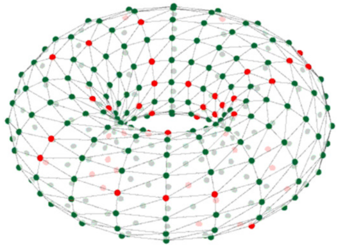
Writing an Application for SpiNNaker - Introduction



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Contents

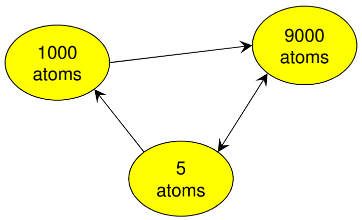
View of an application distributed across parallel processors

- Two main activities:
- Computation
- Communication

- Think of the problem as a graph:
- Vertex = computation node
- Edge = flow of information between nodes

- Node can hold a collections of objects of the same type, which we call ***atoms***

- e.g. Many spiking neurons in one population



Design Process for New Applications

- **The application designer** creates components (nodes and communication types)

- These components plug into our tool chain

- A **user** can then invoke the Graph Front End (GFE) to create and run their own networks on SpiNNaker

- Input is textual, like a PyNN script, in which the user instantiates the components created by the application designer

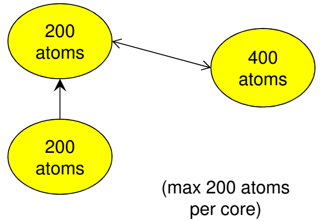
- Graph Front End is NOT a Graphical Interface - No GUI!

Example script: Conway's Game of Life

```
import spinnaker_graph_front_end as front_end
import sys

# set up the front end and ask for a machine with 48 chips
front_end.setup()

cell_1 = MyCell()
cell_2 = MyCell()
edge = MachineEdge(cell_1, cell_2)
front_end.add_machine_vertex_instance(cell_1)
front_end.add_machine_vertex_instance(cell_2)
front_end.add_machine_edge_instance(edge, "STATE")

# run the simulation for 5 seconds
front_end.run(5000)

# clean yp the machine for the next application.
front_end.stop()
```


Design Considerations I: Finite resources per core

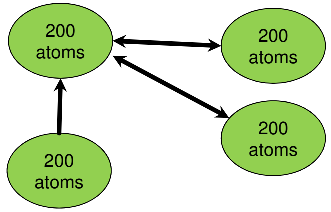
- The user's graph will be mapped to the cores of the SpiNNaker machine



- Each core has finite resource:
- Compute power
- Local memory
- Share of SDRAM capacity & bandwidth
- Communications bandwidth for packets

- Where each vertex represents many atoms we ***partition*** each one into smaller pieces, so that one piece fits on one core:

- **Application graph** maps to **Machine Graph**
- Edges also split to maintain correct connectivity



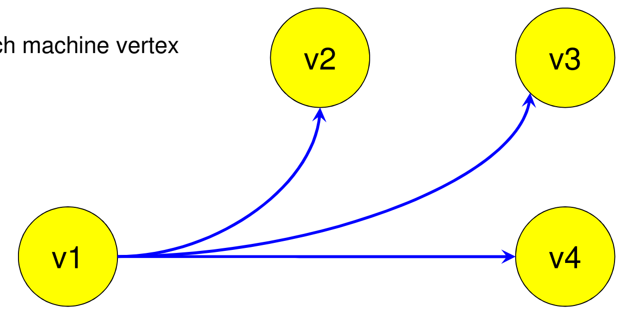
- Merging of vertices NOT currently supported!

Design Considerations II: Dataflow between Vertices

- Consider the pattern of messages flowing from each vertex:
- Case 1: Messages always go to the same set of targets
- Case 2: Messages go to different targets at different times

- Case 1: Homogeneous data flow
- e.g. spikes in neural simulation

- One **identifier** for each machine vertex



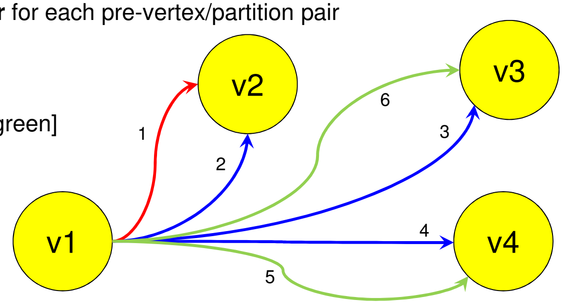
Design Considerations II: Dataflow between Vertices

- Case 2: Data send to different targets at different times:
- e.g. multi-layered perceptron, with forward and backward data flow
- Useful when there are different modes of operation

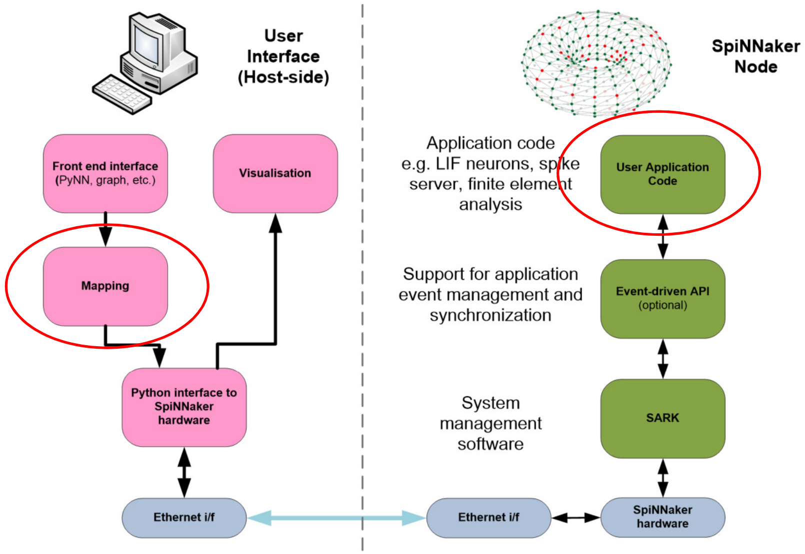
- Group edges so that those in same mode are together
- A grouping is called a **partition**

- Assign a separate **identifier** for each pre-vertex/partition pair

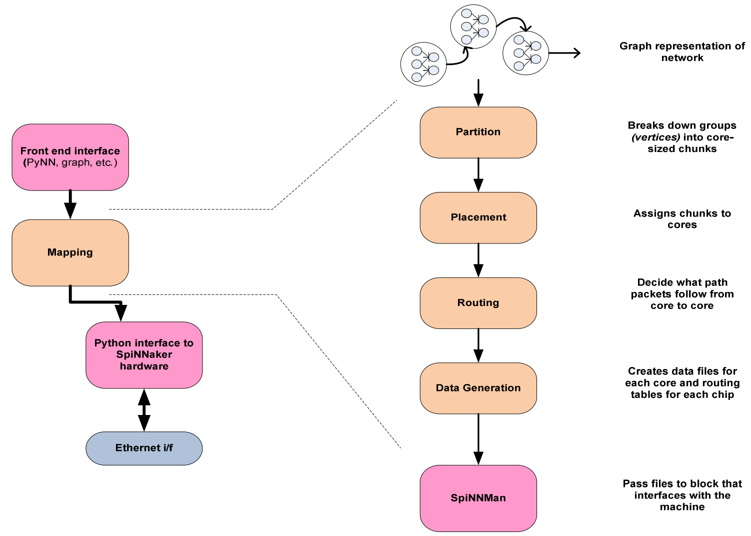
- Six edges [1, 2, .., 6]
- Three partitions [red, blue, green]



Software Stack



Where do you need to supply new information?



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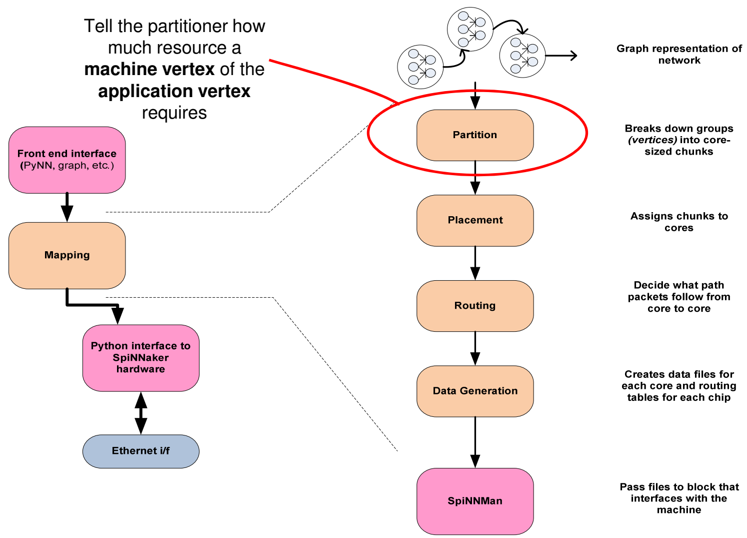

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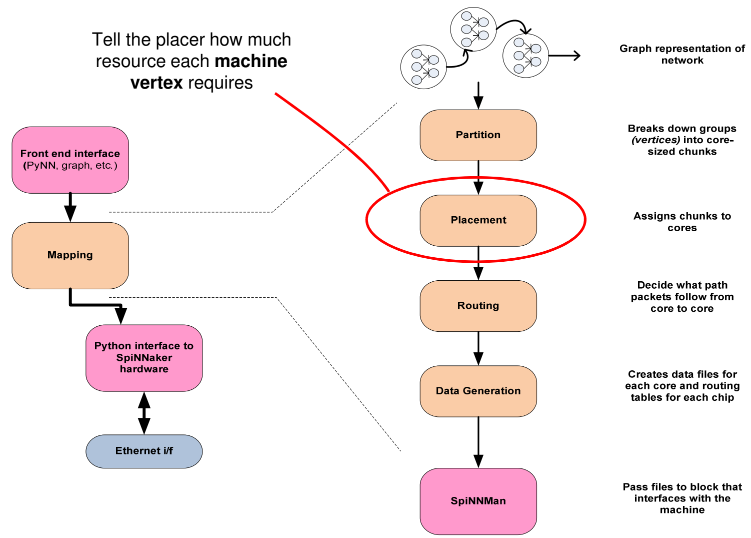

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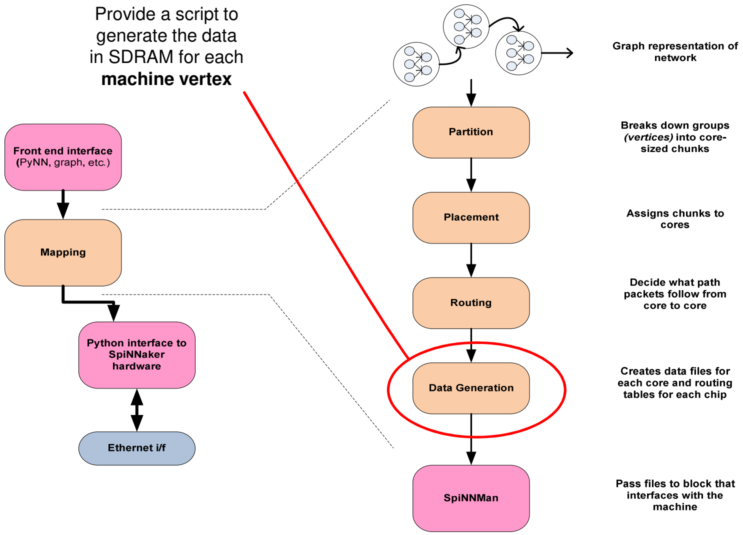

Data Spec. and Data Generation

- Each core running your application needs to generate its local data before it starts simulation
- We provide a simple ***virtual machine*** in which you can execute simple programs to generate this data
- This is the **Data Spec Executor (DSE)**
- The tools run code called the **Data Spec Generator (DSG)** that create a program (the specification or **spec**) for each core that is run by the DSG to generate its data

Summary

- It is useful to abstract any parallel application into the form of a graph with:
- Centres of computation (vertices)
- Connected by communication pathways (edges)

- **Application designer** must describe the computational elements and the communication types and plug those into our tools:
- Executables to run on SpiNNaker (typically written in C)
- Data specification, used to create each nodes data
- Describe resource requirements to allow tools to map networks to cores

- **User** can then specify application networks and run them using the Graph Front End.The tools handle :
- Mapping
- Routing table generation
- Data generation
- Loading
- Simulation
- Results gathering
- And other stuff ….