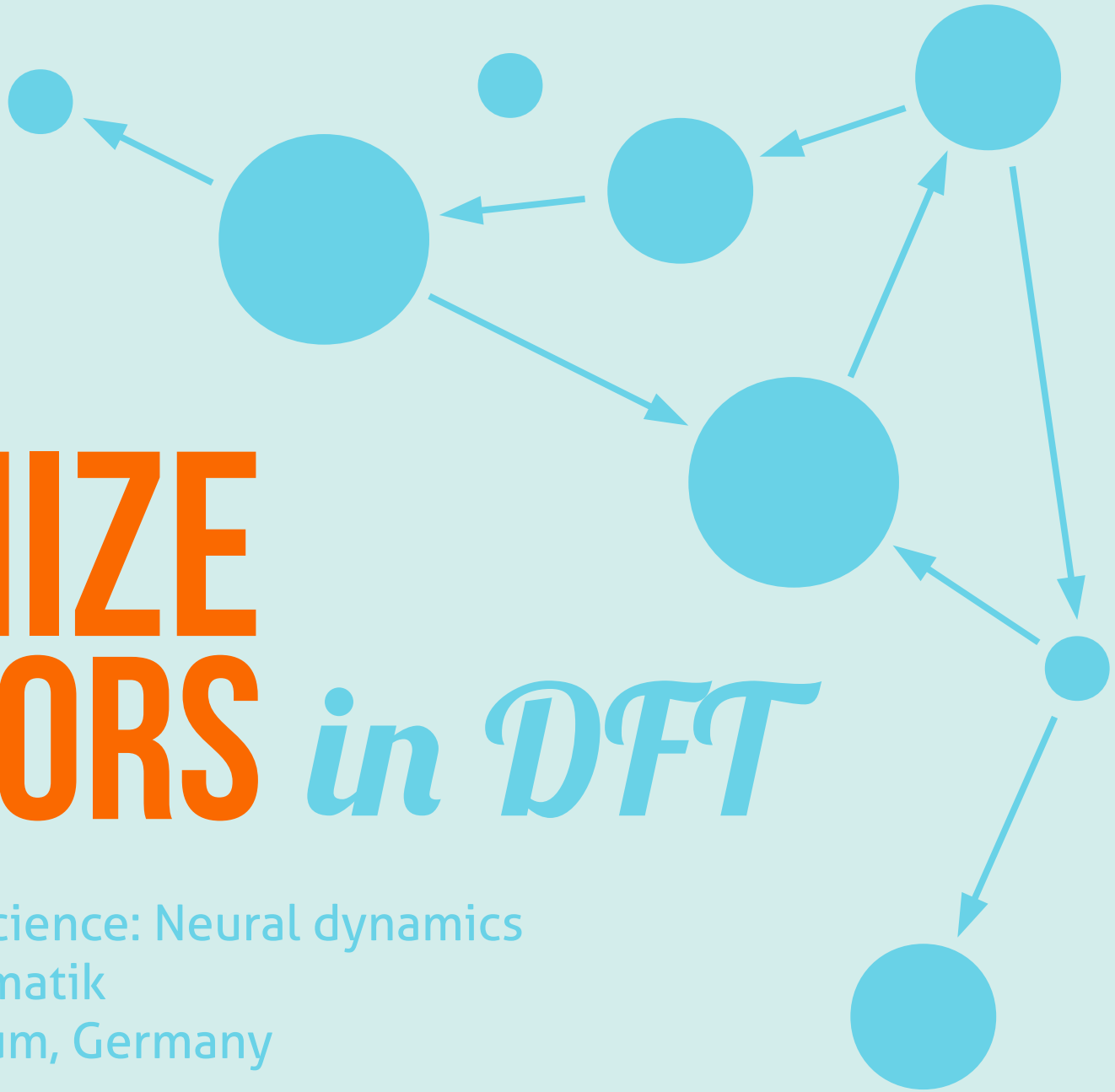


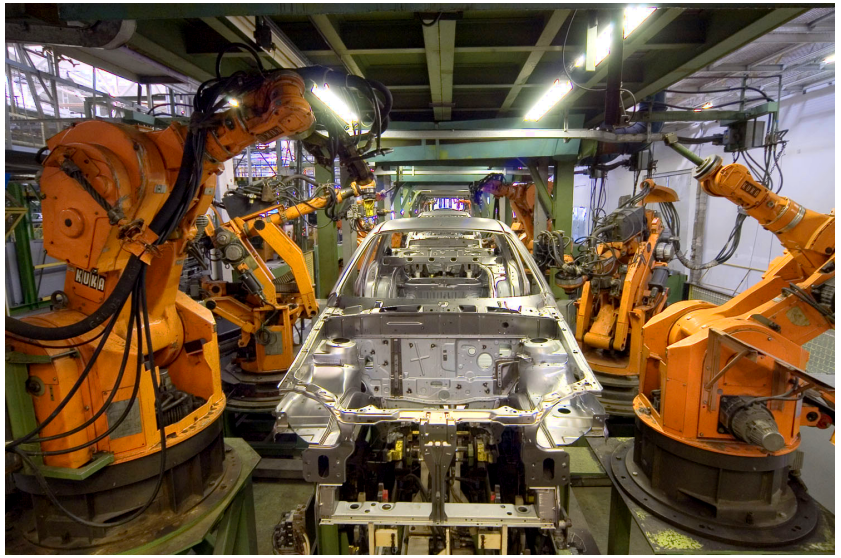
How to ORGANIZE BEHAVIORS *in DFT*

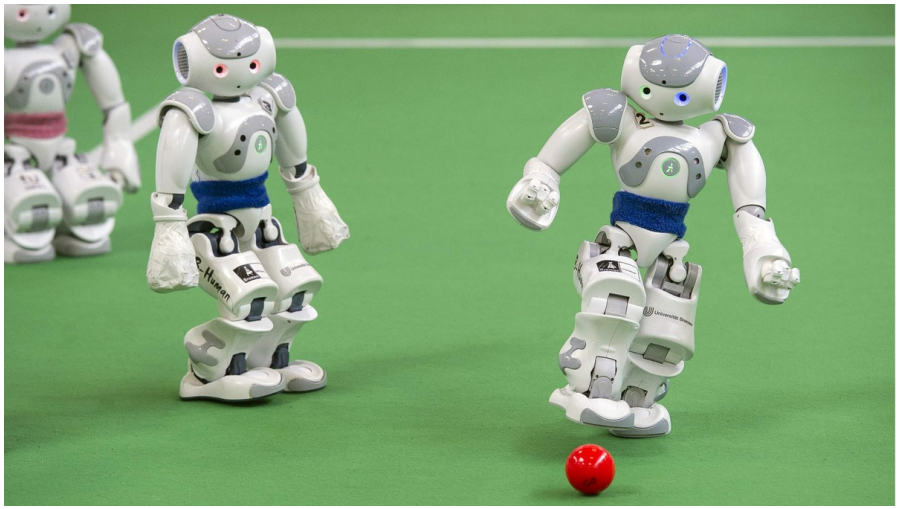
Computational neuroscience: Neural dynamics
Institut für Neuroinformatik
Ruhr-Universität Bochum, Germany
November 30, 2017

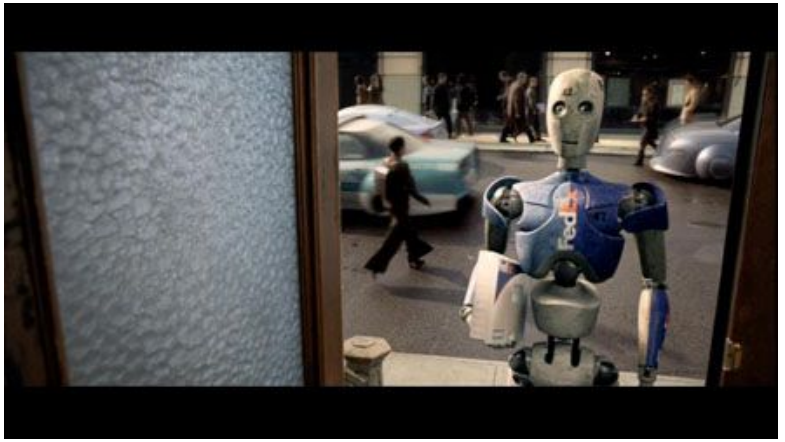
Mathis Richter

ORGANIZING *behaviors*

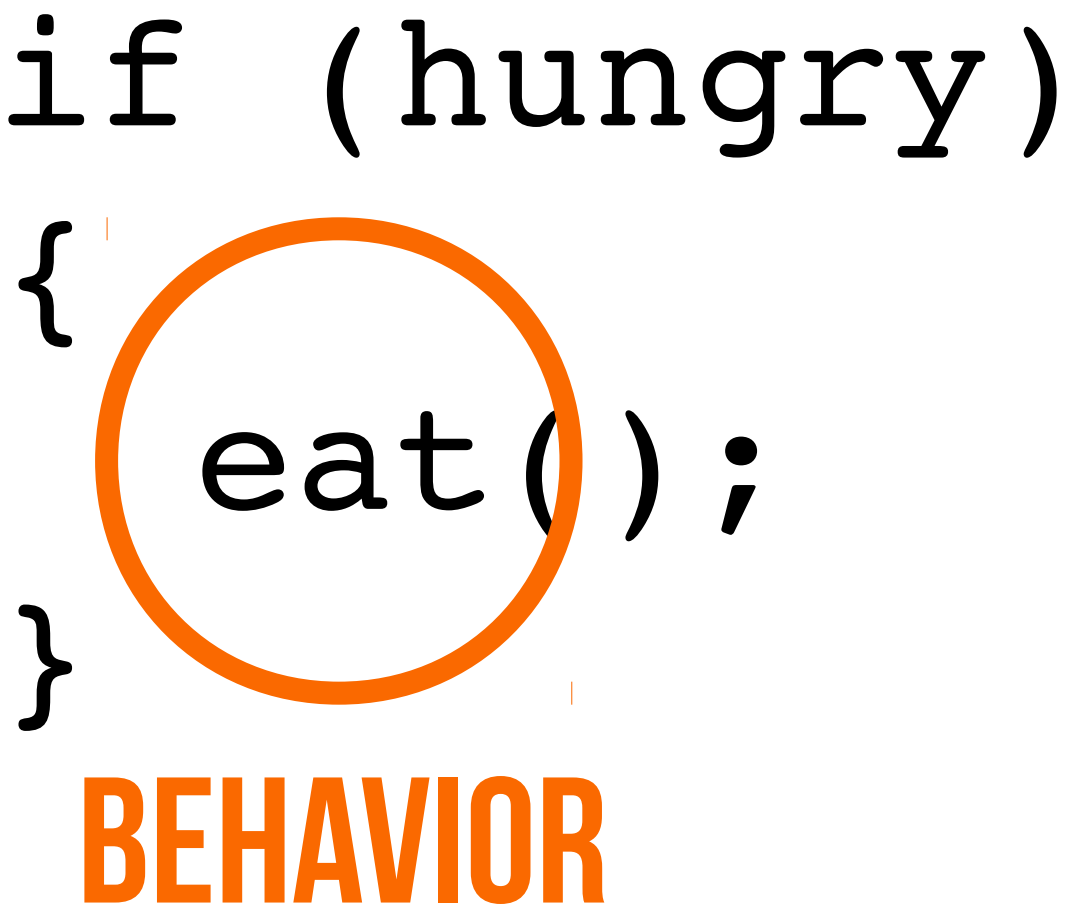
ORGANIZING *behaviors*



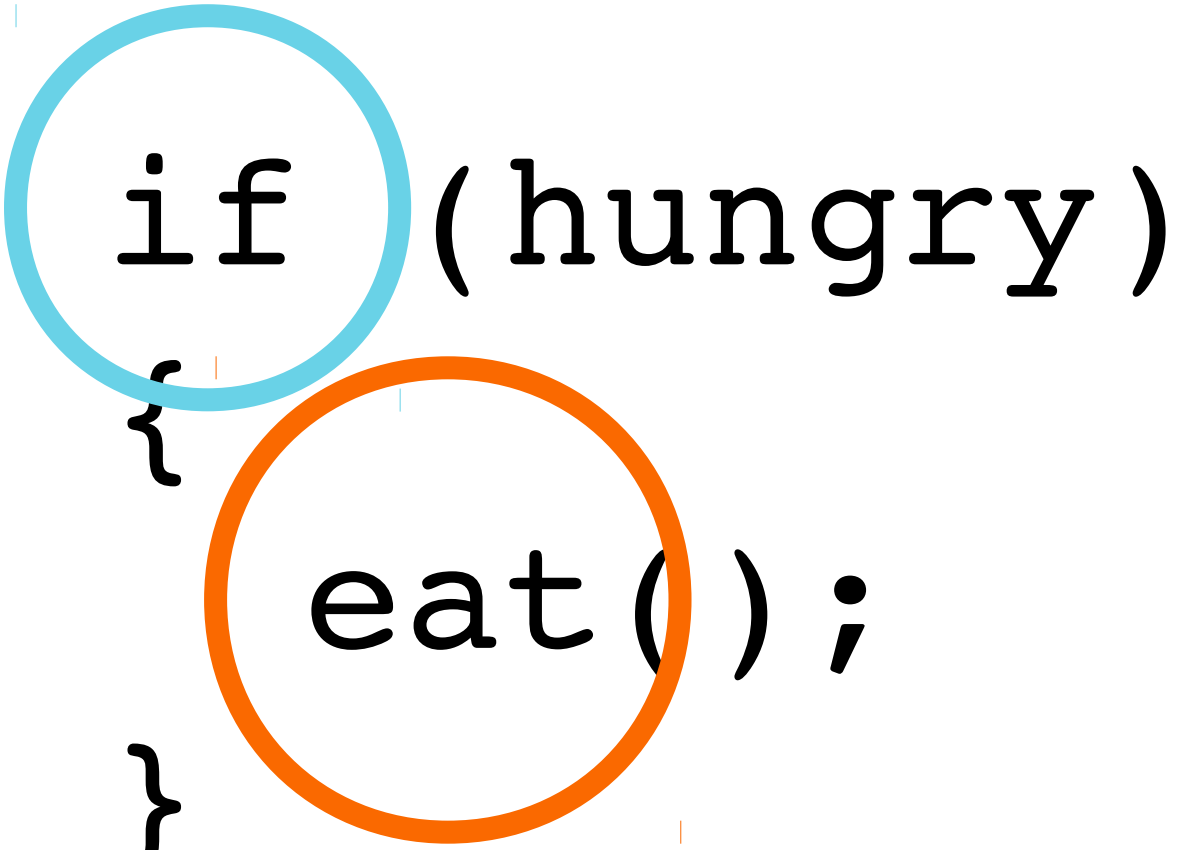




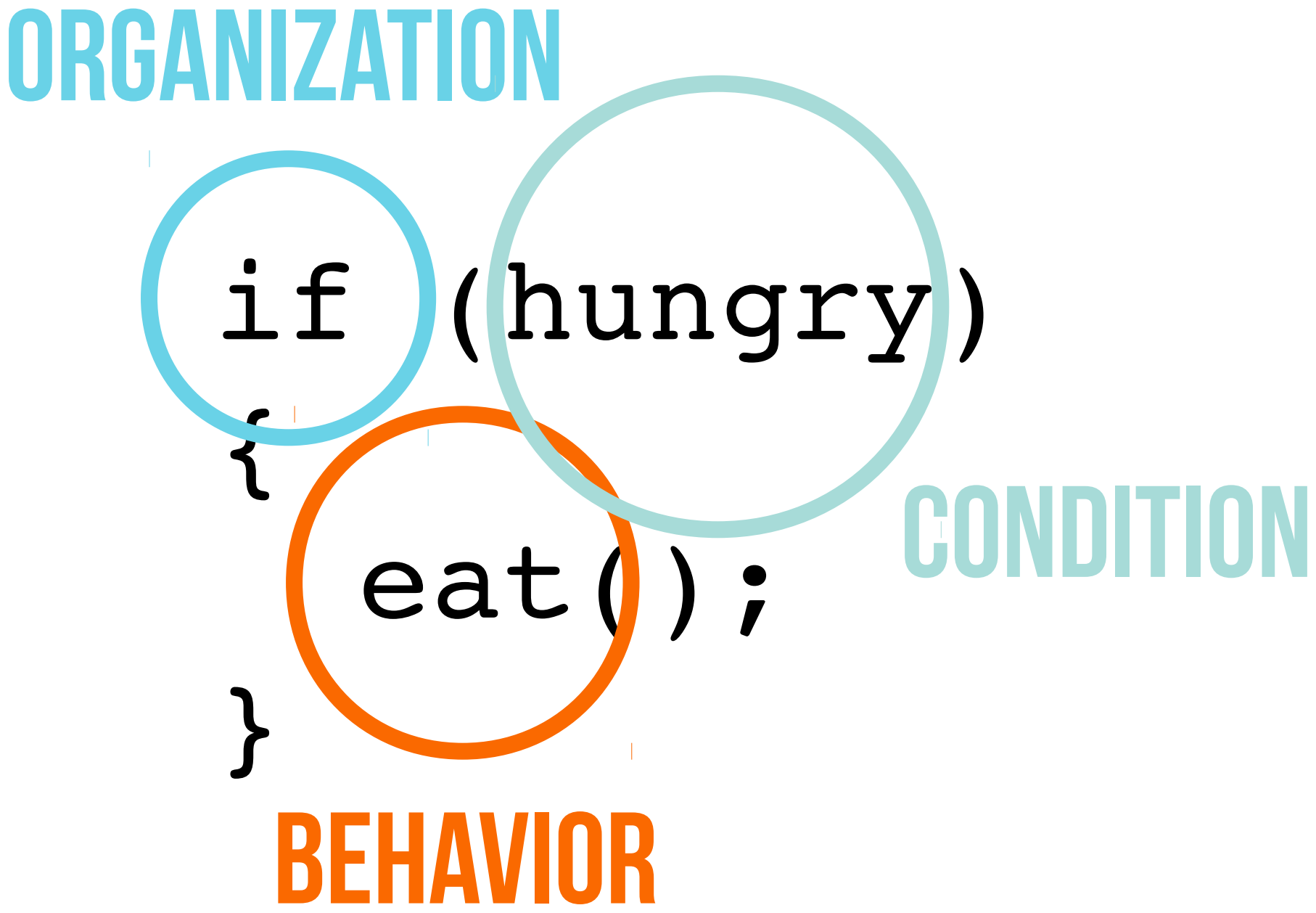
```
if (hungry)
{
  eat();
}
```


if (hungry)
{
eat();
}
BEHAVIOR

ORGANIZATION

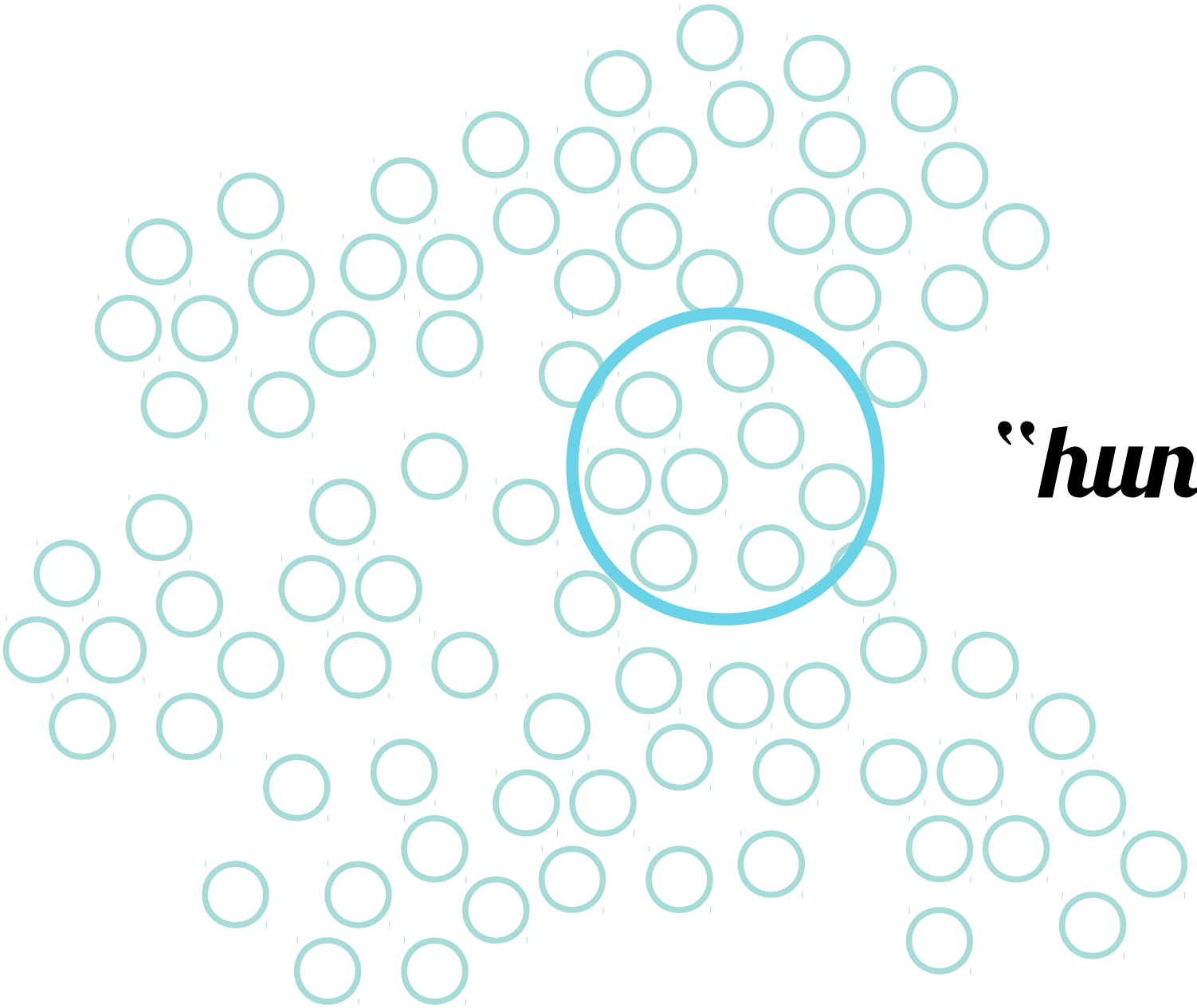


BEHAVIOR


ORGANIZATION
if (hungry)
{
eat();
}
CONDITION
BEHAVIOR

NEURONS

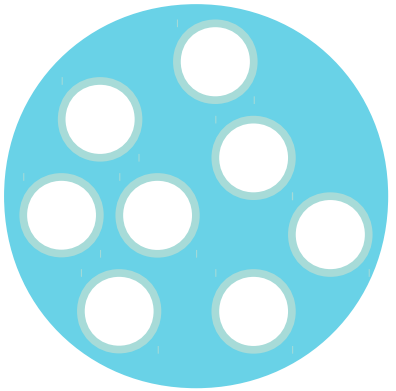
NEURONS



"hungry?"

NEURAL *dynamics*

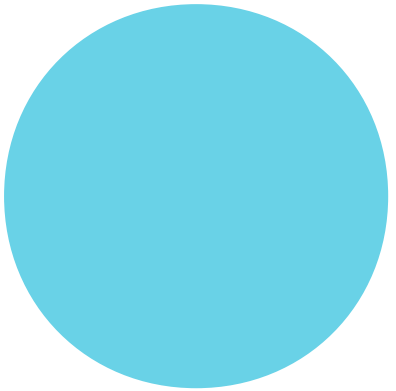
NEURAL NODE



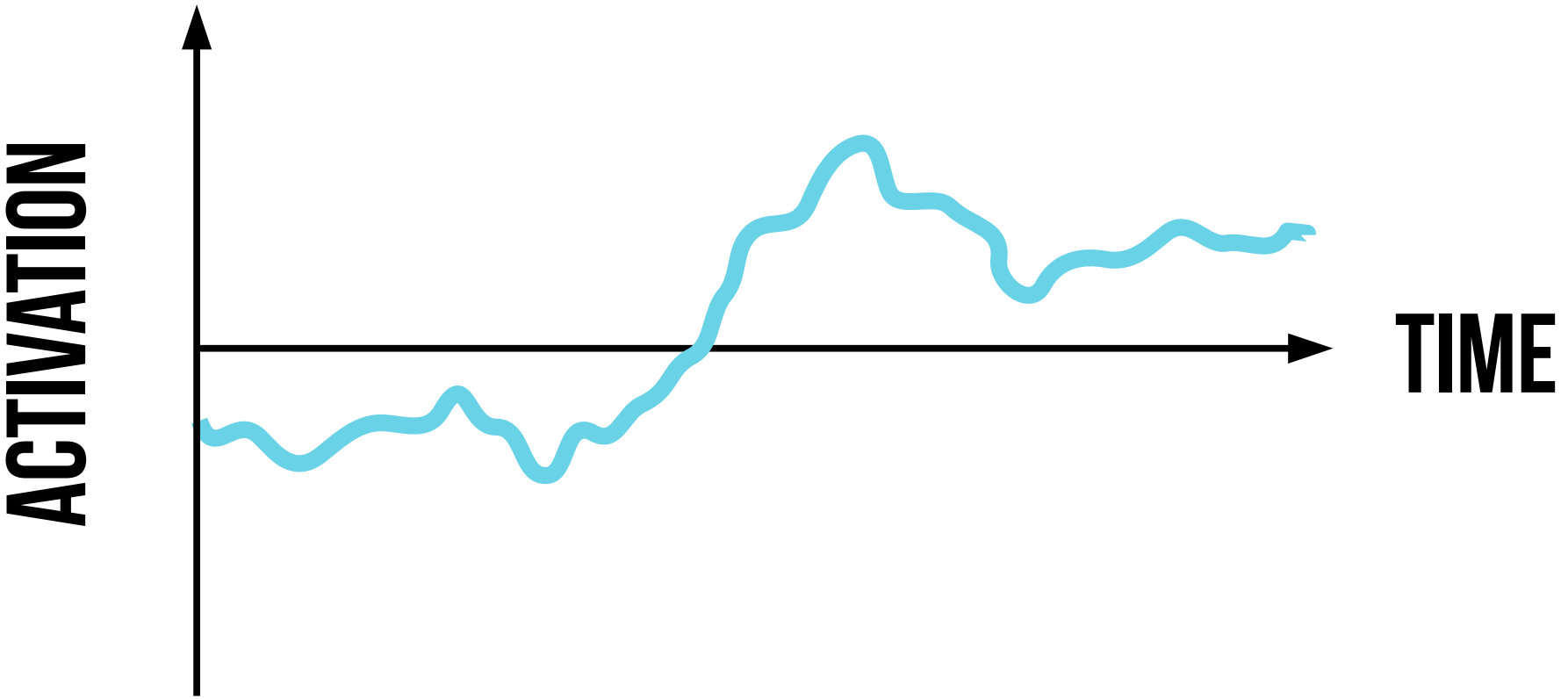
"hungry?"

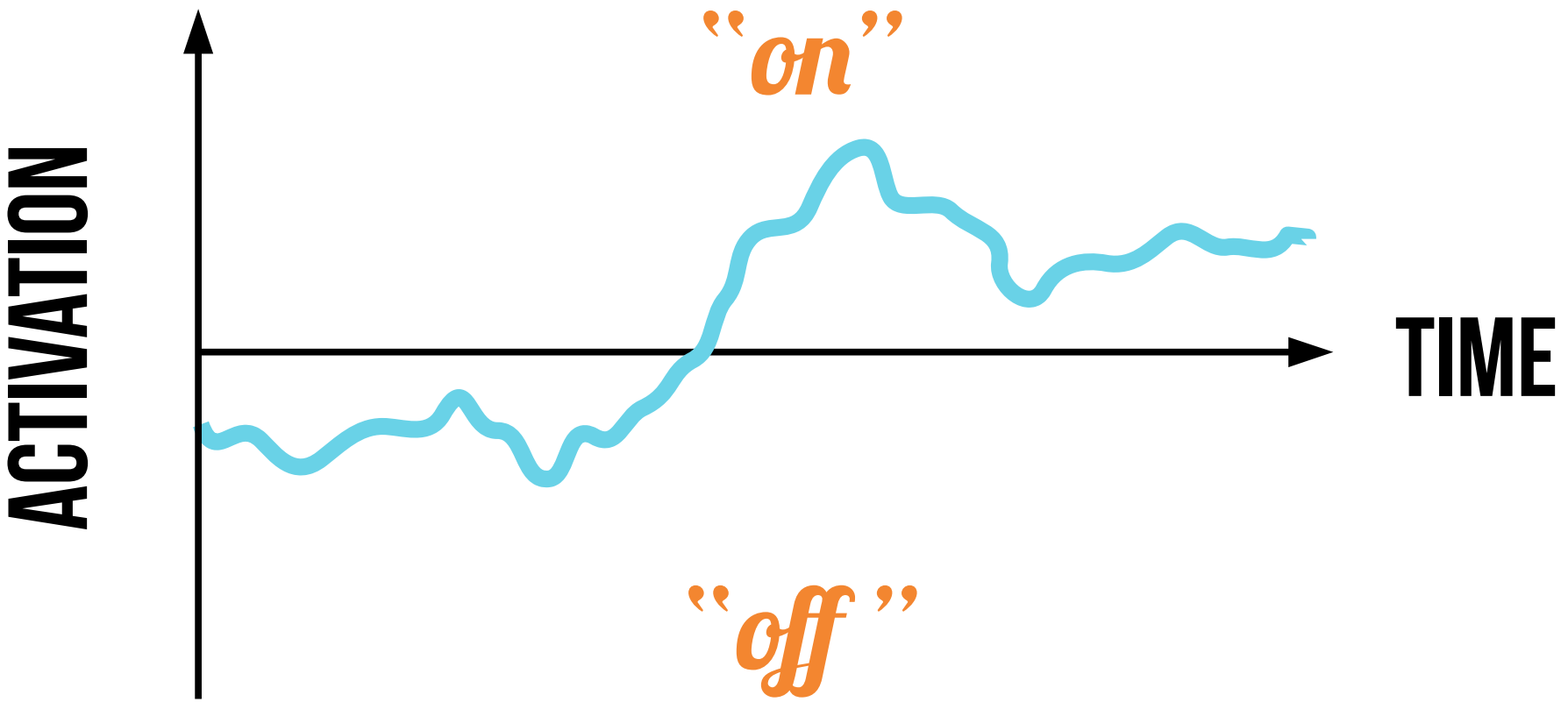
NEURAL *dynamics*

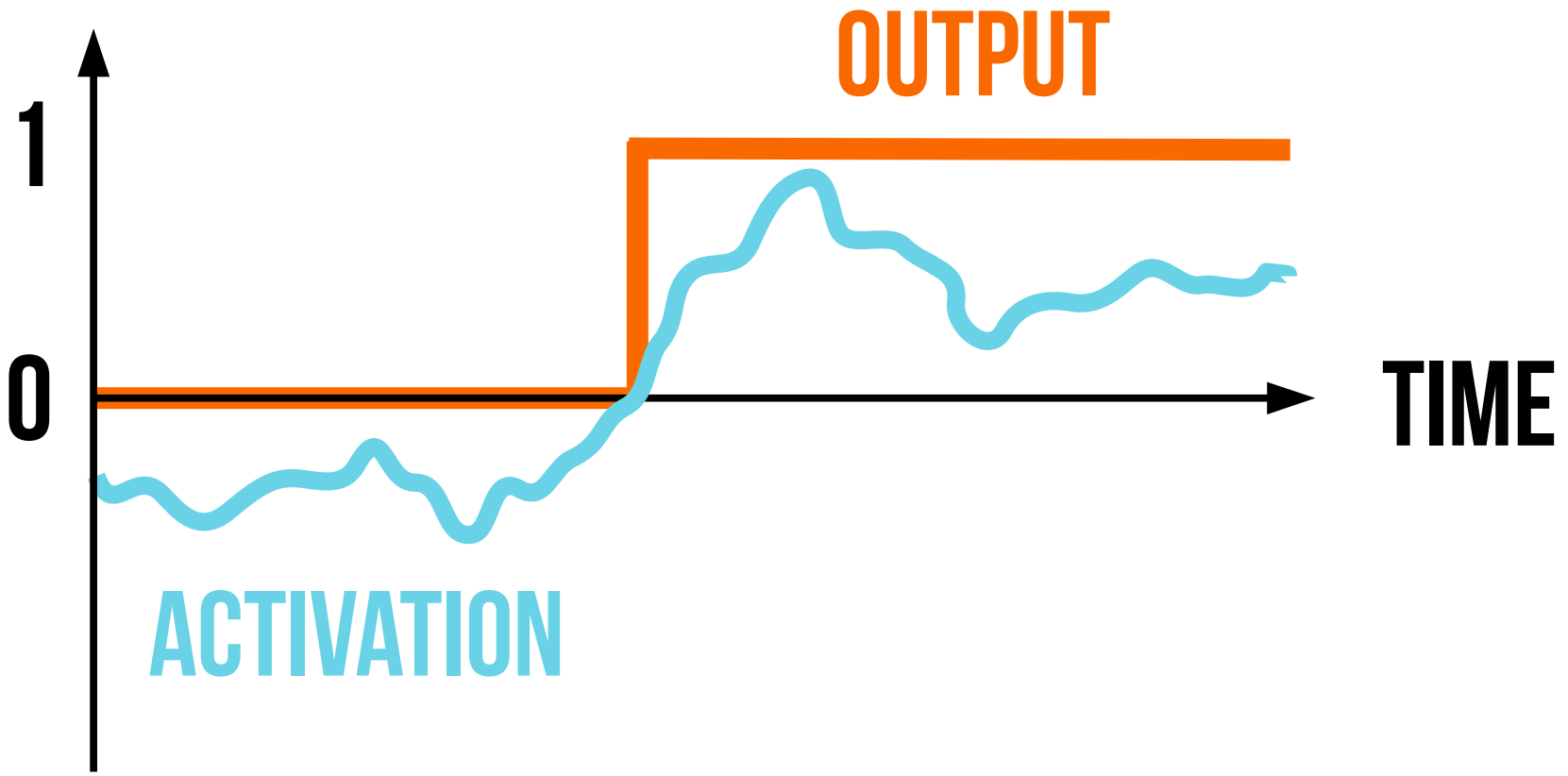
NEURAL NODE



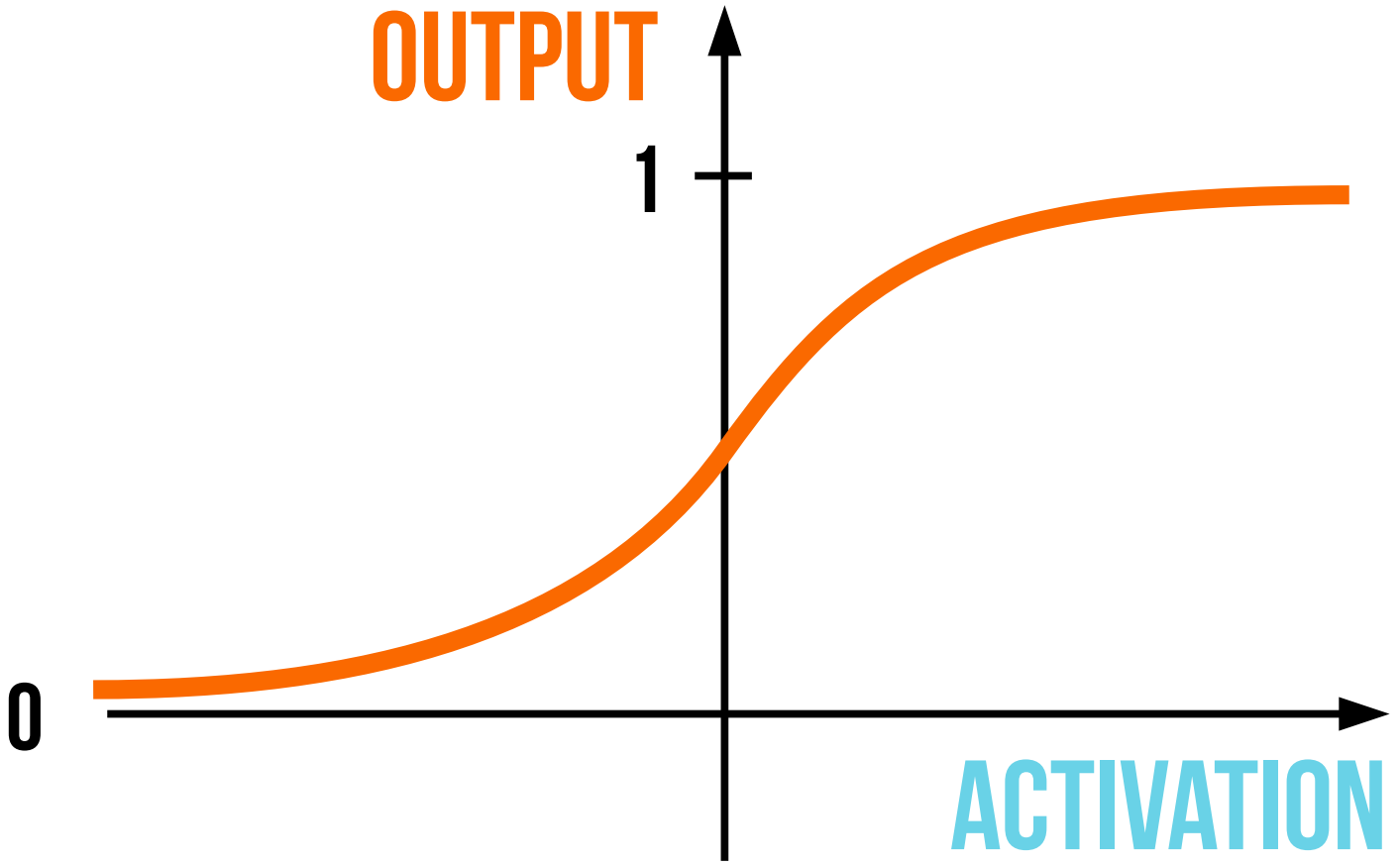
"hungry?"

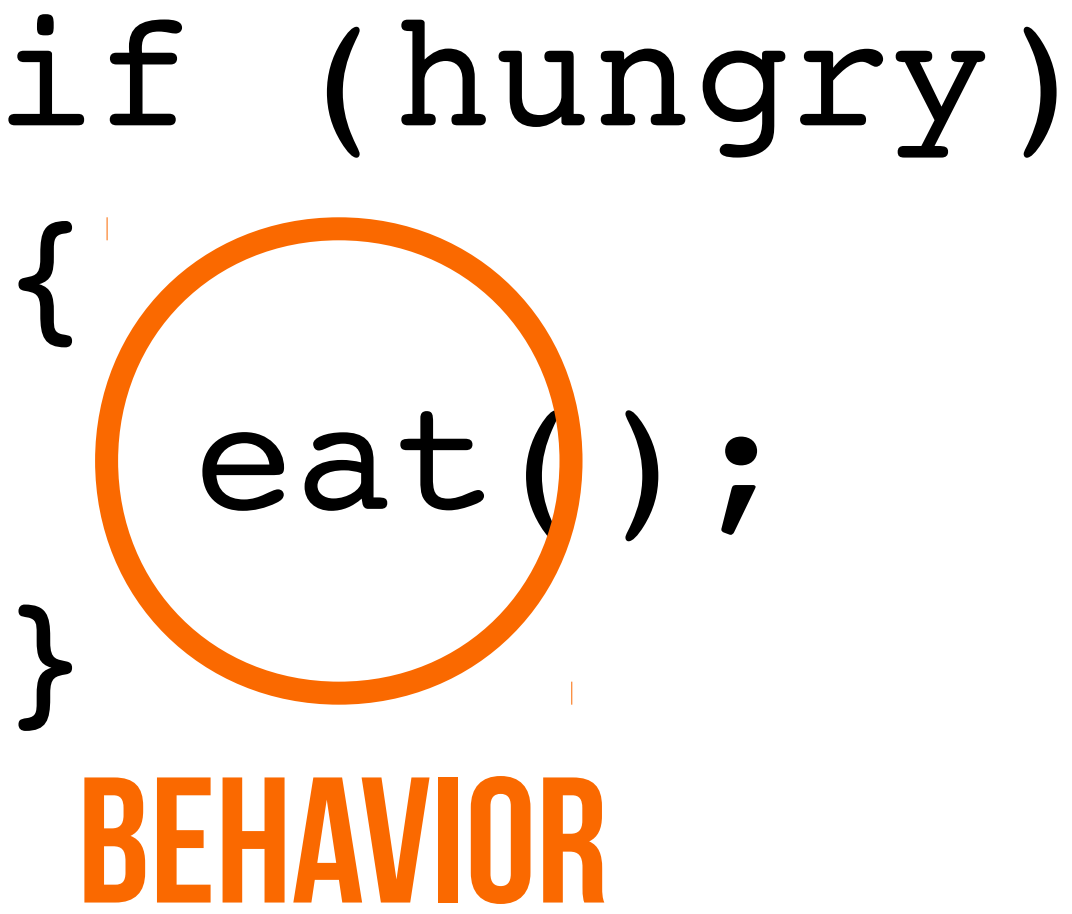

ACTIVATION
TIME


"on"
ACTIVATION
TIME
"off"


OUTPUT
1
0
TIME
ACTIVATION

SIGMOID *function*




if (hungry)
{
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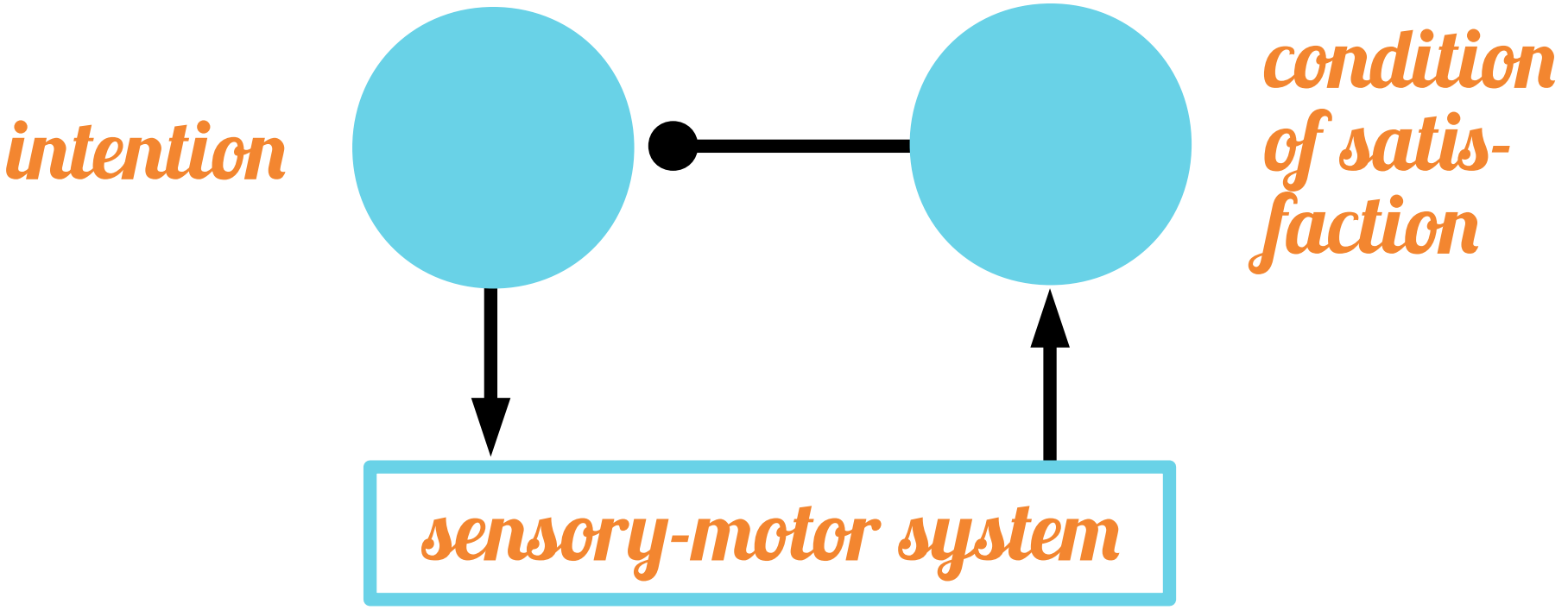
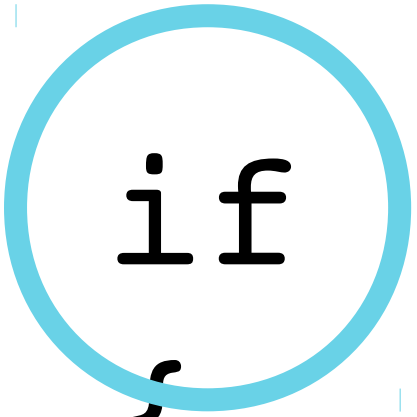
}
BEHAVIOR

Elementary BEHAVIOR



ORGANIZATION



```
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{
   eat();
}
```
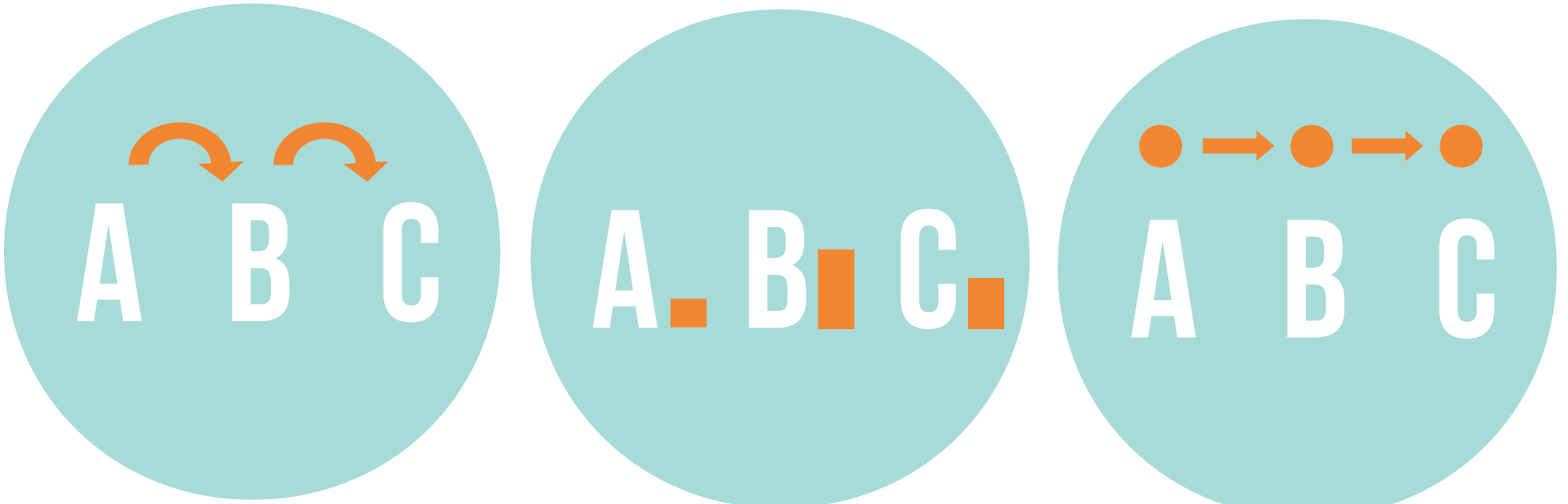

3 COGNITIVE MODELS *of sequences*



chaining *ordinal* *positional*

(Henson, 1998)

EXAMINING
short term memory

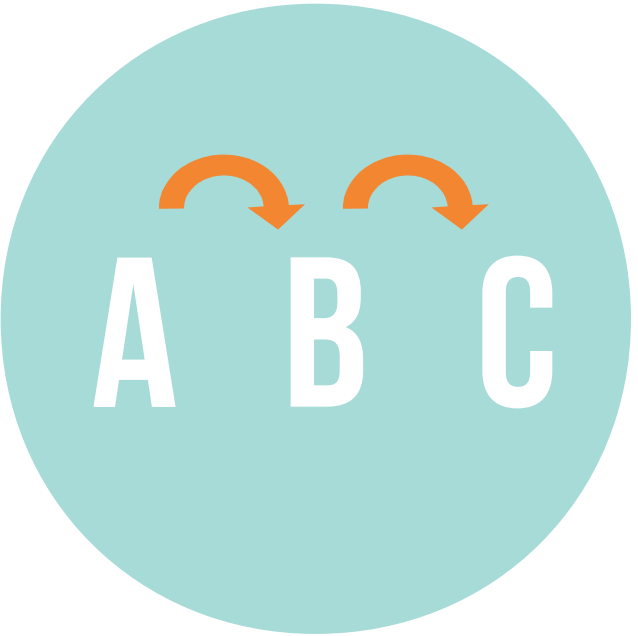
similar BTGPDV → ?

dissimilar HRMQJY → ?

memory span task

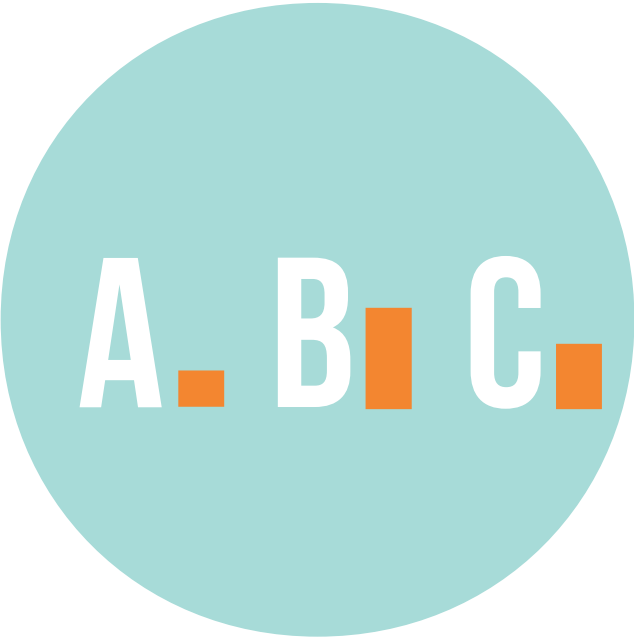
→ *phonological storage*

chaining



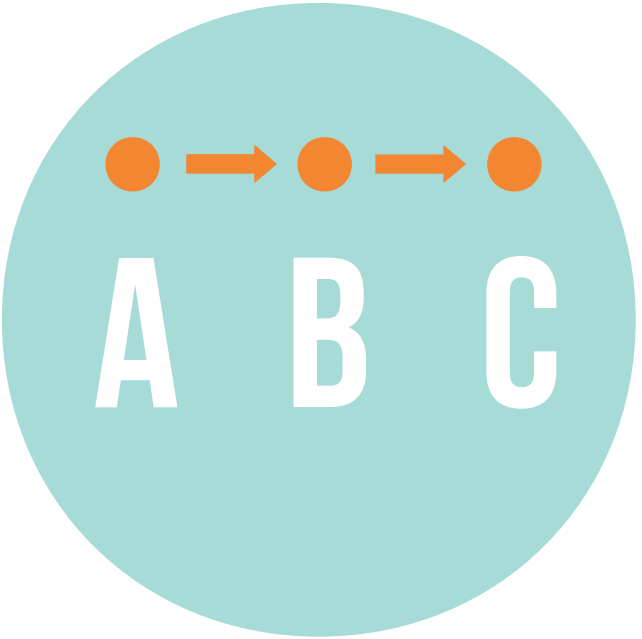
- Retrieval cue is the previous item
- Problems with repeated items
- No evidence for higher errors following repeated items
- No difference in errors if sequence is mixed (BRGQDY)
- Probability of correct retrieval is independent from previous errors

ordinal



- Retrieval cue is the associated value
- Order is defined relationally; if the order changes (due to noise), items are transposed → people make these kinds of errors too
- Position of an item can be defined only by referring to its neighbors

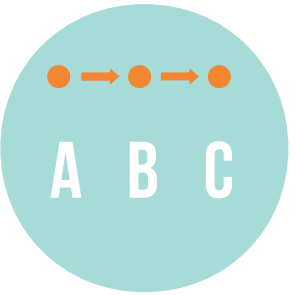
positional



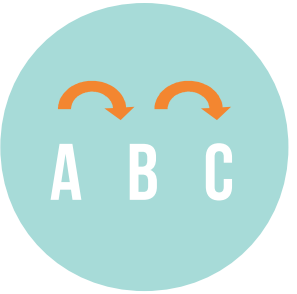
- Retrieval cue is the positional code
- Position of an item can be defined independent of its neighbors
- No problem with repeated items
- No problem with erroneous responses because items are independent
- Most common errors are transpositions and: erroneous items are clustered around their correct position
- But another error is interposition, transposition between groups → position of items is coded for in groups, independently of surrounding items

2 TYPES
of organization

1 Serial order



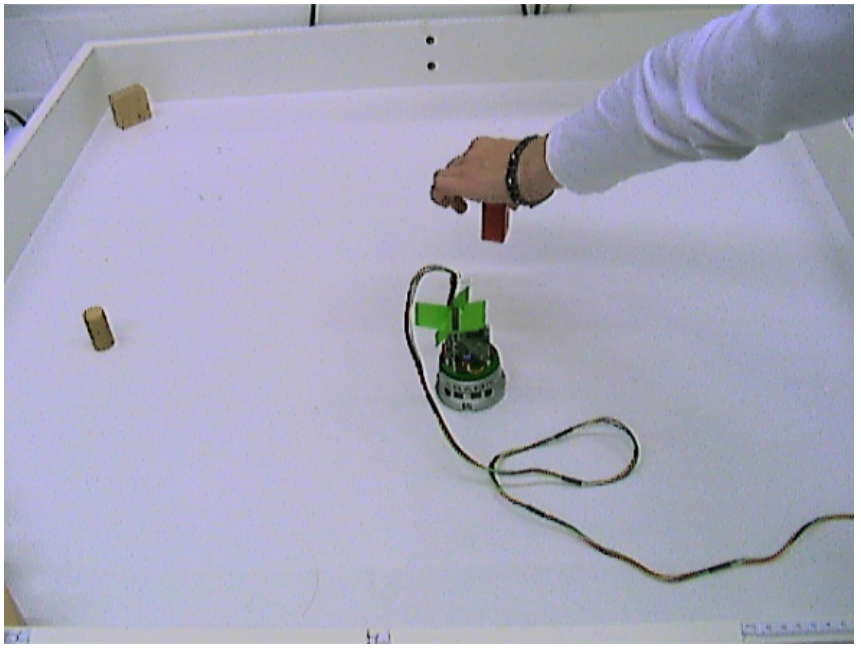
2 Behavioral organization

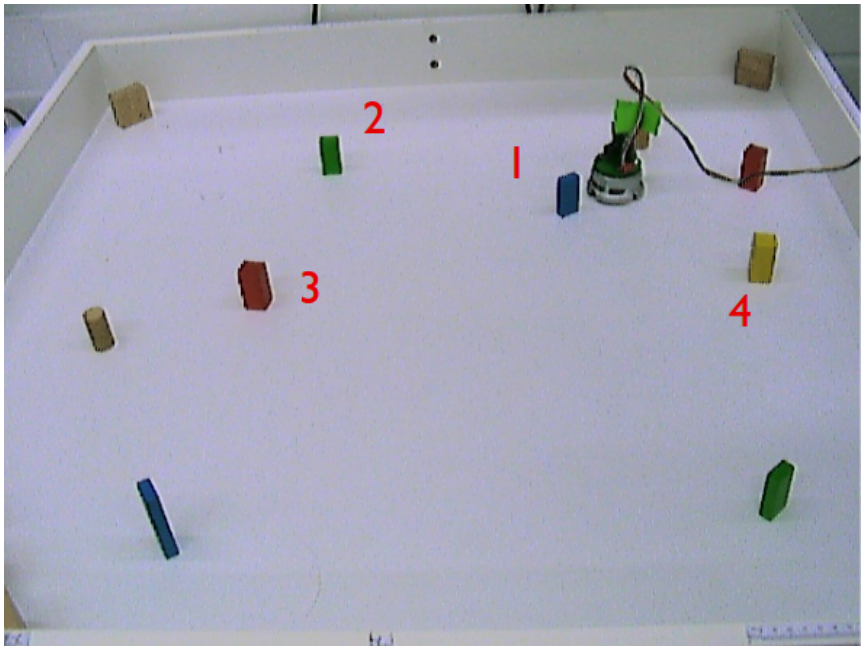


1 SERIAL ORDER

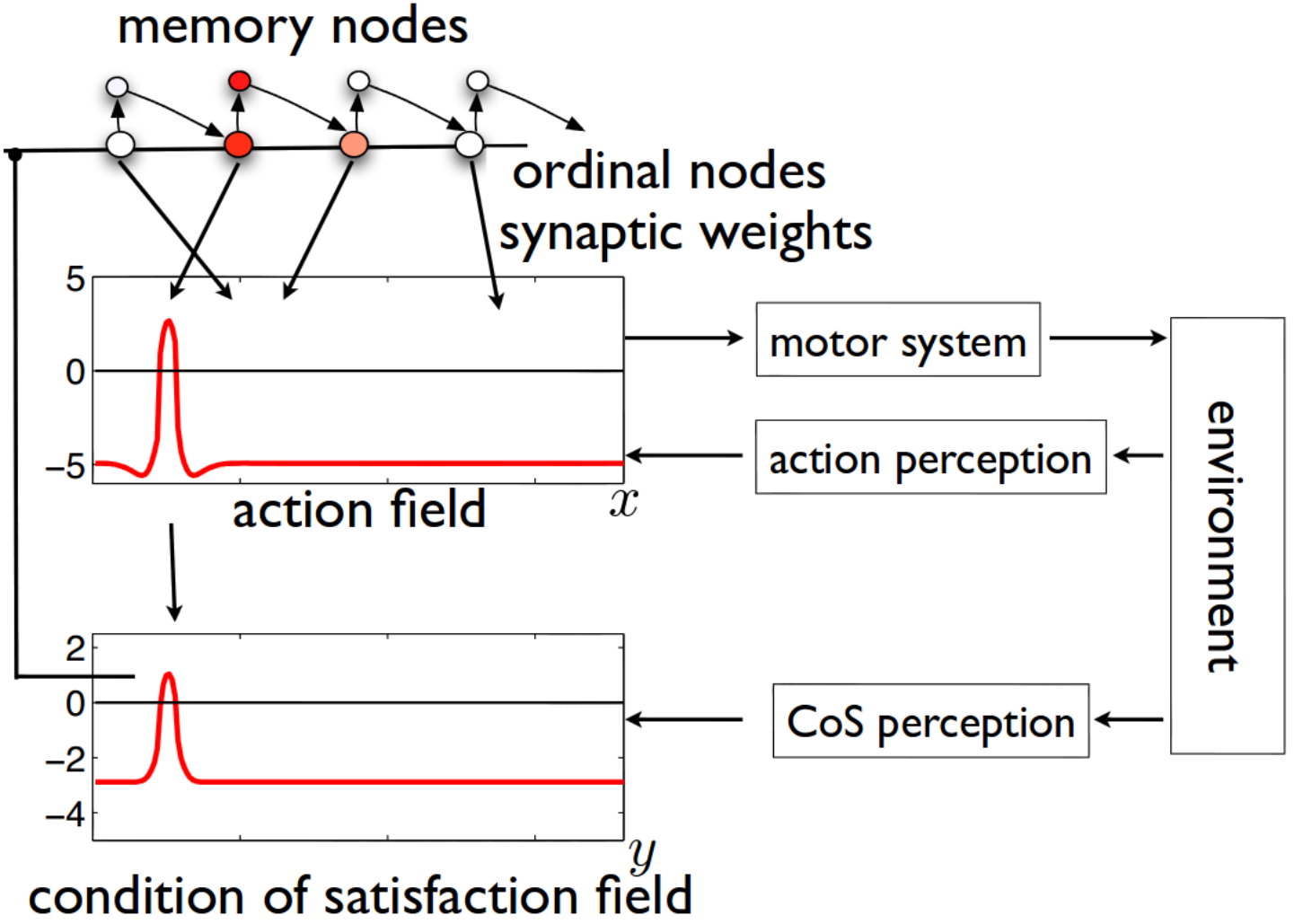
arbitrary sequences

a ROBOTIC *example*



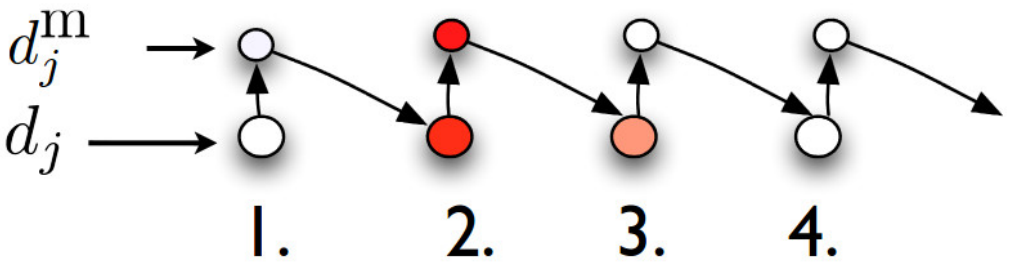


SERIAL ORDER *architecture*



(Sandamirskaya, Schöner, 2010)

Serial order EQUATIONS

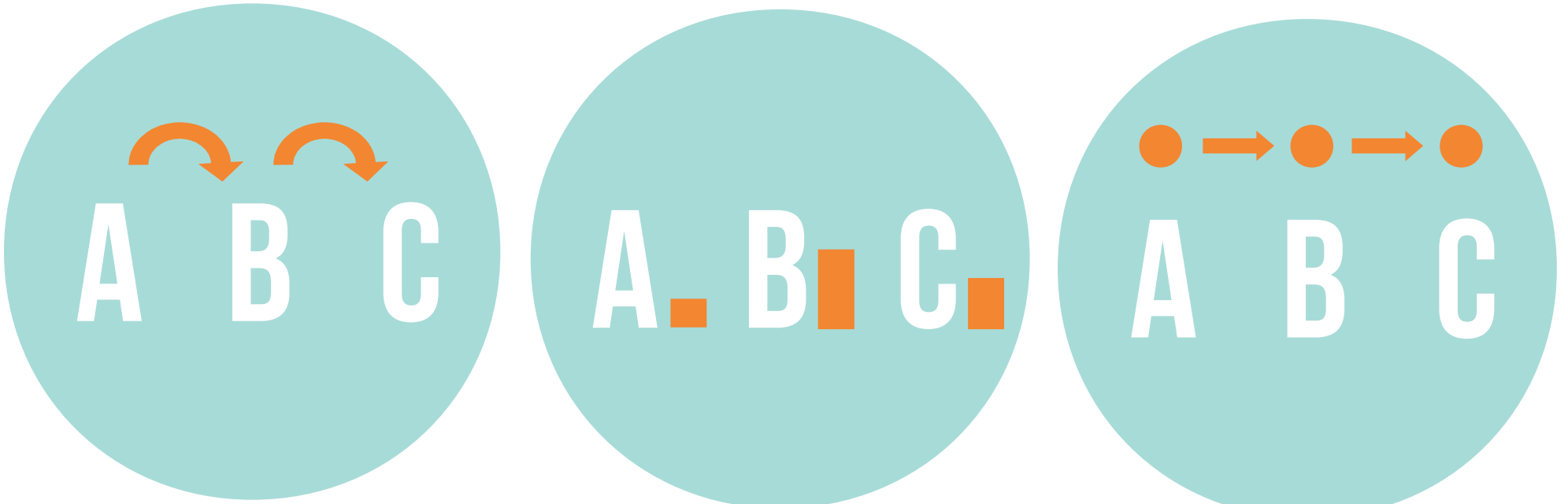


$$\begin{aligned}\tau \dot{d}_i(t) \;=\; & -d_i(t) + h_d + c_0 f\left(d_i(t)\right) \\ & - c_1 \sum_{i' \neq i} f\left(d_{i'}(t)\right) + c_2 f\left(d^m_{i-1}(t)\right) \\ & - c_3 f\left(d^m_i(t)\right) - I_C(t)\end{aligned}$$

$$\begin{aligned}\tau \dot{d}^m_i(t) \;=\; & -d^m_i(t) + h_m + c_4 f\left(d^m_i(t)\right) \\ & - c_5 \sum_{i' \neq i} f\left(d^m_{i'}(t)\right) + c_6 f\left(d_i(t)\right)\end{aligned}$$

2
BEHAVIORAL ORGANIZATION
flexibility
QUARTZ

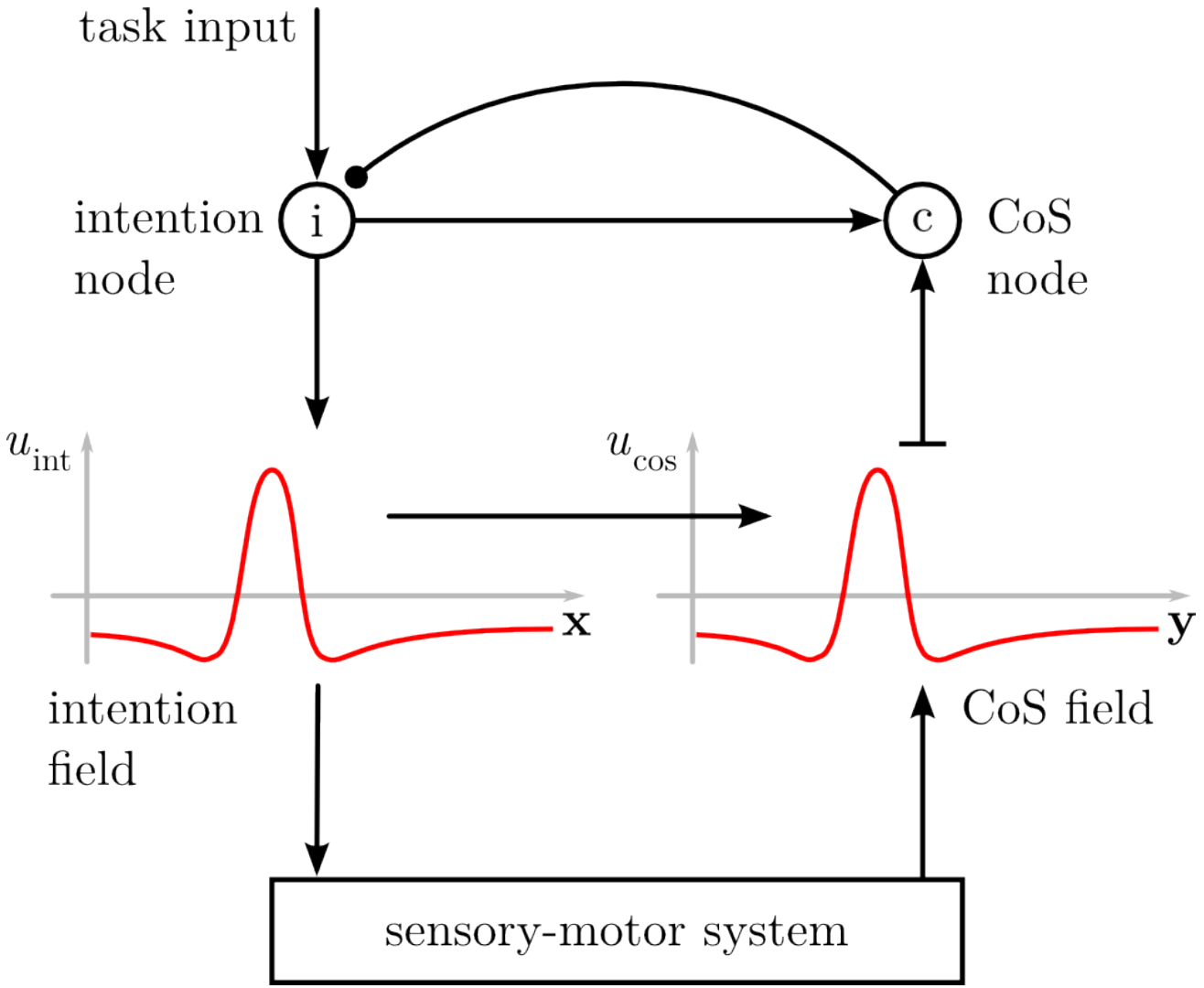
3 COGNITIVE MODELS *of sequences*



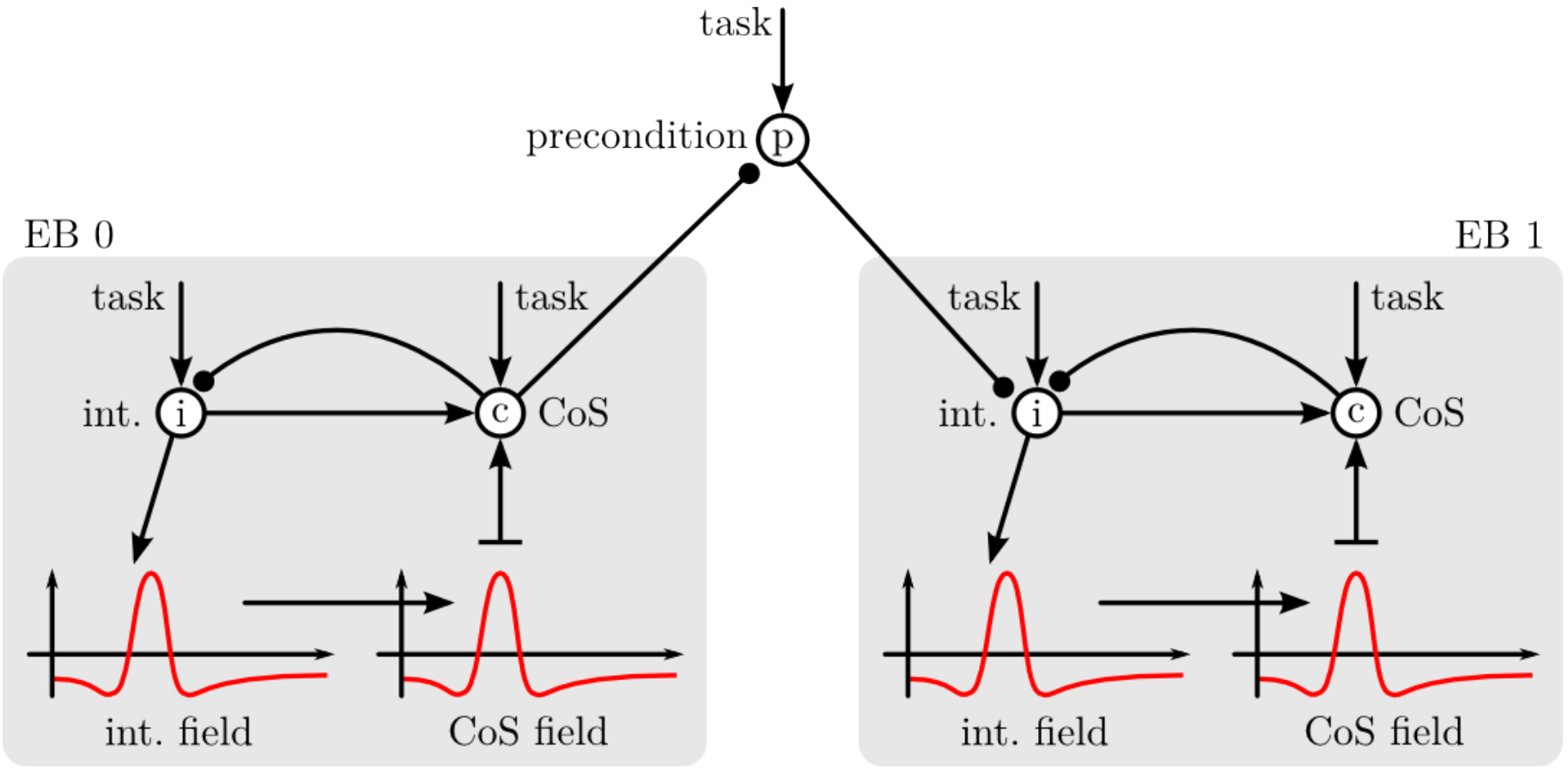
chaining *ordinal* *positional*

(Henson, 1998)

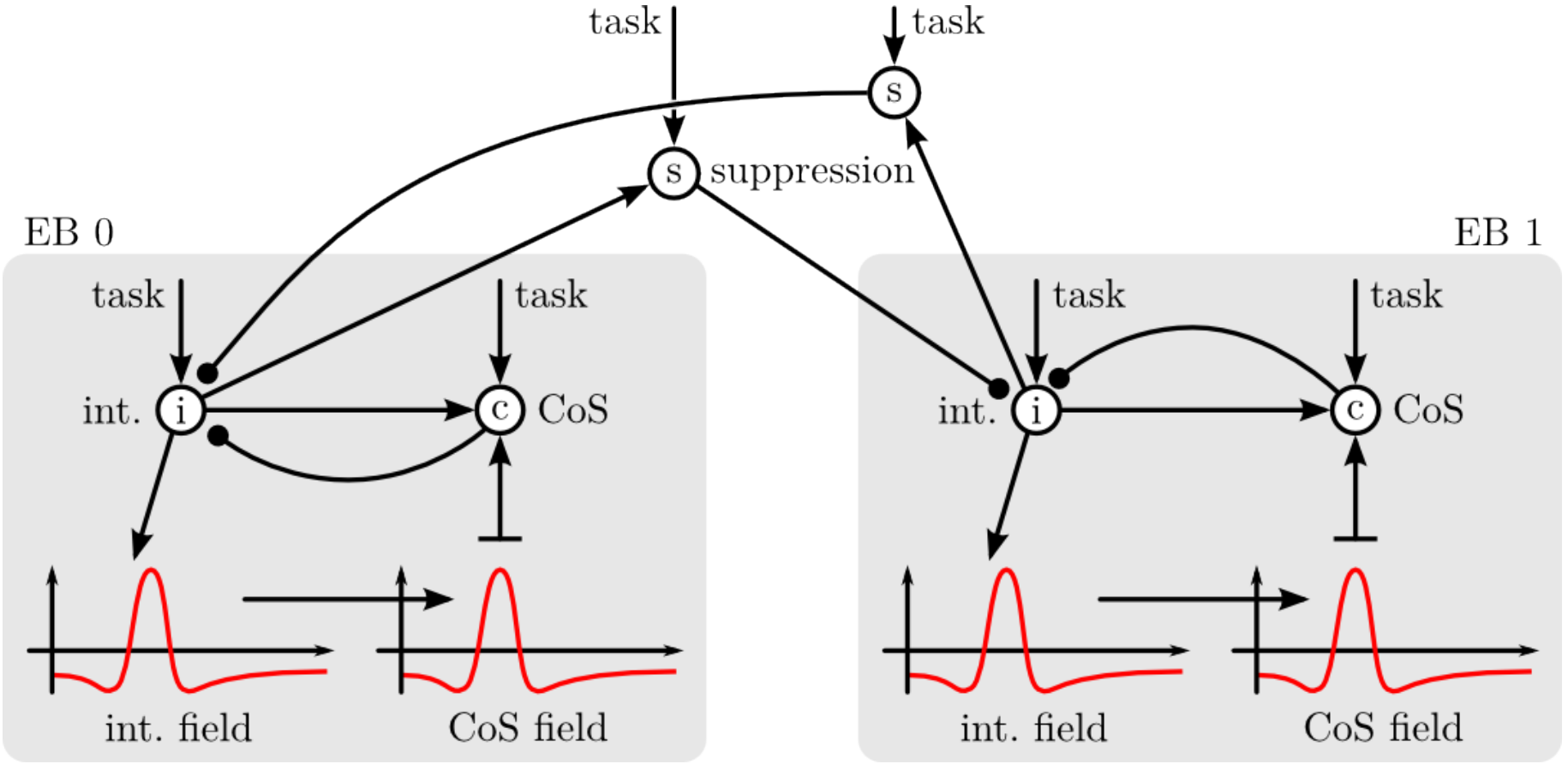
Elementary BEHAVIOR



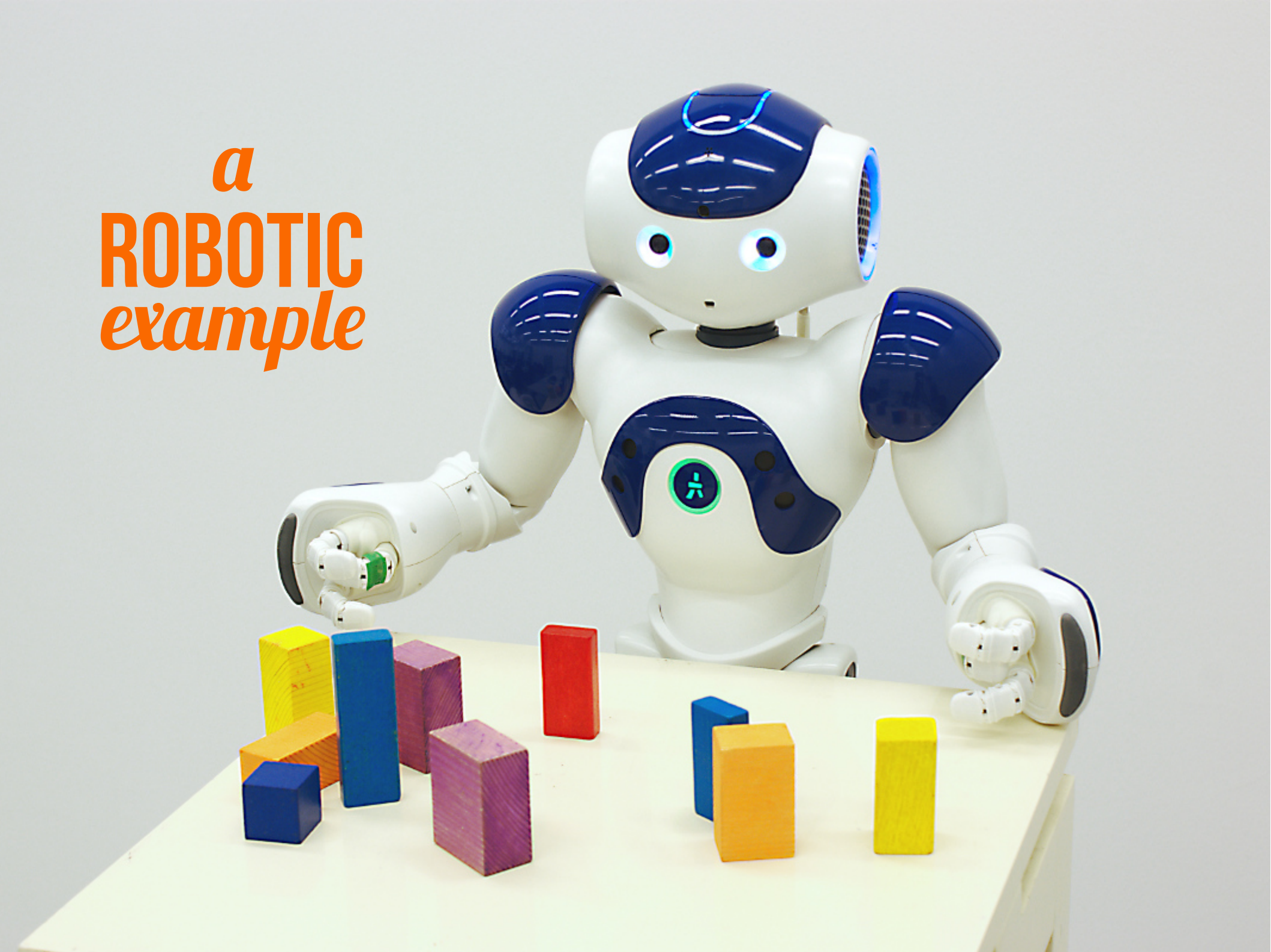
PRECONDITION *constraint*



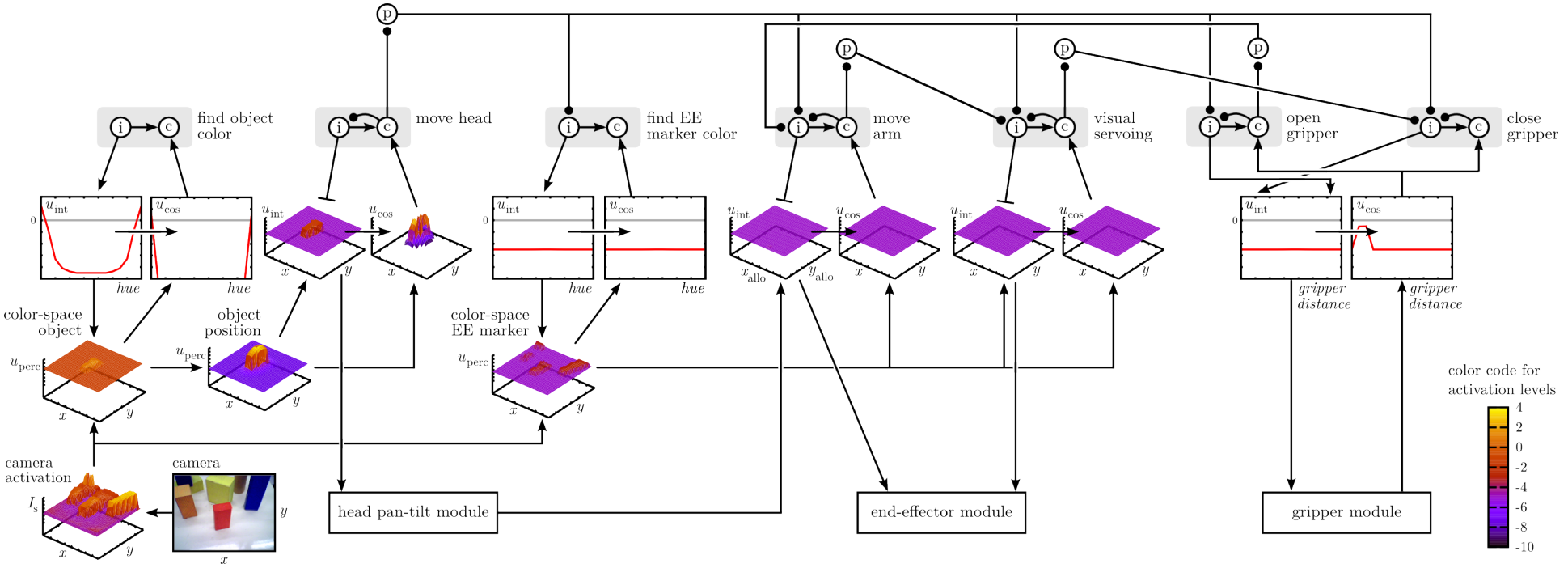
COMPETITION *constraint*

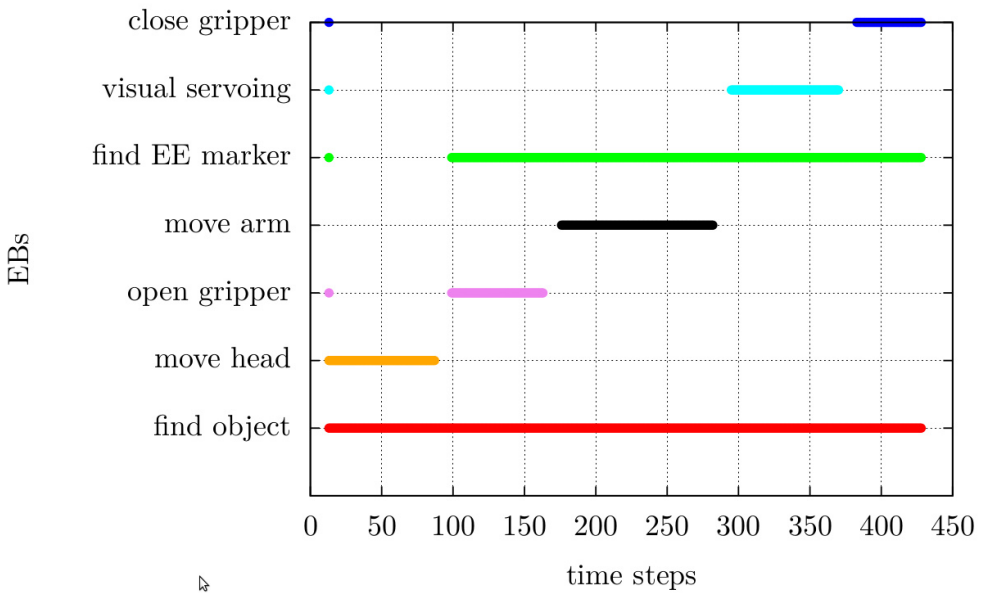


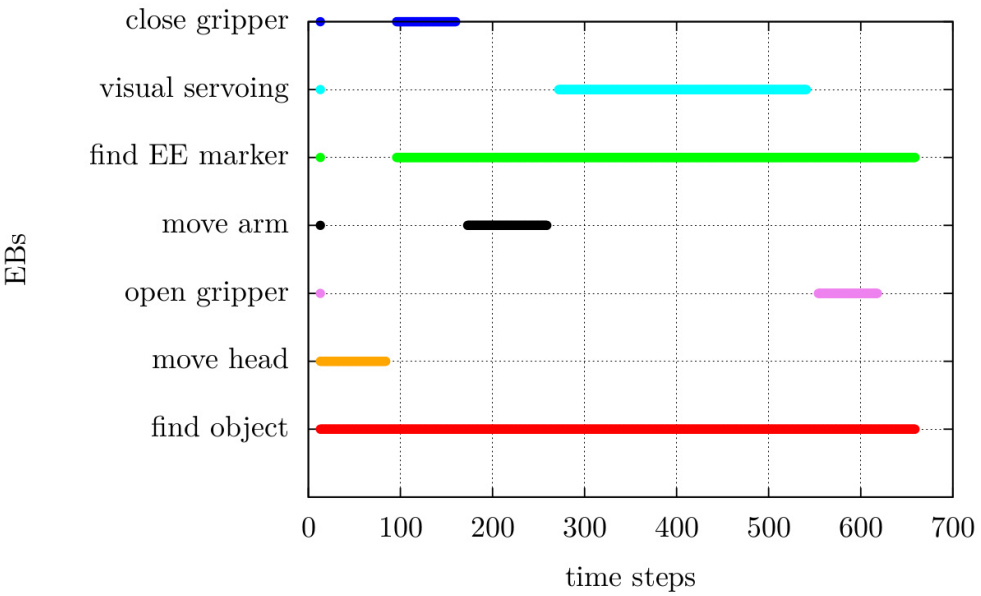
a
ROBOTIC
example



(almost) the whole
ARCHITECTURE

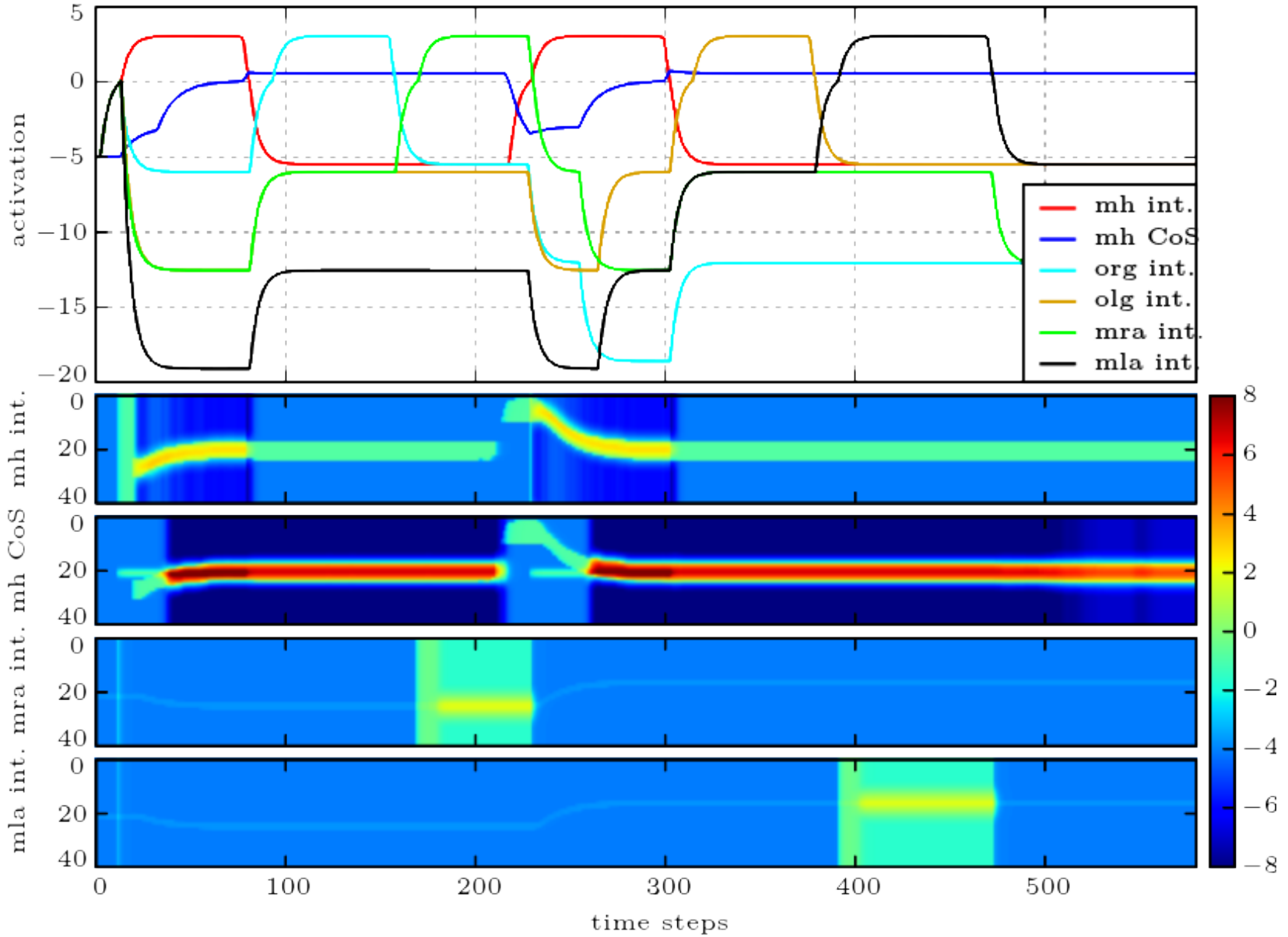






GRASPING *and* POINTING

ACTIVATION *over time*



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SEVENTH FRAMEWORK PROGRAMME

EUCOG