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# **Software Automation & Knowledge Engineering**

Research Broadcast  
(June 9, 2004)

Dirk Deridder, Johan Brichau, Thomas Cleenewerck, Peter Plessers



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## → Software Automation

*Bringing the development of Interactive Media in reach of media producers and within the constraints of media productions.*

## Knowledge Engineering

*The ability to handle evolution of knowledge (using ontologies) and to manage the consequences of these evolutions*



# Interactivity in Media

## Online Games



## Virtual Communities

Hoi daar!

Welkom in Kid City ! We heben deze week hoog bezoek. Harry Potter is te gast bij Mike met zijn derde film en de meiden van K3 zitten op schoot bij CJ te luisteren naar hun nieuwe cd. Alsjeblieft! Dankuwel!

Maar dat is natuurlijk niet alles. Fonkelnieuw is ook de fotoreportage in de weetkeet, de quiz in de bank en het leesvoer in de bieb.

Roland de burgemeester

## Interactive TV-Quiz

**BLOKKEN**

vraag 2  
juist 0/1

Wat is een 'dragonder'?

- een cavaleriesoldaat
- een speerlijplant
- een meteorenzwerm

**BLOKKEN**



# Interactive Media

## 'Classic' Media

- **Content** Management
- Media Production



## Interactive Media

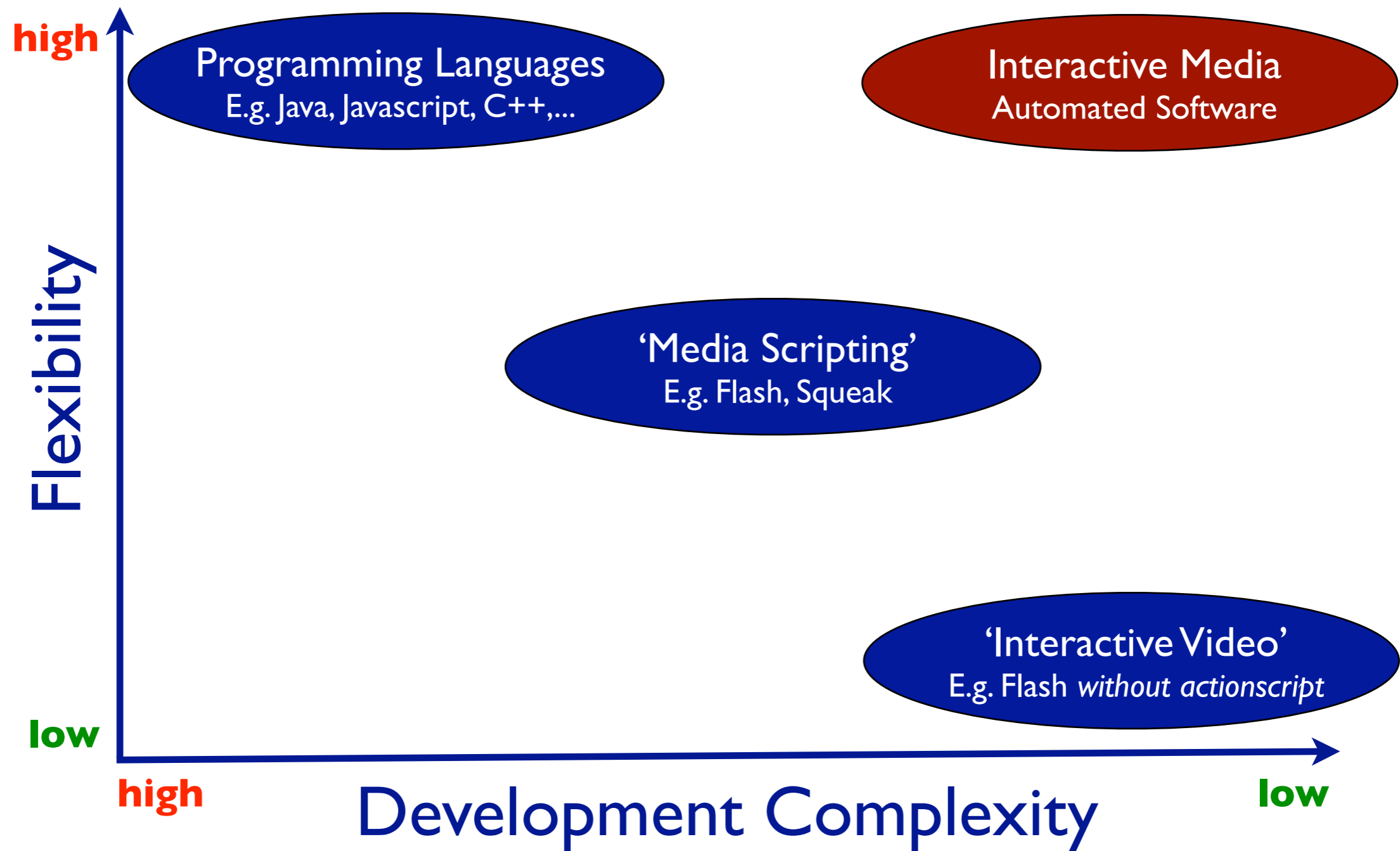
- **Behaviour** Management
- Software Development



- Extremely **Strict Deadlines**
  - Broadcast time
- Extremely **Short Time-to-Market**
  - Software is an enabler, not a product
- Extreme **Flexibility & Adaptability**
  - Software must allow rapid and last-minute changes
- Extreme **Deployment**
  - Multi channel / Multi platform



# Software Development for IM



Programmer

Media Producer

# Software Automation for IM

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“We want to create Interactive TV-Quizzes”

Media Producer

Programmer

Specification of a Quiz

“Here is a language to describe your TV-Quizzes”

Quiz-Description Language

Generates

- Ok • Extremely **Strict Deadlines**
- Ok • Extremely **Short Time-to-Market**
- Ok • Extreme **Flexibility & Adaptability**
- Ok • Extreme **Deployment**

Media Consumer



# Automated Software Engineering

## Domain Specific Languages

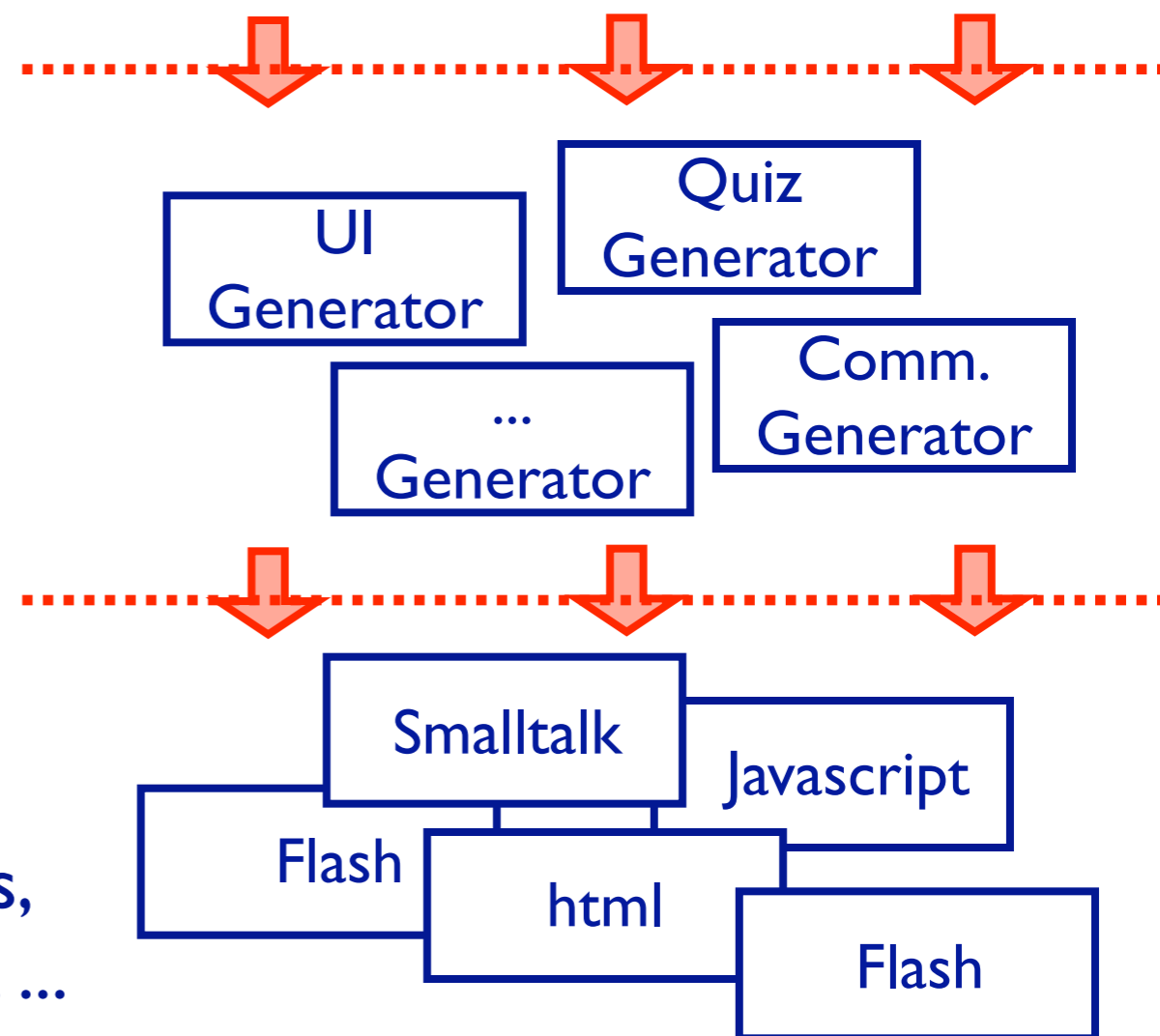
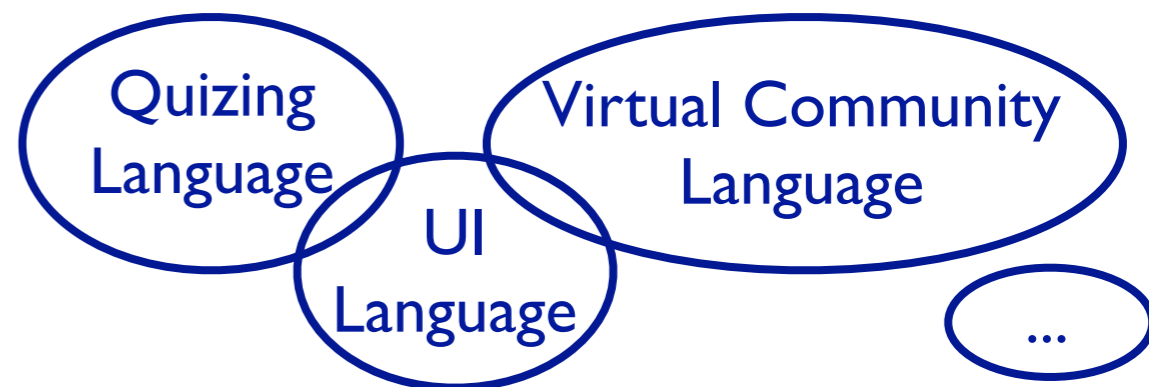
- 'Programming' Languages that can be used by Domain Experts

## Generative Programming

- Transformations, Generators, Metaprogramming, ...

## Programming Languages

- Object-Orientation, Components, Aspect-Orientation, Frameworks, ...



**But ...**



# Software Automation for IM

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“The QDL is no longer sufficient for my Quizzes”

Media Producer

Programmer

...  
**what about  
Evolvability  
&  
Reusability ?**

Evolution of

- Quiz DSL
- Generators
- ...

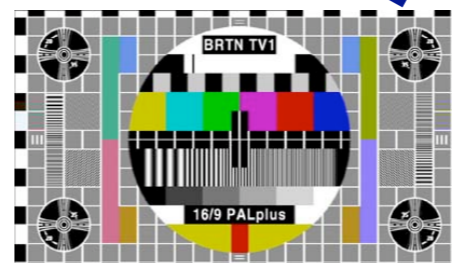
Long Development Cycle

- Impact Analysis
- Code Comprehension
- ...

~~Quiz-Description Language~~

~~Generates~~

Media Consumer



So ...



# Ongoing PROG Research

- **A Concept-Centric Approach to Software Evolution**
  - Manage / tackle the evolution of the interactivity component starting from the domain knowledge possessed by the media producer (D. Deridder)
- **Composable Program Generators**
  - Reuse, evolve and compose the generators responsible for creating the behavioural component of interactive media (J. Brichau)
- **Evolution of Domain Specific Language Implementations**
  - Overcome the complexity of evolving and reusing a DSL implementation for interactive media software creation (T. Cleenewerck)
- **A Declarative Meta Programming Approach for GUI Concern Separation**
  - Enable multi channel / multi platform software publication of interactive media by factoring out crosscutting and entangled UI concerns (S. Goderis)
- **Progressive Application Streaming for Software Broadcasting**
  - Broadcast the interactive media software to millions of users and get it up-and-running as soon as possible? (C. Devalez)



# Contents

## Software Automation

*Bringing the development of Interactive Media in reach of media producers and within the constraints of media productions.*

## → Knowledge Engineering

*The ability to handle evolution of knowledge (using ontologies) and to manage the consequences of these evolutions*



# Context

- Content Management System
  - Annotation of Media Items with Metadata
  - Annotations are grounded in an Ontology
    - cf Terminology in VRT Thesaurus
  - Support for Advanced Knowledgeable Queries
- Focus on Ontology Evolution
  - How can we Evolve the Annotations?
  - How can we Evolve the Metadata?



# Ontology Evolution : Why?

- To reflect changes in the real world
  - e.g. Admission of new EU countries
- Changes in the user's requirements
  - e.g. New types of queries
- Flaws in the initial design
  - e.g. Changes in concept hierarchy
- To 'refactor' the existing ontology



# Situation after MPEG Project

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Media Library



Ontology

Instance Level

“Guy Verhofstadt”

is-a

Concept Level

Party Leader



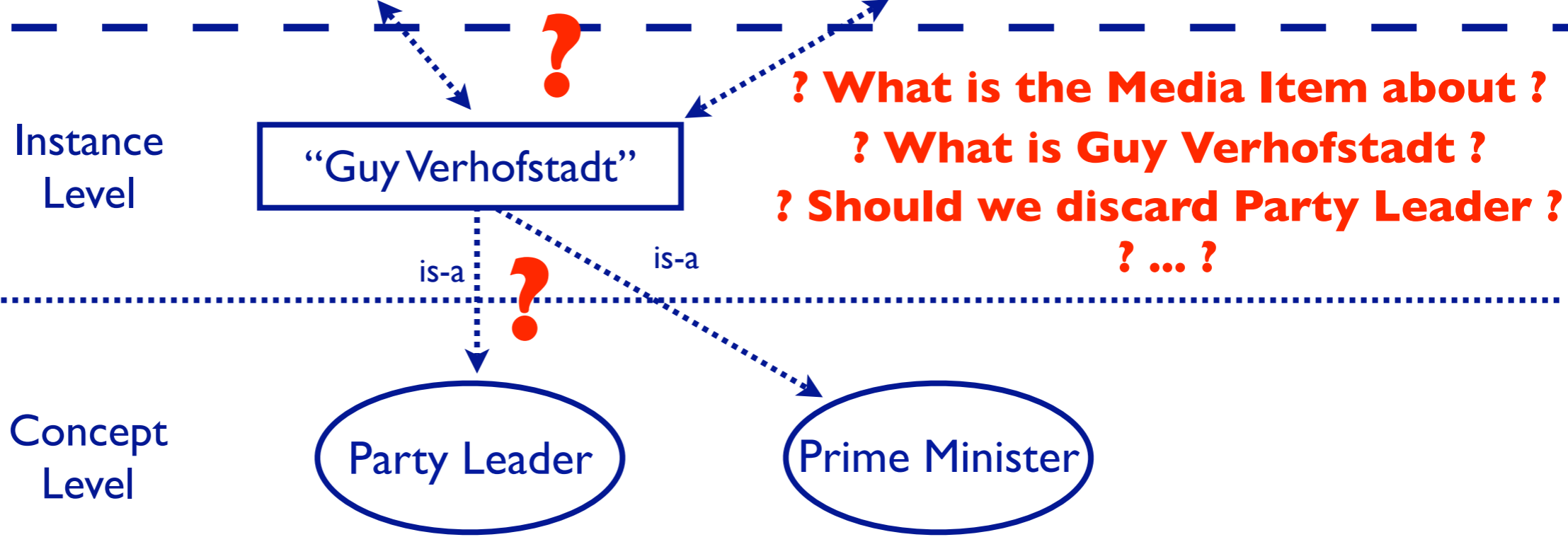
# Verhofstadt has 'Evolved'

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Media Library



Ontology



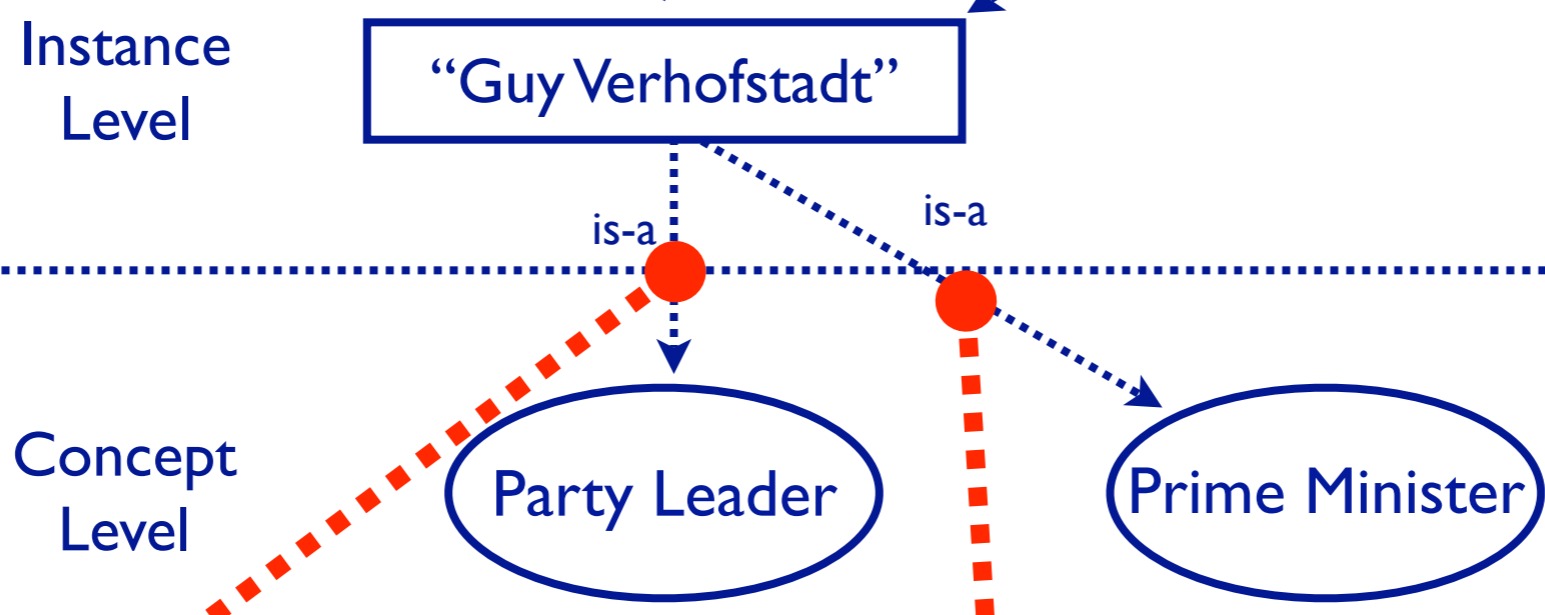
# Introducing Temporal Aspect

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Media Library



Ontology



[somewhere in 80ies]

[12/07/1999 ...]

t



# Adapting Media Annotations

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Media Library



Ontology

Instance Level

“Guy Verhofstadt”

Concept Level

Party Leader

Prime Minister

**Media Items of Belgian Prime Ministers between 1970 and 1975?**

**Media Items for Guy Verhofstadt before he became Prime Minister?**

[somewhere in 80ies]

[12/07/1999 ...]

t





# Evolution of Ontology Concepts

Besides evolution of instances:  
evolution of ontology concepts

Merge Concepts	Replace several concepts with one and aggregate all instances
Extract Subconcepts	Split a concept into several subconcepts and distribute properties among them
Pull up properties	Move properties from a subconcept to a superconcept
Move properties	Move properties from one concept to another concept
...	...



# Ontology Evolution : Consequences

- Intra-Ontology Dependencies
  - Consistency of concepts inside the ontology
- Inter-Ontology Dependencies
  - Consistency between network of ontologies
- Ontology-Committer Dependencies
  - Impact on Applications (e.g. annotations)



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# SAKE

<http://www.xmt.be/>

<http://prog.vub.ac.be/>

<http://wise.vub.ac.be/>

