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**SEMINAR 2:**
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**Mon. June 9, 14:30-15:30:**

SPEAKER: **Federico Stella (SISSA)**

TITLE: **"How Euclidean is your brain? Neural mechanisms for representing geometry of space. "**

**ABSTRACT:**

The study of the functioning of brain revolves around explaining how this incredibly complex assembly of neurons and connections is used to processes information to form representations of different aspects of the world and to use them to plan and execute actions. The aim of theoretical neuroscience is to develop causal models that can describe, in terms of neural activity, the principles governing the generation of these representations, their mutual interactions and their relationship with the external world.
The portion of brain called Medial Temporal Lobe (MTL), comprising the hippocampus and various other surrounding cortices, has been identified as the centre of a large, distributed network dedicated to the representation of space and contributing to the control of navigation. Among the various cell populations found in this region (like place cells, head direction cells and border cells), conveying information about different aspects of the animal location with respect to the external environment, grid cells, due to their salient properties, have attracted much of the attention of theoreticians. A grid cell fires when the animal is located at a set of locations in an environment. Strikingly, these locations form a grid of equilateral triangles covering the entire environment, providing a regular tessellation of space that appears to be essentially invariant across environments.

Grid cells properties have been explored (either experimentally or theoretically) only in the case of planar, two-dimensional environments. Therefore their properties might reflect this particular condition and consequently environments of different geometries might affect the kind of tessellation developed by these cells. With the use of a simplified neural network model we study the activity configurations expressed by grid cells in the presence of different spatial topologies. We show how, through a self-organization process, grid cells can express a tessellation of the environment that reflects the underlying spatial curvature. The final appearance of the grid is thus the result of the interaction between internal computations and the structure of the external world. The work provides predictions on the way brain might represent non-Euclidean geometry. Also it sheds light on the possible relations existing among different networks in the MTL and can contribute to identify what sort of information each of these representations is carrying and what is its contribution in directing behaviour.