Applications of Artificial Intelligence

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Chapter 4:
Knowledge-Based Systems

4.2: Rule-Based Reasoning

Application from practice: Technical diagnosis

Run time system:

(knowledge-based systems call this **problem solver / inference engine**)

Input:

- Setting certain control inputs
- Observing values depending on this setting

Output:

- A unique instruction how to repair which component

This is where diagnostic systems do *not* *differ !*

Application from practice: Technical diagnosis

Knowledge-based diagnosis:

1) Knowledge acquisition: Input into knowledge base

- rule-based (symptom-based)
- case-based
- model-based

as alternatives

2) Knowledge structure

- depends on knowledge acquisition

3) Knowledge processing be the problem solver

- depends on knowledge structure

This is where diagnostic systems may differ !

1. Symptom-Based Diagnosis

Input to knowledge base:

- Causing and manifest faults for the overall system

- Possible symptoms (measurements)

- Relations between faults and symptoms (rules)

  - Symptoms may confirm a fault or even explain it.

  - Symptoms may exclude a fault.

Structure of knowledge base:

- Semantic network

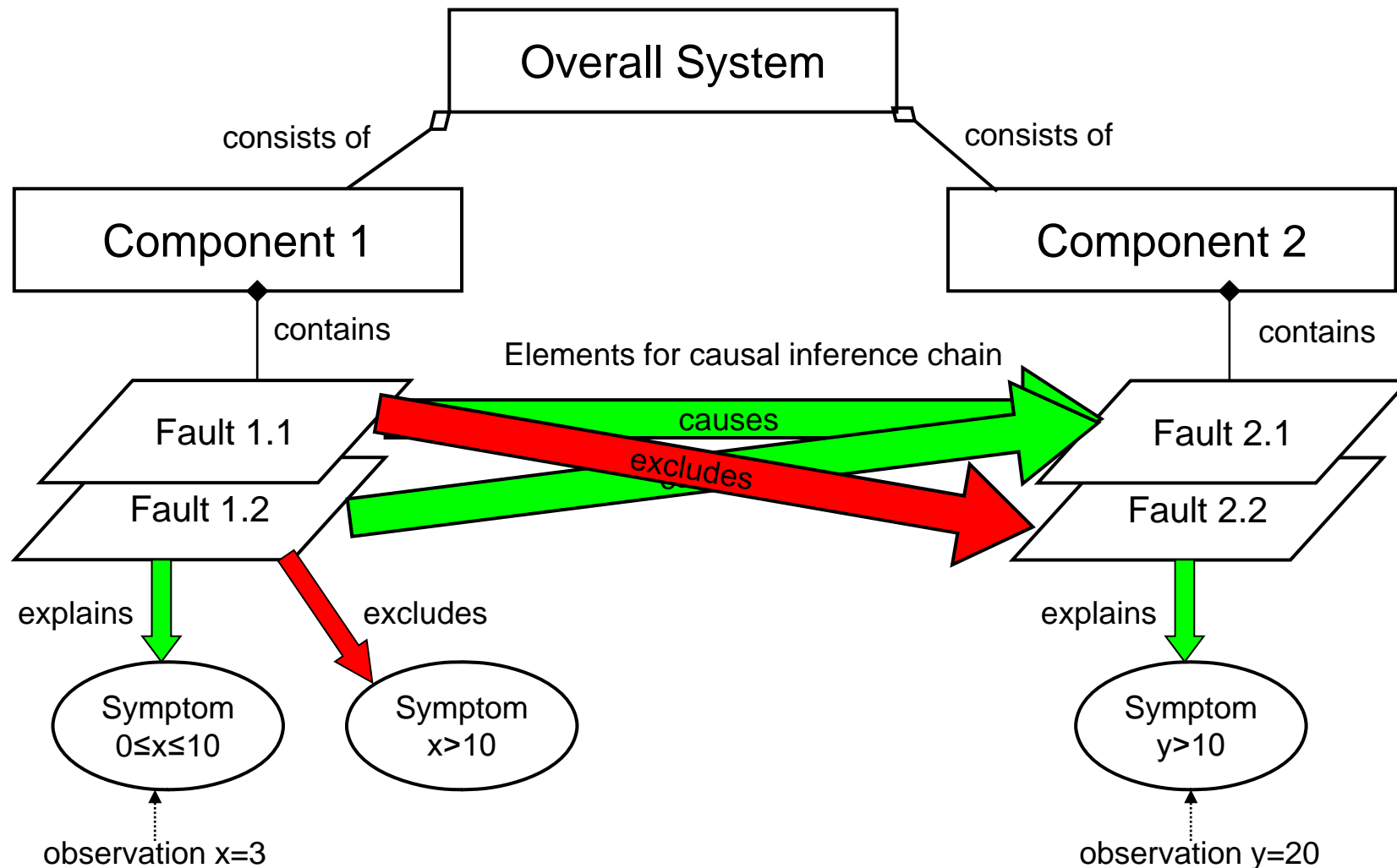- Feasible structures:

  - Fault networks (trees)

  - Decision trees

Task of inference engine:

- Navigation in semantic network
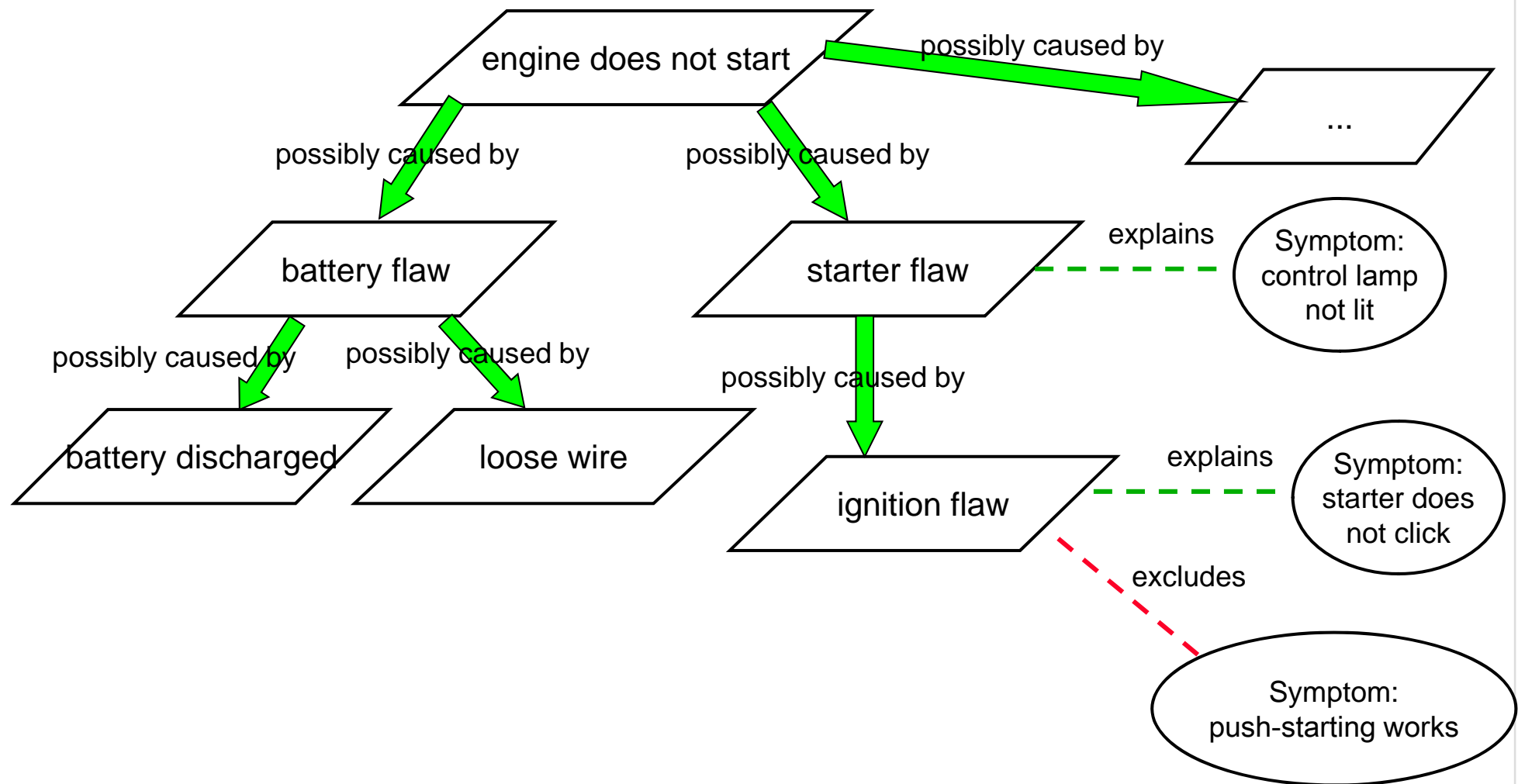
This is „classical" expert system technology

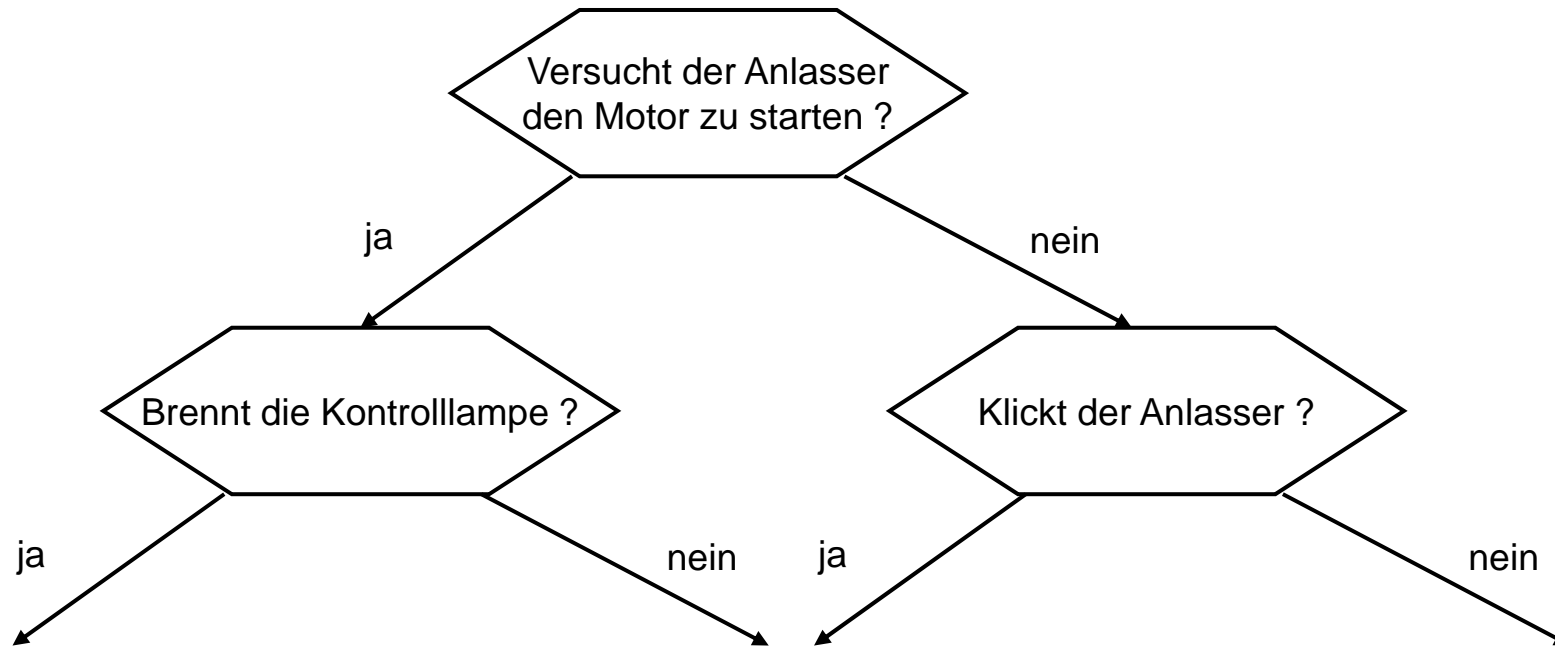# 1. Symptom-Based Diagnosis

Example for elements of the knowledge base:

1. Symptom-Based Diagnosis

Example for a fault tree:

1. Symptom-Based Diagnosis

Example for a decision tree:

1. Symptom-Based Diagnosis

Job of inference engine:

- **Navigation in semantic network**
  (e.g. fault tree or decision tree)

- **Possible start points of navigation:**

  - Suspected faults

  - Observed symptoms

- **Main task is evaluating and firing of rules:**

  - Insert a concluded result of one rule into the antecedent of another rule.

  - Work with probabilities and fuzzy rules.

    Such input must be allowed for knowledge acquisition.

1. Symptom-Based Diagnosis

Advantages and Disadvantages:

- **Knowledge structure complies to terminology of experts.**

  - An expert can easily handle the knowledge acquisition component.

  - Knowledge acquisition costs a lot of time.

- **Knowledge is stored very goal-oriented.**

  - Diagnosis of run time component is fast.

  - Knowledge base may not easily be altered.

  - Reusability is a fundamental problem.

  - There are methods for reusing parts of knowledge though.

1. Symptom-Based Diagnosis

Advantages **und** **Disadvantages:**

- **Knowledge base does not contain deep knowledge.**

  - Every application domain is feasible in principle.

  - Knowledge base is often not complete.

  - Knowledge base is confusing and is thus not easily verifiable.

    A lot of knowledge bases contain faults.