Flocking models

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We shall investigate flocking models from the perspective of multi-agent consensus.

Consensus

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The modelling of flocks has been an active area of applied mathematics for the past twenty years. One of the first breakthroughs occurred in the 1980's, when Craig Reynolds used a simple set of algorithms to generate realistic computer models of flocking agents, which he called *boids*.

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Vicsek et al. developed *self-propelled particle models* which incorporated disturbances/noise to the swarms whereas Kennedy and Eberhart focussed on optimisation models to simulate the complex choreography of flocking animals.

Simple rules

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- track your neighbours
- don't crash

Networks

A *network* is a weighted graph, that is, a set of elements called *nodes* or *vertices*, which may be connected to one another via relational links (*edges*). To each node we assign a *state* and to each edge a weight (or *gain*), $\sigma_{i,j}$.

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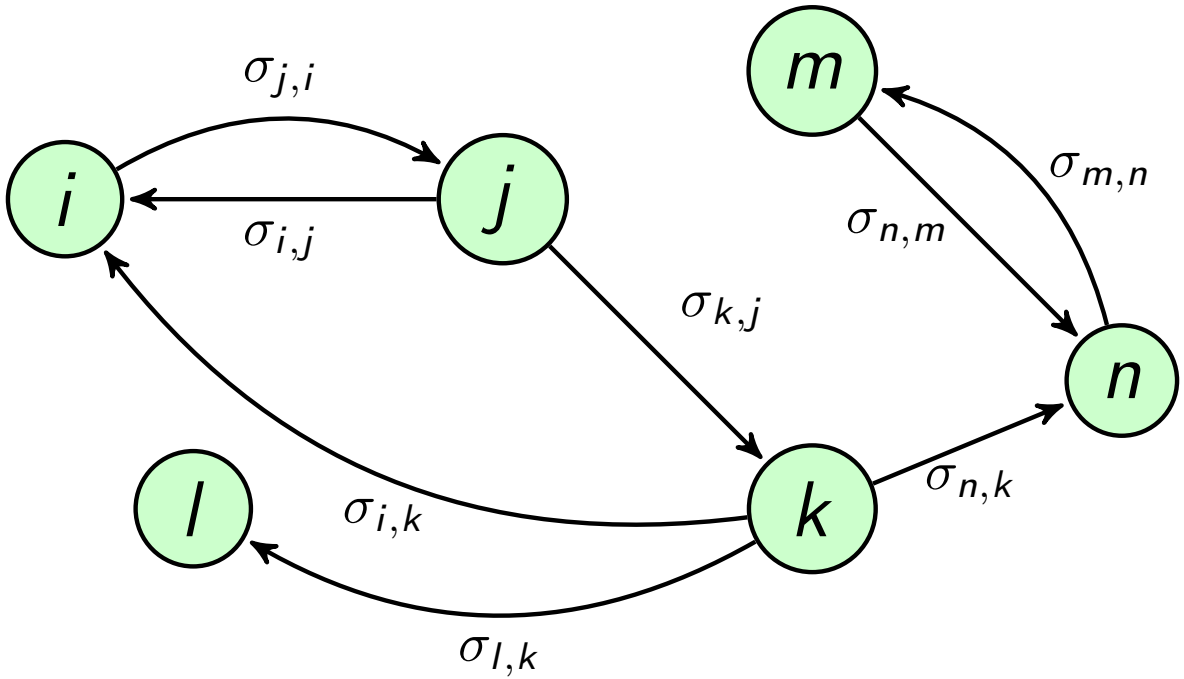

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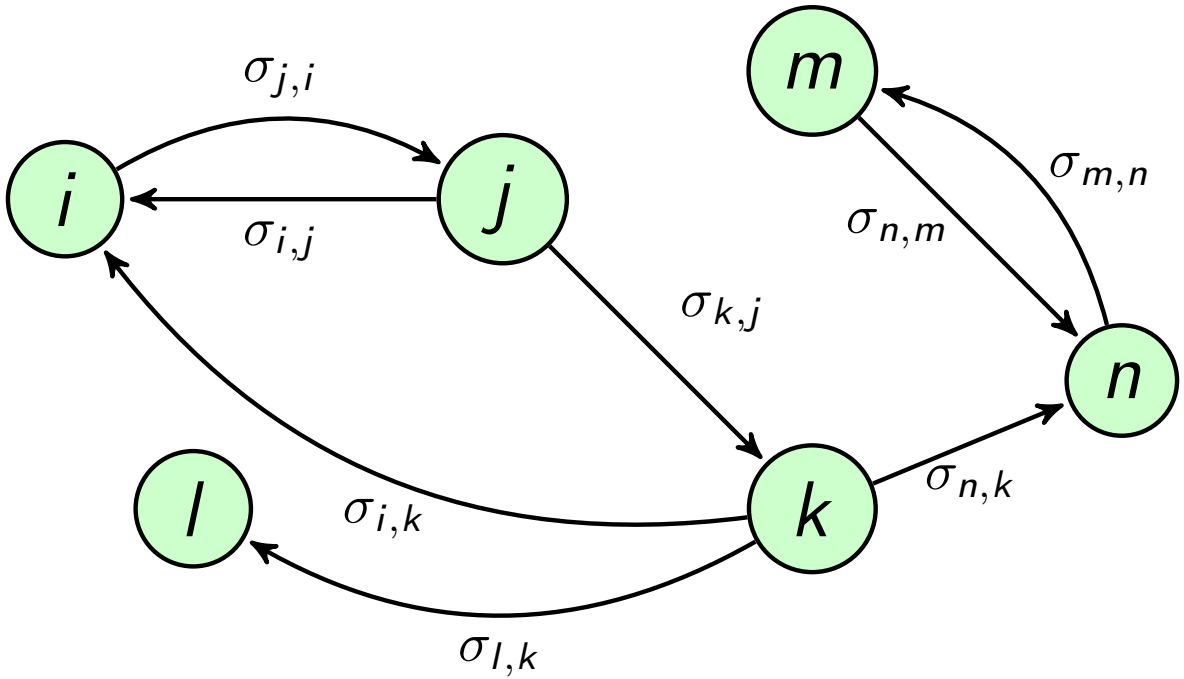

We want our states and gains to evolve until consensus is achieved.

Differential equations

The state and gain evolutions are governed by a system of coupled differential equations. The general form being:

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References

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