The European HBP
Karlheinz Meier
NICE2018
Portland OR

Programmatic Panel
The basic idea of the Human Brain Project
From Science to Infrastructures to Science and Innovation

The Joint Platform – Unified access through SW Collaboratory

- Neuroinformatics
- Brain Simulation
- HPAC

- Medical Informatics
- Neuromorphic
- Neurorobotics

Co-Design

Mouse
Human
Cognition
Theory

HBP Neuroscience

Knowledge About the brain Basic Science
Application in brain technology Innovation

What USERS get from the platforms
The basic idea of the Human Brain Project
From Science to Infrastructures to Science and Innovation

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What USERS get from the platforms

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Medical Informatics
Neuromorphic
Neurorobotics
Why and how neuromorphic?

Future computing based on biological information processing

Understanding biological information processing

Requires model system to test principles

Two fundamentally different modeling approaches

- **NUMERICAL MODEL (Turing)** represents model parameters as **binary numbers**
- **PHYSICAL MODEL (not Turing)** represents model parameters as **physical quantities**
  \[ \text{voltage, current, charge} \] (like the biological brain)

Combined into hybrid system
<table>
<thead>
<tr>
<th>SpiNNaker-1 machine</th>
<th>BrainScaleS-1 machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Many-core system</td>
<td>Physical model system</td>
</tr>
<tr>
<td>0.5 (1.0) Million ARM cores</td>
<td>4M neurons, 1B plastic syn.</td>
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<tr>
<td>Real-time simulator</td>
<td>Accelerated emulator</td>
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<table>
<thead>
<tr>
<th>SpiNNaker-2 prototype</th>
<th>BrainScaleS-2 prototype</th>
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<tbody>
<tr>
<td>144 Cortex M4F per chip</td>
<td>On-chip plasticity processor</td>
</tr>
<tr>
<td>36 GIPS/Watt per chip</td>
<td>Flexible hybrid plasticity</td>
</tr>
<tr>
<td>x10 with constant power</td>
<td>Active dendritic spatial structure</td>
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</tbody>
</table>

Common software ecosystem, remote access, open user facility
Very collaboration with theoretical neuroscience
<table>
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<th><strong>The HBP Neuromorphic Computing Strategy</strong></th>
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<td><strong>SpiNNaker-1 machine</strong></td>
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<tr>
<td><img src="image1" alt="SpiNNaker-1 machine" /></td>
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<tr>
<td>Steve Furber</td>
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<tr>
<td><strong>BrainScaleS-1 machine</strong></td>
</tr>
<tr>
<td><img src="image2" alt="BrainScaleS-1 machine" /></td>
</tr>
<tr>
<td>Sebastian Schmitt</td>
</tr>
<tr>
<td><strong>SpiNNaker-2 prototype</strong></td>
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<tr>
<td><img src="image3" alt="SpiNNaker-2 prototype" /></td>
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<tr>
<td>Sebastian Höppner</td>
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<tr>
<td><strong>BrainScaleS-2 prototype</strong></td>
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<tr>
<td><img src="image4" alt="BrainScaleS-2 prototype" /></td>
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<tr>
<td>Johannes Schemmel</td>
</tr>
<tr>
<td>Eric Müller (Demo)</td>
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<td>Wolfgang Maass</td>
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</table>
Groundbreaking Ceremony
European Institute for Neuromorphic Computing (EINC)
Heidelberg (Germany), May 5th 2017

Supported by
The Klaus Tschira Foundation (KTS)
The Dietmar Hopp Foundation
The Wild Foundation
The HBP Neuromorphic Computing Platform

The Neuromorphic Computing Platform allows neuroscientists and engineers to perform experiments with configurable neuromorphic computing systems. The platform provides two complementary, large-scale neuromorphic systems built in custom hardware at locations in Heidelberg, Germany (the "BrainScaleS" system, also known as the "physical model" or PM system) and Manchester, United Kingdom (the "SpiNNaker" system, also known as the "many core" or MC system). Both systems enable energy-efficient, large-scale neuronal network simulations with simplified spiking neuron models. The BrainScaleS system is based on physical (analogue) emulations of neuron models and offers highly accelerated operation (10^3 x real time). The SpiNNaker system is based on a digital many-core architecture and provides real-time operation.

- **Getting started**
  - Request a compute time allocation
  - Run a simulation
  - Copy data to longer-term storage
- **Building models**
  - The PyNN model description API
  - A simple example
  - Using different backends
  - "Physical model" (BrainScaleS) system
  - "Many core" (SpiNNaker) system
- **Running simulations**
  - Format of a job