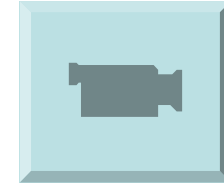


Evolutionary Robotics

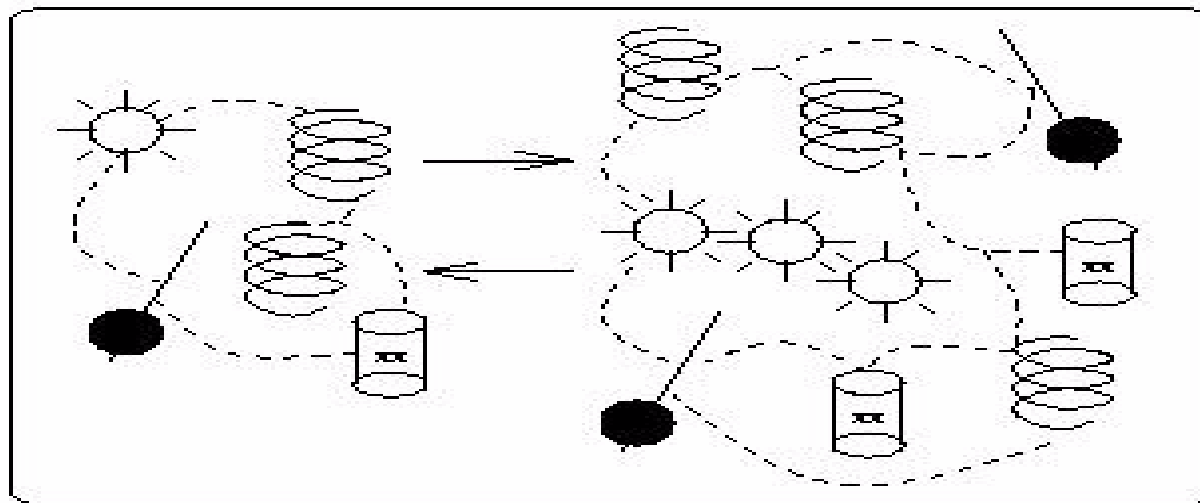
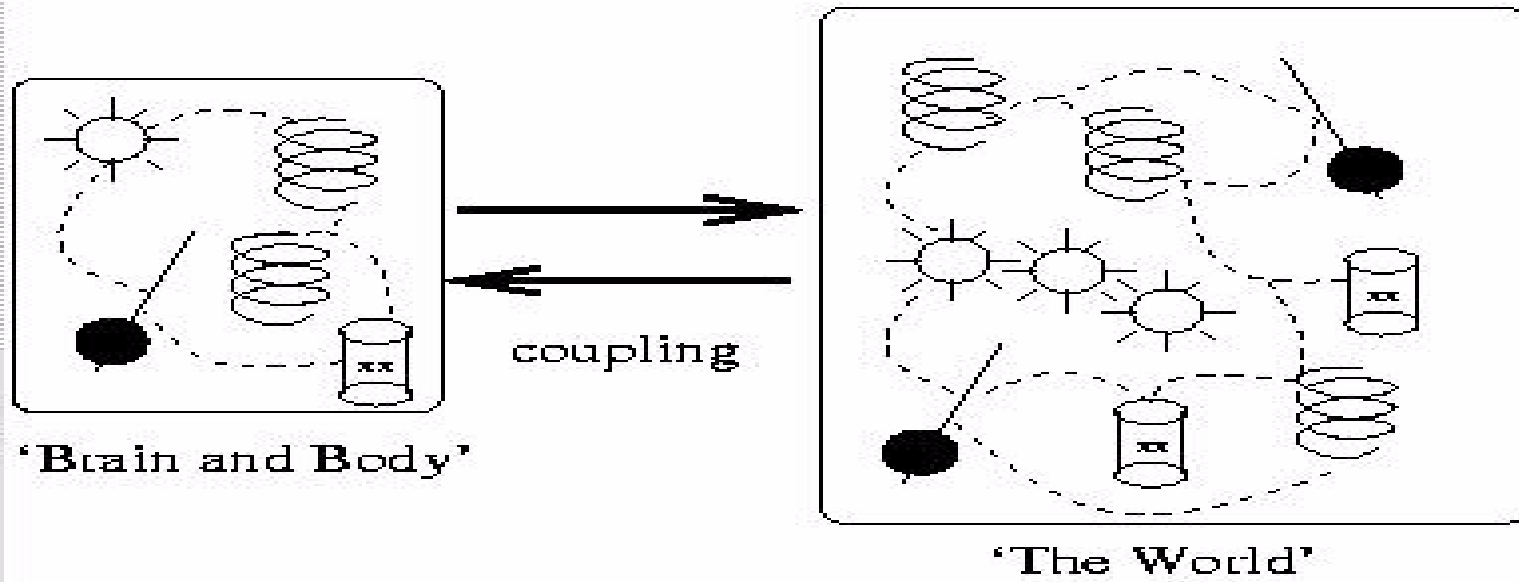
- The target of evolution is *behaviour*
- The control system could be anything we like – it doesn't have to be easy for humans to design it
 - have to think about *evolvability*, which does not imply ease of analysis
- Ideally, we'd evolve body, sensors, actuators, controller, all together... tricky

Karl Sims: Evolved Virtual Creatures 1994

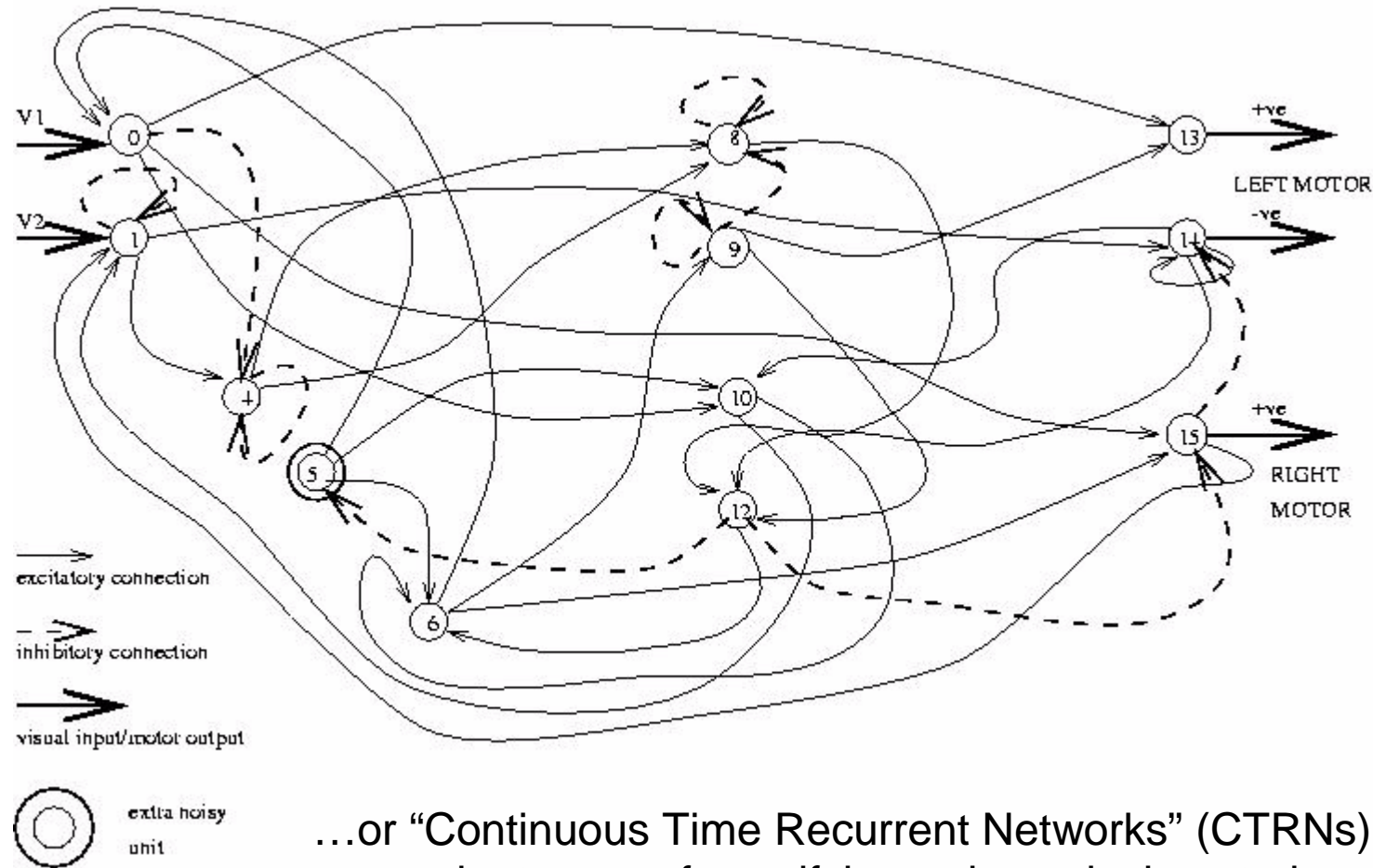


- Brain and body evolved (clever genetic encoding)
- Powered Hinges controlled by neural net
- Fairly realistic simulation, but not expected to work in reality
- Took a supercomputer in 1994, but now you can do it on your PC using “physics engines” such as ODE (www.ode.org)

DYNAMICAL SYSTEMS



Dynamical Recurrent Neural Networks (DRNN)



...or “Continuous Time Recurrent Networks” (CTRNs) are convenient ways of specifying a dynamical control system. The genotype specifies which units connect to which, with what strengths, and maybe characteristics of the units like time constants and nonlinearity (cf. standard backprop nets – soon)

Typical Fitness Evaluation

To evaluate an individual's fitness:

1. Decode its genotype into the neural architecture and parameters to give a network that can be simulated
2. Maybe decode genetic specification for aspects of sensors, actuators, body
3. Set up the specified robot in simulation or reality
4. In some test environment(s), run it for n seconds while gathering performance data
5. Calculate a fitness value based on the performance compared to the desired behaviour

Blackboard Demo

- Fitness functions for obstacle avoidance behaviour for the Khepera robot
- Typical “trap” behaviours requiring refinement of fitness func:
 - staying still
 - jittering on the spot
 - only ever turn in one direction



To be continued...