

Concluding Remarks

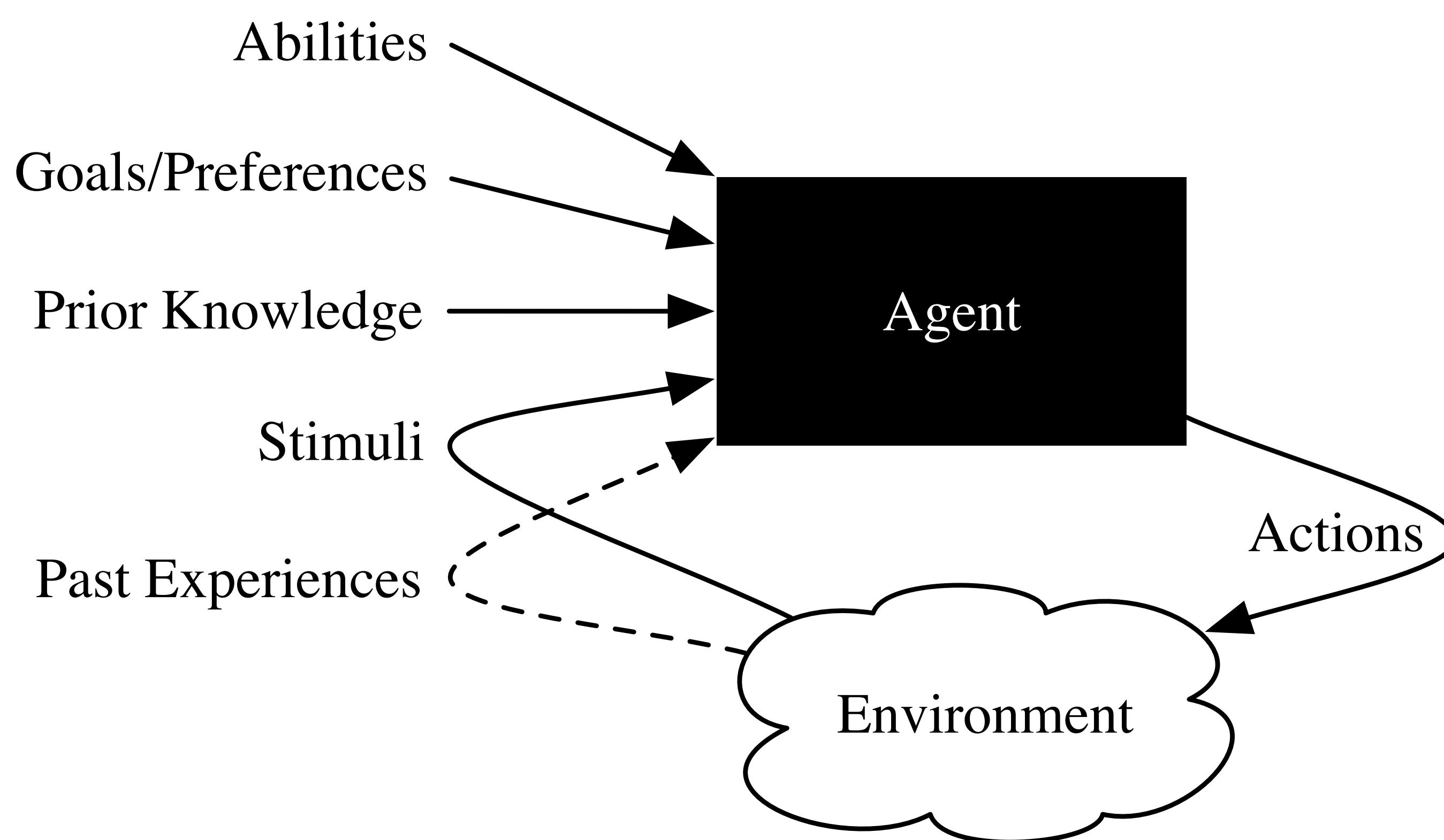
Artificial Intelligence

So what is artificial intelligence?

- No universal definition as intelligence takes many forms.
- A broad (and somewhat cyclic) definition for AI would be along the lines of *“the synthesis and analysis of computational agents that act intelligently”*.
- Aspects of interest include:
 - acting appropriately given goals and circumstances
 - being flexible/adaptive in changing environments
 - reasoning
 - learning from experience
 - dealing with perceptual and computational limitations

AI architectures

Agents acting in an environment



Example: autonomous car

abilities: steer, accelerate, brake, ...

goals: safety, get to destination, timeliness, ...

prior knowledge: what signs mean, what to stop for, street maps, ...

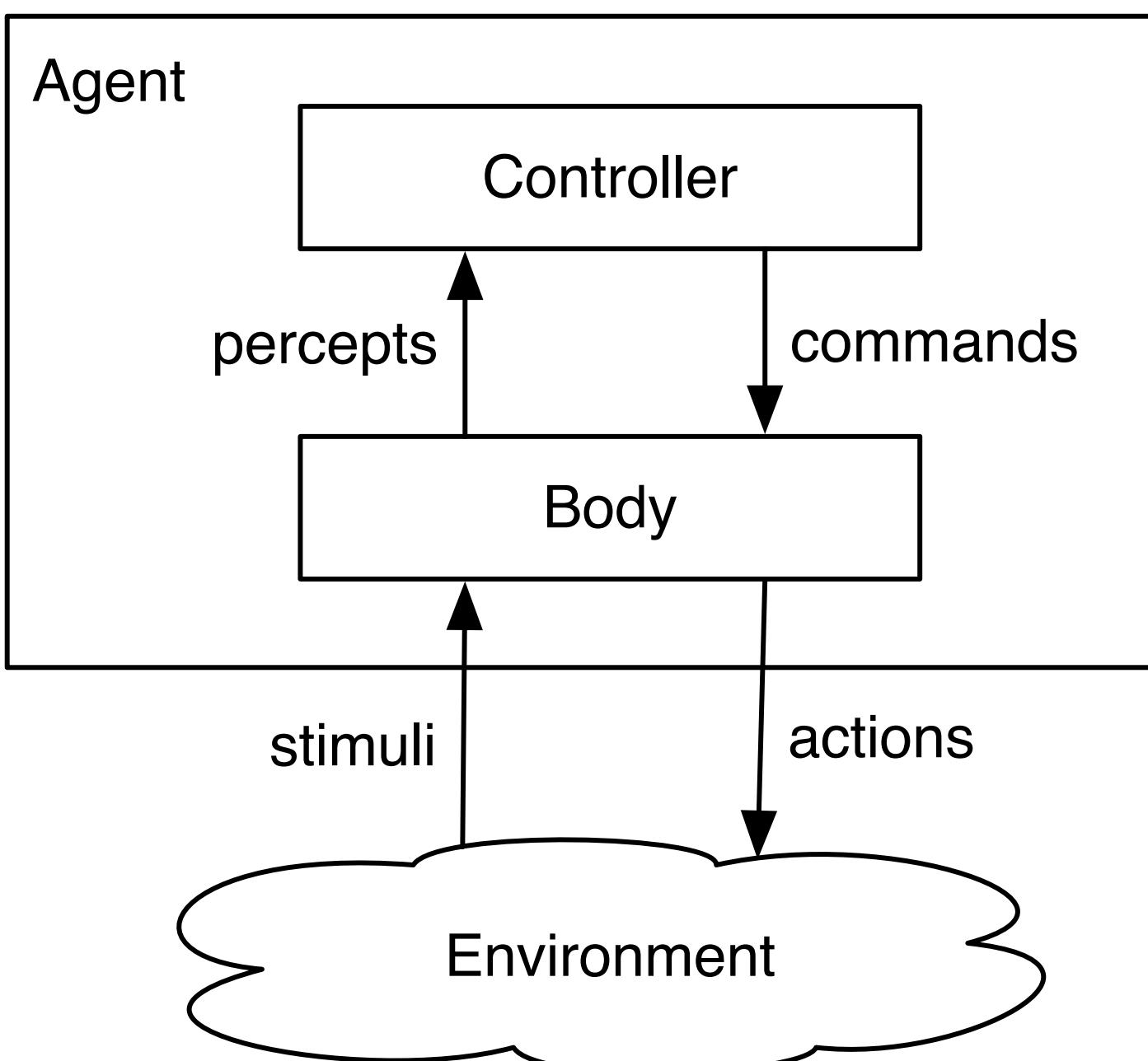
stimuli: vision, laser, GPS... .

past experiences: how breaking and steering affect direction, street maps, ...

AI architectures

Agent architecture

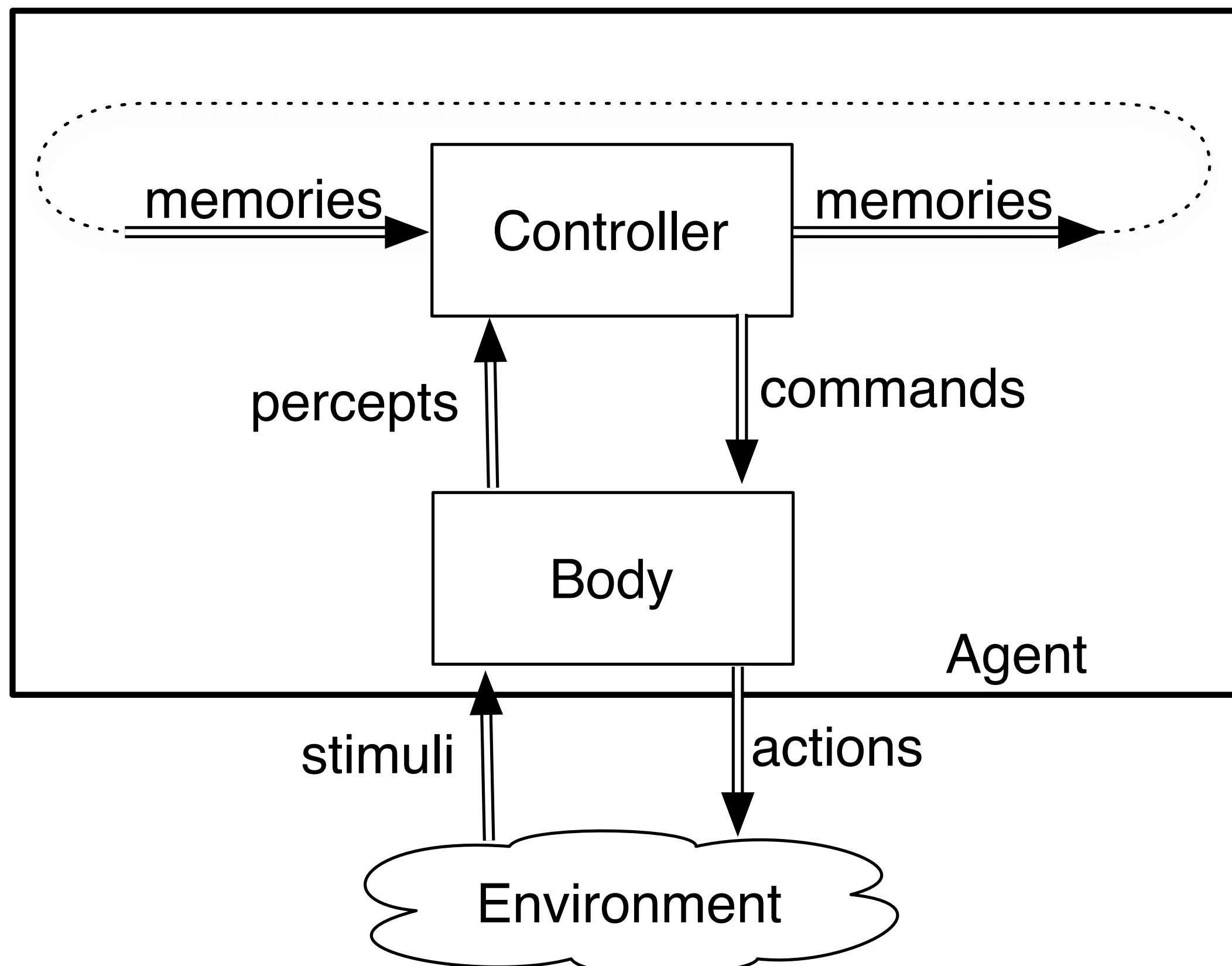
An agent is made up of a **body** and a **controller**.



- An agent interacts with the environment through its body.
- The **body** is made up of:
 - ▶ **sensors** that interpret stimuli
 - ▶ **actuators** that carry out actions
- The controller receives **percepts** from the body.
- The controller sends **commands** to the body.
- The body can also have reactions that are not controlled.

AI architectures

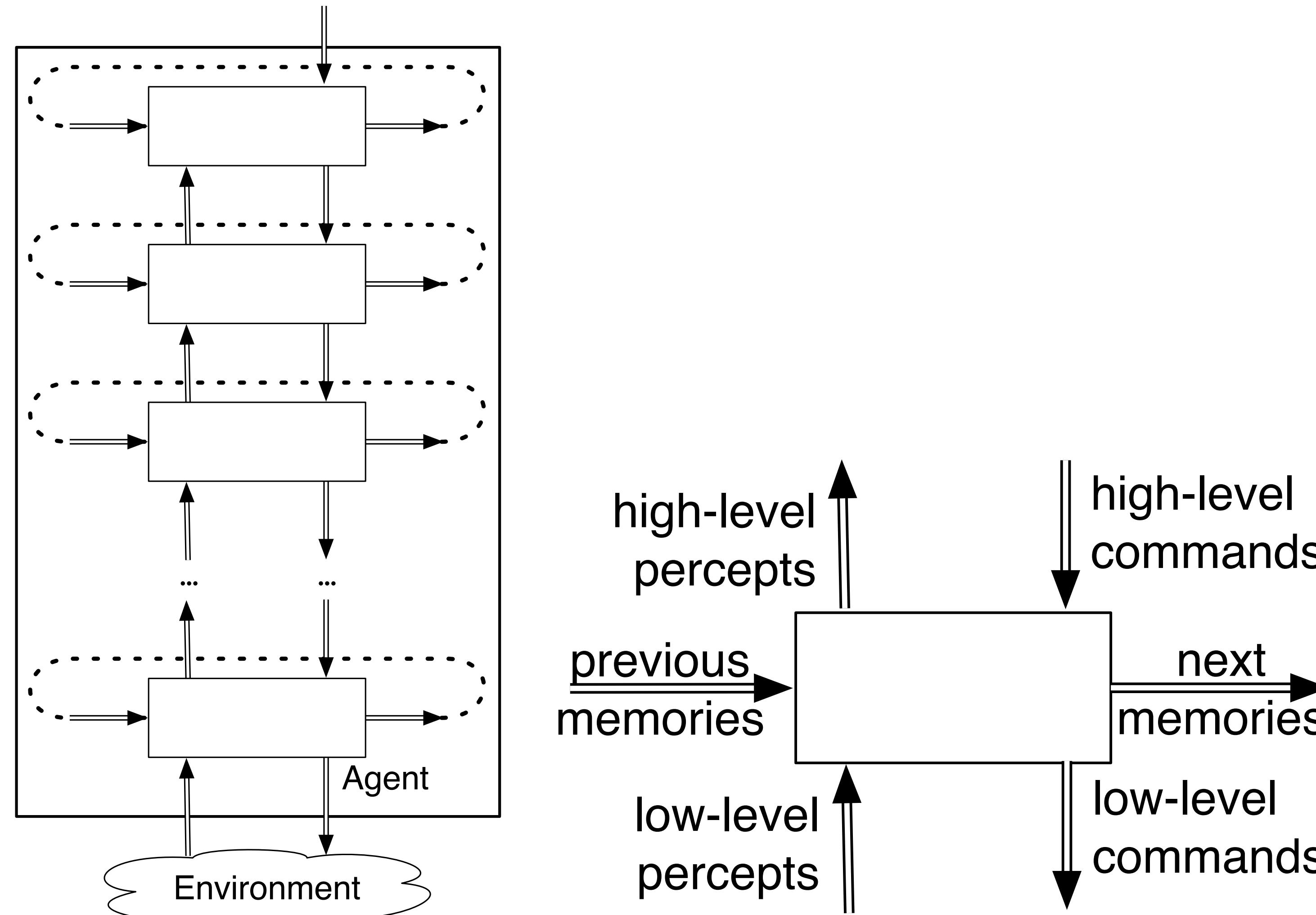
Controllers



- Controllers are the “brains” of the agents.
- Agents are situated in time, they receive sensory data in time, and do actions in time.
- Controllers have (limited) memory and (limited) computational capabilities.
- The controller specifies the command at every time.
- The command at any time can depend on the current and previous percepts.
- Controllers may have states or collect past experiences.

AI architectures

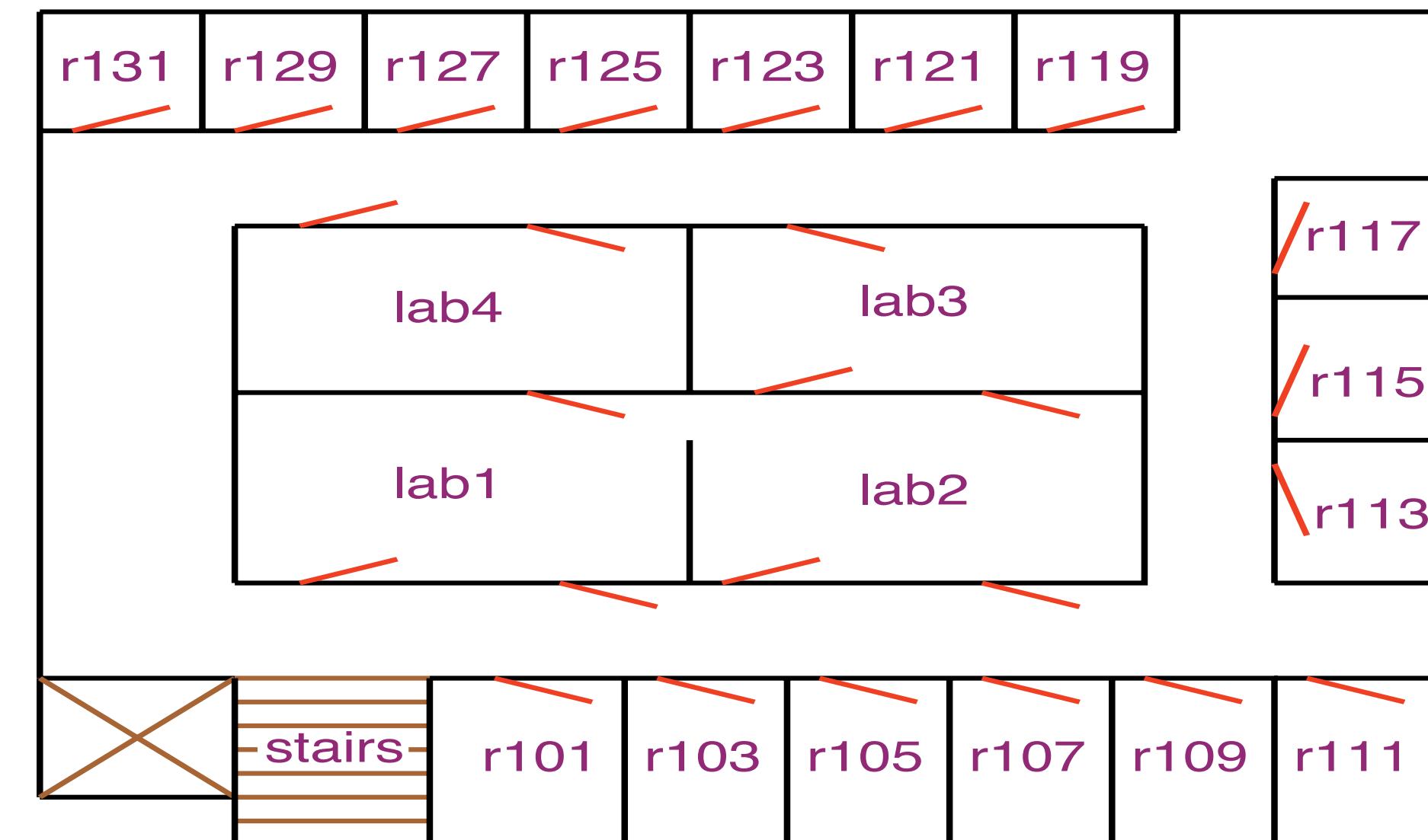
Hierarchical design



AI architectures

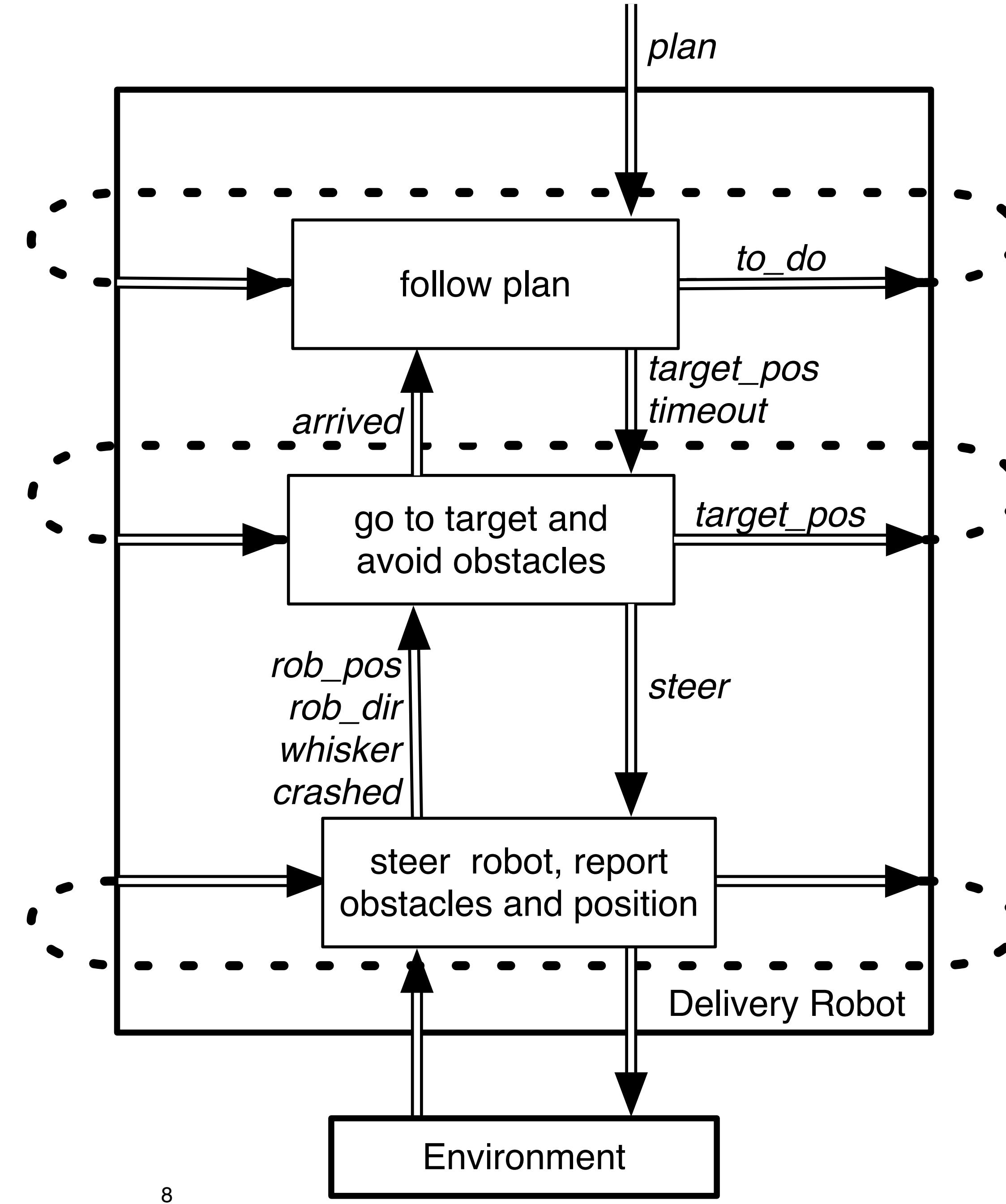
Example: delivery robot

- The robot has three **actions**: go straight, go right, go left.
- It can be given a **plan** consisting of sequence of named locations for the robot to go to in turn.
- The robot must avoid obstacles.
- It has a single whisker **sensor** pointing forward and to the right. The robot can detect if the whisker hits an object. The robot knows where it is.
- The obstacles and locations can be moved dynamically.



AI architectures

Example: delivery robot



Under the bonnet

How a self-driving car works

Signals from **GPS (global positioning system)** satellites are combined with readings from tachometers, altimeters and gyroscopes to provide more accurate positioning than is possible with GPS alone

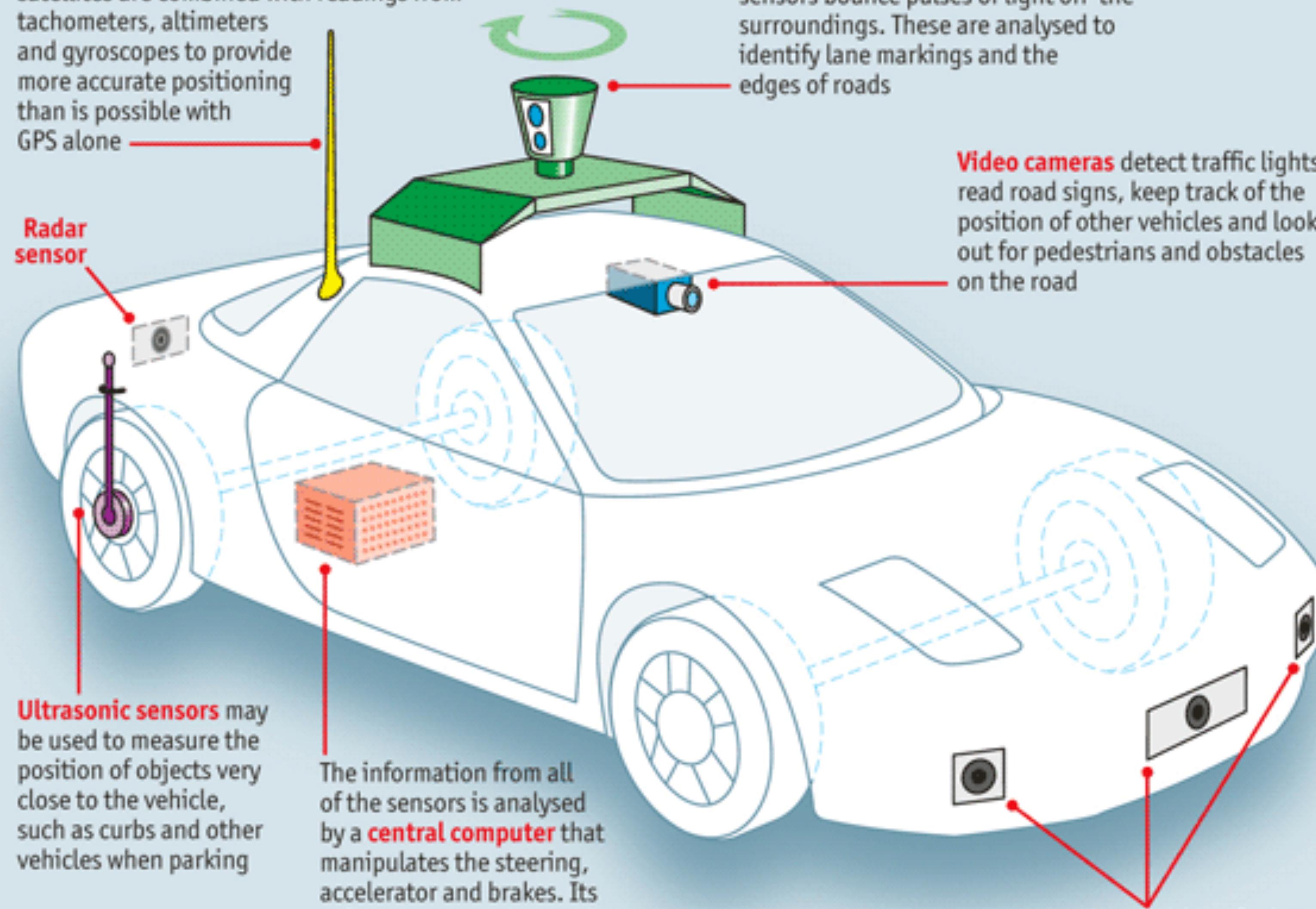
Radar sensor

Ultrasonic sensors may be used to measure the position of objects very close to the vehicle, such as curbs and other vehicles when parking

The information from all of the sensors is analysed by a **central computer** that manipulates the steering, accelerator and brakes. Its software must understand the rules of the road, both formal and informal

Lidar (light detection and ranging) sensors bounce pulses of light off the surroundings. These are analysed to identify lane markings and the edges of roads

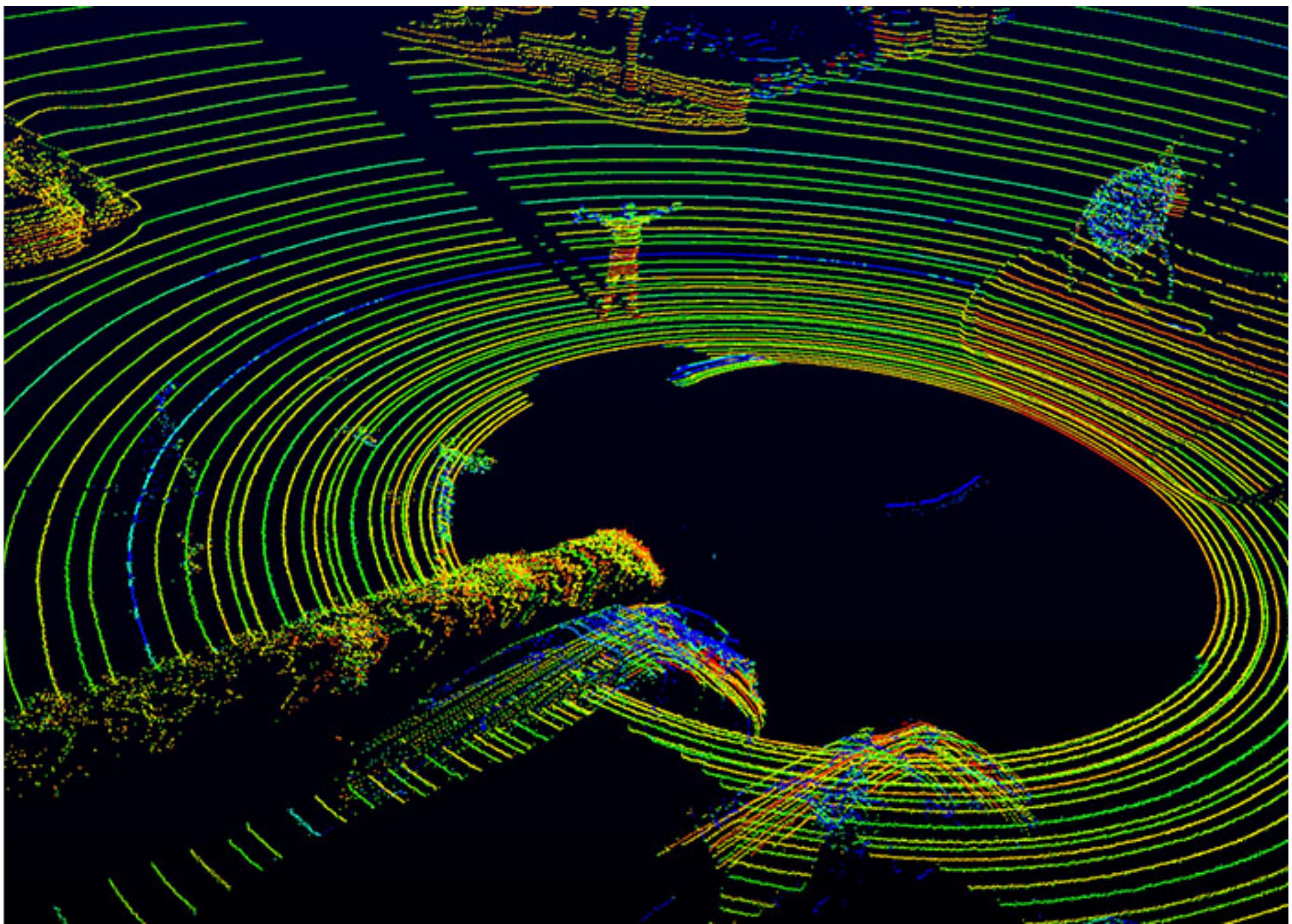
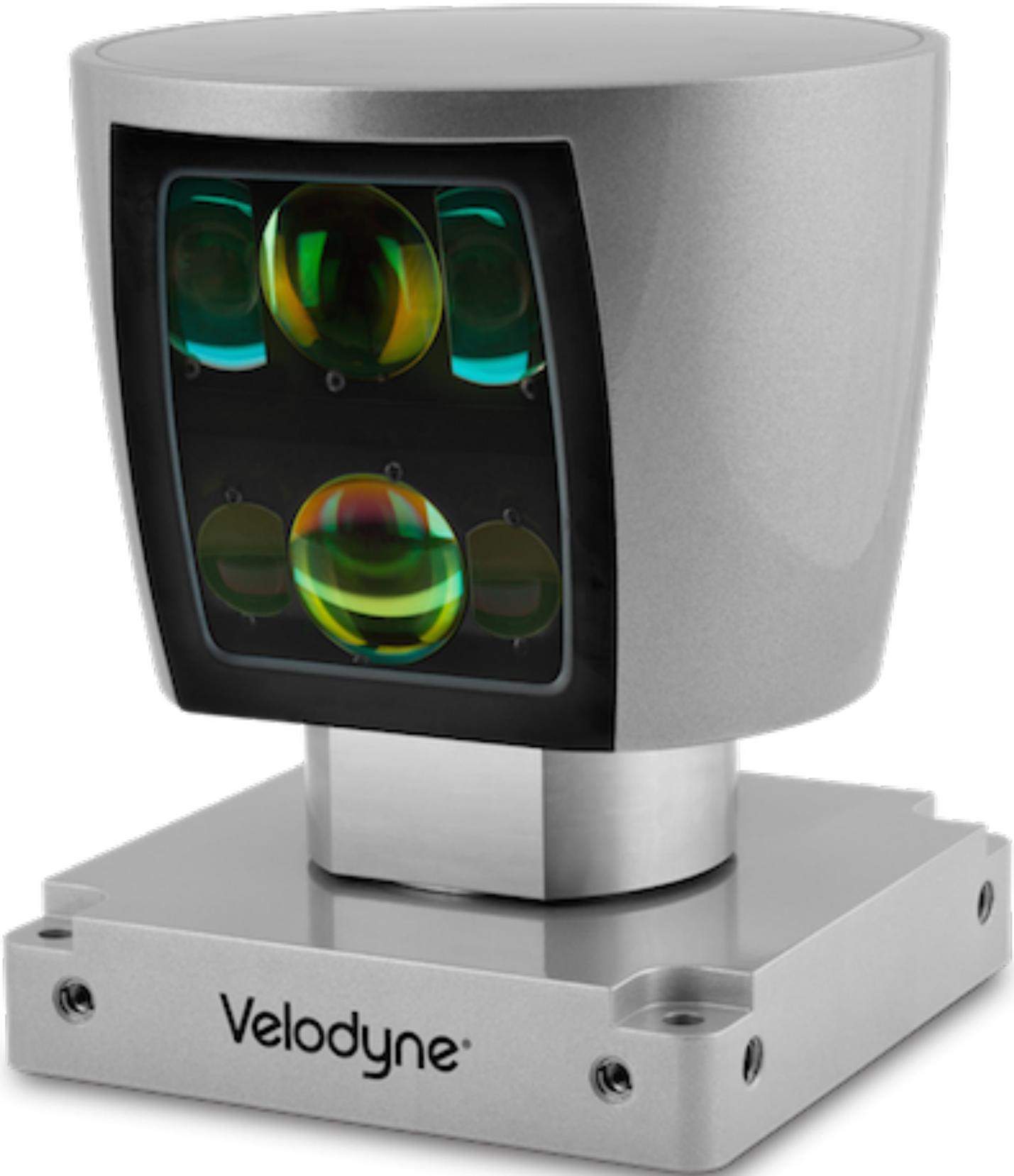
Video cameras detect traffic lights, read road signs, keep track of the position of other vehicles and look out for pedestrians and obstacles on the road



Self-driving cars: sensors

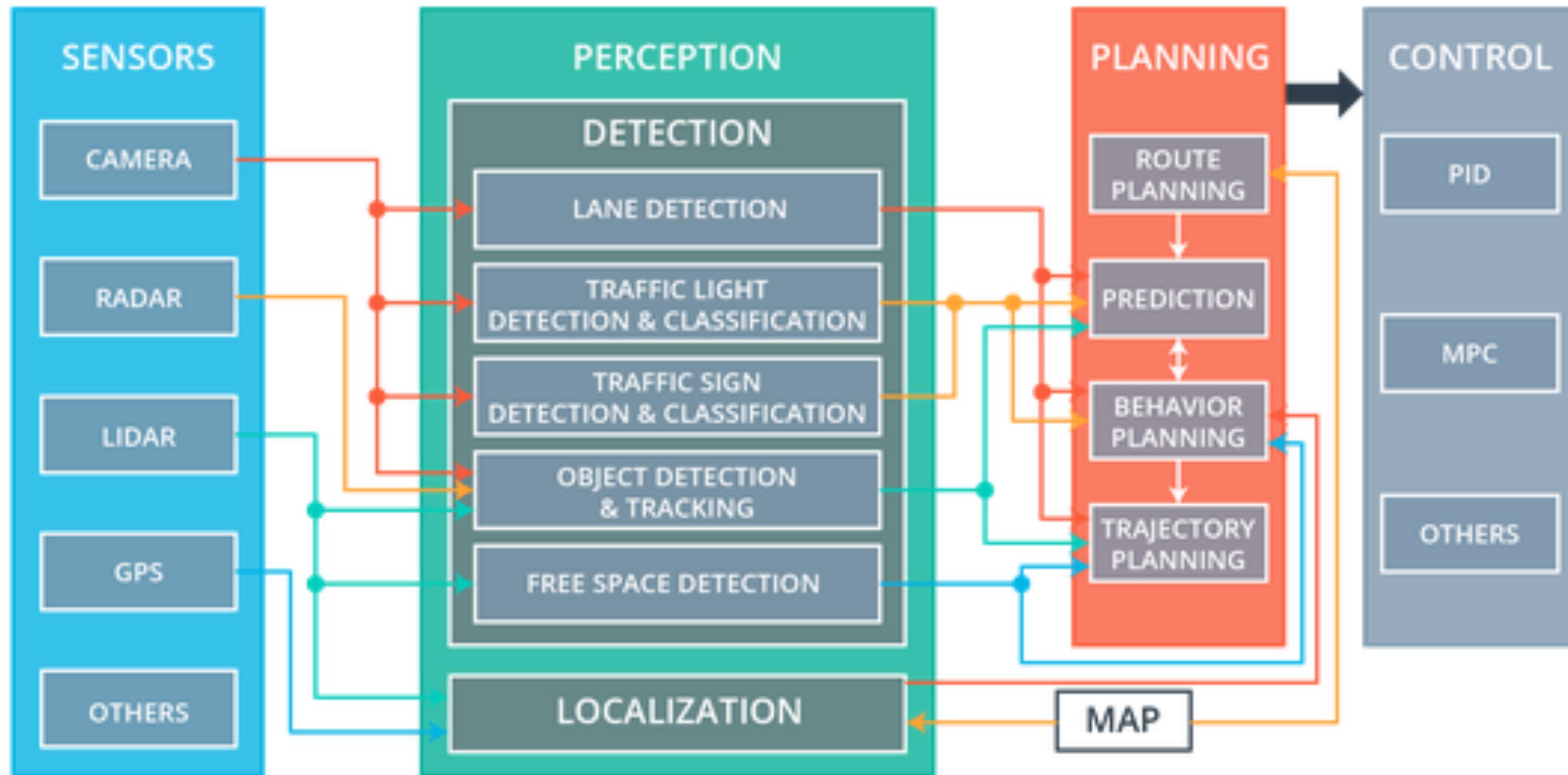
Self-driving cars

Lidar



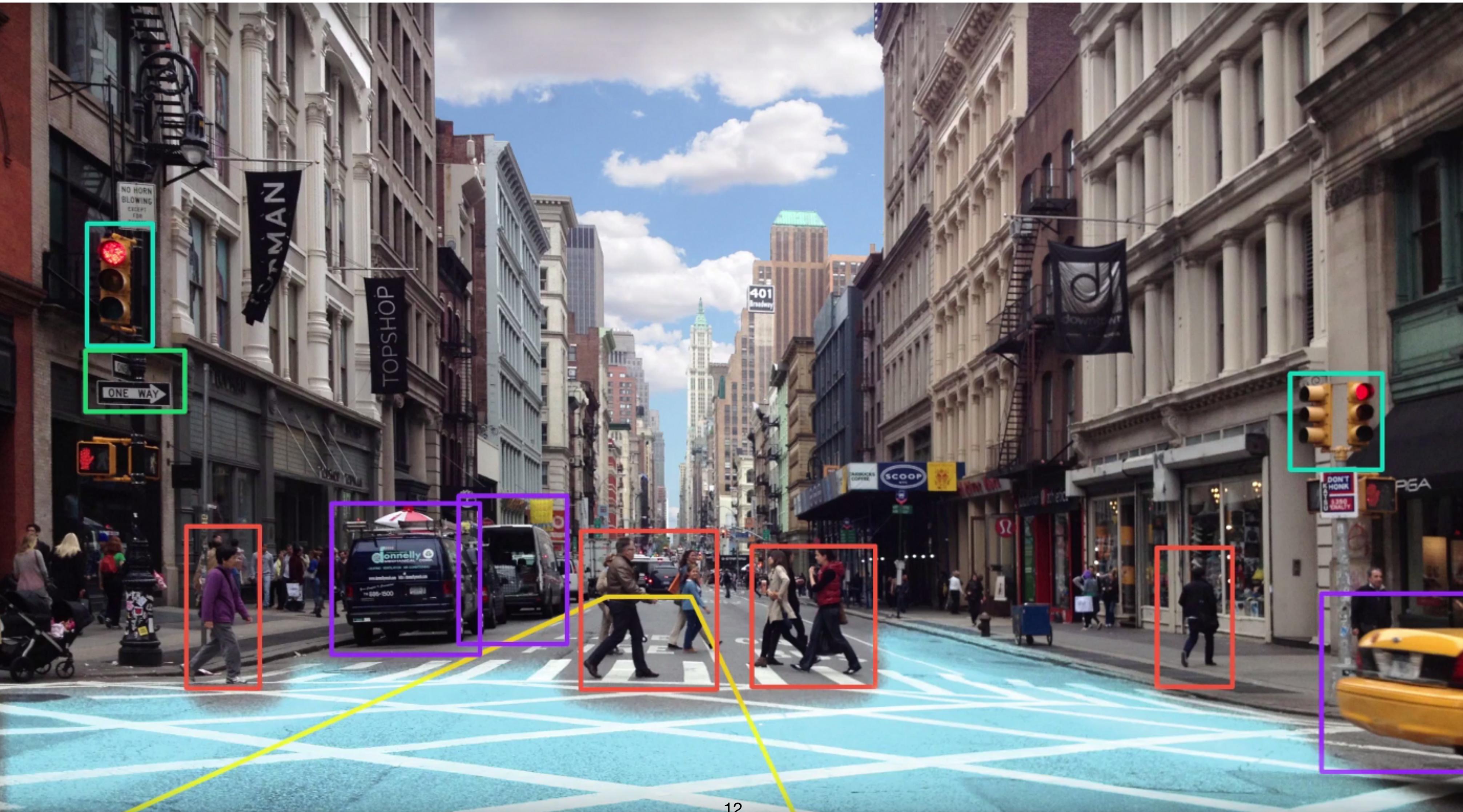
Self-driving cars

Components



Self-driving cars

Object detection and classification with neural networks



Major challenges in AI

- Knowledge representation
- Common sense

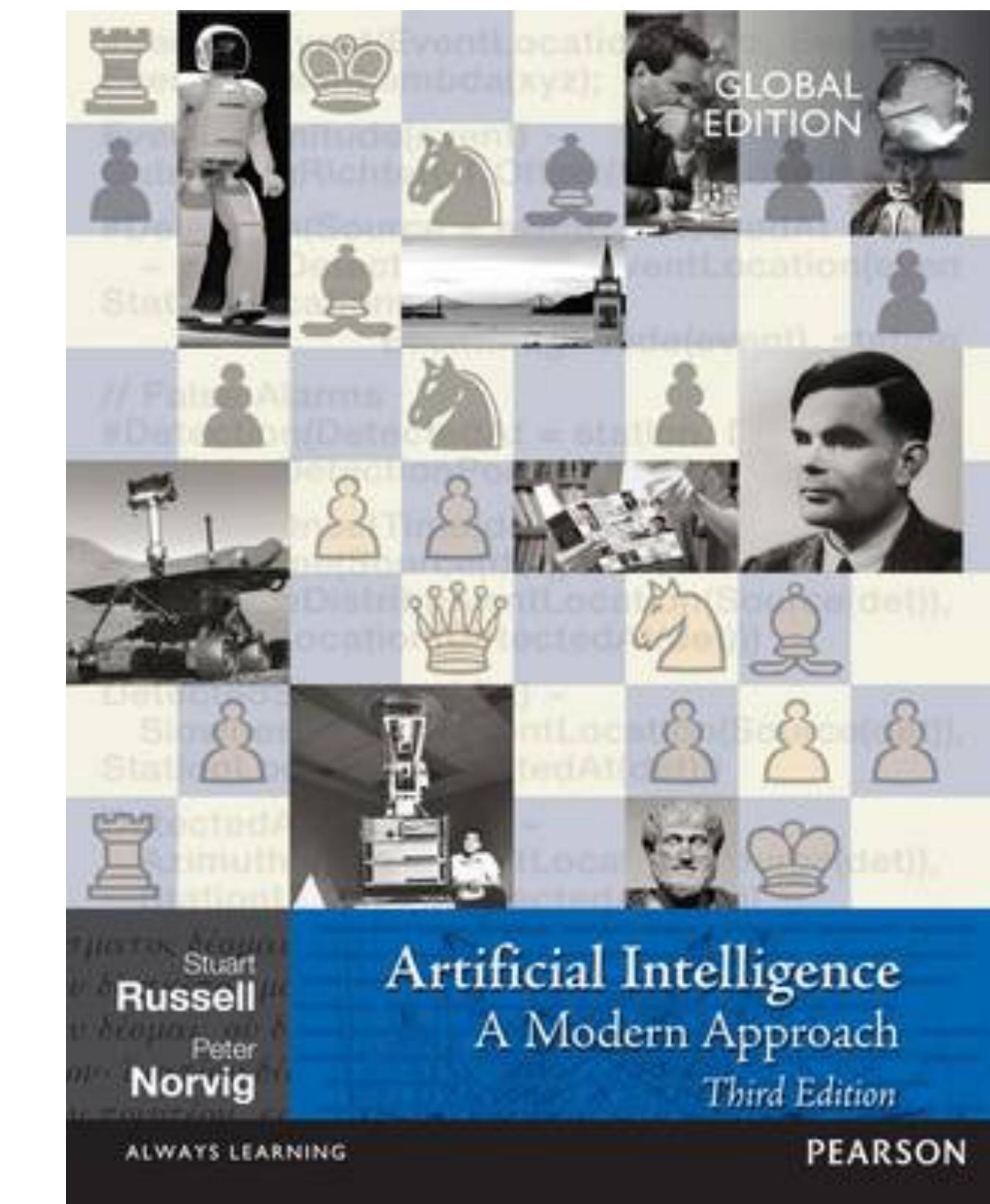
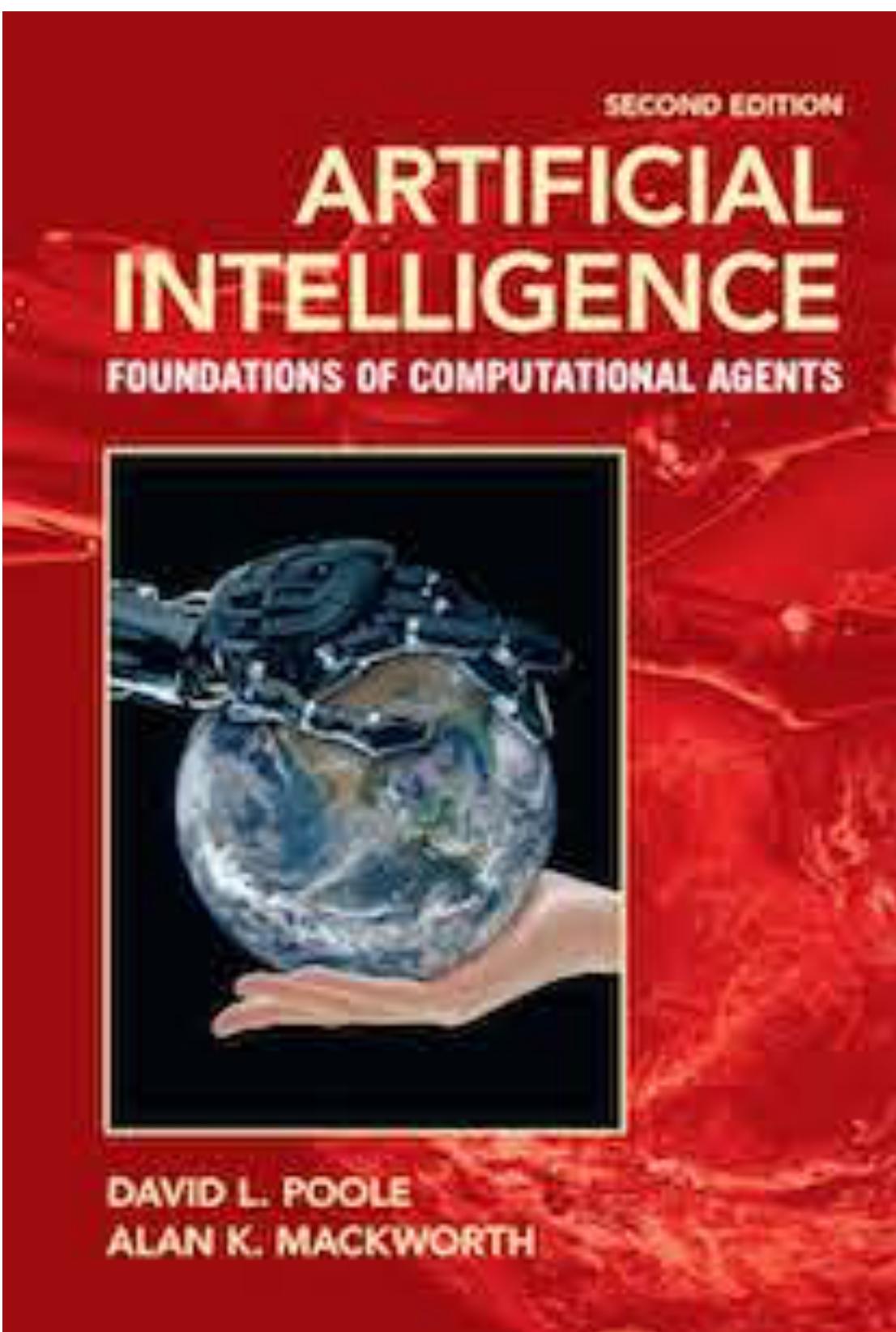
“The trophy would not fit in the suitcase because it was too small/large.”

- Natural language understanding
- General artificial intelligence

Major concerns in AI

- Reliability
- Fairness
- Transparency and interpretability
- Job opportunities
- Distribution of wealth
- Singularity

How far did we go in the course?



Where to next?

Related topics:

- Advanced algorithms
- Logic
- Probability theory, Multivariate statistics, Bayesian Inference
- Linear algebra, Optimisation, Functional analysis

Courses Offered at CSSE:

- COSC401: Machine Learning (somewhat theoretical, requires some maths)
- COSC440: Deep learning
- COSC428: Computer Vision
- COSC420: Intelligent Tutoring Systems

Also see many courses offered by Maths