AS-~~[illegible]~~ 5.1 Positive feedback

* Pos feedback is very different to Neg feedback
  * Negs are assoc w/ stability
  * Pos feedbacks are assoc w/ instabil & growth

Delays can make negs behave like positive

Pos can often lead to expo growth

An example = Speakers, microphone, feedback loop

Millenium bridge swaying — walking pattern

Population models = Pos (birth) + Neg (Death)
→ more pop = more able to give birth = Pos feed

Neg feedback Acting like Positive

"Sensors" have delay.
- Can result in info in wrong direction

~~if delay counts~~

Summary

Pos isn't inherently bad but needs to be controlled

②

5.2 Stigmergy & chaos

* Pos = can be dang but funda to growth & self-org
* Stimeg intro – often involves pos feedback
* Systems w/ non-linear feedback may be chaotic
* chaos can be suprisy useful
  ↳ will give example of first self adaptive sys

Stigmergy ⟶ PP Grasse (1959)

"Stigmergy is an indirect, mediated mech of coordination between action – in which the trace of an action left on a ~~med~~ medium stimulates the performance of a sub action"

Artifacts of previous behaviour influence future behaviour

A way to concept this would be the agent is imparting a store of memory into the enviroment

Ants use pheremones to communicate via env
- Trails to follow – mark on env

Double bridge experiment – ~~Assymetric~~
- Ants follow path collectively & converge on path
- Asymetric will converge on short path
- Ants will follow stronger concentration
- Hence shorter will have ~~more~~ more pheromones after time
- Phone builds up more slowly

3

Some ants leave phones on paths once they find Fo[od]
- Pos feedback

Human Paths are a result of Stimergy

Pathological Stigmergy - Ants Death circle

Lecture 5 - Part 1 END

More Stimergmergy ⟶ then onto chaos

Ants are self-adaptive systems
Phenomes

Positive feedback being halted to avoid expo growth

using thresholding points - feedback until point reached

Chaos

Deterministic chaos

Definition: Feldman

* A Dynamical Sys is chaotic if it has all Props
1. Its time evo is given by Determin func (not random)
2. orbits are bounded (cannot grow to infin)
3. orbits ~~Depend~~ sensitive on initial conditions (will diverge even if start close)
4. orbits are aperiodic (dont repeat)

4

$$x_{t+1} = R x_t (1 - x_t)$$

logistic map

All pops reach stable level given R

large R will create oscillations $x_{t+1} = R x_t (1 - x_t)$

very large will vary chaotically

Sensitive to start point
- may start same but diverge over time

even for fully deterministic system, still impossible to predict behaviour due to lack of precision

Bifurcation ~~Bifurcation~~ plot
- Parameter sweep

Chaotic systems can be used as pseudo random number generators

Central Pattern Generation

Kangaroo jumping pattern - stable, repeating

Stable & efficient locomotion

Shim & Husbands - CPG

Summary

4 types of feedback in The models:

1. Neg
2. Pos
3. Non-lin
4. feedback from envs (sensory loop)