Lecture 1

Introduction

Lecture Plan

1. Course Administration
2. What is intelligence? What is involved in creating artificial intelligence.
3. Course Topics
4. Group Discussion/Question Formulation
5. Panel Discussion

Course Admin

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Course Admin

Prerequisites and required knowledge.

No formal prerequisites. But you should be comfortable with basic:

- Probability theory / Statistics
- Linear Algebra

If you are not, you should brush up.

Course Admin

Readings

- You should research the topics presented in the lectures further.
- The course page provides suggested readings for most lectures. These readings come from:

  Russell and Norvig, Artificial intelligence : A Modern Approach, 3rd Ed

  Statistical Learning: Data Mining, Inference and Prediction, 2nd Ed

  Haykin, Neural Networks and Learning Machines, 3rd Edition
- It is not compulsory that you use these sources: There are many fine sources available for free on the internet. You should have no trouble finding clarification and deeper explanations about the topics we cover.

Assessment

Lab Projects	50%
Exam	50%
Exercises	Hurdle

Lab Assignments are group activities. For now: Find groups (of approx. 4) and **set up R and an R Studio environment**.

Some time will be provided for this in the Lab lecture, but you should expect to have to work in your groups outside of class time.

To pass the course you must also complete three class exercises. These are compulsory and Pass/Fail

Course Goals

Students should

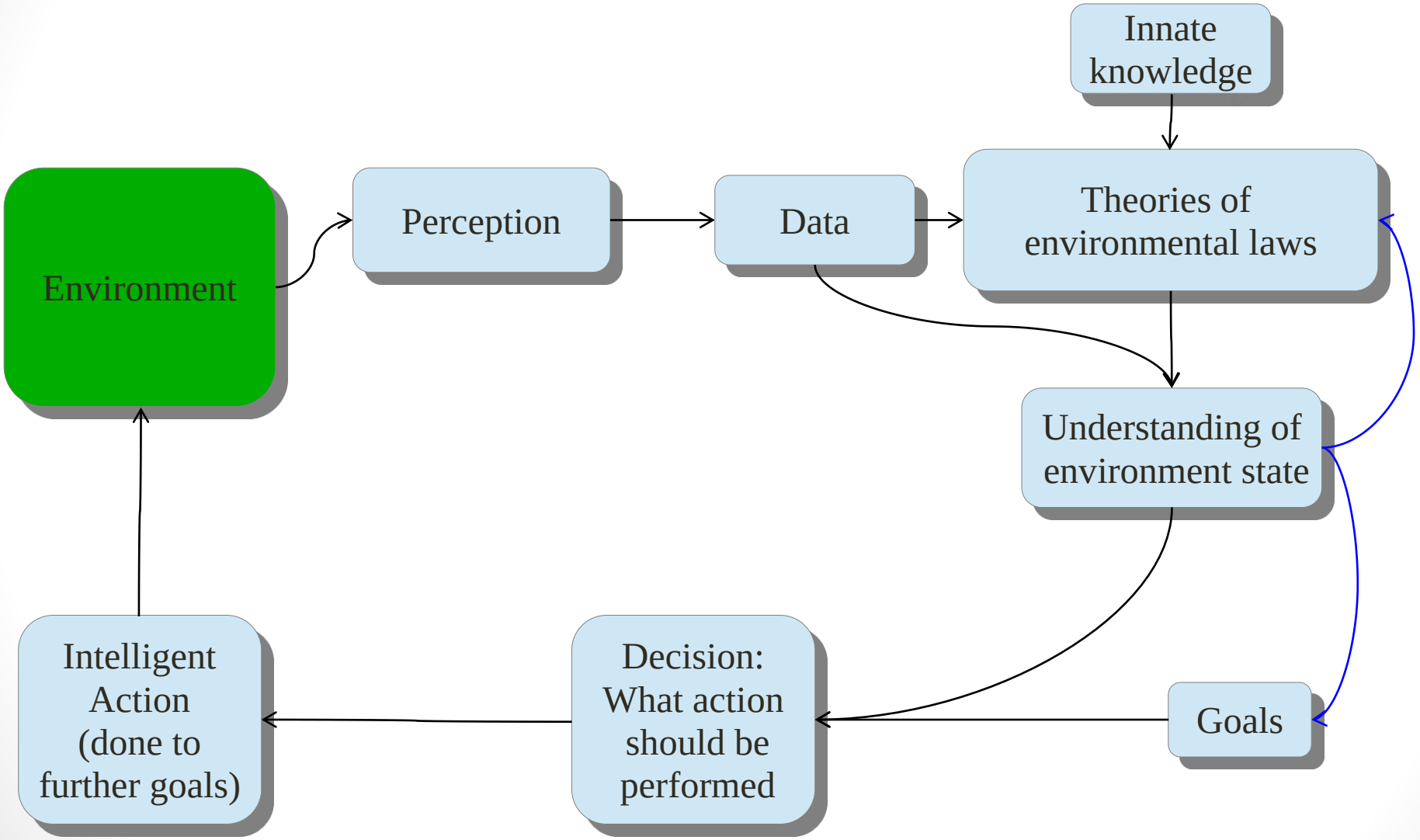
1. Understand the problem areas involved in producing intelligent systems.
2. Be aware of many of the fields that research the problems areas encountered, and the types of solutions they propose.
3. Appreciate the factors that are important when choosing an AI algorithm to apply to a particular problem.
4. Be able to suggest suitable algorithms for basic model generation, inference and decision making for problem areas similar to those covered in the course.
5. Be comfortable researching and implementing AI algorithms of the types we encountered in the course.

WHAT IS INTELLIGENCE?
WHAT FIELDS REPLICATE IT?

History of AI:

- Precursors
  - Modern mathematics and its formalization
  - The advent of digital computing
- Classic AI (1943-1970s)
  - Numerous techniques developed, hyped and failed.
    - Symbol manpulation and search based techniques
    - Early neural networks
    - Micro-worlds
    - Early natural language processing
- Second coming (late 1970s-1980s)
  - Expert Systems developed, hyped and fail.
  - 'AI hardware' developed and fails
  - Unnoticed advances in many AI algorithms
- Death and rebirth of AI (1990s)
  - Many 'novel' approaches of AI increasingly understood in traditional terms, particularly statistical.
  - AI as a discipline largely disintegrates. Competitor and successor disciplines target aspects of the AI project:
    - Machine Learning, Data Analytics (Data Mining), Sensor Engineering, Robotics, Image Processing, Systems and Control, Natural Language Processing…
- Triumph of AI under any other name (early 21st century)
  - Amazing developments in many of the successor fields.
  - Distributed systems and big data mean sophisticated, data driven machine learning as well as online, real time (often remote) intelligent systems become feasible on a mass scale.

The circle of intelligent life



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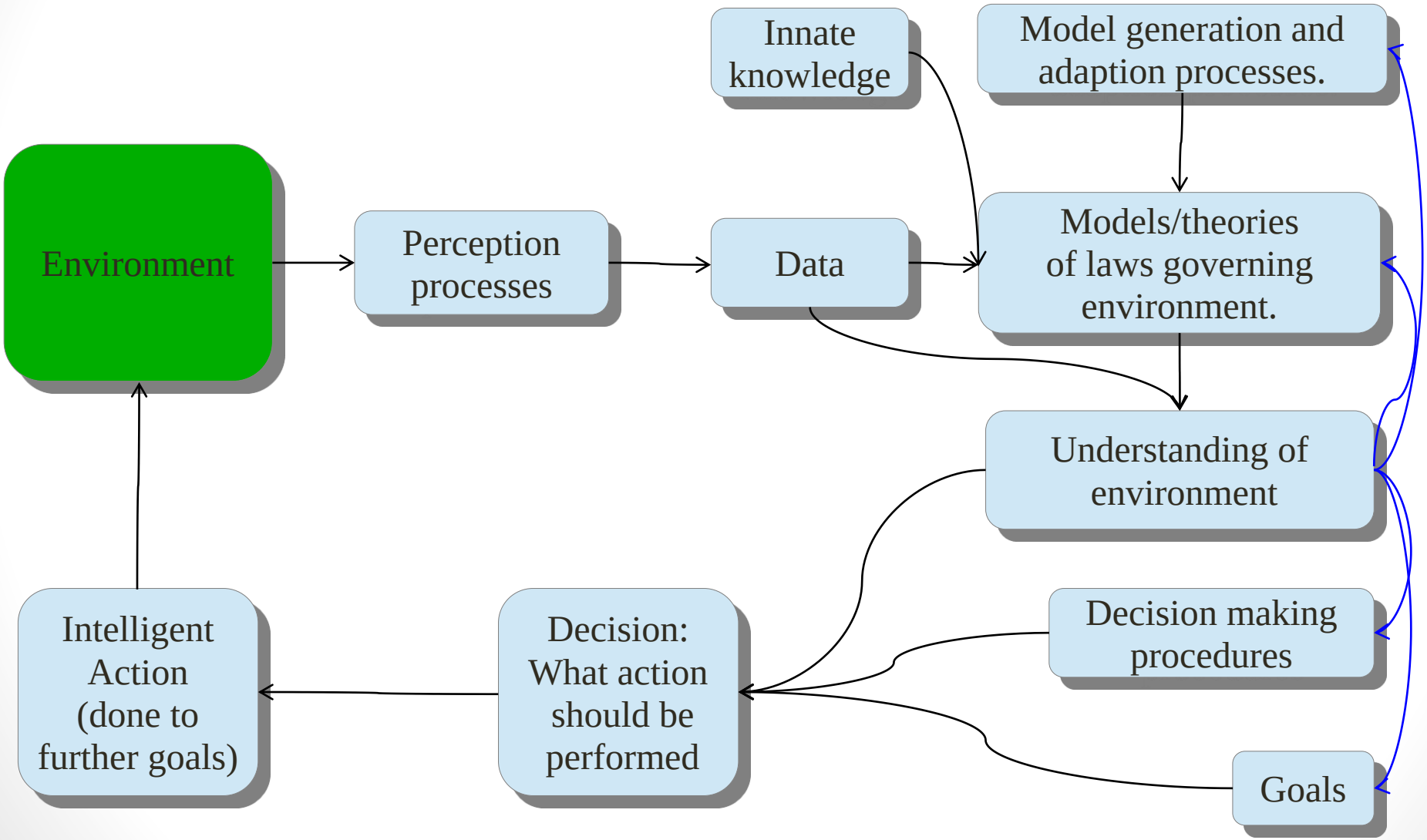
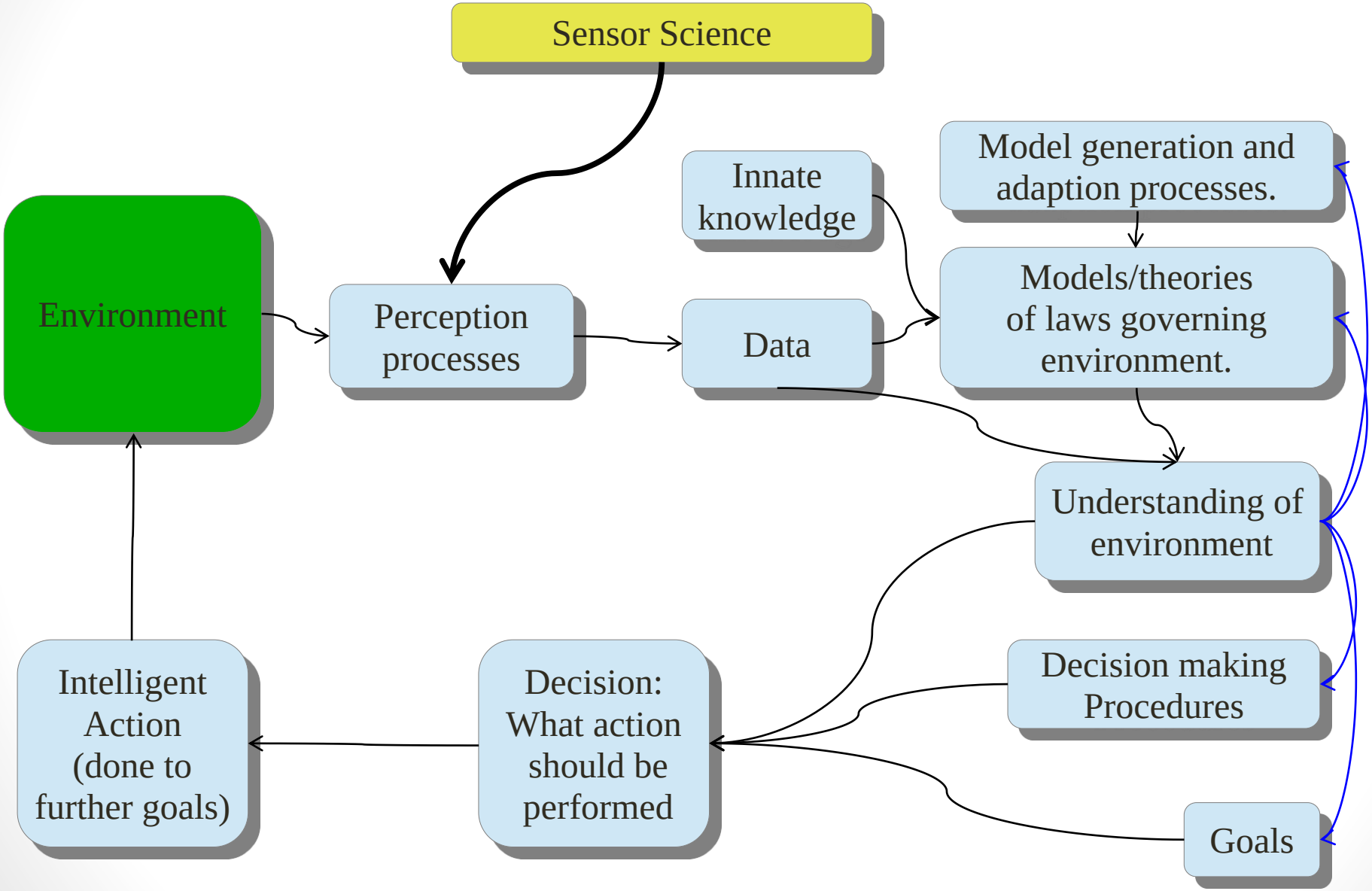


The circle of intelligent, artificial life



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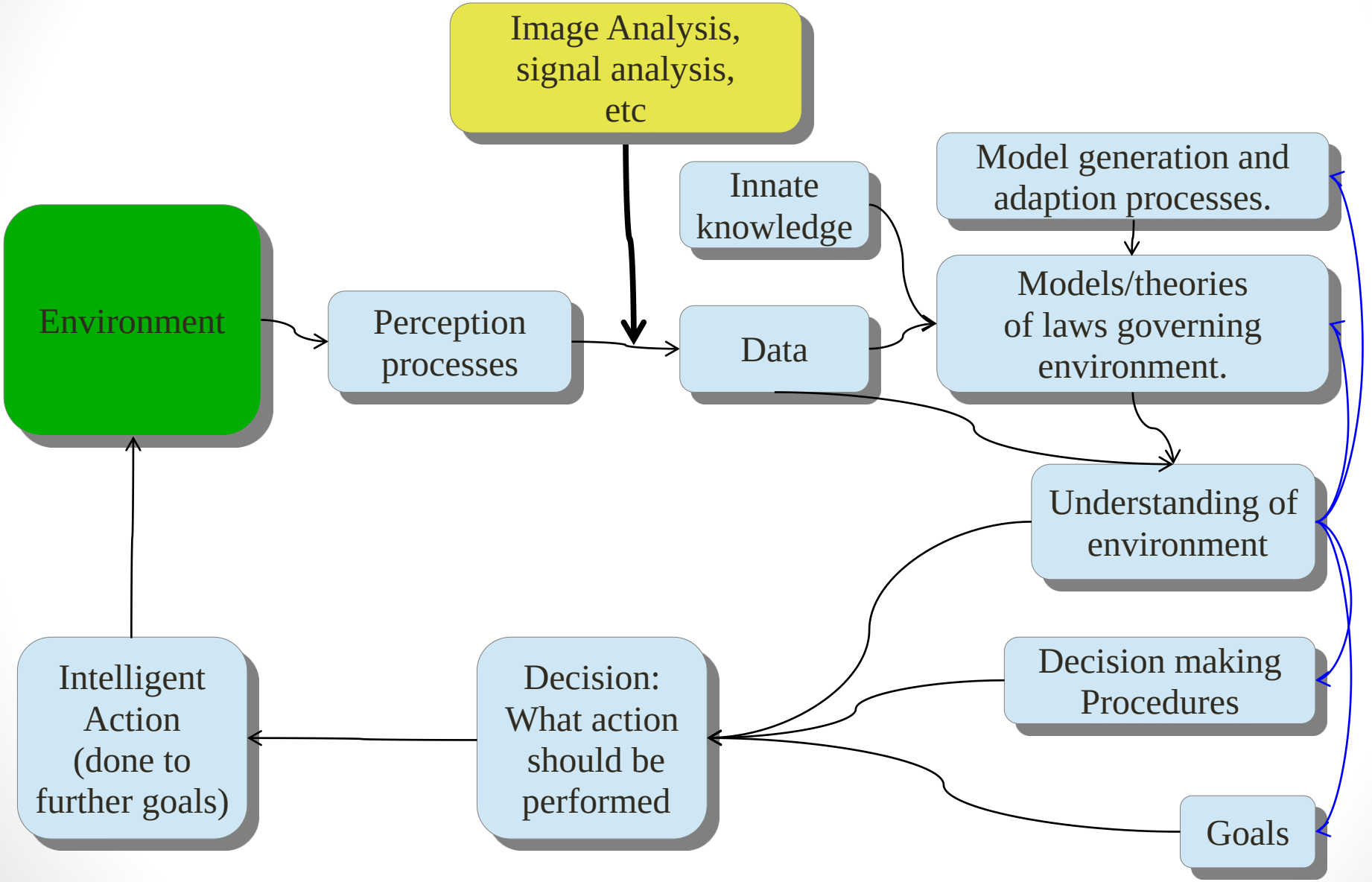

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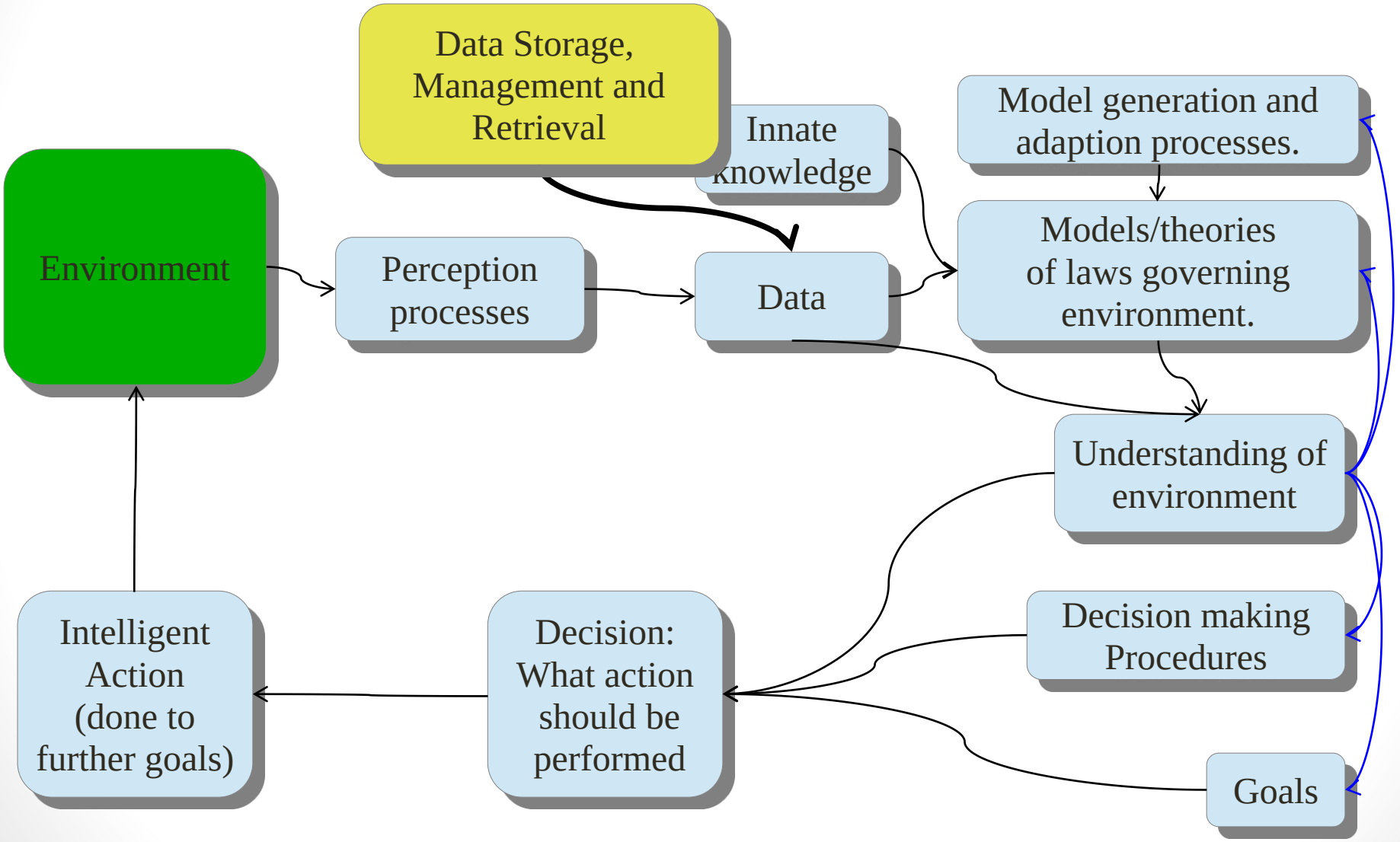

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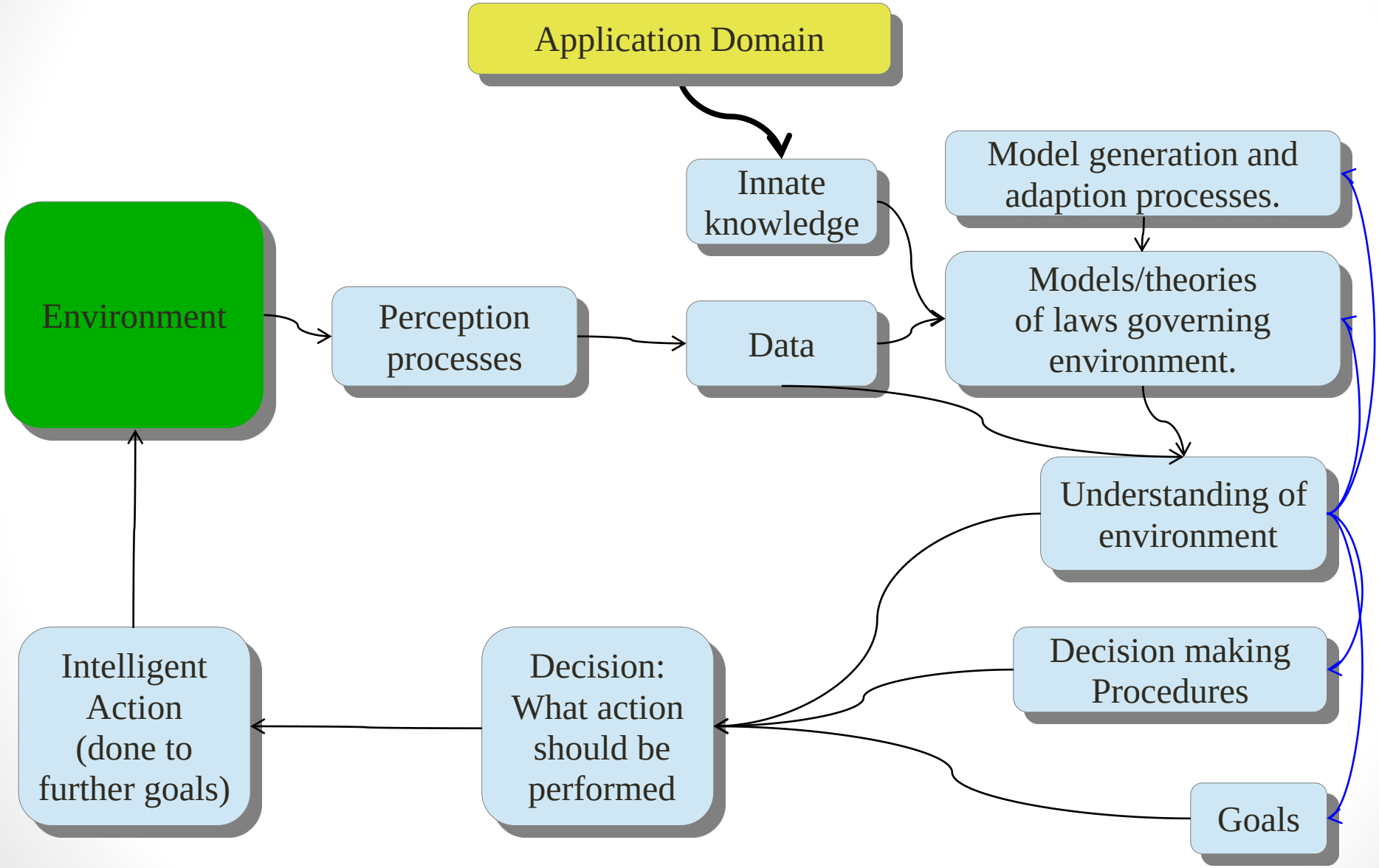

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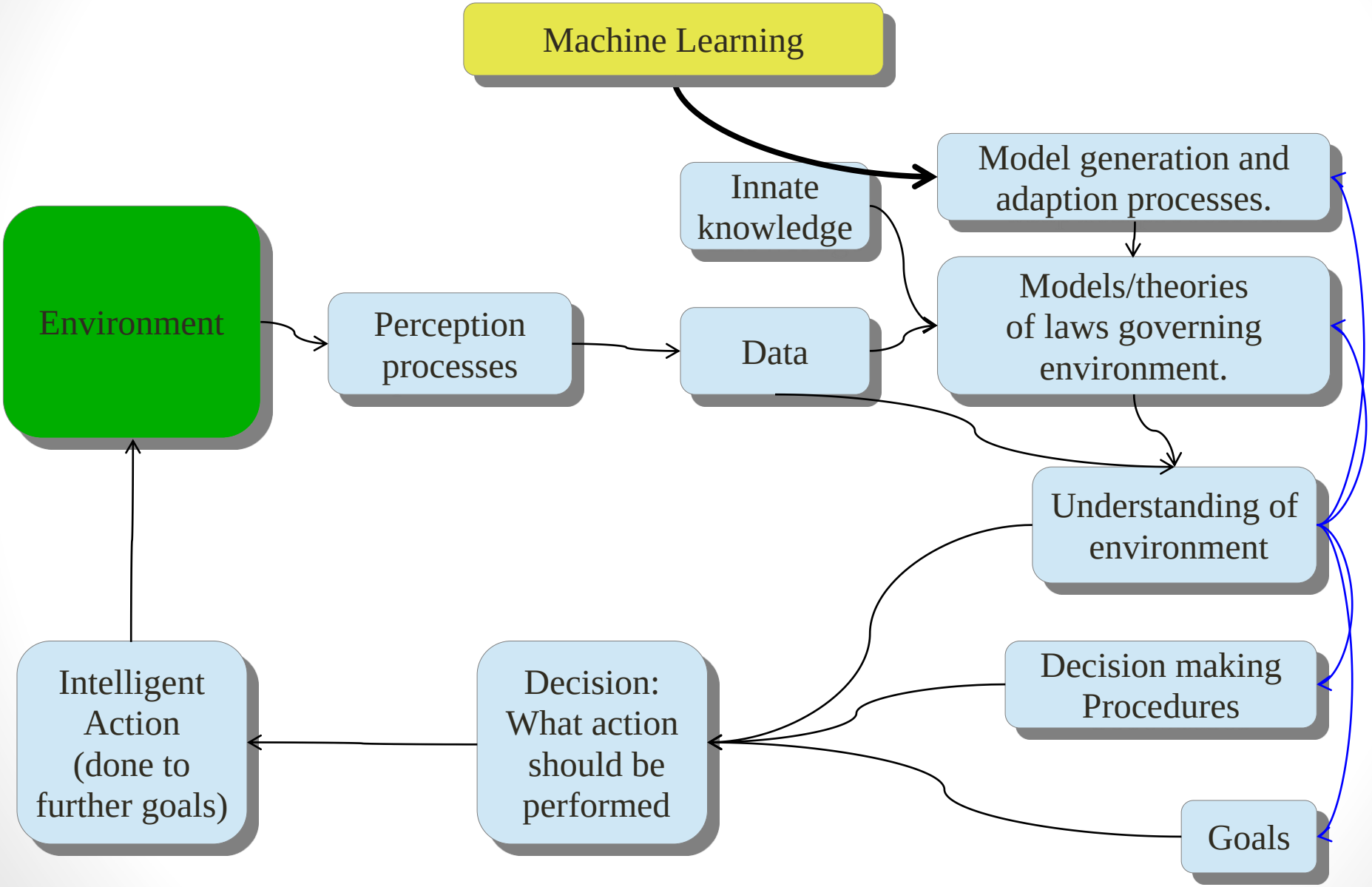

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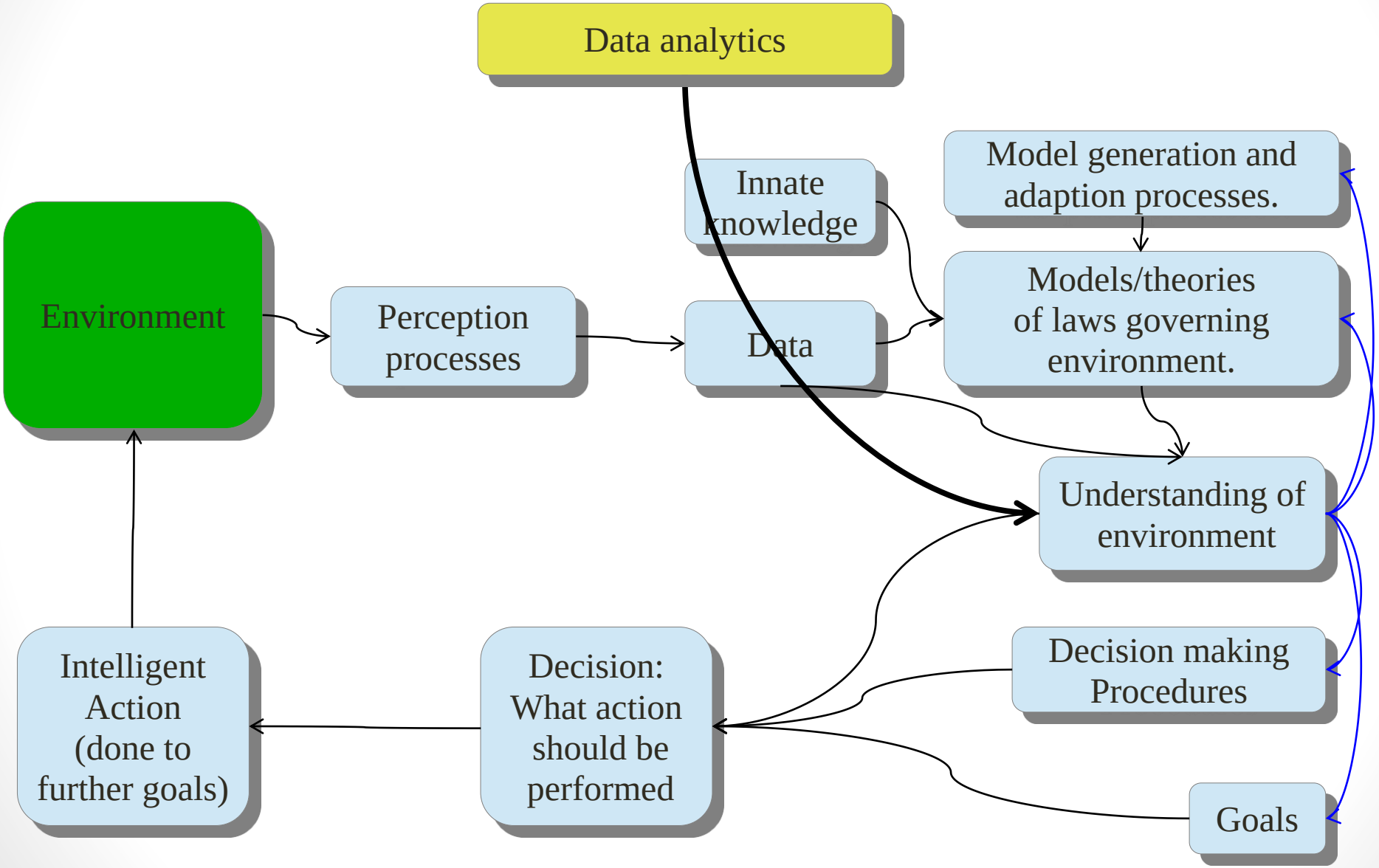

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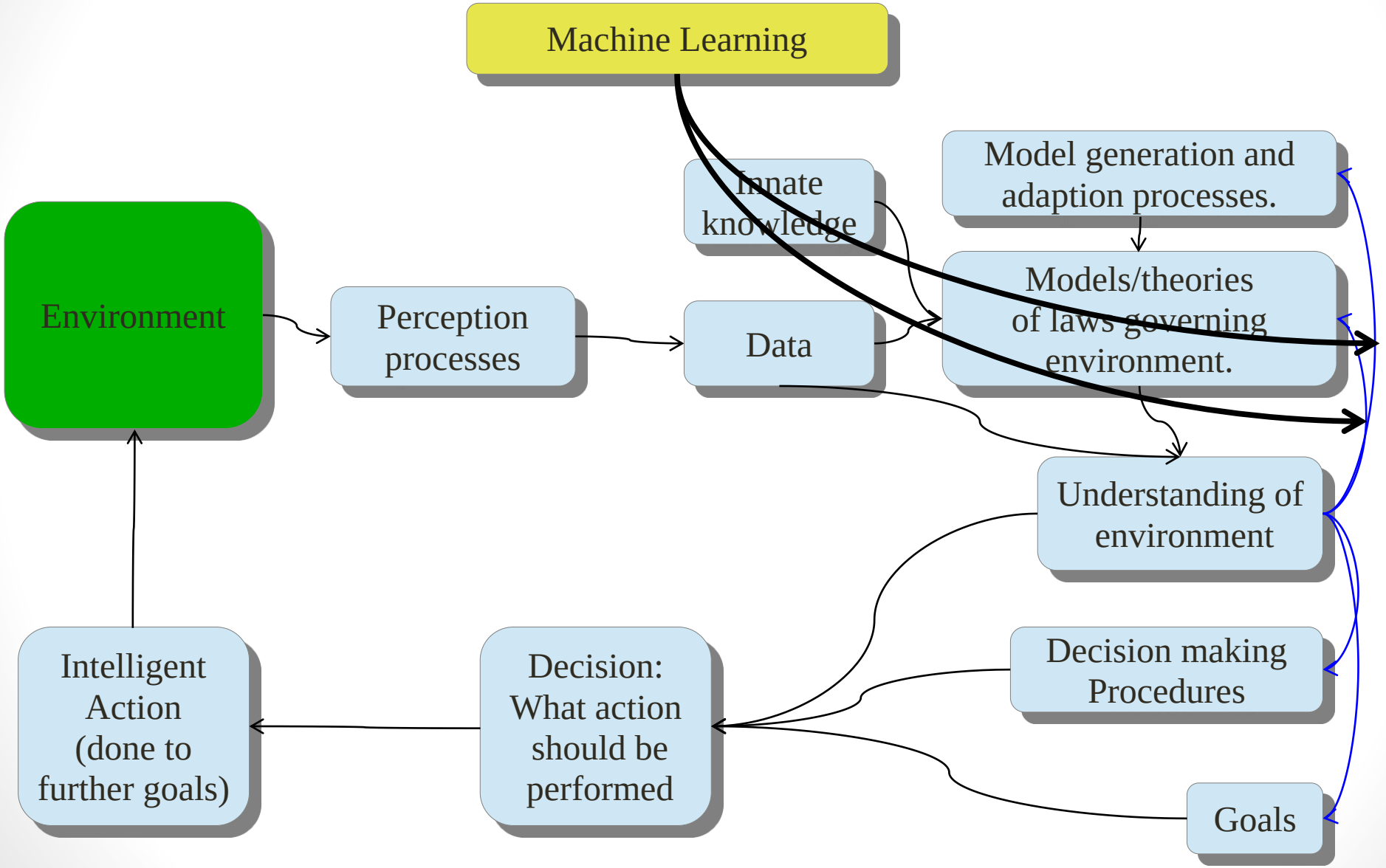

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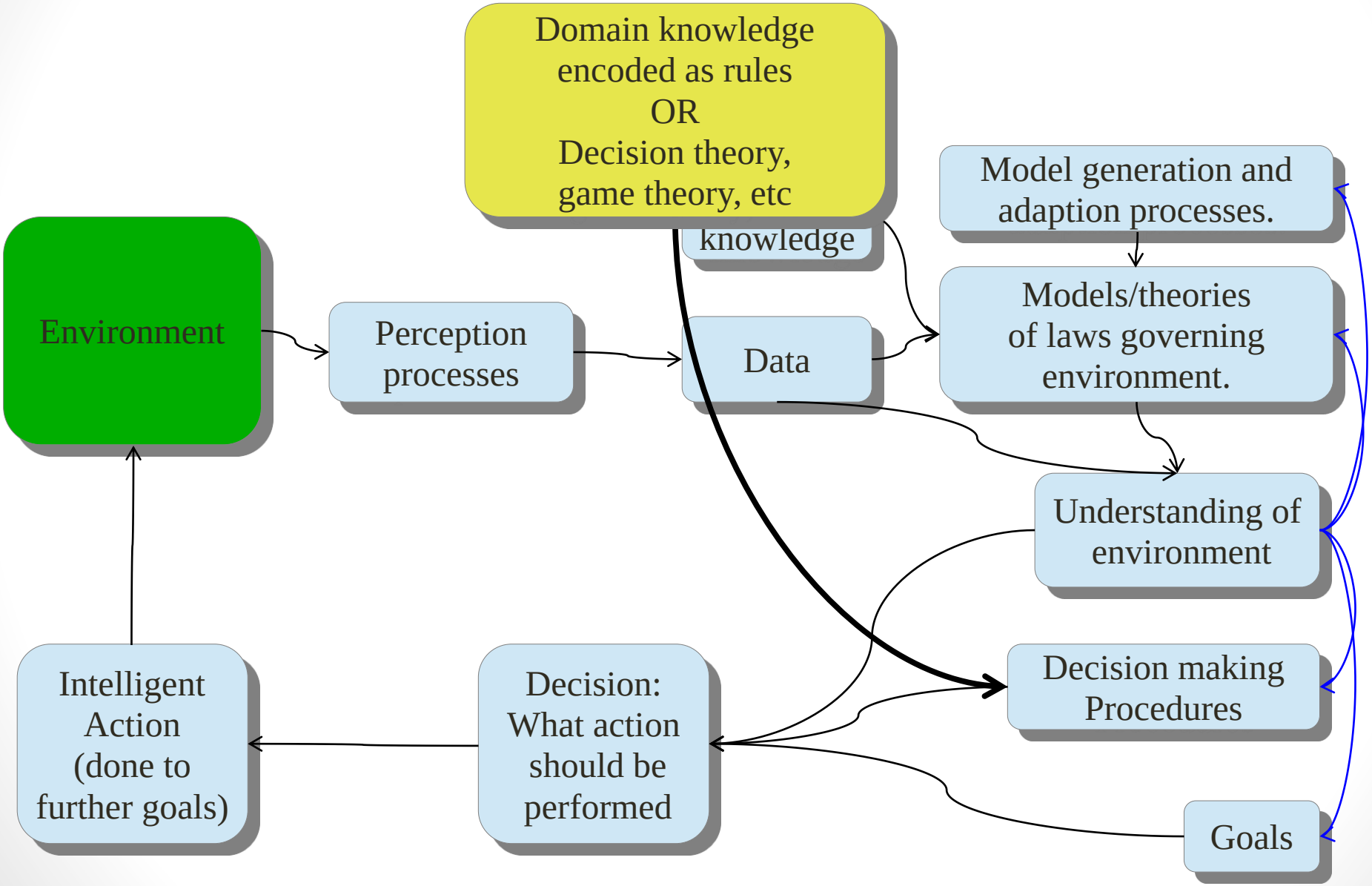

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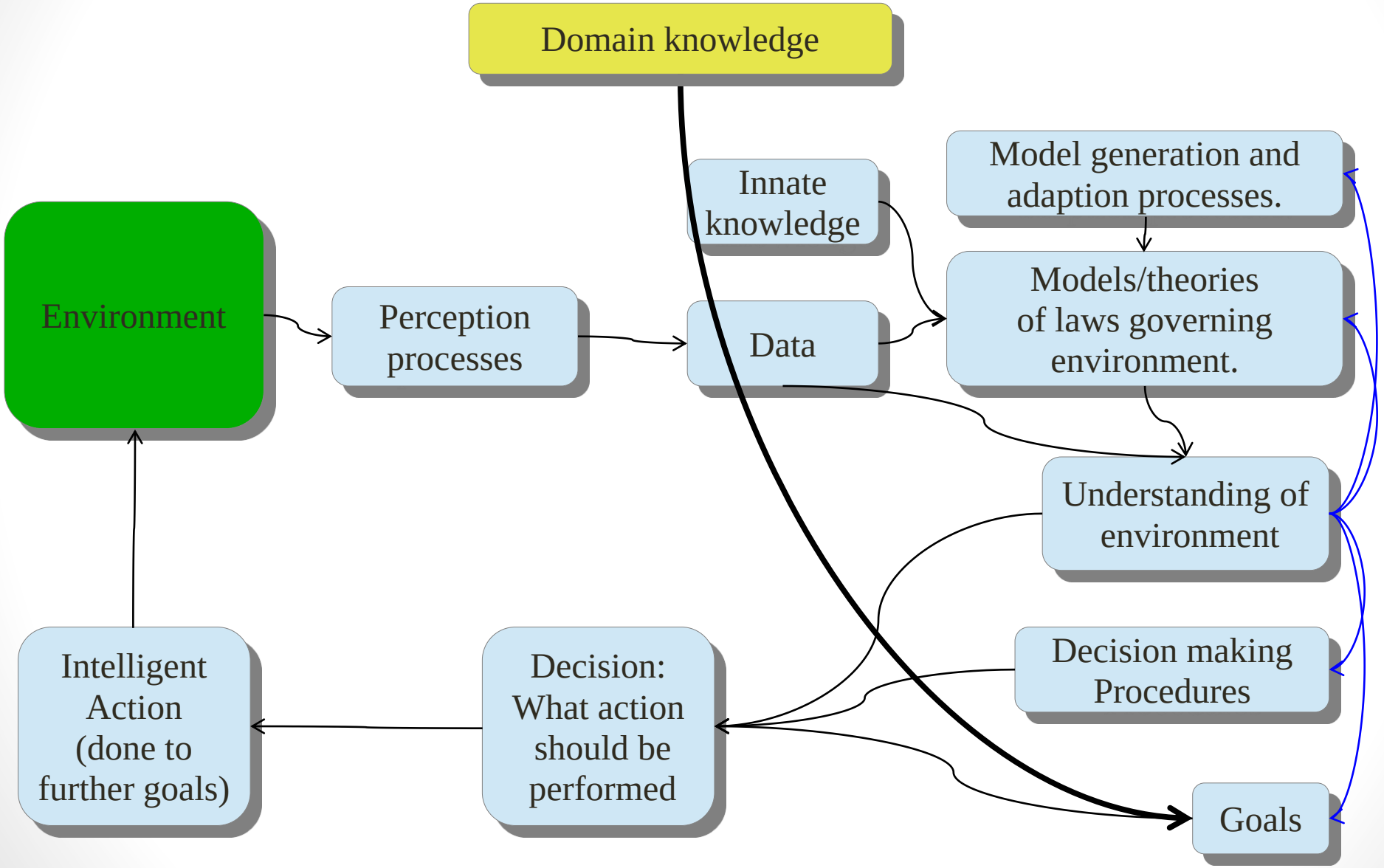

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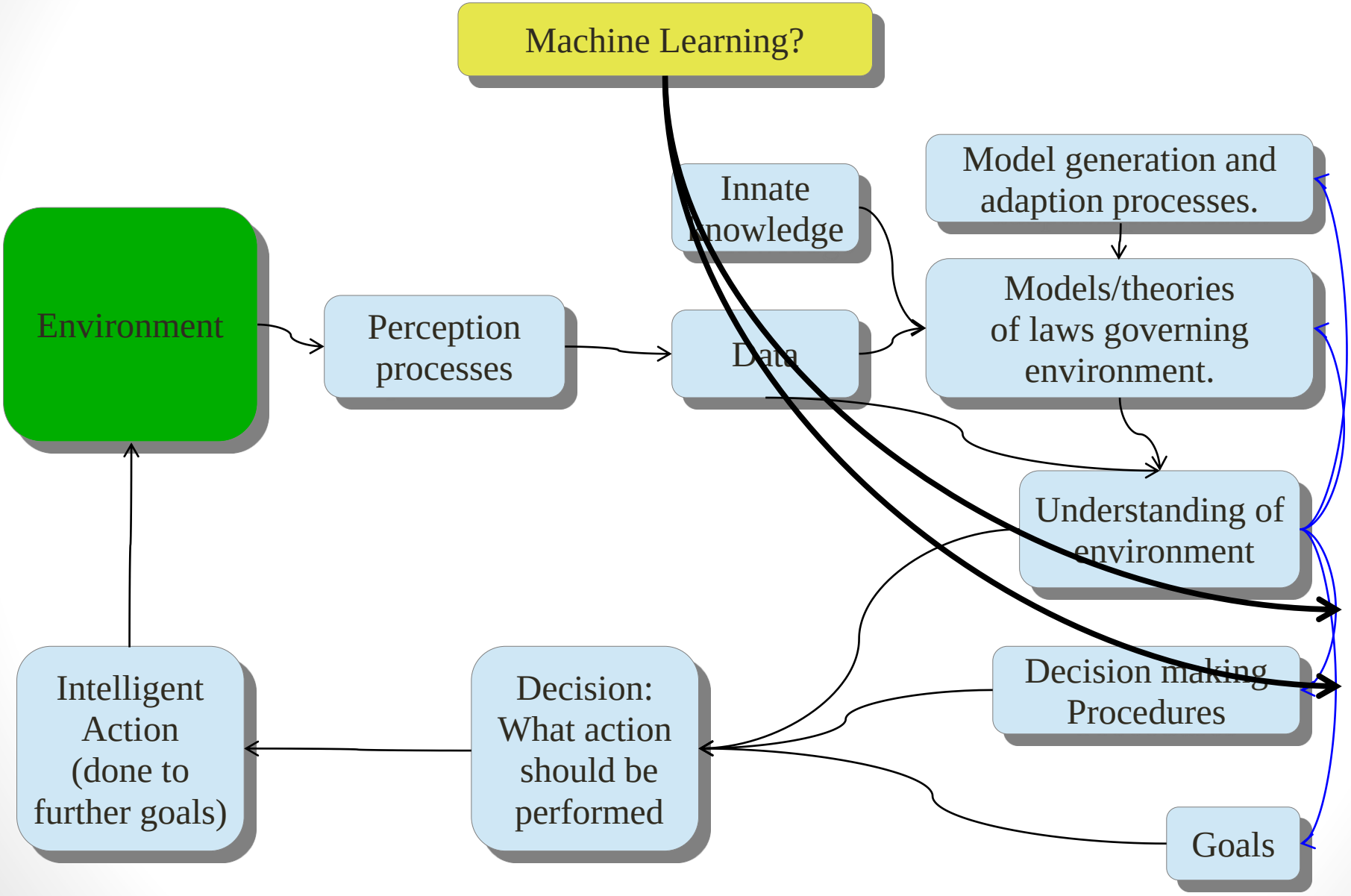

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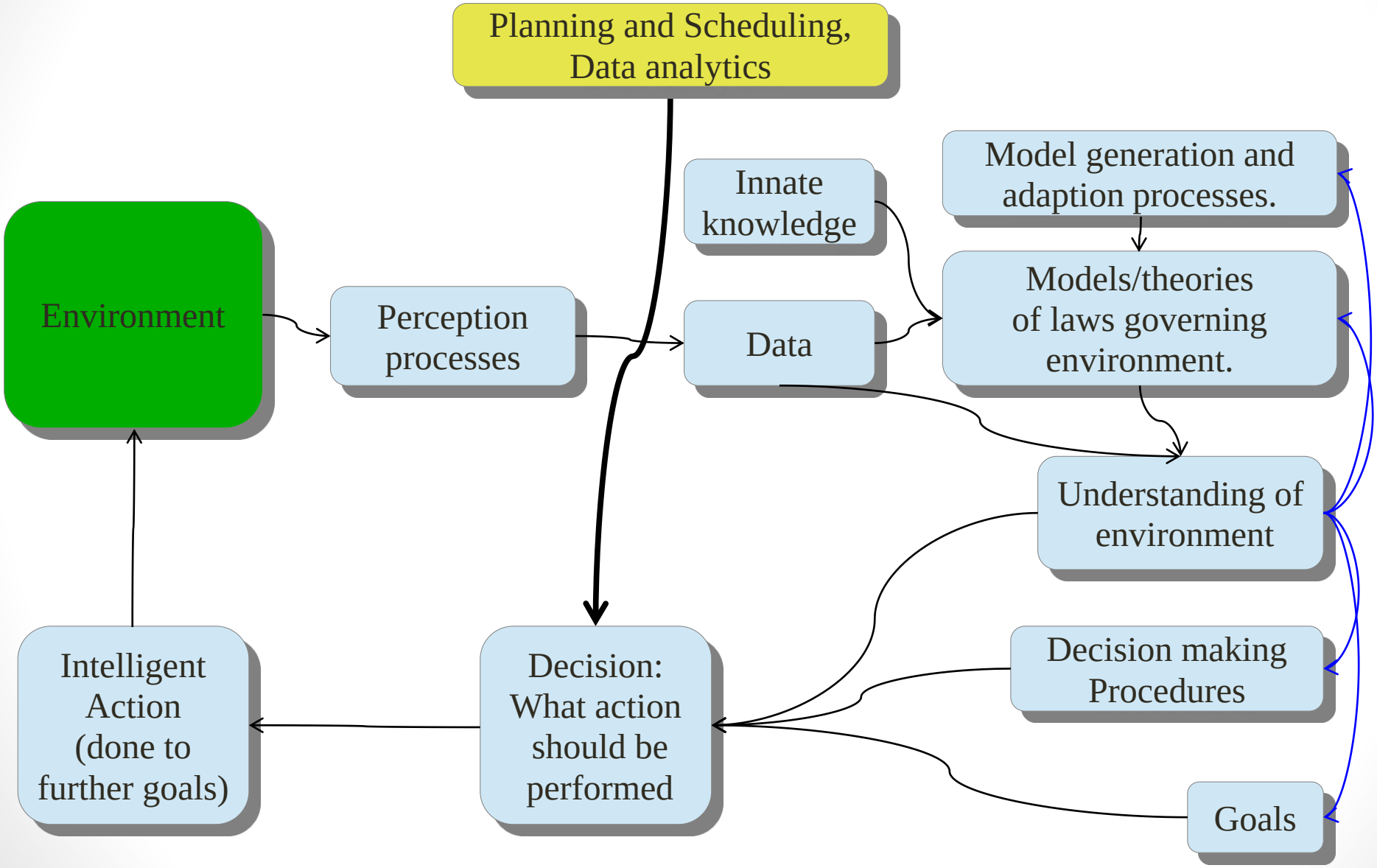

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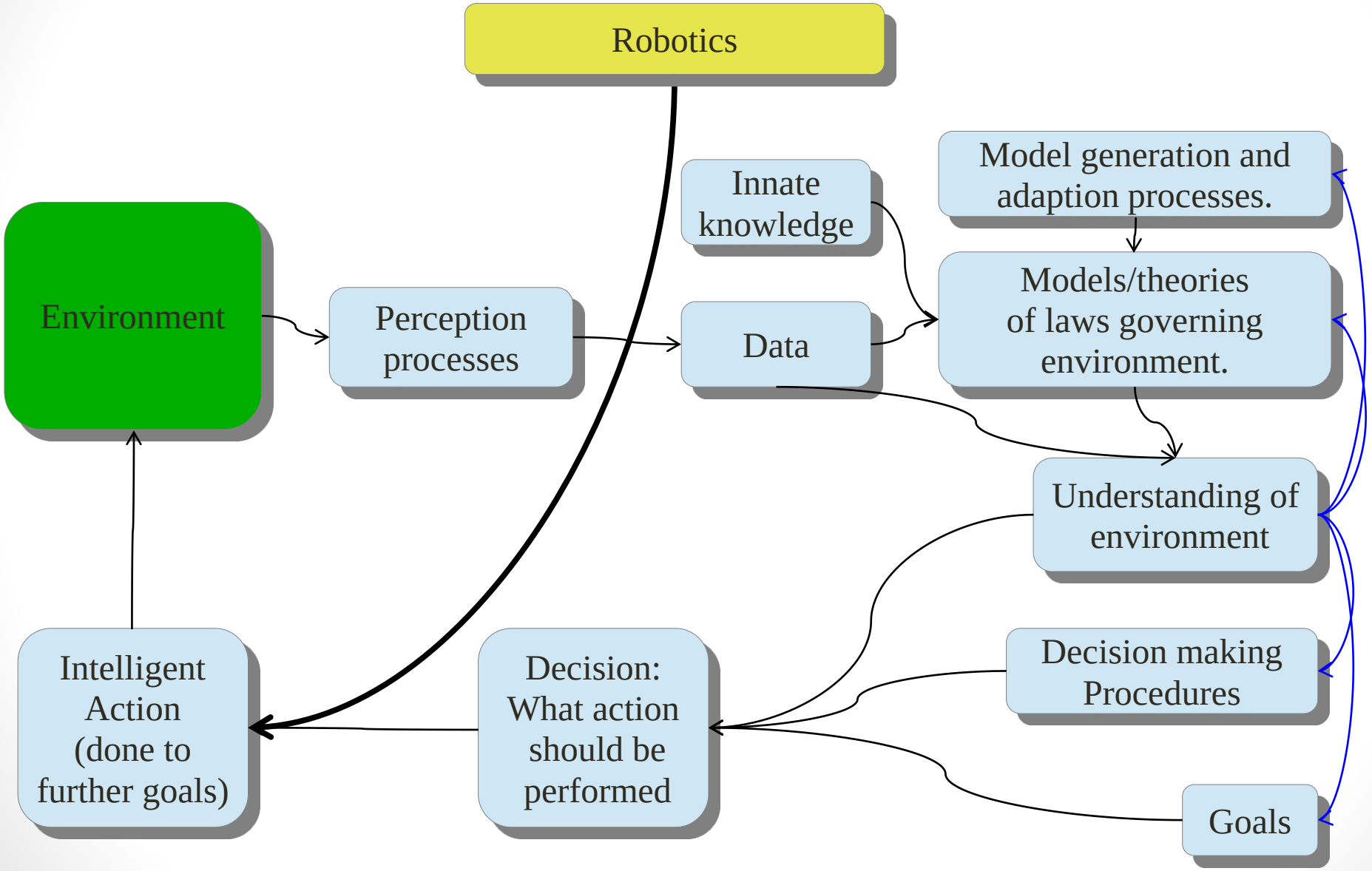
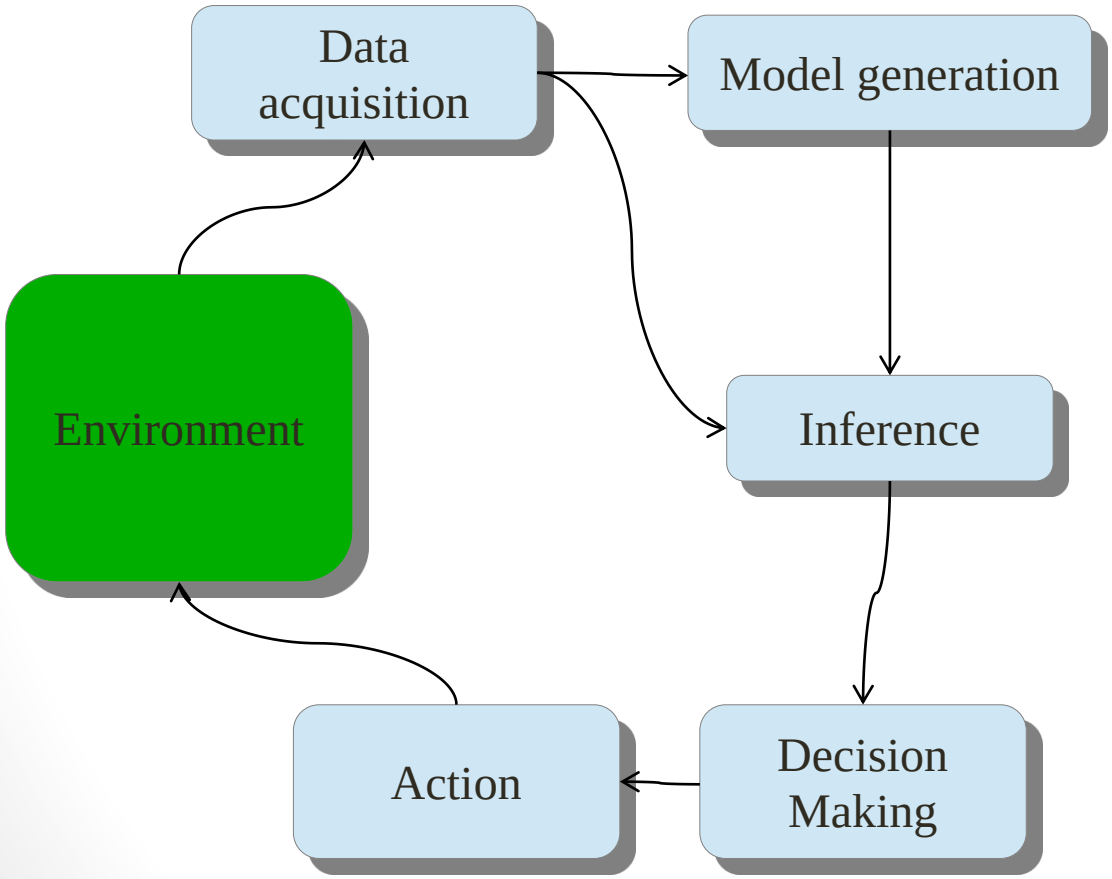


Distinct sub-problems



Often only part of this process is automated.

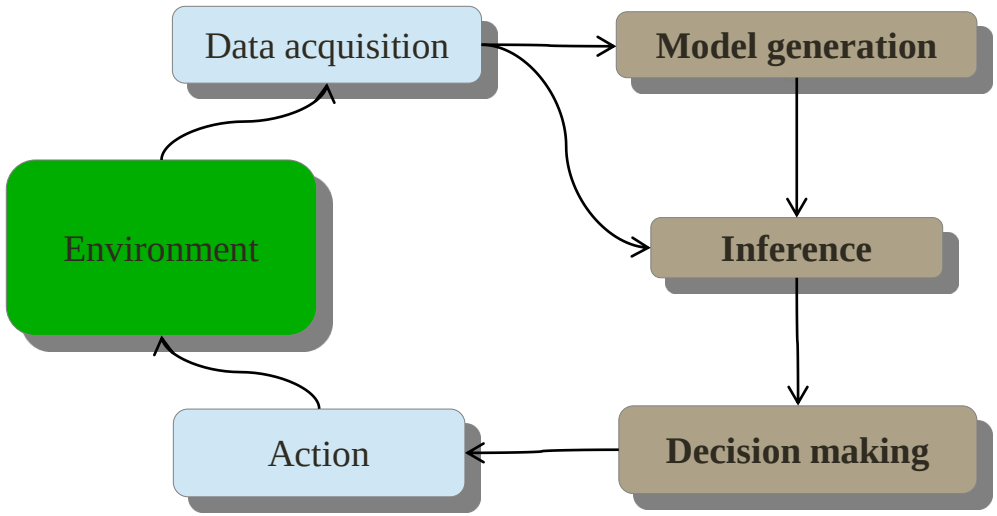
- Humans may collect data and enter it into a database.
- Humans may use automated inference algorithms but then decide what to do on the basis of this information themselves.
- Humans may specify the state of the environment to automatic decision programs.
- Humans may implement the decisions produced.

COURSE OVERVIEW

1. Search

Sub-topics:

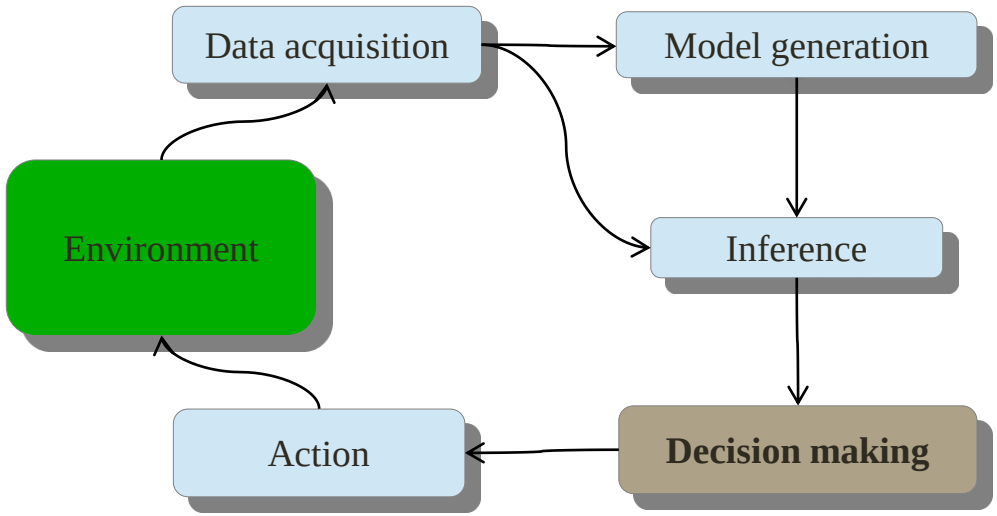
- Basic Search
- Local Search
- Dynamic Programming for Pathfinding
- Heuristic Search
- Minimax Pruning
- Class Exercise I
- Lab Project I



2. Planning and Scheduling

Sub-topics:

- Planning Definition Domain Language
- Partial Ordering and Graph Planning Algorithms
- Scheduling Domain Language
- Scheduling with resource constraints
- Scheduling algorithms
- Class Exercise II

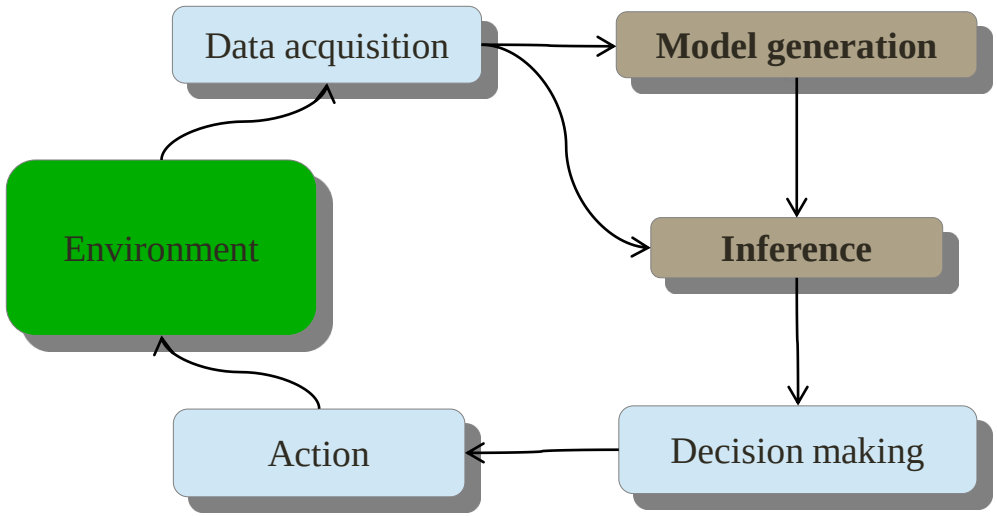


3. Natural Computation

Sub-topics:

- Neural Networks
- Genetic Algorithms
- Swarm Intelligence

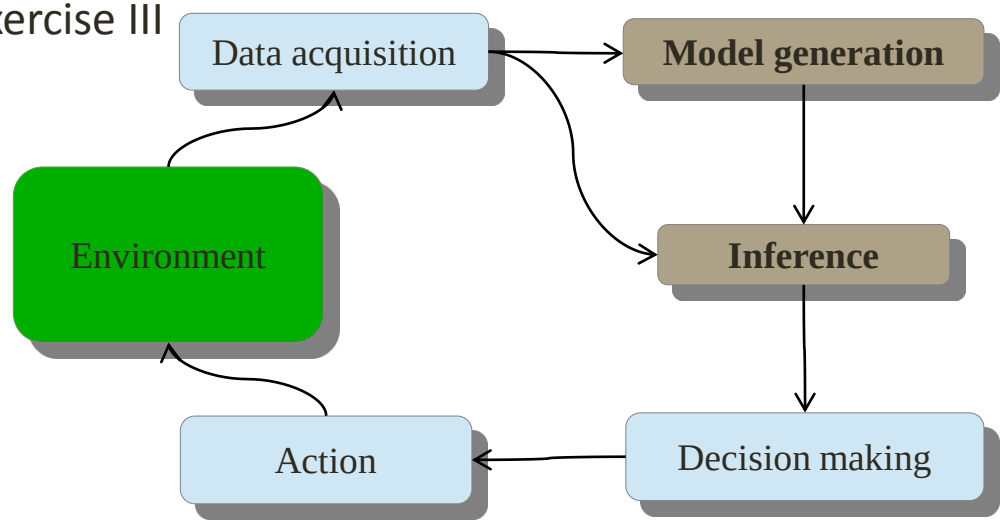
You'll see more of these and other techniques in Machine Learning



4. Dynamic Systems, Graphical Models & Deep Learning

Sub-topics:

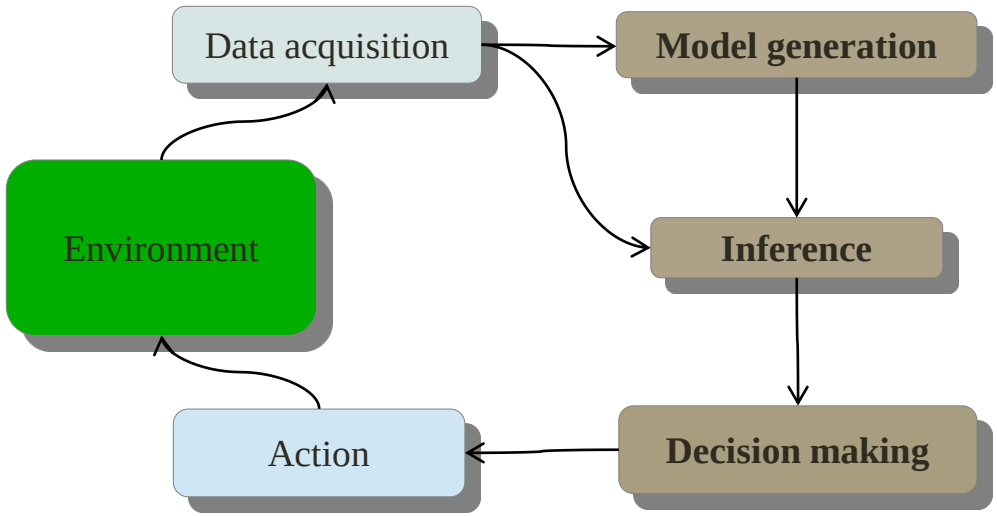
- Markov Chains
- Hidden Markov Models
- Lab Project II
- Markov Fields
- Bayesian Networks
- Restricted Boltzmann Machines
- Deep Belief Networks
- Deep Neural Networks
- Transfer Learning
- Class Exercise III



5. Artificial Intelligence in Computer Games

Sub-topics:

- Simulation (for enjoyment) vs Optimization



6. Natural Language Processing

- TBA

Discussion

- What is AI?
- What has it been?
- What will it be?
- What is its relationship to other academic areas?
- What can AI techniques achieve?
- What can AI techniques not achieve?
- What value are the uses AI techniques can be put to?
- What concerns should we have about the future of AI?