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TACKLING THE SHL RECOGNITION CHALLENGE WITH PHONE POSITION DETECTION AND NEAREST NEIGHBOR SMOOTHING

TASK

- Recognize 8 modes of transport and locomotion from 5 second frames of IMU data recorded with a smartphone.
- Training data of **only one user** and four phone wearing positions.
- Test data from **two other users** and an **unknown phone wearing position**.
- Small validation data set from users in test set and all four phone wearing positions.

PHONE POSITION RECOGNITION

- All samples are from the same phone position!
- Compute phone position *p* in test set *X*:

$$p_X = argmax_p \prod_{d \in X} P(p|f_d)$$

NEAREST NEIGHBOR SMOOTHING

- Aside from the transport mode, the sensor signals are influenced by many other factors: the particular vehicle, traffic condition, road pavement, etc.
- Therefore, instances in the test set do not always have the same class label as the most similar instances in the training set.
- For the same reason, groups of samples in the test set, that were recorded in the same “situation” (pavement, traffic, vehicle, driver,...) are very similar.
- Averaging over groups of similar samples (k Nearest Neighbors) in the test set can improve classification performance.

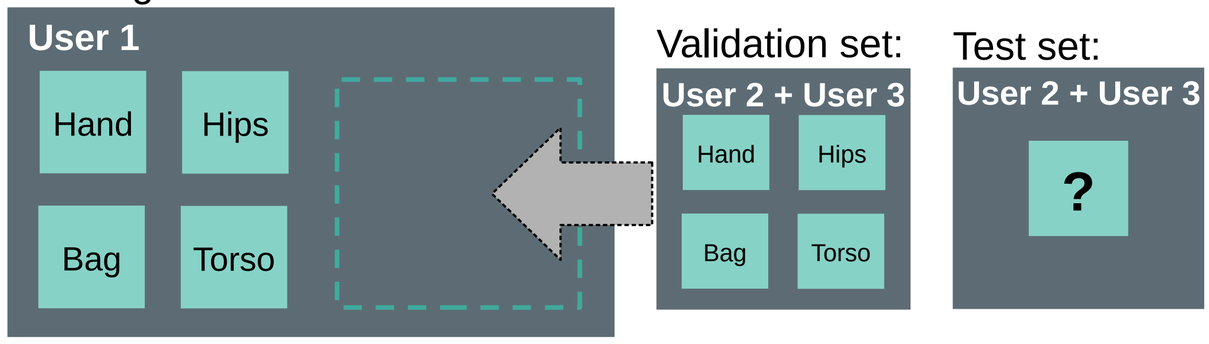
RESULTS

	Avg. F1
Original training set:	**56.0%**
Enhanced training set:	**63.3%**
Enhanced training set + Nearest Neighbor Smoothing:	**75.3%**

actual activity (%)	predicted: Still	Walking	Run	Bike	Car	Bus	Train	Subway
Still	18.8	0.6	0.0	0.0	0.2	0.5	0.3	0.2
Walk	1.7	14.0	0.4	1.5	0.3	0.0	0.0	0.1
Run	0.0	0.1	1.6	0.2	0.0	0.0	0.0	0.0
Bike	0.4	0.1	0.0	7.3	0.1	0.4	0.0	0.0
Car	2.3	0.0	0.0	0.0	7.9	1.9	2.0	0.1
Bus	1.1	0.1	0.0	0.0	1.3	3.2	0.6	0.1
Train	1.1	0.1	0.0	0.0	0.2	0.4	11.5	1.8
Subway	0.2	0.0	0.0	0.0	0.1	0.0	2.1	12.7
Recall:	90.7	77.2	81.6	87.2	55.8	50.9	76.0	84.1
Precision:	73.5	93.1	80.0	79.6	77.6	49.9	69.7	84.7
avg. F1:	**75.3**							

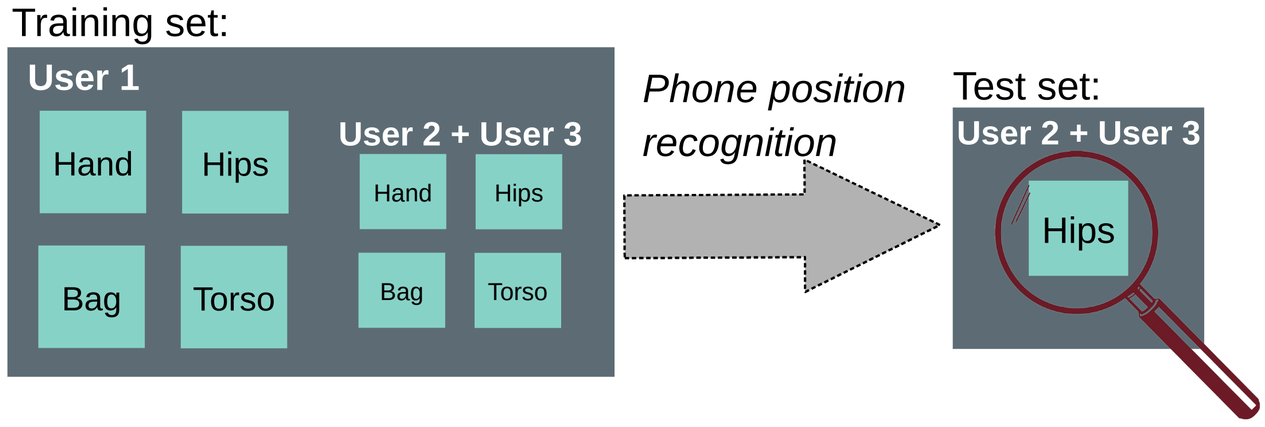
PROCESSING PIPELINE

1) Add validation set to training data.



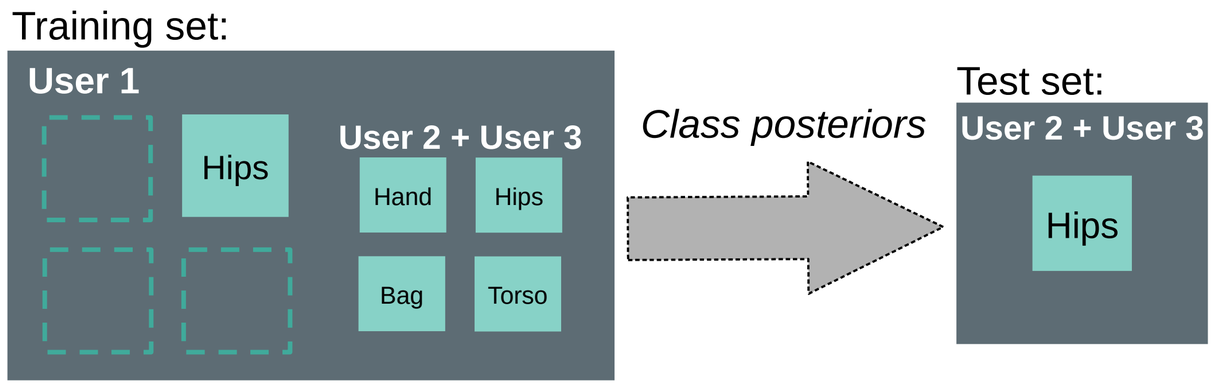
2) Extract features from sensor data.

3) Train MLP to recognize phone position in test set.

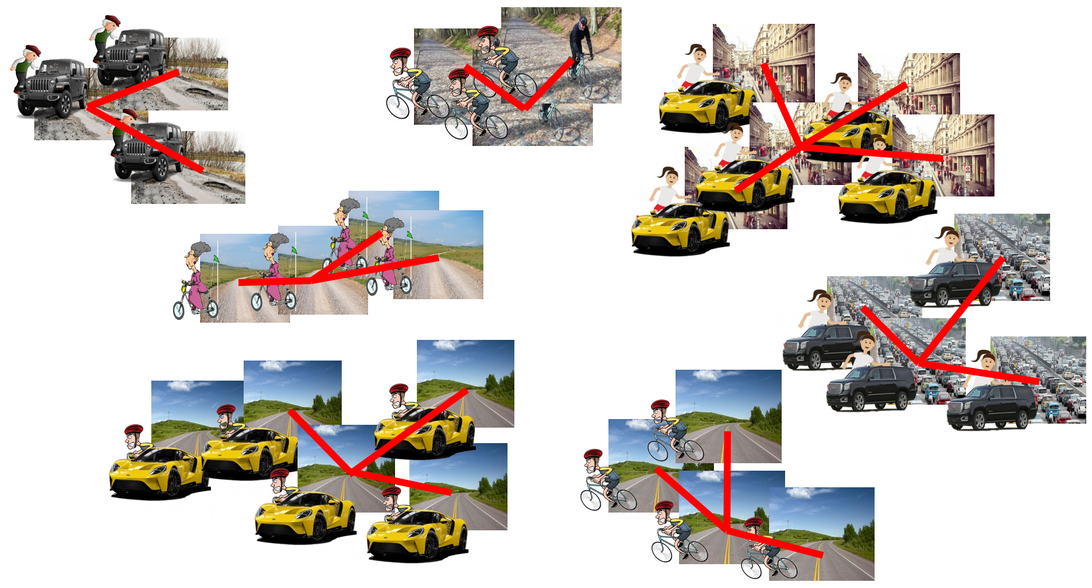


4) Retain only data from recognized phone position.

5) Train MLP to compute class posteriors for each sample in test set.



6) Average class posteriors over k-Nearest Neighbors in test set.



7) Compute class label maximizing averaged class posterior.