

# Technical Overview

## Neronet

*Toolbox for managing the training  
neural networks*

CSE-C2610  
Software Project

Aalto University

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# Outline

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**Neronet** is a framework designed to facilitate the specification, submission, monitoring, control, analysis and management of many different computational experiments.

The Neronet family consists of three members:

1. **Neroman** – a user run tool that acts as the *Neronet frontend* and user interface to provide access to Neronet's features and functionality. It is the researchers workhorse.
2. **Neromum** – a **Nerokid** manager daemon that helps the family stay organized while the kids are playing in distant clusters, possibly in collaboration with a **Warden** that is predesignated to supervise and control the playing grounds.
3. **Nerokid** – a tiny creature that looks after your computational toy and reports to mum in case it breaks.

# Introduction

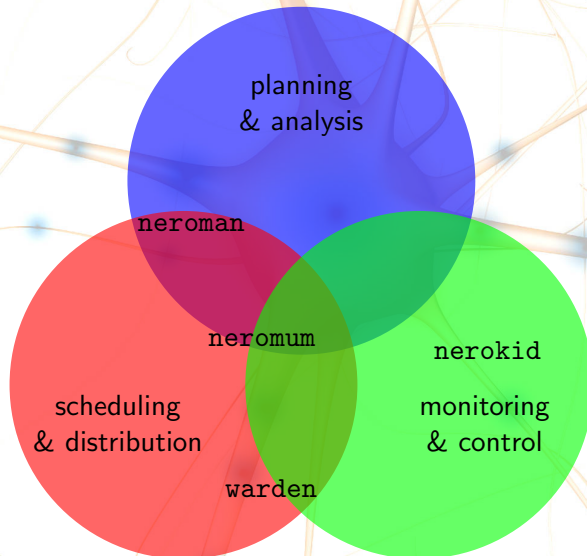
In more technical terms:

- ▶ **Nerokid** is a program designed to be launched by a job scheduler or **Neromum** directly in a cluster node to monitor, analyse and control a single experiment job and its environment in tandem with a **Neromum**
- ▶ **Neromum** is a job scheduler, manager and communications agent designed to work by herself or with a standard cluster job scheduler such as SLURM, OGE or Jobman (a **Warden**)
- ▶ **Neroman** is a tool that acts as the *Neronet frontend* and user interface to provide Neronet's functionality by dispatching **Neromums** in specified clusters or nodes with a bunch of jobs to do. The **Neromums** in turn dispatch the jobs to the **Nerokids** and then continue as communication intermediaries.

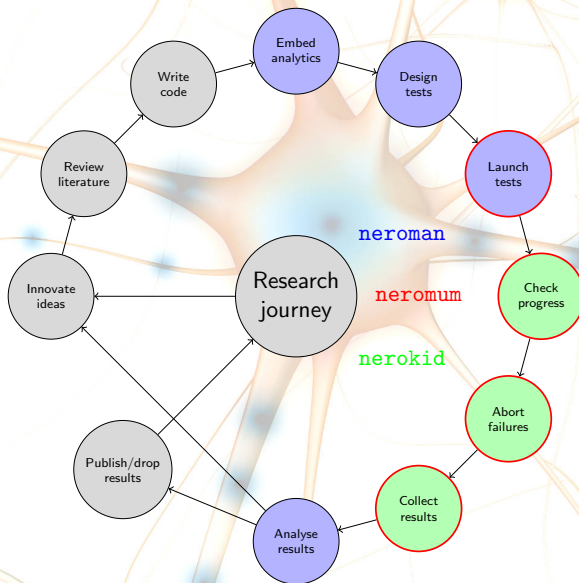
The following three slides provide a good introduction:

1. *Job management* – the associated problem domain spheres and how the system components are related to them
2. *Journey map* – the journey or work flow of a typical system user (a computational researcher) and the steps in which the Neronet tools are designed to be used
3. *Basic use case* – A sample basic system use case description

# Job management



# Journey map



neroman

neromum

nerokid



- ▶ **User:** A computational researcher
- ▶ **Goal:** To test how well a new design works with several different configuration options and parameter values
- ▶ **Preconditions:** SLURM cluster and Neronet setup, code and analytics developed and test inputs setup in Neronet compatible manner
- ▶ **Basic flow:**
  1. Specify a batch of **Nerokids** in the *config* YAML with parameters, inputs and other configurations
  2. Dispatch the jobs to the SLURM setup with autogenerated sbatch scripts and arguments: `neroman --submit triton 124-186`
  3. Receive and check progress notifications from email
  4. Monitor the experiment to see near realtime updates of analytics variable updates: `neroman --submit triton 124-186`
  5. Receive final results data and updates. To a log data file.
  6. Analyse, reiterate and/or publish results
- ▶ **Post conditions:** Computational experiments have been conducted in a very straightforward, effective and researcher friendly fashion

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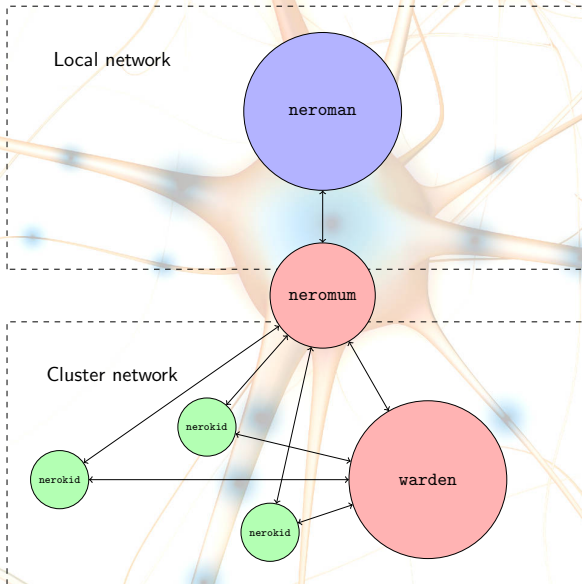
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- ▶ All Nero components are lightweight Python programs run with just the researcher's privileges on any modern \*nix
- ▶ SSH is used for communication between **Neroman** and **Neromums** (user's existing ssh keys, ssh configs and privileges are used)
- ▶ Sockets are used between **Neromums** and **Nerokids**
- ▶ **Neromum** communicates with any **Wardens** using their CLIs and/or APIs
- ▶ The system is ment to be easy to setup, lightweight and the usability good for several types of uses.

# Communication



- ▶ A daemon administered and configured by the researcher herself
- ▶ Should be run on a system with two way SSH access to the cluster gateway or nodes where the **Neromums** are deployed
- ▶ Key functionality
  - ▶ Facilitate and standardize experiment specification
  - ▶ Batch submit experiment jobs to **Neromums**
  - ▶ Send email notifications with progress data
  - ▶ Facilitate monitoring and control of running jobs
  - ▶ Autocollect key job results into a researcher specifiable format (f. ex. Excel)
  - ▶ Facilitate experiment analysis and history management
  - ▶ Lightweight and extendable with custom functionality
  - ▶ Configurable via YAML files

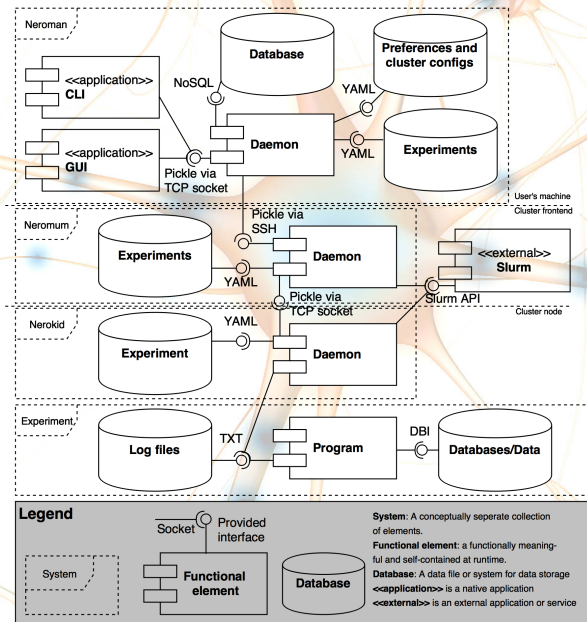
- ▶ A daemon started and administered by a **Neroman**.
- ▶ Should be run on a system with two way SSH access to the **Neroman** and socket access to the nodes where **Nerokids** are deployed
- ▶ Collaborates with standard **Wardens**.<sup>1</sup>
- ▶ Key functionality
  - ▶ Receive and execute commands from **Neroman**
  - ▶ Communicate with any **Wardens** by autogenerating job scripts (eg. sbatch) and their CLIs and/or APIs.
  - ▶ Collect information from **Nerokids**, process and cache them, send them to **Neroman** on request
  - ▶ Transmit commands from **Neroman** to the **Nerokids**

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<sup>1</sup>SLURM is currently used by Triton and CSC. OGE is still used worldwide. Jobman could be setup for the CS gpu cluster.

- ▶ A daemon started and administered by a **Neromum** directly or through a **Warden** on any modern \*nix system (typically a cluster node) to start and monitor computational jobs
- ▶ Key functionality
  - ▶ Send information to **Neroman** via **Neromum** as configured
    - ▶ computing environment information
    - ▶ experiment job progress information read either through an API or by parsing output logs and data files (eg. CSV, JSON)
  - ▶ Interact with the **Warden** as specified (eg. autotermination based on poor experiment progress)
  - ▶ Lightweight and extendable with custom functionality
  - ▶ Configurable via YAML files and perhaps a Python API

# Structural architecture





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- ▶ A server (**Neroman**) per user approach is chosen because
  - ▶ easy minimalist setup (easy to try)
  - ▶ no need for special privileges
  - ▶ fully customizable by the user herself
  - ▶ low resources overhead per setup
  - ▶ total number of users relatively low as well
- ▶ SSH is used because
  - ▶ it is an existing standard among target system environments
  - ▶ user's existing SSH keys and configs provide an easy and effective way to provide secure networking
  - ▶ no need for network, port routing or privileges adjustments

- ▶ Python 3 is used because
  - ▶ it is already available in most modern \*nix systems
  - ▶ it has good support for the known software requirements
  - ▶ it is already popular among computational researchers
  - ▶ many related research libraries use it (Scipy, Numpy, Theano, Lasagne, Pylearn, Blocks)
- ▶ Sockets are used because
  - ▶ they provide fast and efficient realtime communication in tightly connected networks
  - ▶ they are lightweight for the cluster filesystem