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

Drop some files out for test. Shuffle and split the rest data as 75% for training and 25% 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 0.997)

|  |  |  |
| --- | --- | --- |
|  | Predicted 0 | Predicted others |
| Actual 0 | 5548 | 14 |
| Actual others | 0 | 525 |

Valid (acc 0.994)

|  |  |  |
| --- | --- | --- |
|  | Predicted 0 | Predicted others |
| Actual 0 | 1828 | 12 |
| Actual others | 0 | 190 |

Test (acc 0.925)

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

Class 1 : 2 : 6

Train (acc 0.884)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Predicted 1 | Predicted 2 | Predicted 6 |
| Actual 1 | 70 | 13 | 39 |
| Actual 2 | 3 | 247 | 7 |
| Actual 6 | 0 | 0 | 156 |

Valid (acc 0.793)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Predicted 1 | Predicted 2 | Predicted 6 |
| Actual 1 | 7 | 6 | 18 |
| Actual 2 | 6 | 87 | 5 |
| Actual 6 | 0 | 2 | 48 |

Test (acc 0.776)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Predicted 1 | Predicted 2 | Predicted 6 |
| Actual 1 | 24 | 16 | 12 |
| Actual 2 | 8 | 45 | 4 |
| Actual 6 | 5 | 0 | 87 |

Class 2 : 6

Train (acc 0.985)

|  |  |  |
| --- | --- | --- |
|  | Predicted 2 | Predicted 6 |
| Actual 2 | 253 | 6 |
| Actual 6 | 0 | 161 |

Valid (acc 0.950)

|  |  |  |
| --- | --- | --- |
|  | Predicted 2 | Predicted 6 |
| Actual 2 | 92 | 4 |
| Actual 6 | 3 | 42 |

Test (acc 0.966)

|  |  |  |
| --- | --- | --- |
|  | Predicted 2 | Predicted 6 |
| Actual 2 | 55 | 23 |
| Actual 6 | 3 | 89 |

Class 1 : 6

Train (acc 0.985)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 6 |
| Actual 1 | 119 | 3 |
| Actual 6 | 1 | 146 |

Valid (acc 0.888)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 6 |
| Actual 1 | 25 | 6 |
| Actual 6 | 4 | 55 |

Test (acc 0.819)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 6 |
| Actual 1 | 46 | 6 |
| Actual 6 | 20 | 72 |

Class 1 : 2

Train (acc 0.981)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 2 |
| Actual 1 | 116 | 5 |
| Actual 2 | 2 | 258 |

Valid (acc 0.905)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 2 |
| Actual 1 | 25 | 7 |
| Actual 2 | 5 | 90 |

Test (acc 0.733)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 2 |
| Actual 1 | 36 | 16 |
| Actual 2 | 13 | 44 |

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

Class 0 : others

Train (acc 0.992)

|  |  |  |
| --- | --- | --- |
|  | Predicted 0 | Predicted others |
| Actual 0 | 5568 | 46 |
| Actual others | 0 | 437 |

Valid (acc 0.986)

|  |  |  |
| --- | --- | --- |
|  | Predicted 0 | Predicted others |
| Actual 0 | 1826 | 27 |
| Actual others | 0 | 159 |

Test (acc 0.989)

|  |  |  |
| --- | --- | --- |
|  | Predicted 0 | Predicted others |
| Actual 0 | 272 | 4 |
| Actual others | 2 | 318 |

Class 1 : 2 : 6

Train (acc 1.000)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Predicted 1 | Predicted 2 | Predicted 6 |
| Actual 1 | 64 | 0 | 0 |
| Actual 2 | 0 | 232 | 0 |
| Actual 6 | 0 | 0 | 151 |

Valid (acc 0.912)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Predicted 1 | Predicted 2 | Predicted 6 |
| Actual 1 | 9 | 5 | 1 |
| Actual 2 | 1 | 90 | 4 |
| Actual 6 | 1 | 1 | 37 |

Test (acc 0.655)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Predicted 1 | Predicted 2 | Predicted 6 |
| Actual 1 | 43 | 32 | 51 |
| Actual 2 | 15 | 63 | 7 |
| Actual 6 | 3 | 2 | 103 |

Class 2 : 6

Train (acc 0.987)

|  |  |  |
| --- | --- | --- |
|  | Predicted 2 | Predicted 6 |
| Actual 2 | 242 | 2 |
| Actual 6 | 3 | 140 |

Valid (acc 0.976)

|  |  |  |
| --- | --- | --- |
|  | Predicted 2 | Predicted 6 |
| Actual 2 | 82 | 1 |
| Actual 6 | 2 | 45 |

Test (acc 0.927)

|  |  |  |
| --- | --- | --- |
|  | Predicted 2 | Predicted 6 |
| Actual 2 | 76 | 9 |
| Actual 6 | 5 | 103 |

Class 1 : 6

Train (acc 0.935)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 6 |
| Actual 1 | 46 | 13 |
| Actual 6 | 0 | 142 |

Valid (acc 0.838)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 6 |
| Actual 1 | 10 | 10 |
| Actual 6 | 1 | 47 |

Test (acc 0.615)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 6 |
| Actual 1 | 37 | 89 |
| Actual 6 | 1 | 107 |

Class 1 : 2

Train (acc 0.973)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 2 |
| Actual 1 | 57 | 1 |
| Actual 2 | 7 | 239 |

Valid (acc 0.921)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 2 |
| Actual 1 | 16 | 5 |
| Actual 2 | 3 | 78 |

Test (acc 0.725)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 2 |
| Actual 1 | 96 | 30 |
| Actual 2 | 28 | 57 |

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

Class 0 : others

Train (acc 0.975)

|  |  |  |
| --- | --- | --- |
|  | Predicted 0 | Predicted others |
| Actual 0 | 5419 | 152 |
| Actual others | 0 | 591 |

Valid (acc 0.977)

|  |  |  |
| --- | --- | --- |
|  | Predicted 0 | Predicted others |
| Actual 0 | 1800 | 46 |
| Actual others | 1 | 208 |

Test (acc 0.955)

|  |  |  |
| --- | --- | --- |
|  | Predicted 0 | Predicted others |
| Actual 0 | 294 | 17 |
| Actual others | 2 | 114 |

Class 1 : 2 : 6

Train (acc 0.831)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Predicted 1 | Predicted 2 | Predicted 6 |
| Actual 1 | 71 | 26 | 49 |
| Actual 2 | 15 | 273 | 9 |
| Actual 6 | 0 | 2 | 154 |

Valid (acc 0.780)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Predicted 1 | Predicted 2 | Predicted 6 |
| Actual 1 | 22 | 7 | 17 |
| Actual 2 | 12 | 87 | 7 |
| Actual 6 | 0 | 1 | 47 |

Test (acc 0.465)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Predicted 1 | Predicted 2 | Predicted 6 |
| Actual 1 | 0 | 13 | 0 |
| Actual 2 | 0 | 8 | 1 |
| Actual 6 | 0 | 48 | 46 |

Class 2 : 6

Train (acc 0.995)

|  |  |  |
| --- | --- | --- |
|  | Predicted 2 | Predicted 6 |
| Actual 2 | 290 | 2 |
| Actual 6 | 0 | 163 |

Valid (acc 0.980)

|  |  |  |
| --- | --- | --- |
|  | Predicted 2 | Predicted 6 |
| Actual 2 | 108 | 3 |
| Actual 6 | 0 | 41 |

Test (acc 0.582)

|  |  |  |
| --- | --- | --- |
|  | Predicted 2 | Predicted 6 |
| Actual 2 | 8 | 1 |
| Actual 6 | 42 | 52 |

Class 1 : 6

Train (acc 0.892)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 6 |
| Actual 1 | 114 | 31 |
| Actual 6 | 1 | 151 |

Valid (acc 0.848)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 6 |
| Actual 1 | 35 | 12 |
| Actual 6 | 3 | 49 |

Test (acc 0.448)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 6 |
| Actual 1 | 13 | 0 |
| Actual 6 | 59 | 35 |

Class 1 : 2

Train (acc 0.957)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 2 |
| Actual 1 | 152 | 0 |
| Actual 2 | 19 | 275 |

Valid (acc 0.859)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 2 |
| Actual 1 | 31 | 9 |
| Actual 2 | 12 | 97 |

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,

}