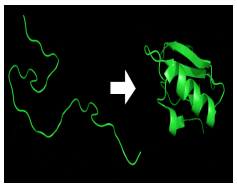
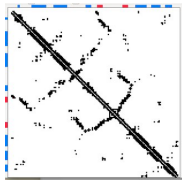
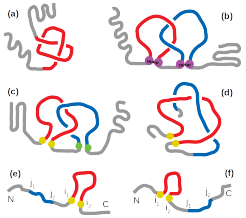
PlexNet: Statistics and Dynamics on Complex Networks

M. Baiesi, F. Baldovin, A. Maritan, E. Orlandini, S. Samir, F. Seno, A. Stella, A, Trovato

Topological constraints in protein folding

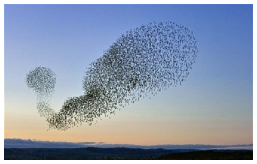


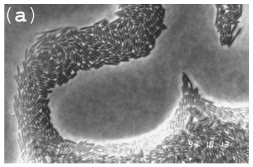




Topological motifs as potential kinetic traps

Non equilibrium statistical mechanics in active systems

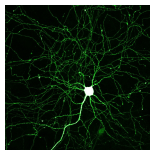




Dynamic clustering, spontaneous flow

Interaction rules between agents strength of activity boundaries.

Statistical mechanics approach to brain activity.

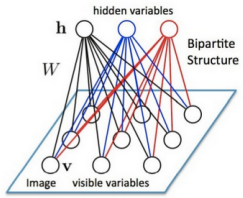


Brain as a large network of connected neurons

Aim: describe the spontaneous and induced activity of the neural network as a collective phenomena

(burst of activity as critical state)

Statistical and dynamical properties of NN used in deep learning unsupervised algorithms



Aims: two-folds and complementary

Use stat mec to understand how two-layers NN works: (i.e. Restricted Boltzmann Machine)

Design and implement Deep NN machinery to identify novel phases, topological motifs and non trivial patterns in complex systems.

PlexNet

Partecipants: (4 FTE)

M. Baiesi, F. Baldovin, A. Maritan, E. Orlandini, S. Samir, F. Seno, A. Stella, A, Trovato
+ 2 Post docs, 3 PhD students, 6 Laurendi

Most relevant pubblications (from 2015)

M. Martinello et al *Neutral Theory and Scale-Free Neural Dynamics,* **Physical Review X**, **7**, 041071 (2017)
J. Grilli et al Feasibility and coexistence of large ecological communities, **Nat. Comm**, 8 14389 (2016)
M. Baiesi et al *Linking in domain-swapped protein dimers*, **Scientific Reports**, **6** , 33872 (2016)
D. Michieletto et al *Polymer model with Epigenetic Recoloring Reveals a Pathway for the de novo Establishment and 3D Organization of Chromatin Domains* **Physical Review X**, **6**, 041047 (2016)
G. Polles et al *Self-assembling knots of controlled topology by designing the geometry of patchy templates*}, **Nat. Comm**. **6**, 6423 (2015)
S. Allesina et al *Predicting the stability of large structured food web,* **Nat. Comm**. **6**, 7842 (2015)

Progetto Europeo COST: EUTOPIA (European Topology Interdisciplinary Action)

Short list of international collaborators

S. Allesina Chicago University, **USA**; J. R. Banavar Dept. Physics, Maryland University, **USA**;
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PlexNet: Preventivo 2018

Missioni e Partecipazione a Conferenze

Missioni Italiane: SISSA,Roma,Firenze,Bologna
Missioni Estere: UK, Spagna, Belgio per collaborazioni scientifiche
8 Ricercatori: 0.7 kE ciascuno. 5.6 kE

Partecipazione e contributi a conferenze internazionali

StatPhys27, July 2019, Buenos Aires, Argentina (2 ricercatori) 1.2 kE ciascuno 2.4 kE

Conference on *Complex systems* Singapore 2019 (1 ricercatore) 1 kE. 1.0 kE

Machine Learning for Physics and the Physics of learning
September 4 December 8 2019, Institute for Pure & Applied Mathematics, UCLA, Los Angeles, USA.

Machine Learning for Physics and the Physics of Learning Tutorials : September 5-10, 2019
Workshop : Interpretable Learning in Physical Sciences : October 14-18, 2019
Workshop III: Validation and Guarantees in Learning Physical Models: from Patterns to Governing Equations to Laws of Nature : October 28 - November 1, 2019
Workshop IV: Using Physical Insights for Machine Learning : November 18-22, 2019

Costo preventivato per singolo ricercatore (1.5kE) (2 ricercatori) 3.0kE

Totale preventivo: 12 kE