COMP62342

Sean Bechhofer

sean.bechhofer@manchester.ac.uk

Uli Sattler

ulrike.sattler@manchester.ac.uk

What have we learnt?

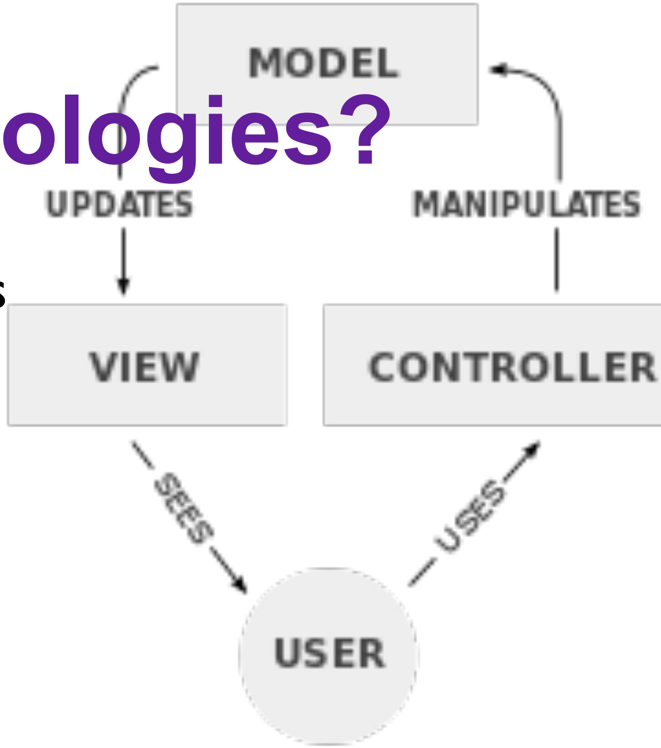
- Intro to Knowledge Representation
  - Why do this?
- Knowledge Acquisition
  - What do we model?
- Formalisation, Ontology Patterns
  - How to represent things (in OWL)?
- Semantics and Reasoning
  - Models, entailments, tableau
  - What exactly is it we are saying and what are the consequences?
- OWL API
  - Using ontologies in applications.
- SKOS
  - An alternative to OWL using OWL
- Linked Data
  - Using OWL or RDF(S) for data on the Web
- …next & last: OBISs

What do we do with ontologies?

E.g., Ontology-Based MCQ Generation

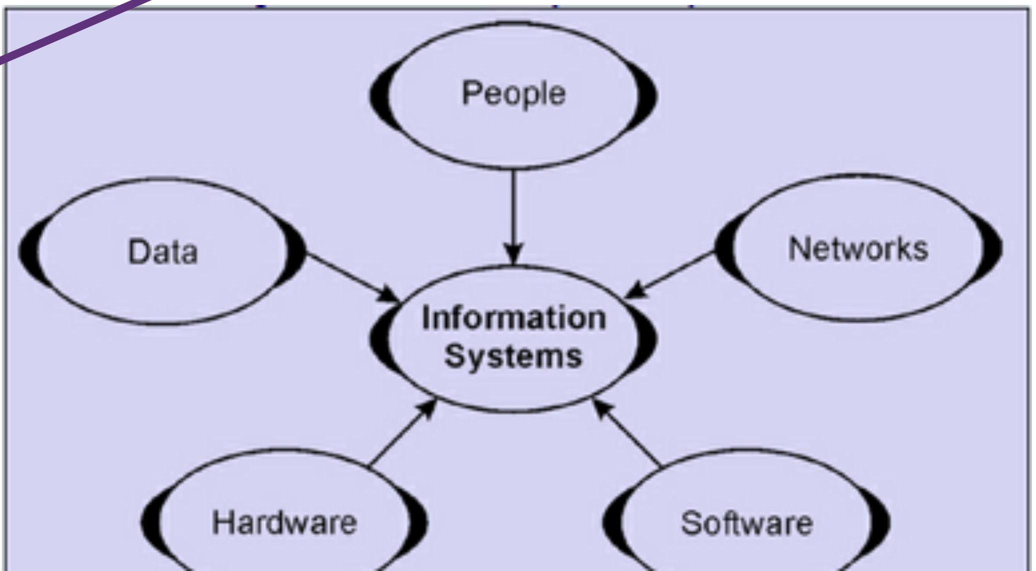
- Given that
  - ontology captures rich domain knowledge
  - assessment/MCQ generation is costly & relevant
  - in particular for healthcare & medicine
- why not auto-generate MCQs from ontologies?
- Building on research we have done so far,
  - in particular on how to make **good** MCQs,
    e.g., control difficulty
- we are now exploring this further with **Elsevier**
  - towards more complex MCQs, e.g., patient cases
- interesting new app with new reasoning problems
  - similarity of concepts and cases

What do we do with ontologies?

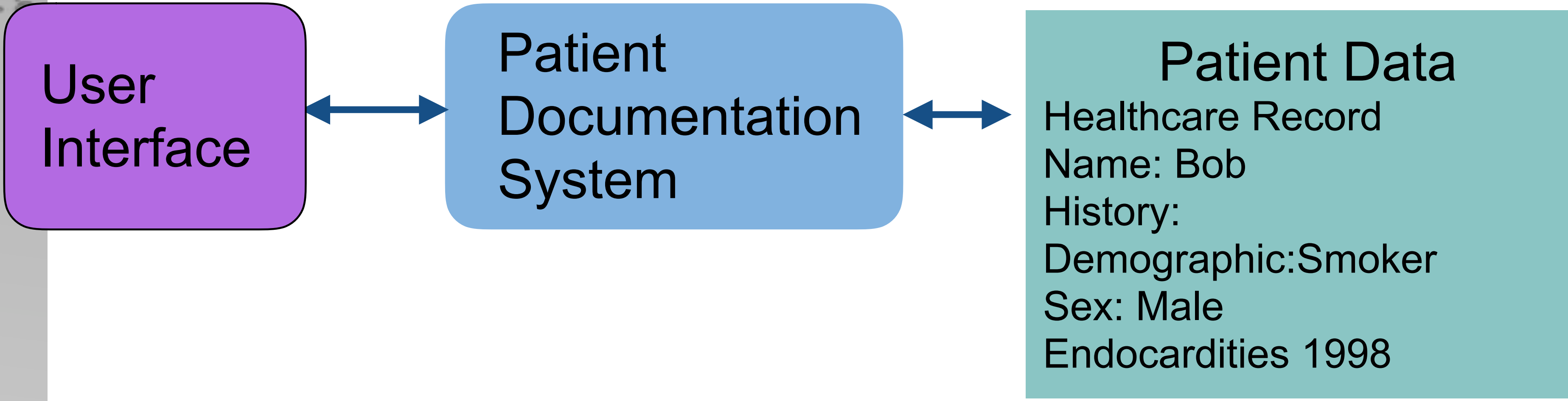


- OBIS: Ontology-Based Information Systems
- Think MVC/Front-End Back-End
- IS needs to store some data, in:
  - relational database
  - no-SQL database
  - files
  - XML docs
  - …
  - Ontology

Which?



E.g.: Patient Documentation System



User Interface

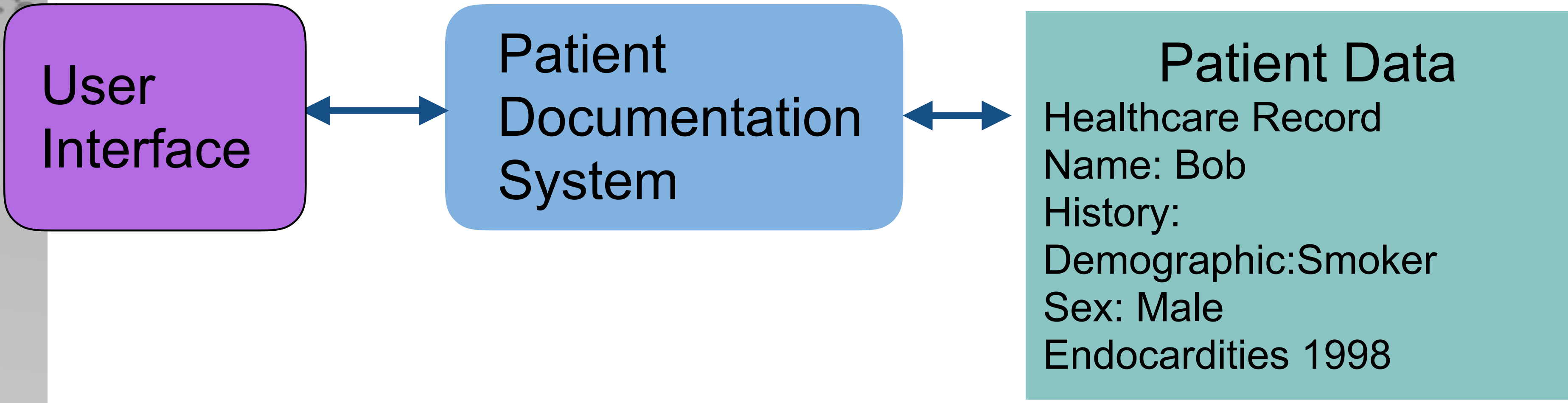
Patient Documentation System

Patient Data

Healthcare Record
Name: Bob
History:
Demographic:Smoker
Sex: Male
Endocardities 1998

- Information System relies on Patient Data
  - recorded in different systems with possibly different structures
  - recorded by different clinicians with different styles
- Holding Data in DB:
  - many complex queries that need to change with changes in medicin

E.g.: Patient Documentation System



User Interface

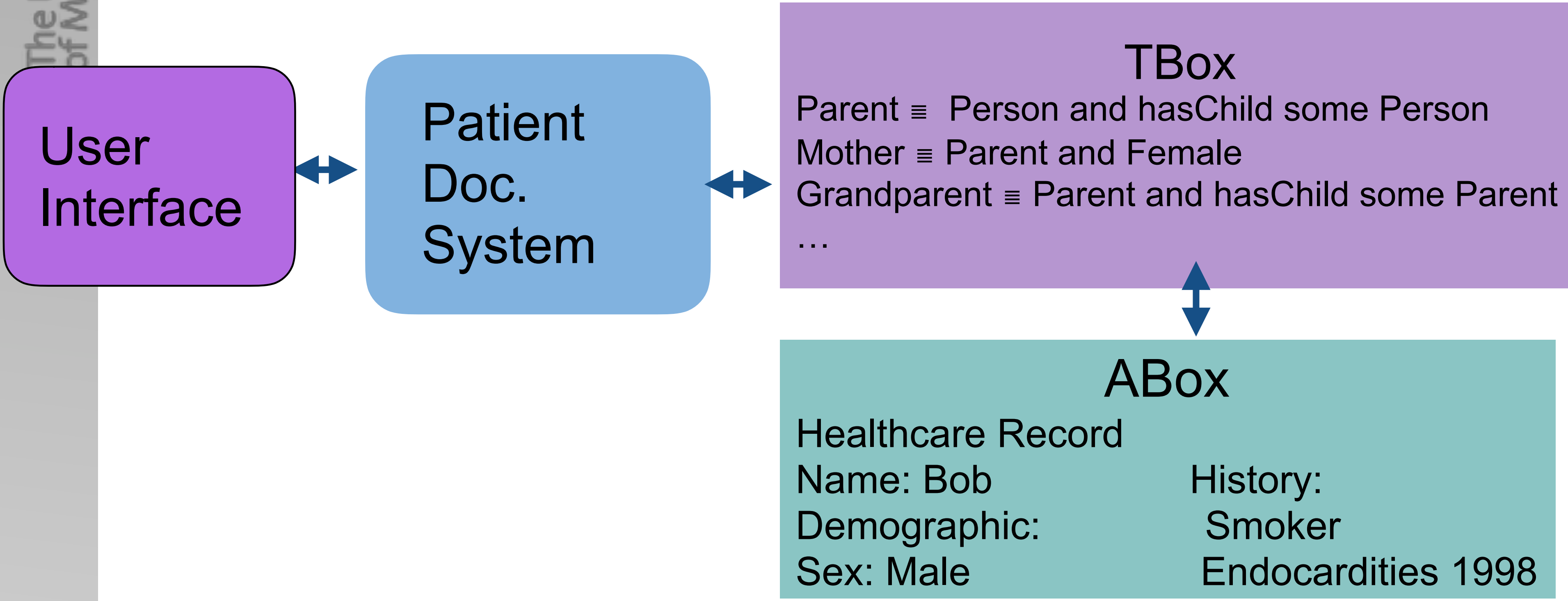
Patient Documentation System

Patient Data

Healthcare Record
Name: Bob
History:
Demographic:Smoker
Sex: Male
Endocardities 1998

- Toy example: get all *Parents* from database - get
  - those who have a *known child*
  - those described as *Mother* or *Father*
  - those described as *Grandmother* or *Grandfather*
  - …

Why basing ISs on Ontologies?



User Interface

Patient Doc. System

TBox

Parent ≡ Person and hasChild some Person
Mother ≡ Parent and Female
Grandparent ≡ Parent and hasChild some Parent
…

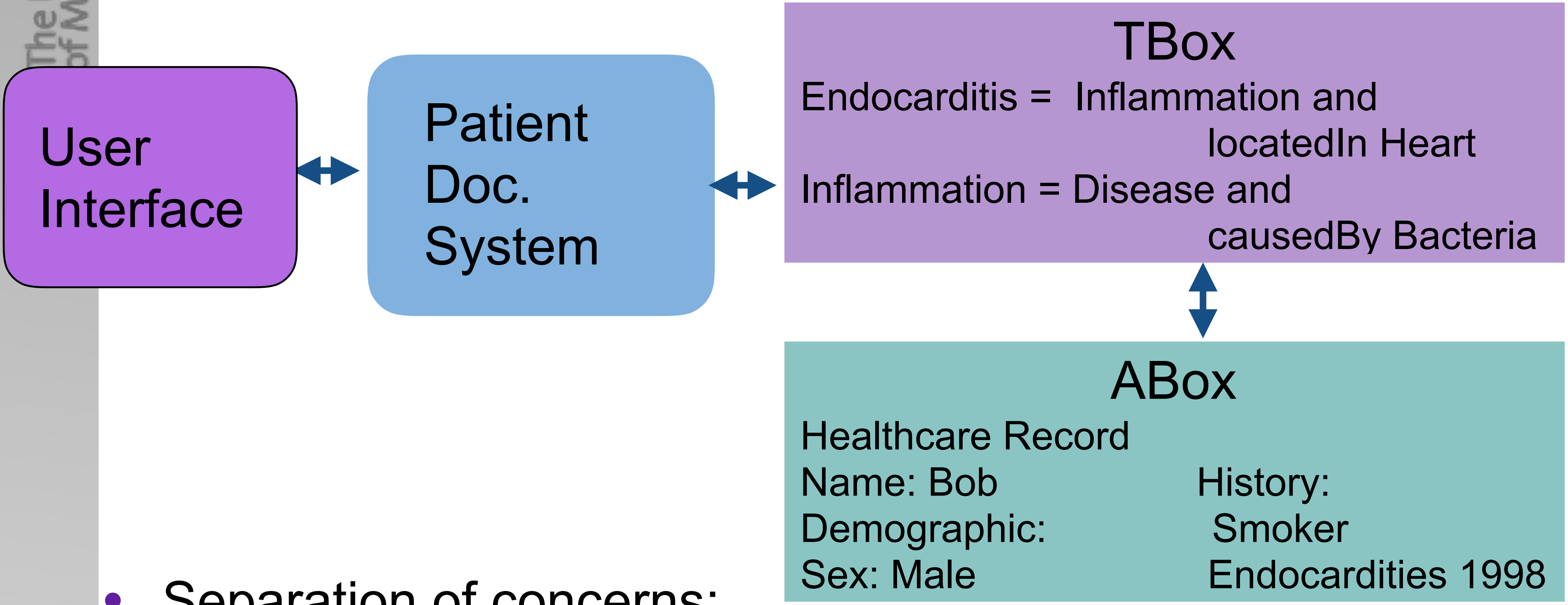
ABox

Healthcare Record
Name: Bob
Demographic:
Sex: Male

History:
Smoker
Endocardities 1998

- Toy example: get all *Parents* from ontology:
  - use suitable TBox and
  - retrieve all those who are **entailed** to be an instance of *Parent*
  - …

Why basing ISs on Ontologies?



User Interface

Patient Doc. System

TBox

Endocarditis = Inflammation and locatedIn Heart

Inflammation = Disease and causedBy Bacteria

ABox

Healthcare Record

Name: Bob

Demographic:

Sex: Male

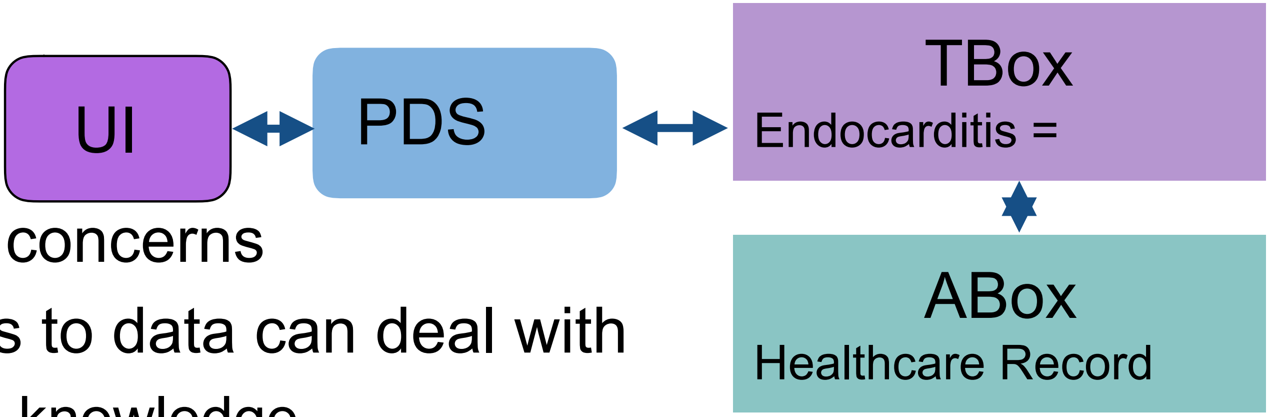
History:

Smoker

Endocardities 1998

- Separation of concerns:
  - background knowledge & terminology into ontology
  - data into DB or ABox
    - suitably linked/mapped
  - behaviour into program code

Why basing ISs on Ontologies?



- Separation of concerns

✓ flexible access to data can deal with

  - **incomplete** knowledge
  - data coded in different ways
  - complex expressions: post-coordination!
  - data coded & queries on varying levels of granularity

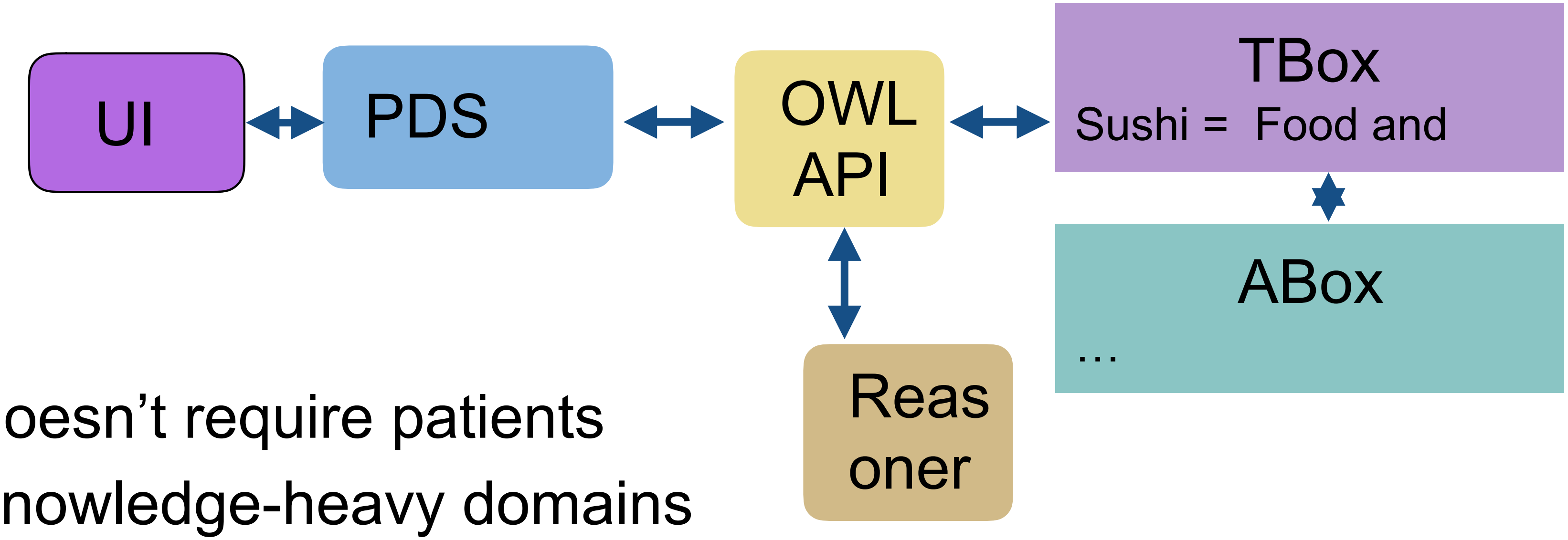
✓ via terms as appropriate to IS

  - same data can be linked to different ontologies

✓ maintainable

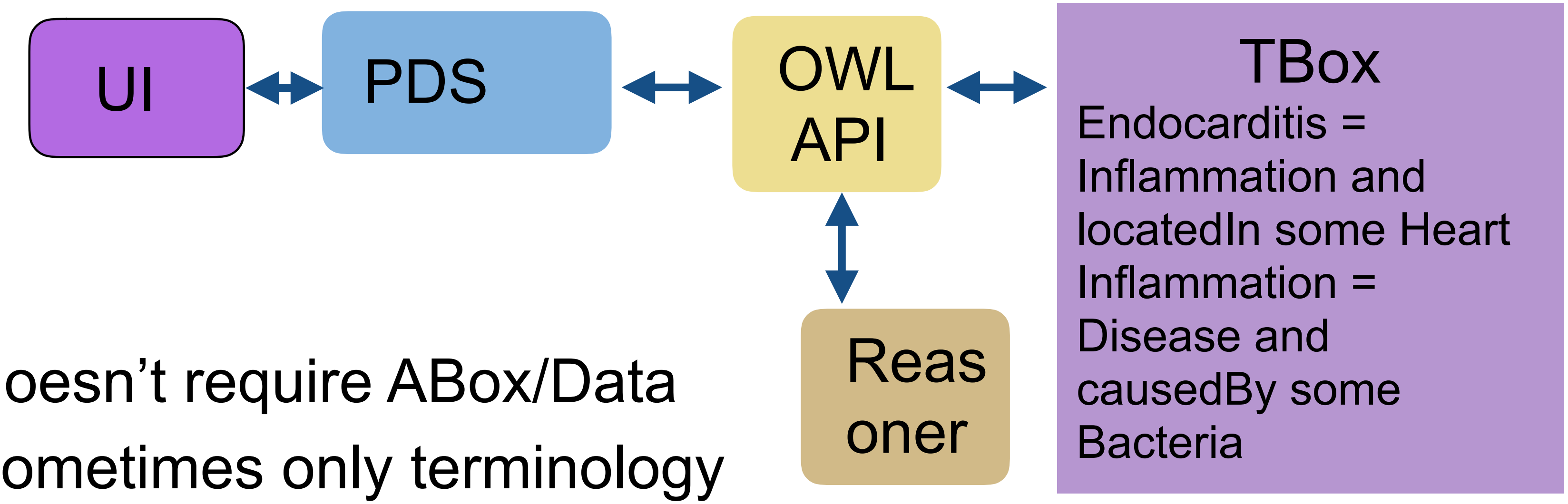
  - changes in background knowledge reflected in updated ontology

Ontology-Based ISs



- doesn’t require patients
- knowledge-heavy domains
- domains where knowledge changes
- Example:
  - restaurants & food properties: allergies, ethical,…
  - biochemistry
  - defence, intelligence
  - (nano) engineering
  - recruitment/skills management (later more)

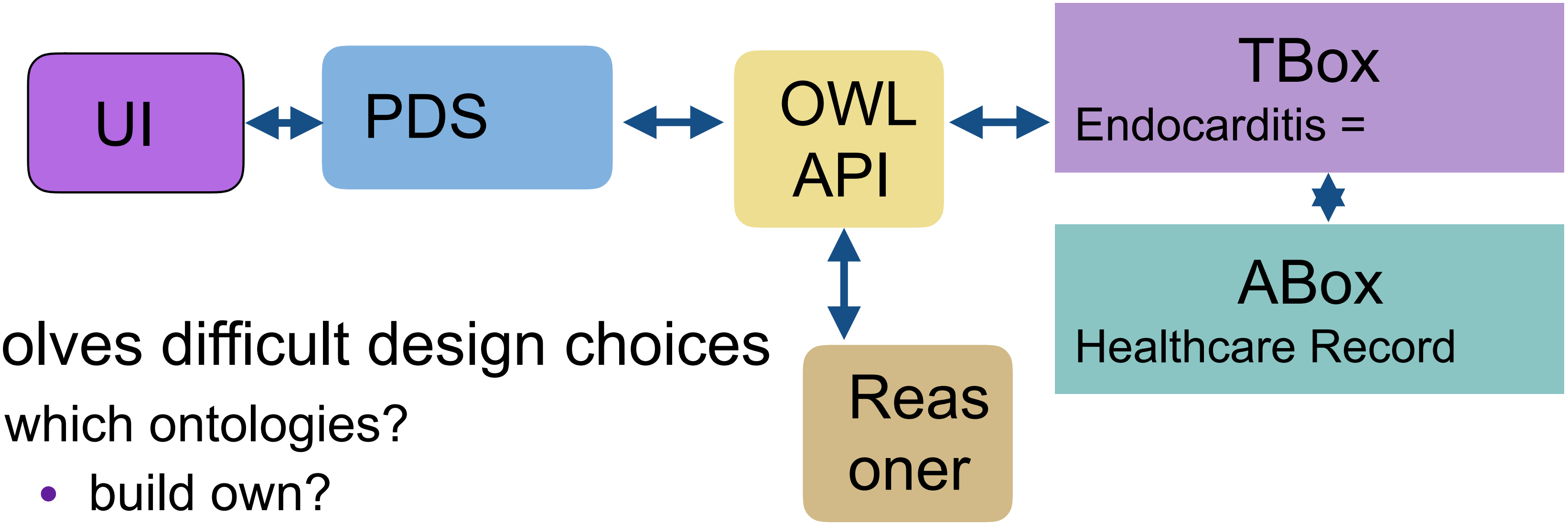
Ontology-Based ISs



Endocarditis = Inflammation and locatedIn some Heart
Inflammation = Disease and causedBy some Bacteria

- doesn’t require ABox/Data
- sometimes only terminology
  - e.g., NCI Thesaurus

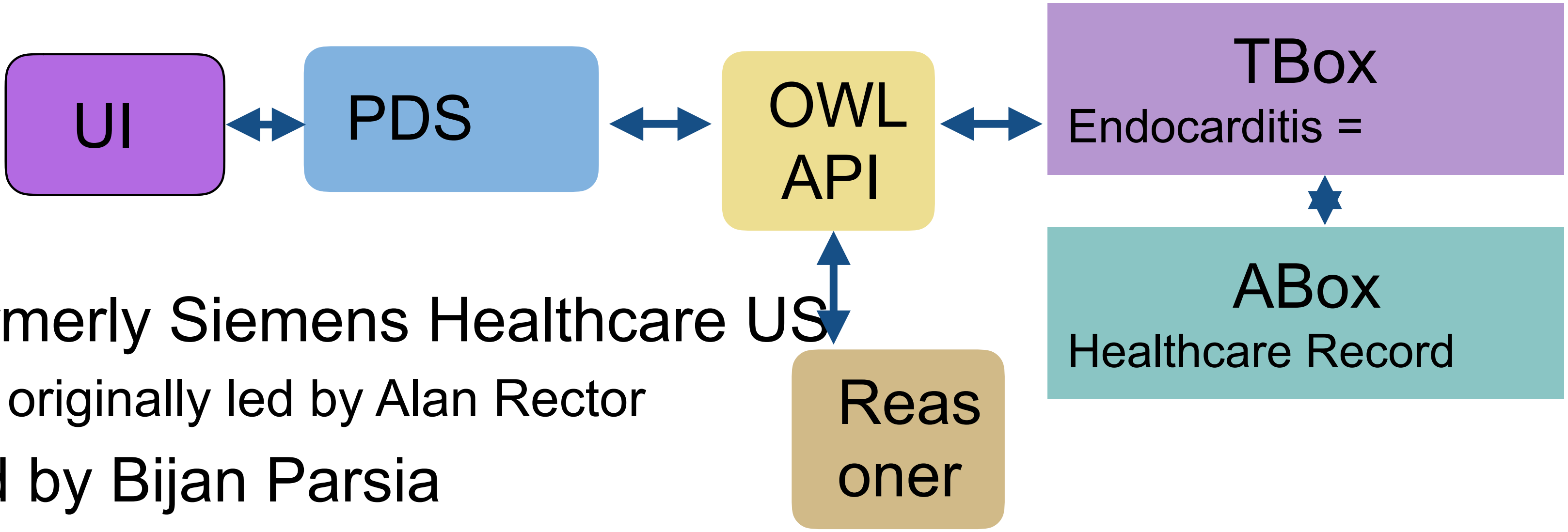
Building Ontology-Based ISs



- involves difficult design choices
  - which ontologies?
    - build own?
    - reuse/extend/combine others?
  - how to map?
  - what to put in OWL classes or Java classes?
  - how to make it scale?
  - which tools to use?
    - OWL API
    - reasoner

We tried to give you knowledge & understanding to answer these questions

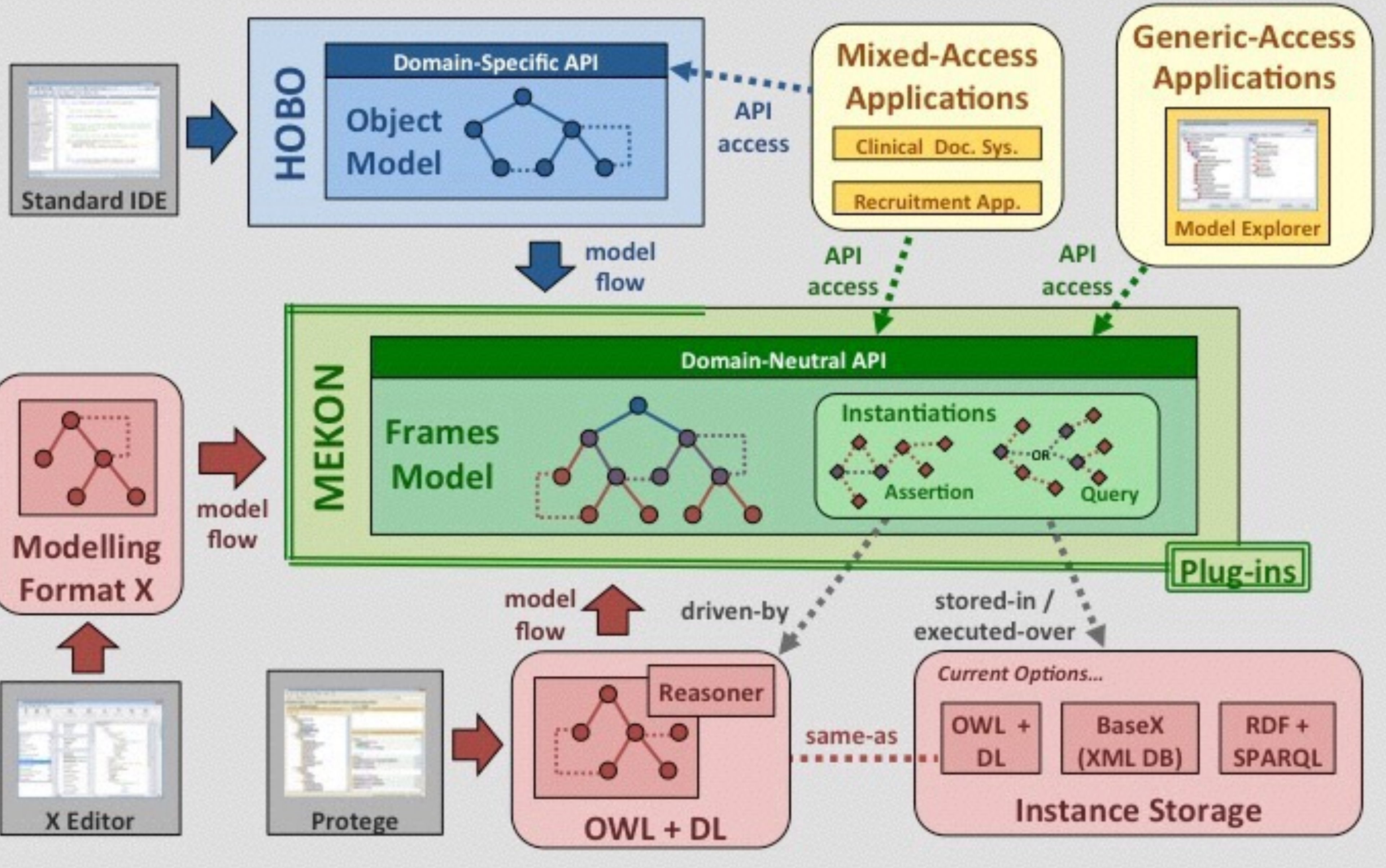
E.g., Cerner Collaboration



- formerly Siemens Healthcare US
  - originally led by Alan Rector
- led by Bijan Parsia
- concerned with patient documentation systems:
  - given the information about patient we have so far
  - what should we ask/document next?
- fine example where
  - **behaviour** depends on but differs from
  - static knowledge captured in ontology
- led to development of Chiron, Hobo, Mekon,…

MEKON & HOBO

Java frameworks for building ontology-driven applications



Colin Puleston, University of Manchester (puleston@manchester.ac.uk)

Demo

Exam

- Online Exam via Blackboard
- Two hours
- Multiple Choice Questions
- Short Essays
- Answer **all** questions

- …use Forum for questions!

Coursework this Week

- Core Task: Sushi Ontology (50% of your coursework mark)
  - Submit your report (individual) Monday, May 15 (65% of CT mark)
  - Submit your ontology (group) Thursday, May 11
  - Peer assess your ontologies (35% of CT mark)

- W5 Query application
  - use the OWL API to query an ontology
- W5 Postcoordination
  - a short essay

The Sushi Ontology

- An ontology of sushi
- Classes that enable us to represent sushi and answer competency questions like
  - Which sushi are suitable for vegetarians?
  - Which sushi have beef and are not spicy?
  - See BB for more CQs
- Class hierarchy organised using the PIMPS upper ontology.
- Peer assessed

- Plus a reflective report on how you built it, interesting aspects of the model