Consensus, network & control in self-organizing systems
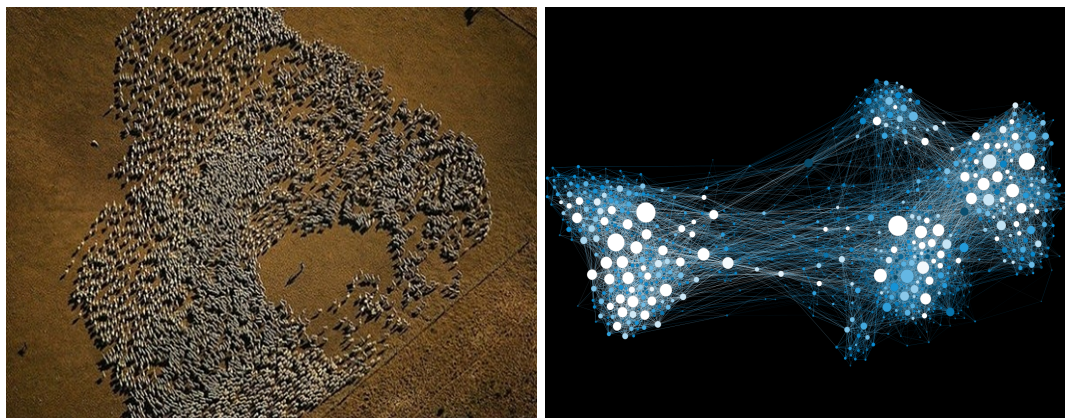

Figure 1: ***"Psychohistory is the mathematical study of the reactions of human conglomerates in response to economic and social stimuli".*** – Isaac Asimov, Foundation, 1951.

Self-organization in social interactions is a fascinating mechanism, which has inspired the development of new areas of applied mathematics and physics, in order to describe multi-agent dynamics towards formation of coherent global behaviors. The mathematical modelling of these phenomena roused a large variety of applications: in biology (cell aggregation and motility, coordinated animal motion,...); in socio-economics (opinion formation or wealth distribution,...); in engineering, (cooperative robots, traffic management,...).

The main question we will address will be *"Under which conditions self-organization can be obtained, and in which way we can promote/control it?"*. To answer we will focus on *consensus-type* dynamics where agents try to align their behavior according to interactions ruled by a *dynamical communication network*. Further, we will try to understand in which way these systems can be influenced by *control strategies*. Direct applications of our findings will be the modelling of **opinion dynamics on social network**.

The methods of study will be non-linear ODEs systems, Markov processes and optimal control. Theoretical and modeling concepts will be complemented by numerical methods and simulations.

Course presentation and schedule confirmation
October 2nd, 15:30-16:30 room M, Ca' Vignal 2.

- The course is part of the international network **ECMI**, (https://ecmiindmath.org/).

- You can follow 7 others ECMI Modelling Seminars, here the list of the topics:
    - Tampere (FI). *Mobile Phone Positioning.* Topics: Iterative Least-Squares Method / Bayesian Formula / Kalmann Filtering.
    - St. Petersburg (RUS). *Stairway to Heaven.* Topics: Basic Physics / ODEs.
    - Koblenz (DE). *Towards the Sun Pursuit Models.* Topics: (ODEs) / Spherical Geometry.
    - Lappeenranta (FI). *Bioecological Modelling.* Topics: Predator-Prey Models / Population Dynamics (ODE systems).
    - Madrid (ESP). *Granular Materials.* Topics: Brownian Motion / Stochastik ODEs.
    - Lisbon (PT). *Optimal Stopping Problems.* Topics: Partial Differential Equations / Continous Optimal Control.

- Courses' material will be available online through the moodle platform: http://moodle.lut.fi/login/index.php

Topics of our course:

- Non-linear ODEs system,

- Graph theory

- Random processes

- Numerical methods for ODEs

- Numerical optimization.

Software: MATLAB / OCTAVE

Schedule

1. Monday 2/10. 15:30-16:30 room M. Presentation.

2. Tuesday 3/10. 12:30-14:30 room G.

3. Friday 6/10. 9:30-11:30 room M.

4. Monday 9/10. 15:30-17:30 room M.

5. Tuesday 10/10. 12:30-14:30 room G.

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Thanks!