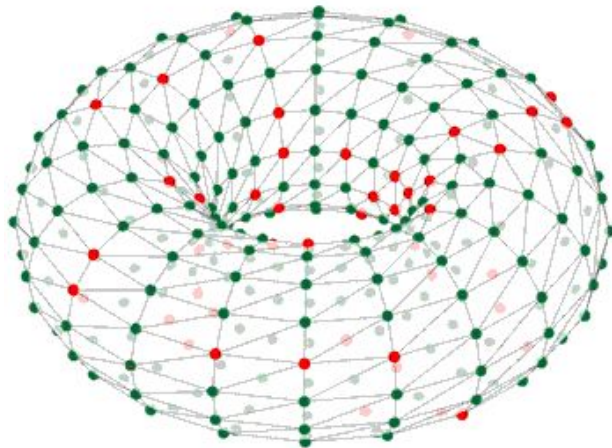


# The SpiNNaker Platform



Andrew Rowley, University of Manchester



European Research Council  
Established by the European Commission



Human Brain Project

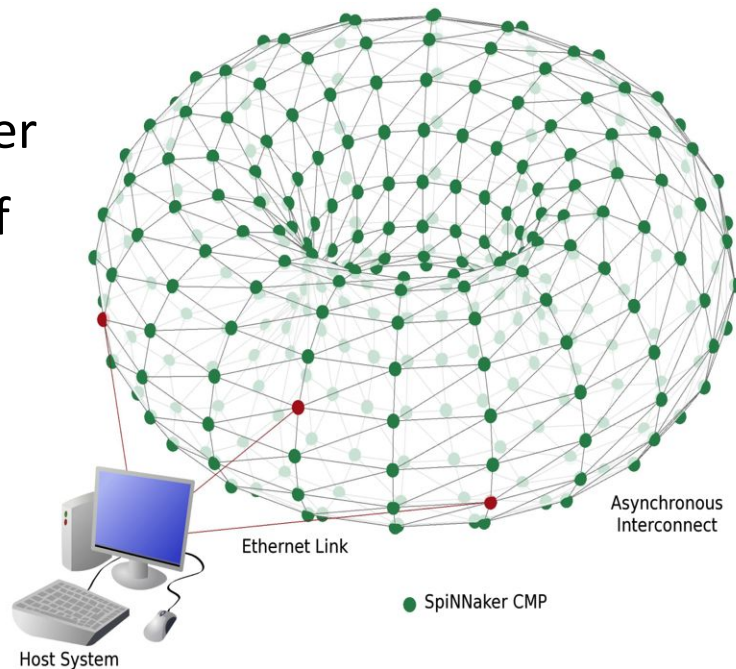
**EPSRC**



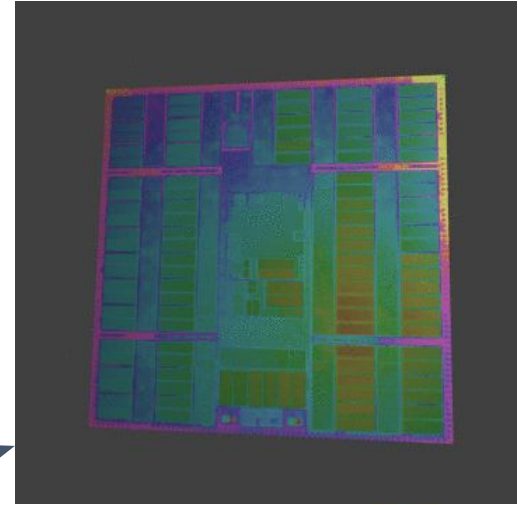
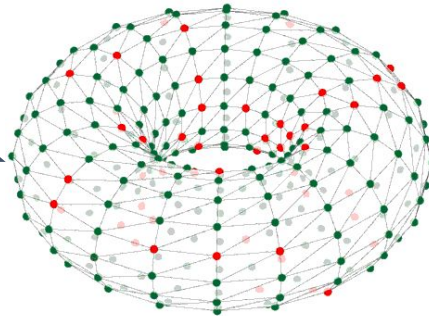
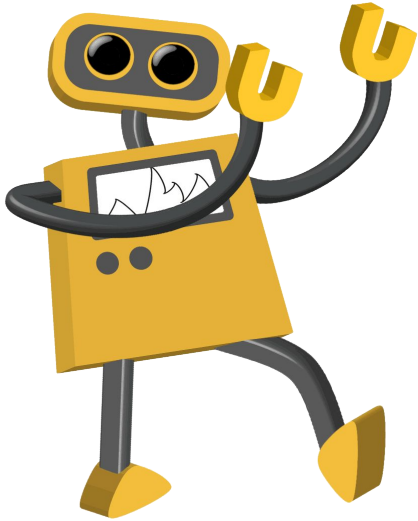
# What is SpiNNaker?

# SpiNNaker Project

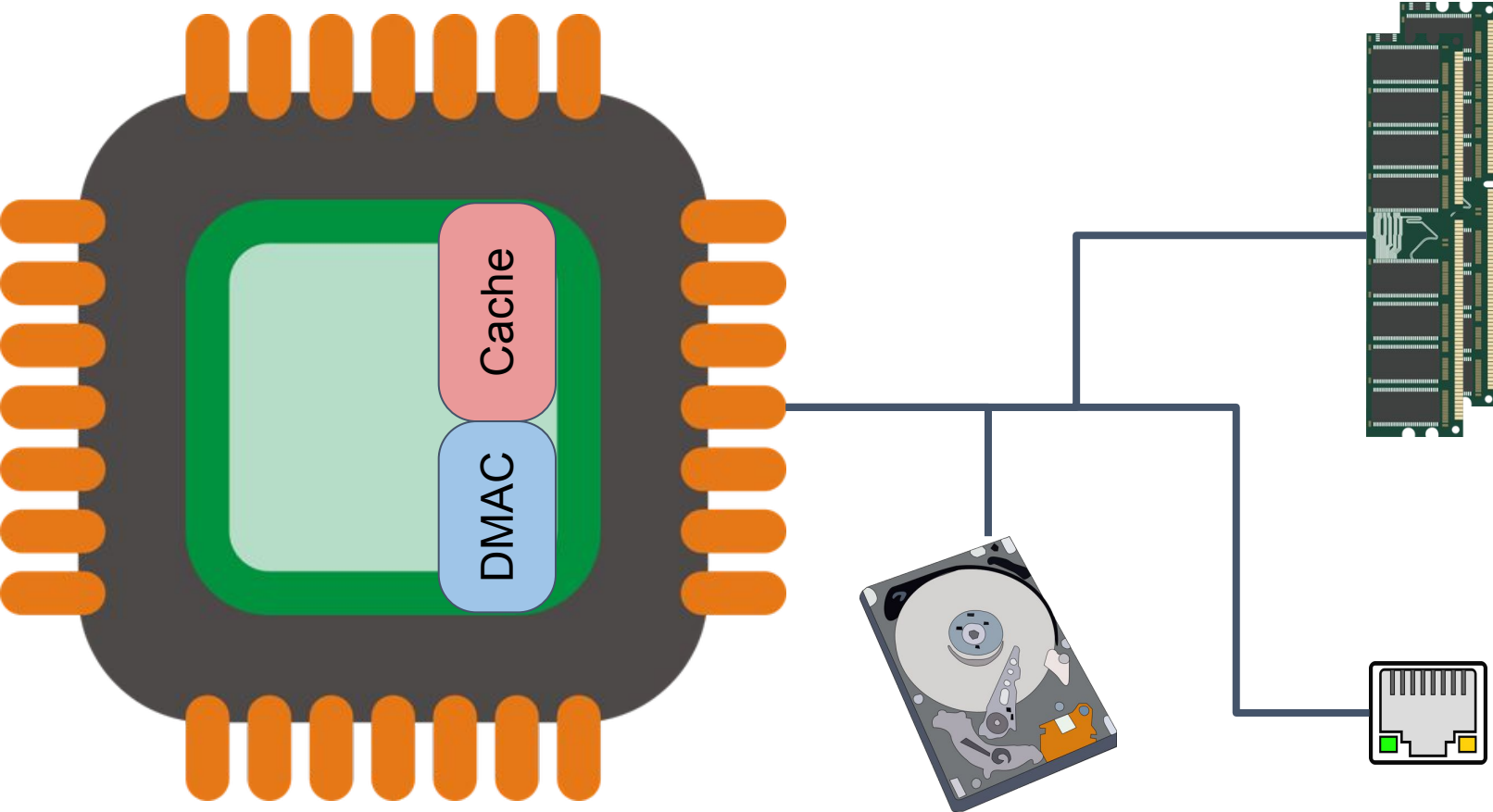
- A million “mobile phone” processors in one computer
- Able to model about 1% of the human brain...
- ...or 10 mice!



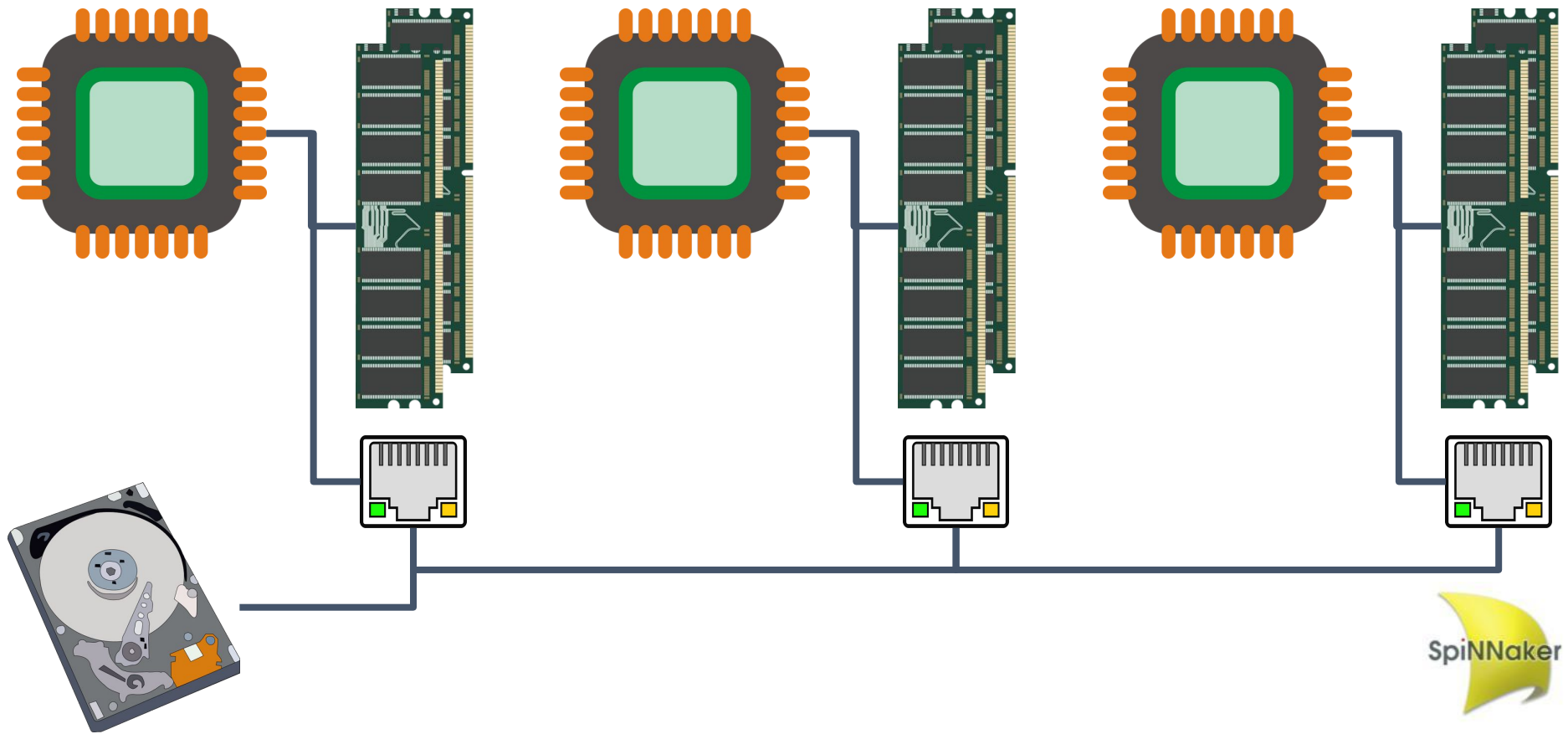
# Application Areas



# “Traditional” Architecture



# "Traditional" Network





# SpiNNaker Chip

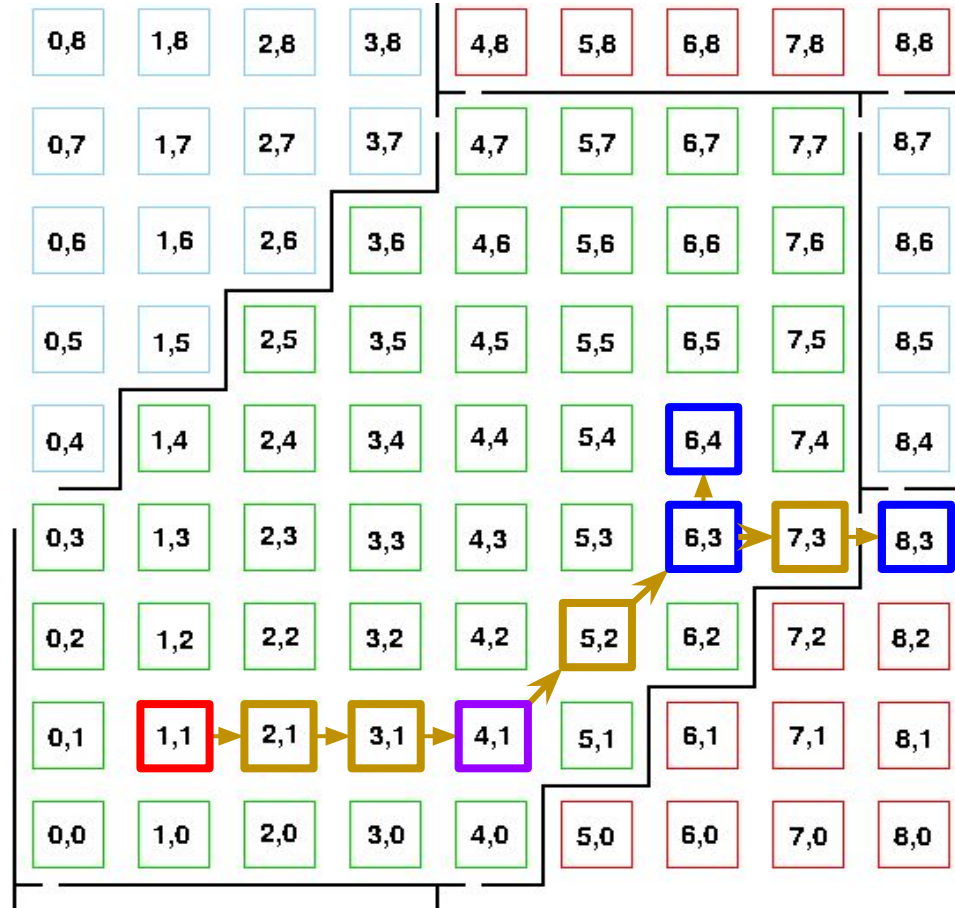
ARM968 Processor  
200Mhz  
No Memory Mgmt  
No Floating Point  
Direct Memory  
Access (DMA)  
Controller  
128MB Shared  
SDRAM (Slow)



32Kb Instruction  
Memory (Fast)  
64Kb Data  
Memory (Fast)  
32Kb Shared System  
RAM  
100Mb/s Ethernet  
Router  
1024 Routing Entries



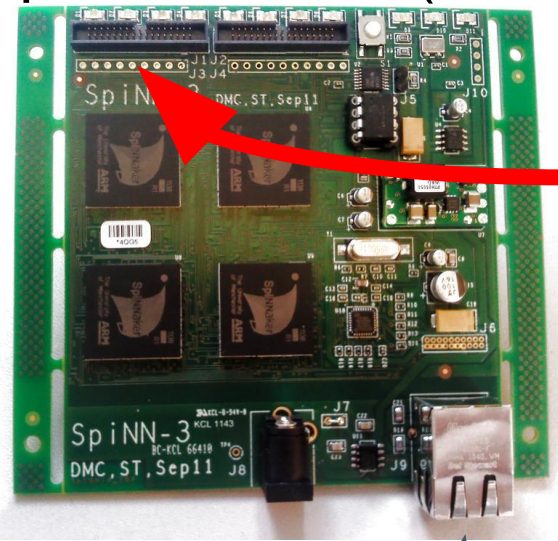
# SpiNNaker Multicast





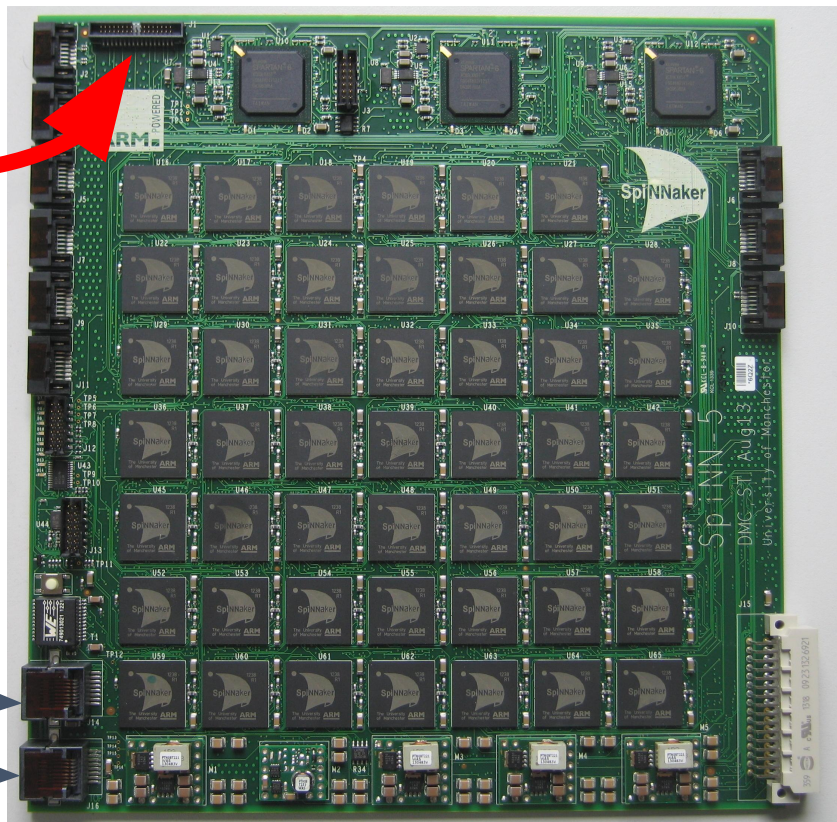
# SpiNNaker Boards

## SpiNN 3 board (~4W)



External  
Device  
Ports

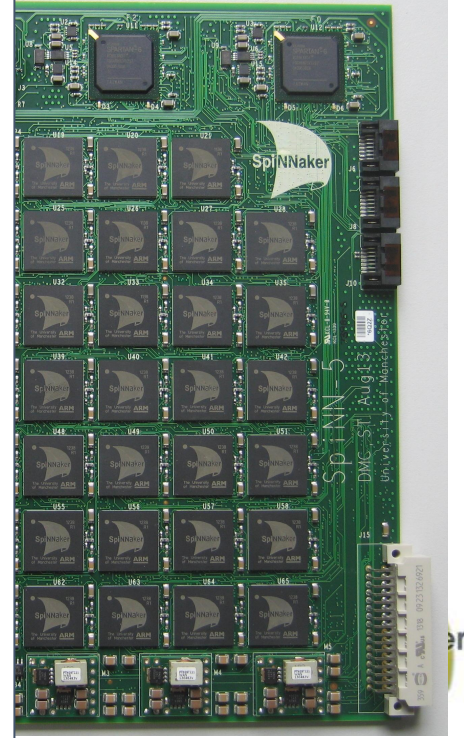
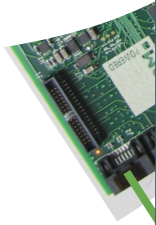
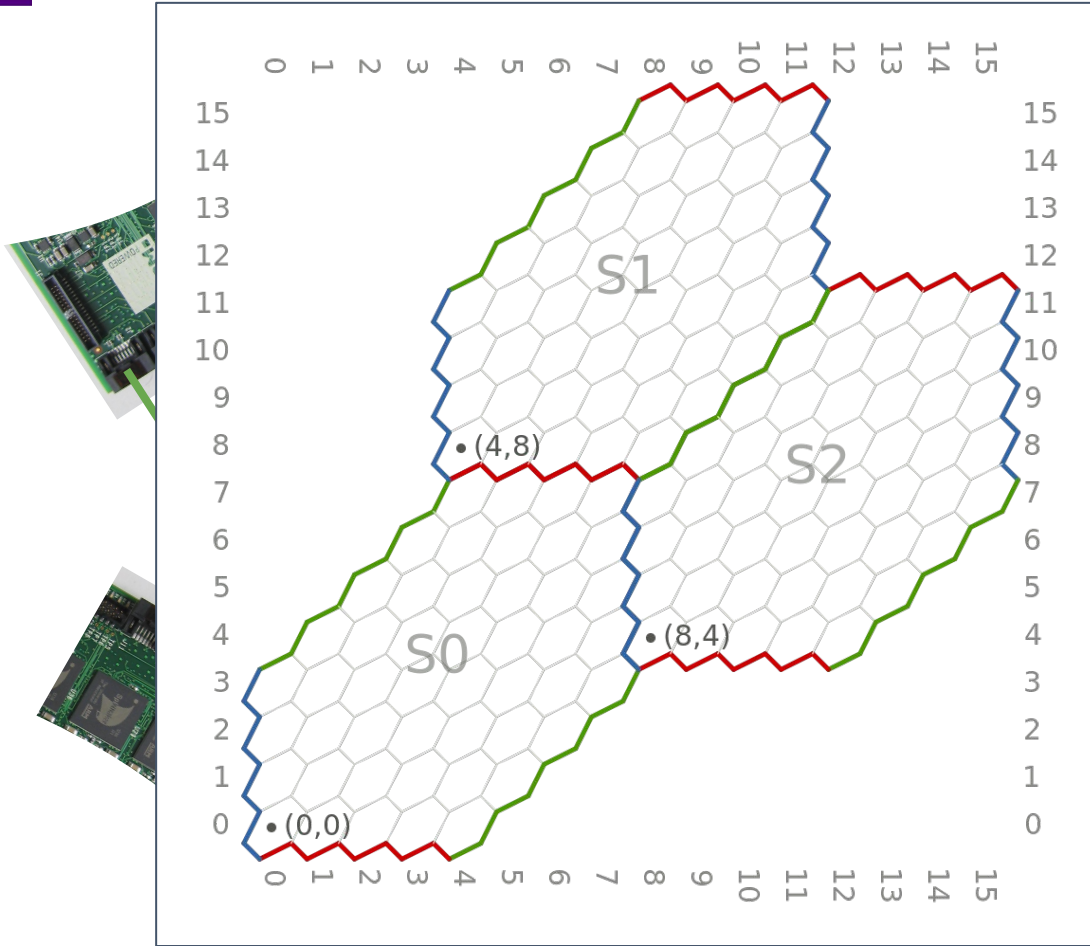
## SpiNN 5 board (~60W)



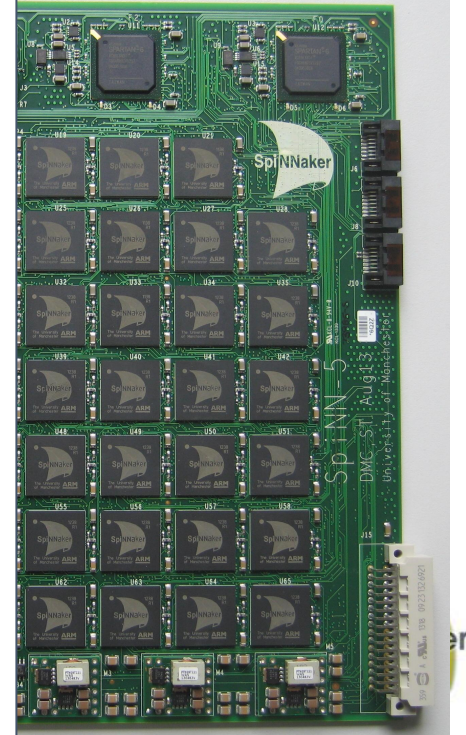
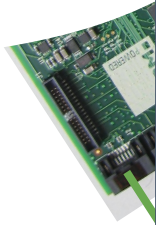
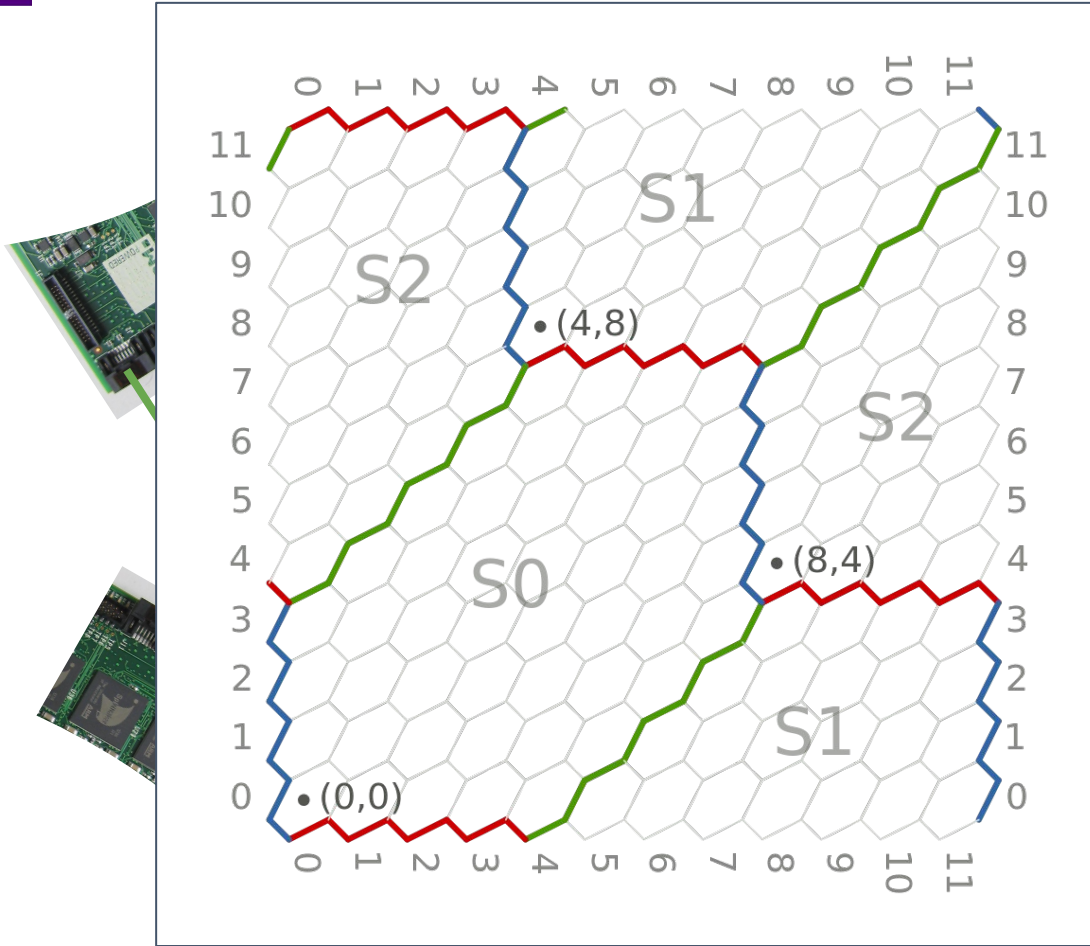
Board Management Processor  
(Power, FPGA Config, etc.)  
SpiNNaker Ethernet



# Building SpiNNaker Machines

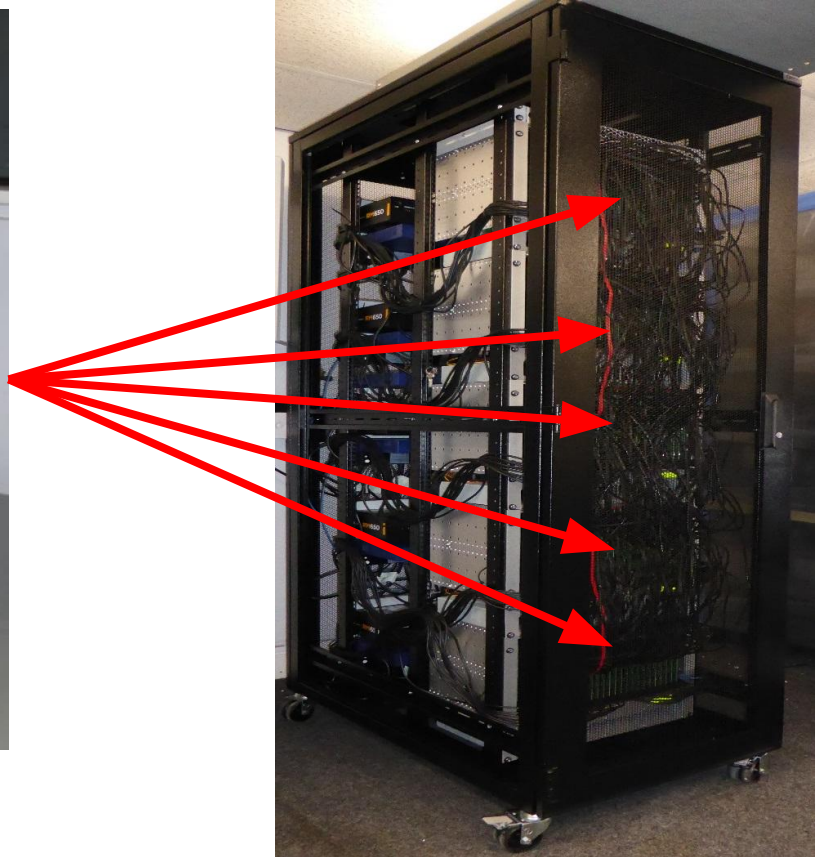


# Building SpiNNaker Machines





# Building SpiNNaker Machines



# SpiNNaker 1 Million Machine

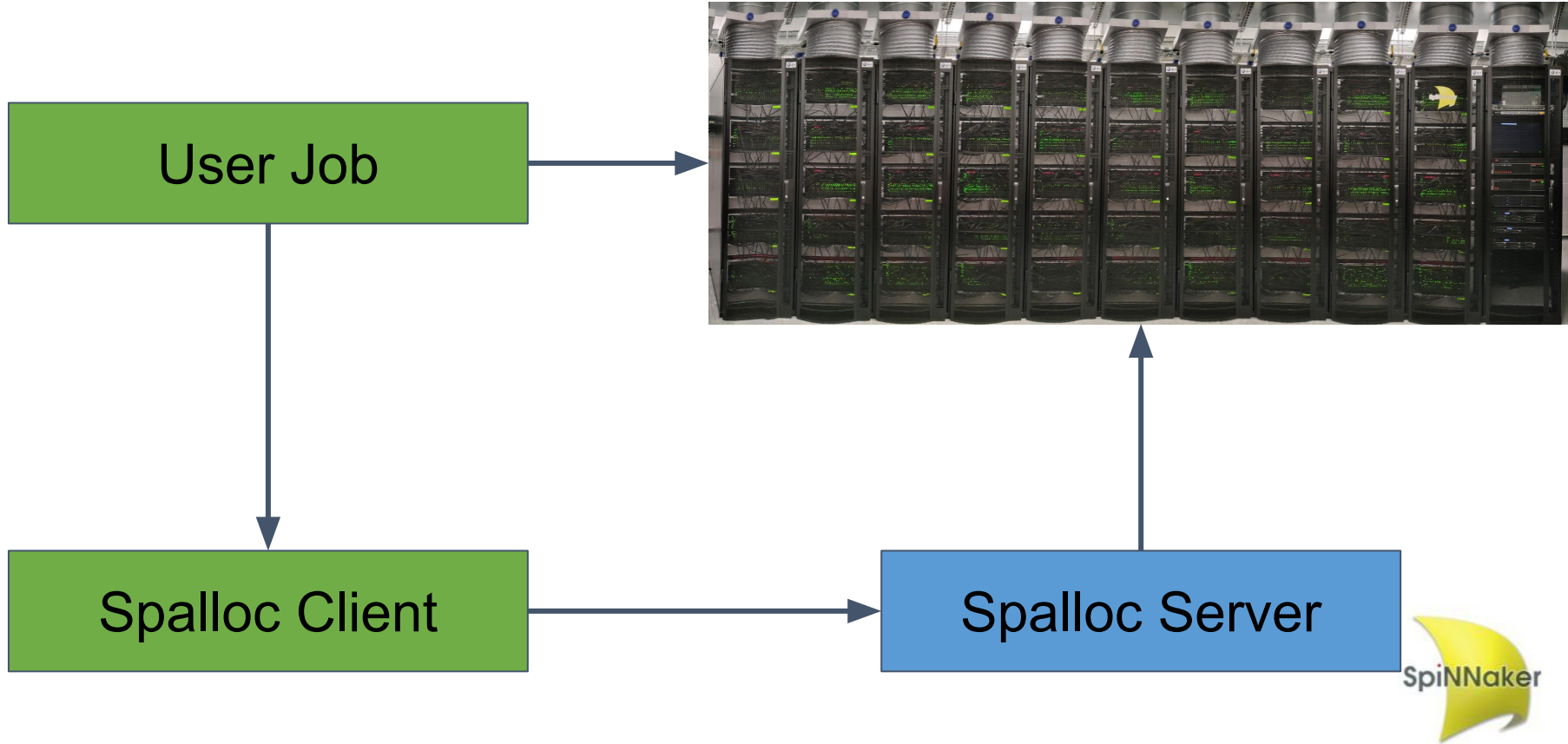


1200 Boards, ~1 Million Cores, 100KW

0,000,000



# SpiNNaker Allocation

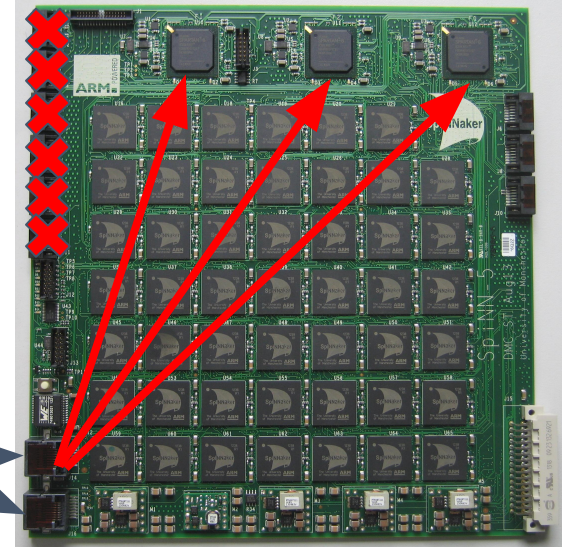




# SpiNNaker Allocation

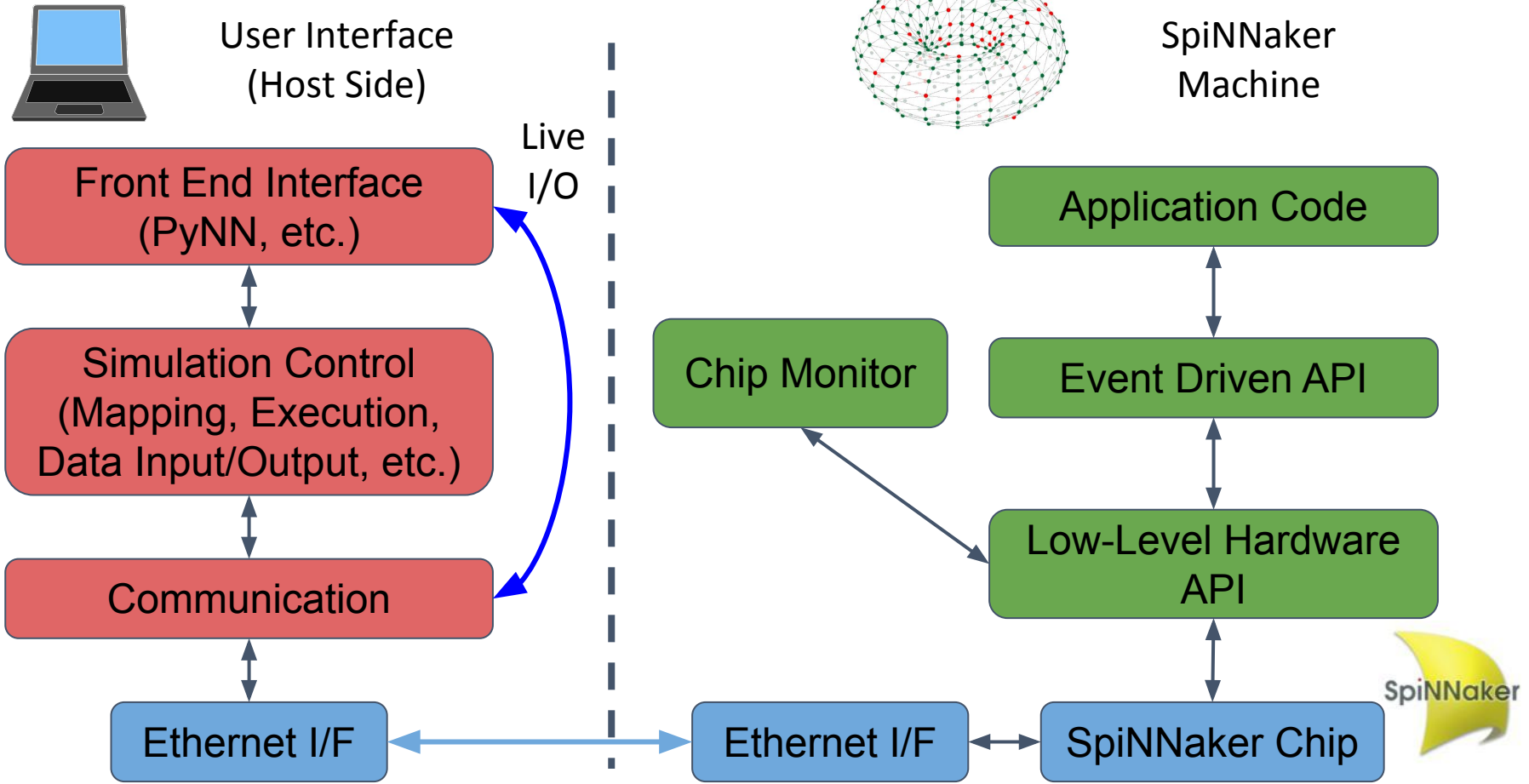
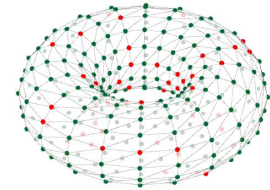
User Job

Spalloc Server

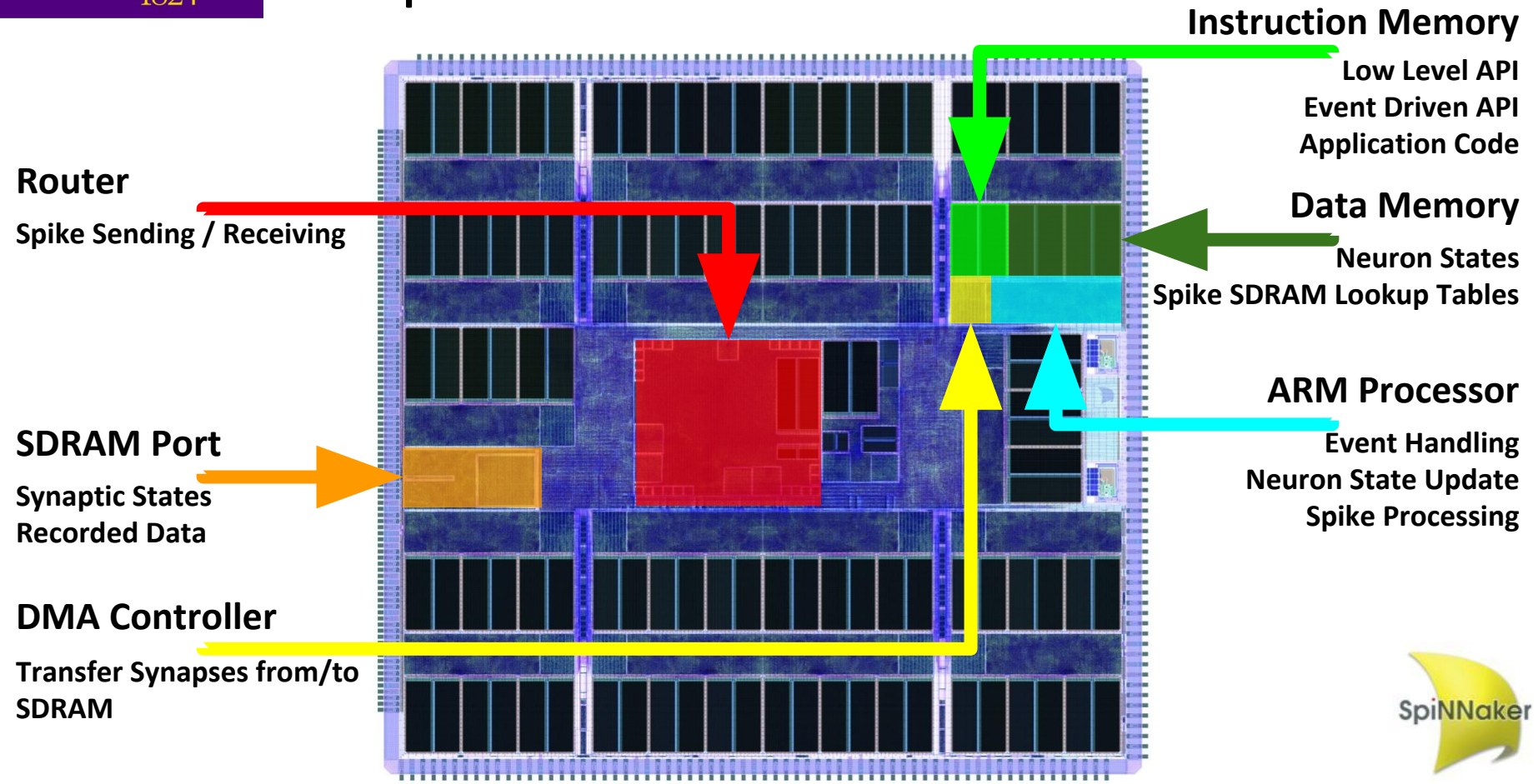


# Using SpiNNaker: Software

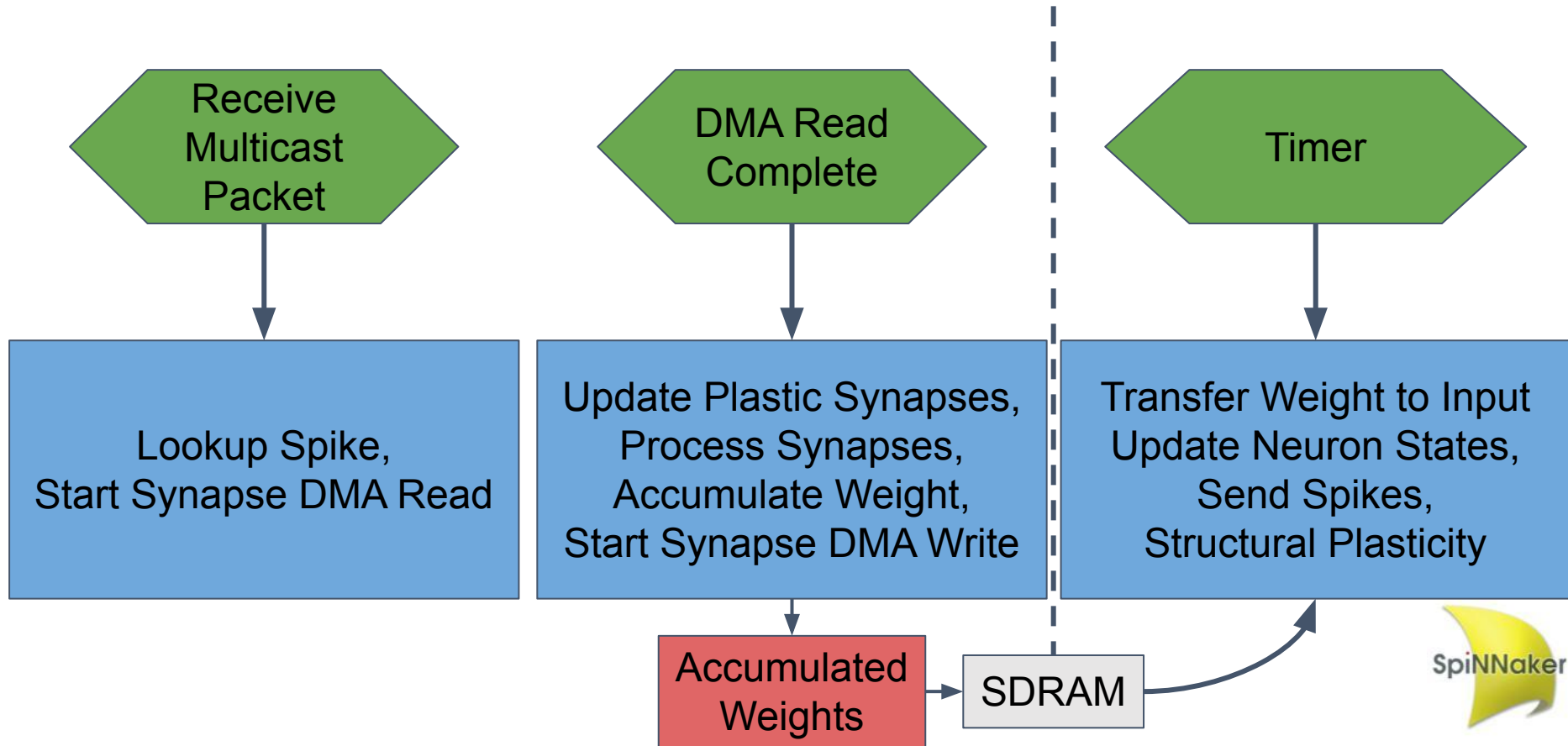
# Software Stack



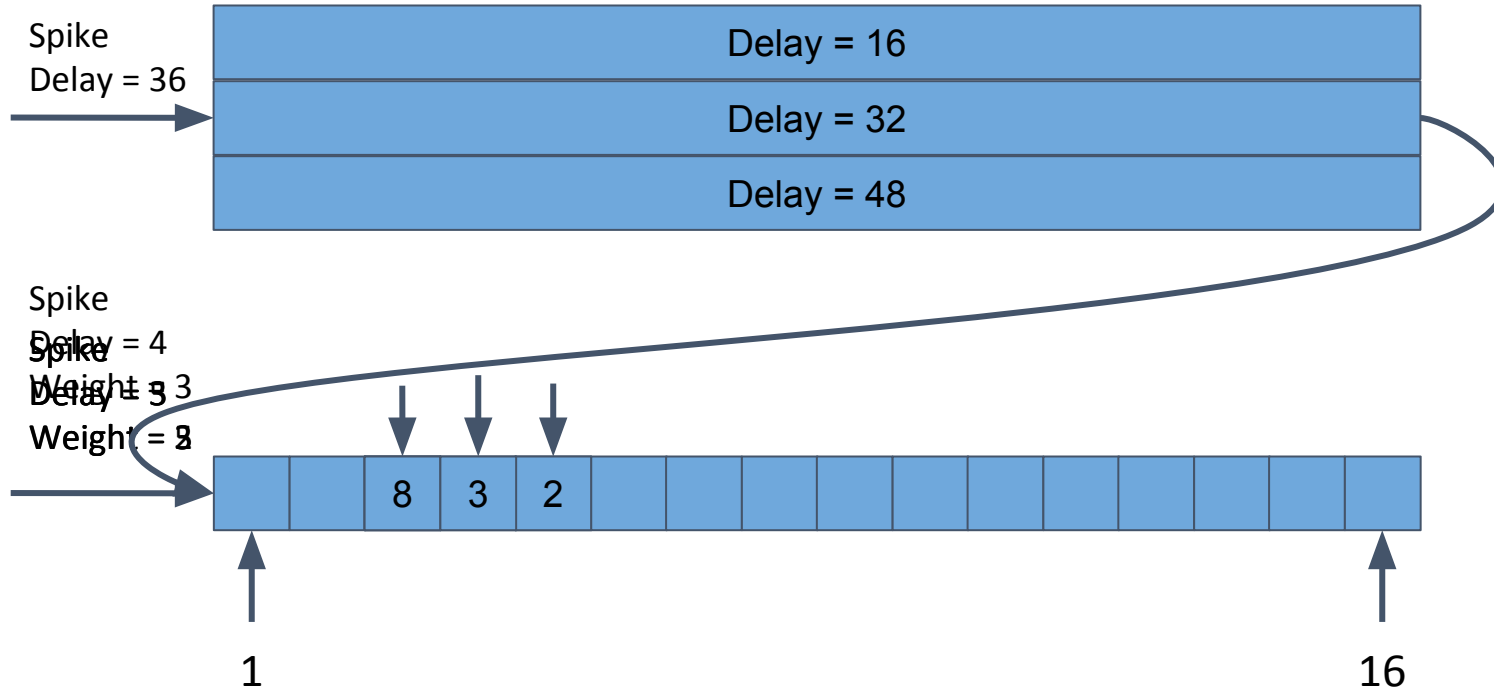
# Chip Neural Network Software



# Neural Network Events



# Weights and Delays

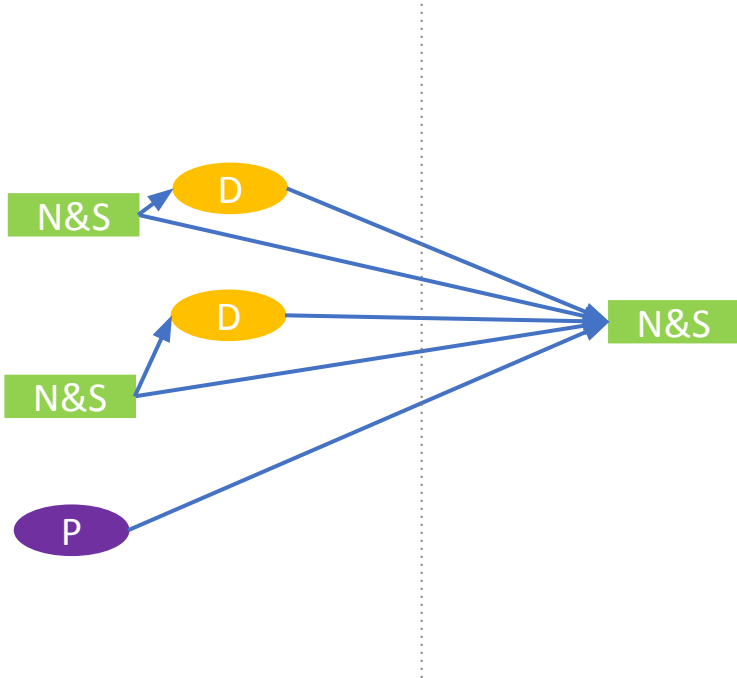




# Alternative Mappings

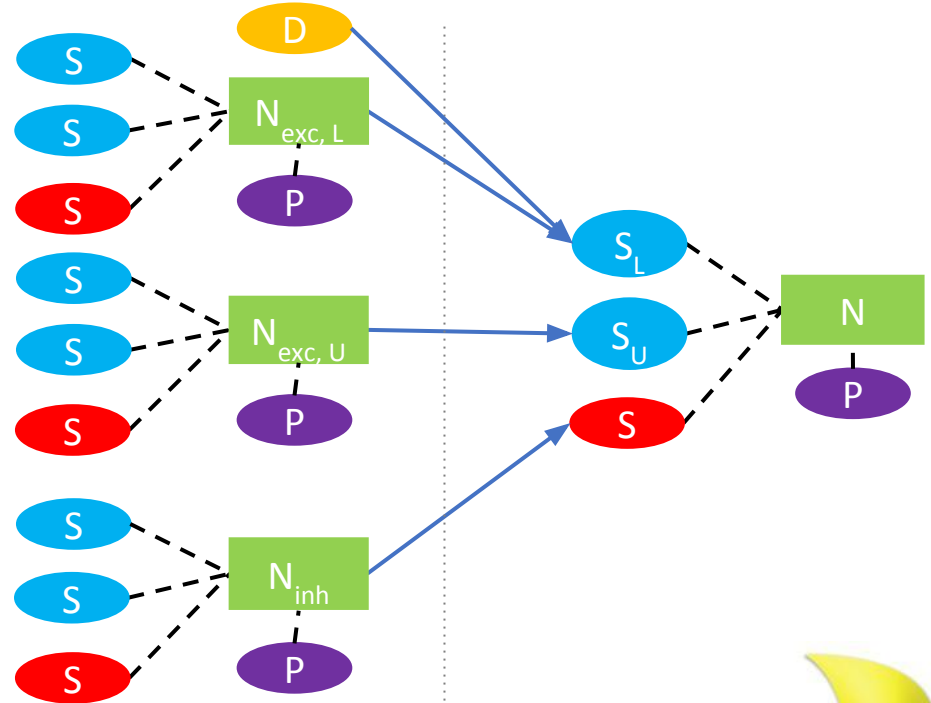
Presynaptic

Postsynaptic

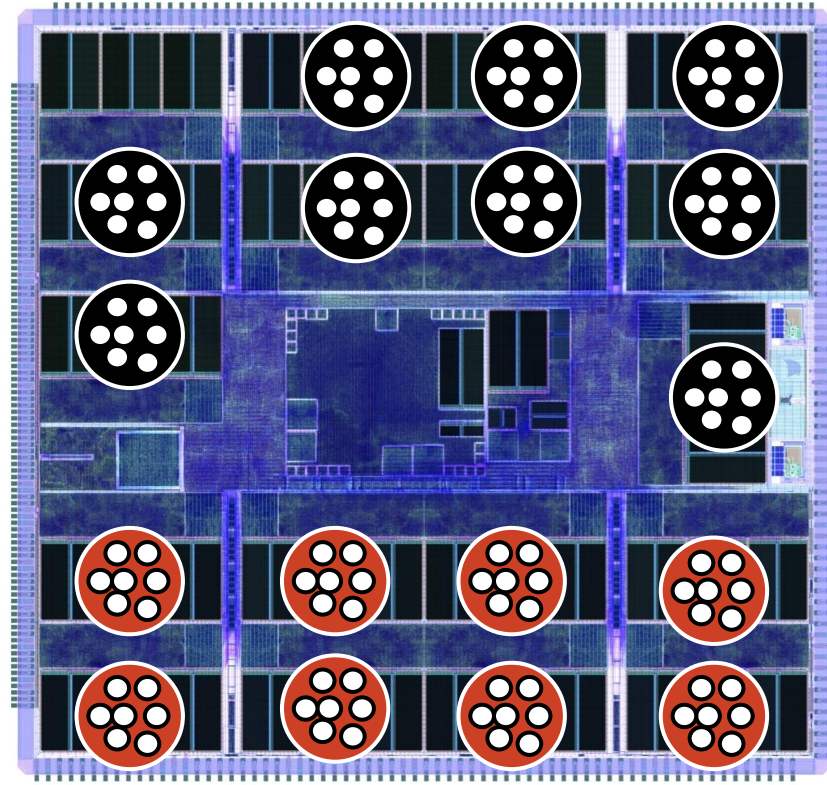
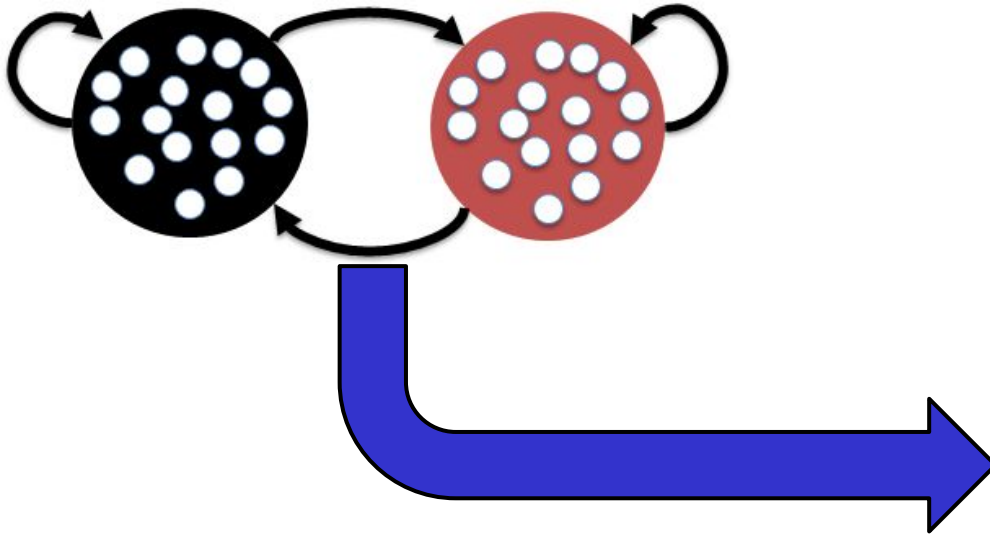


Presynaptic

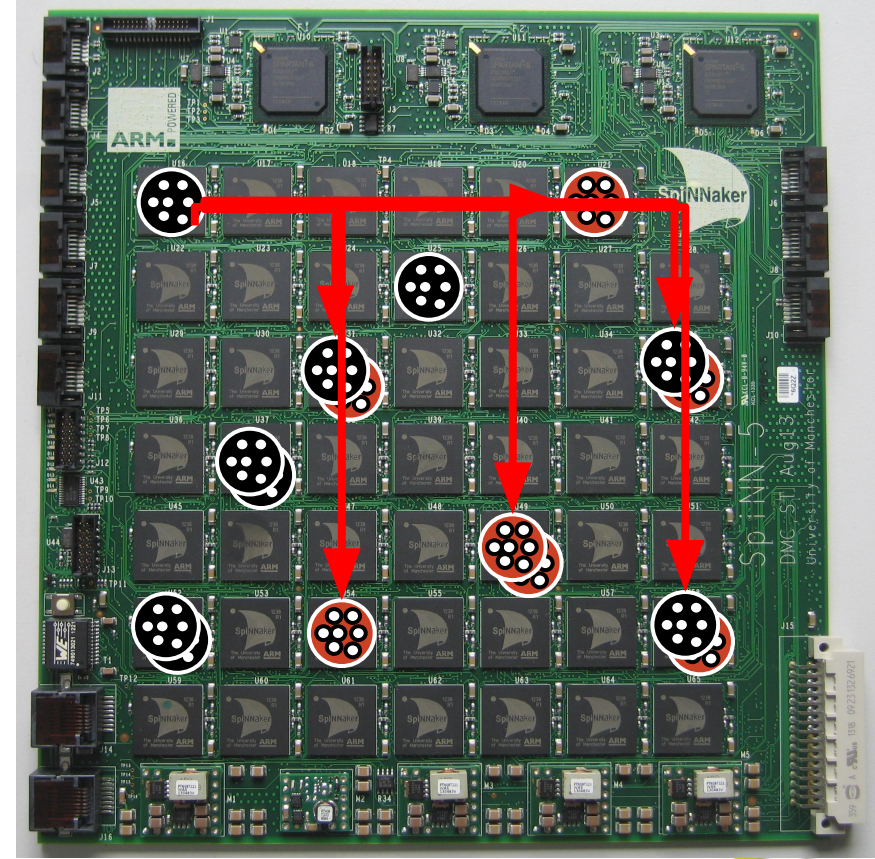
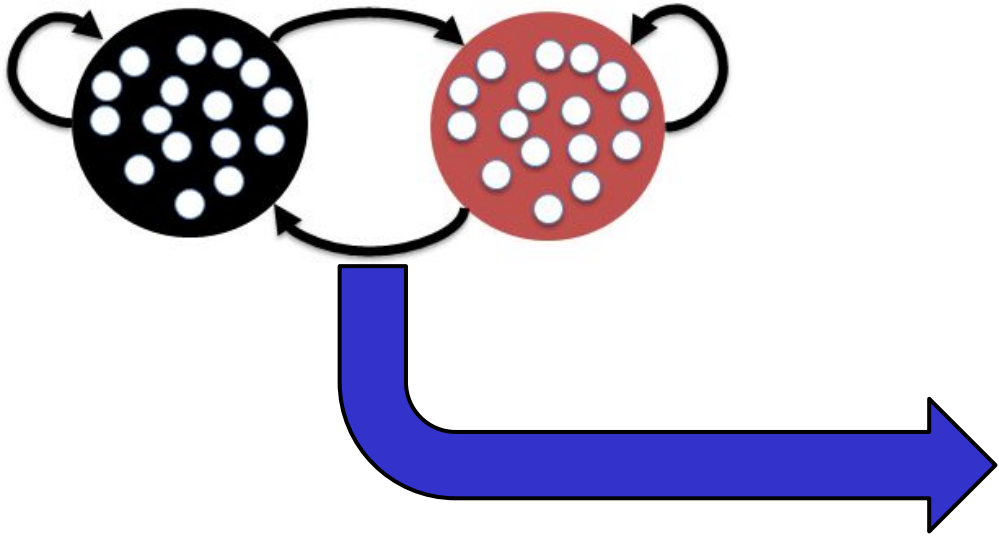
Postsynaptic



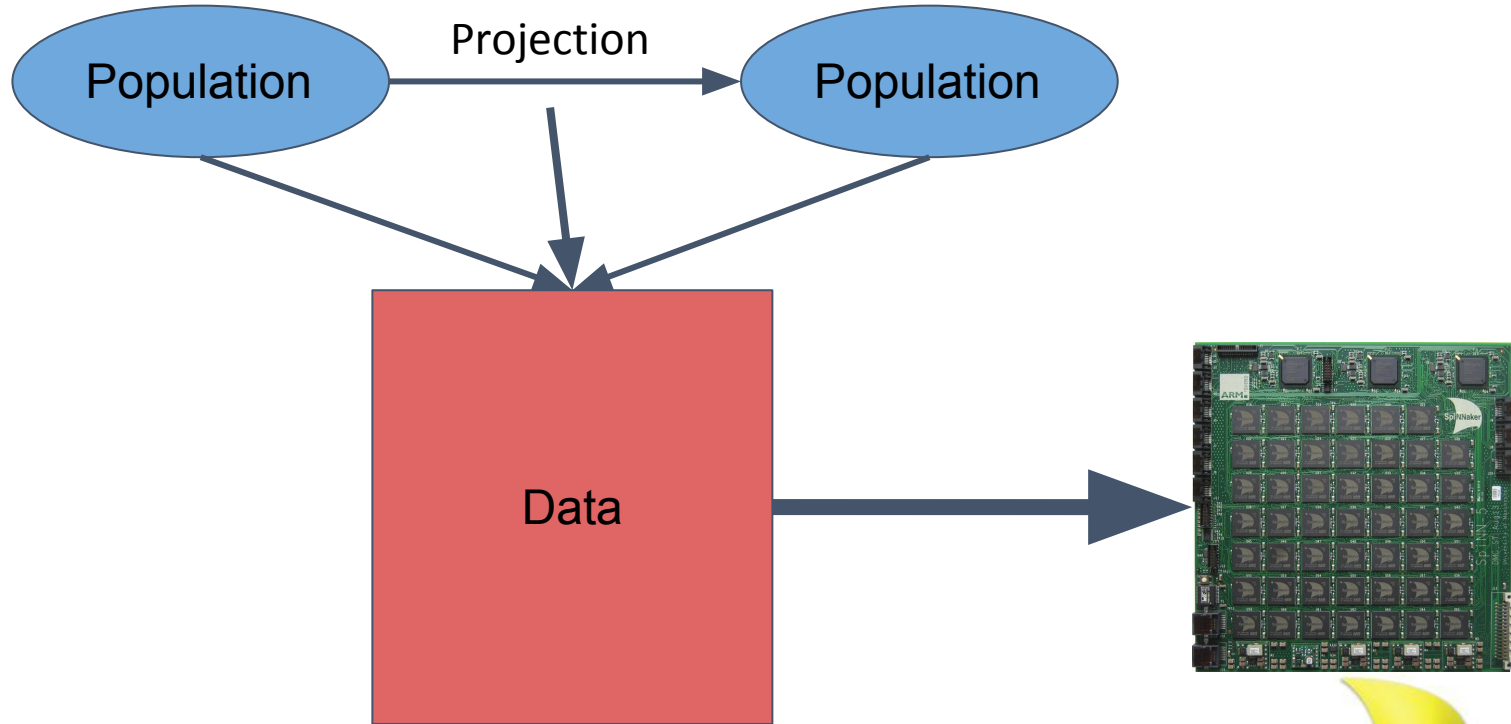
# Host Neural Network Software



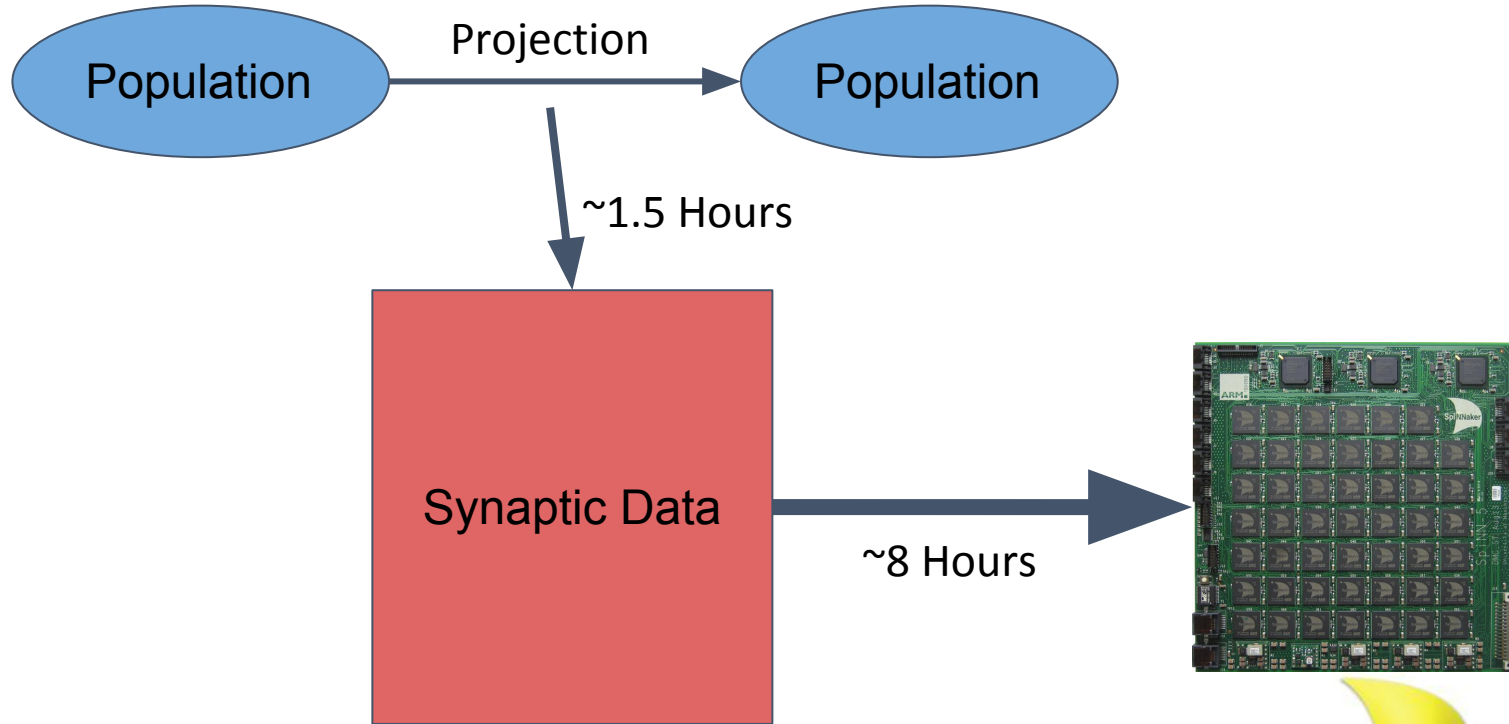
# Host Neural Network Software



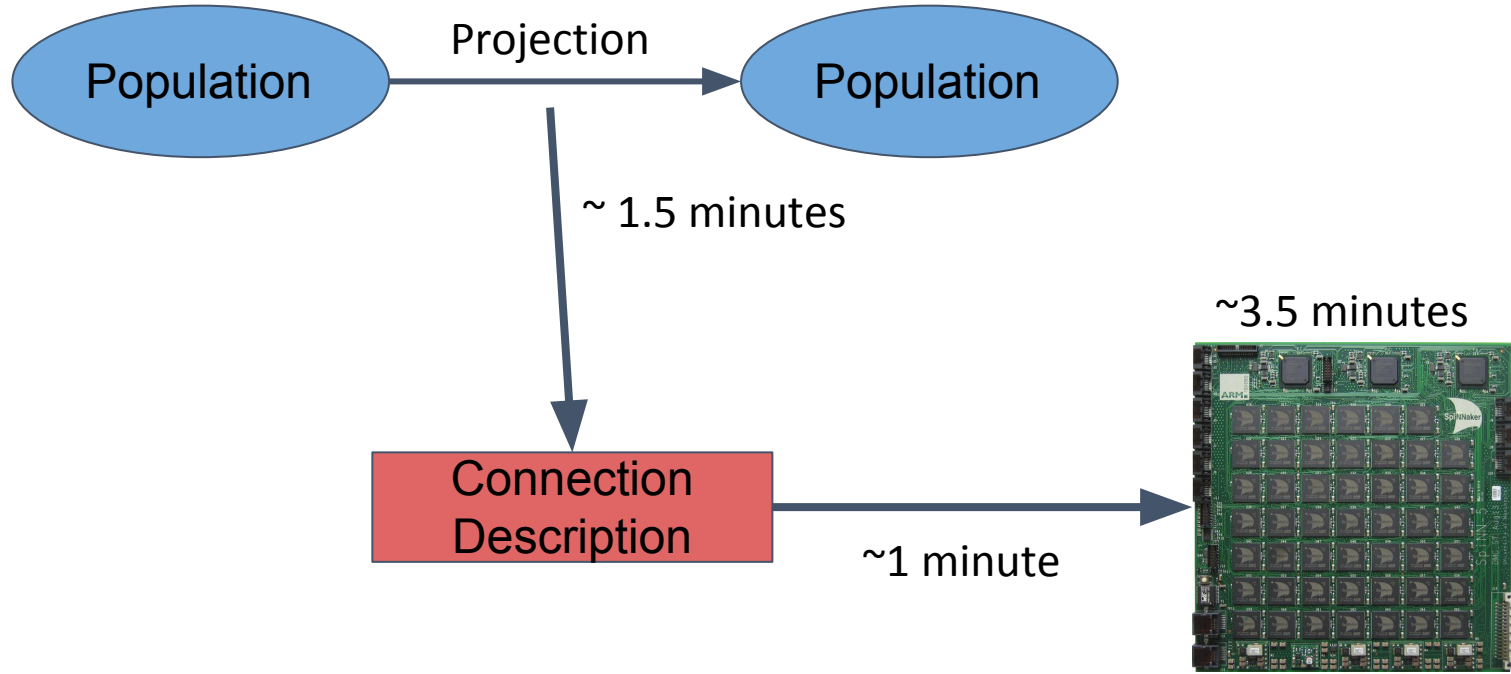
# Loading Neural Networks



# Loading Neural Network Connectivity

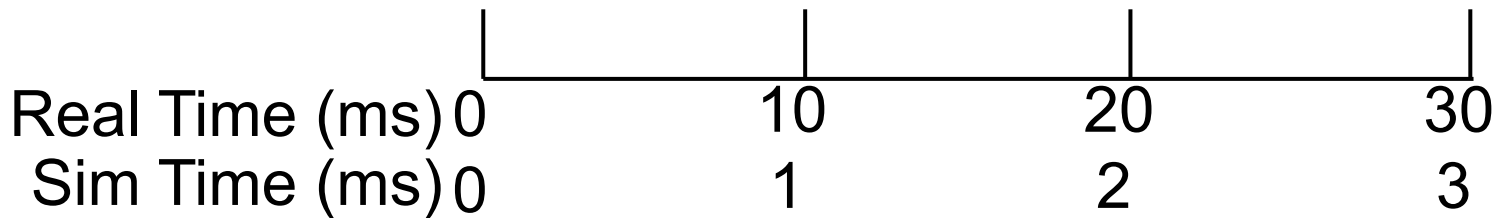
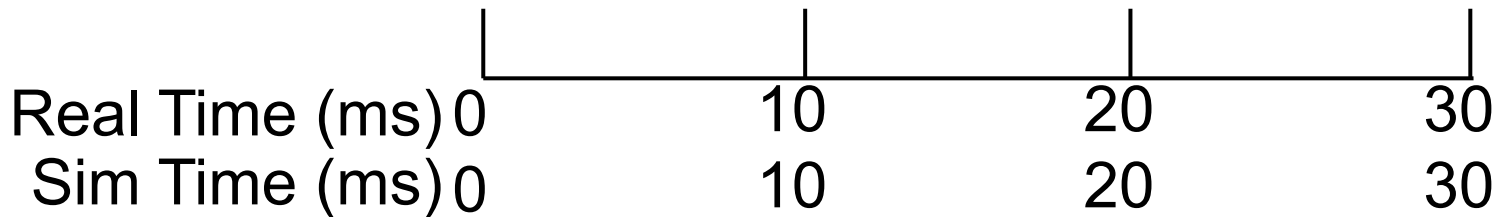


# Loading Neural Network Connectivity





# Execution: Time Scaling



# Live I/O Support

Robot

Spikes or Commands

SpynnakerLiveSpikes  
Connection

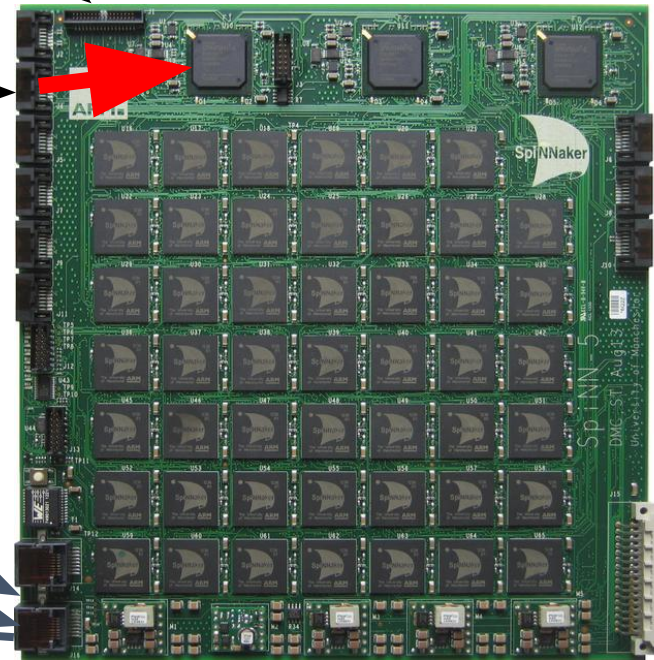
SpynnakerPoissonControl  
Connection

EthernetControl  
Connection

Spikes

Poisson  
Rates

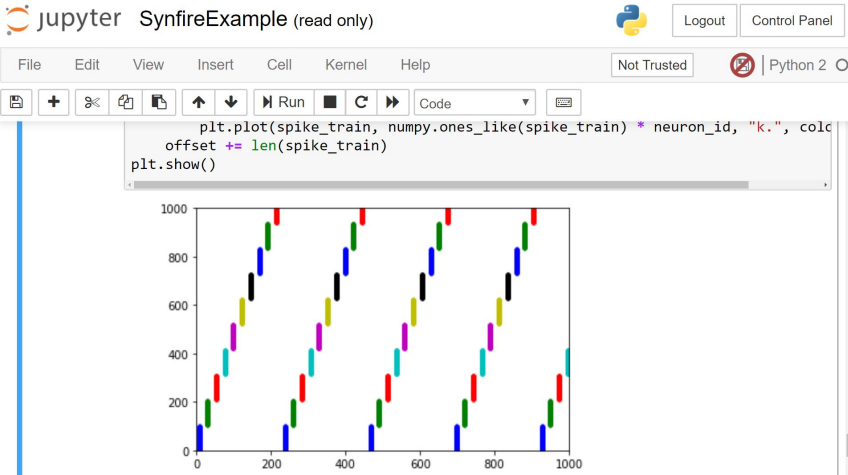
Membrane  
Voltages



# Access to SpiNNaker



Remote SpiNNaker  
Batch Processing



COLLABORATORY HOME COLLABS PLATFORMS HELP FEEDBACK FORUM

Neuromorphic Computing Platform Public Member

Navigation Overview Guidebook Create a Collab Storage Team Settings News Issues

Workspace Overview

Collaboration 12 members - 0 available Show all

## Neuromorphic Computing platform

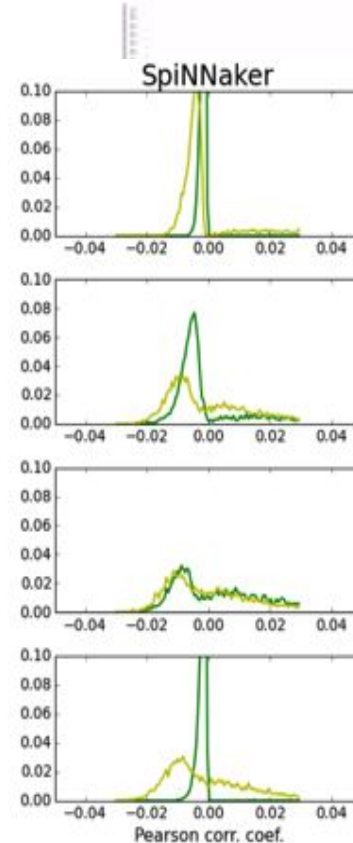
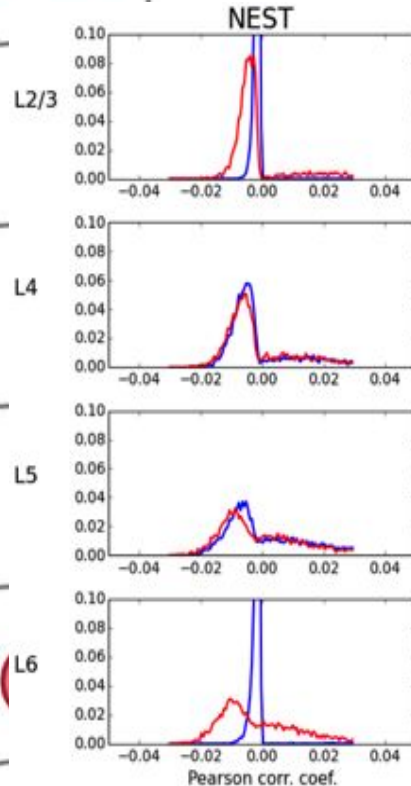
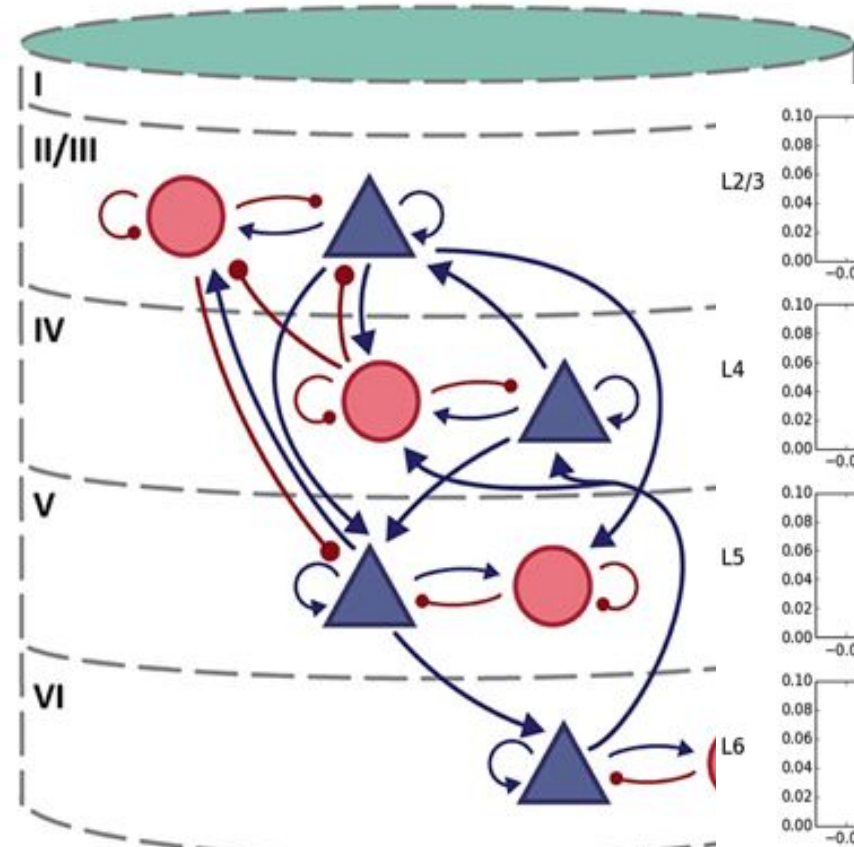
A sub-project of the Human Brain Project

Get started! Twitter Youtube Contact-us

Human Brain Project 2017. Cookie statement Terms of Service

# Examples

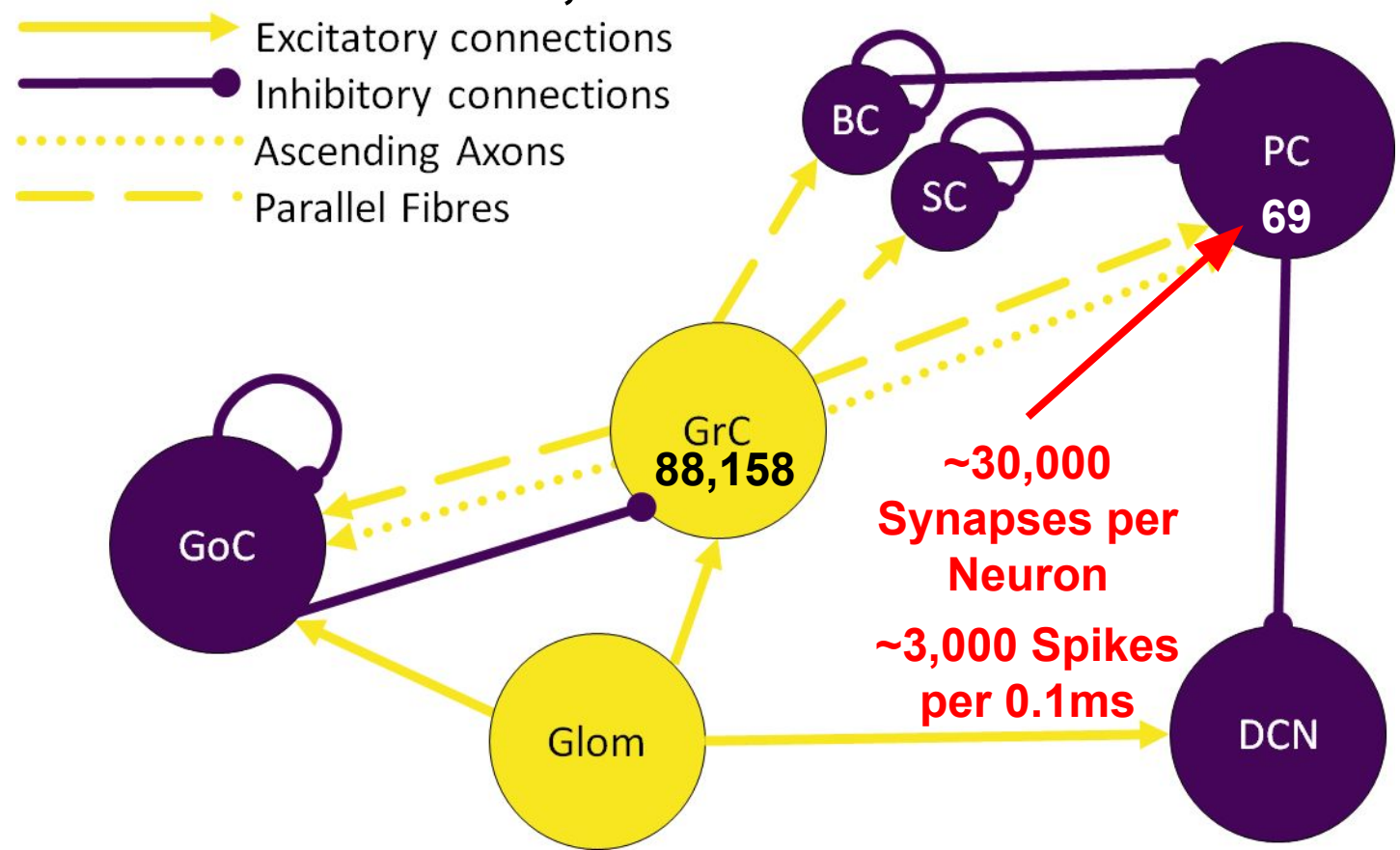
# Cortical Microcircuit Model



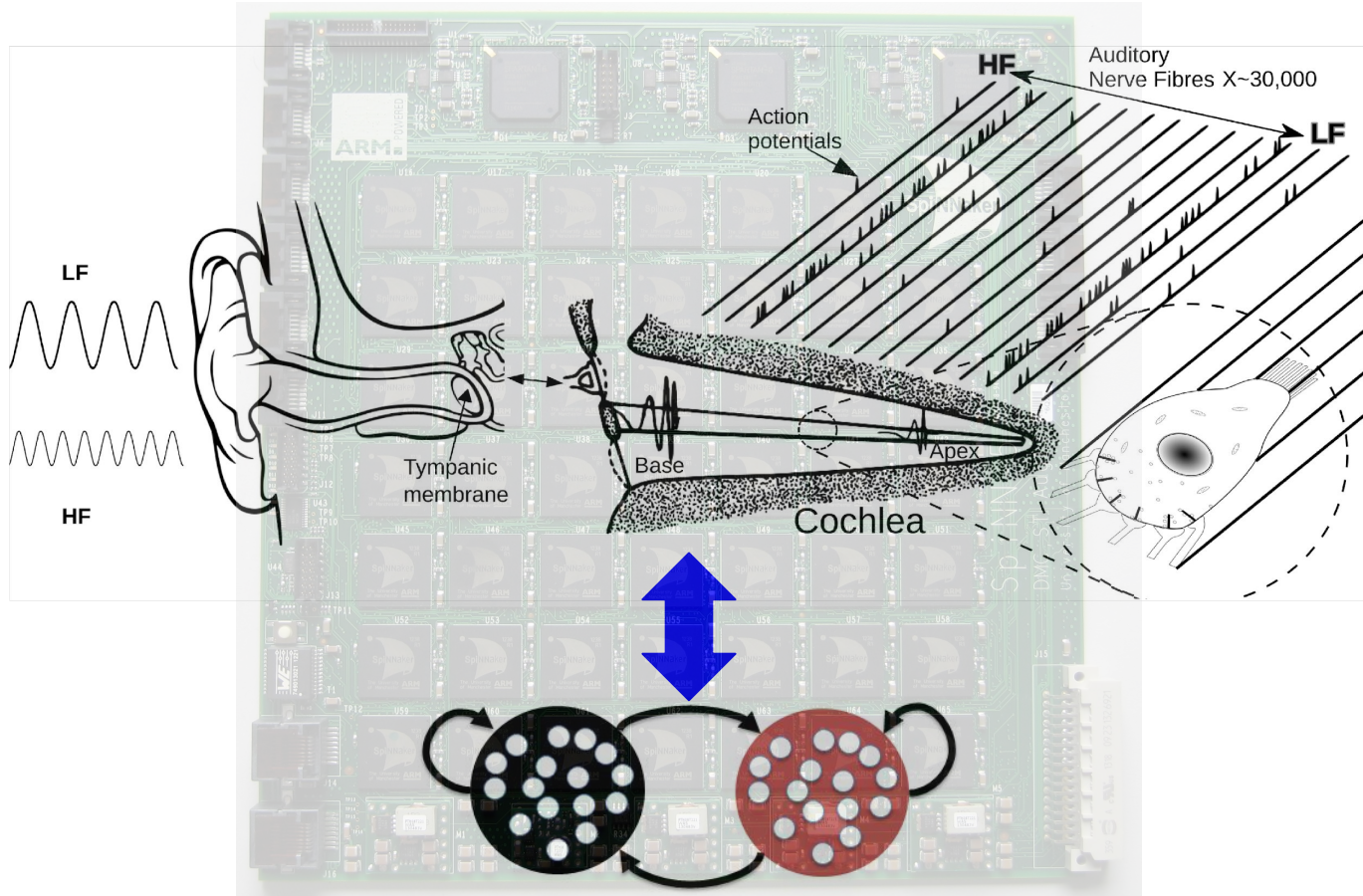


# Cerebellum Model (in progress)

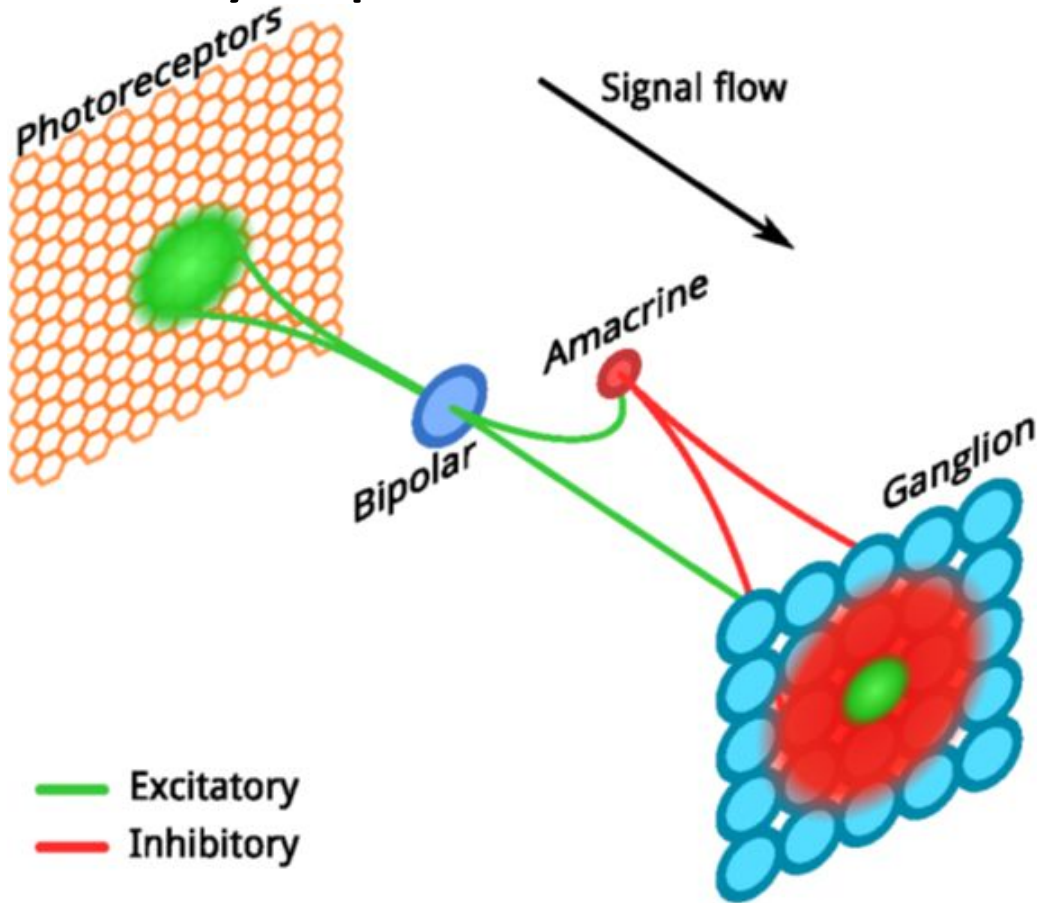
## 96,737 Neurons



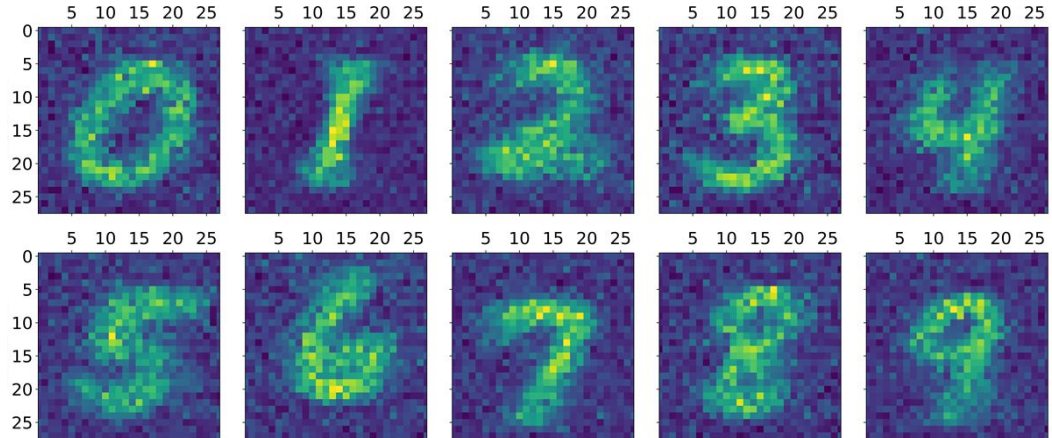
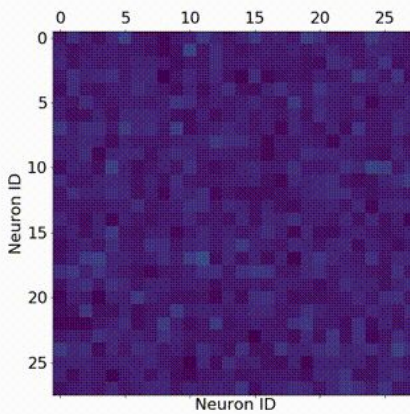
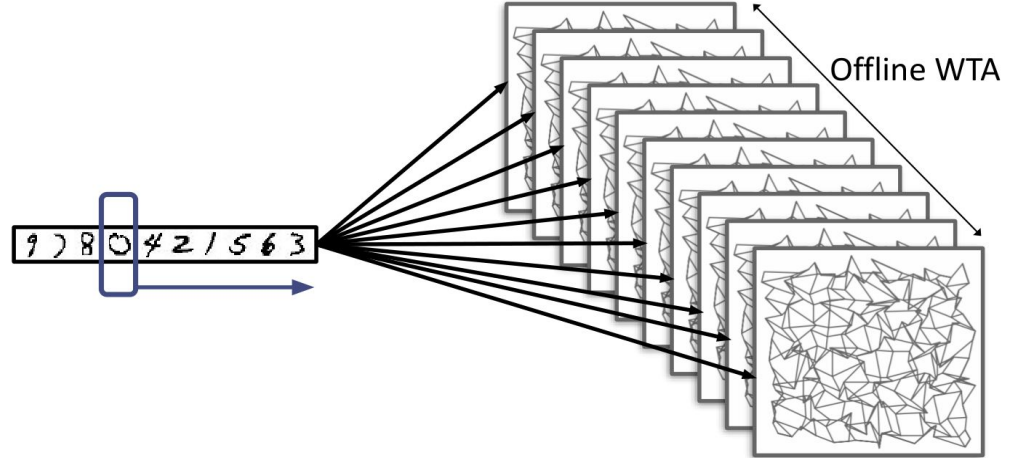
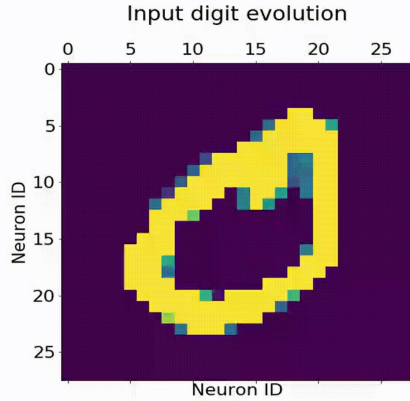
# Sensory Input: SpiNNaker



# Sensory Input: Retina

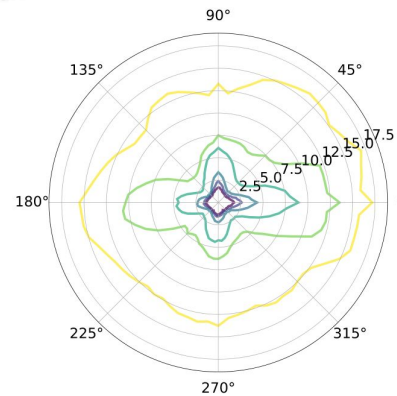
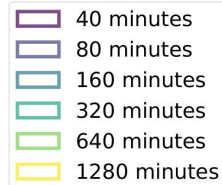
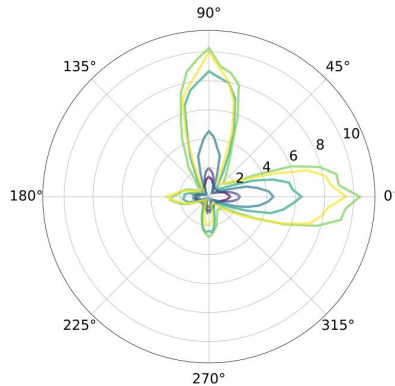
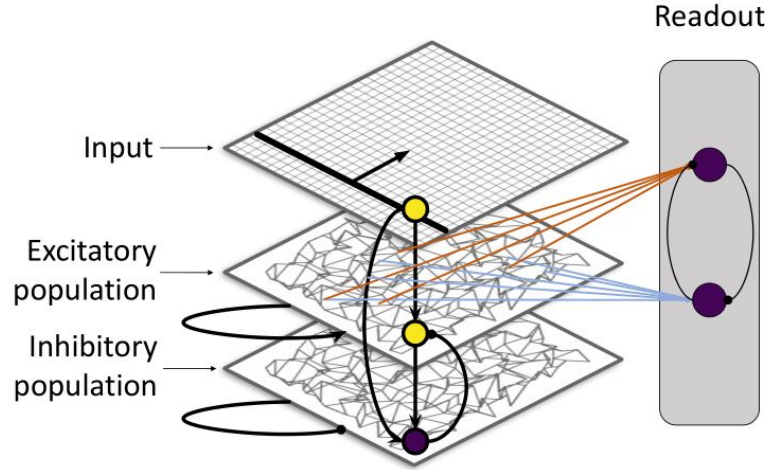


# Structural Plasticity: MNIST



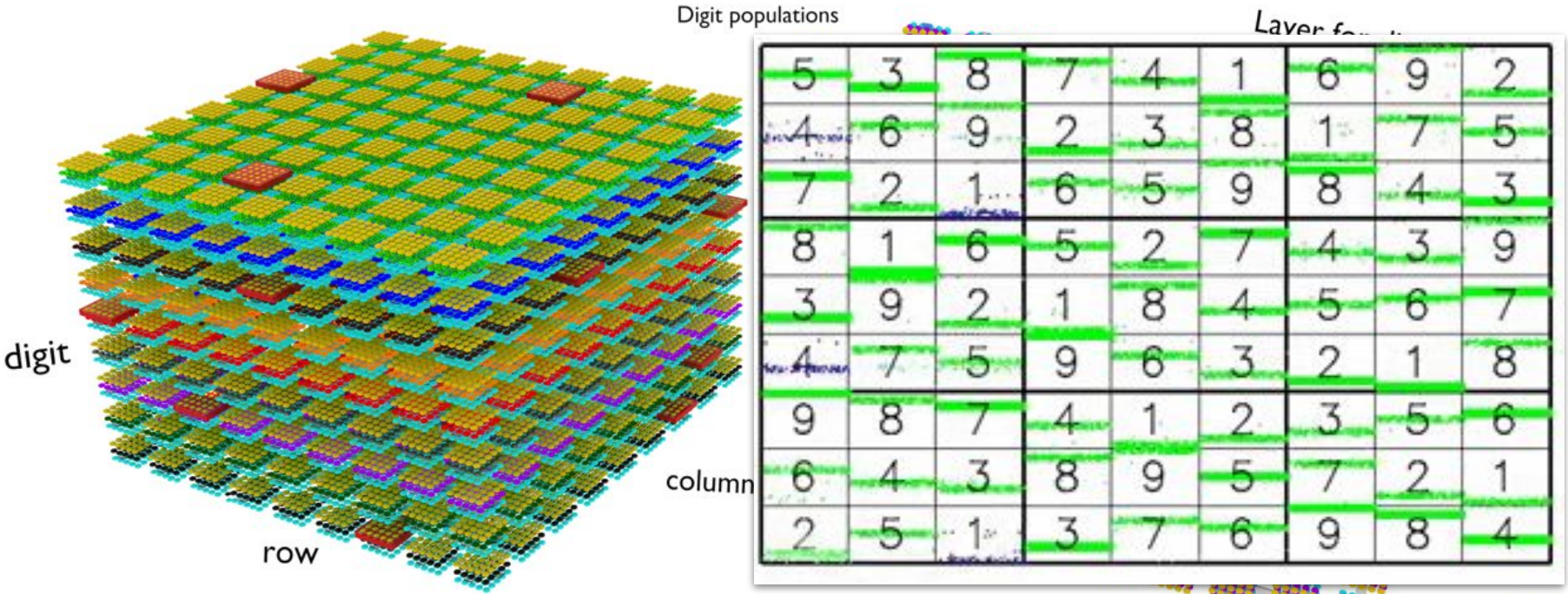


# Structural Plasticity: Motion Detection



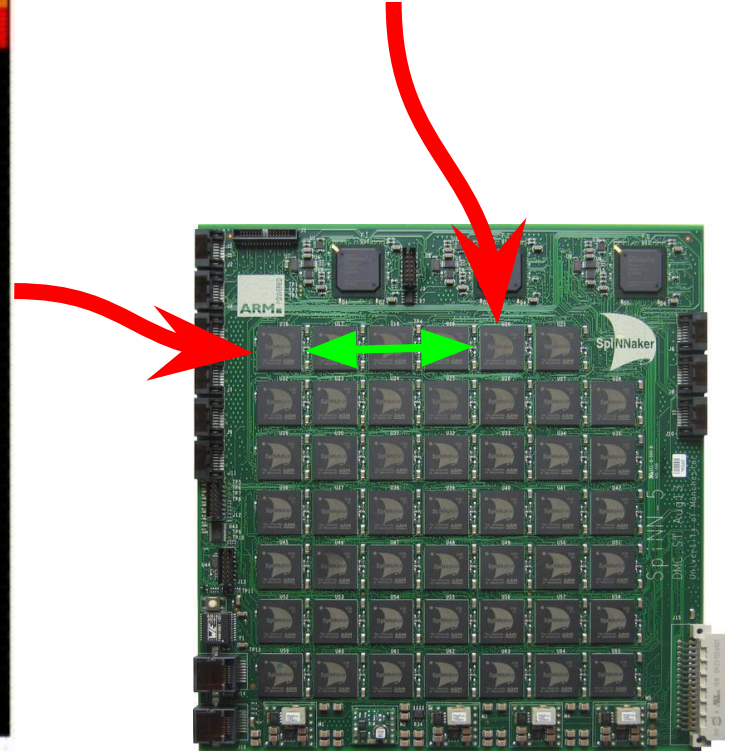
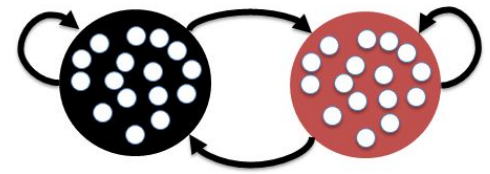
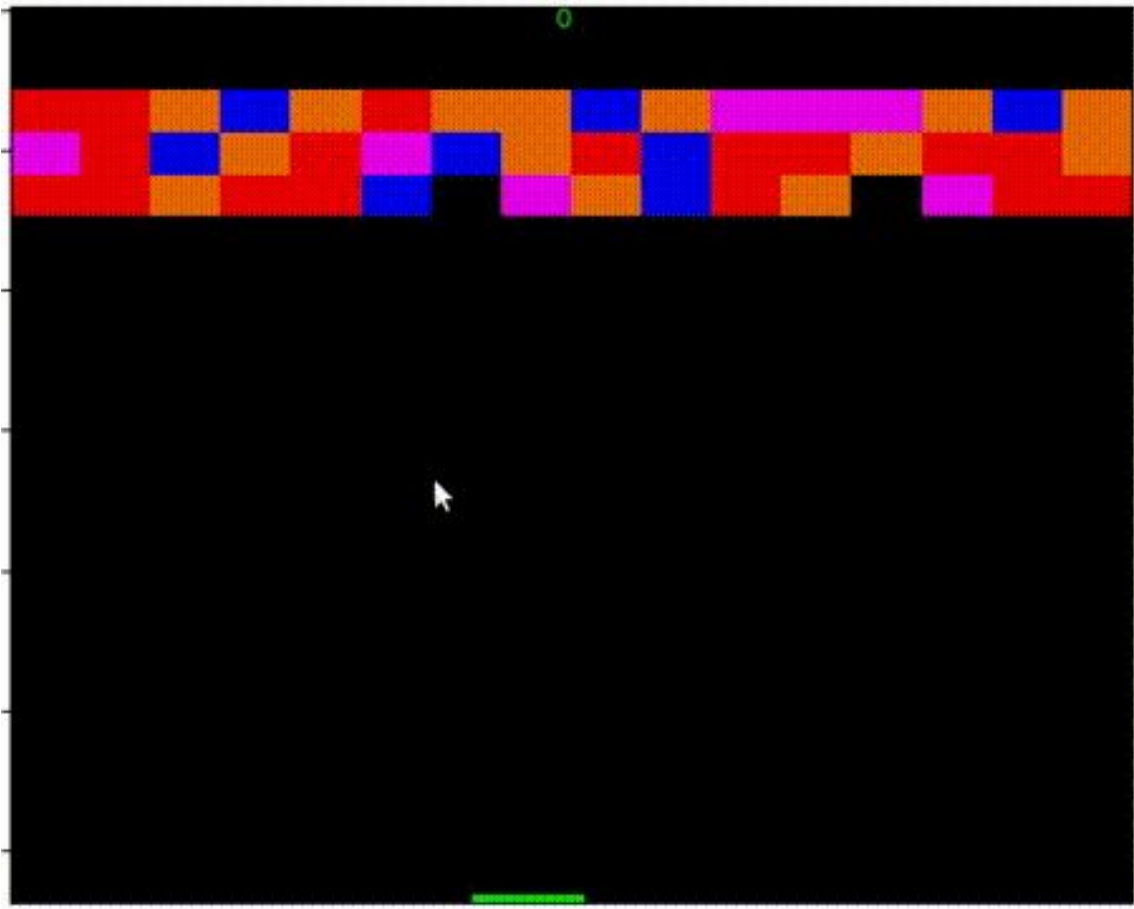


# Sudoku "Solver"

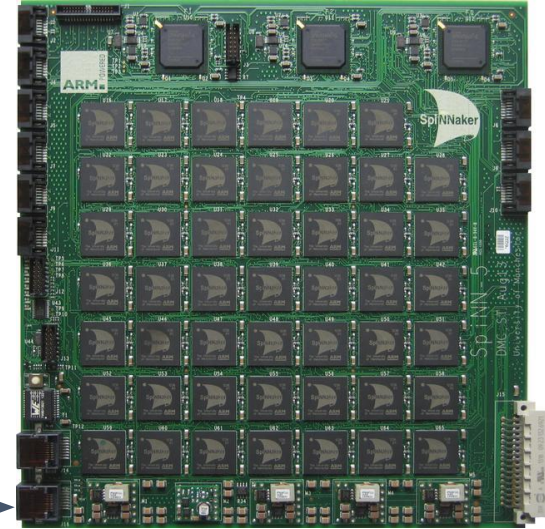


● Stimulation population   
 ● Dissipation population   
 ■ Clues population   
 ■ Inhibitory connections

# Virtual Environments: Breakout

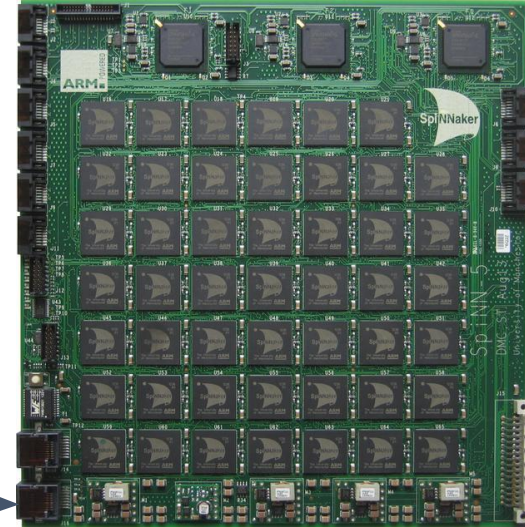


# Virtual Environments: OpenAI Gym

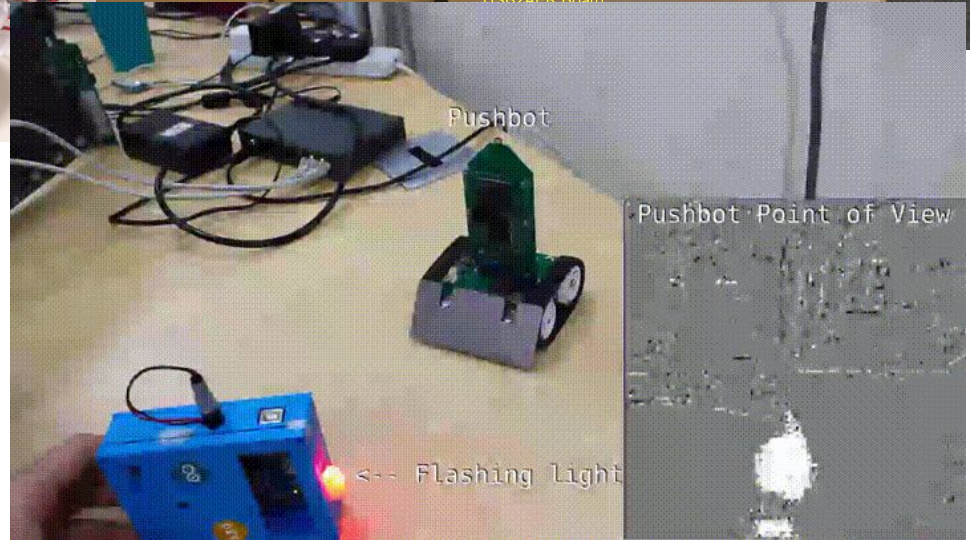
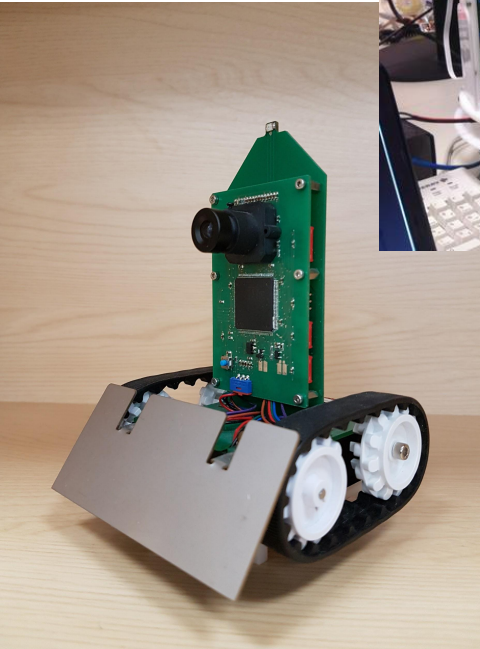
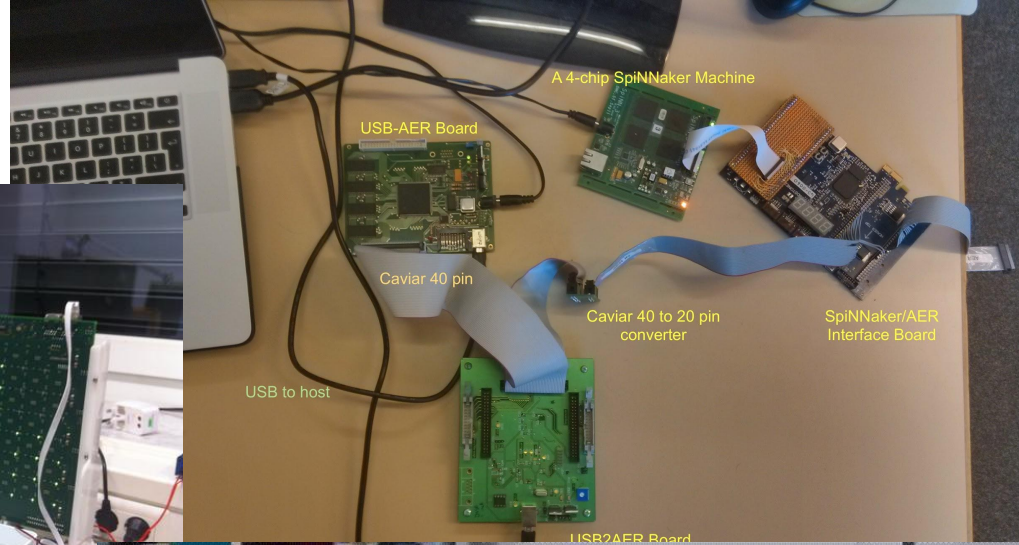
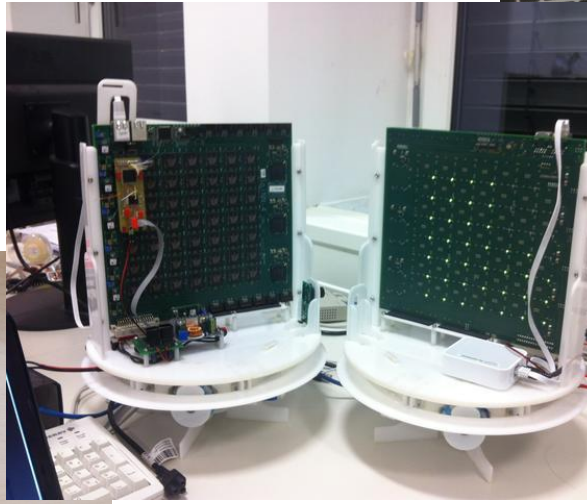




# Virtual Neurorobotics Environment

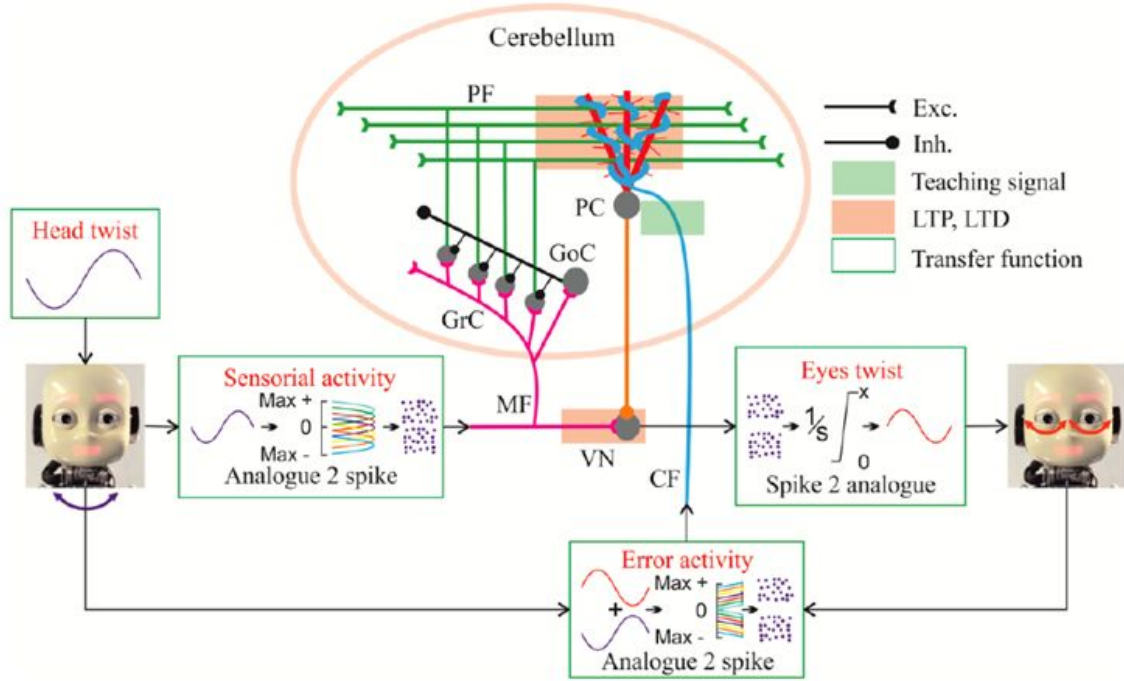


# Robotics

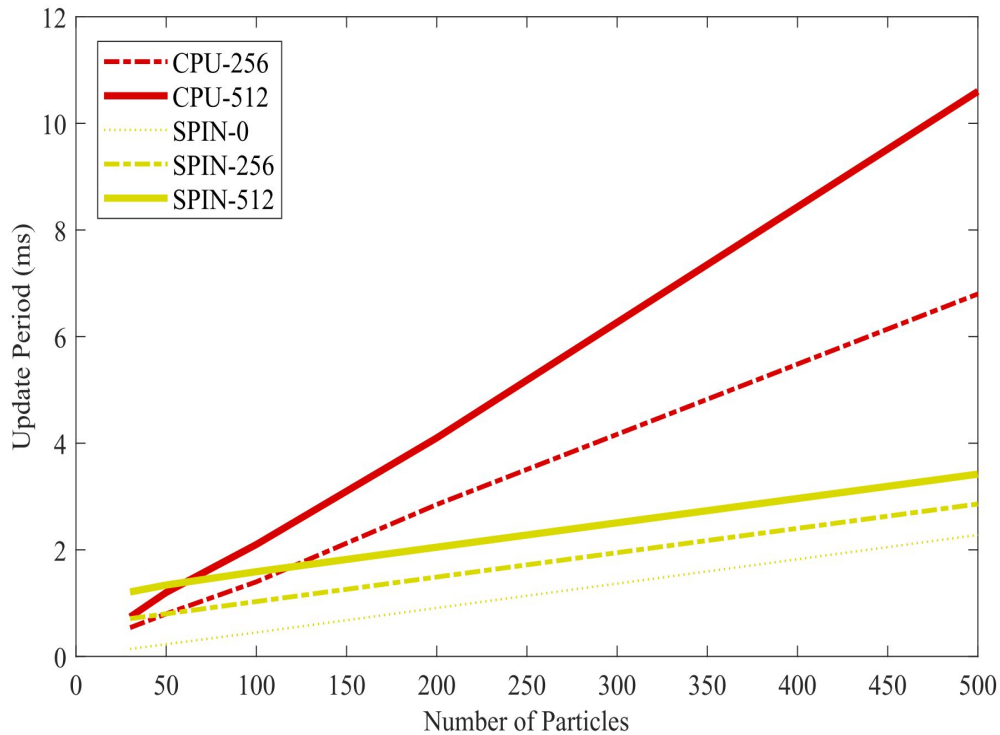
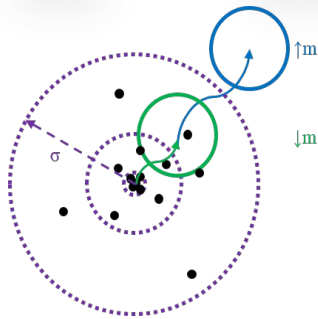
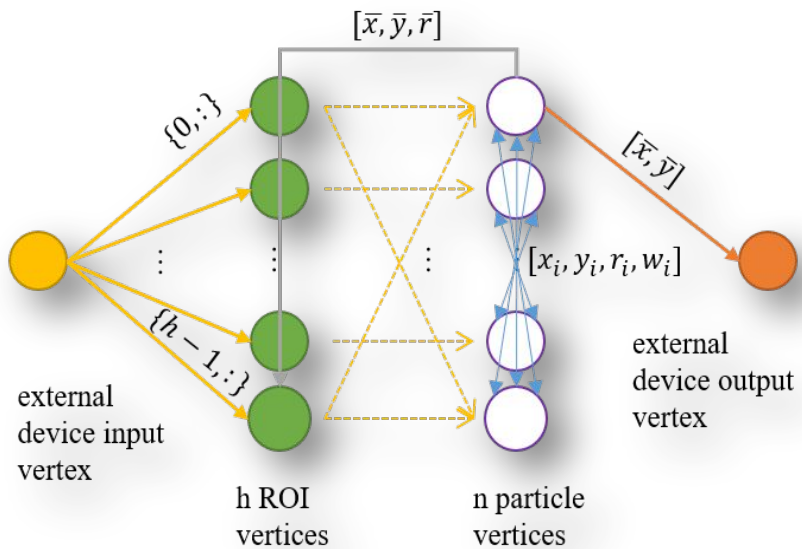




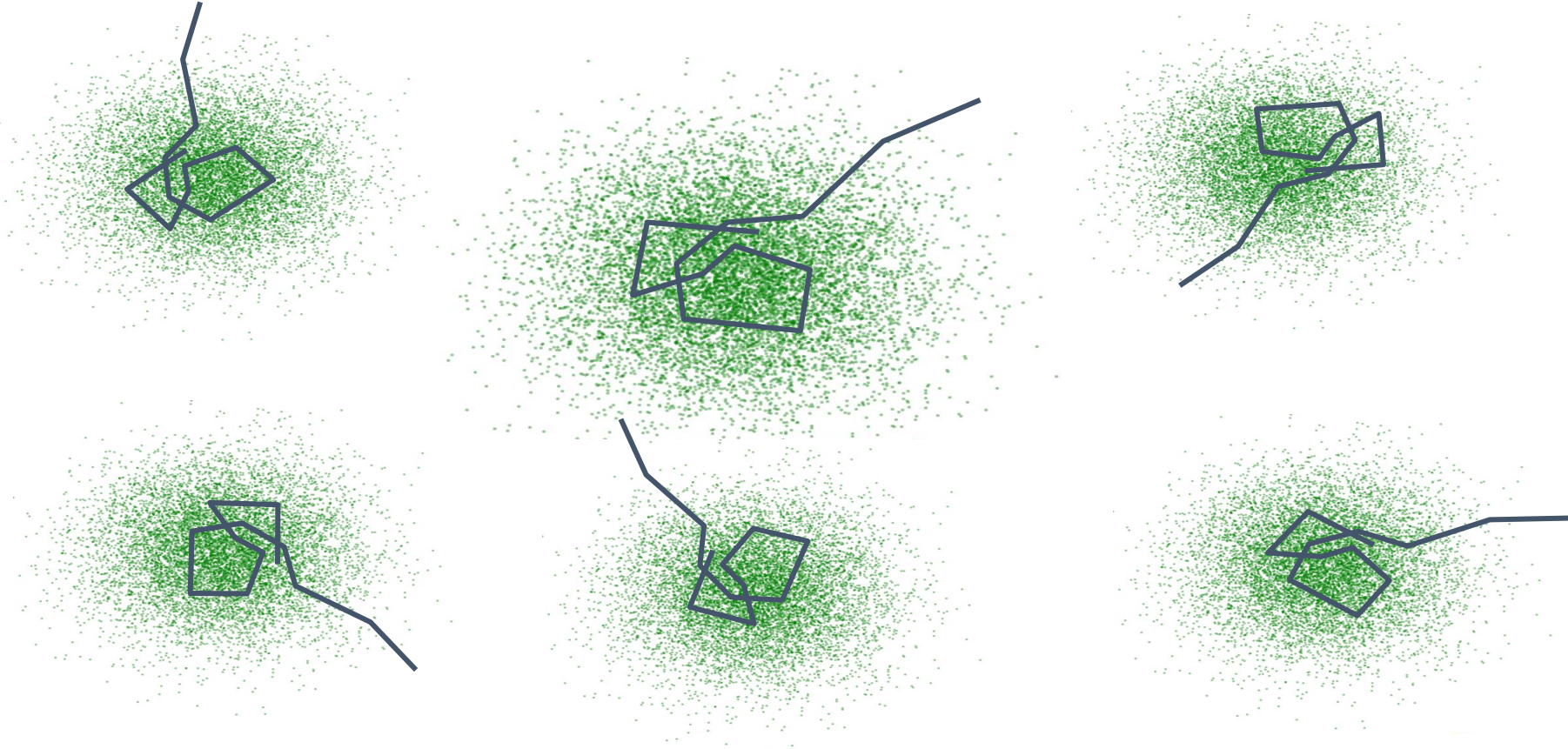
# iCub Cerebellum (in Progress)



# Non-Neural Applications: Particle Filter

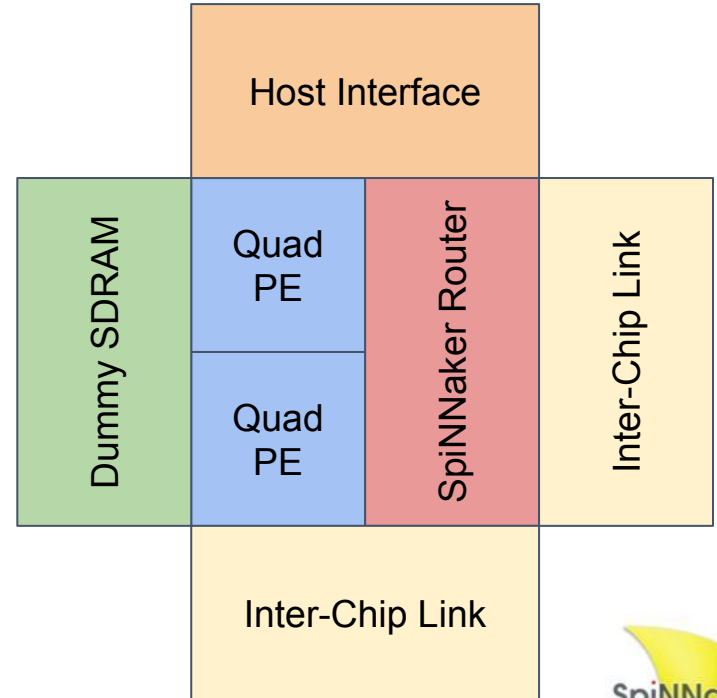
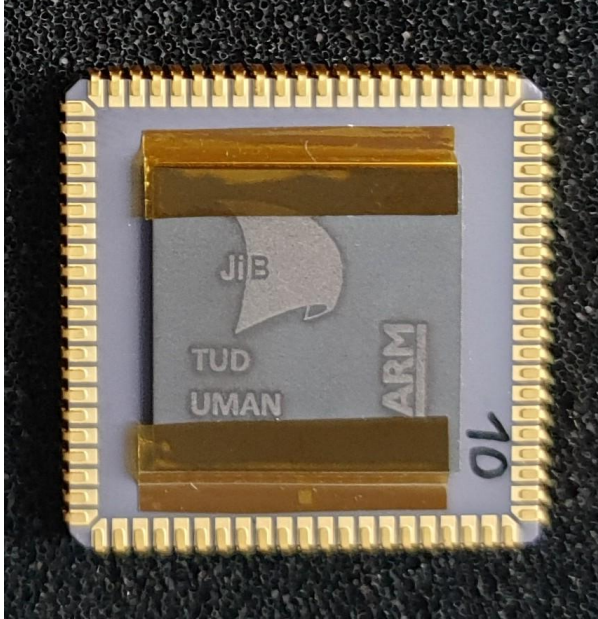


# Non-Neural Applications: Markov Chain Monte Carlo (MCMC)



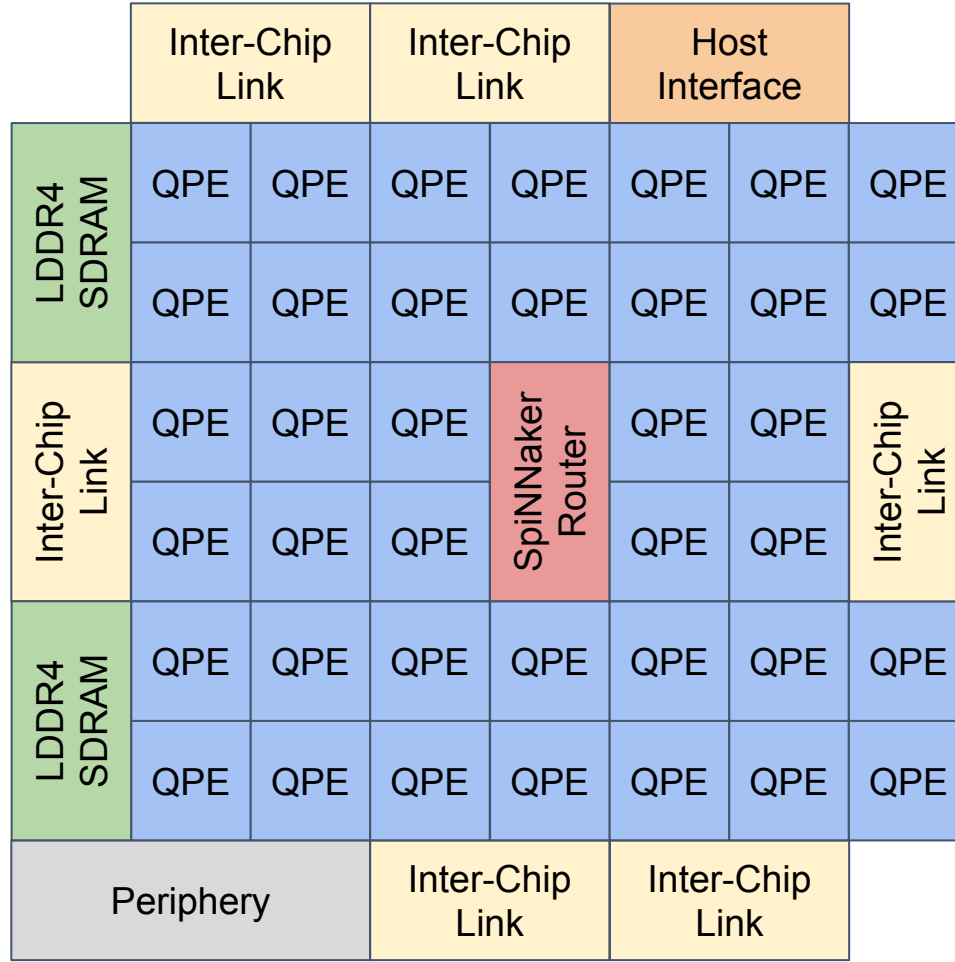
# The Future

# SpiNNaker 2: JIB 1 Test Chip

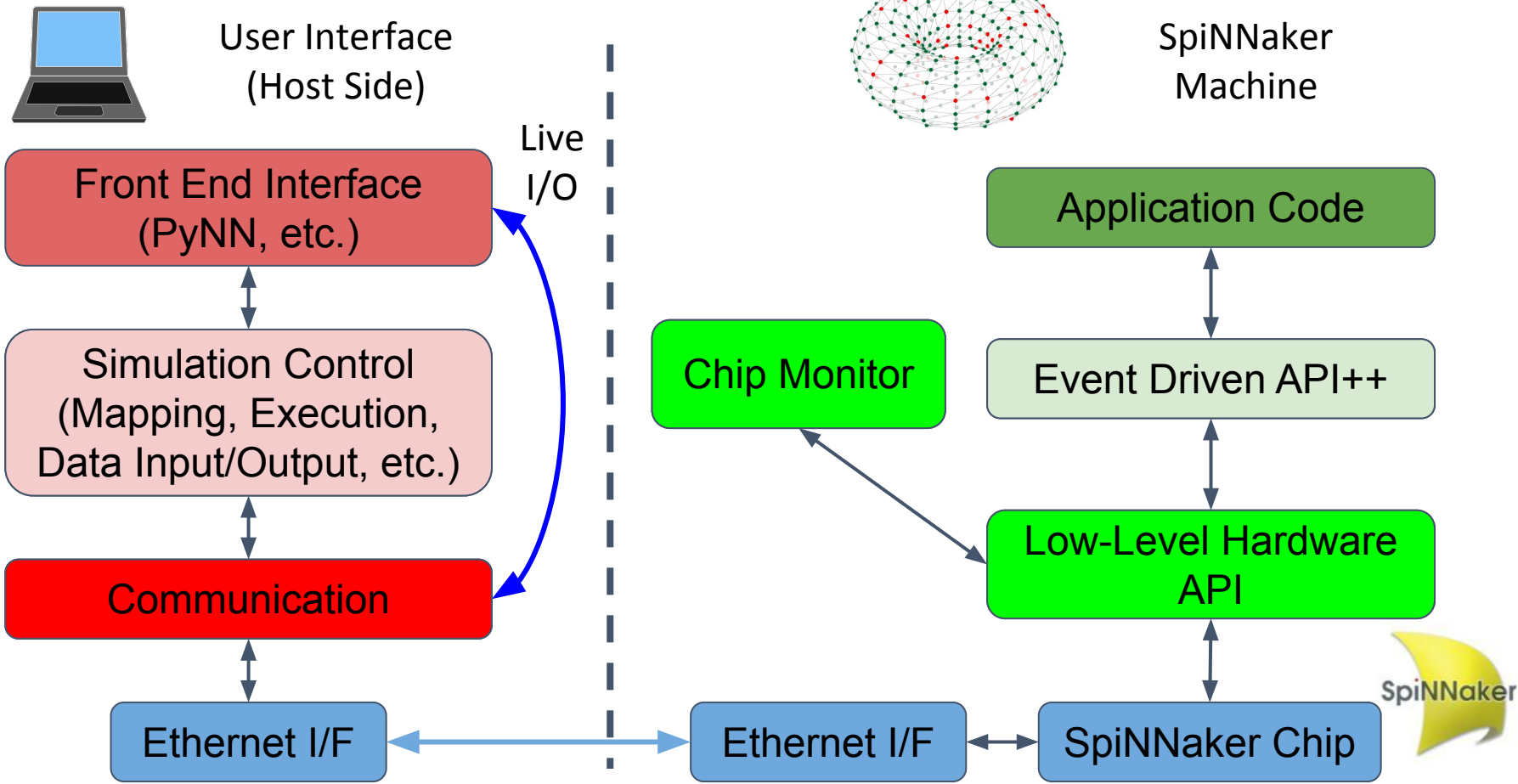
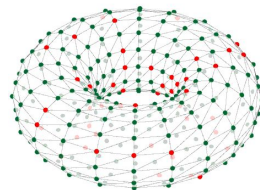


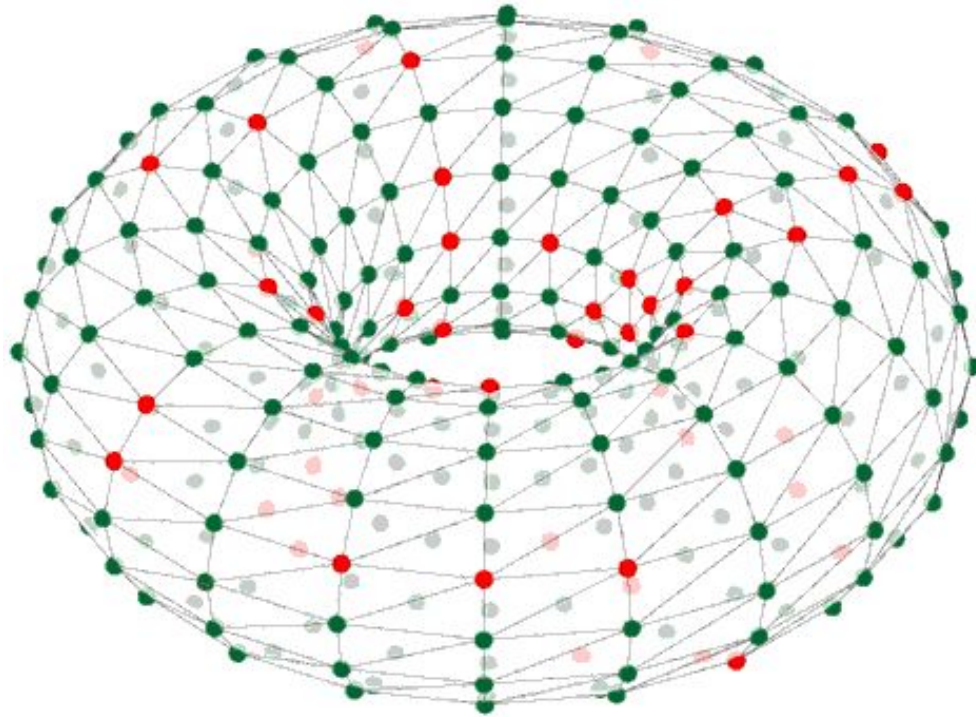


# SpiNNaker 2



# SpiNNaker 2 Software





# Questions?