

# Project report

## Neronet

*Toolbox for managing the training  
neural networks*

CSE-C2610  
Software Project  
Aalto University

April 13, 2016

# Outline

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"I have supervised several bachelors' theses and other student projects.

You and the product surpassed my expectations. I did not expect such professional results."

Pyry Takala, PO

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# Team

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At the start of the course, we were all both

- ▶ terrified, and
- ▶ inspired

by our project topic!



# Product owner

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Pyry Takala

- ▶ Machine learning researcher at Aalto
- ▶ Past: Amazon, McKinsey & Company, Goldman Sachs, August...

# Agile coach

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Eero Laukkanen

- ▶ Continuous delivery researcher at Aalto
- ▶ Past: Prosys PMS Ltd, WiRCA-miehet, Aalto...

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## Challenges in training neural networks:

- ▶ Long duration of individual experiments
- ▶ Difficult to manage of experiment variations, queues and computing nodes
- ▶ Difficult to monitor and analyse experiment progress
- ▶ Difficult to log experiment histories

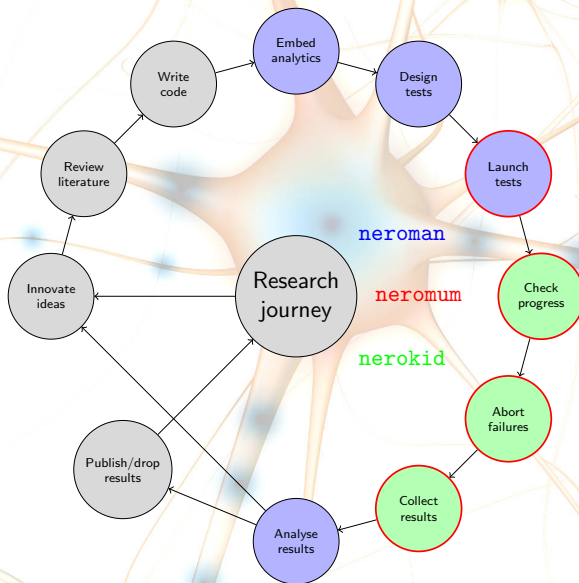
Could a toolbox be developed that would

- ▶ monitor experiment logs and detect problems
- ▶ notify of and/or autoterminate poorly developing experiments
- ▶ facilitate experiment variation
- ▶ facilitate experiment and queue management
- ▶ enable easy access to experiment data
- ▶ potentially also visualize parameter evolution

Such a toolbox should also be

- ▶ lightweight
- ▶ easily extensible
- ▶ open source
- ▶ framework agnostic
- ▶ convenient in practice

# Journey map



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# Technical challenges & ASRs

- ▶ deeply technical and an advanced domain
- ▶ remote computing nodes and cluster management
- ▶ good usability? according to whom?
- ▶ framework agnostic?

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A three component tool involving Python, SSH and sockets that ... **meets the vision!**

- ▶ All core functionality **Done.**
- ▶ Most features accessible both via CLI and GUI.
- ▶ PO satisfied.
- ▶ We are proud!

# Solution

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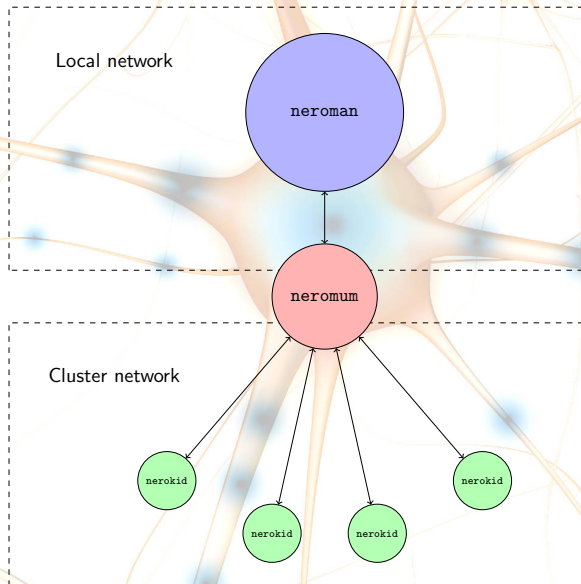
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# Structural architecture

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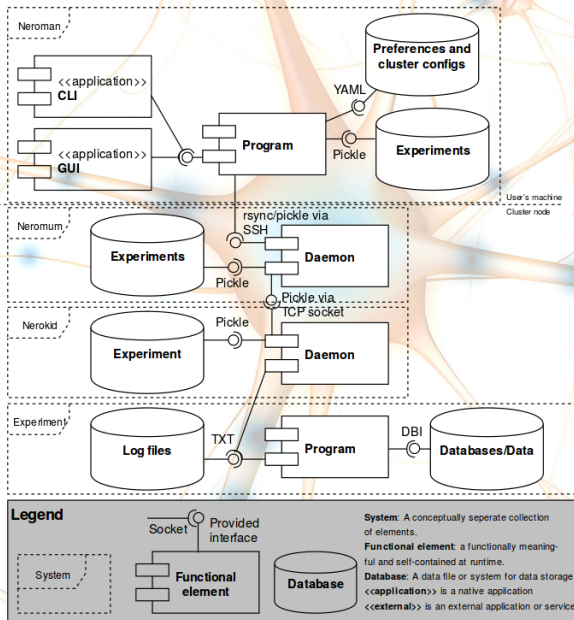
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# Features

## Core features:

- ▶ extensible experiment specification system
- ▶ easy experiment submission to remote nodes
- ▶ experiment state and progress information easily accessible
- ▶ access to computing node resources information
- ▶ customizable notification and autotermination system
- ▶ additional conveniences: drag drop, experiment template, customizable parameter value plotting

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Live demonstration of the final product including:

1. Cluster & experiment configuration
2. Experiment submission
3. Fetching updates/results
4. Viewing plots

Focus on the GUI this time.



# Recap

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In essence the product is a Python-based tool that enables computational researchers to conduct their research more effectively.

- ▶ It utilizes SSH and TCP sockets to distribute computational experiments into remote computer nodes.
- ▶ It is framework agnostic in that it permits the use of a very wide variety of tools to actually conduct the computing needed (Theano, Torch, Scipy, Matlab, R, C++, whatever).

# User feedback

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We utilized lots of end user testing and received great feedback from Simo Tuomisto, a Triton admin:

- ▶ Thought that our design and architecture was well devised.
- ▶ Offered performance improvement ideas.
- ▶ In general he liked our usability.

# User feedback

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From our peer team we received feedback as well.

Thus we did several

- ▶ bug fixes
- ▶ usability improvements
- ▶ improvements to project documentation and the user guide

# User feedback

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Pyry also gave us great feedback during development, regarding requirements and usability etc.

In the end he claimed that

- ▶ the end product was surprisingly professional
- ▶ the usability was excellent
- ▶ and that our team had expertise

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Quality assurance was based on

- ▶ the DoD, and
- ▶ our QA practices

We updated our DoD and practices several times.



# Definition of done

We defined **Done** at the BI, sprint and project level.

- ▶ BI level: unit tests, code conformity, commenting, documentation, peer review
- ▶ Sprint level: BIs **Done**, unit and system tests ok, sprint goal achieved.
- ▶ Project level: all sprints **Done** and PO satisfied.

Used QA practices and tools:

- ▶ Unit test framework
- ▶ Commenting & documentation
- ▶ System testing
- ▶ Peer review

# Quality attributes

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Added emphasis on these attributes:

- ▶ Usability
- ▶ Reliability
- ▶ Extendability
- ▶ Performance

Achieving great quality was/is very challenging!

- ▶ Several issues are still unsolved
- ▶ More stress testing would be necessary
- ▶ There is room for refactoring

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# Process overview

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- ▶ Each developer as a sprint team leader in turn
- ▶ Teamwork sessions almost every Wed & Fri at Maari
- ▶ Scrum as required
- ▶ Tried to employ professional SD practices
- ▶ Tools: Github, Agilefant, Flowdock, WhatsApp, Google Calendar, ShareLaTeX, Skype, Floobits

# Schedule

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Time	Event	Participants
30.10. 16-18	Project kickoff	team, PO
13.11. 15-17	S0 demo	team, Coach
16.11. 11-13	S1 planning	team, PO
04.12. 16-17	S1 & progress review	team, PO, Coach
04.12. 17-18	S2 planning	team, PO
13.01. 19-20	S2 review & S3 planning	team, PO
01.02. 14-16	S3 review & S4 planning	team, PO
29.02. 13-14	S4 & progress review	team, PO, Coach
29.02. 14-15	S5 planning	team, PO
30.03. 16-18	S5 review & S6 planning	team, PO
13.04. 16-17	S6 & project review	team, PO, Coach
19.04. 16-20	Quality award & party	team, Coach



# Sprints

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- ▶ S0: Prepare for project **Done**
- ▶ S1: Develop a prototype that offers the most basic functionality via a CLI **Done**
- ▶ S2: Develop a stable version for end user testing **Done**
- ▶ S3: Finish asynchronous system functionality and create a GUI mockup **Done**
- ▶ S4: Publish Neronet as an open source project **Done**
- ▶ S5: Finish Neronet 1.0 **Done**
- ▶ S6: Wrap things up **Done**

There were few stories that were deferred or completely cancelled, but no unpleasant surprises.

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Spent and budgeted effort in hours by team member and sprint:

S	Samuel	Teemu	Tuomo	Joona	Iiro	Matias
0	140/50	36/35	45/35	40/35	36/35	43/35
1	52/30	37/33	42/33	46/33	32/33	37/33
2	42/30	27/33	41/33	25/33	27/33	30/33
3	24/15	28/33	14/33	23/33	20/33	27/33
4	37/15	35/33	28/33	32/33	25/33	32/33
5	18/20	31/40	49/40	16/40	39/40	29/40
6	17/15	9/18	10/18	16/18	16/18	10/18
	330/175	203/225	229/225	198/225	195/225	208/225

# Burnup

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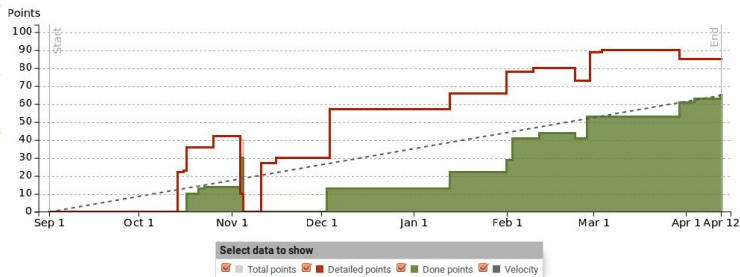
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The goal was to develop a tool with a bright future.

- ▶ Extensive documentation, manual and start guide
- ▶ Published as an open source project
- ▶ Located in Github and installable via pip

# Complicating factors

## Complicating factors

- ▶ PO mostly in London
- ▶ Little additional CSE expertise available (only the Coach)
- ▶ Very difficult domain
- ▶ Inexperienced team
- ▶ Only five developers
- ▶ The PO nor the scrum master had participated in the course before

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# Simplifying factors

## Simplifying factors

- ▶ Our PO was straightforward, very motivated and gave great feedback
- ▶ Our coach also gave us valuable support and feedback
- ▶ We had high motivation

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# Additional points

## Additional points

- ▶ Sprint team leader system
- ▶ User guide/manuals enhanced communication
- ▶ Early end user testing
- ▶ Open source future focus

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# Summary

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## Summary:

- ▶ The process was smooth
- ▶ All sprints were successful
- ▶ More than fulfilled the initial vision
- ▶ Surpassed PO's expectations

# Thank you!

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We learned and had fun together :)