 |
| Actual 1 | 120 | 0 |
| Actual 2 | 37 | 241 |

Valid (acc 0.827)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 2 |
| Actual 1 | 22 | 11 |
| Actual 2 | 8 | 69 |

Test (acc 0.697)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 2 |
| Actual 1 | 48 | 4 |
| Actual 2 | 29 | 28 |

## Drop Files[7,30,31,32,33,34,35]:

Class 0 : others

Train (acc 0.989)

|  |  |  |
| --- | --- | --- |
|  | Predicted 0 | Predicted others |
| Actual 0 | 5833 | 65 |
| Actual others | 1 | 466 |

Valid (acc 0.981)

|  |  |  |
| --- | --- | --- |
|  | Predicted 0 | Predicted others |
| Actual 0 | 1529 | 25 |
| Actual others | 6 | 123 |

Test (acc 0.969)

|  |  |  |
| --- | --- | --- |
|  | Predicted 0 | Predicted others |
| Actual 0 | 273 | 3 |
| Actual others | 15 | 305 |

Class 1 : 2 : 6

Train (acc 0.860)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Predicted 1 | Predicted 2 | Predicted 6 |
| Actual 1 | 10 | 43 | 8 |
| Actual 2 | 0 | 249 | 6 |
| Actual 6 | 2 | 6 | 143 |

Valid (acc 0.736)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Predicted 1 | Predicted 2 | Predicted 6 |
| Actual 1 | 1 | 11 | 6 |
| Actual 2 | 0 | 69 | 3 |
| Actual 6 | 0 | 14 | 25 |

Test (acc 0.567)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Predicted 1 | Predicted 2 | Predicted 6 |
| Actual 1 | 4 | 64 | 58 |
| Actual 2 | 4 | 70 | 11 |
| Actual 6 | 0 | 1 | 107 |

Class 2 : 6

Train (acc 0.967)

|  |  |  |
| --- | --- | --- |
|  | Predicted 2 | Predicted 6 |
| Actual 2 | 247 | 8 |
| Actual 6 | 5 | 146 |

Valid (acc 0.855)

|  |  |  |
| --- | --- | --- |
|  | Predicted 2 | Predicted 6 |
| Actual 2 | 68 | 4 |
| Actual 6 | 12 | 27 |

Test (acc 0.891)

|  |  |  |
| --- | --- | --- |
|  | Predicted 2 | Predicted 6 |
| Actual 2 | 64 | 21 |
| Actual 6 | 0 | 108 |

Class 1 : 6

Train (acc 0.915)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 6 |
| Actual 1 | 51 | 10 |
| Actual 6 | 8 | 143 |

Valid (acc 0.842)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 6 |
| Actual 1 | 12 | 6 |
| Actual 6 | 3 | 36 |

Test (acc 0.717)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 6 |
| Actual 1 | 69 | 57 |
| Actual 6 | 9 | 99 |

Class 1 : 2

Train (acc 0.977)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 2 |
| Actual 1 | 60 | 1 |
| Actual 2 | 6 | 249 |

Valid (acc 0.866)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 2 |
| Actual 1 | 9 | 9 |
| Actual 2 | 3 | 69 |

Test (acc 0.710)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 2 |
| Actual 1 | 85 | 41 |
| Actual 2 | 20 | 65 |

## Drop Files[5,30,31,32,33,34,35]:

Class 0 : others

Train (acc 0.983)

|  |  |  |
| --- | --- | --- |
|  | Predicted 0 | Predicted others |
| Actual 0 | 5764 | 106 |
| Actual others | 0 | 629 |

Valid (acc 0.957)

|  |  |  |
| --- | --- | --- |
|  | Predicted 0 | Predicted others |
| Actual 0 | 1478 | 69 |
| Actual others | 4 | 167 |

Test (acc 0.915)

|  |  |  |
| --- | --- | --- |
|  | Predicted 0 | Predicted others |
| Actual 0 | 297 | 14 |
| Actual others | 22 | 94 |

Class 1 : 2 : 6

Train (acc 0.855)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Predicted 1 | Predicted 2 | Predicted 6 |
| Actual 1 | 81 | 19 | 51 |
| Actual 2 | 8 | 295 | 13 |
| Actual 6 | 0 | 0 | 162 |

Valid (acc 0.723)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Predicted 1 | Predicted 2 | Predicted 6 |
| Actual 1 | 4 | 13 | 24 |
| Actual 2 | 2 | 78 | 7 |
| Actual 6 | 0 | 1 | 41 |

Test (acc 0.646)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Predicted 1 | Predicted 2 | Predicted 6 |
| Actual 1 | 0 | 12 | 1 |
| Actual 2 | 0 | 6 | 3 |
| Actual 6 | 0 | 25 | 69 |

Class 2 : 6

Train (acc 0.985)

|  |  |  |
| --- | --- | --- |
|  | Predicted 2 | Predicted 6 |
| Actual 2 | 313 | 3 |
| Actual 6 | 4 | 158 |

Valid (acc 0.968)

|  |  |  |
| --- | --- | --- |
|  | Predicted 2 | Predicted 6 |
| Actual 2 | 85 | 2 |
| Actual 6 | 2 | 40 |

Test (acc 0.417)

|  |  |  |
| --- | --- | --- |
|  | Predicted 2 | Predicted 6 |
| Actual 2 | 8 | 1 |
| Actual 6 | 59 | 35 |

Class 1 : 6

Train (acc 0.779)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 6 |
| Actual 1 | 94 | 57 |
| Actual 6 | 12 | 150 |

Valid (acc 0.626)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 6 |
| Actual 1 | 13 | 28 |
| Actual 6 | 3 | 49 |

Test (acc 0.196)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 6 |
| Actual 1 | 13 | 0 |
| Actual 6 | 86 | 8 |

Class 1 : 2

Train (acc 0.899)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 2 |
| Actual 1 | 149 | 2 |
| Actual 2 | 45 | 271 |

Valid (acc 0.867)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 2 |
| Actual 1 | 34 | 7 |
| Actual 2 | 10 | 77 |

Test (acc 0.409)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 2 |
| Actual 1 | 0 | 13 |
| Actual 2 | 0 | 9 |

## Model parameters:

args = {'num\_steps': 1024,

'channels': 8,

'conv\_activation': 'relu',

'dropout\_rate': 0.2,

'wavelet\_mother': 'haar',

'wavelet\_levels': 5,

'wavelet\_trainable': False,

'moving\_avg\_window': 50,

'kernel\_size':3,

}