NEST: Simulator for large-scale neural networks

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What is NEST?

NEST = NEural Simulation Tool

- Goal: understanding brain (dis)function
- Interaction of multiple scales
  - single neurons – populations – brain areas – whole brain
- Large networks of spiking point-neuron models
- Detailed morphology (see NEURON, GENESIS)
Performance

- **world record for large-scale spiking network simulations** with 1.86 billion neurons and 11.1 trillion synapses on the full Japanese K computer using NEST 2.6.0 technology [Kunkel et. al (2014)]
- **Same code** that you can compile and run **on your laptop**
General

- **C++** kernel
- Neuron and synapse models defined in C++
- Hybrid parallelization
  - multi-threading for shared-memory machines
  - MPI for clusters and supercomputers
- Built-in **simulation language interpreter** (SLI)
- **Python**-based user interface (PyNEST, PyNN)
- Interface to Multi Simulator Coordinator (MUSIC)
Accuracy

• **Exact integration** for linear sub-threshold dynamics
• **Suitable solver** for non-linear models
• Globally time-driven simulation
  • By default spikes restricted to grid
  • **Continuous time interaction** for some models
Quality Assurance

- Extensive test suite
- Strict code guidelines and code review
- Continuous integration
Neuron Models

- Leaky integrate-and-fire neuron (LIF)
- Adaptive exponential LIF model (AdEx)
- Binary neurons (McCulloch-Pitts, sigmoidal)
- MAT2 neuron model
- Hodgkin-Huxley-type models
- Neuron models with few compartments
- *<your model here>*
Synapse & Connectivity

- Static synapses (current & conductance based)
- Spike-timing dependent plasticity
- Short-/long-term plasticity
- Neuromodulatory synapses using dopamine
- **Gap junctions** [Hahne et al. (2015)]
- *<your model here>*

- Efficient high-level connectivity functions
- Topology module for **spatially-structured** networks
- Connection set algebra (CSA)
  - Compact definition of **complex connectivities**
Supported Platforms

- Linux
- Mac OS X
- IBM Blue Gene (L/P/Q)
- K („kei“)

- Windows (*please use a virtual machine*)
Get it now!

- Open source (GPLv2)
- Latest stable release
  - current release: NEST 2.10.0
  - http://www.nest-simulator.org/download
- Development version
  - https://github.com/nest/nest-simulator
  - Report issues!
  - Fork and contribute!
Help!

- Documentation
  - http://www.nest-simulator.org/documentation
- NEST user mailing list
  - http://www.nest-simulator.org/community
- Developer space
  - https://nest.github.io/nest-simulator
- Community
  - http://www.nest-initiative.org