CD-1061-17

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FACULTAD DE CIENCIAS EXACTAS Y NATURALES FOLIO 4

Universidad de Buenos Aires
Facultad de Ciencias Exactas y Naturales

Planilla a completar para presentación de Cursos de Posgrado

1.- DEPARTAMENTO de COMPUTACIÓN

2.- NOMBRE DEL CURSO: Machine Learning aplicado a datos electrofisiológicos (MEEG y fMRI)

3.- DOCENTES:

RESPONSABLE/S: Diego Fernandez Slezak
COLABORADORES: Nick Oosterhof (a cargo del curso)
AUXILIARES: ....

4.- CARRERA de DOCTORADO

5.- AÑO: 2017 CUATRIMESTRE/S: ....

6.- PUNTAJE PROPUESTO PARA CARRERA DE DOCTORADO: .... 2 ....

7.- DURACIÓN (anual, cuatrimestral, bimestral u otra): semanal

8.- CARGA HORARIA SEMANAL:

Teóricas: ....
Problemas: ....
Laboratorio: ....
Seminarios: ....
Teórico – Práctico: 48hs.
Salida a Campo: ....

9.- CARGA HORARIA TOTAL: .... 48 ....

10.- FORMA DE EVALUACIÓN: ...Trabajo práctico final..............................

11.- PROGRAMA ANALÍTICO:

After an introductory presentation, it starts with basic operations of reading, writing, selecting, and aggregating dataset structures. This is followed by MVPA correlation and classficiation analysis of fMRI data in a region of interest. Subsequently, this is extended to exploratory searchlight analysis, representational similarity analysis, and MEEG analysis in the space and time dimensions. Finally approaches to multiple comparison are discussed.

Goals of this course

- Learn typical MVPA approaches (correlation analysis, classification analysis, representational similarity analysis).
- Learn how these approaches can be applied to both fMRI and MEEG data.
- Learn how to use CoSMoMVPA to perform these analyses:
  - Understand the dataset structure to represent both the data itself (e.g. raw measurements or summary statistics) and its attributes (e.g. labels of conditions (targets), data acquisition run (chunks).
  - See how parts of the data can be selected using slicing and splitting, and combined using stacking.
  - Introduce measures that compute summaries of the data (such as correlation differences, classification accuracies, similarity to an a prior defined representational simillarity matrix) that can be applied to both a single ROI or in a searchlight.
- Learn multiple-comparison approaches.
- Make yourself an independent user, so that you can apply the techniques learnt here to your own datasets.

List of topics:

- Machine learning and its application to neuroimaging analysis
- Split-half correlation analysis
- Single-fold classification
- Classification with cross-validation
- Measures, neighborhoods, searchlight applied to fMRI data
- fMRI ROI RSA
- fMRI searchlight RSA
- fMRI resting-state, different approaches
- EEG temporal and spatio-temporal classification searchlight
- EEG time generalization
- fMRI and EEG: multiple comparison correction using Threshold-Free Cluster Enhancement

12.- BIBLIOGRAFÍA:

Connolly, A. C., Guntupalli, J. S., Gors, J., Hanke, M., Halchenko, Y. O., Wu, Y. C., Abdi, H., and Haxby, J. V. The Representation of Biological Classes in the Human Brain. Journal of Neuroscience, 32(8):2608–2618, February 2012. [Representational similiarity analysis applied to fMRI data of participants viewing pictures of six animals]

Cox, D. D. and Savoy, R. L. Functional magnetic resonance imaging (fMRI) "brain reading": detecting and classifying distributed patterns of fMRI activity in human visual

Oosterhof, N. N., Connolly, A. C., and Haxby, J. V. CoSMoMVPA: multi-modal multivariate pattern analysis of neuroimaging data in Matlab / GNU Octave. Frontiers in Neuroinformatics, 2016. doi:10.3389/fninf.2016.00027.

Oosterhof, N. N., Tipper, S. P., and Downing, P. E. Visuo-motor imagery of specific manual actions: A multi-variate pattern analysis fMRI study. NeuroImage, 63(1):262–271, October 2012. [Illustration of how a-symmetric decoding accuracy may arise]

Oosterhof, N. N., Wiestler, T., Downing, P. E., and Diedrichsen, J. A comparison of volume-based and surface-based multi-voxel pattern analysis. NeuroImage, 56(2):593–600, May 2011. ['searchlight' concept applied to fMRI surface-based data]

Oosterhof, N. N., Wiggett, A. J., Diedrichsen, J., tipper, S. P., and Downing, P. E. Surface-based information mapping reveals crossmodal vision-action representations in human parietal and occipitotemporal cortex. Journal of neurophysiology, 104(2):1077–1089, August 2010. [Illustration of cross-decoding]

Peelen, M. V., Wiggett, A. J., and Downing, P. E. Patterns of fMRI activity dissociate overlapping functional brain areas that respond to biological motion. Neuron, 49(6):815–822, 2006. doi:doi:10.1016/j.neuron.2006.02.004.

Pereira, F., Mitchell, T., and Botvinick, M. Machine learning classifiers and fMRI: A tutorial overview. NeuroImage, 45(1):S199–S209, 2009. doi:10.1016/j.neuroimage.2008.11.007.

Smith, S. M. and Nichols, T. E. Threshold-free cluster enhancement: addressing problems of smoothing, threshold dependence and localisation in cluster inference. NeuroImage, 44(1):83–98, 2009.

Stelzer, J., Chen, Y., and Turner, R. Statistical inference and multiple testing correction in classification-based multi-voxel pattern analysis (MVPA): Random permutations and cluster size control. NeuroImage, 65(C):69–82, January 2013.