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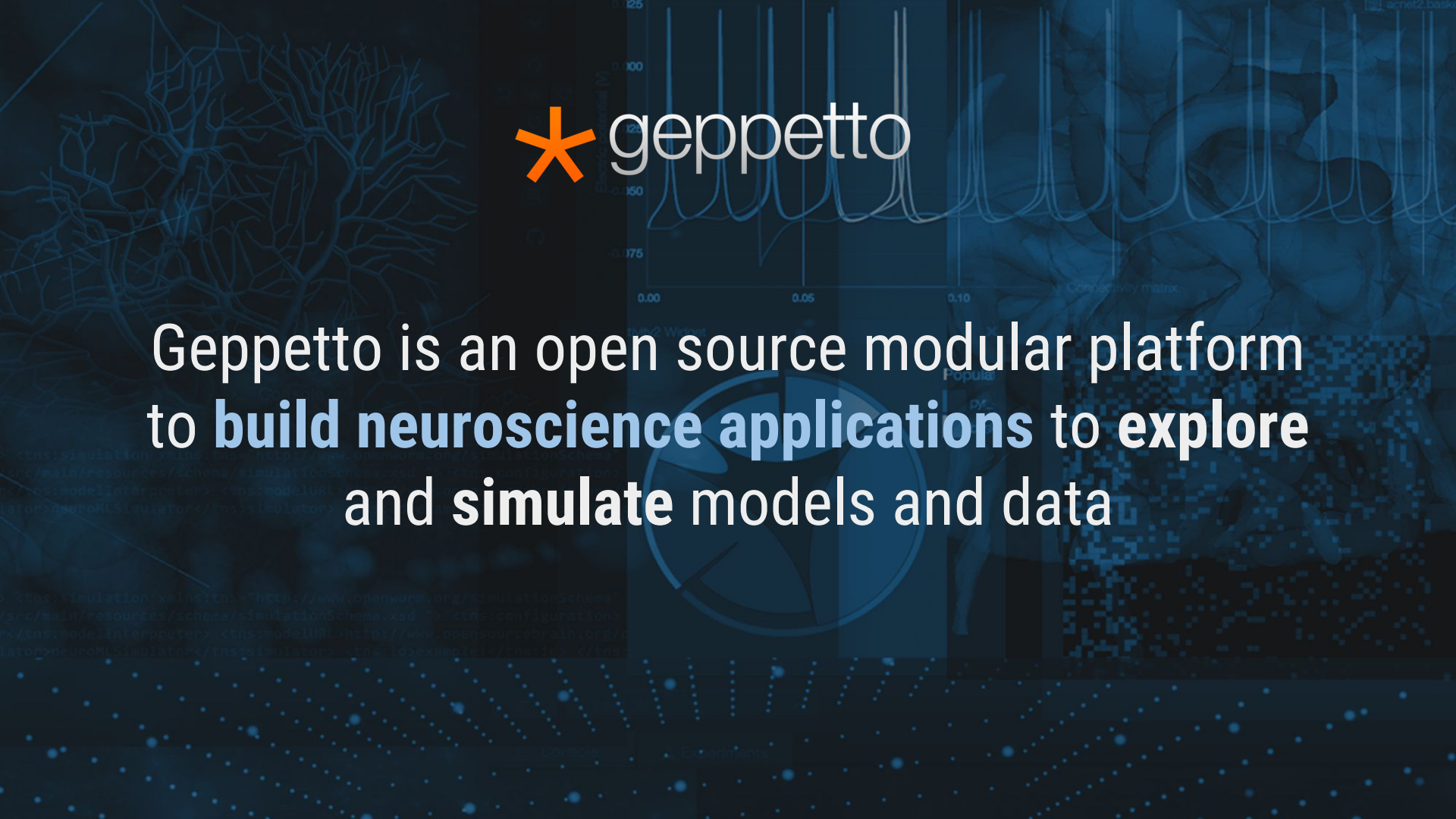
CodeJam #9, Palermo

November 26th 2018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Geppetto is an open source modular platform to **build neuroscience applications** to **explore** and **simulate** models and data

What can Geppetto applications do?

- Visualize **neuroscience data** in the browser
  - Computational Neuroscience Models (NeuroML, NEURON, *)
  - Morphologies (SWC, OBJ, Collada, *)
  - Electrophisiology recordings (NWB, HDF5, *)
  - Medical data (MRI, Electromicroscopy via DICOM, NIFTI, DZI, *)

- **Run simulations** from the browser
  - Connect to an external simulator
  - Create your computational experiments, record model variables via the UI
  - Set model parameters
  - Simulate on remote clusters (e.g. San Diego Neuroscience Gateway)

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What else can Geppetto applications do?

- Connect your application directly to a Python Kernel
  - Use the Geppetto Jupyter Backend to create an application that talks directly to the Python Kernel. Call Python methods and evaluate Python instructions from Javascript.
- Synchronize the user interface with your Python models
  - Edit your models from the user interface or programmaticaly via an embedded Jupyter Notebook
- Connect to external data sources to provide data and models (e.g. Neo4j, AberOWL, *)
- Simplify the **exploration** of data and models
  - Every model loaded in Geppetto is indexed and easily searchable.
- Facilitates **reproducibility** of workflows
  - The entire user interface works on top of an API layer. Every user action corresponds to an API command easy to inspect and reproduce.

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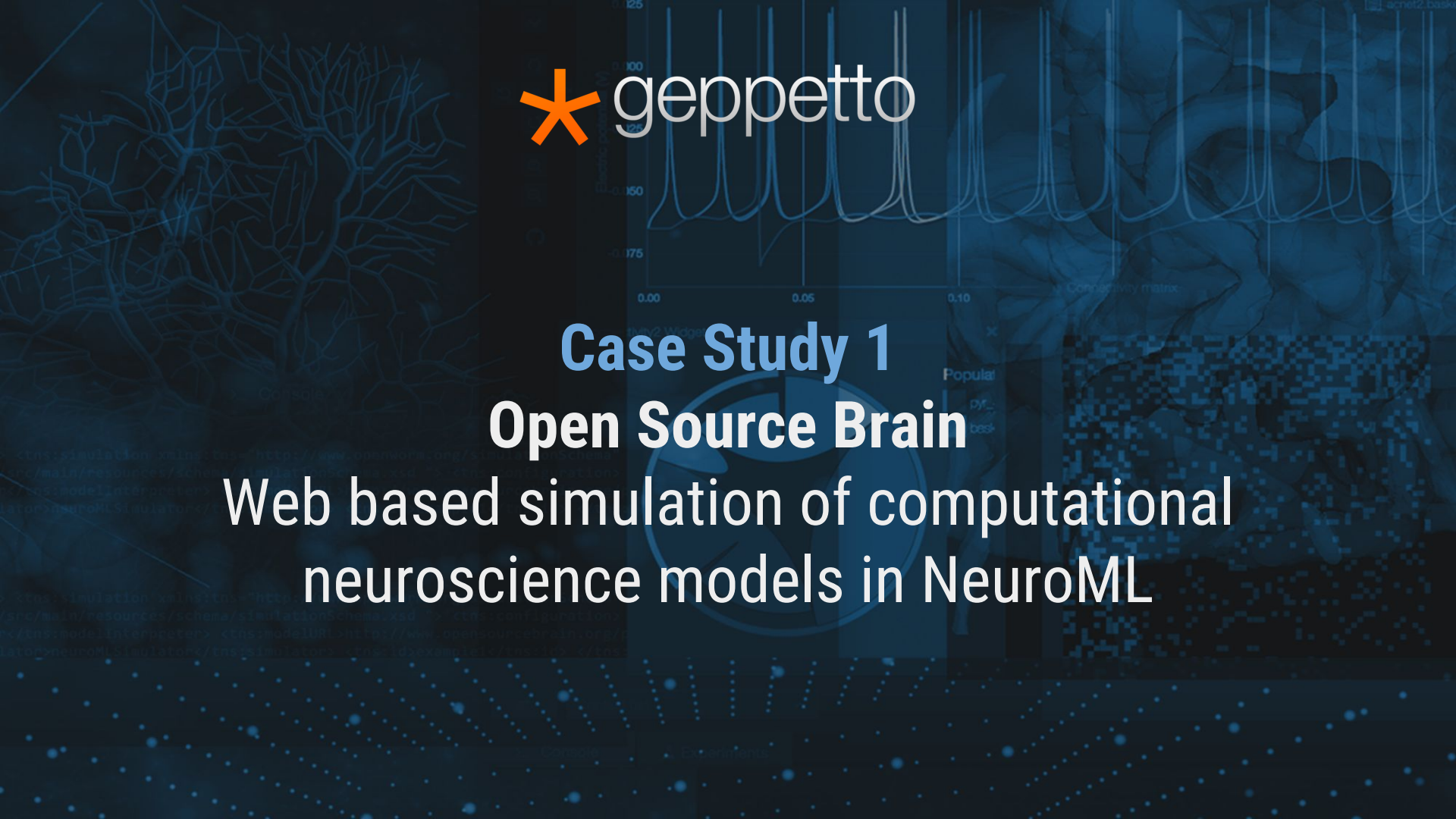

Case Study 1

Open Source Brain

Web based simulation of computational neuroscience models in NeuroML

OPEN SOURCE BRAIN

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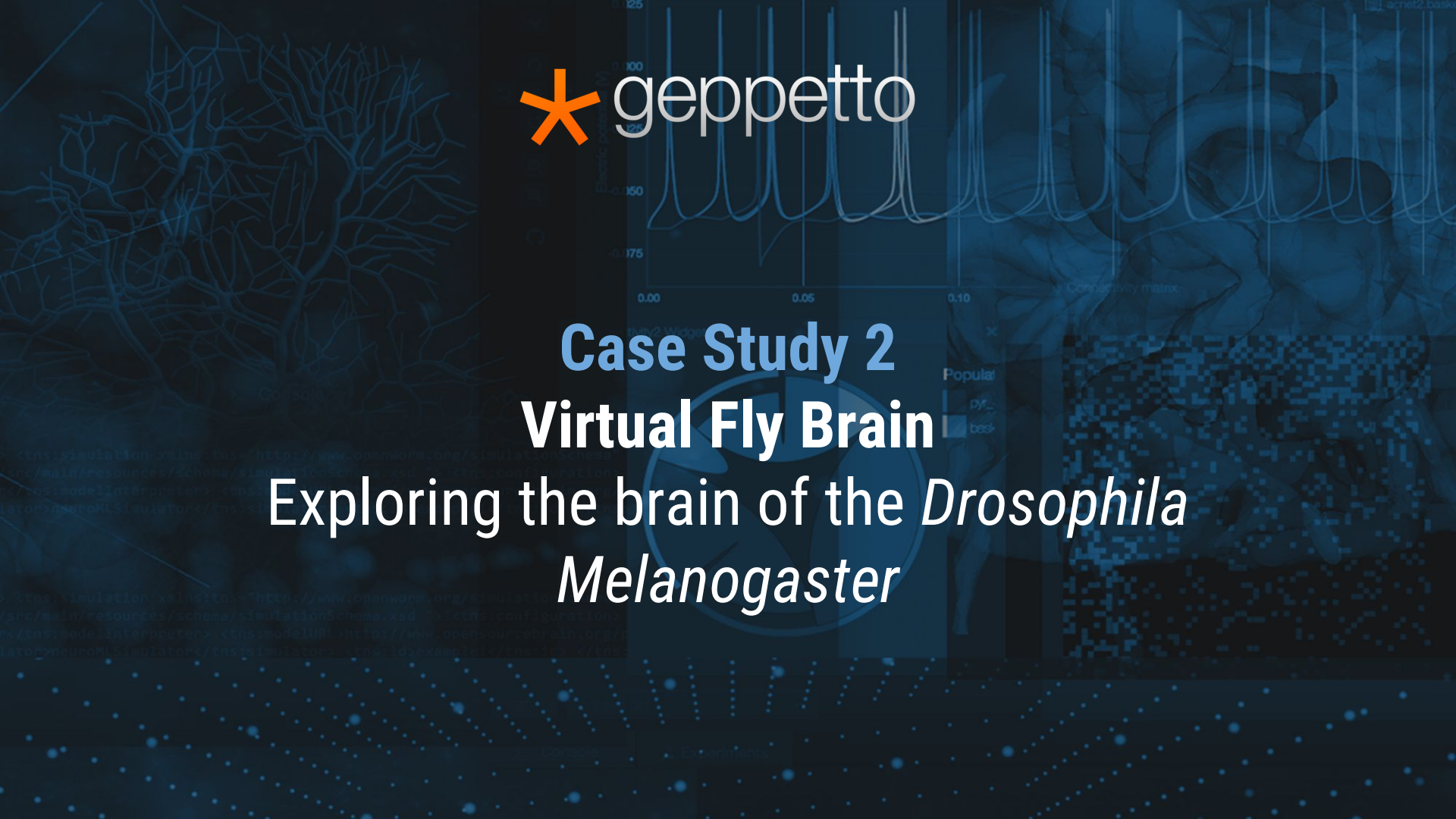
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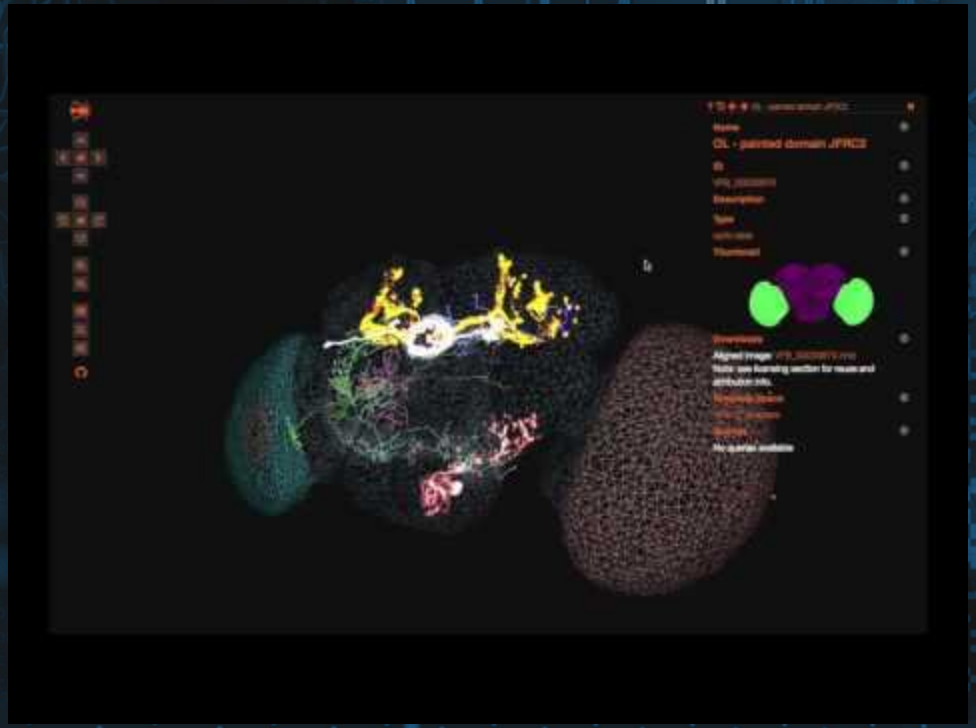
Case Study 2
Virtual Fly Brain
Exploring the brain of the *Drosophila Melanogaster*

VIRTUAL FLY BRAIN



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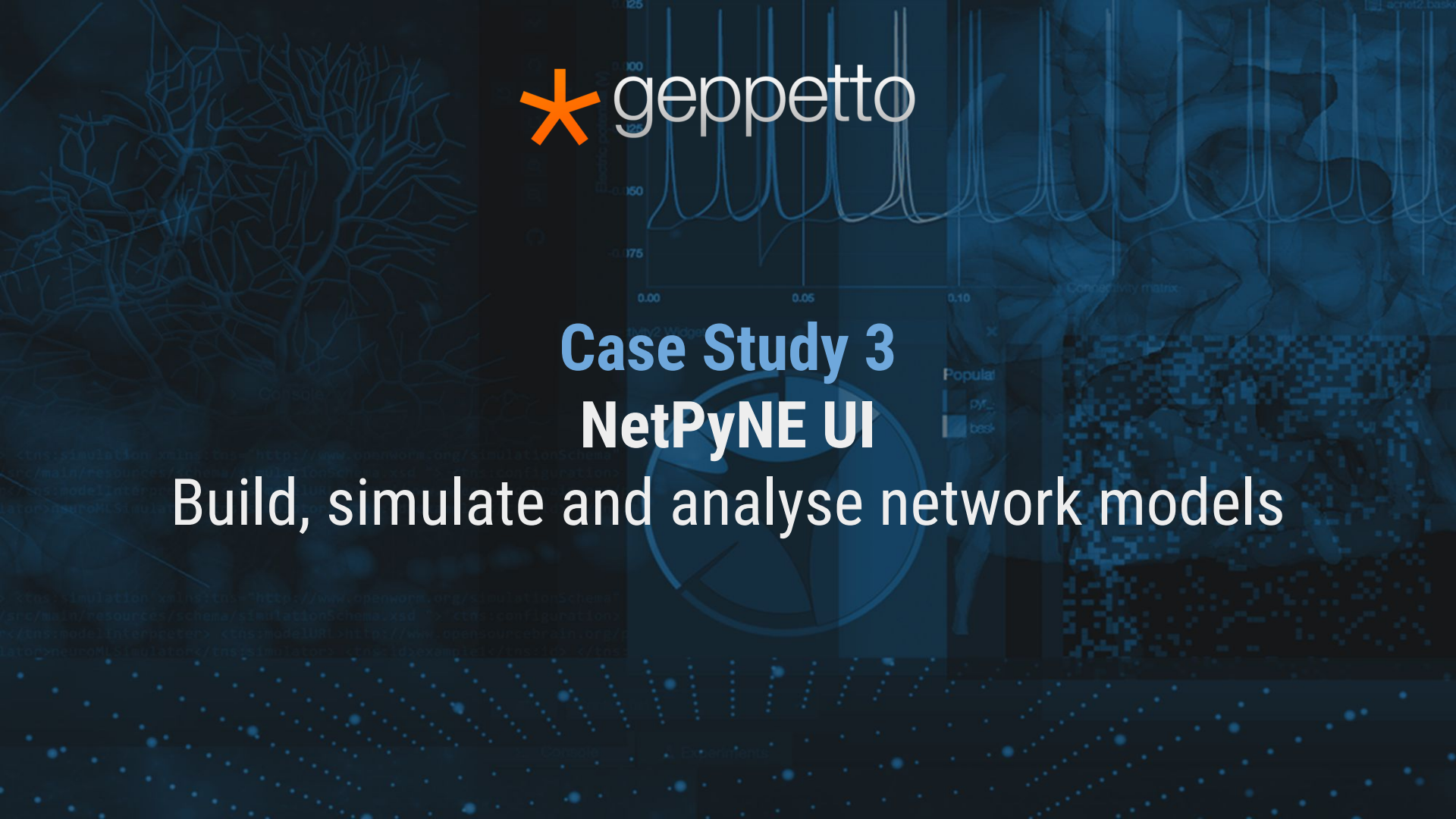
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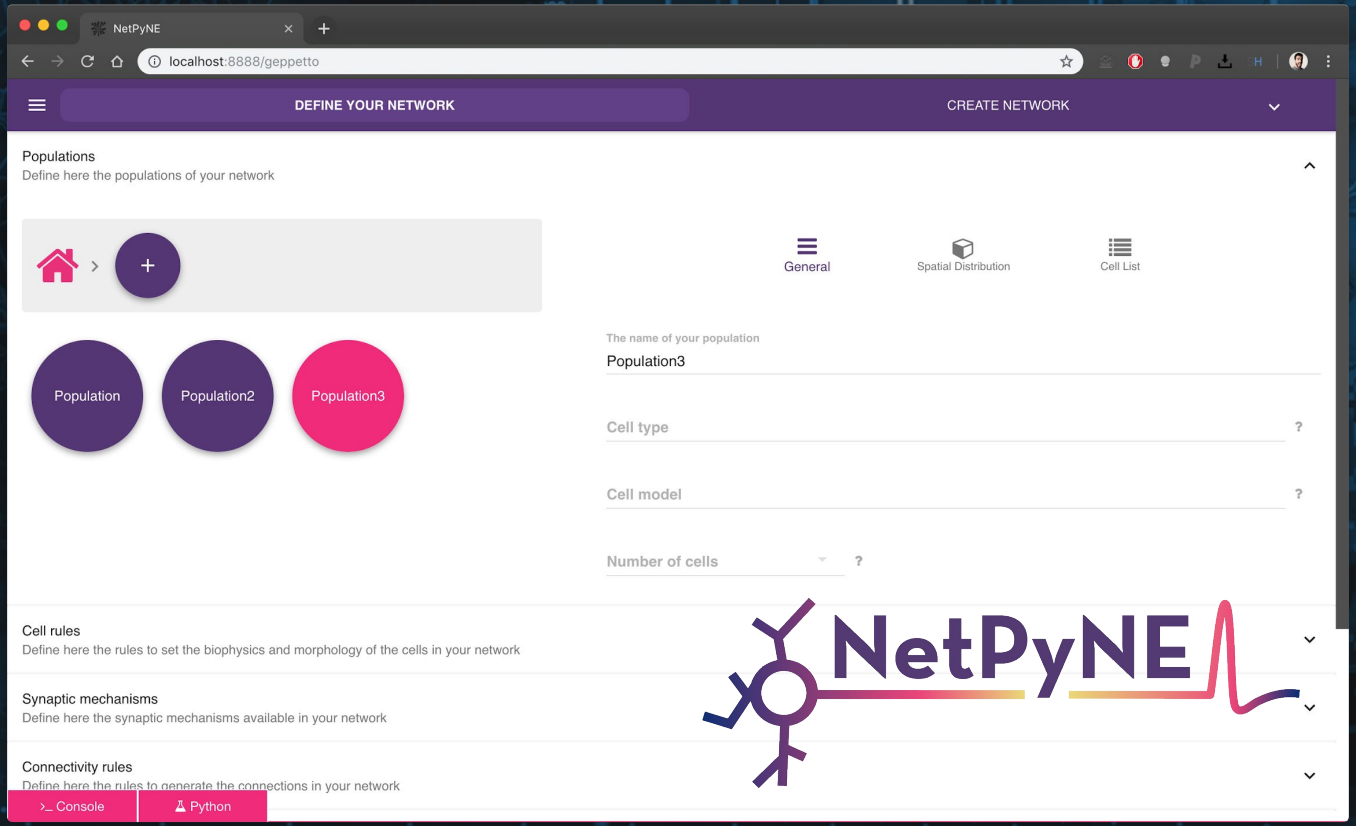
Case Study 3
NetPyNE UI
Build, simulate and analyse network models



NetPyNE

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Geppetto Architecture

- Data/Model agnostic web-based architecture to efficiently lazy load data and stream it in a compressed fashion
- Defines an internal **abstraction** to represent hierarchical models and data
- **Modular backend** to extend supported models, simulators and data source
- Generic and extensible **widgets** framework to expand frontend visualization capabilities

  [3D CANVAS, PLOT, CONNECTIVITY, STACK VIEWER, MRI VIEWER, BIG IMAGE VIEWER, AUDIO/MOVIE PLAYER, ...]
- Generic and extensible **components** framework to augment user interface

  [SEARCH, CONTROL PANEL, SIMULATION CONTROLS, EXPERIMENTS CONTROLS, DASHBOARD, BASIC UI CONTROLS, ...]

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Is Geppetto a platform or an application?

- **Geppetto is an open-source platform to build neuroscience applications**
- Every Geppetto application can be hosted privately or publicly
- Every Geppetto application can be fully customised
  - **Decide what your interface will look like**
  - Decide what data, models and simulator you want to use
  - Choose only the components and widgets you need

Whether you only need to visualize some surface models or create a system that enables visualization and simulation of integrated data and models Geppetto will save you between two and five years of development.

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How to get started?

- Read the paper! http://**paper**.geppetto.org
- **Pick your backend**
  - Java
  - Python Django
  - Jupyter Notebook
- **Build your frontend extension**
  - This is your blank canvas, here you define your **custom user interface and custom workflows**
- Reuse any of the pre-existing 20+ UI components
  - E.g. 3D Viewer, Connectivity Analysis, Plotting widget, MRI Viewer, etc.
- Reuse any of the pre-existing backend modules
  - E.g. NeuroML, NEURON, SWC support, etc.

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Open Source, MIT Licensed

20+ Contributors

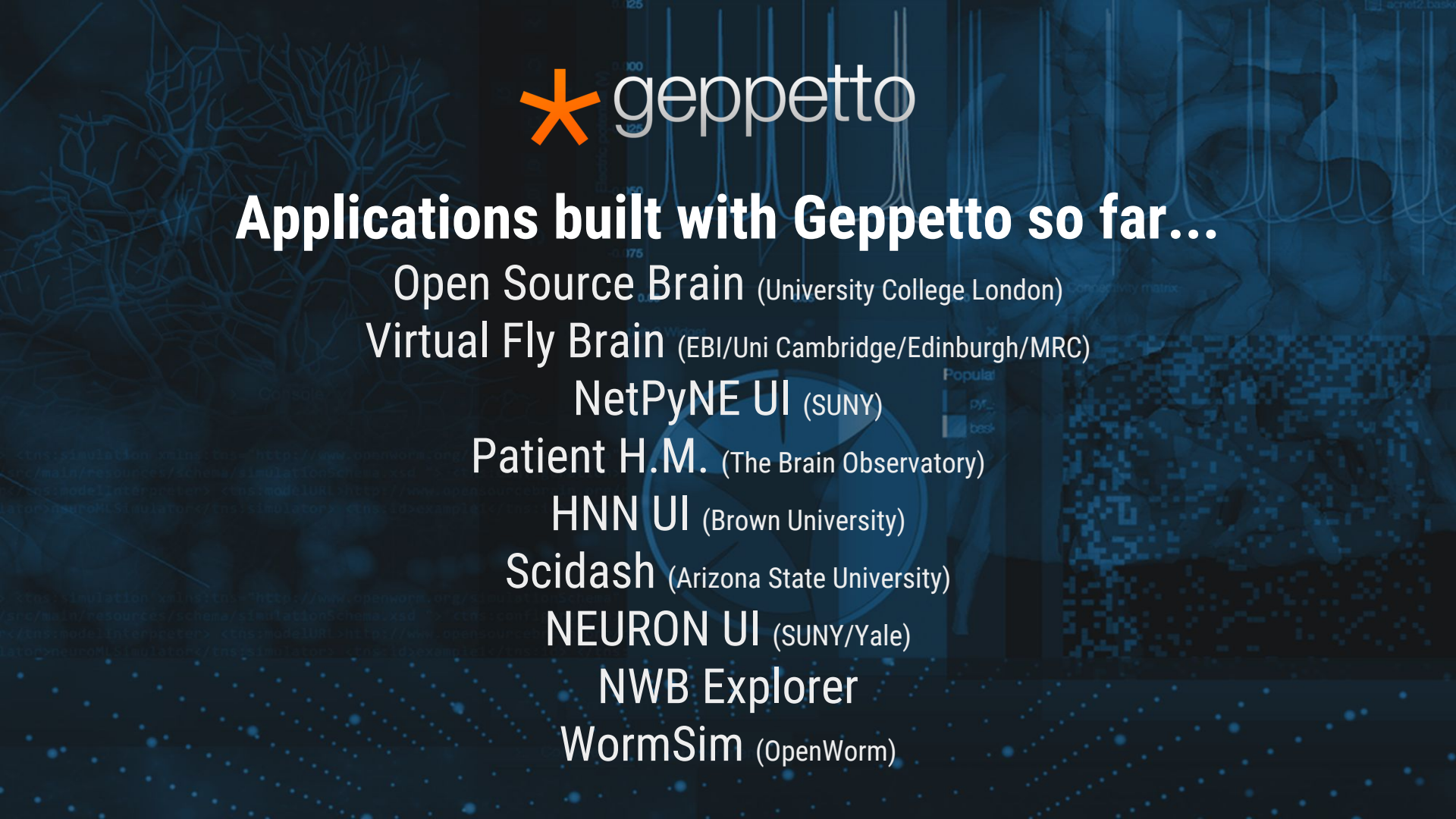
30 repositories

42 releases

6+ years of development

Automated Travis+Docker+Casper based testing

http://www.geppetto.org | paper.geppeto.org | docs.geppetto.org | live.geppetto.org | git.geppetto.org | board.geppetto.org | blog.geppetto.org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Applications built with Geppetto so far...
Open Source Brain (University College London)
Virtual Fly Brain (EBI/Uni Cambridge/Edinburgh/MRC)
NetPyNE UI (SUNY)
Patient H.M. (The Brain Observatory)
HNN UI (Brown University)
Scidash (Arizona State University)
NEURON UI (SUNY/Yale)
NWB Explorer
WormSim (OpenWorm)

Advantages

- **Unified platform for computational modeling, visualization and data exploration**
- Reused by multiple groups and projects
  - More users, more testing, more features, less bugs.
  - Open Source features developed for one Geppetto application are available to all Geppetto applications.
- Solutions to common problems are reused and optimised
  - Abstract meta-meta-model definition, streaming of data, scriptable UI, lazy loading, data visualization, data compression, automated unit and UI testing, etc.
- Enterprise architecture for better scalability and robustness
- Growing open source community

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Acknowledgements

Core Contributors

Matteo Cantarelli
Giovanni Idili
Adrian Quintana Perez
Jesus Martinez
Matt Earnshaw
Boris Marin

See full list of contributors:
contributors.geppetto.org

Supporting Groups

MetaCell
Open Source Brain and UCL
Virtual Fly Brain and EBI-EMBL
NeuroSim Lab and SUNY
Wellcome Trust
OpenWorm Foundation

JOIN US!

Thanks for your time!

Questions? Get in touch!

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