

Prerequisites for a Theory of Intelligence

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- Simon Benjaminsson

Popper Vs Feyerabend

- Popper

- The Logic of Scientific Discovery
- Theory has temporary status
- Falsifiability of a theory
- Against psuedo-theories like Freudian psychology etc.

Feyerabend

Against Method

No precise rules

Anything goes

Anarchist approach to scientific theory

This book traverses somewhere in between

Abstraction, Algorithms, Dynamical Systems etc.

- Abstraction is necessary
 - Principles of systems can be predicted, but specific system needs some empirical values
- Can a theory of intelligence be algorithmic?
 - Can we have an algorithm which computes and thereby explains all intelligence?
- Dynamic systems – chaos theory
 - Structured systems emerge from chaotic conditions
- Analytical component + Design aspect

Diversity (exploitation) - Compliance

- **Soft Rules**

- Choice about compliance
- Syntax Vs Semantics & Grammar Vs Content
- Grammatically incorrect – no compliance
- Grammatically correct, but repetitive – no diversity

- **Hard Rules**

- Laws of Physics
- No choice but to comply
- Only possible to exploit
- Rock only complies, does not exploit

Exploitation and Knowledge

- Rock flowing down river –
 - does not exploit, no diversity,
 - only complies with fluid dynamics
- Asimo – robot that can dance, walk etc. – diversity, exploits friction and gravity
- Fish – exploits fluid dynamics
 - Do they know they are exploiting?
- Humans write poems, exploiting some figures of speech, possibly breaking some soft rules
 - Do we know? Do we need to know?

Stability-Flexibility (accomodation - assimilation)

- Category learning

- Representation of the world
- Do we need only one example or several examples?
- Role of the right features?
- Categorizing unknown objects
- Soft categorization
- Exploration-Exploitation

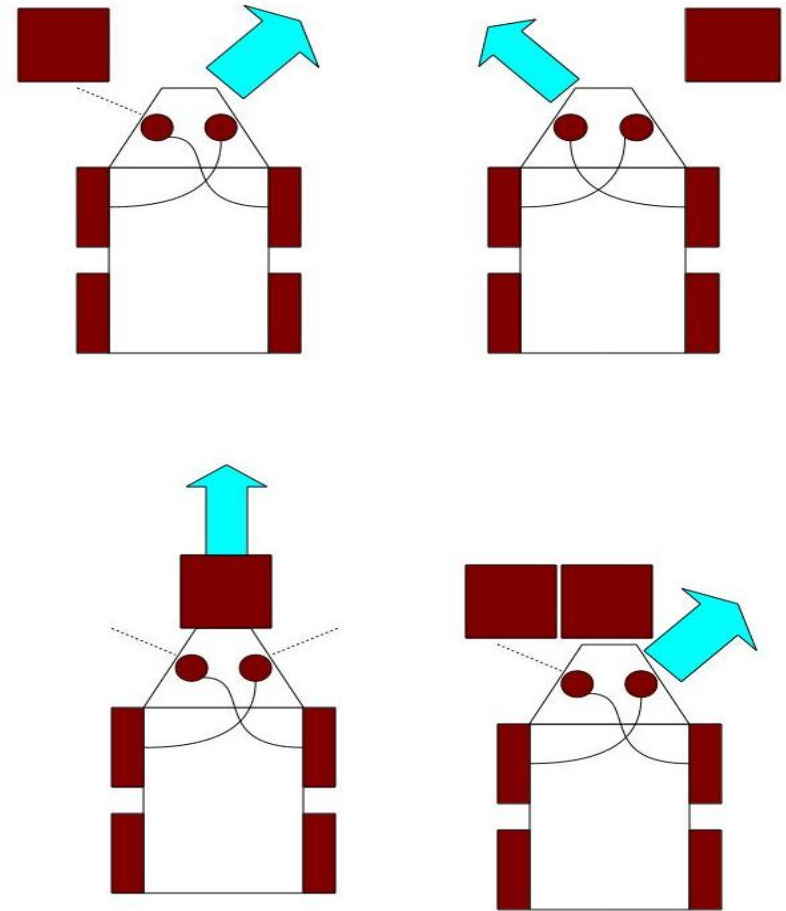


Frame-of-reference problem

- An intelligent agent
 - Conforms to rules/laws (Hard or Soft)
 - Exploits the environment
 - Exhibits diverse behavior
 - May or may not be aware of this behavior
- Complex behavior with simple rules –
 - e.g., beach ant walks around puddles, twigs etc. without knowing what the obstacles are
- From ant's perspective – simple rules
- From observer's perspective – complex behavior

Swiss Robots

- [The Swiss Robots Demo](#)
- Simple rules
- Unexpected behavior
- Robots do not see cubes
- Intelligent? - Depends on perspective
- Different location of sensors?

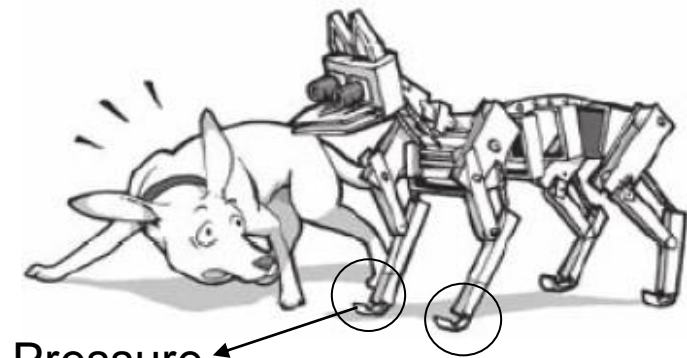


Interaction - Emergence

- Robot's perspective – reaction to sensory stimulus
- Our perspective – cleaning up of Styrofoam cubes
- Effect of interaction of internal mechanism with environment
- Behavior cannot be estimated solely by the internal mechanism – embodiment, environment
- Emergence of complexity from simple rules and interaction with environment
- What if cubes were heavier, what if sensor was placed differently, what if the cubes were slightly larger or slightly smaller?

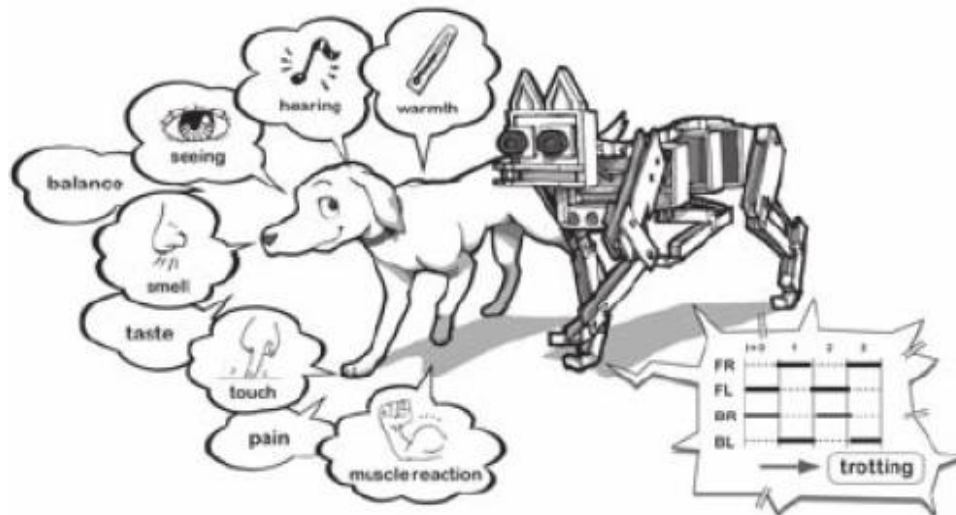
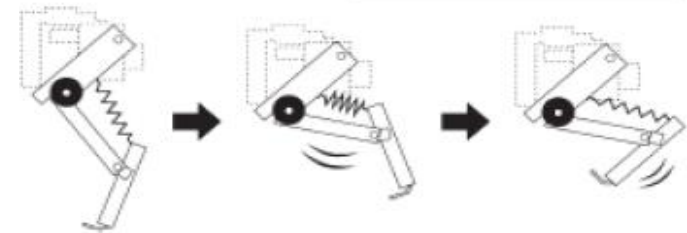
Robot Puppy

- Motor and spring mechanism copies the gait of a puppy
- Uses pressure sensors on the feet to sense the ground
- Hip and shoulders are moved periodically



Pressure Sensors

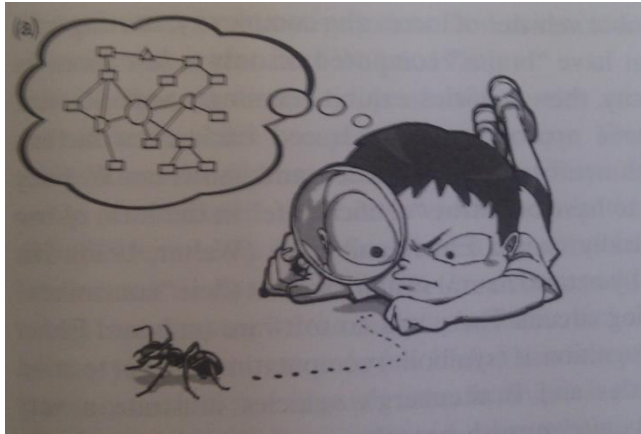
● : motor, ~~~~ : spring



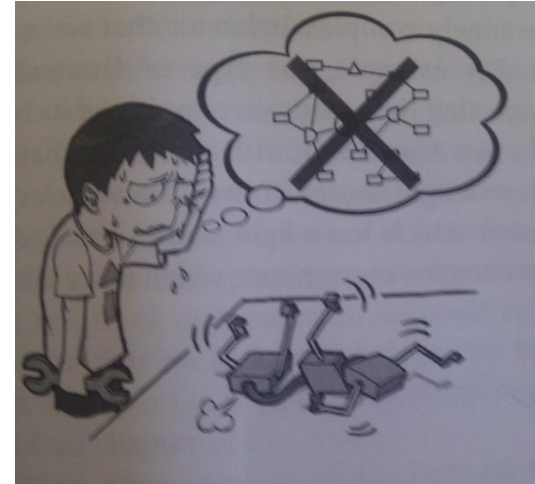
- The dog sees the world from the view of its sensors
- Complex gait mechanism from simple principles

Synthetic methodology - “Understanding by building”

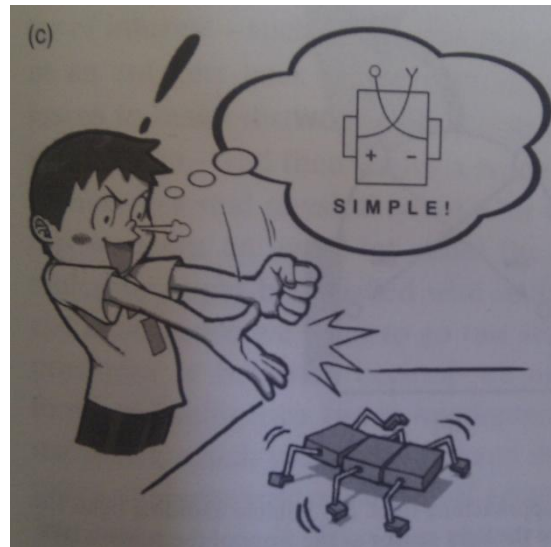
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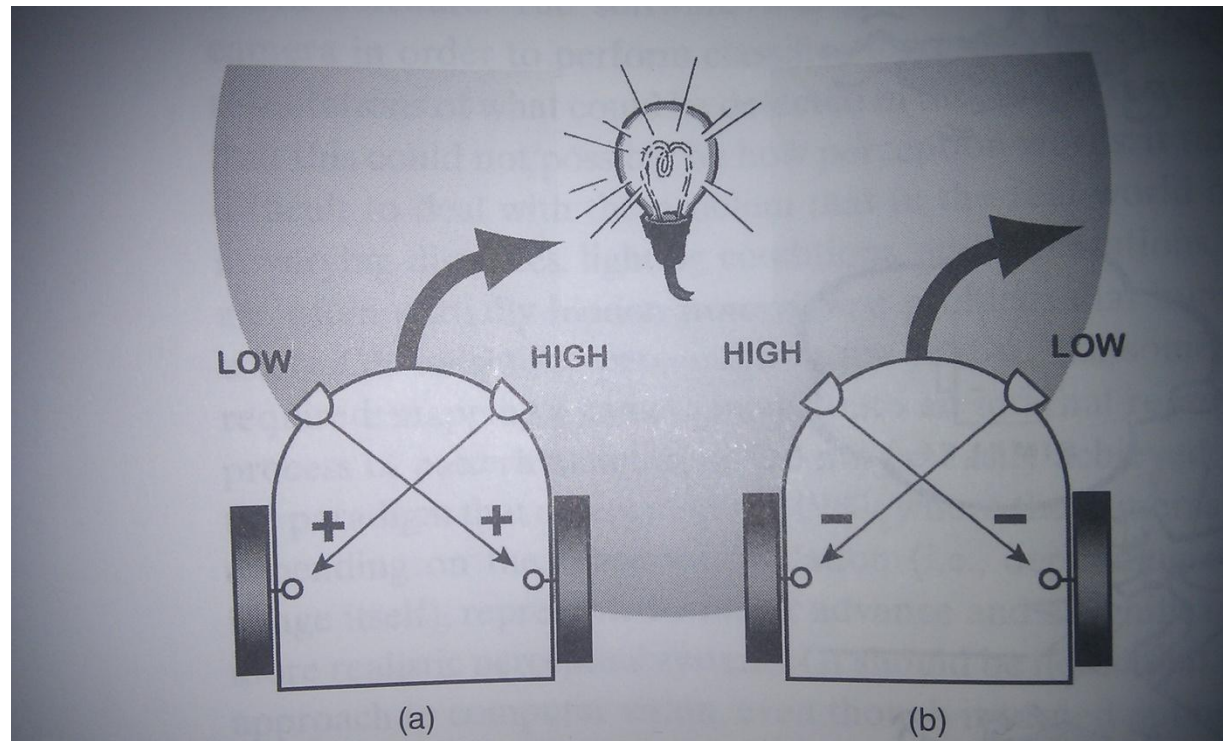
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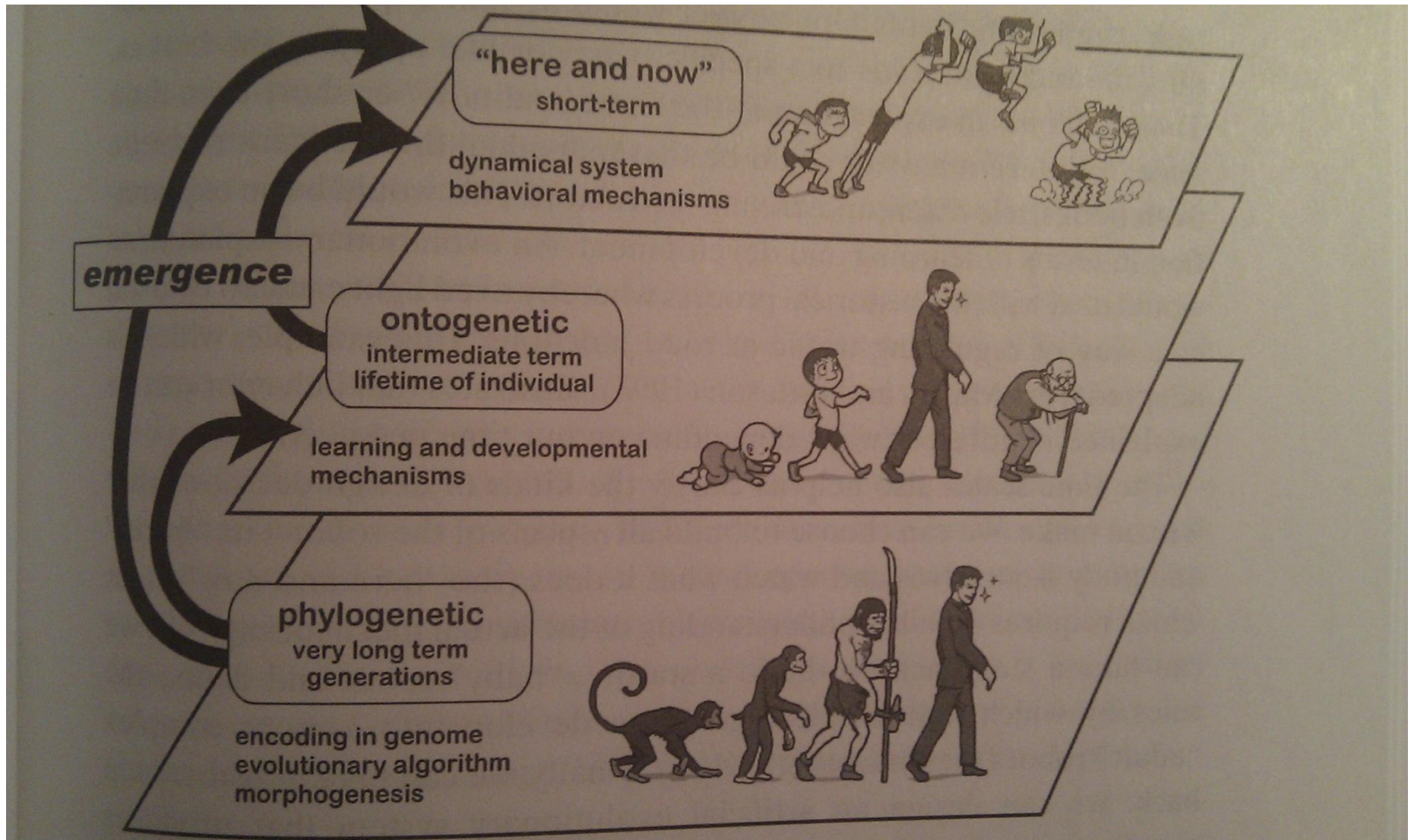


Example: Braitenberg vehicle



Conclusion: Simple neural circuits may be involved in producing complex behaviors

Time perspectives



Emergence

- Designates behavior that has not been explicitly programmed into a system.
 - Global phenomena
 - Individual behavior from interaction with environment
 - Emergence of behavior from one time scale to another
- Design for emergence
 - “Design is out, evolution is in!”

Summary

- Diversity-compliance
- Frame-of-reference issue
- The synthetic methodology – “understanding by building”
- Three time scales
- Emergence