A Short History of Configuration Technologies

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Contents

• Rule-based Configurators
• Early model-based Configurators
• Mainstream Configuration Environments
• Mass Customization Toolkits
Rule-based Configurators (1)

- **Weak Artificial Intelligence („Weak AI“)**
  - Narrow-sense interpretation of AI: support of specific problem solving tasks such as „configuration“.

- In the line of weak AI many expert systems were built in the 1970‘s.

- **Examples:**
  - R1/XCON (computer configurator for DEC VAX systems)
  - VT (vertical transportation for Westinghouse Elevator Company)

- **Structure of a rule:**
  - IF <condition> THEN <action>
Rule-based Configurators (2)

ASSIGN-POWER-SUPPLY-1

IF: THE MOST CURRENT ACTIVE CONTEXT IS ASSIGNING A POWERSUPPLY
AND AN SBIMODULE OF ANY TYPE HAS BEEN PUT IN A CABINET
AND THE POSITION IT OCCUPIES IN THE CABINET IS KNOWN
AND THERE IS SPACE IN THE CABINET FOR A POWER SUPPLY
AND THERE IS NO AVAILABLE POWER SUPPLY
AND THE VOLTAGE AND FREQUENCY OF THE COMPONENTS IS KNOWN

THEN: FIND A POWER SUPPLY OF THAT VOLTAGE AND FREQUENCY
AND ADD IT TO THE ORDER

• Example of a rule in R1/XCON configurator
  • Condition part: current configuration context
  • Action part: actions to extend the current configuration
Rule-based Configurators (3)

• Problem of rule-based knowledge representations
  • Intermingling between domain and problem solving knowledge
  • Outcome of a configuration process depends on rule ordering

• Model-based knowledge representations
  • Clear separation between domain and problem solving knowledge
  • For example: \( x > y \) defines a constraint but does not include directives how to instantiate \( x \) and \( y \).

• Example of rule-based vs. model-based representations
  • \( x > y \) (\( x, y \) in \([1..10]\)) (model-based)
  • IF \( x = 10 \) THEN \( y = 9 \) (rule-based)
Early Model-based Configurators

- **Model-based Configuration**
  - Domain knowledge and problem solving knowledge is separated
  - Domain knowledge = the model
  - Changes in the domain knowledge do not effect the problem solving knowledge and vice-versa.

- **Knowledge Representations**
  - Constraint Satisfaction (CSPs) [Lauriere, 1978; Mackworth, 1977]
  - First component-oriented knowledge representations

- **Example Systems**
  - COSSACK, COCOS, Beologic, Trilogy, Selectica, Cameleon, SAP
Mainstream Configuration Environments (1)

- Component-oriented
- Development & test environments
- ERP integration
- Often: support of generative configuration functionalities (= generation of components on-demand) [Fleischanderl et al., 1998; Stumptner et al., 1998]

- Example Systems
  - Tacton, ConfigIT, EngCon, ILOG, SAP, BAAN, ORACLE
Mainstream Configuration Environments (2)

• Challenge: increasing size and complexity of configuration models

• In interactive settings the response time should be below 1 sec. [Card et al., 1991]

• Knowledge compilation
  • Binary decision diagrams (BDDs) [Andersen et al., 2010]
  • Solution automata [Amilhastre et al., 2002]

• Divide & Conquer based algorithms
  • Conflict detection [Junker 2004]
  • Diagnosis [Felfernig et al. 2012]

• Intelligent Testing & Debugging [Felfernig et al., 2004]
Mass Customization Toolkits

- Mass Customization toolkits ≈ Configurators
- Personalization functionalities [Cöster et al., 2002; Ardissono et al., 2003; Tiihonen and Felfernig, 2010]
- Integration of „Open Innovation“ paradigm [Chesbrough, 2003]
  - Strategic exploitation of external resources for the improvement of the innovation potential of a company
  - Open Configuration: new product/component ideas can be directly entered by customers
  - Example: cooperative development of computer games [Piller et al. (2004)]
Further Configuration Approaches

- Resource-based configuration [Heinrich & Jüngst, 1991]
- Functional configuration approaches [Stein, 1995]
- Description logic based configuration [McGuinness and Wright, 1998]
- Overviews: Forza and Salvador (2002); Günter and Kühn (1999); Jannach et al. (2007); Sabin and Weigel (1998); Soininen et al. (1998); Stumptner (1997)
Summary

• From initial applications as rule-based expert systems,

• Via early model-based configurators, which allow a clear separation of domain knowledge and problem-solving knowledge,

• To mainstream model-based configuration environments integrated in supply chains and ERP systems,

• And mass customization toolkits.
Thank You!
References (1)


References (2)


References (3)


References (4)


References (5)


References (6)


References (7)


References (8)


References (9)


References (10)


References (11)


References (12)


References (13)


References (14)


References (15)


References (17)


