Intelligent Systems

– Agent and Multiagent Technology –

Part 2

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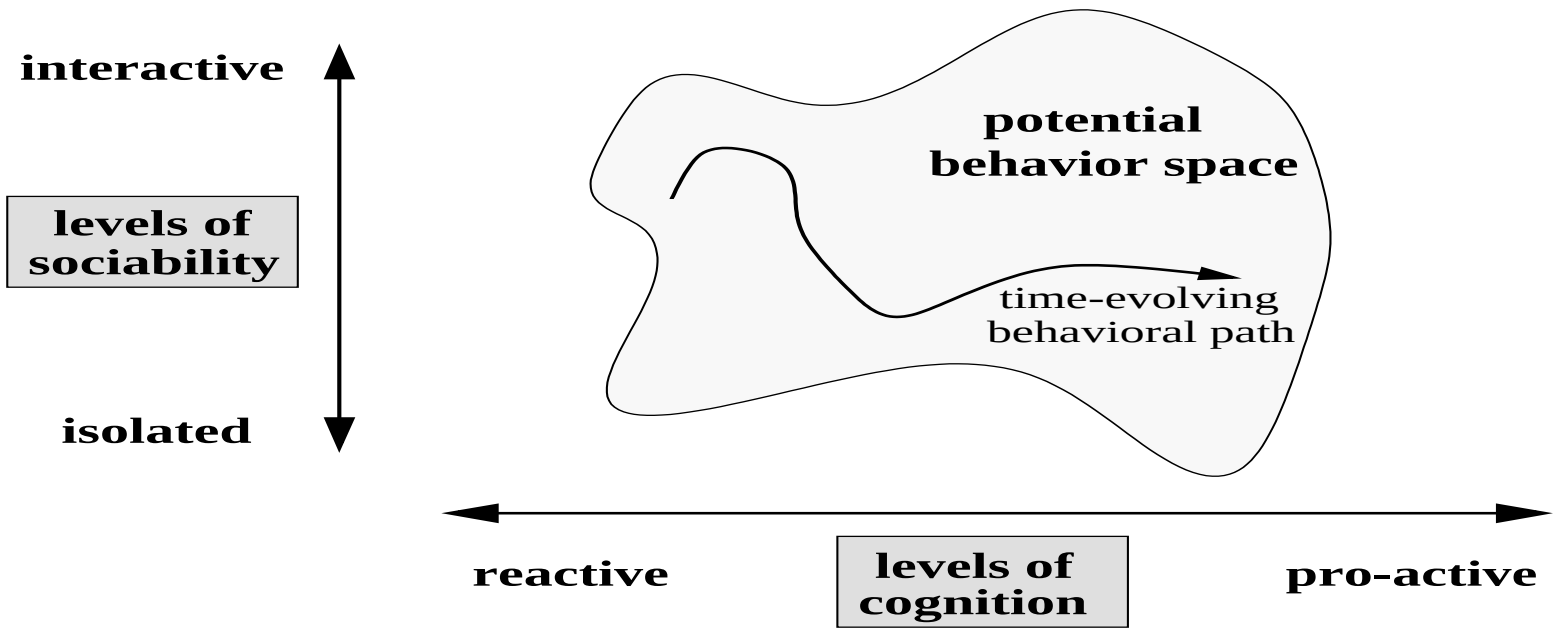
Outline

Outline

What is an (Agent) Architecture?

- Architecture =
  - arrangement of data and algorithms
  - \+ flow of data and control
- Architectures determine behavioral space:



Types of Agent Architectures

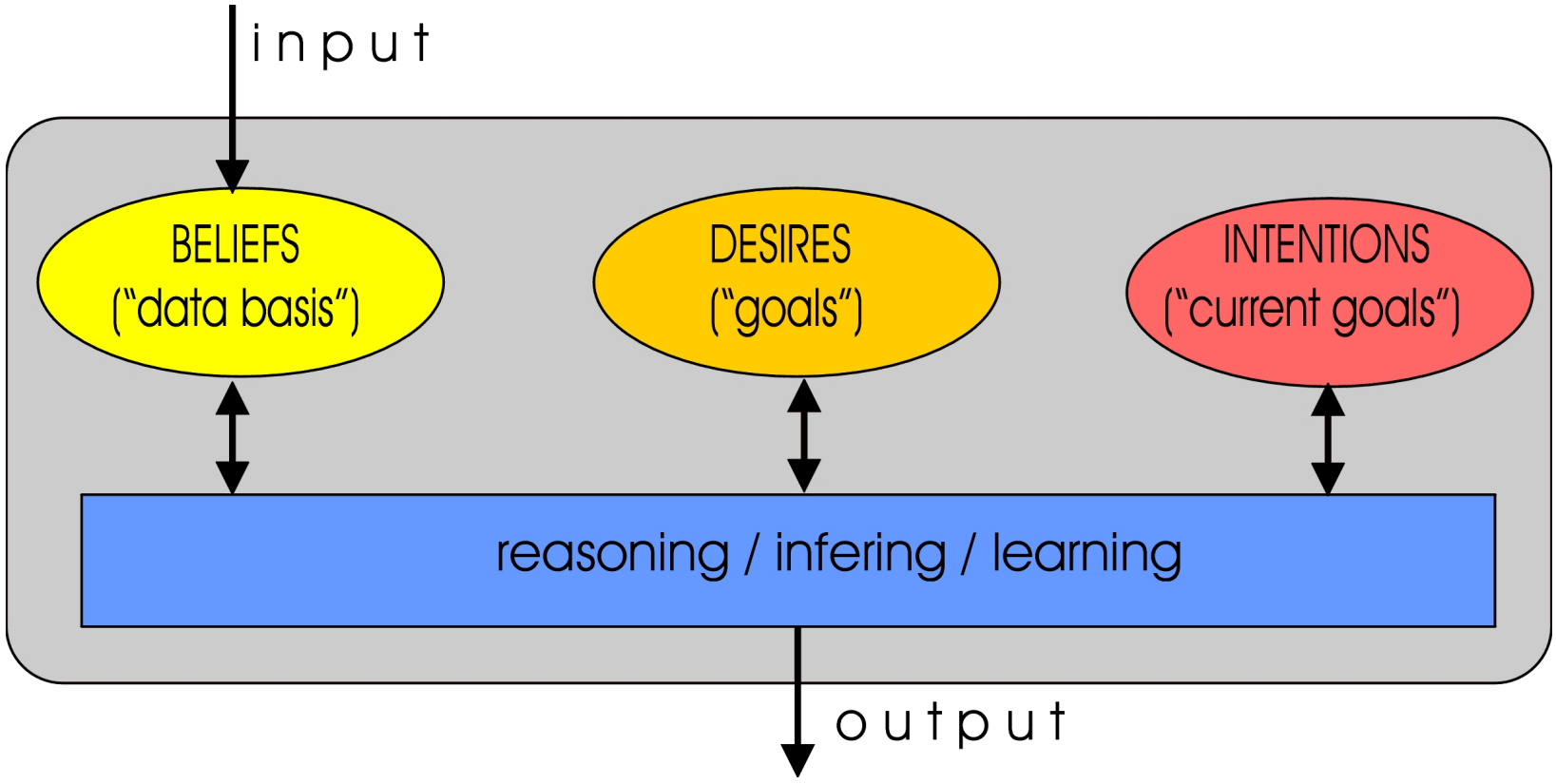
- Belief-Desire-Intention (BDI) architectures
- Layered architectures
- Constraint-oriented architectures

- Other characterizations:
  - reactive versus deliberative architectures
  - isolated versus social architectures

Outline

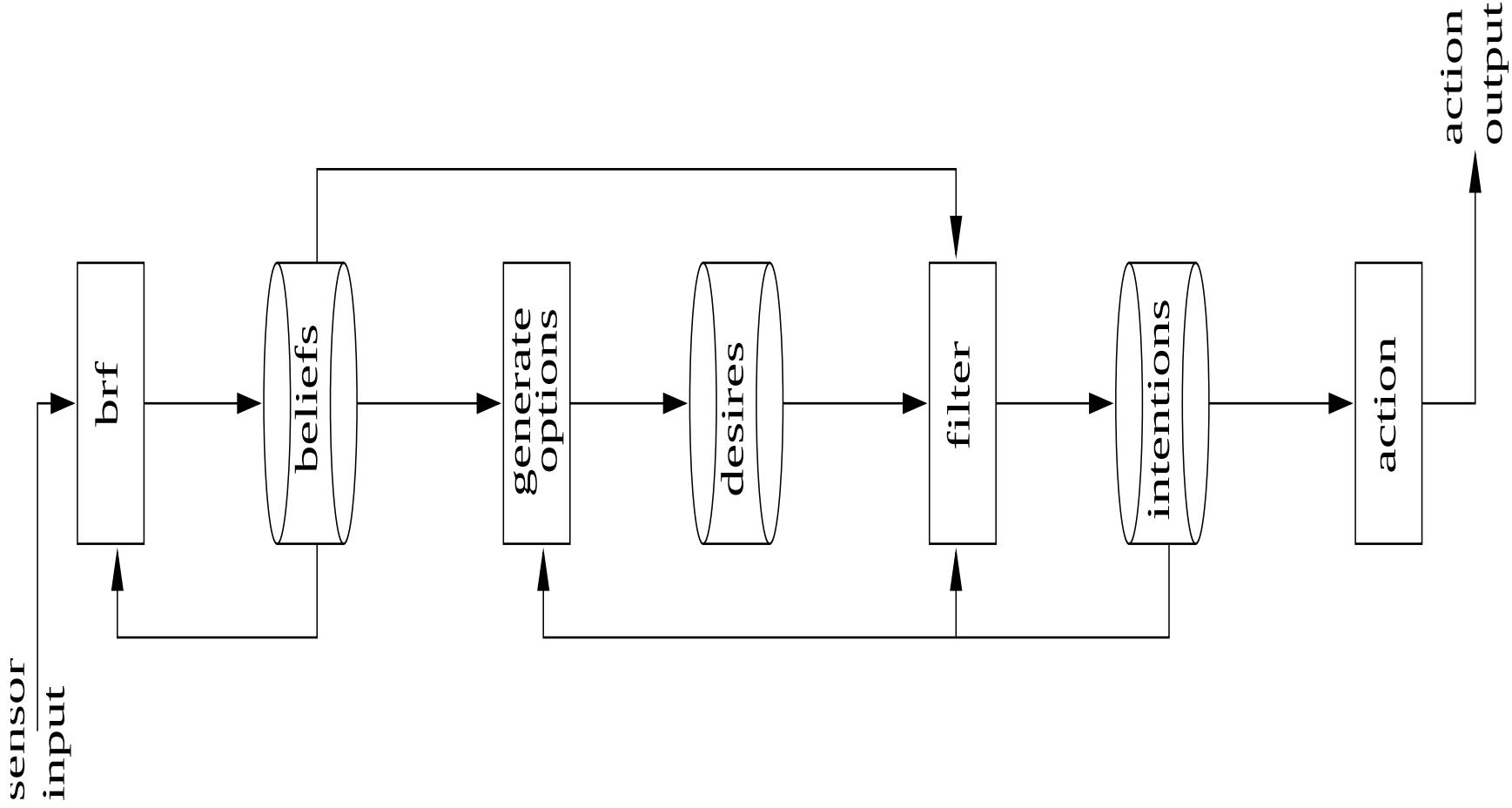
General Principle

- Basic structure:



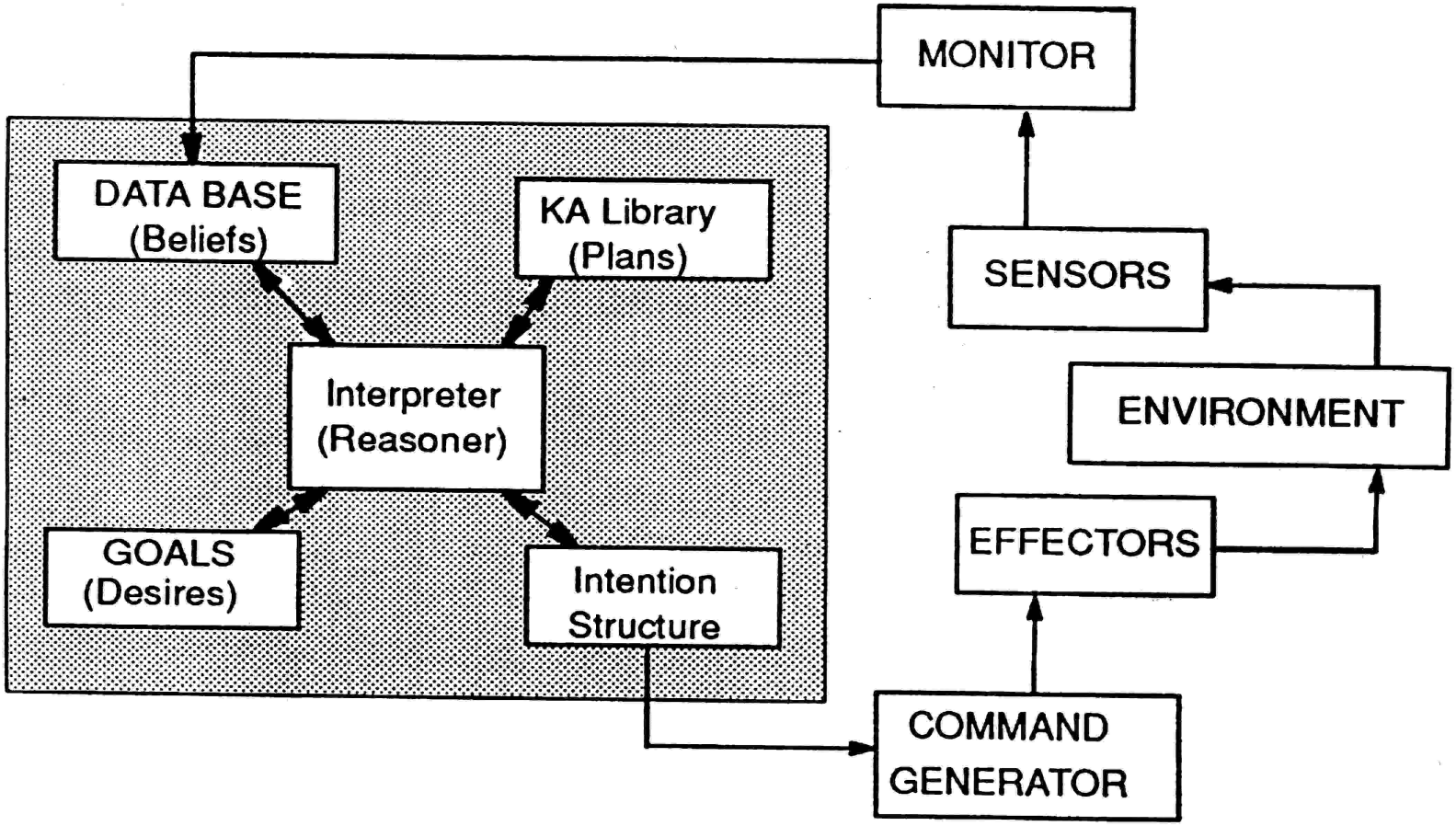
General Principle (Cont'd)

- Basic flow of internal data and control:



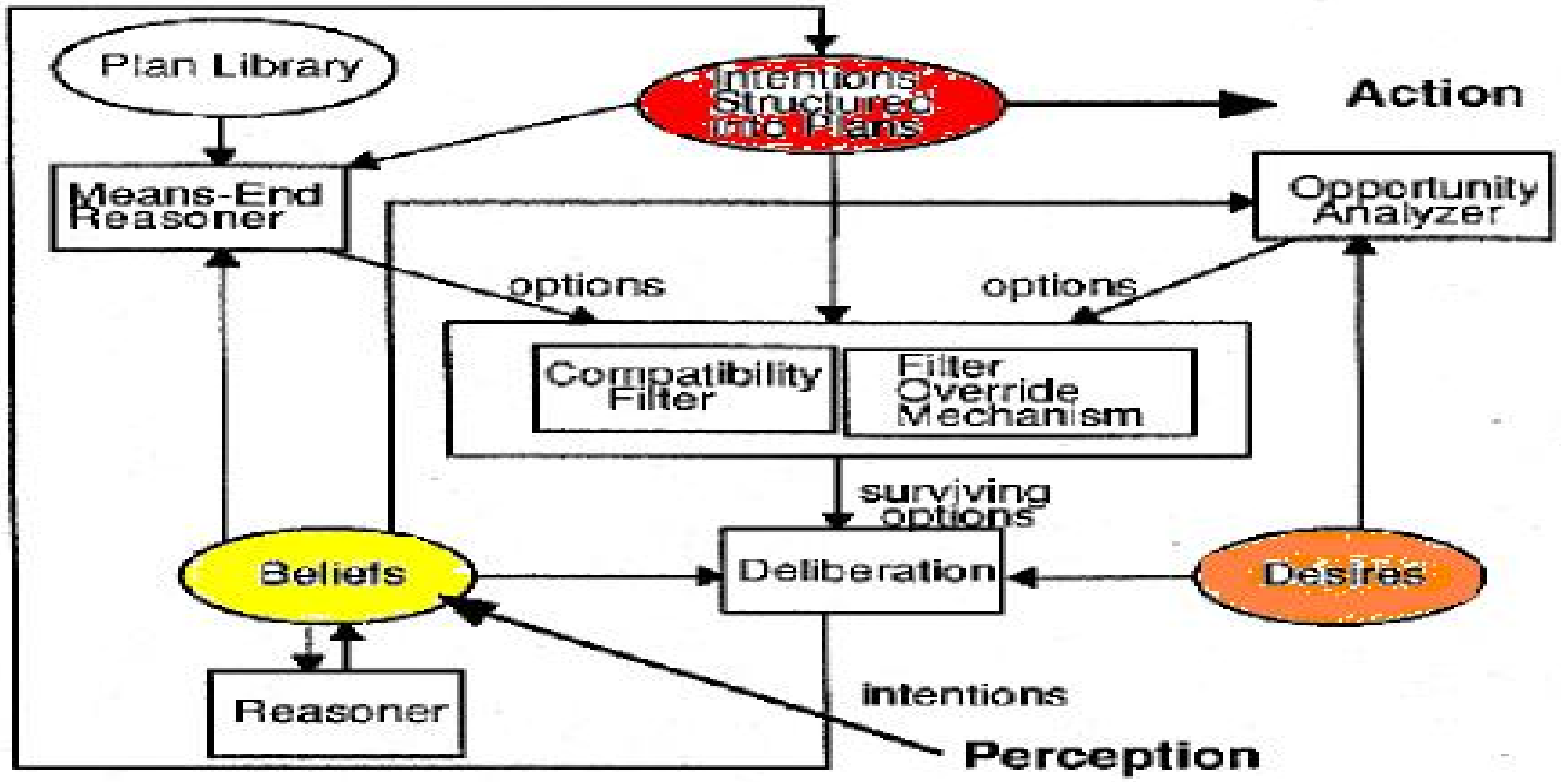
PRS

PRS = “Procedural Reasoning System”



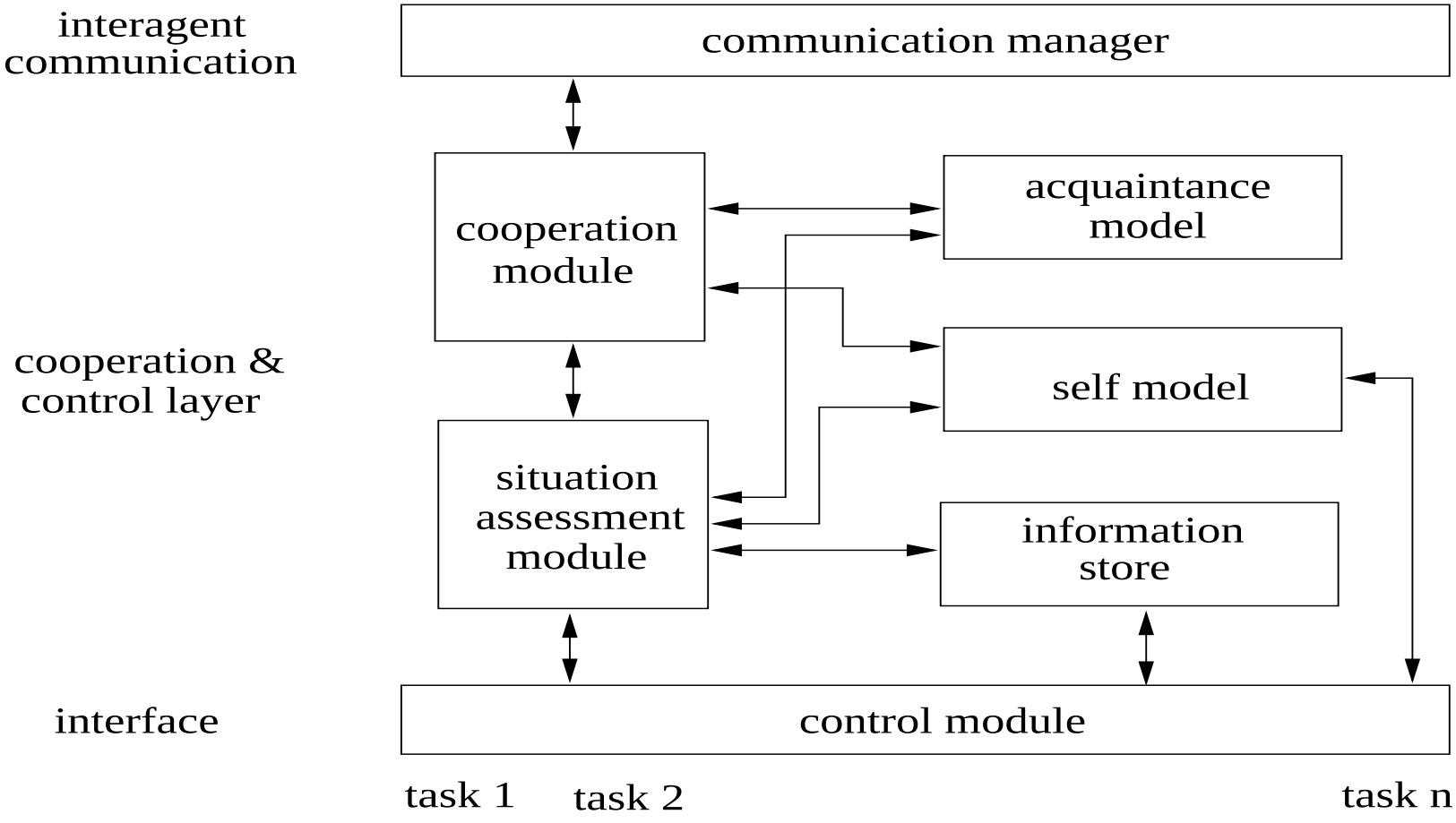
IRMA

IRMA = “Intelligent Resource-bounded Machine Architecture



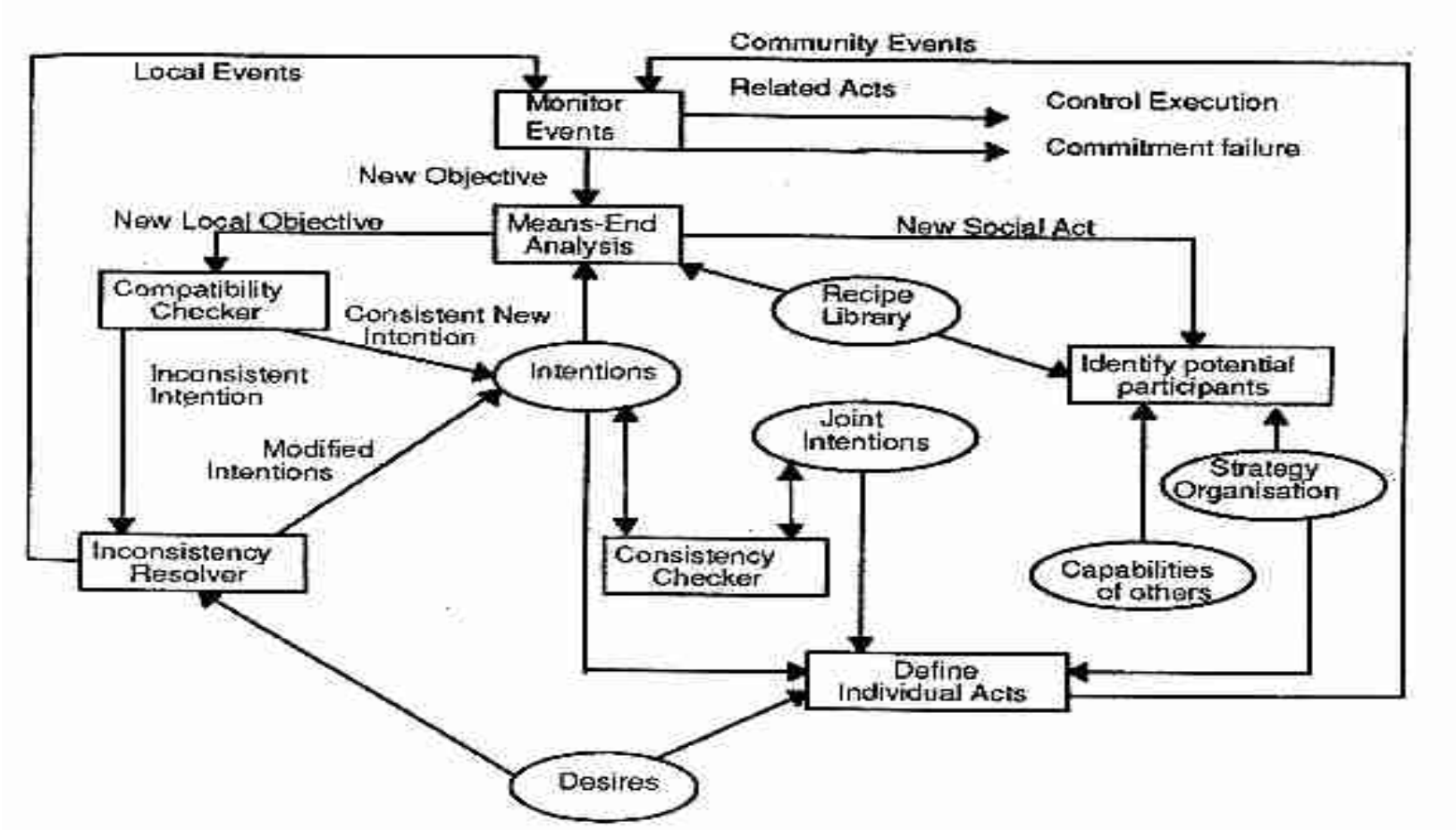
GRATE*

- Top-level view:



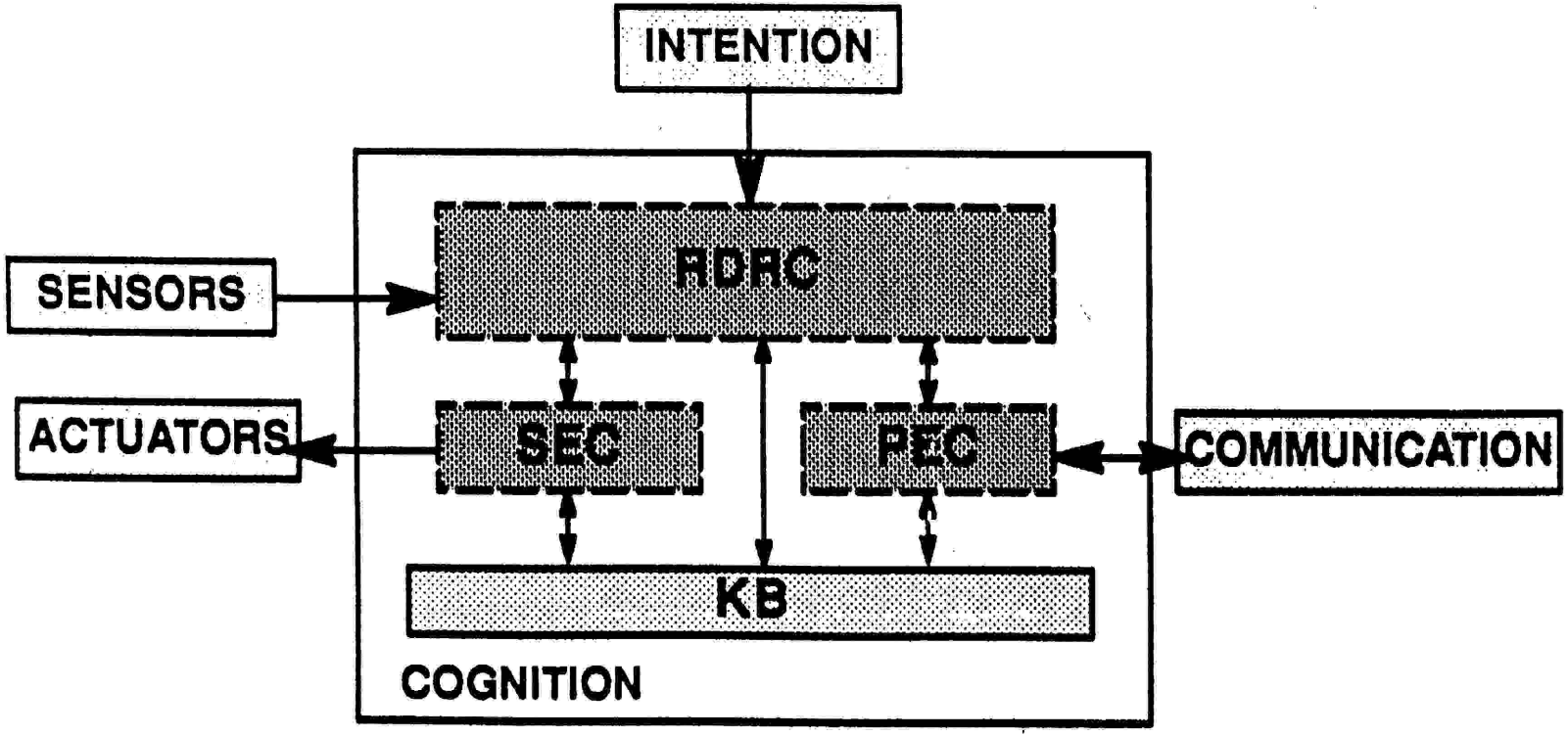
GRATE* (Cont'd)

- Details:



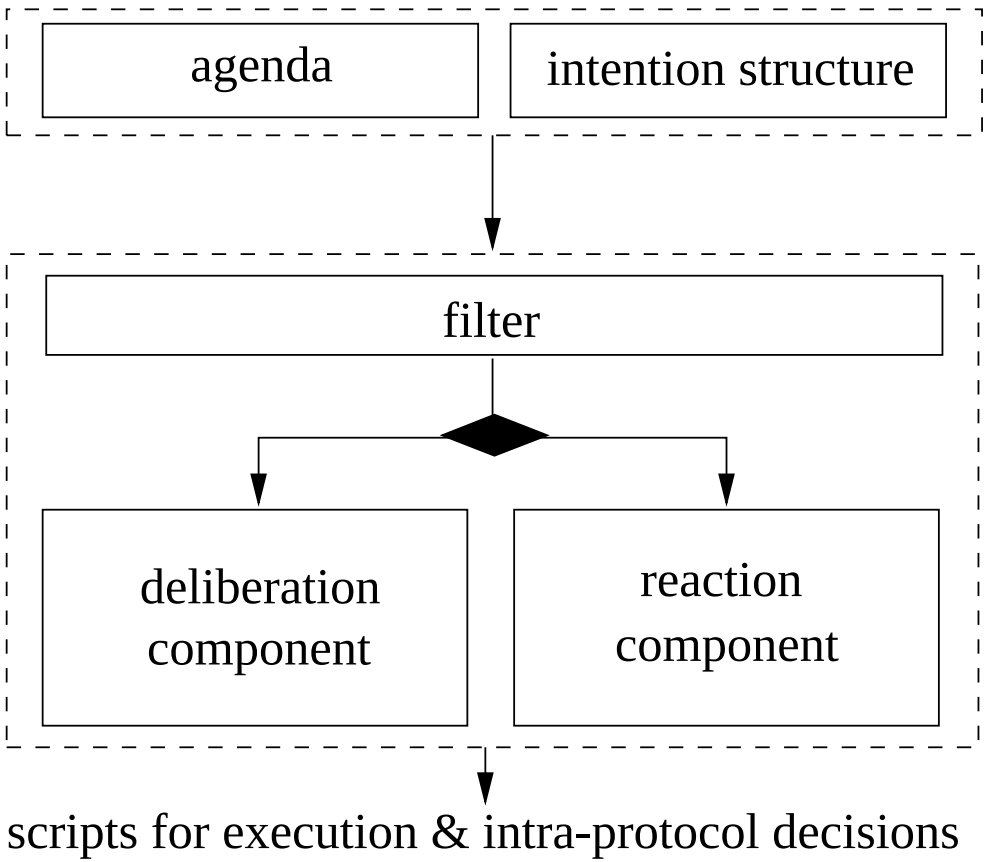
COSY

- Top-level view



COSY (Cont'd)

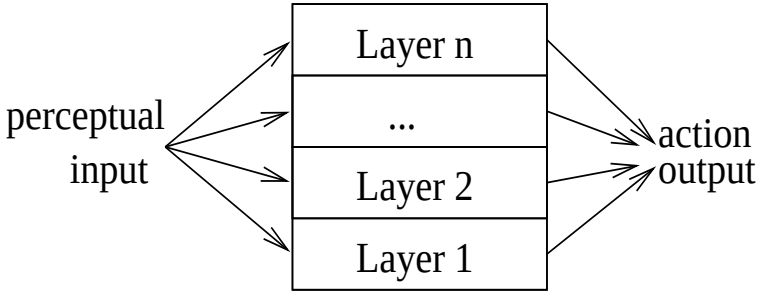
- RDRC in detail:



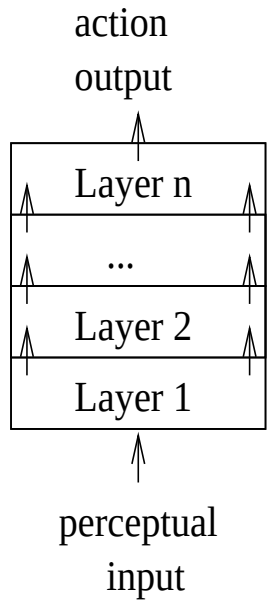
Outline

General Principle)

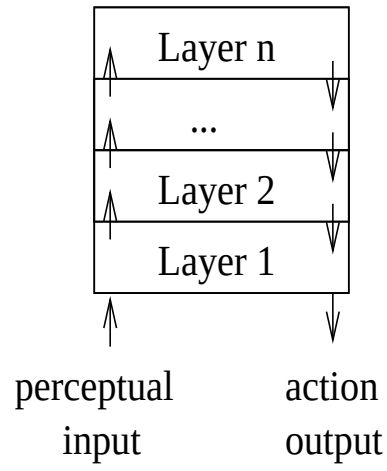
Structure and flow of data/control:



(a) Horizontal layering



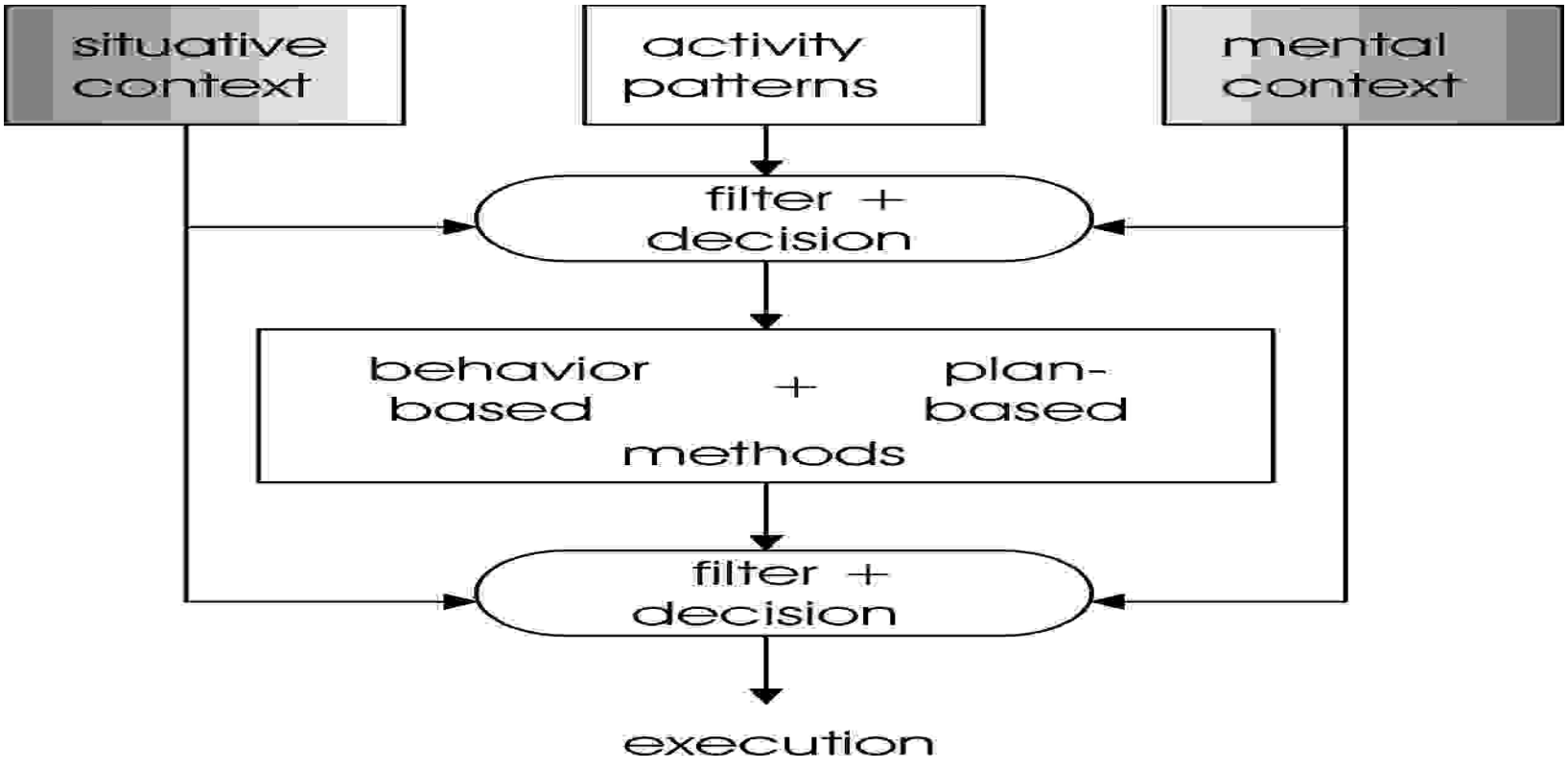
(b) Vertical layering
(One pass control)



(c) Vertical layering
(Two pass control)

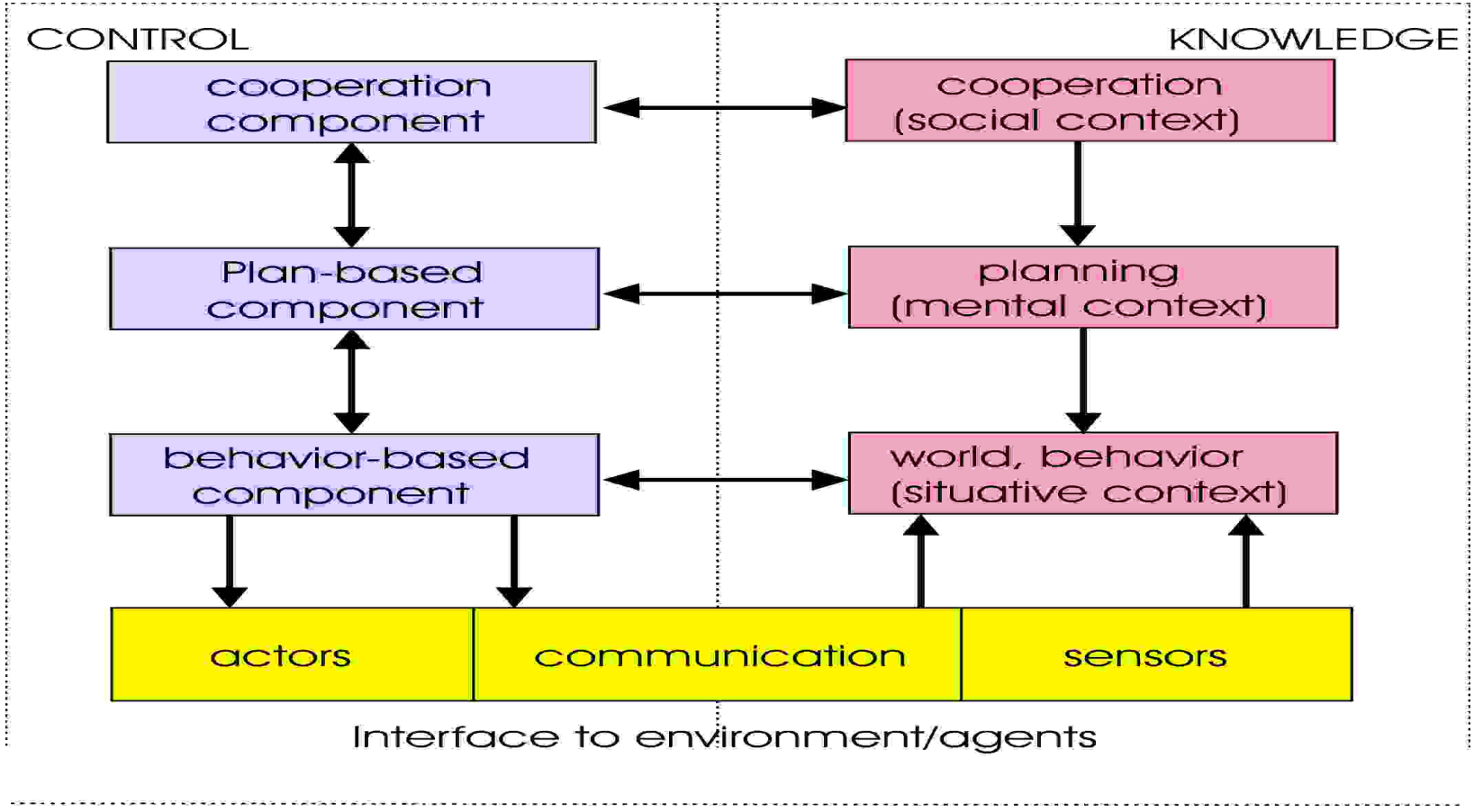
INTERRAP

- Top-level view:



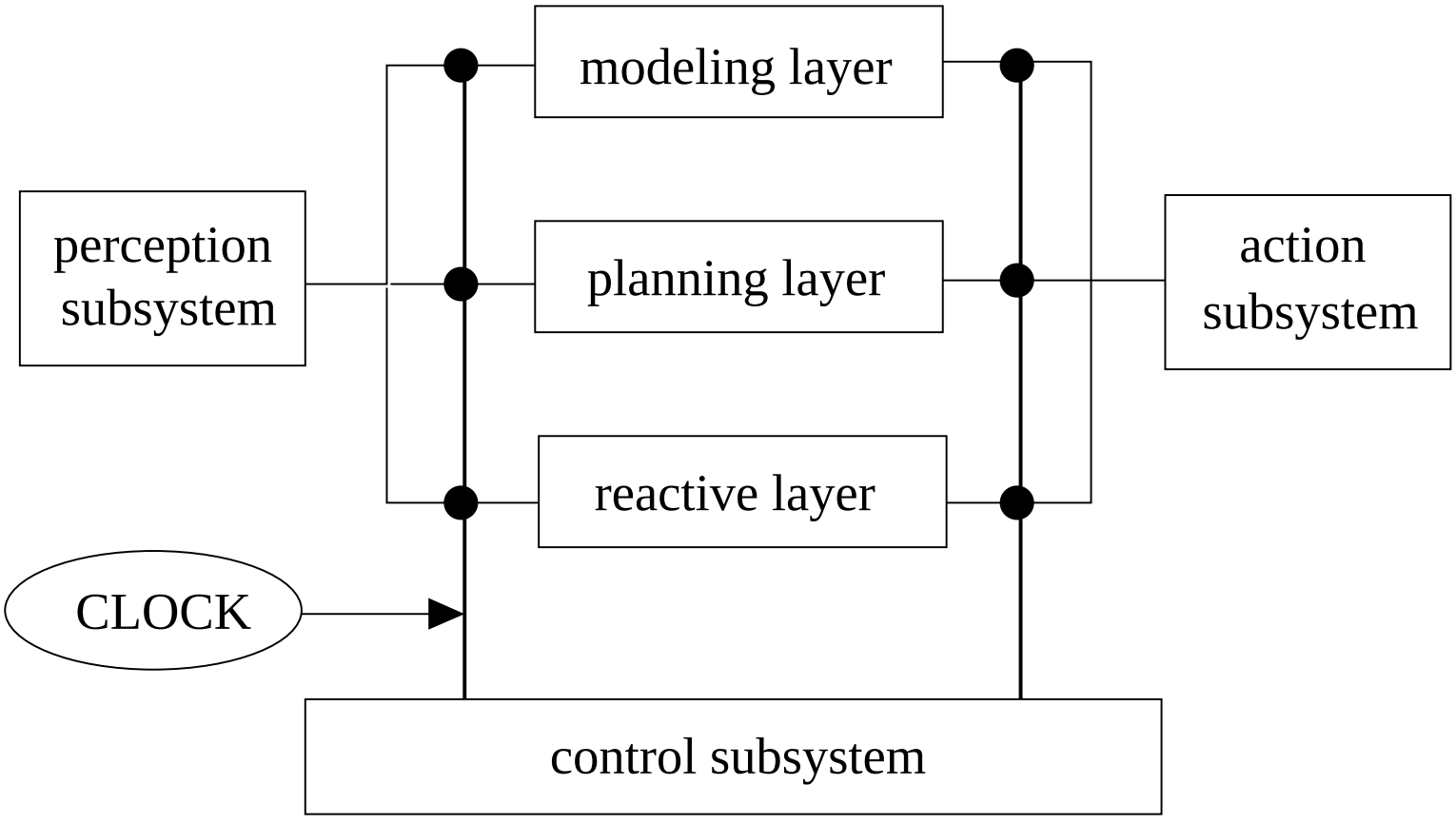
INTERRAP (Cont'd)

- Details:



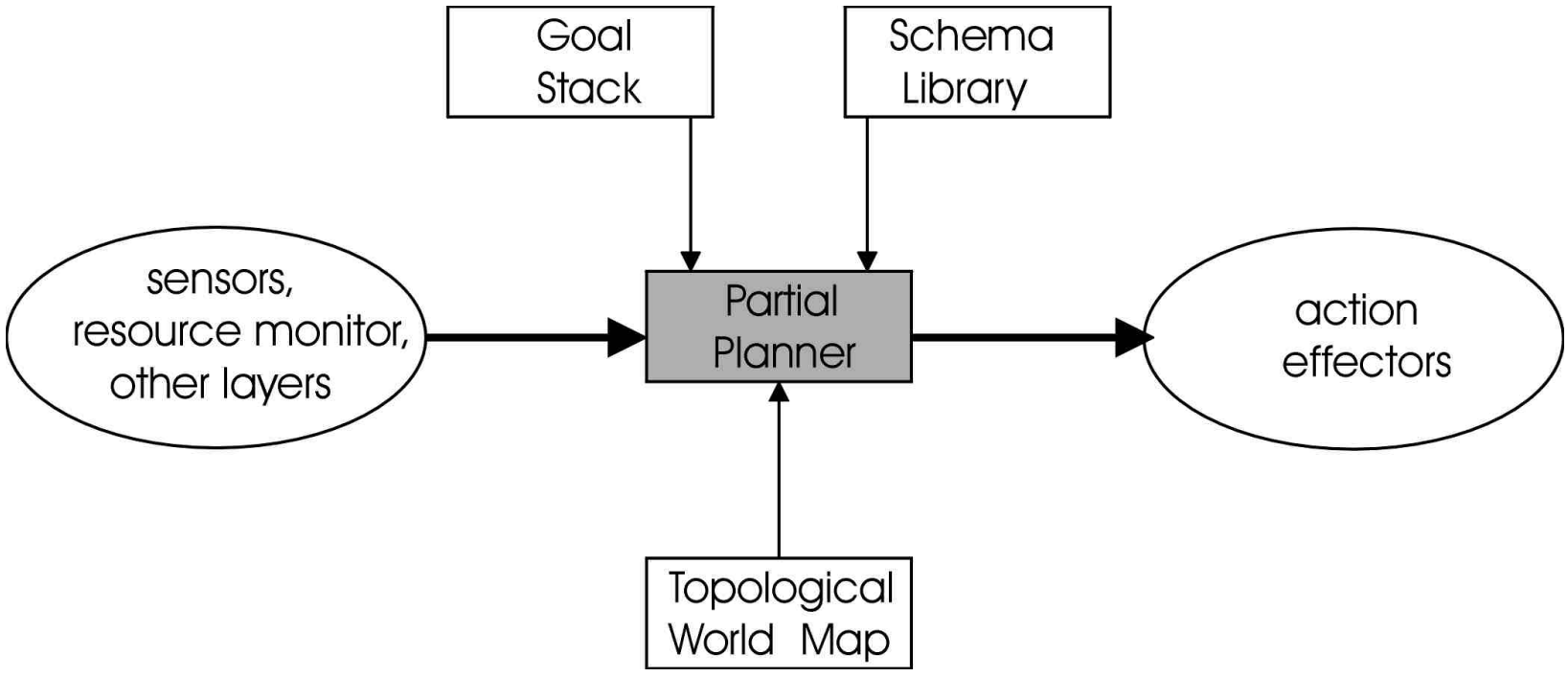
TouringMachines

- top-level view:



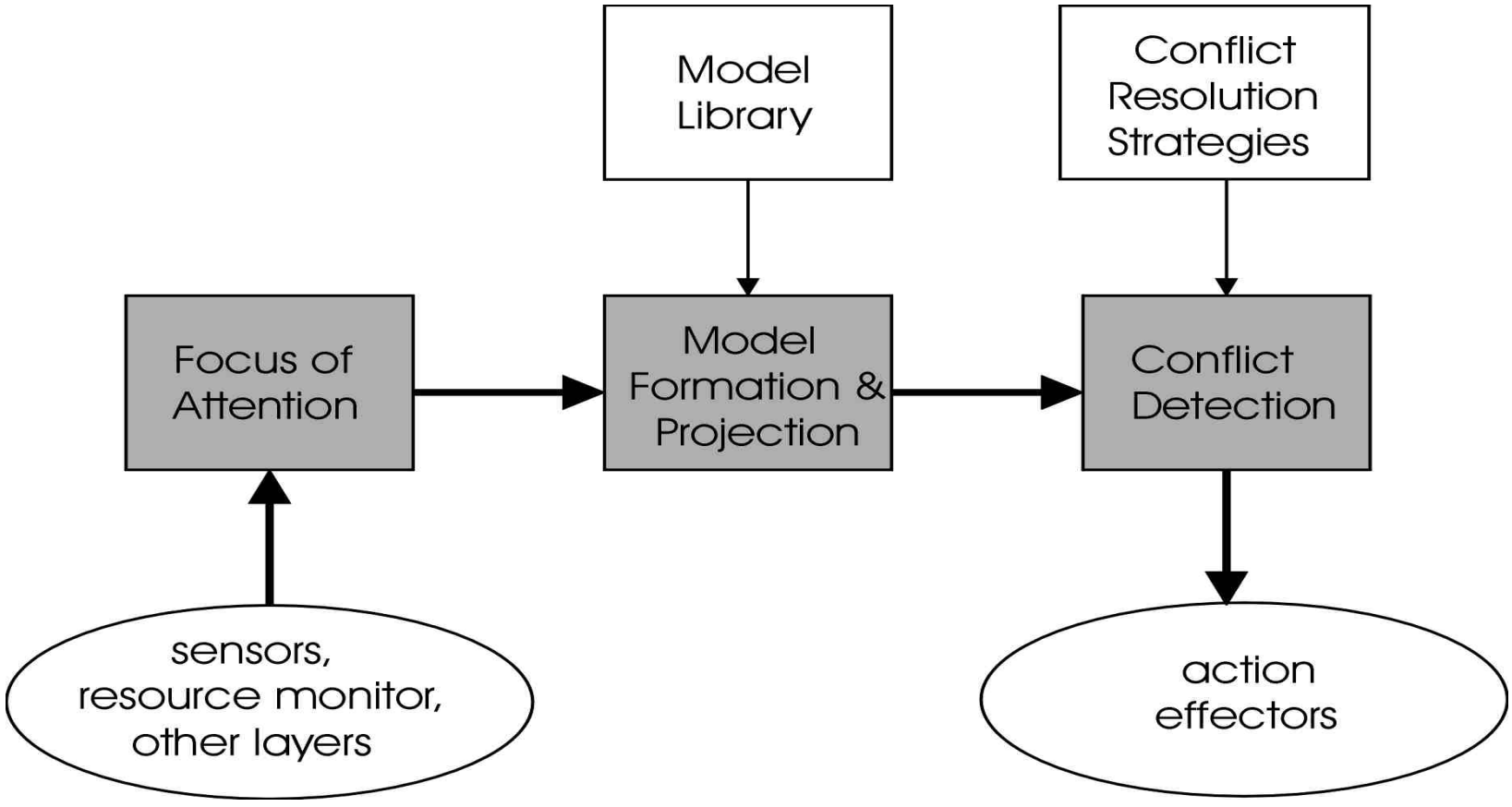
TouringMachines (Cont'd)

- details on planning layer:



TouringMachines (Cont'd)

- details on modeling layer:



Outline

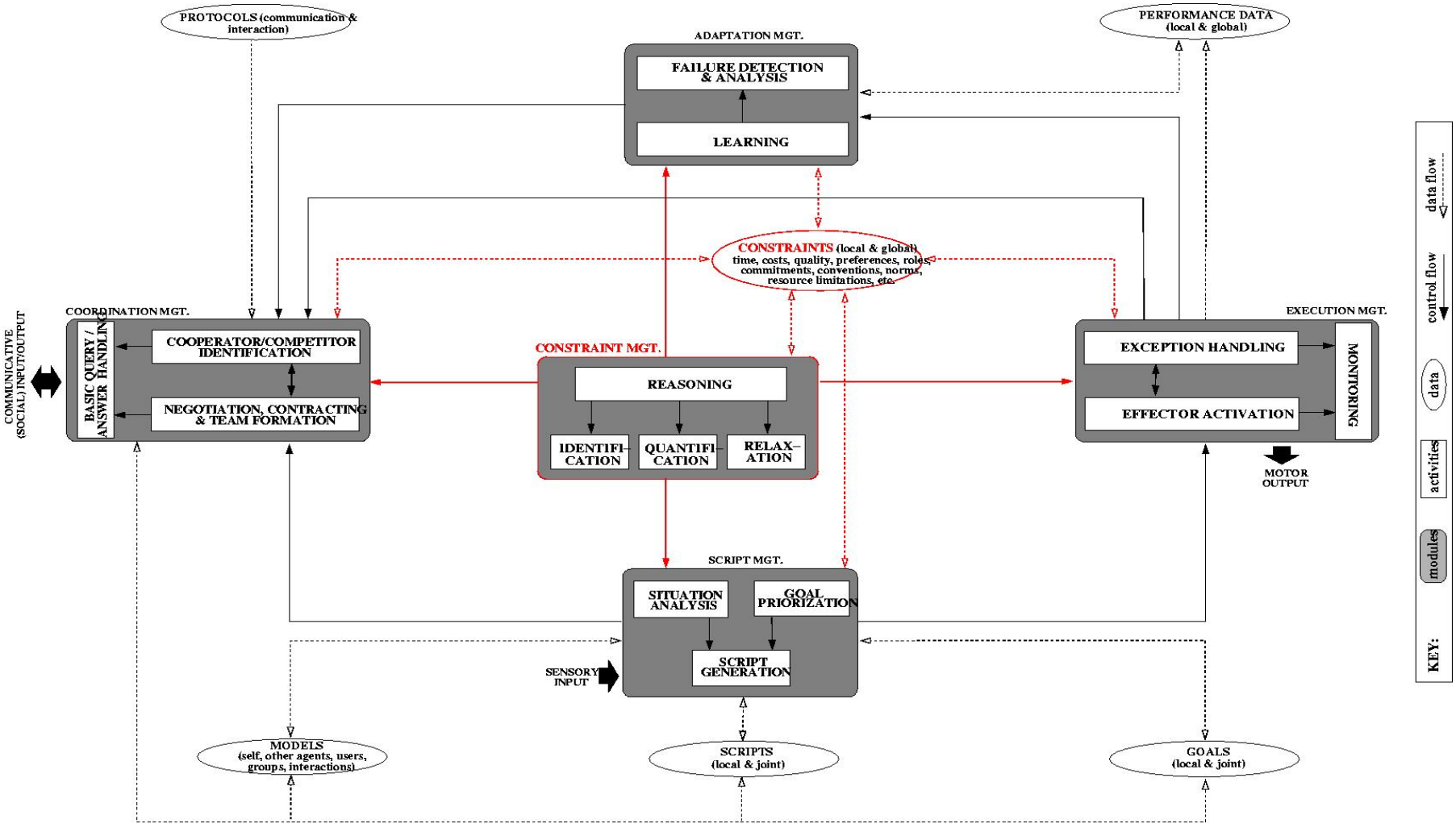
General Principle

- constraint = condition under which activity is to be carried out, thus behavior-influencing
- “constraints everywhere”
  - standard constraints: time, cost, quality
  - others: individual preferences, collective preferences, psychological and social commitments, resource limitations, roles an agent has to play, conventions, ...
- Key assumption: ability to act flexibly has much to do with flexible handling of constraints
- usual distinction: soft versus hard constraints
- particularly challenging: handling constraints in applications that are distributed, dynamic, and/or real-time

CCAF

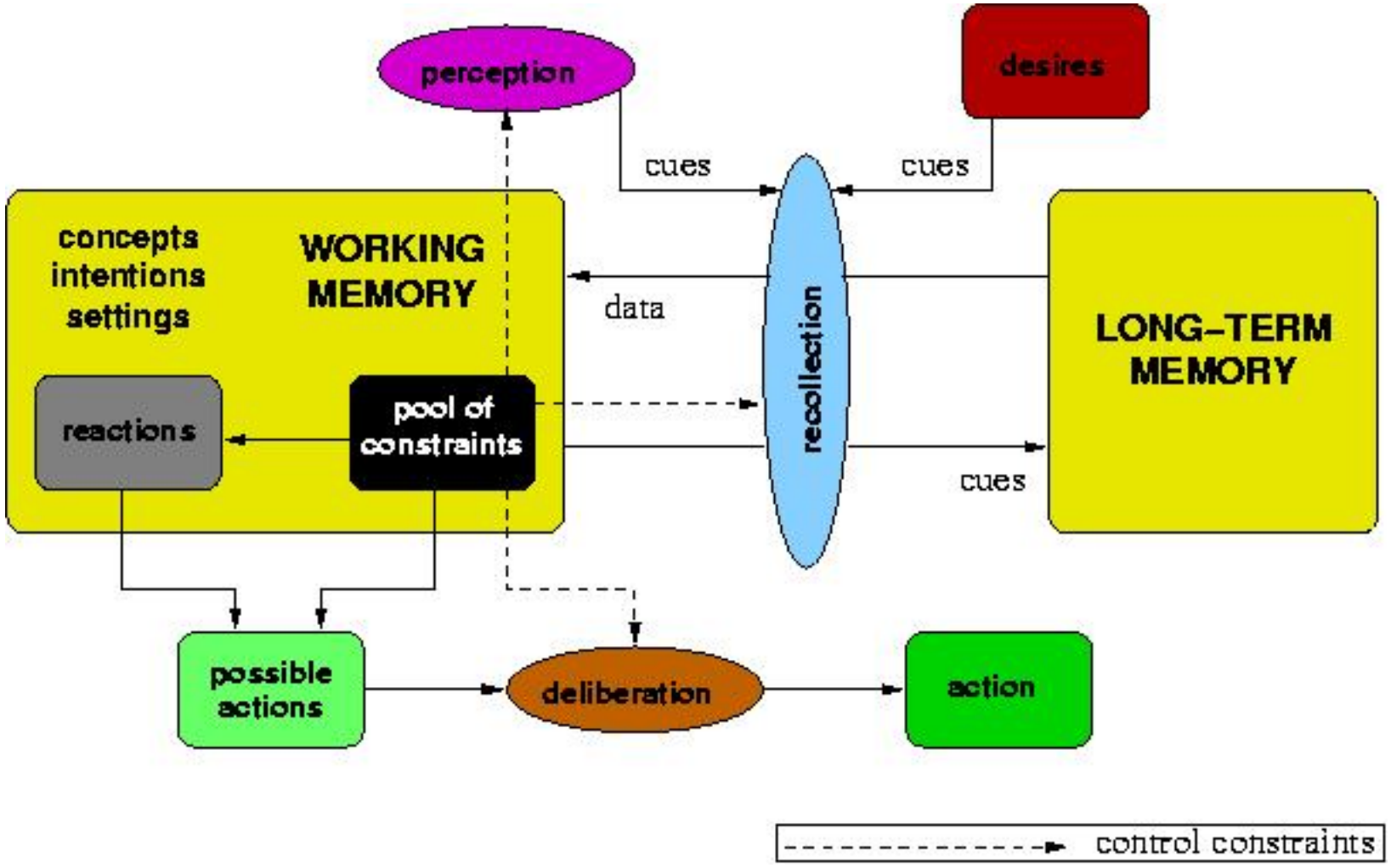
- CCAF = “Constraint-centered Architectural Framework”
- Underlying assumptions:
  - constraints and all agent-internal activities must be tightly intertwined
  - an agent must be able to carry out activities in cooperation with others (shared/delegated), when required by constraints
  - communication must be sensitive to constraints
  - agents must be able to reason about constraints (quantification of strength, importance, risk of violation)
  - constraint handling within an agent to be realized as a centralized process (efficiency)

CCAF (Cont'd)


PROTOCOLS (communication & interaction)
PERFORMANCE DATA (local & global)
ADAPTATION MGT.
FAILURE DETECTION & ANALYSIS
LEARNING
CONSTRAINTS (local & global) time, costs, quality, preferences, roles, commitments, conventions, norms, resource limitations, etc.
COMMUNICATIVE (SOCIAL) INPUT/OUTPUT
COORDINATION MGT.
BASIC QUERY / ANSWER HANDLING
COOPERATOR/COMPETITOR IDENTIFICATION
NEGOTIATION, CONTRACTING & TEAM FORMATION
CONSTRAINT MGT.
REASONING
IDENTIFI-CATION
QUANTIFI-CATION
RELAX-ATION
EXECUTION MGT.
EXCEPTION HANDLING
EFFECTOR ACTIVATION
MONITORING
MOTOR OUTPUT
SCRIPT MGT.
SITUATION ANALYSIS
GOAL PRIORIZATION
SCRIPT GENERATION
SENSORY INPUT
MODELS (self, other agents, users, groups, interactions)
SCRIPTS (local & joint)
GOALS (local & joint)
KEY:
modules
activities
data
control flow
data flow

Waffler

- Waffler: after a colloquialism for improvisation (“waffling”)
- top-level view:



Waffler (Cont'd)

- the role of constraints in more detail: