Expert system approach for optimization of fibre production processes

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Overview

- Work in progress
- Invasive plants
  - How can we use them?
- Outline of a potential system for decision support
- Possible solutions
- Critical issues

Goals

- Support paper production from alternative fibres (using invasive plants)

- Development of a multidisciplinary methodology for alternative fibre production with the focus on optimised material and process

- Chance for generalization for other bio-based industrial applications?

Invasive plants

- Invasive plants can have a negative impact on their environment

- Eradication is costly

- Any way for alternative use?
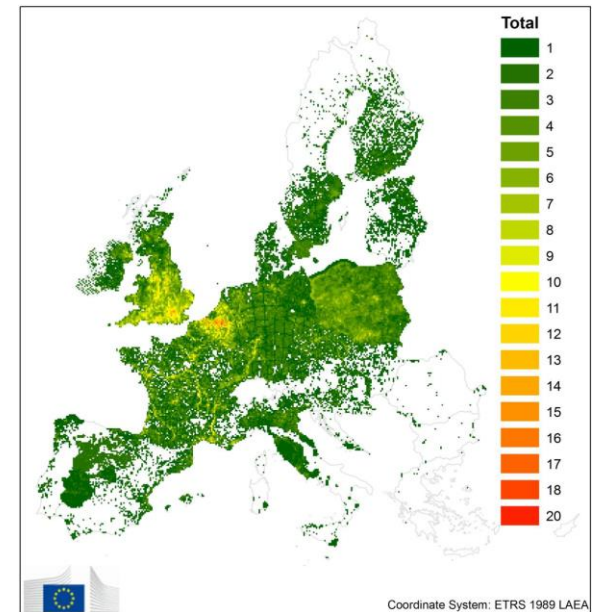
Cumulative number of invasive alien species of Union concern at grid level in EU.
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Invasive plants

- Characterization is important

- Identifying critical properties common to all potential species, e.g.

    – cellulosse content

    – morphology

    – data about harvest

   – ...

Potential uses

- Determining the potential application fields for these plants, e.g.

  – paper production, biomass

- These fields have to be taken into account when identifying the common set of features for the invasive plants

Historical instances

- A database of historical instances also has to be maintained

- Each record contains the characteristics of a given instance, as well as its potential application fields

- Characteristics can also be extended by data measured during the different transformation processes

Process outline

Input Characteristics: I_1, I_2,…I_n

Process Settings: S_1, S_2,…S_n

Output Characteristics: O_1, O_2,…O_n
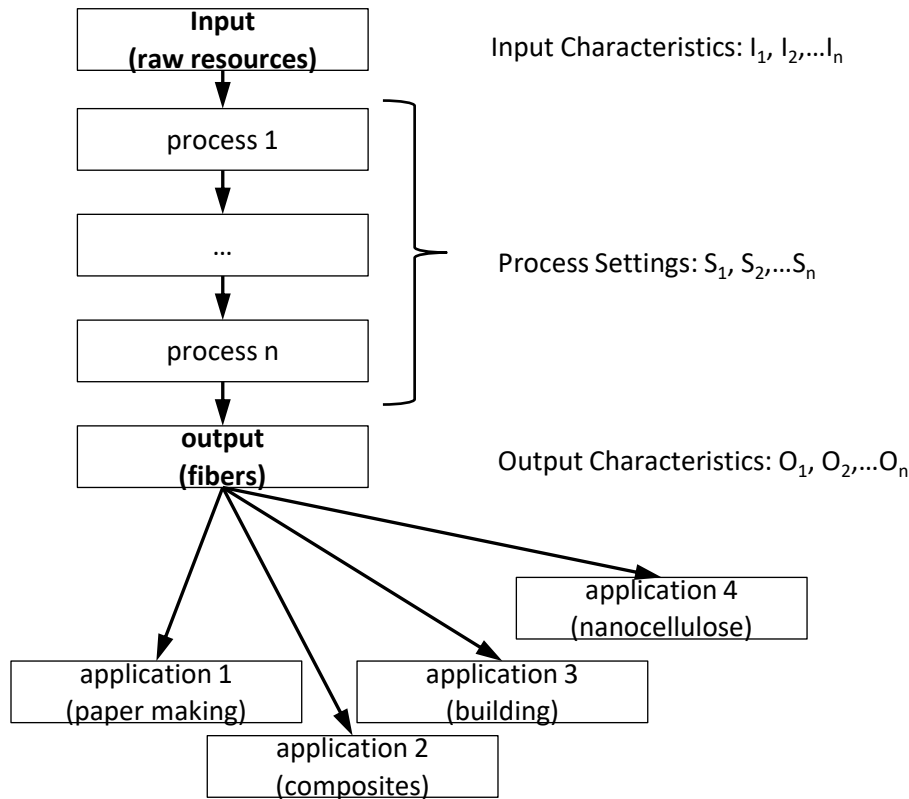
- Known data
  - Characteristics of the input material
  - Possible process settings
- Output characteristics can be predicted
  - This also determines the possible field(s) of application

Expert system for prediction

- The system takes characteristics of one given invasive plant instance

- Cross-references it against the database of collected records

- Predicts the possible application field of the instance in question

Expert system for prediction
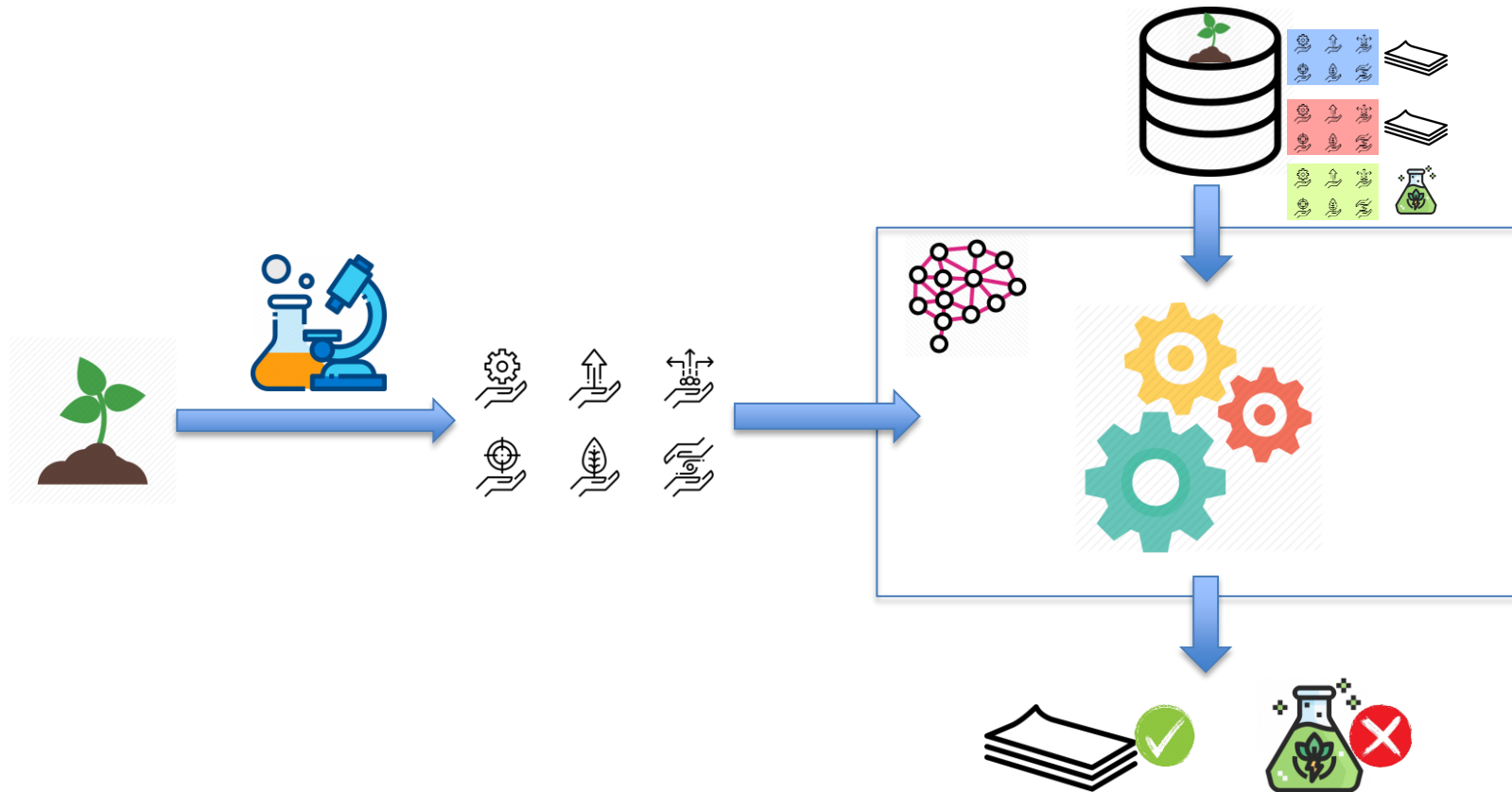
Expert system for prediction

- Different prediction models can be applied
  - Deep Neural Networks are powerful for such tasks
- Historical database as a **training dataset**
- Characteristics of the chosen instance as a **feature vector**
- Potential application fields as **classes**
- Determine for each class if it fits the given feature vector

Critical issues

- Prediction systems need a large training dataset to provide an accurate result

- Hundreds of records should be collected for each possible application

  – If multiple fields are possible at the same time, different combinations of applications should also be examined

Critical issues

- Producing a data record from and instance is time consuming
  - The required transformation steps have to be carried out to determine the possible application field(s)

- Many different characteristics can be measured
  - Hard to find only the most important ones manually
  - Feature selection has to be carried out on the dataset

Conclusions

- The outline of an expert system

- Can provide decision support if a given batch of invasive plants should be harvested and processed, or not

- A large amount of data is needed for it to function

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Thank you for your attention and time!