CS230 Project Proposal

Project Members: Akash Levy (akashl), Jonas Messner (messnerj), Nicholas Gaudio (nsgaudio)
Project Title: HATRNet: Human Activity/Transition Recognition using Deep Neural Networks
Project Category: Healthcare

Project Proposal:
We propose a deep learning solution for categorizing accelerometer data collected from smartphones into different activities/postural transitions. This is an interesting problem for many reasons; we are taking an unstructured dataset (raw accelerometer time trace vectors) and using it to develop a model that produces structured data (activities). This structured data could enable many novel analyses in the healthcare domain; for example, frequency of activity/postural transitions could be correlated with overall wellbeing of a person. The challenges in this task are to select which features to use from a large feature set and to attain high accuracy with the noisy data we are provided, using an optimized neural network architecture. We anticipate that hyperparameter tuning and feature selection will be the main challenges.

We will use the human activity dataset provided in [Rey15]. It contains 3-axial linear acceleration and 3-axial angular velocity at a rate of 50 Hz. The dataset is labelled with six activities (walking, walking upstairs, walking downstairs, sitting, standing, laying) and six postural transitions (stand-to-sit, sit-to-stand, sit-to-lie, lie-to-sit, stand-to-lie, and lie-to-stand).

We plan to experiment with various neural network architectures including fully-connected networks, recurrent neural networks, and convolutional neural networks with 2-D convolutional layers to leverage the correlations between the 6-D time series. The PerceptionNet will be referenced to begin testing model architectures [Kas18]. We will then optimize over the hyperparameter space to maximize categorization accuracy on the test dataset. We plan to improve on prior implementations with our improved network architecture and smart feature selection.

We will evaluate our results, and provide a comparison to the existing literature. We expect to show figures of our optimized architectures, a table describing the features we used, a table giving our maximal performance on training/test datasets, and plots demonstrating our process of hyperparameter optimization. For our softmax models, we will use accuracy as our main metric (percentage of samples correctly classified). For our probabilistic models, we will use the vector distance to the correct classification.

References:
[Rey15] Jorge-L. Reyes-Ortiz, Luca Oneto, Albert SamÃ , Xavier Parra, Davide Anguita. “Transition-Aware Human Activity Recognition Using Smartphones.” Neurocomputing. Springer 2015.

[Kas18]Kasnesis, Panagiotis, Charalampos Z. Patrikakis, and Iakovos S. Venieris. "PerceptionNet: A Deep Convolutional Neural Network for Late Sensor Fusion." Proceedings of SAI Intelligent Systems Conference. Springer, Cham, 2018.