lecture 7 - Ultrastability Ashby

Ashby most known theories
1 requisitive variety
2 Ultrastability
3 good ol regulator theorem * NOT in model

Requisitite variety =
* A factor in systems ability to adapt
* but not required for adaptive beg

Ultrastability is also known as self-adaptivity
- is necessary & sufficient for a system to be adaptive

Structure
* law req variety
* L6 recap
* L2 recap
* Ultrastab
* Homeostat

Variety = num of disturbance a sys might encounter

Also used to describe num action/response a controller/regulator can take to counter disturbance

And num of outcomes of disturbance
AKA resulting system states

Any option the variety is a number

the only way to block the effects of all disturbance is to have the requisite variety of actions

e.g. imagine a sword fight - to win...

the variety of blocks cannot be less than variety of attacks

variety = number

requisite variety must match

the example requires a predictor to select correct Block

Notice the variety in Blocks can equal or exceed the variety of Attack but still loose - Bad Blocks, wrong Block

this is why requisite variety is a necessary property but not a sufficient

Must have the ability to match but it will not always be enough

"Potential"

levels of variety - Scope in, high level

lecture 2 recap

Dynamical system, impact system & outcomes by adjusting parameter

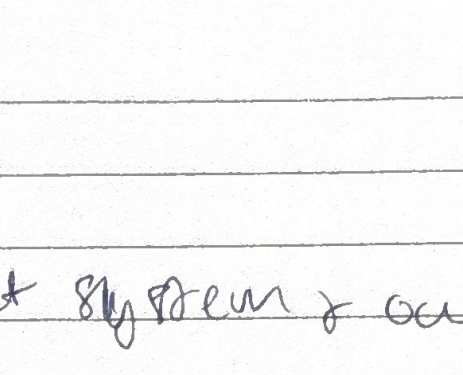
Reason to adapt system is to maintain viability

When to adapt → would be better to adapt before leaving region of viability

How to adapt? params? depends on sys & its mechanisms

theory of Ultrastability

Adapted behavior sensimotor loop



R = subsystem of organism & coupled to env

S = Param that affects R of organism

Behavior is influenced only by S

env ⇆ R is unlikely to be stable, unless env is naturally very stable

need a way for R to impact the params that allow it to respond & adapt

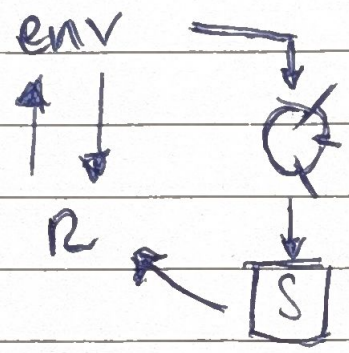
A ultrastable organism has essential variables

Ess vars are affected by environment

when these ess vars go out of bounds changes are induced in the params S

if a new equilib is found - A sys is adaptive

↳ inside region of viability



whole point of system is to regulate essential variables

if ess var goes outside of bounds

Start changing params until ess vars go back to stable levels

behaviour of system could be completely different due to DS params

→ only focus is stability of ess vars

unless ess var is directly related to sys

ASBy claimed two types of disturb:

- Small frequent impulse to main vars
  Stabilised w/ First order feedback
- Occasional step changes to params
  Stabilised w/ second order ~~params~~ feedback
  needs to be able to adapt its own behaviour

Ultrastability is the power of a system to always find a suitable equilib despite change to its environment

e.g. Stable Blood Sugar by varies other variables

Ultrastable has double feedback
- first-order: Sensorimotor coupl
- Send-order: paras adjusted to Stable ess var

how are params adjusted?

- Ashby step functions - Random Search

The Homeostat machine