the DayOne project: how far can a robot develop in 24 hours?

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the DayOne project presentation: how much can I prepare in 24 hours?

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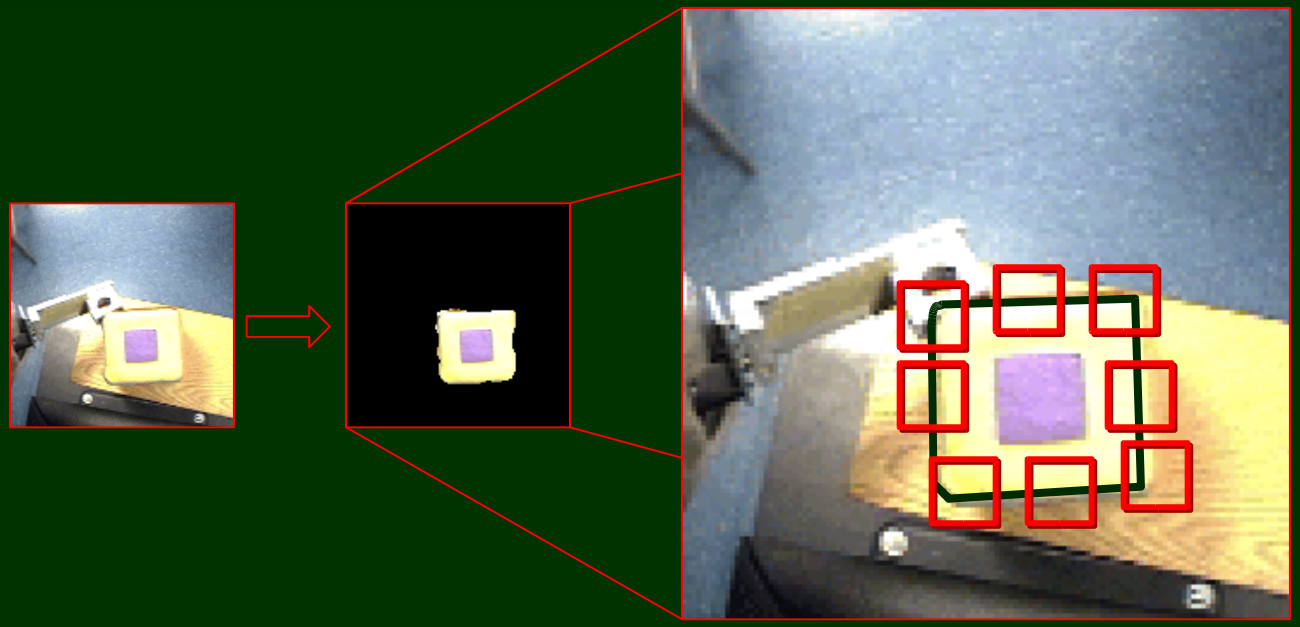
what is the DayOne project?

- An exercise in integration: creating a robot whose abilities expand qualitatively and quickly
- Motivated by ability of young of many species to “hit the ground running” when born
- e.g. a foal can typically trot, groom, follow and feed from its mare, all within hours of birth
- Human infants are born in relatively “premature” state

"abilities expand qualitatively, quickly"

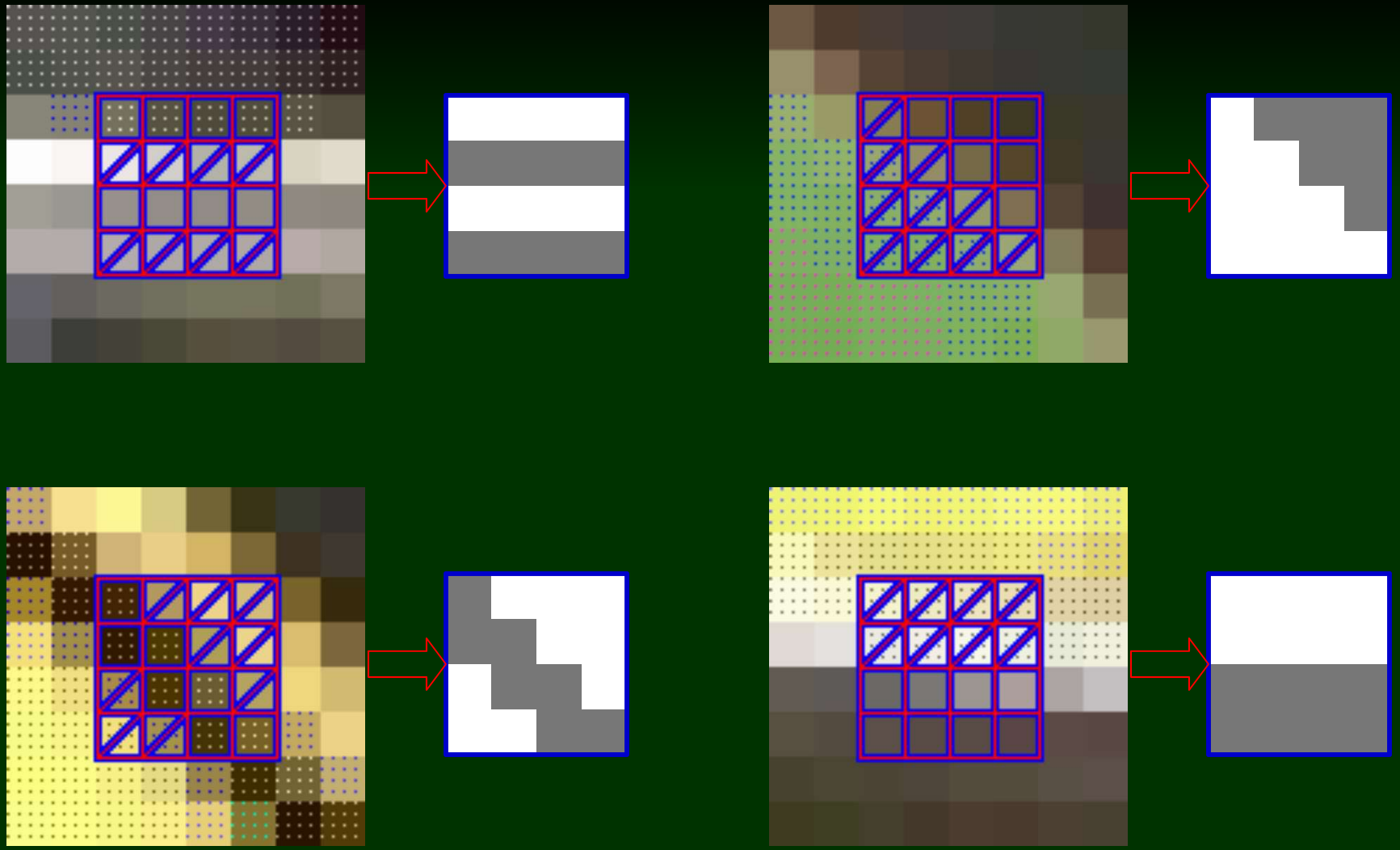
- Robot is not just getting better at a specific problem
- Low-level vision
  - Robot learns basic edge orientation filter
- Mid-level vision
  - Robot learns to segment familiar objects from background
- Mid-level audition
  - Robot learns to differentiate utterances
- High-level perception
  - Robot learns role of objects and utterances within tasks
- All can run in real-time, during a single session

low-level vision



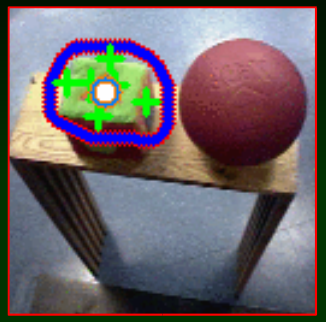
- Orientation filter trained from physical probing of object boundaries

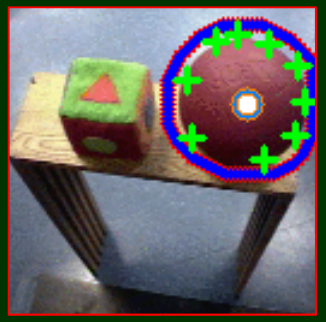
low-level vision



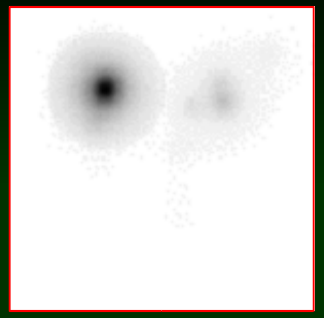
mid-level vision

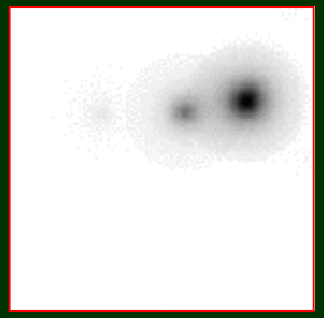
camera image





implicated edges found and grouped



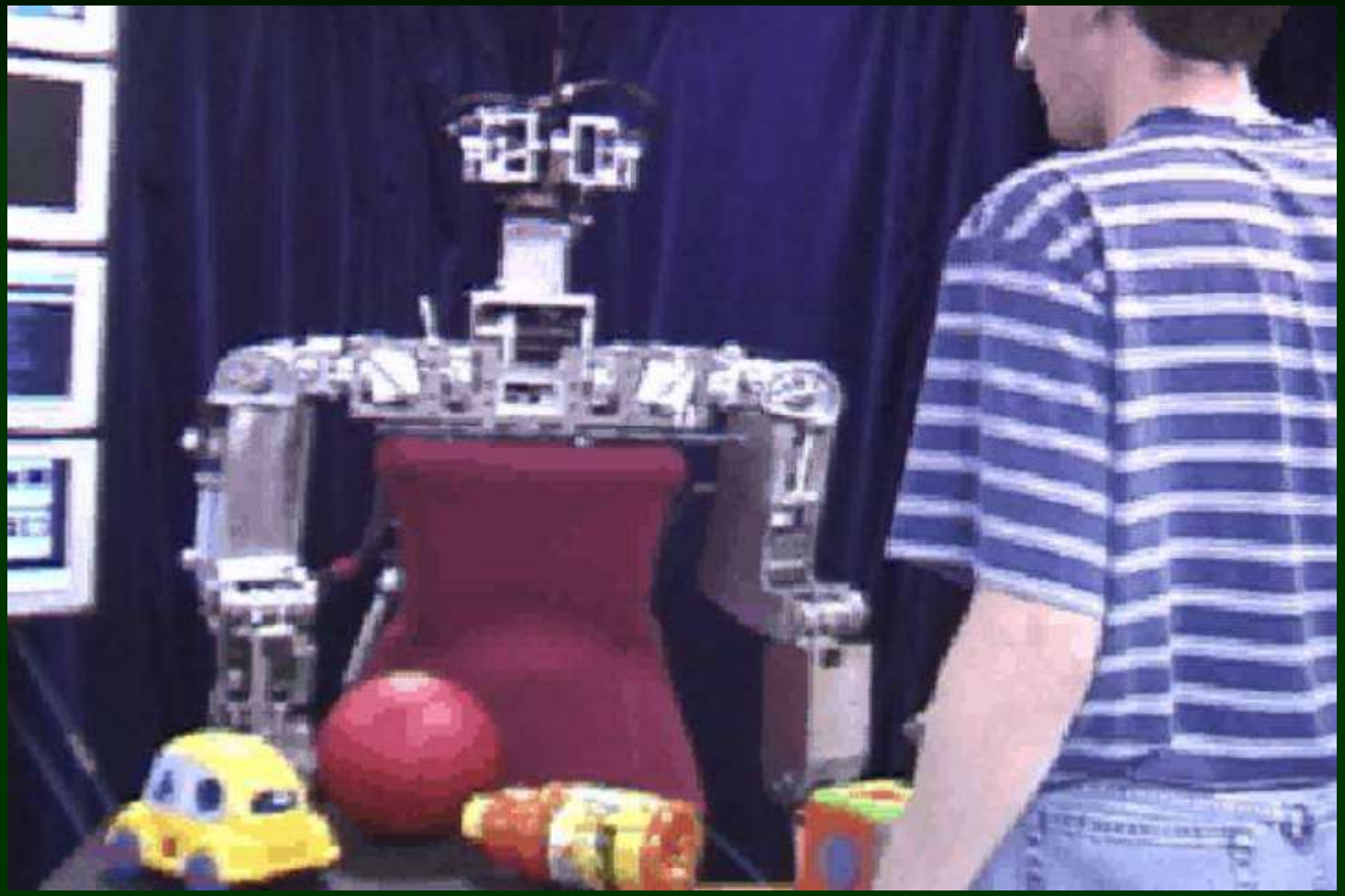


response for each object

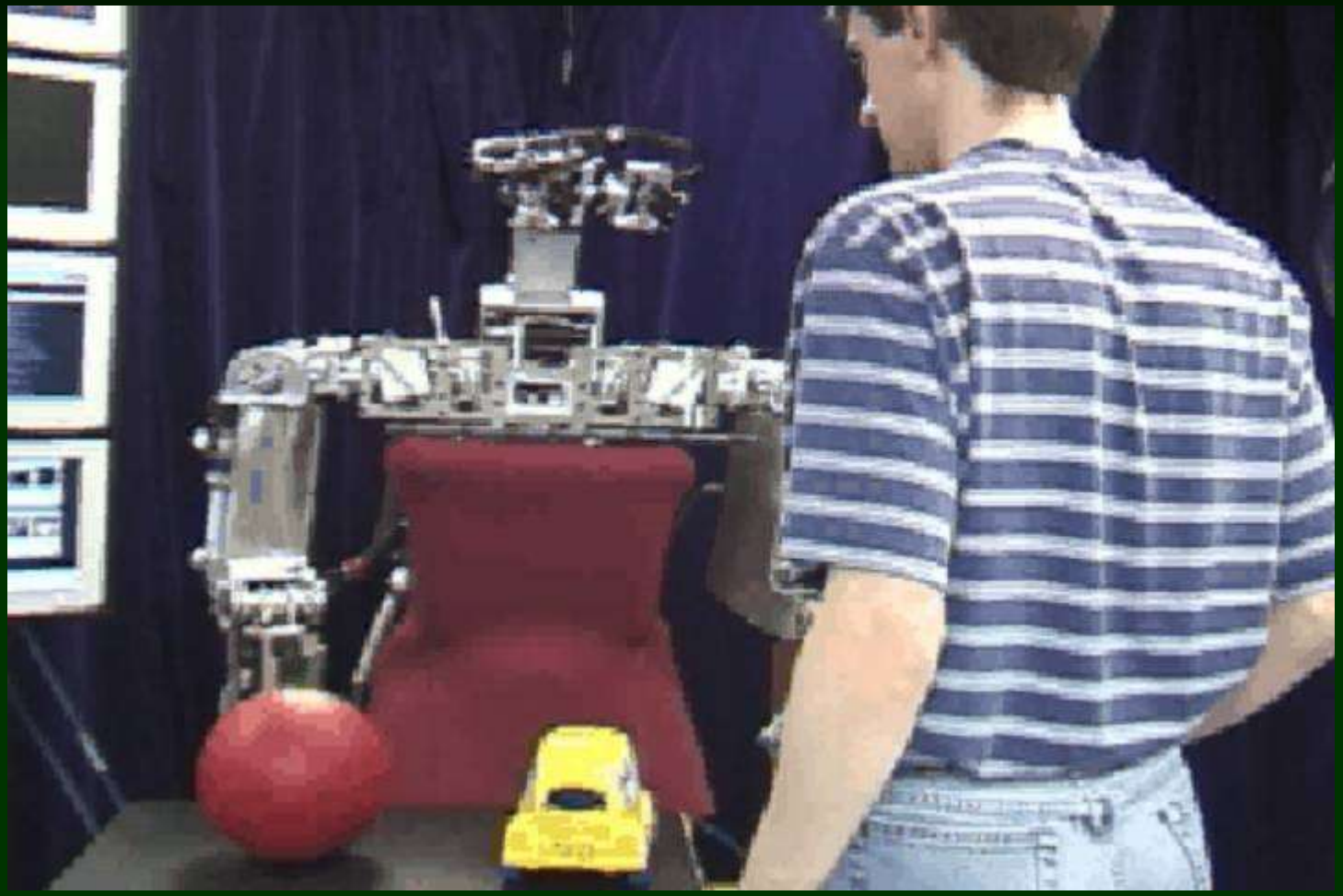
- Object appearance found through physical probing is learned, using features that depend on a well-trained orientation filter

mid-level audition

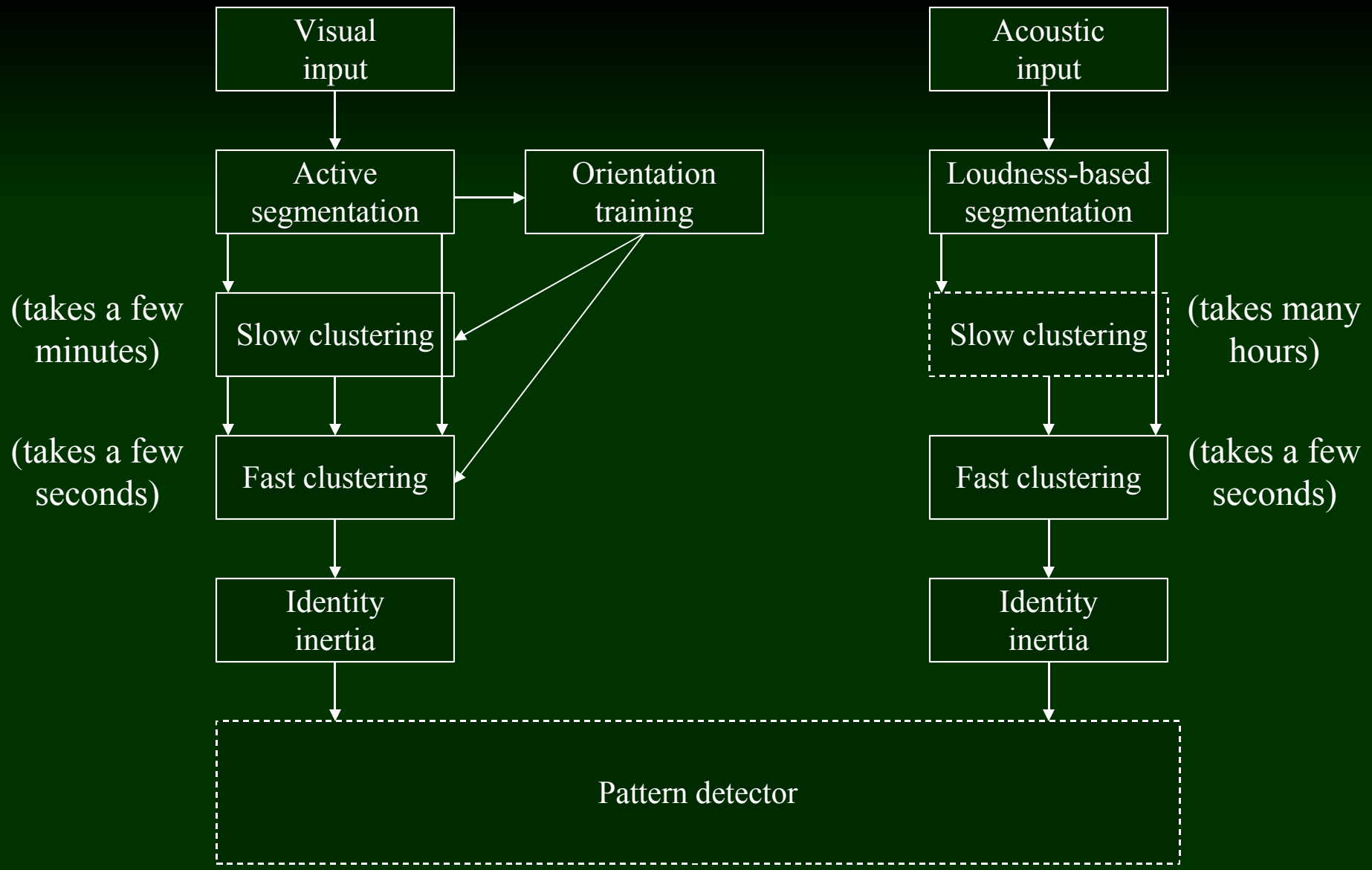
high-level perception



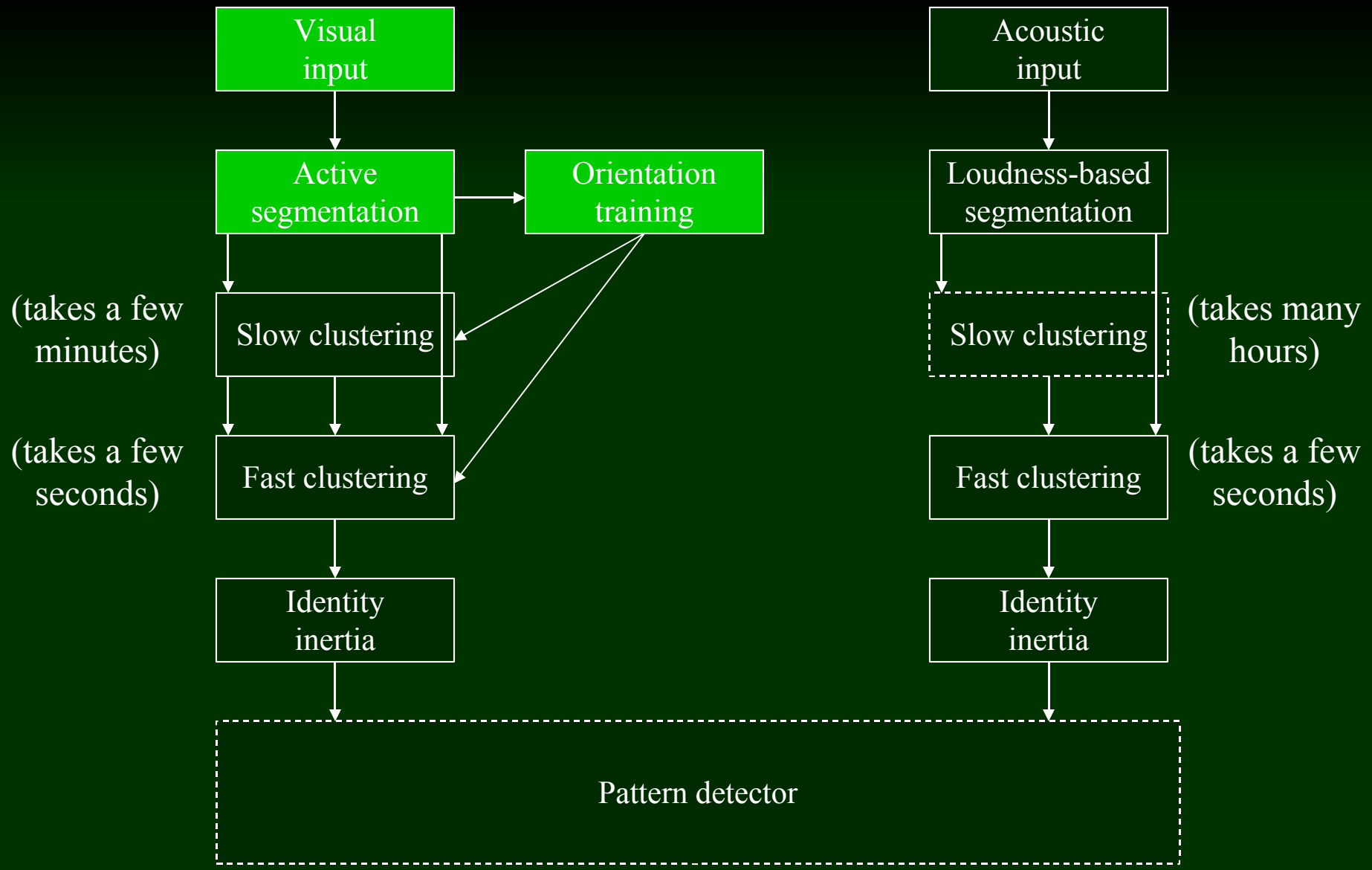
high-level perception



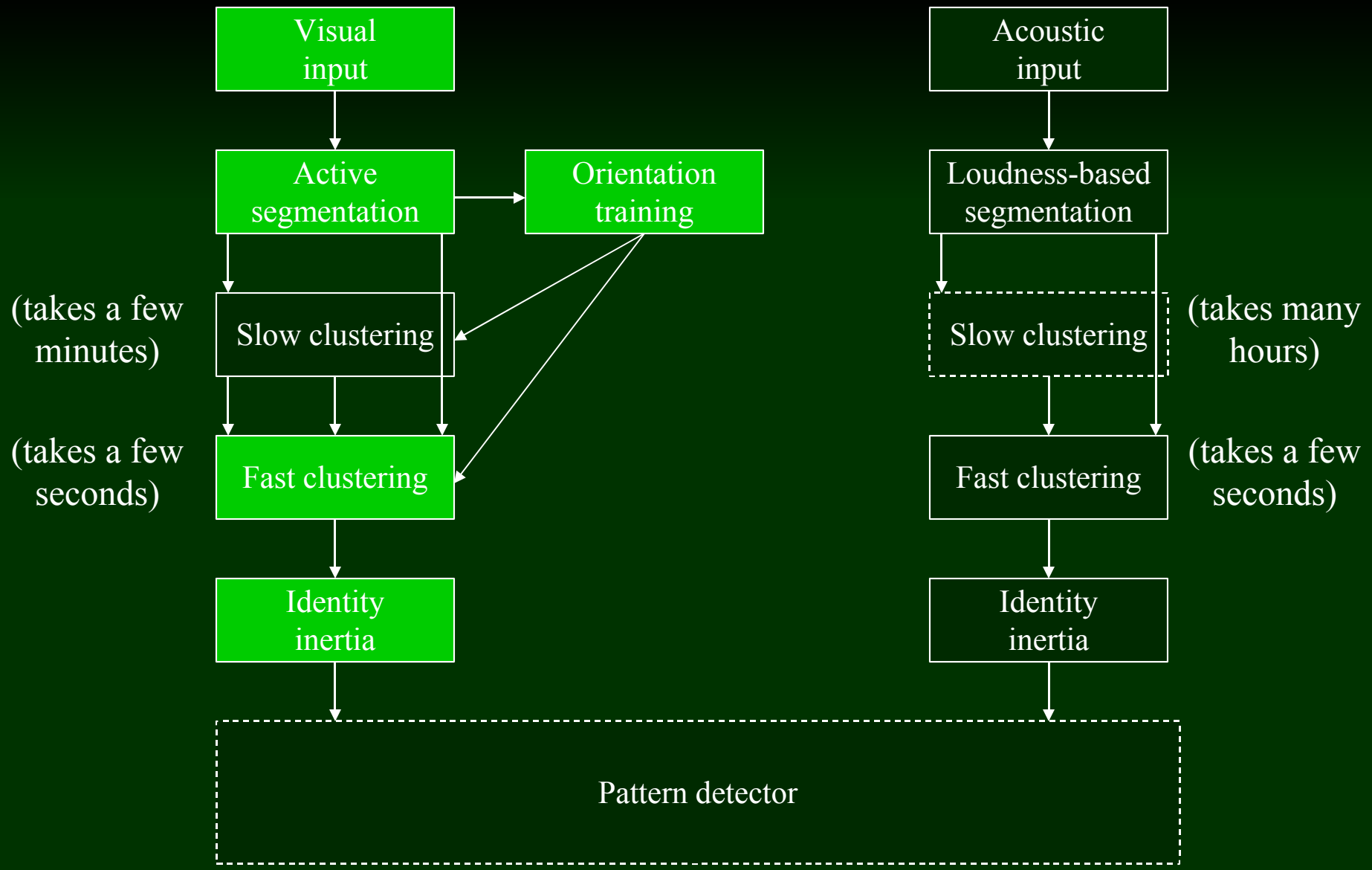
system organization



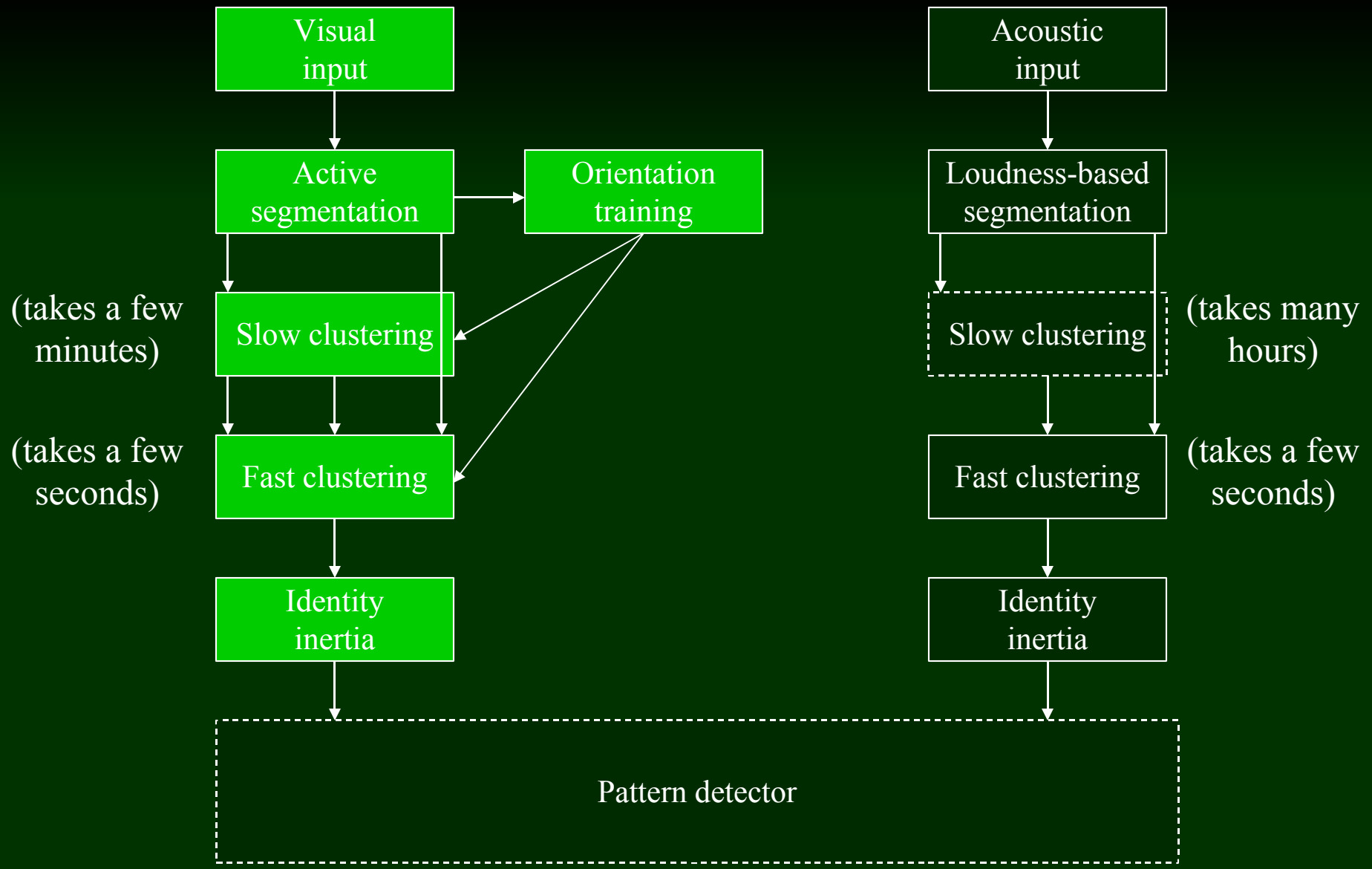
system organization



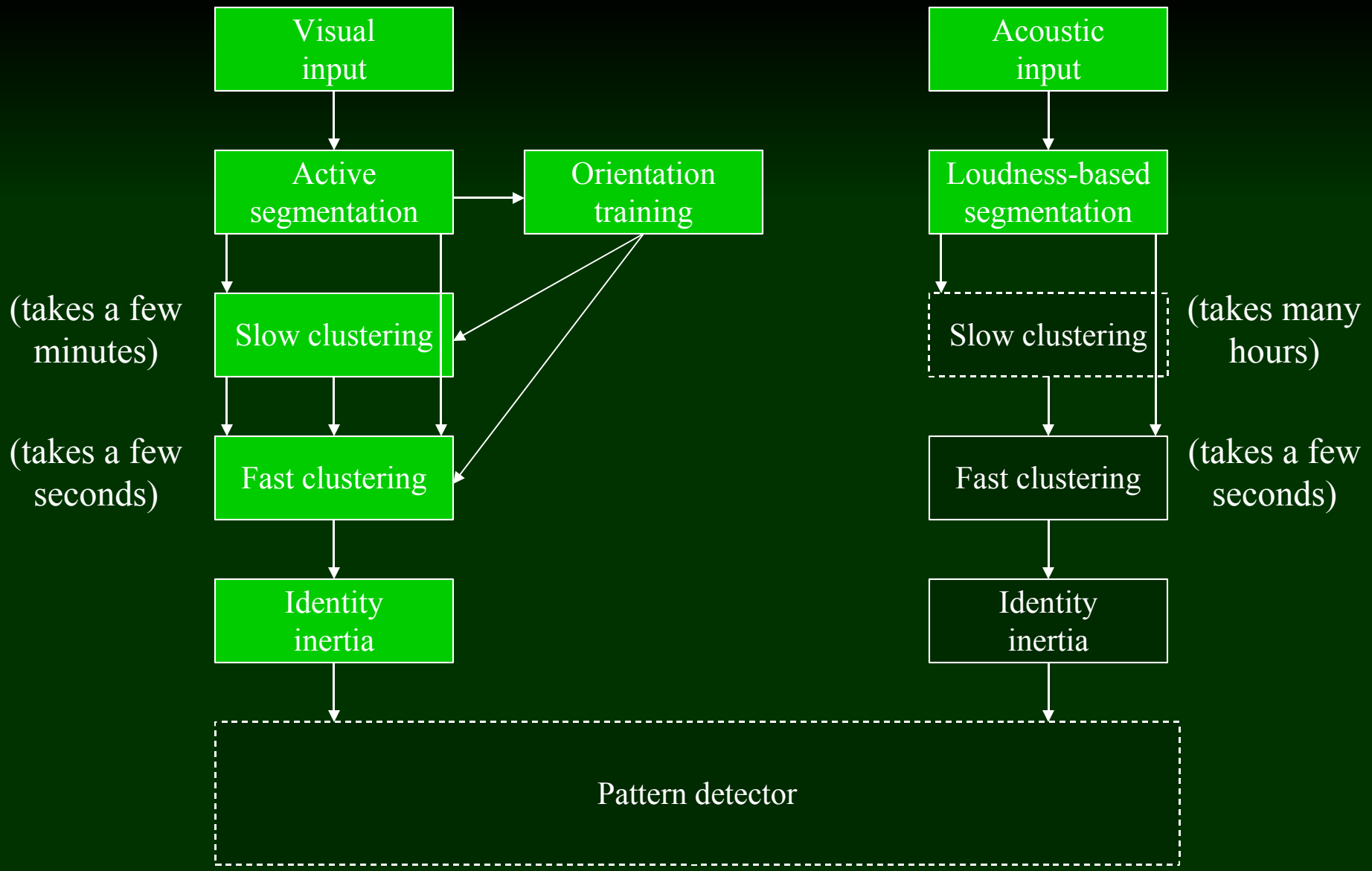
system organization



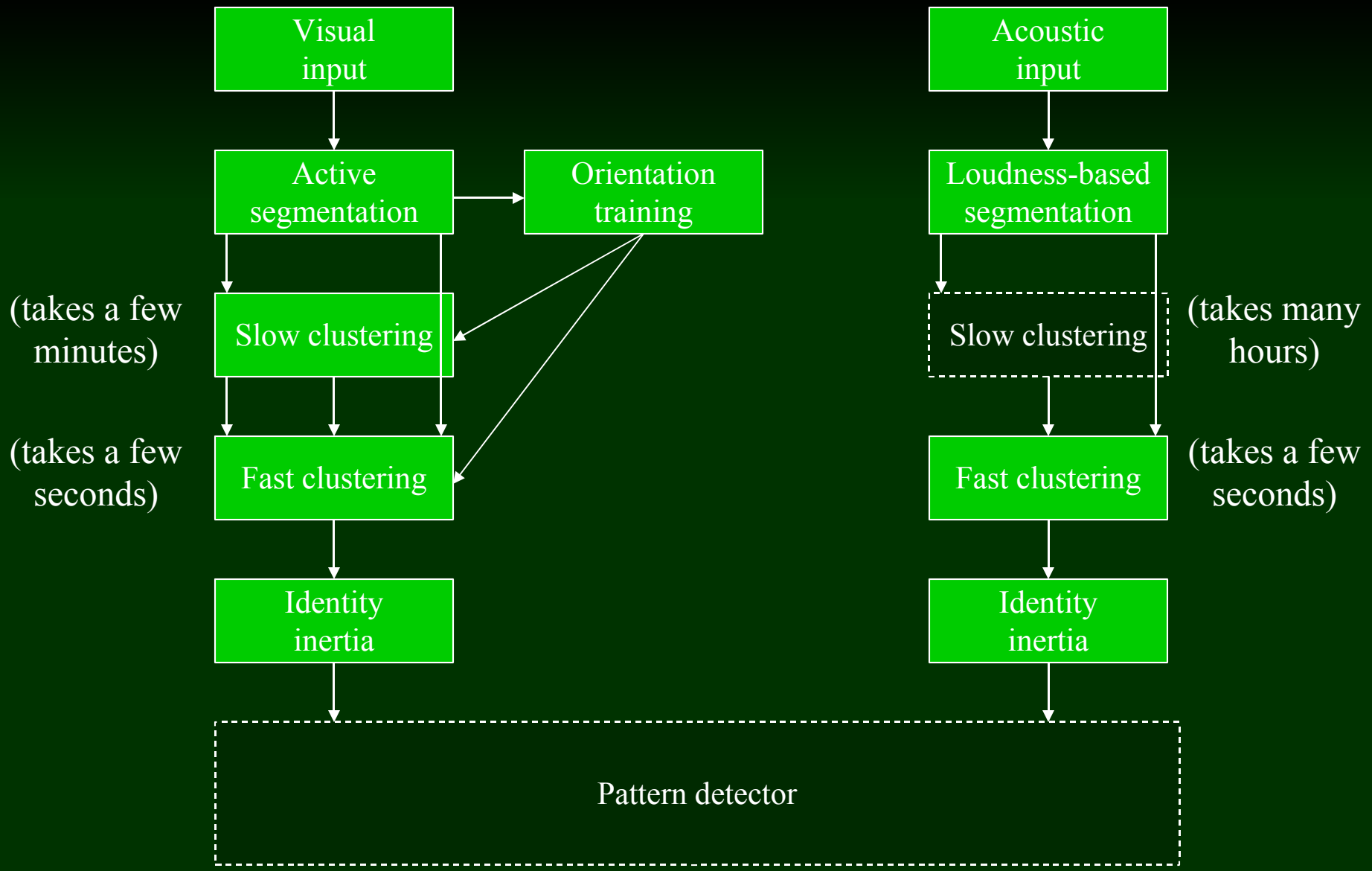
system organization



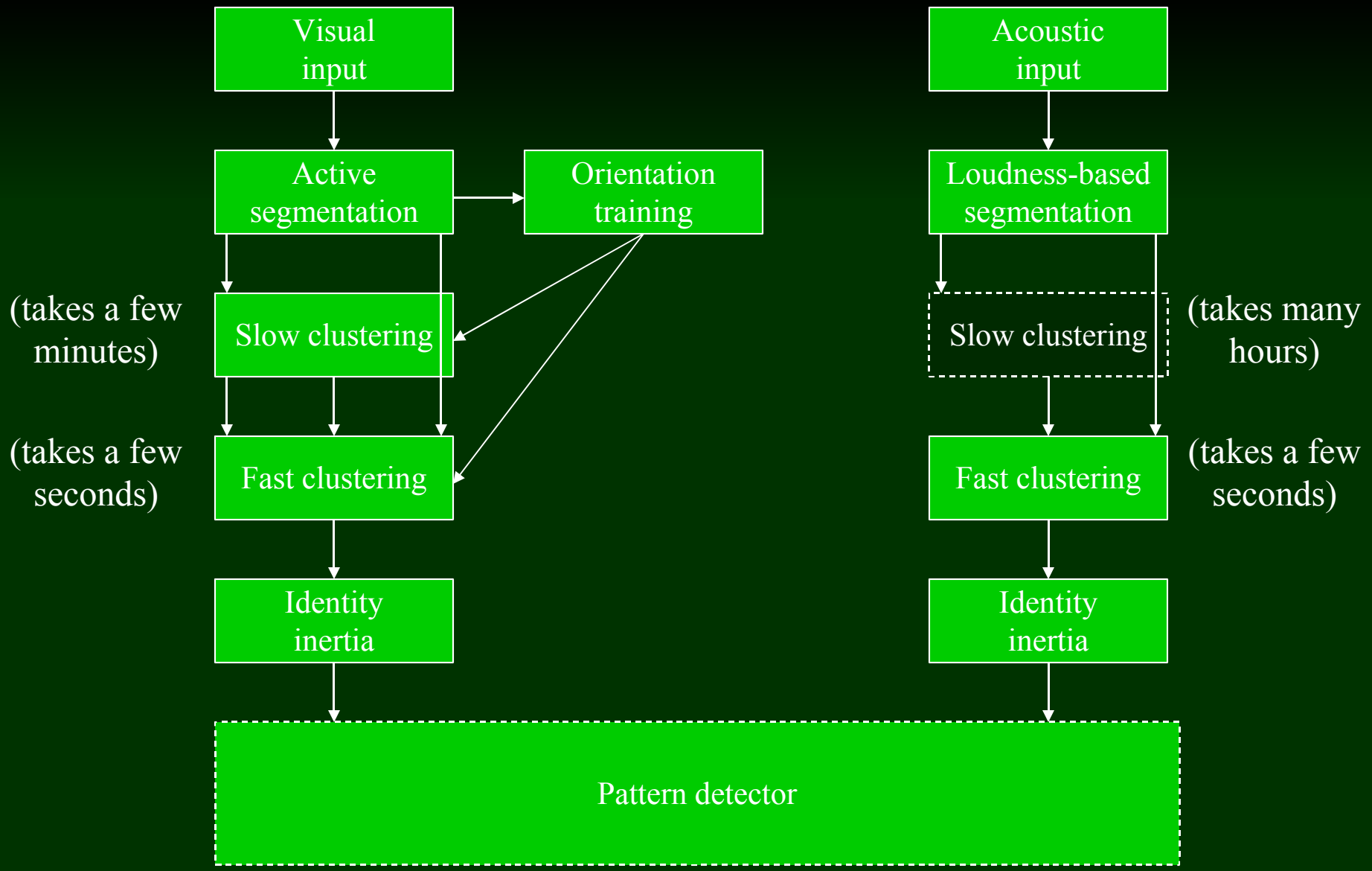
system organization



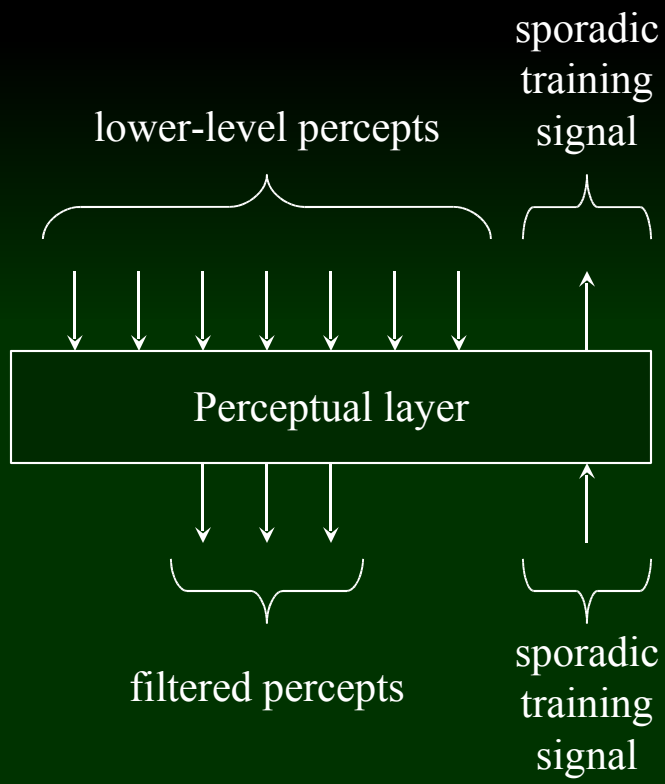
system organization



system organization

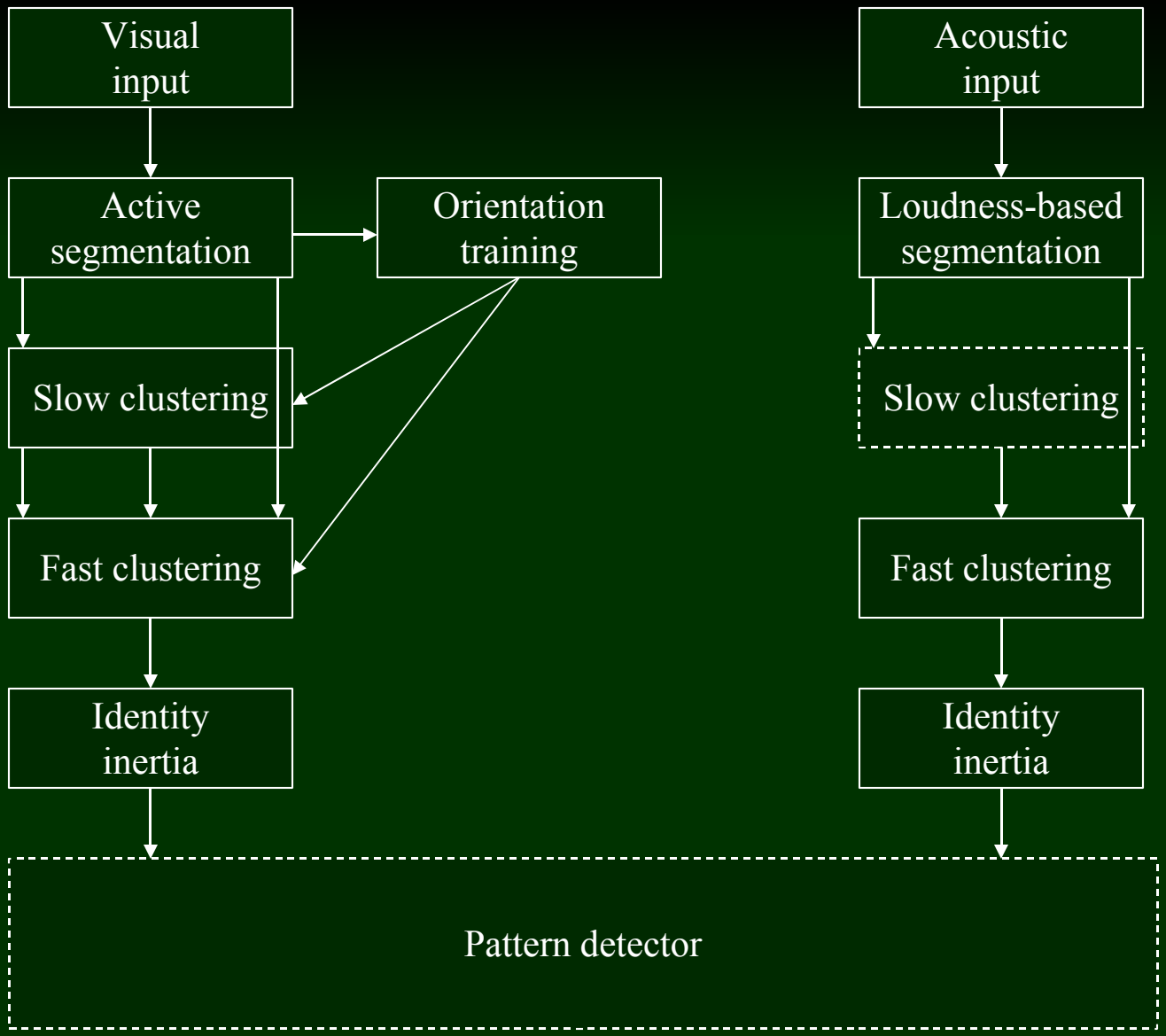


identity inertia



- Convention: sender should not dramatically change the meaning of an out-going signal line
- *Unless* requested by receiver
- Like supporting a legacy API

problem: pattern detector is monolithic



solution: distribute pattern detector

- Make perceptual layers smarter
- Basically the approach in Fitzpatrick&Arsenio, EpiRob'04
- Periodic patterns are detected early
- But what about more complex patterns?

desired ability

Sequence	*Guessed pattern*	*Prediction*
01010	(01)*	1010…

desired ability

Sequence	*Guessed pattern*	*Prediction*
01010	(01)*	1010…
0101110	(01+)*	1010…, 1011…, 1101…, 1110…, 1111…

counting patterns

Length	*Distinct sequences*	*With local identity*
1	1	1
2	4	2
3	27	5
4	256	15
5	3,125	52
6	46,656	203
7	823,543	877
8	16,777,216	4,140
9	387,420,489	21,147
10	10,000,000,000	115,975
11	285,311,670,611	678,570
12	8,916,100,448,256	4,213,597

results

Sequence	*Guessed pattern*	*Prediction*
01010	(01)*	1010…

results

Sequence	*Guessed pattern*	*Prediction*
01010	(01)*	1010…
0101110	(01+)*	1010…, 1011…, 1101…, 1110…, 1111…

results

Sequence	*Guessed pattern*	*Prediction*
01010	(01)*	1010…
0101110	(01+)*	1010…, 1011…, 1101…, 1110…, 1111…
0120130120	(012013)*	1301…

results

Sequence	*Guessed pattern*	*Prediction*
01010	(01)*	1010…
0101110	(01+)*	1010…, 1011…, 1101…, 1110…, 1111…
0120130120	(012013)*	1301…
0120130130	(01[23])*	1201…, 1301…

results

Sequence	*Guessed pattern*	*Prediction*
01010	(01)*	1010…
0101110	(01+)*	1010…, 1011…, 1101…, 1110…, 1111…
0120130120	(012013)*	1301…
0120130130	(01[23])*	1201…, 1301…
0011220011	(001122)*	2200…

results

Sequence	*Guessed pattern*	*Prediction*
01010	(01)*	1010…
0101110	(01+)*	1010…, 1011…, 1101…, 1110…, 1111…
0120130120	(012013)*	1301…
0120130130	(01[23])*	1201…, 1301…
0011220011	(001122)*	2200…
0011221122	((.)\2)*	0000…, 0011…, 0022…, 0033…, 1100…, 1111…, 1122…, ……, 3344…

obligatory baby pictures