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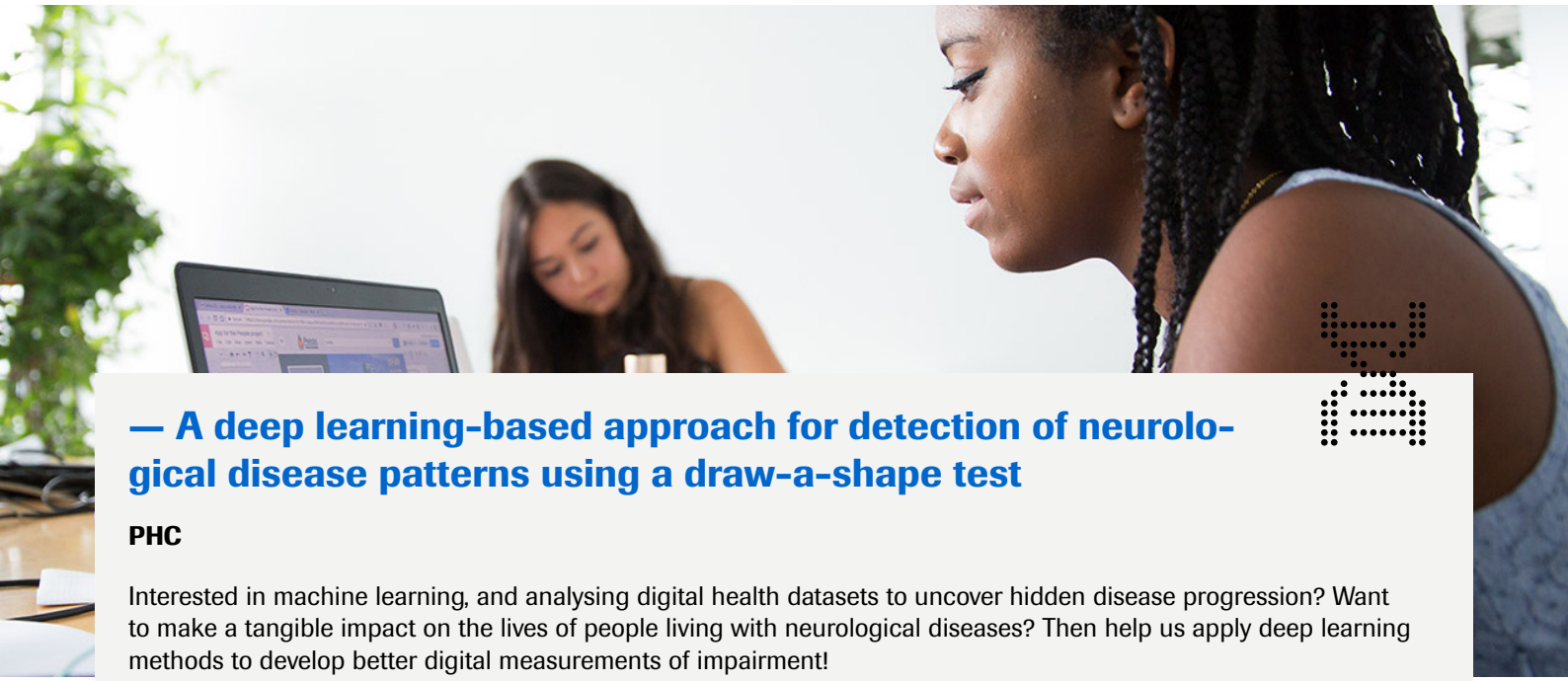
Roche



— A deep learning-based approach for detection of neurological disease patterns using a draw-a-shape test

PHC

Interested in machine learning, and analysing digital health datasets to uncover hidden disease progression? Want to make a tangible impact on the lives of people living with neurological diseases? Then help us apply deep learning methods to develop better digital measurements of impairment!

Apply until **April 18, 2021** / Xplorers Camp on **May 3, 2021**

Question to be solved

Can we use deep learning methods to derive digital measures that capture information about neurological impairments?

General Background

Roche is at the forefront of the digital health space, with regular deployments of digital health solutions in clinical studies of neurological diseases (Lipsmeier et al., 2018, Midaglia et al. 2018). One of the flagship tests for assessing fine motor control is the Draw-a-Shape test (Creagh et al. 2020), which involves tracing pre-determined shapes on a smartphone screen. Processing of the resulting touch data allows us to determine features that are associated with upper limb motor impairment and disease progression in neurological diseases.

The aim of this challenge is to determine whether machine learning approaches can be used to detect disease patterns that have not been captured by the existing Draw-a-Shape features. Both generative and discriminative modelling could be used. Note that the touch data can be thought of as a temporal sequence of inputs.

Data Types & Technologies

The input data will consist of touch traces of pre-defined shapes on a smartphone screen. Each test consists of the following shapes: Line (top to bottom), line (bottom to top), square, circle, figure eight, spiral. The data is collected during clinical studies of people with neurological disorders. Each participant performs the test daily for the duration of the study. The following are some approaches that could be considered for this challenge, but we are open to other solutions:

- Neural decomposition methods (Märtens & Yau, 2020).
- Classifier predicting clinical measures (such as tests of hand function).
- Sequence processing models such as LSTM networks (Hochreiter & Schmidhuber, 1997), Temporal-Convolutional Networks (Bai et al., 2018), and Transformers (Vaswani et al., 2017).

Supporting Material or Links

- Bai, S., Kolter, J. Z., & Koltun, V. (2018). An empirical evaluation of generic convolutional and recurrent networks for sequence modeling. arXiv preprint arXiv:1803.01271.
- Baker et al. Digital health: Smartphone-based monitoring of multiple sclerosis using Floodlight. https://www.nature.com/articles/d42473-019-00412-0 [Accessed 20 November 2020].
- Creagh, A. P., Simillion, C., Scotland, A., Lipsmeier, F., Bernasconi, C., Belachew, S.,van Beek, Baker, J., et al. (2020). Smartphone-based remote assessment of upper extremity function for multiple sclerosis using the Draw a Shape Test. Physiological Measurement, 41(5), 054002.
- Hochreiter, S., & Schmidhuber, J. (1997). Long short-term memory. Neural computation, 9(8), 1735-1780.
- Lipsmeier, F. et al. (2018). Evaluation of smartphone-based testing to generate exploratory outcome measures in a phase 1 Parkinson's disease clinical trial. Mov Disord. 33(8):1287-1297.
- Märtens, K., & Yau, C. (2020). Neural Decomposition: Functional ANOVA with Variational Autoencoders. In S. Chiappa & R. Calandra (Eds.), Proceedings of the Twenty Third International Conference on Artificial Intelligence and Statistics (Vol. 108, pp. 2917–2927). PMLR.
- Midaglia et al. (2019). Adherence and Satisfaction of Smartphone- and Smartwatch-Based Remote Active Testing and Passive Monitoring in People With Multiple Sclerosis: Nonrandomized Interventional Feasibility Study. J Med Internet Res 21(8):e14863.
- Vaswani, A., Shazeer, N., Parmar, N., Uszkoreit, J., Jones, L., Gomez, A. N., … & Polosukhin, I. (2017). Attention is all you need. In Advances in neural information processing systems (pp. 5998-6008).

Needed Skills

- Good communication skills
- Solid Python skills
- Experience with deep learning frameworks, e.g. PyTorch, TensorFlow
- Understanding of the statistical underpinnings of machine learning methods

Mentors

Frank Dondelinger
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Marcin Elantkowski
Principal Associate Data Analyst, Digital Biomarkers, pREDi

Form of Cooperation

Internship, 3 months. Preference full-time, part-time possible.

How to present your Idea

Preferred presentation format: 3-5 slides. Other forms of presentation are possible if they serve a purpose. Knowledge of Python and machine learning will be checked during the pitch sessions.