Phased Human Activity Recognition based on GPS

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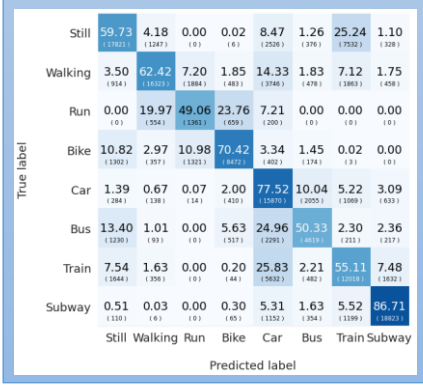
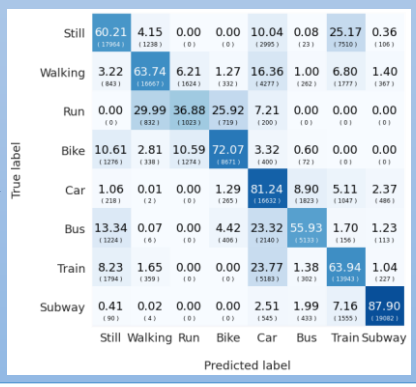
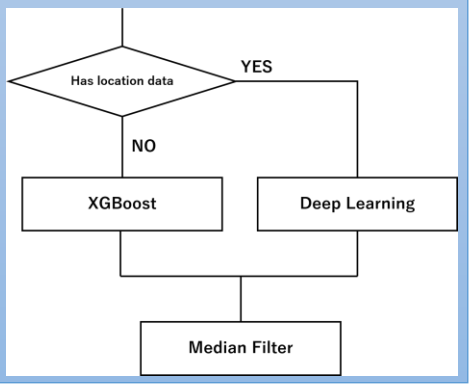
Data including location were classified by Deep Neural Network including LSTM layer.
Data excluded location were classified by the Gradient Boosting Decision Tree.
The 2 outputs have been combined. They were optimized by applying a median filter.
In the submission phase, the best F-measure obtained for the SHL validation-set was 65%.







Preprocessing

Hubeny formula first term was used to calculate the distance traveled per second using latitude and longitude.
The calculated distance was converted to velocity by multiplying by 3.6.
Angular acceleration was calculated from the azimuth angle. Angular Acceleration is the difference in azimuth angle.

$$D = \sqrt{(M \times dP)^2 + (N \times \cos(P) \times dR)^2}$$

D: distance between 2 points (m)
P: mean latitude from 2 points
dP: latitude difference between 2 points
dR: longitude difference between 2 points
M: radius of curvature
N: radius of prime vertical circle

$$V = D \times 3.6$$

V: velocity (km/h)

$$AA = \arctan\left(\frac{\sin(dR)}{\cos(LP) \times \tan(TP) - \sin(LP) \times \cos(dR)}\right)$$

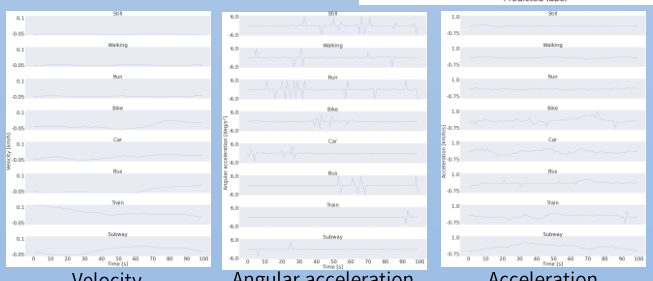
AA: azimuth angle
dR: longitude difference between 2 points
LP: latitude of the starting point
TP: latitude of the end point

Deep Learning (data with location)

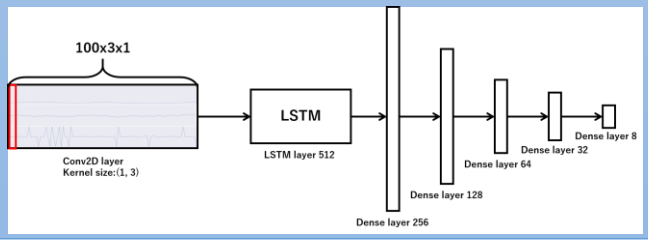
We employed a Deep Neural Network (DNN) model with a Long-Term Short Memory (LSTM) layer.

Feature values were velocity, acceleration, and angular acceleration for 100 s.

If feature values were not acquired for 100 s, we centralized it with padding by zero.



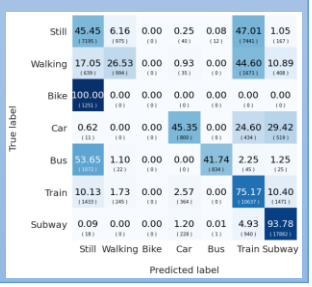
Velocity | Angular acceleration | Acceleration



XGBoost (No Location)

Cell (LTE, WCDMA, GSM) features
- The number of each cell
- Mean and valiance of each signal strength from the cell

Wi-Fi features
- The number of received Wi-Fi access points
- Mean and standard deviation of Wi-Fi access point's RSSI.
  Calculated from 3 frequency ranges
- The number of SSID from 29 Wi-Fi access points
  that is received high frequency in the Training-set
- The number of Wi-Fi access point includes the following text in its SSID
  - free, hotel, restaurant



Post-processing

We applied a median filter to estimate from the combined output of two model outputs.
The filter length is 101 s.
Correcting the output label improves accuracy.

Train Train Train Train Subway Train ⋯ Train Train

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