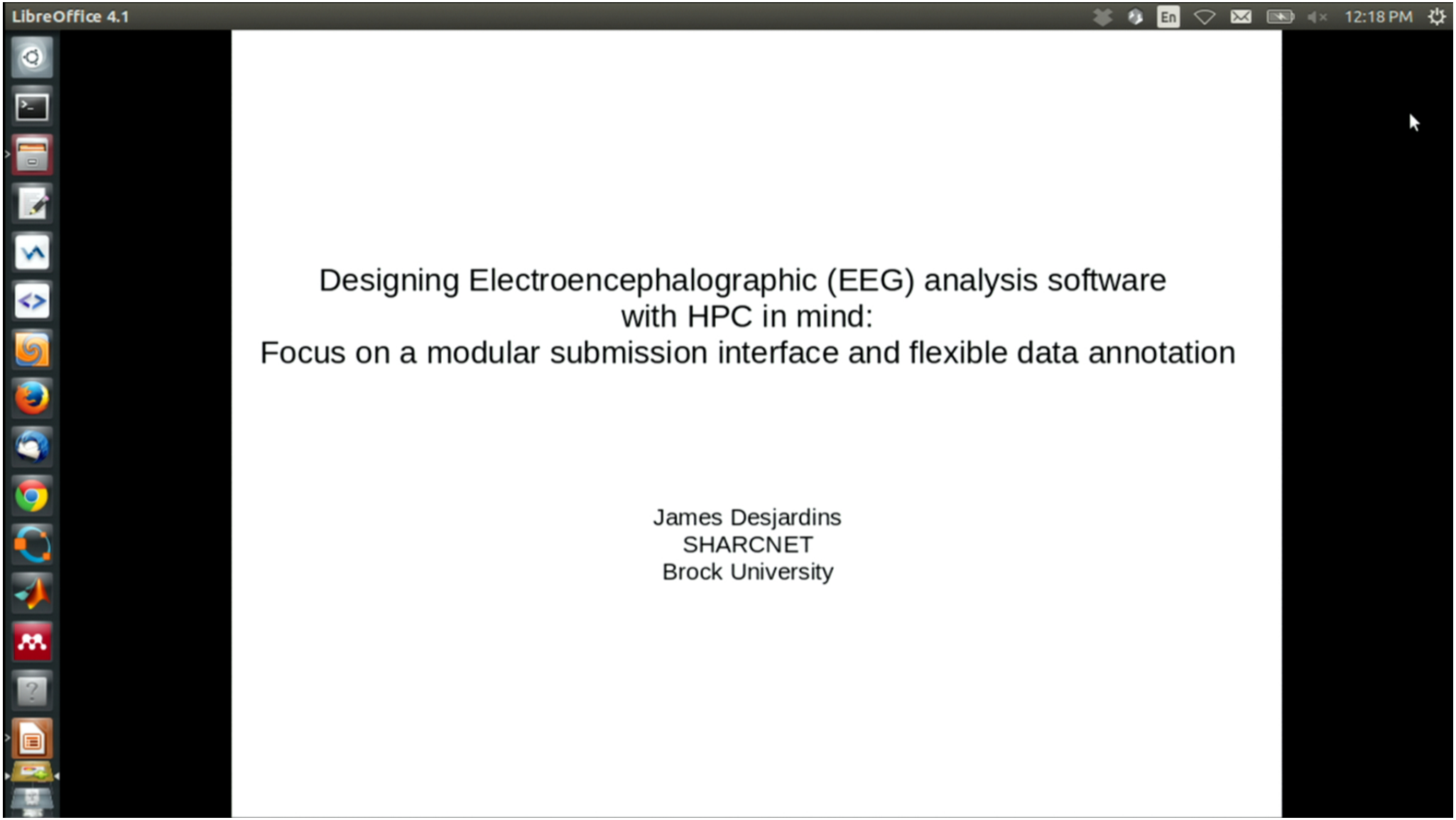
Title: Designing Electroencephalographic (EEG) analysis software with HPC in mind: Focus on a modular submission interface and flexible data annotation

Date: May 07, 2014 12:10 PM

URL: http://pirsa.org/14050044

Abstract: Electroencephalography (EEG) is a method for measuring brain activity by recording electrical fields at the scalp surface. Although it has the highest temporal resolution among brain imaging techniques it has low spatial resolution and is very sensitive to various forms of noise (e.g. movement artifacts electrical sources in the environment impedance artifacts and various biological artifacts typically generated from muscle activation). Substantial progress in the implementation of new signal processing and statistical strategies for EEG data analysis is currently changing the specificity with which EEG researchers can interpret their data. Because EEG studies can produce large data sets (e.g. 100 participants each contributing an EEG recording that consists of 130+ recording channels for 1 hour at a common sampling rate of 500 Hz or 1000 Hz) and the new processing strategies are computationally intensive (e.g. Independen Components Analysis (ICA) and bootstrapping) the computation time involved is not feasible for many research situations. Thus often these advanced methods are not used due to computation limitations even though there is no information based downside to their outcome. In this talk I present two software extensions being developed at the Brock University Lifespan Research Center for integration with the leading open source EEG analysis software platform EEGLab (developed at the Swartz Center for Computational Neuroscience UCSD). The first is a modular interface for submitting unsupervised procedures to a compute cluster and the second is a flexible off line visualization tool that allows for the interactive annotation of extensive unsupervised processing. These software extensions together with resources such as SHARCNet can remove the computation constraints of advanced data processing from EEG research labs.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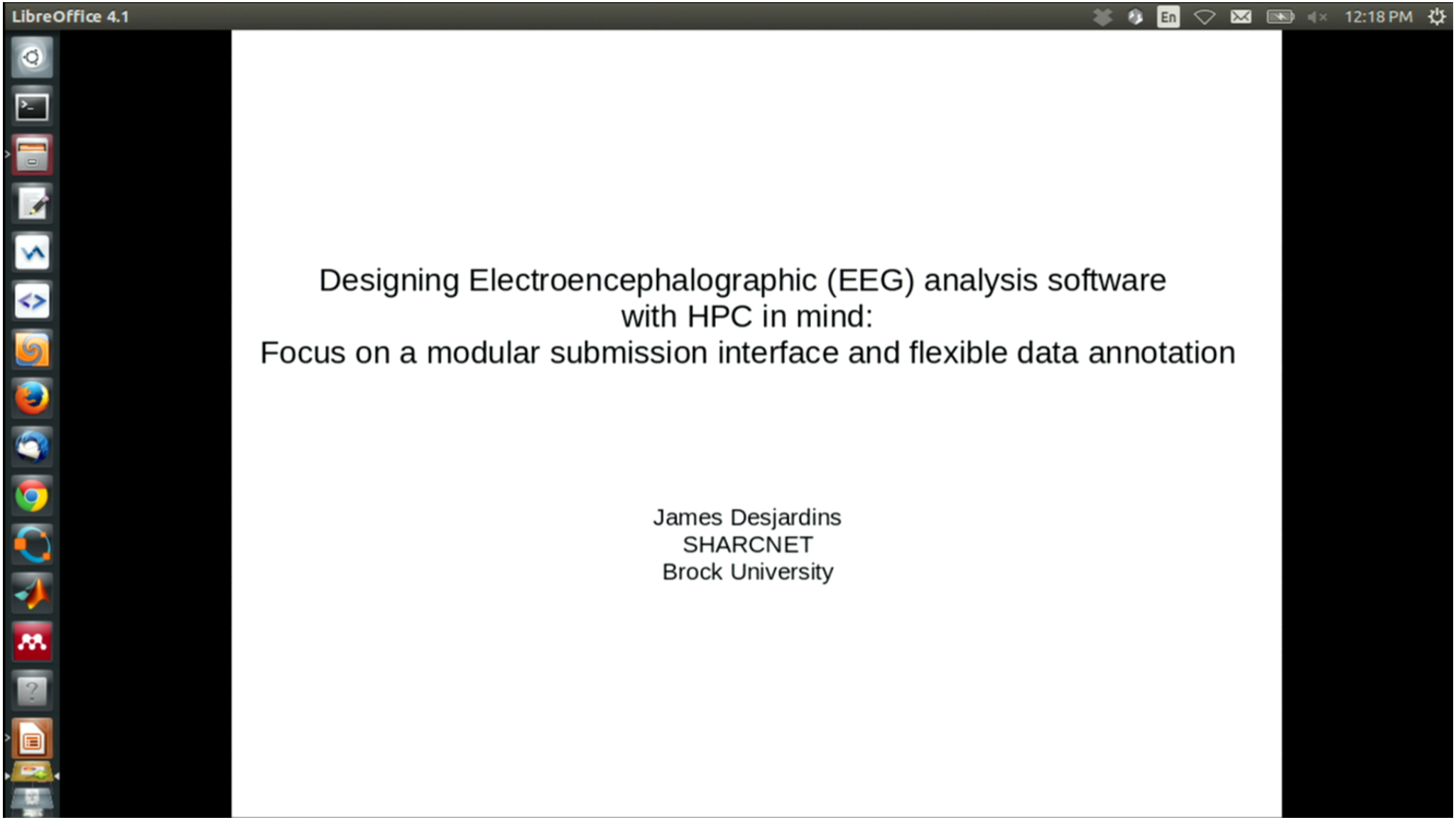
Designing Electroencephalographic (EEG) analysis software
with HPC in mind:
Focus on a modular submission interface and flexible data annotation
James Desjardins
SHARCNET
Brock University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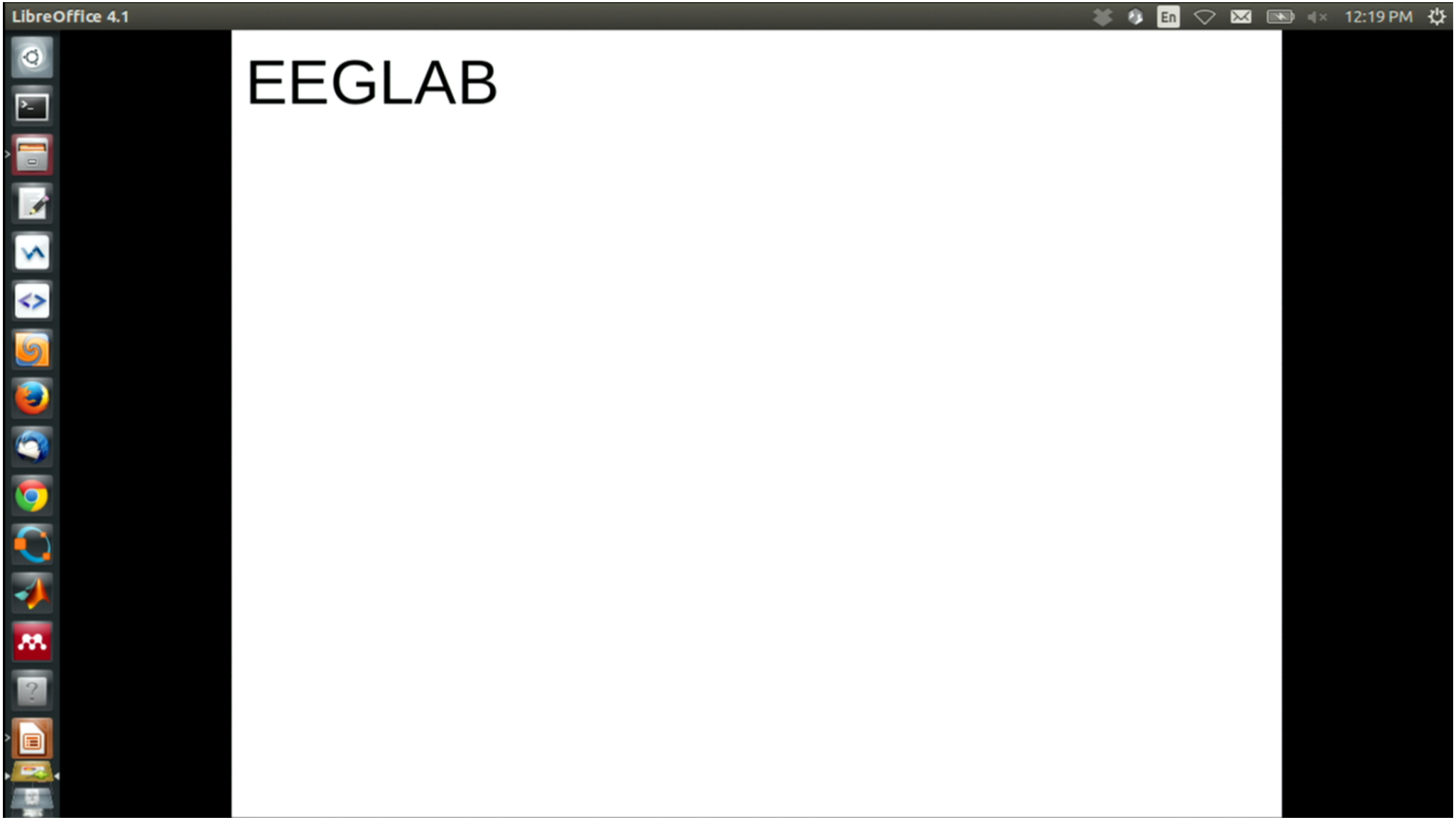
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EEGLAB

EEGLAB

- Delorme, A., & Makeig, S. (2004). EEGLAB: An open source toolbox for analysis of single-trial EEG dynamics including independent component analysis. *Journal of Neuroscience Methods*, 134, 9–21.

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Swartz Center for Computational Neuroscience

Some key features:

- Vast import capability

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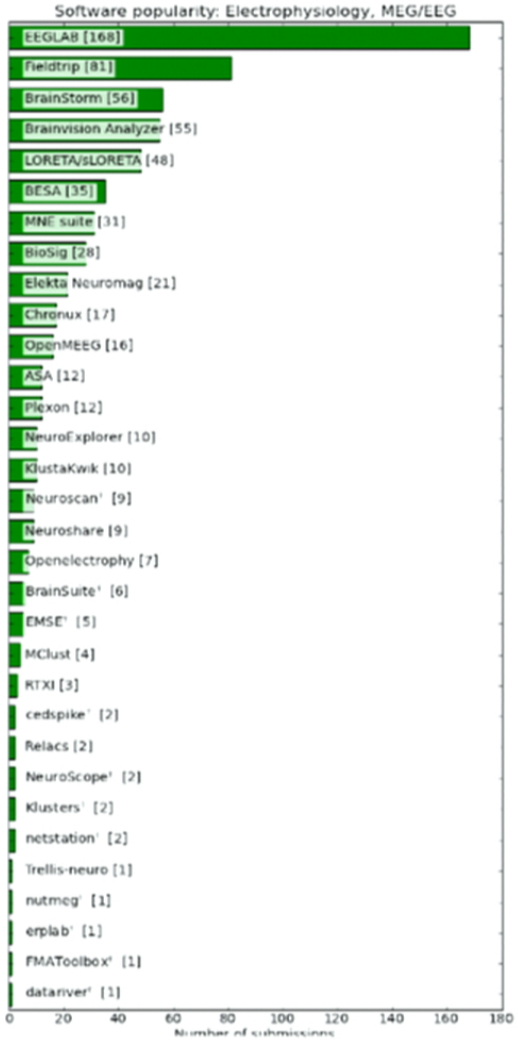

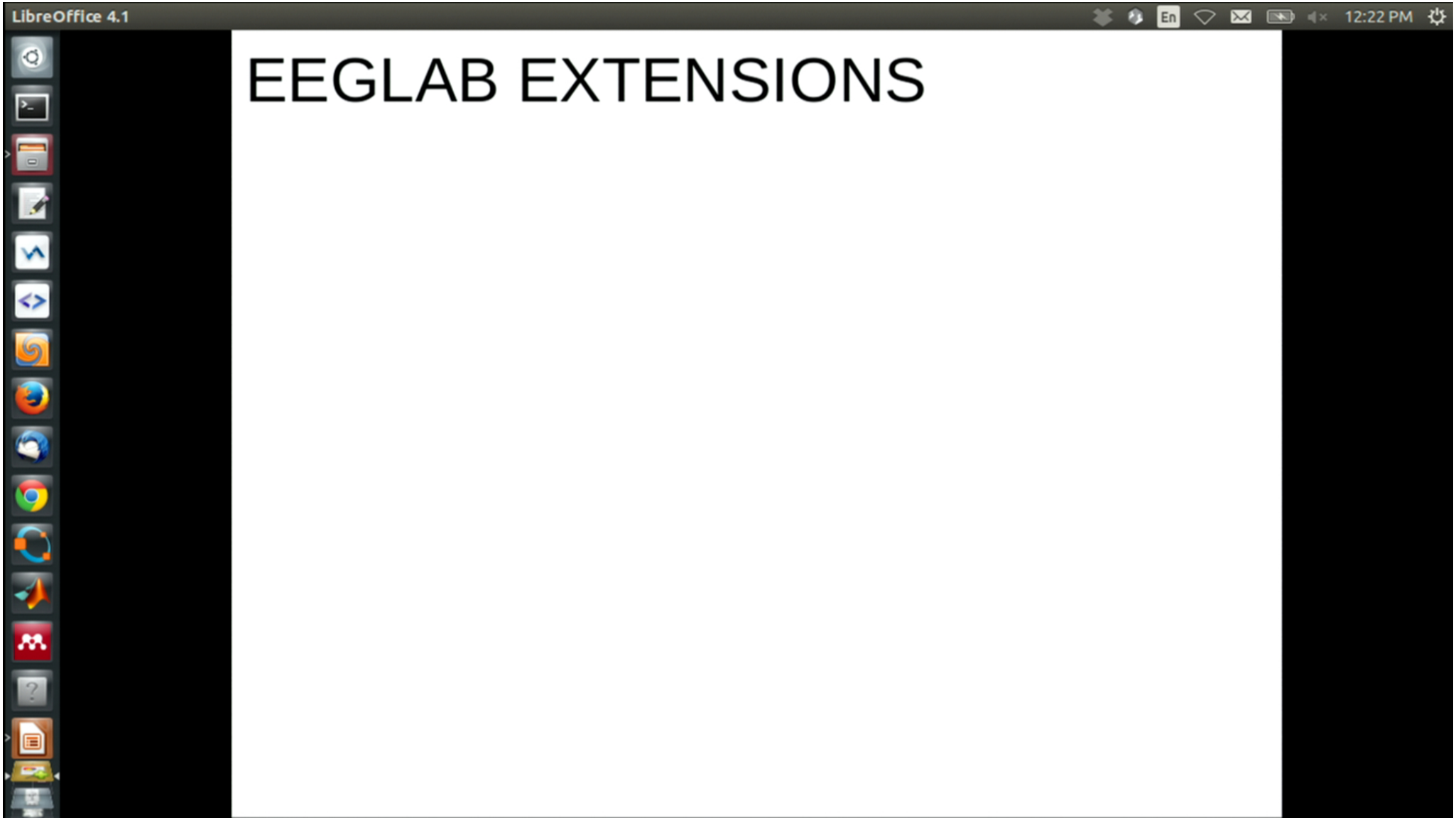
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EEGLAB EXTENSIONS

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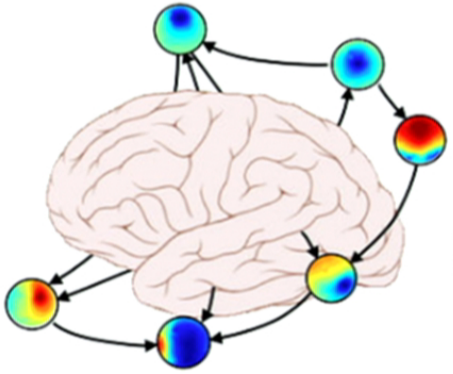
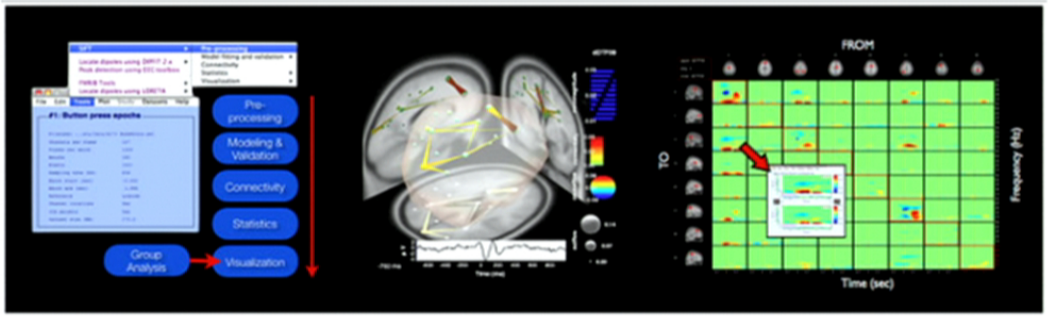


SIFT

Source Information Flow Toolbox

Version 0.1-Alpha



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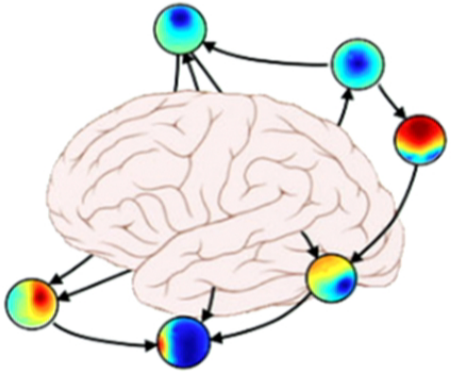

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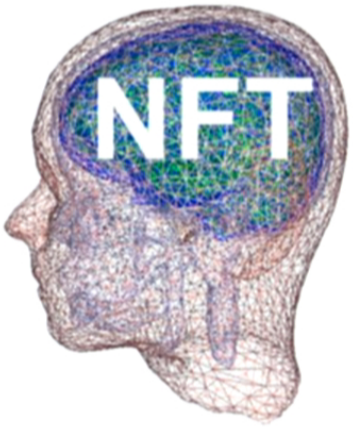

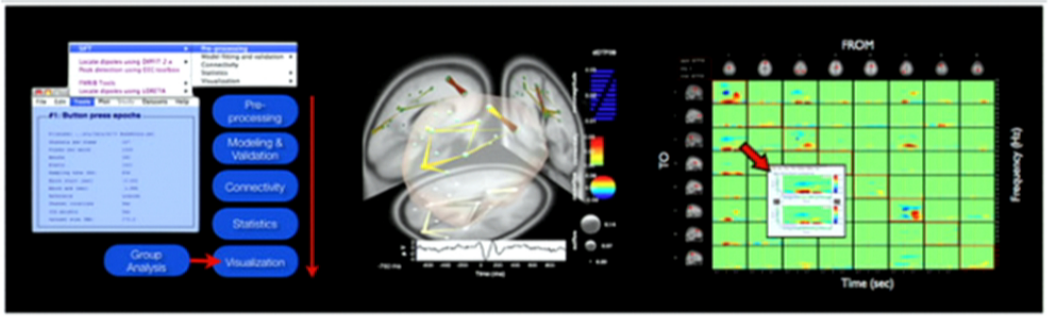

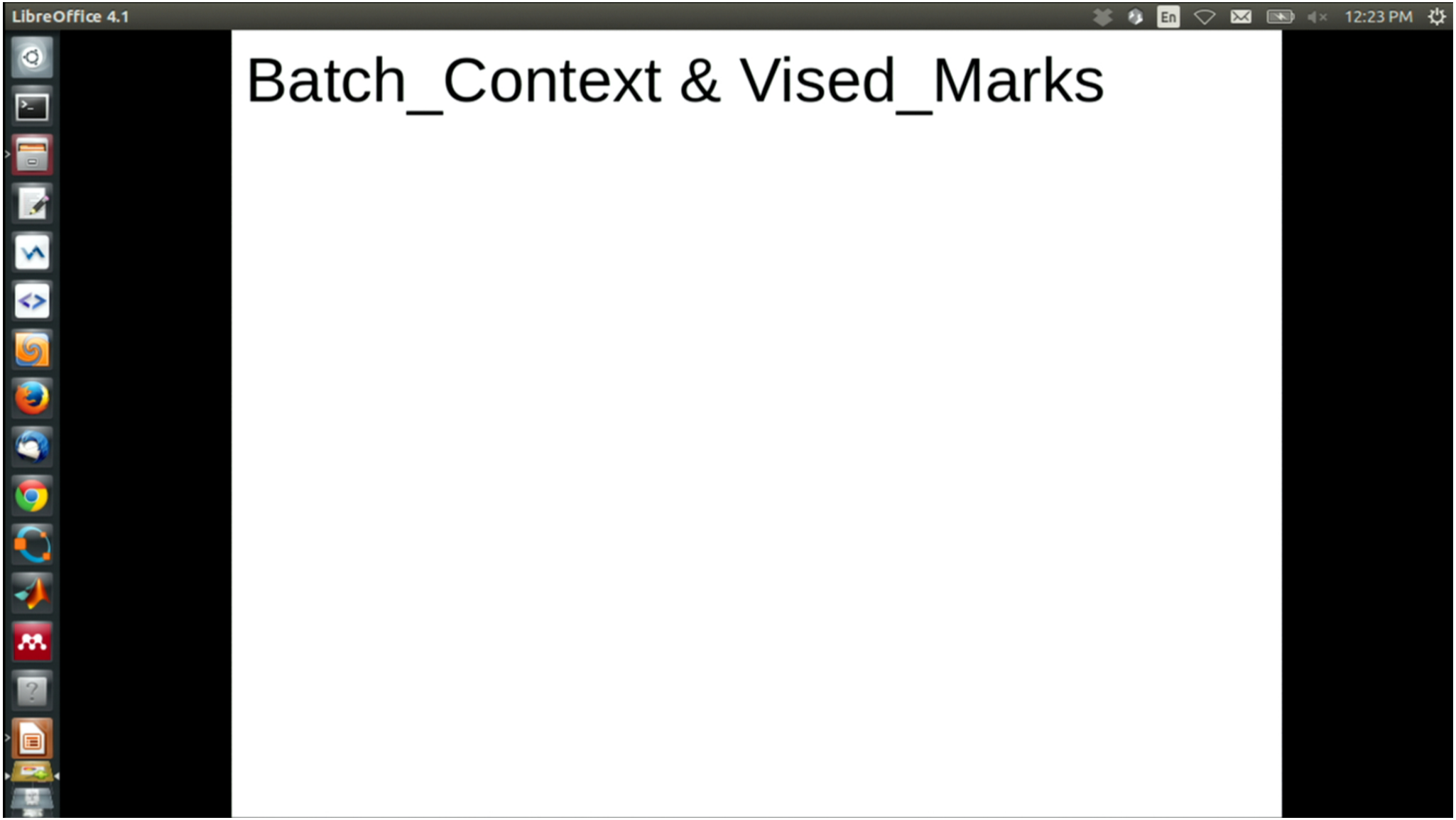
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Batch_Context & Vised_Marks

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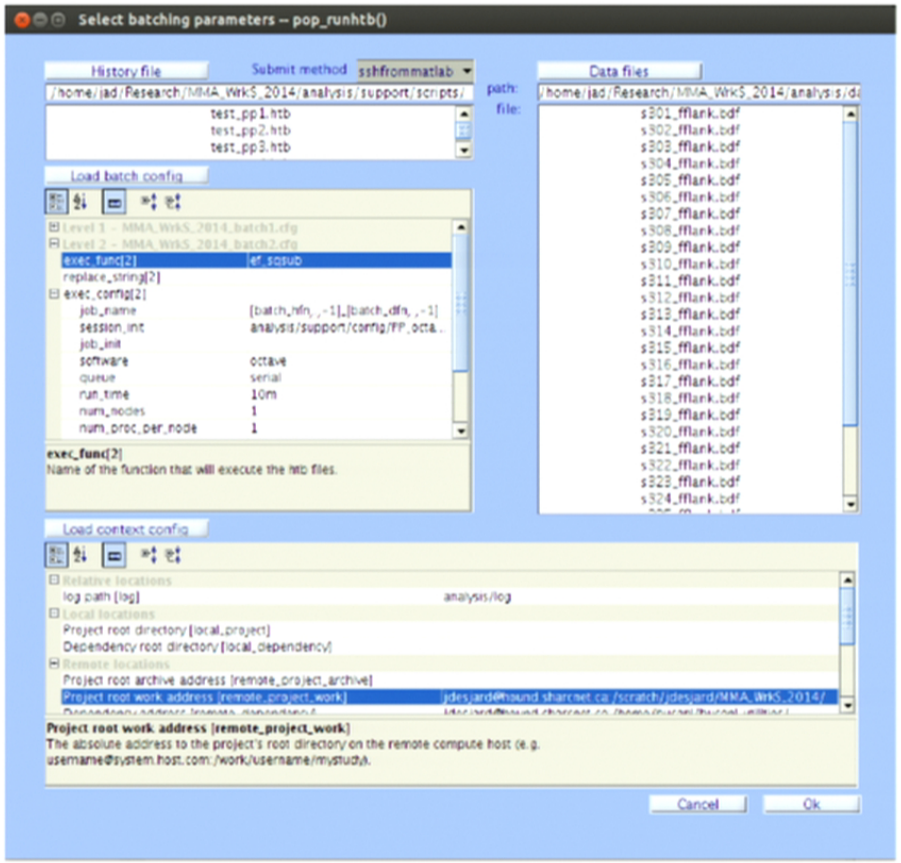

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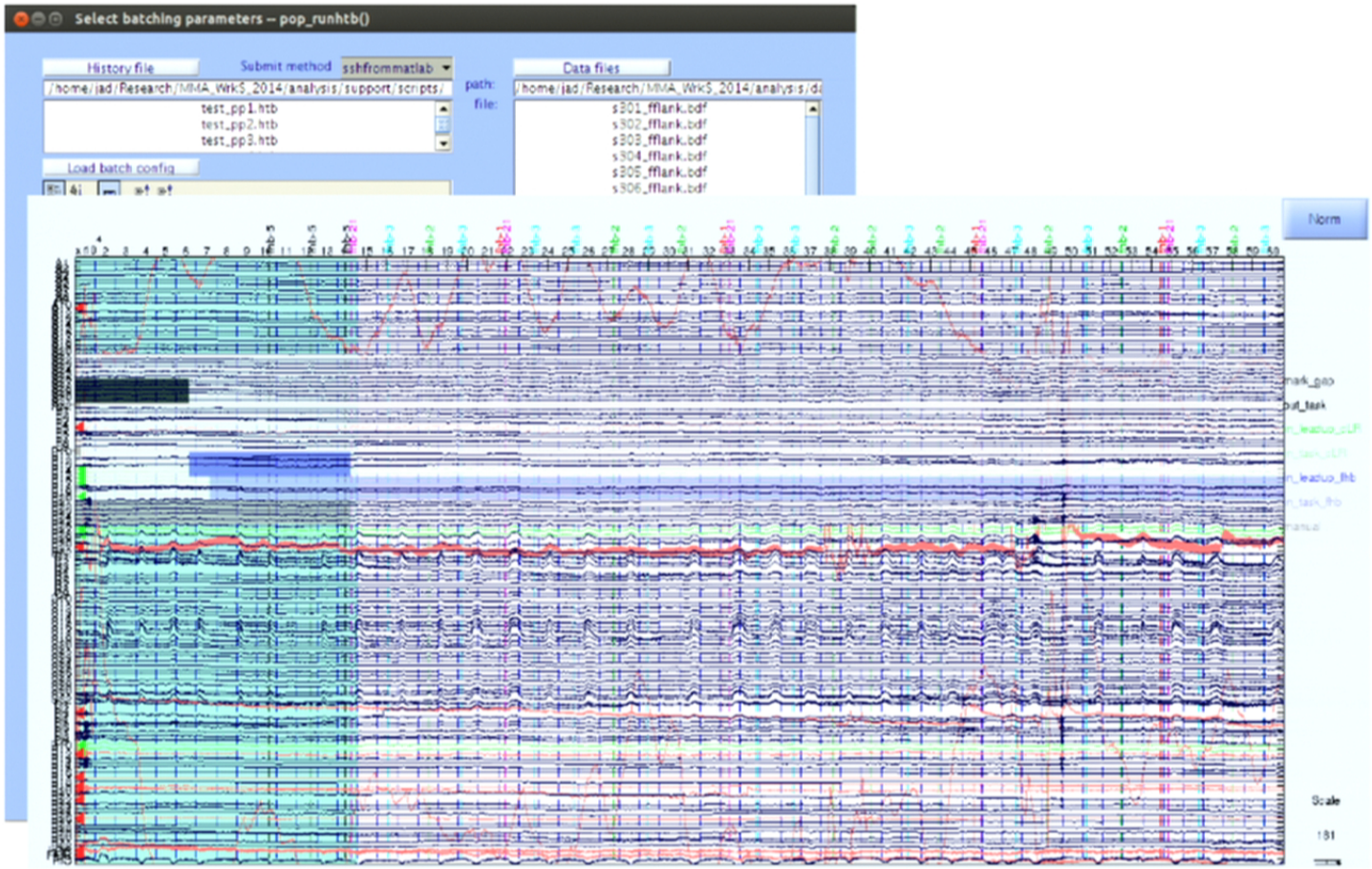

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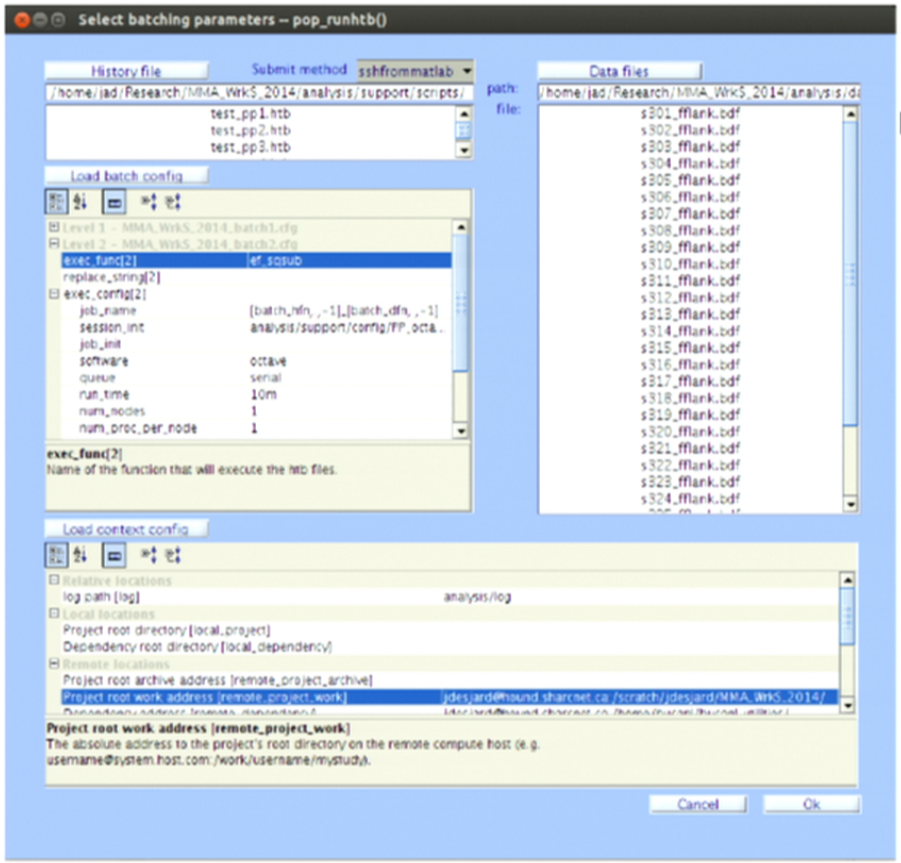

Hierarchy of script execution

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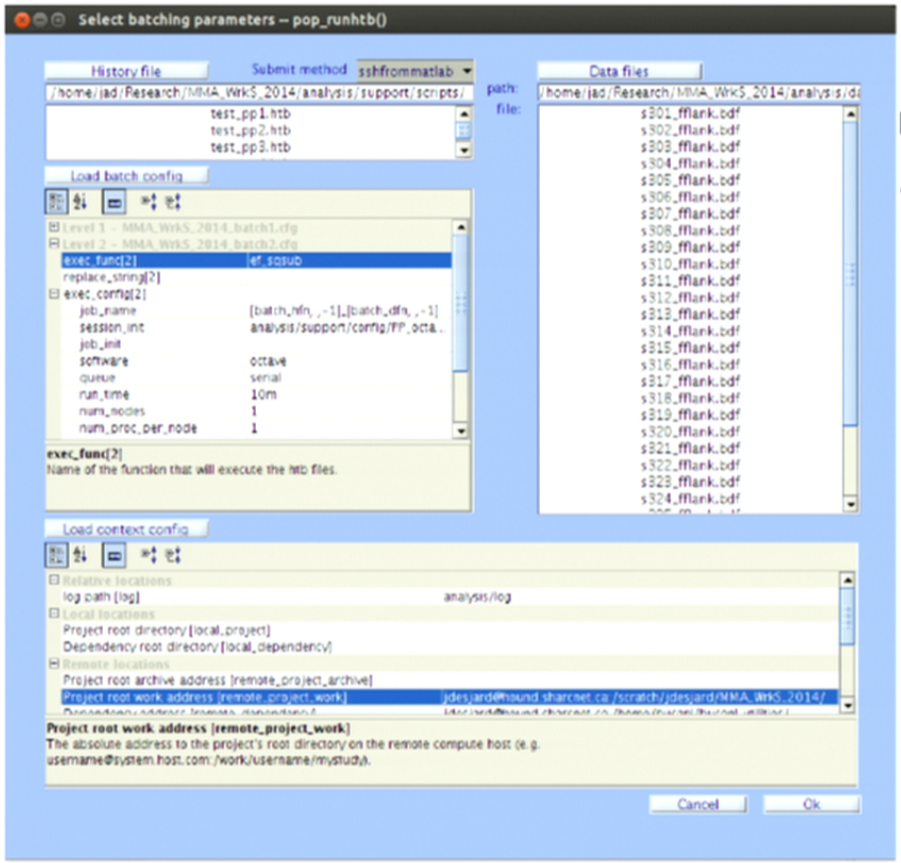

Hierarchy of script execution

- **Scripts** contain functions
(that may be shared across studies)

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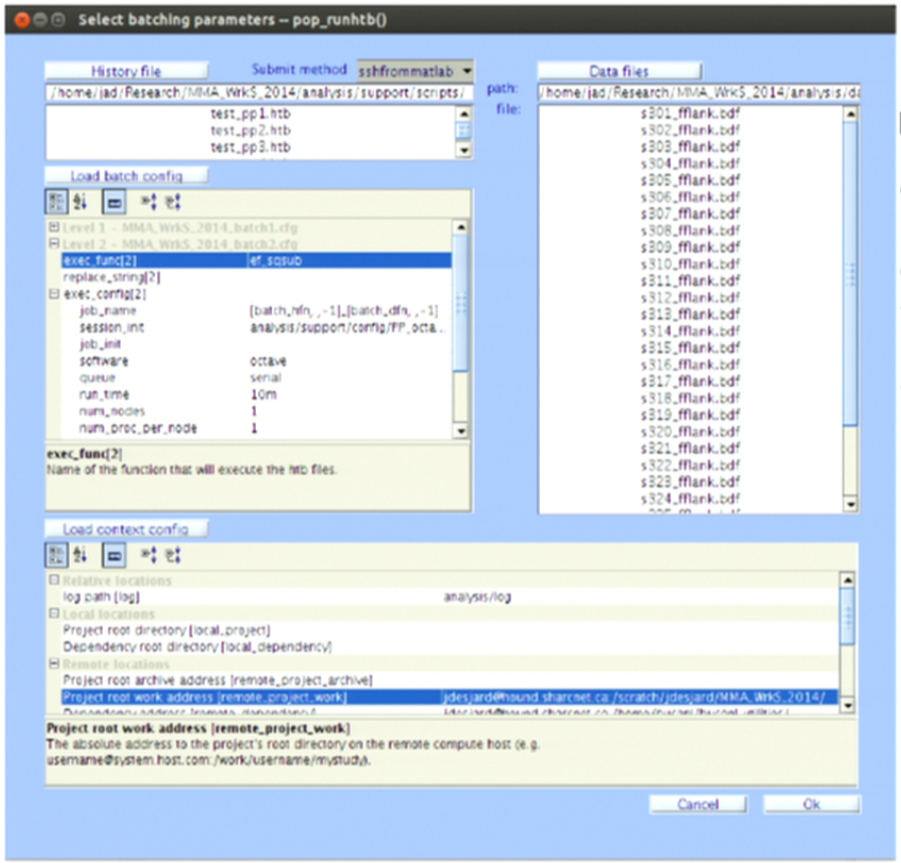
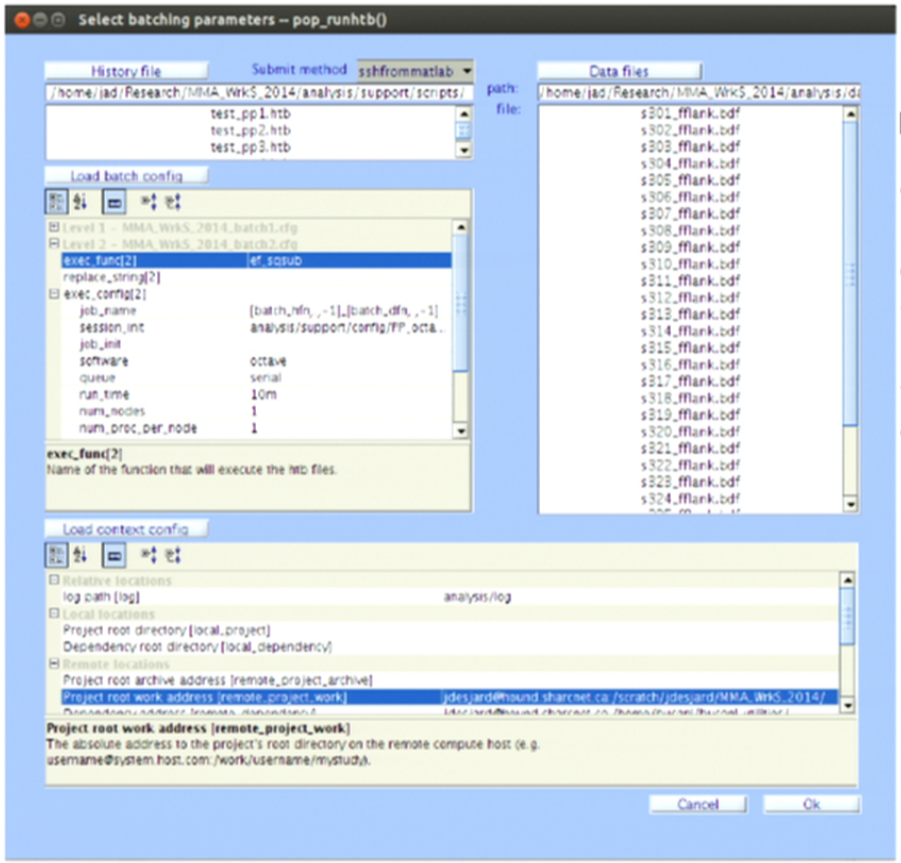


Hierarchy of script execution

- **Scripts** contain functions (that may be shared across studies)
- **Configurations** contain function inputs and execution properties (that may be common to an acquisition format)

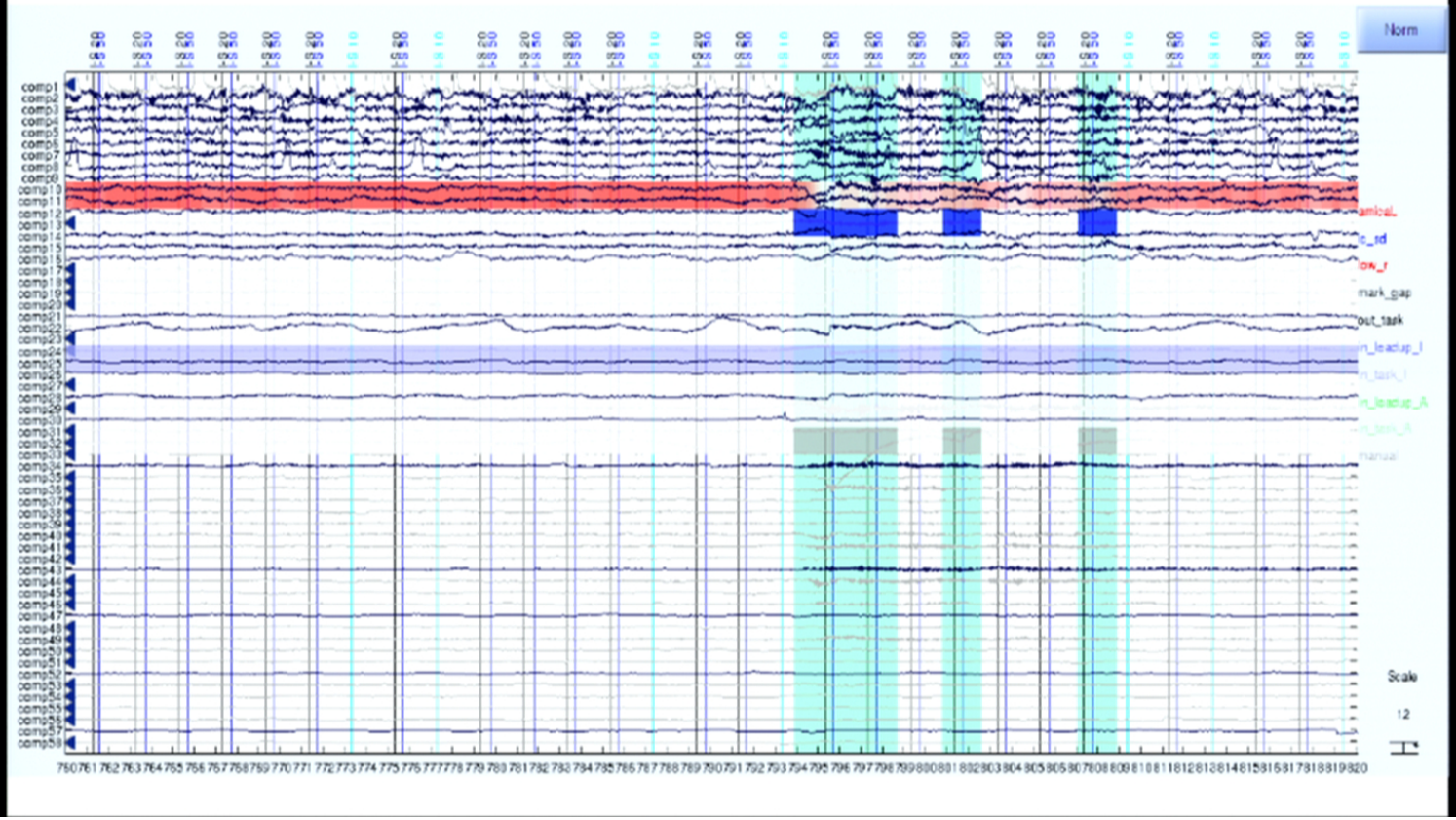
Batch_Context & Vised_Marks



Hierarchy of script execution

- **Scripts** contain functions (that may be shared across studies)
- **Configurations** contain function inputs and execution properties (that may be common to an acquisition format)
- **Contexts** contain addresses and paths (that are study specific)

Batch_Context & Vised_Marks



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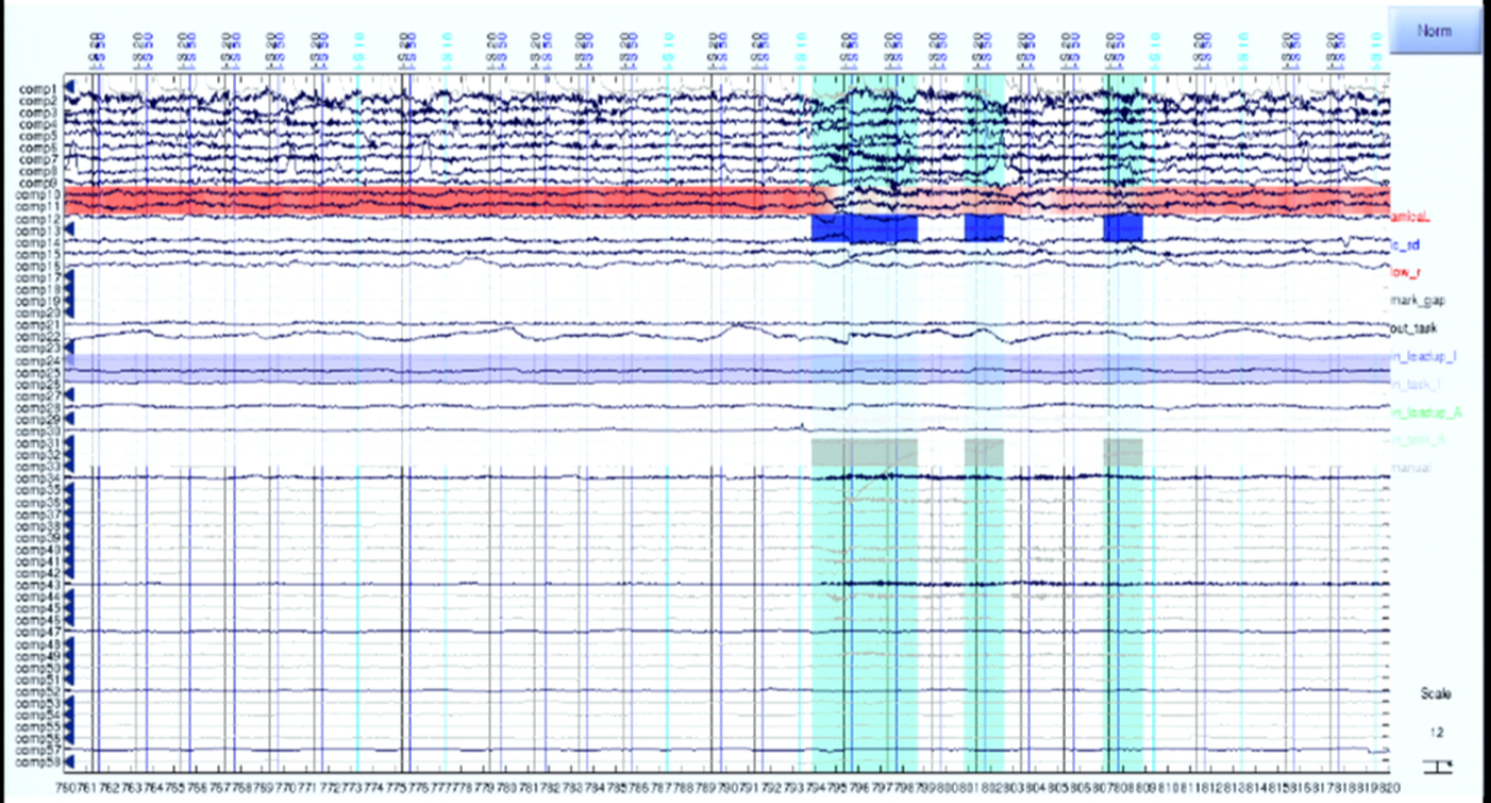
Batch_Context & Vised_Marks

- With a flexible annotation structure extensive unsupervised procedures can be examined after completion, the results of which are permanently logged



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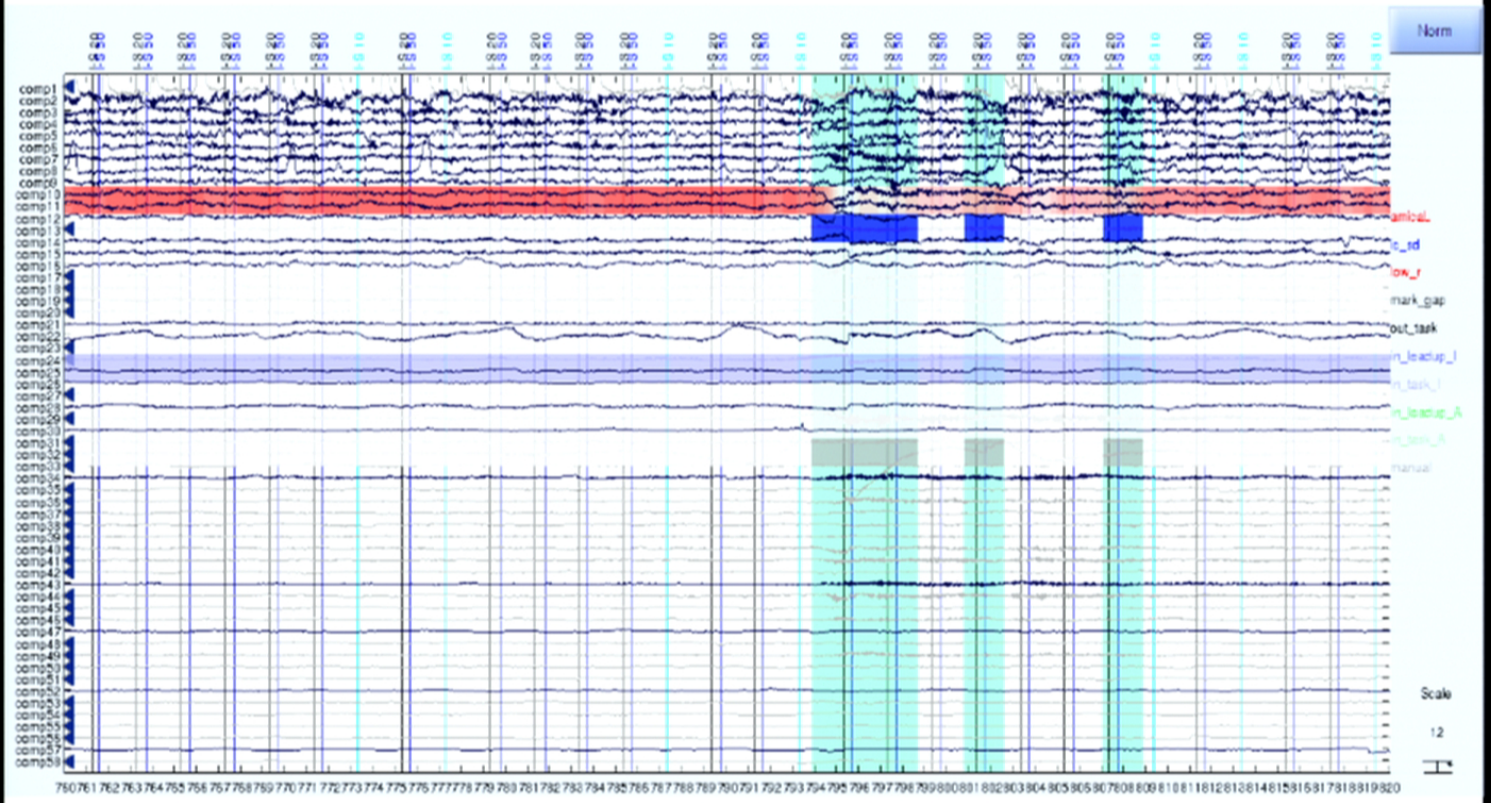
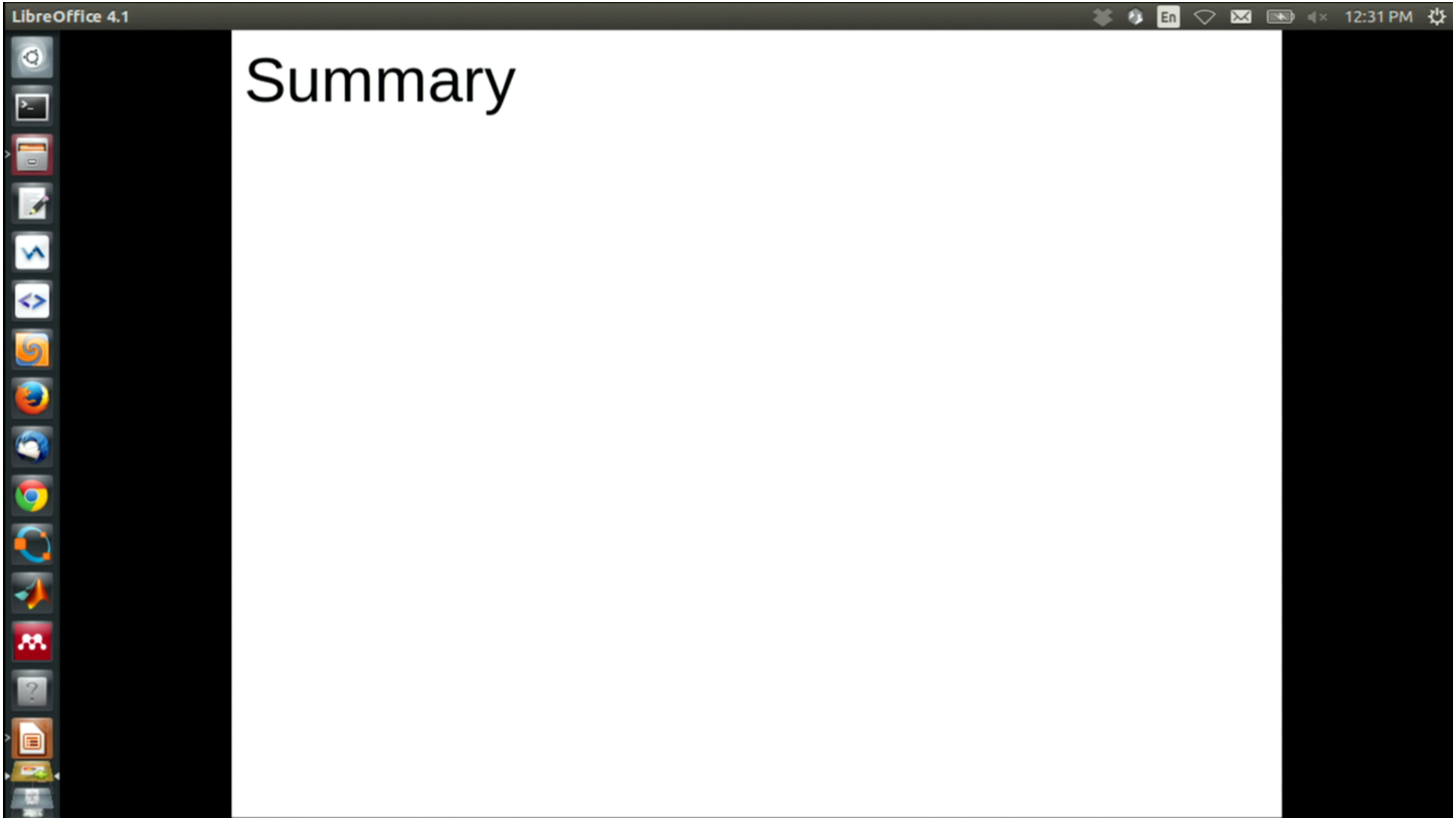
Batch_Context & Vised_Marks

- With a flexible annotation structure extensive unsupervised procedures can be examined after completion, the results of which are permanently logged
- This allows for massive scales of data processing to be execute on compute clusters

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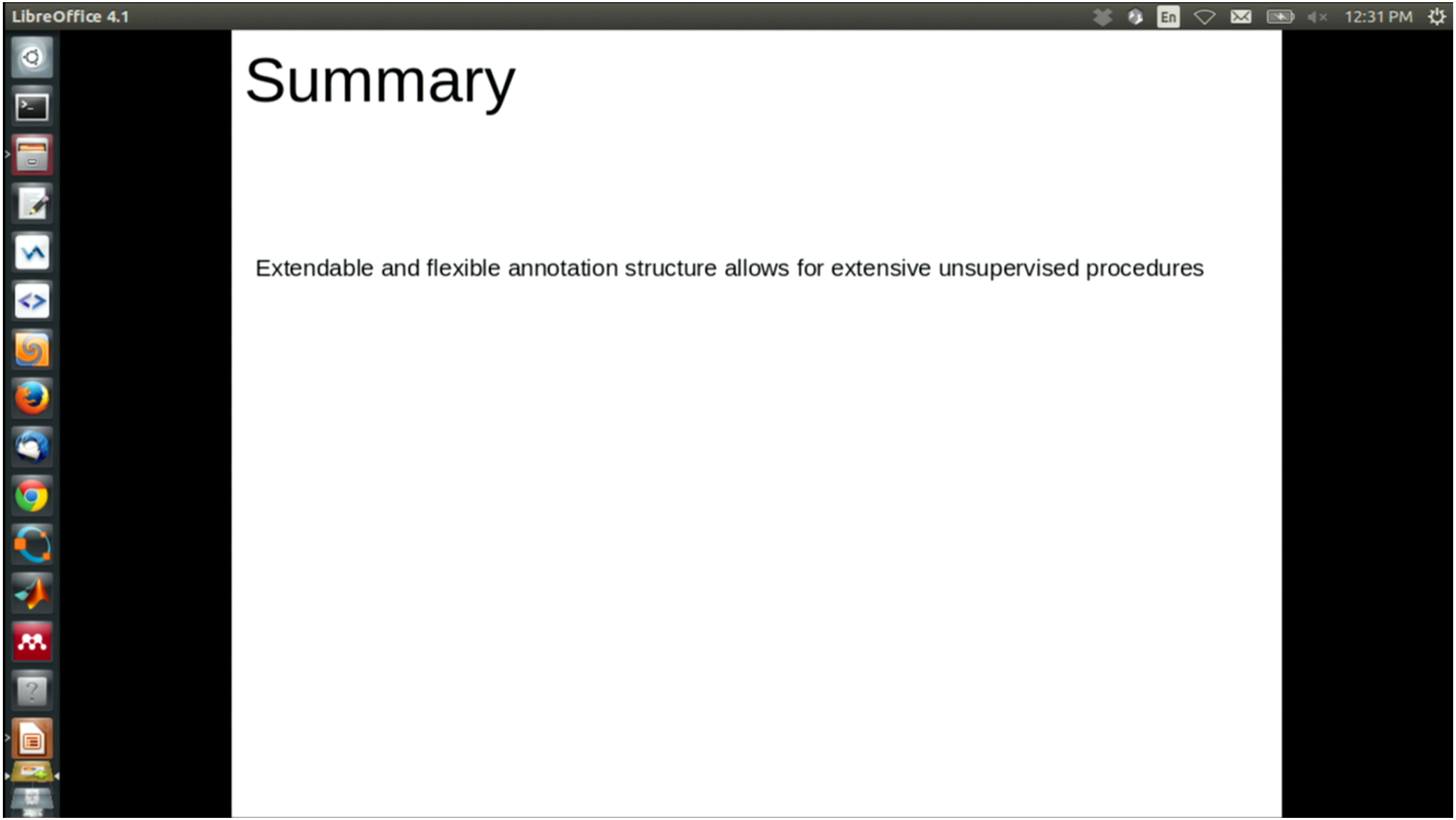
Summary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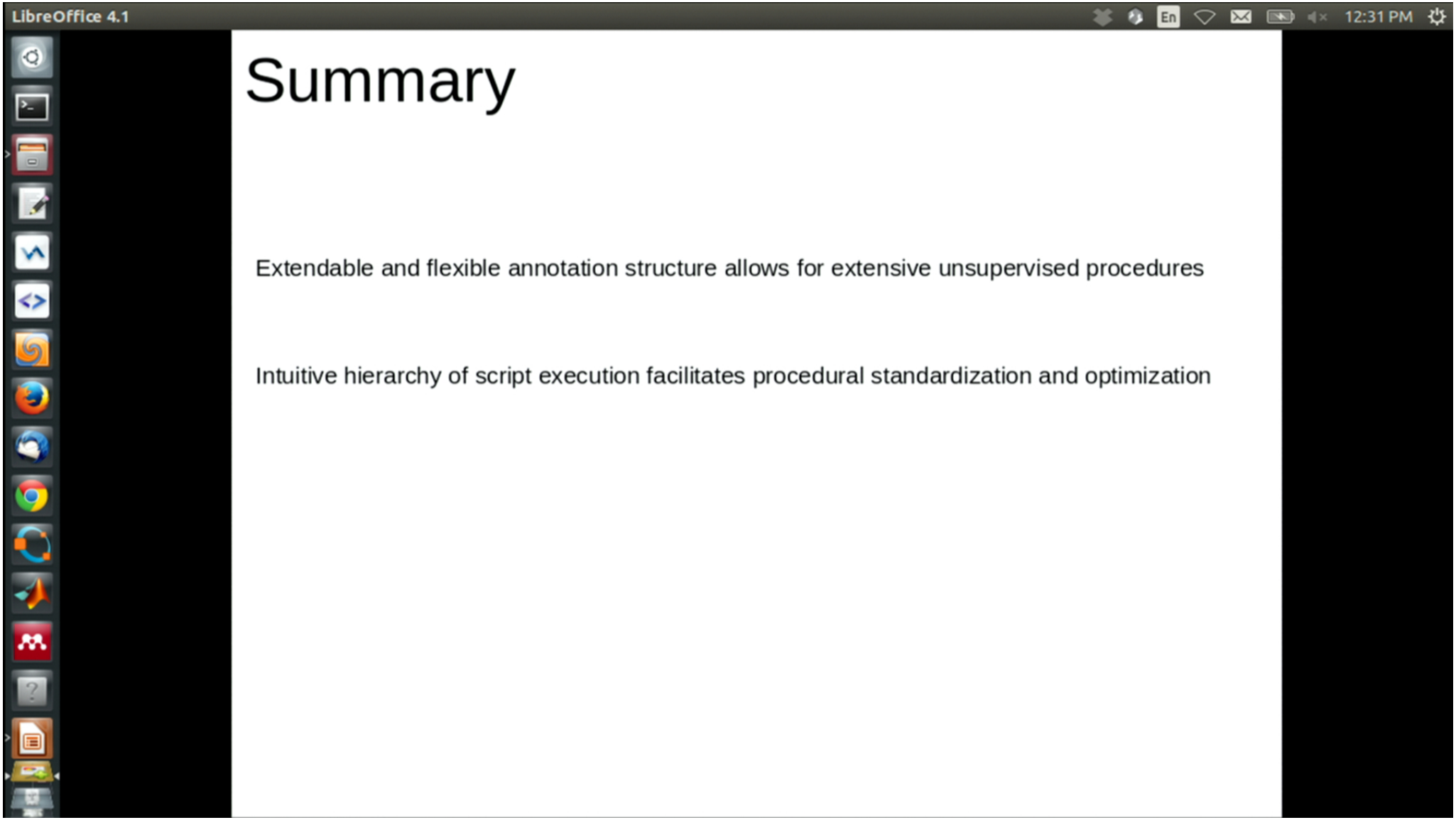
Summary
Extendable and flexible annotation structure allows for extensive unsupervised procedures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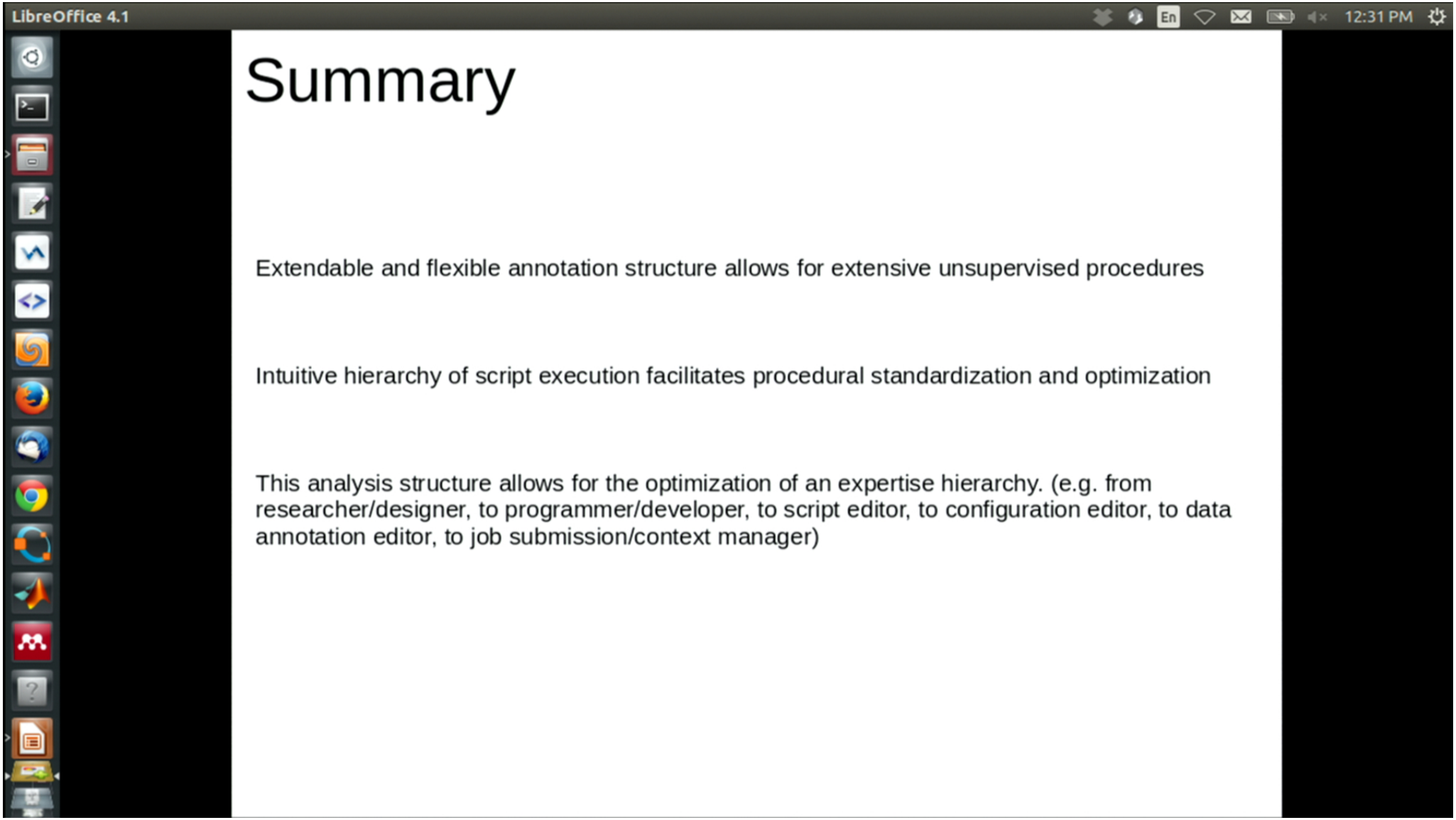
Extendable and flexible annotation structure allows for extensive unsupervised procedures
Intuitive hierarchy of script execution facilitates procedural standardization and optimization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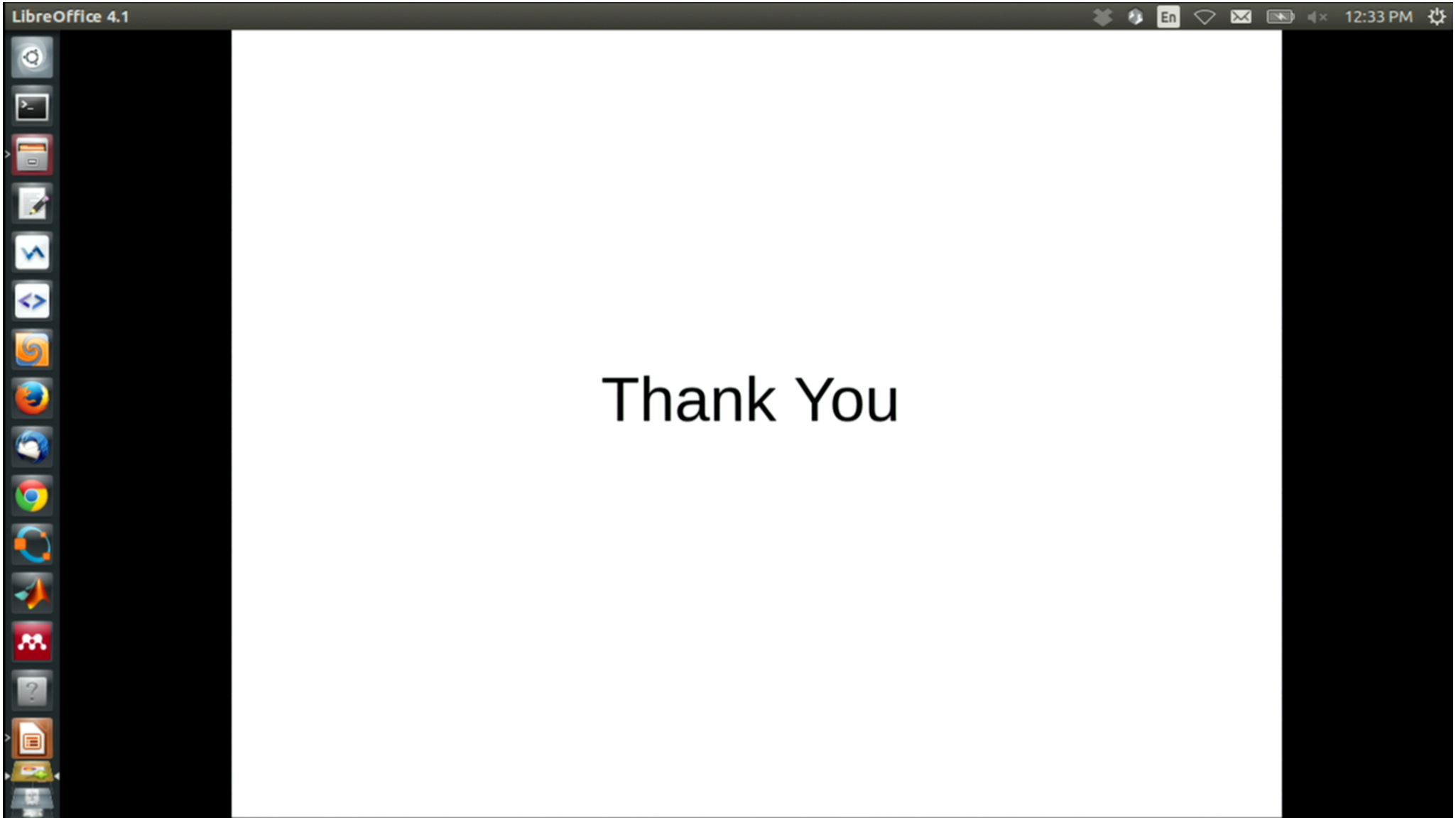
Summary
Extendable and flexible annotation structure allows for extensive unsupervised procedures
Intuitive hierarchy of script execution facilitates procedural standardization and optimization
This analysis structure allows for the optimization of an expertise hierarchy. (e.g. from researcher/designer, to programmer/developer, to script editor, to configuration editor, to data annotation editor, to job submission/context manager)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Thank You