Flavors of AI

Overview

AI research triggered many debates
- within the field as well as outside
- often quite emotional
- and philosophical

e.g., **hard** vs **soft** AI

=> there are different "flavors" of AI
(philosophical branches)

Overview

note:

- though some concepts may seem very abstract and philosophical at first glance,
- they are very helpful for implementing real world applications

Behaviors and Goofai

Good Old-Fashioned AI (GOOFAI) vs Nouvelle AI

- "classic"
  - sense-model-plan-act
  - vertical flow of data
  - using actions

- "reactive"
  - close coupling
  - horizontal flow
  - using behaviors

- hybrid
  - mix of both
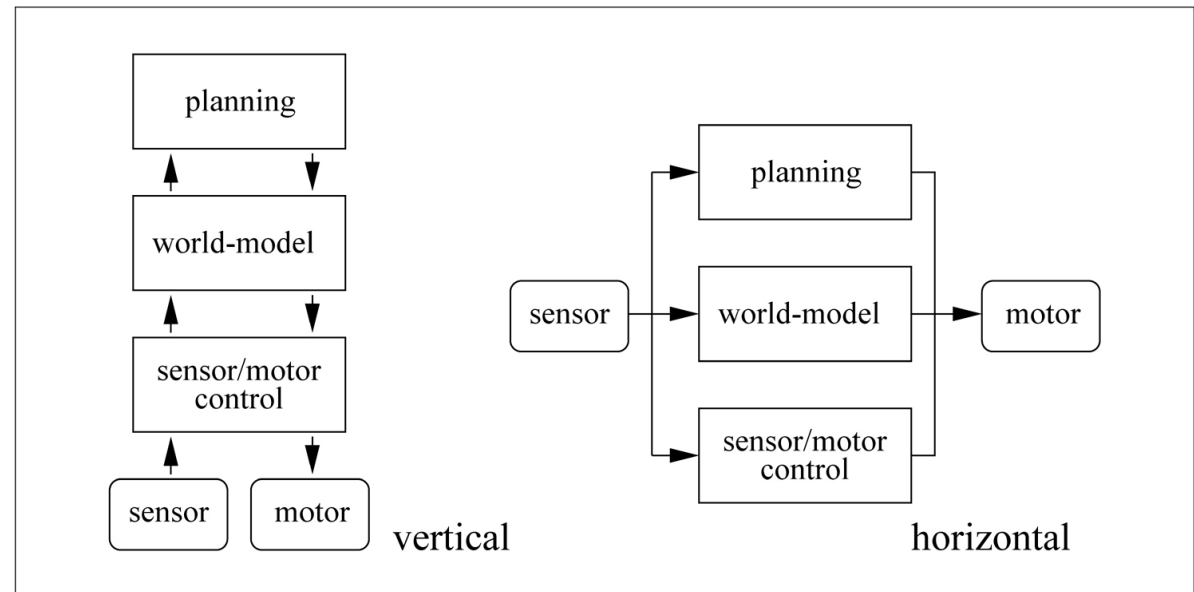
Action versus Behavior

action

- well-defined start/stop
  - pre-/post-conditions
  - duration in time

- no side-effects
  - issued on its own
  - few non-conflicting ones

behavior

- dynamic processes
  - parallelism
  - no central control
  - fast sensor/motor links

- emergence
  - exploiting side-effects
  - close coupling between environment / system

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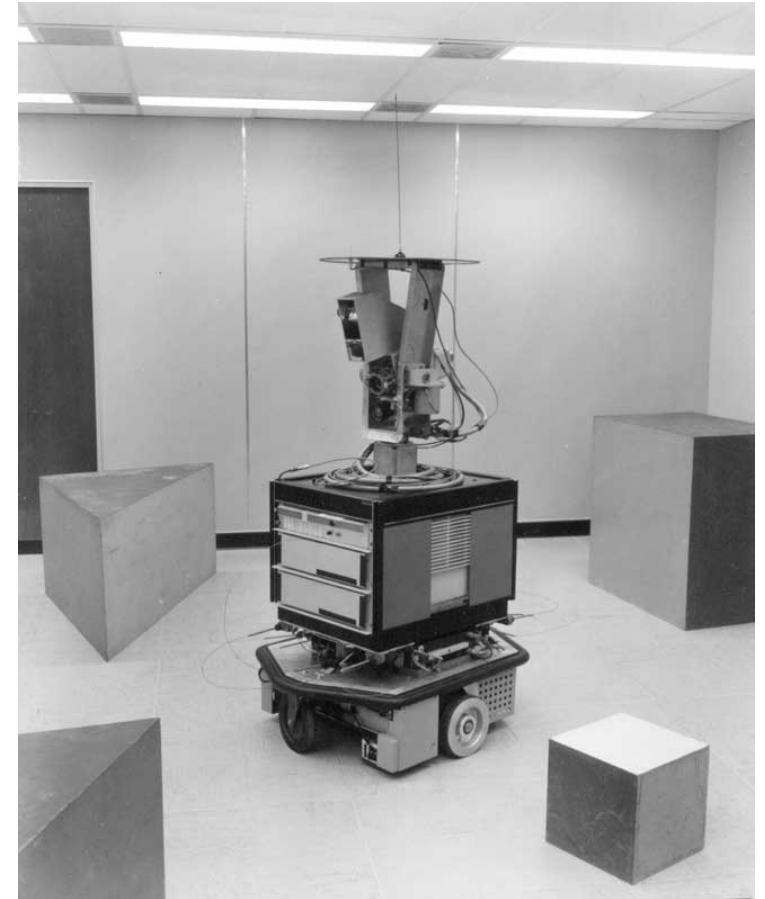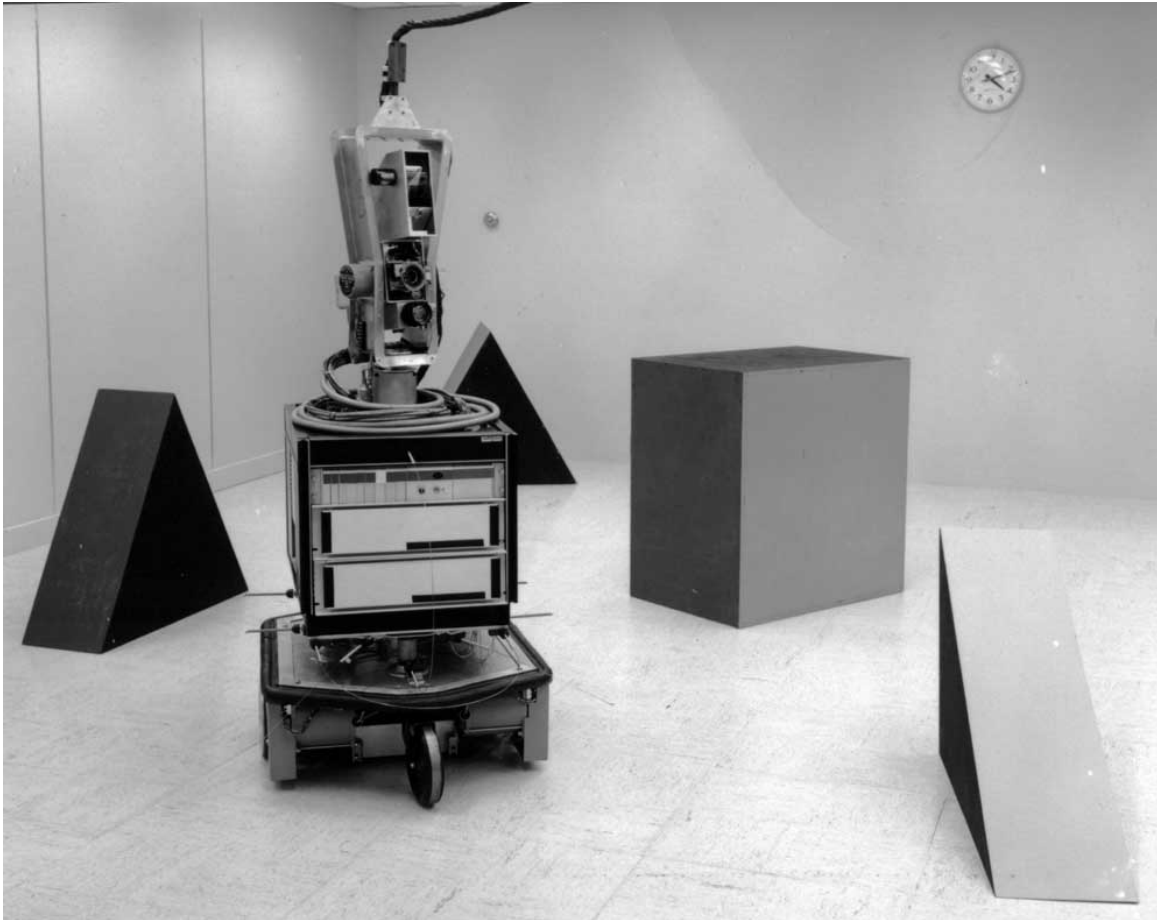 - close coupling between environment / system

The classic "action"-robot: Shakey

- 1966-1972
- SRI AI Center
  - SRI International, then Stanford Research Institute
- mobile robot system
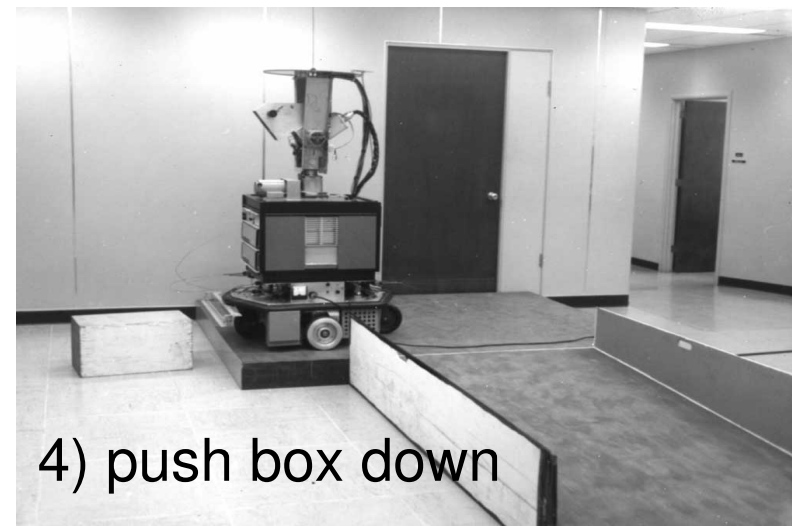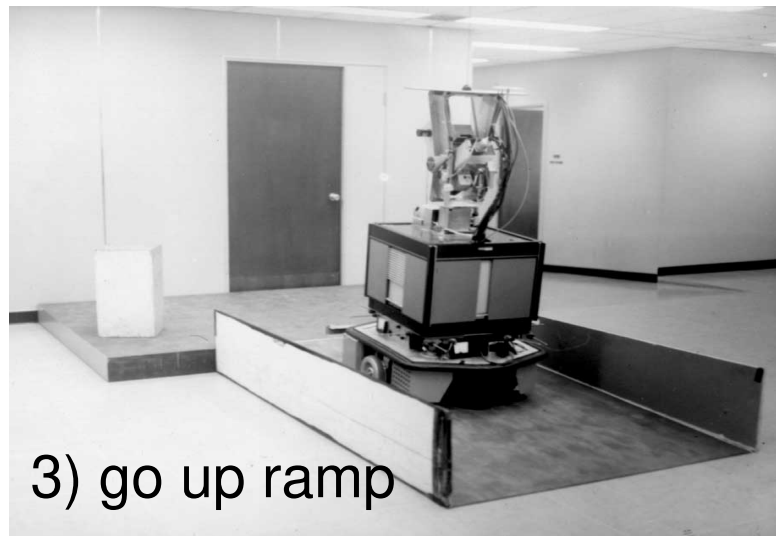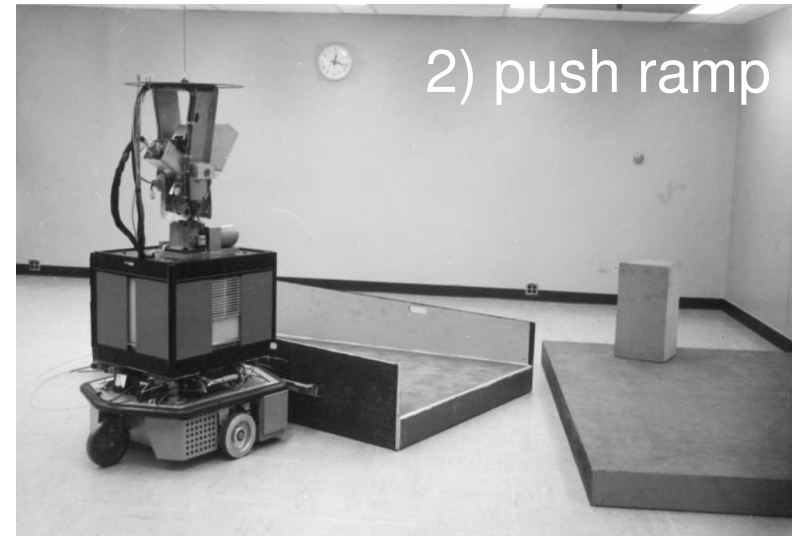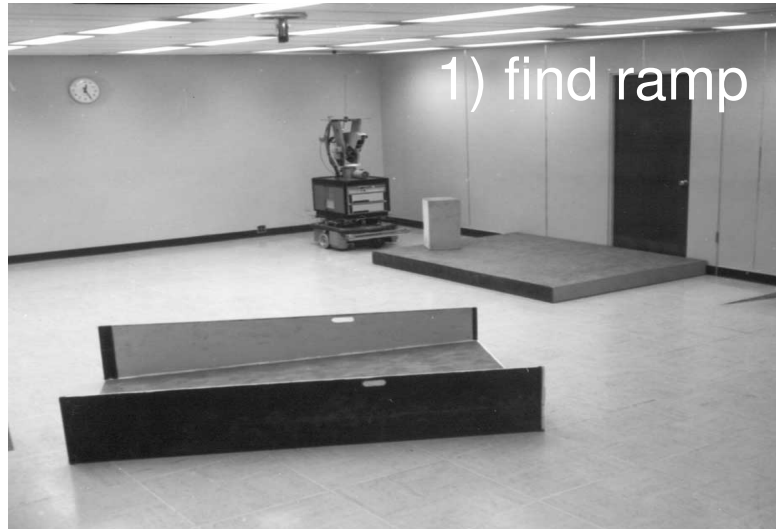 - with perception, world modeling, planning
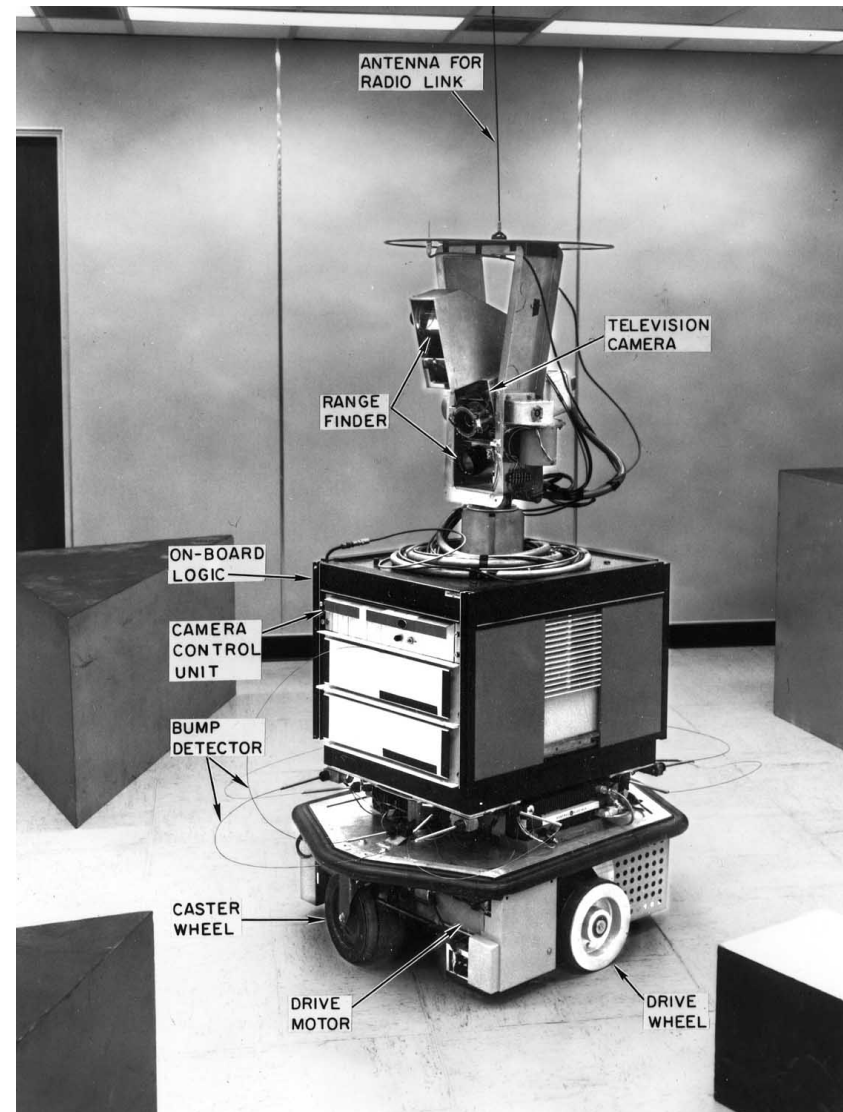
Acting in a "Blocks-World"

Example: Perceive, Plan, Do...

goal: get box on elevated floor

1) find ramp

2) push ramp

3) go up ramp

4) push box down

Shakey in Action

Shakey's Planning

- given
  - a logical description of the initial situation
  - a logical description of the goal conditions
  - a logical description of a set of possible actions
- find a sequence of actions
  - a so-called plan that
  - brings the robot from the initial situation
  - to a situation where the goal conditions hold

STRIPS

- STRIPS
  - STandard Research Institute Problem Solver
  - early 70s
  - approach is obsolete
  - but the formalism is still used
- problem solving
  - aka planning
  - as logical inference

Shakey's Planning

- "logical description"
  - in STRIPS = proposition calculus
  - 0, 1, not, and, or, *predicates*
  - predicate: fct X -> {0,1}
  - plus 1st order quantifiers (forall, exists)

- and inference
  - propositional calculus is "simple"
  - everything can be based on *modus ponens*
  - given: *{A => B , A}* then you can infer: *B*

General criticisms of GOOFAI (as logical planning)

- computational complexity

- handling of continuous aspects (time, space, …)

- handling of uncertainty

- ***who specifies all the formal knowledge?***
  - e.g., Cyc project
    - generate comprehensive ontology (vocabulary & taxonomy) and knowledge base (actual rules) of everyday common sense knowledge
    - since 1984
  - use WWW, e.g., RoboEarth project

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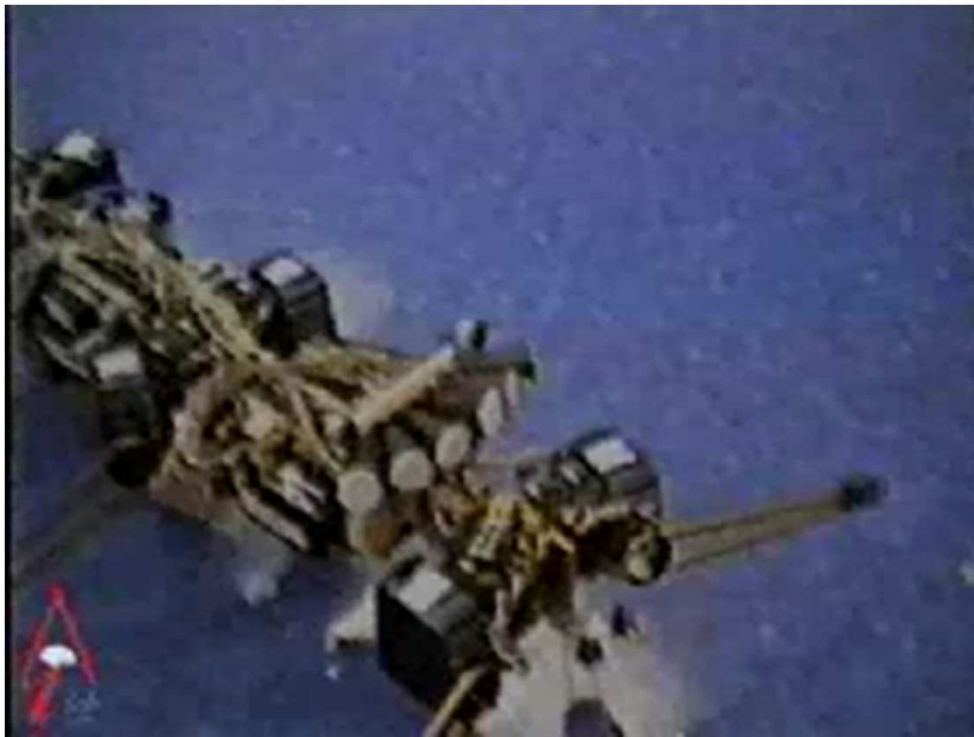 - issued on its own
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Classical behavior-based robot: Ghenghis

- Rodney Brooks, MIT
- 1989

# Classical behavior-based robot: Ghenghis

- 6 legs with 2 DoF
  - forward/back & up/down
  - each DoF: +/- 25deg

- sensors
  - 2 binary whiskers in front (touch)
  - 12 force sensors on motors via current sensing ("resistance" against the leg)
  - inclinometer, tilt in 16 values
  - far IR sensor (bodyheat)

- control via 51 Finite State Machines
  - running all in parallel
  - being connected to each other

Influence of Ghenghis

- today's perspective: so what?
  - MIT / Boston Dynamics Cheetah
  - Boston Dynamics Big Dog
- but big impact of Ghenghis at that time
  - even in pop culture (magazines, film, …)

0.0 mph

Boston Dynamics
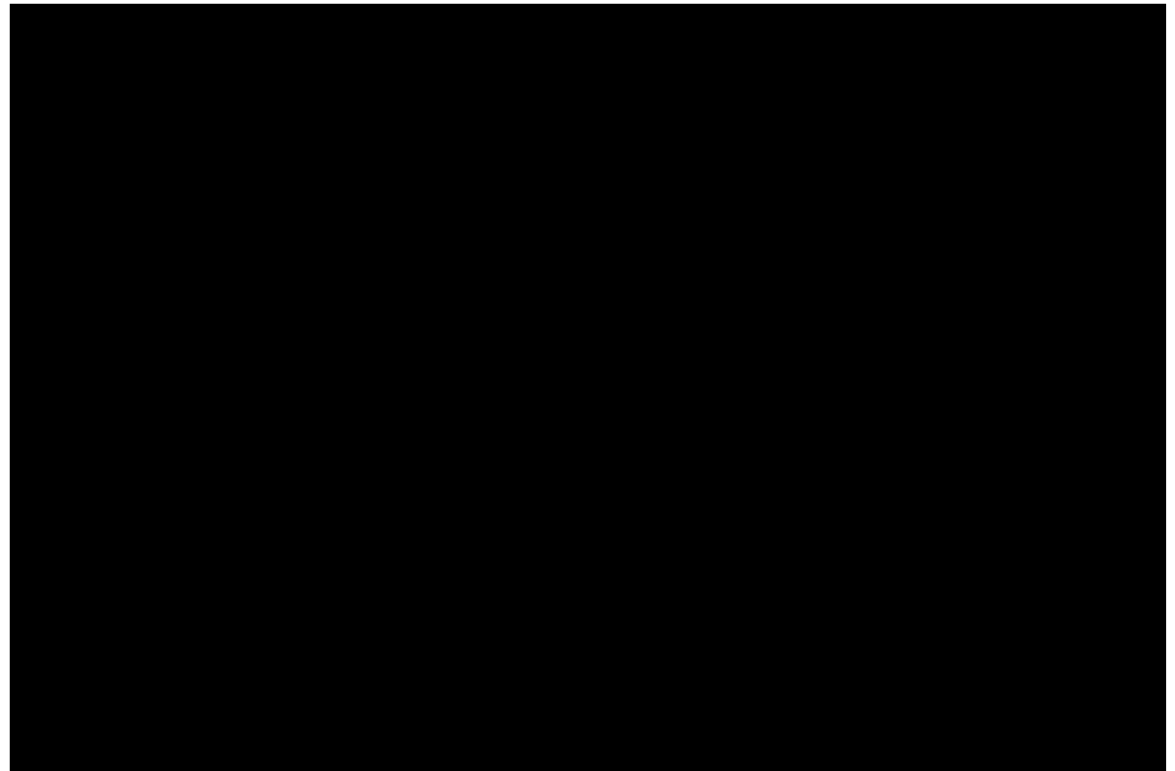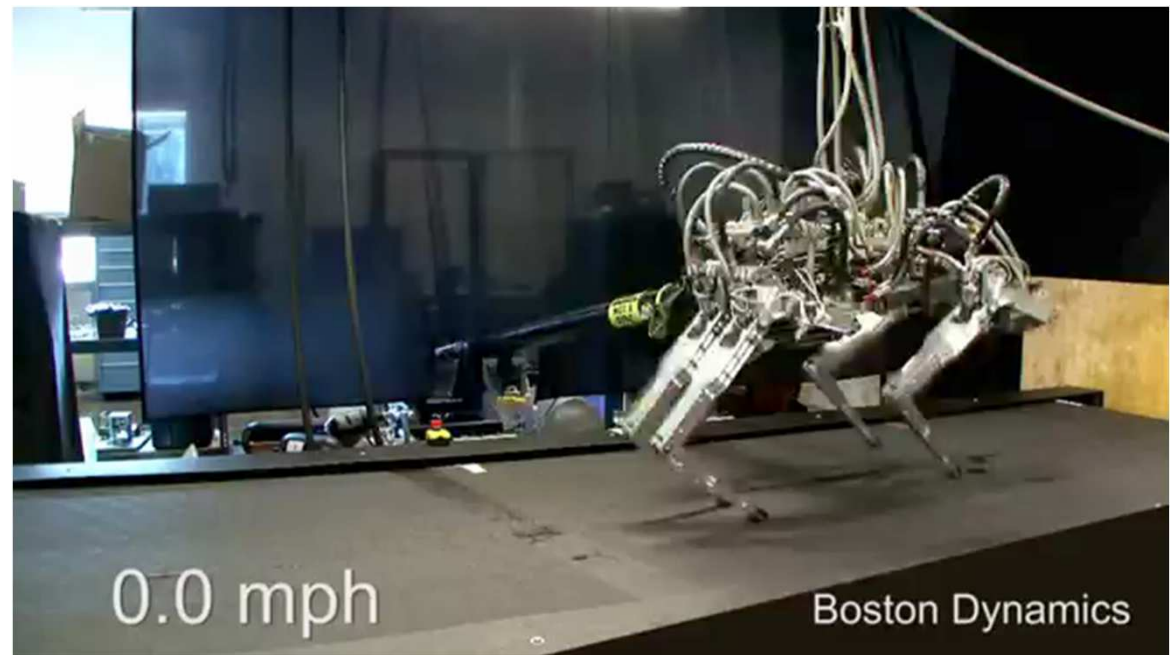
The two meanings of "behavior"
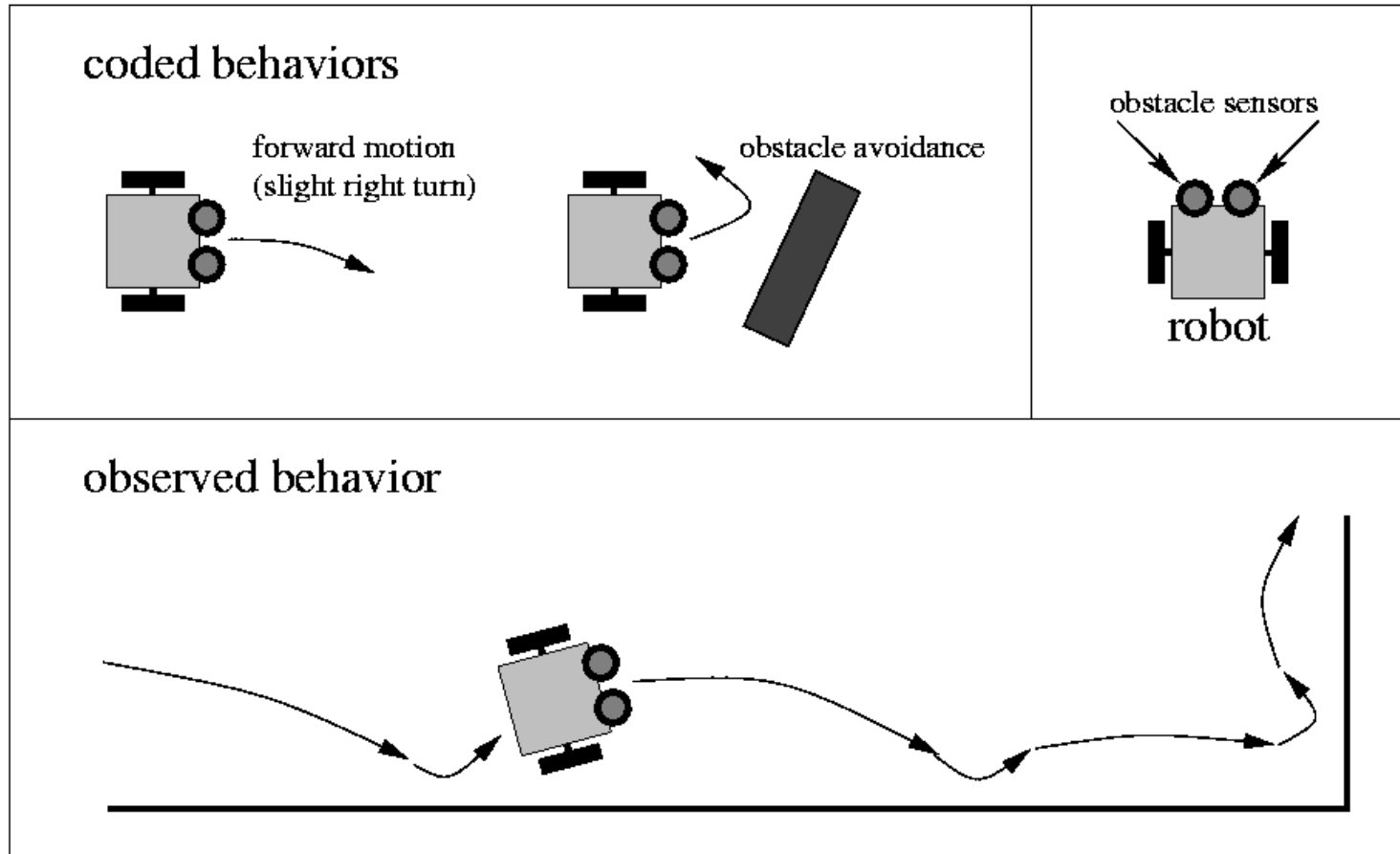
emergent behavior: observed behavior with side-effects