



Reference Frame

The key to understanding the brain

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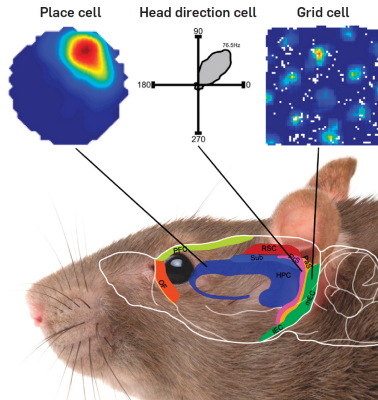
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Outline

- 1 Location & Spatial Mapping
- 2 Cortical Columns
- 3 Thousand Brains Theory
- 4 Our Research

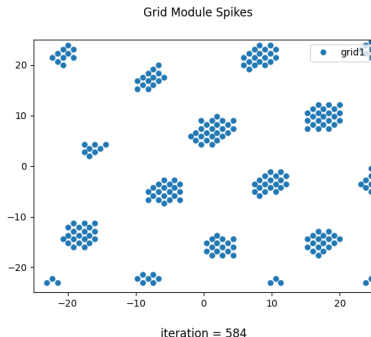
Location Related Cells

There are several cells in **old brain** contributing to navigation and path integration including **border cells**, **head direction cells**, **speed cells**, **grid cells** and **place cells**.



What are Grid Cells?

A grid cell generates a hexagonal pattern of activity that maps an animal's position in space, providing a **coordinate system** for navigation.

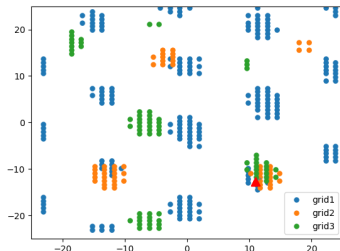
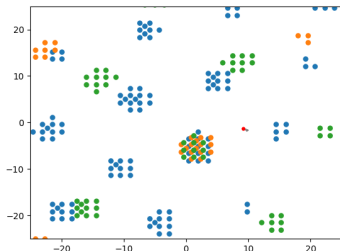


Problems with the activity of a single grid cell

- It fires action potentials only in certain location.
- The representation is ambiguous.

Unique Path Integration

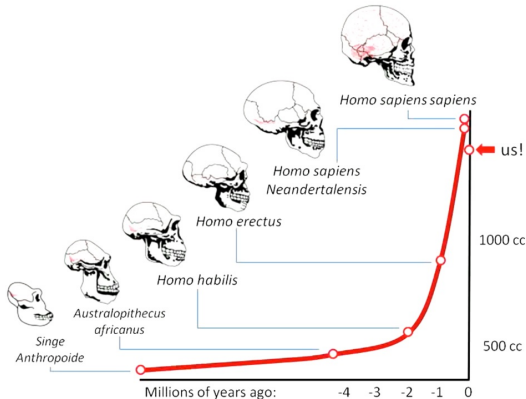
By combining the activity patterns of multiple grid cells with different spatial orientations and scales, the brain can create a unique and precise representation of an animal's location in its environment.



- All the raster plots are from our proposed **Spiking Grid Cell** model, based on **LIF** and **Continuous Attractor Network** model.

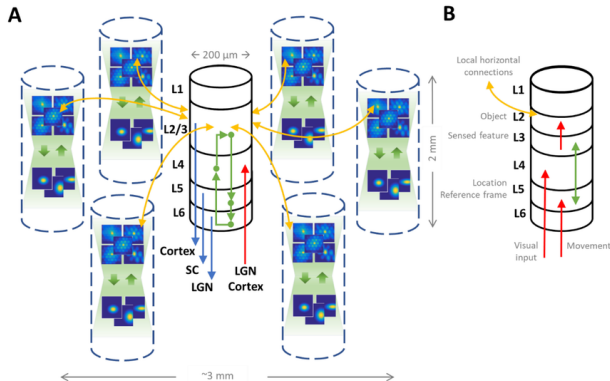
Brain Copies & Pastes!

The **Evolutionary** evidence and also **Brain Slices** of different parts of neocortex, suggests that all different parts of the neocortex has the same structure and building block which has been copied **thousands of times**.



Building Block of Intelligence

The neocortex is composed of thousands of identically structured functional units called **cortical columns**, consisting of 6 cortical layers.



Reference Frame

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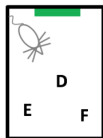
You can think of Reference Frames as **coordinate axis**. Where each model of object and things are put inside these coordinates and the neocortex can keep track of them using **cortical grid cells**.

A

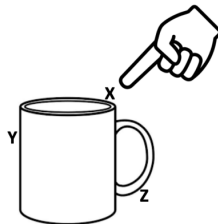
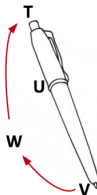
Room 1



Room 2

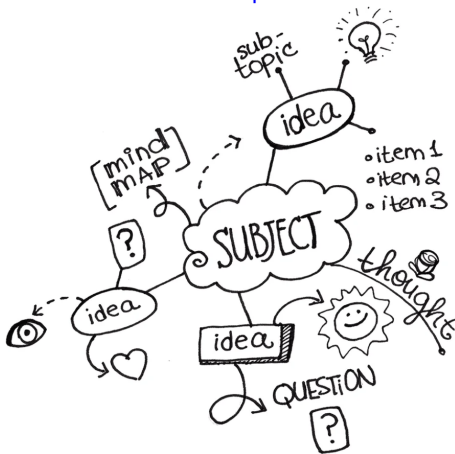


B



Location, Real or Conceptual?

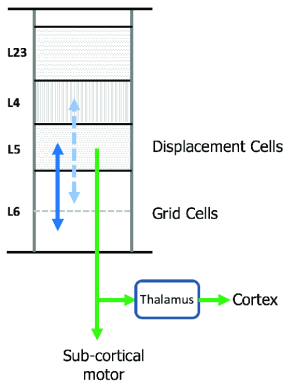
In the **Thousand Brains Theory of Intelligence**, reference frames are crucial for intelligent behavior. meaning, Thinking in all sense is simply **Moving around in reference frame space.**



Where are grid cells in Neocortex?

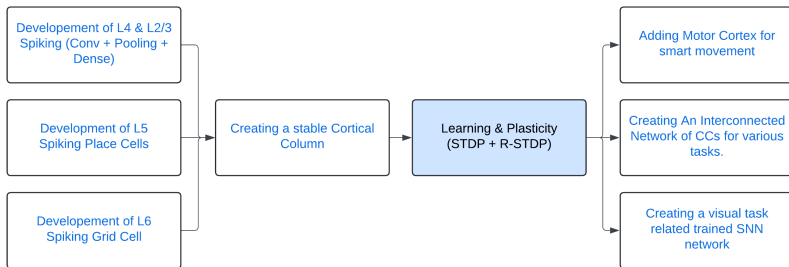
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It has been proposed that grid cells not only exist in MEC, but also all around the neocortex as an essential part of each **cortical column** locating at L6 layer.



Our Research!

Our research focuses on building a cortical column-based intelligent system with combining sensory and location input.



Thanks for listening!
Stay Motivated!



Please feel free to reach out, I'm open to all questions & ideas.
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