

# **Interdisciplinary Research at the London Knowledge Lab**

Alex Poulouvassilis

London Knowledge Lab, Birkbeck, Univ. of London

# London Knowledge Lab

[www.lkl.ac.uk](http://www.lkl.ac.uk)

- Joint interdisciplinary collaboration between Birkbeck's department of Computer Science (DCS) and the UCL Institute of Education (IoE)
- Aims to explore the ways in which digital technologies and new media are shaping the future of learning and knowledge
- About 50 academic staff, research staff, research students (of whom some 20 from Birkbeck) working on 25+ projects, funded by the research councils, EU, JISC, industry
- Extended in 2010 to postgraduate teaching on the MSc in Learning Technologies, jointly taught by DCS and IoE staff

# Challenges of interdisciplinary research projects

- requires development of a common language of discourse between researchers from the different disciplines – often, a specialist term has different meanings in different disciplines e.g. *ontology, design, implementation*
- typically a lack of well-defined “requirements” at the outset of the research project: identification of an initial set of requirements on the basis of which to begin to research and design initial prototype software is a necessary first step
- production of the first prototype and trialling with domain experts leads to elicitation of more precise requirements (sometimes contradicting the initial requirements); followed by further research and design of a second prototype
- the project typically progresses in this *iterative collaborative* fashion, comprising successive cycles of requirements elicitation, research, design, and trialling

# Our research at the London Knowledge Lab

- **Intelligent Tools for Learning and Teaching:**
  - designing tools that provide personalisation, support and guidance to learners and teachers
- **Participatory design approaches** to developing **Mobile and Pervasive applications:**
  - generation of knowledge from data collected through mobile devices
  - resulting in innovative applications in areas such as monitoring biodiversity, healthcare, urban development, transportation, art
- Creation, integration, analysis, visualisation of **specialist data and knowledge bases**, collaborating with researchers and practitioners from the sciences, social science, arts and humanities

# MiGen: intelligent support for learning algebra

The screenshot displays the 'MiGen Teacher Tools' interface. At the top, the task is 'Collaboration Traintrack' with a timer set to '10 mins on'. Below the task name are tabs for 'Class Dynamics', 'Student tracking', 'Goal achievement', and 'Grouping students'. A 'Refresh' button is located below the tabs. The main area contains the text 'Students' circles can be dragged' and a grid of 32 student progress indicators. Each indicator is a circle containing a student ID and a progress fraction. The circles are arranged in four columns and eight rows. The progress fractions are: Column 1: MM (3/4), BL (3/4), AH (4/4), MT (4/4), EE (1/4), PY (4/4), EB (2/4); Column 2: SB (4/4), ES (0/4), MD (0/4), MJ (0/4), EW (4/4), CI (2/4); Column 3: AT (0/4), JG (2/4), TG (3/4), AW (0/4), GP (3/4), LC (4/4); Column 4: DG (2/4), NC (0/4), NS (0/4), EH (0/4), CC (4/4), CP (3/4). The MD circle is highlighted in red, while all other circles are green or yellow.

Student ID	Progress
MM	3/4
BL	3/4
AH	4/4
MT	4/4
EE	1/4
PY	4/4
EB	2/4
SB	4/4
ES	0/4
MD	0/4
MJ	0/4
EW	4/4
CI	2/4
AT	0/4
JG	2/4
TG	3/4
AW	0/4
GP	3/4
LC	4/4
DG	2/4
NC	0/4
NS	0/4
EH	0/4
CC	4/4
CP	3/4

MiGen Teacher Tools

Task: Collaboration Traintrack Time: 10 mins on

Class Dynamics Student tracking Goal achievement Grouping students

Refresh

Students' circles can be dragged

Student ID	Progress	Color
MM	3/4	Green
SB	4/4	Yellow
AT	0/4	Green
DG	2/4	Green
BL	3/4	Yellow
ES	0/4	Yellow
JG	2/4	Green
NC	0/4	Green
AH	4/4	Green
MD	0/4	Red
TG	3/4	Yellow
NS	0/4	Yellow
MT	4/4	Yellow
MJ	0/4	Green
AW	0/4	Green
EH	0/4	Green
EE	1/4	Green
EW	4/4	Yellow
GP	3/4	Green
CC	4/4	Green
PY	4/4	Yellow
CI	2/4	Green
LC	4/4	Green
CP	3/4	Green
EB	2/4	Green

MiGen Teacher Tools

Task: Collaboration Traintrack Time: End

Class Dynamics Student tracking Goal achievement Grouping students

Refresh

Students' circles can be dragged

SE 1/4 sy 4/4 kw 1/4 fh 1/4 kw 0/4 AC 4/4 cb 2/4 th 4/4 ss 1/4 jr 0/4

kw 0/4 da 1/4 sn 0/4 jo 2/4 jm 0/4 nb 4/4 jr 1/4

kk 2/4 PT 0/4 rm 4/4 re 4/4 JA 1/4 na 4/4 lb 0/4 sa 1/4

Model for sy

$9 \times 7 + 5$

MiGen Teacher Tools

Task: Collaboration Traintrack Time: 10 mins on

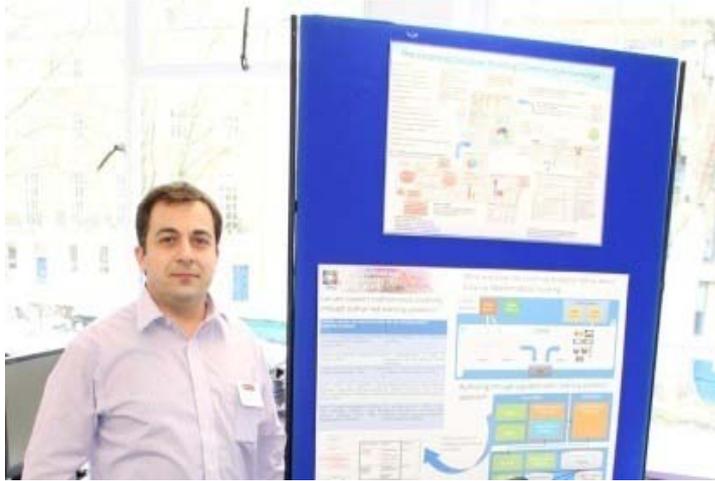
Class Dynamics Student tracking Goal achievement Grouping students

	Construct Pattern	Colour My World	Structural Generality	Find General Rule
CI	Green		Green	
DG				
SB				
EH				
EB				
PY	Green	Green	Green	Green
CP	Green			
TG				
LC				Green
ES				
GP	Yellow	Green	Yellow	Yellow
BL				

NS				
CC				
AW				
JG				
EE				
MJ				
MD	Green	Yellow	Green	Green
AH	Green	Green	Green	Yellow
MM	Green	Green		Green
AT				
MT				
EW				
NC				

Ann Smith 1/1	Lisa Smith 1/1	Angela Lefevre 1/1	Mike 1/1
Tile placed			
	Pattern created		
	Goal 1 accomplished		Pattern cr
			Goal 1 acc
	Local rule created		
	Local rule created		
	Local rule created	Tile placed	
			Local rule
Feedback: inactive		Tile placed	
			Local rule
Tile placed		Tile placed	
Tile placed			
Tile placed		B.Block created	
Tile placed			
Tile placed			Local rule
Tile placed		Tile placed	
Tile placed	Feedback: animation	B.Block created	
Tile placed	Pattern animated		Pattern cr
Tile placed			Goal 1 acc
Tile placed	Unlock number		
Tile placed			
Feedback: Rhythm			Local rule
B Block created	Pattern animated		

# Learning Designer & LIBE projects



The Learning Designer project has produced software that supports teachers and lecturers in capturing their pedagogic ideas, allowing them to build on what others have learnt and to share their experiences with their community. It promotes novel approaches to teaching, encouraging teachers to move away from traditional instruction towards more personalised learning experiences

The LIBE project is implementing a learning environment to support young adult learners in developing key literacy, numeracy and problem-solving skills. The project is adopting an inquiry-based approach to learning, extended with computerised adaptive testing (CAT) and personalisation of the individual learner's experience



# Wearable technologies; Museum trails



Wearable technologies developed at the London Knowledge Lab: Carnival performance costumes with embedded environmental sensing capabilities that display the current levels of various pollutants via LEDs sewn into the garments.

Inferring museum visitors' motivations from their patterns of spatial navigation:  
London Zoo visitor trails

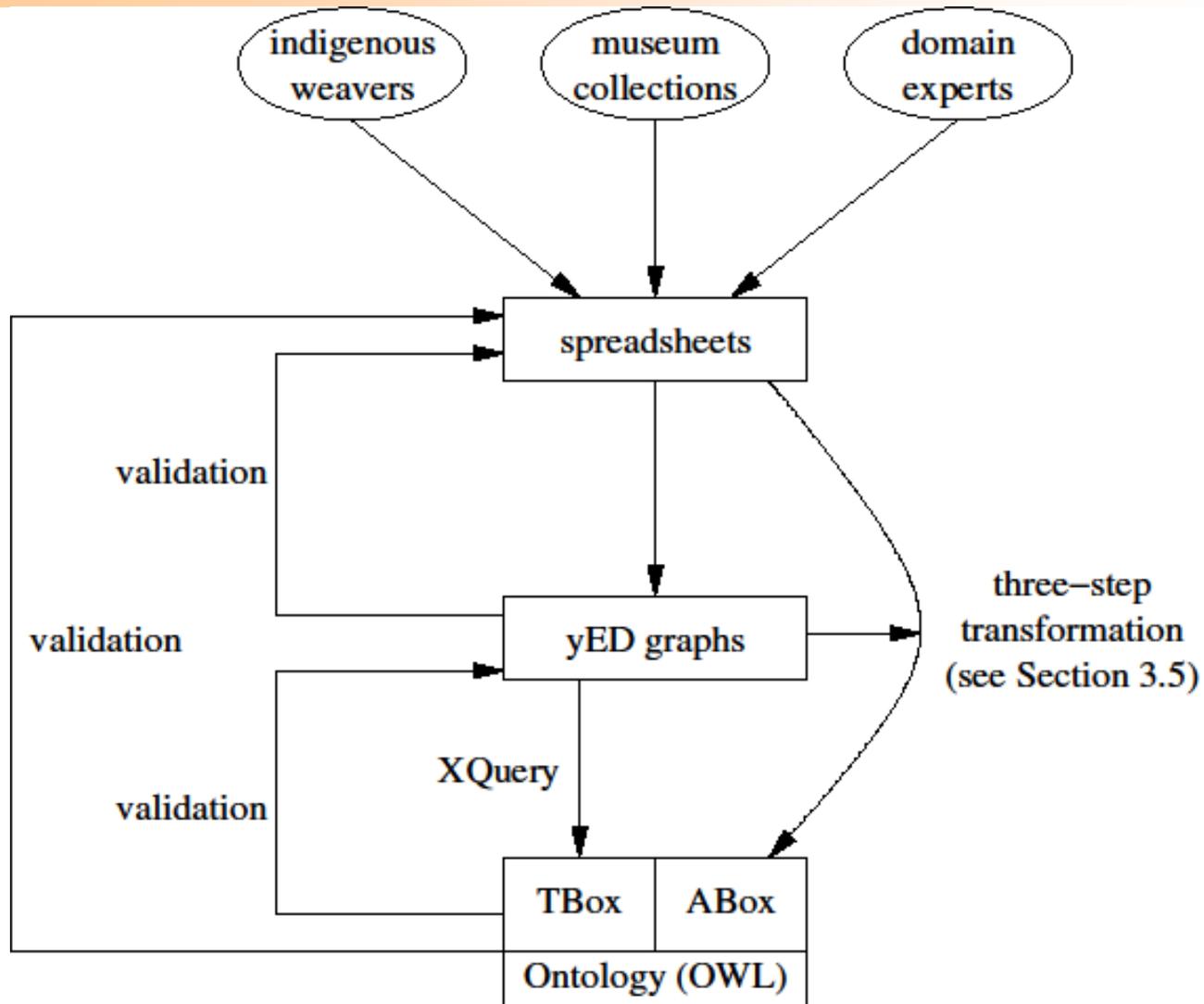


# Weaving Communities of Practice project

[www.weavingcommunities.org](http://www.weavingcommunities.org)

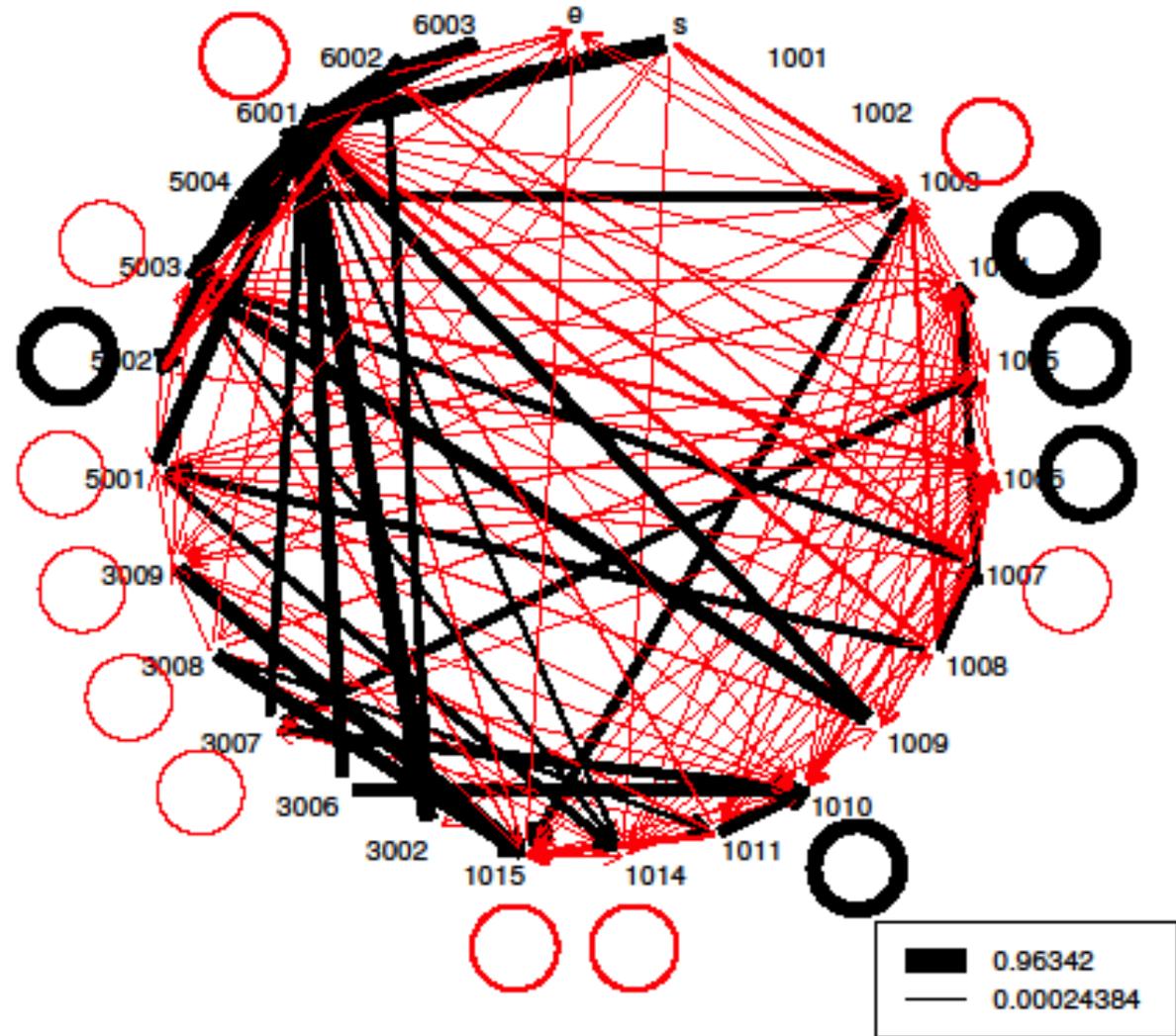
- Pilot project to create a Knowledge Base of Andean weaving designed to contribute to curatorial practice and heritage policy
- The research team gathered data on the chain of activities, instruments, resources, peoples, places and knowledge involved in the production of textiles, relating to over 700 textile samples
- A major part of the project was the modelling and representation of the knowledge of domain experts, and information about the textile objects themselves, in the form of an **OWL ontology**
- Followed by the development of a suite of search facilities to be supported by the ontology
- We opted to develop an ontology rather than a relational database, or other structured database, due to:
  - more flexibility in integrating domain knowledge and data as this becomes available and evolves
  - formal reasoning to validate the evolving knowledge model

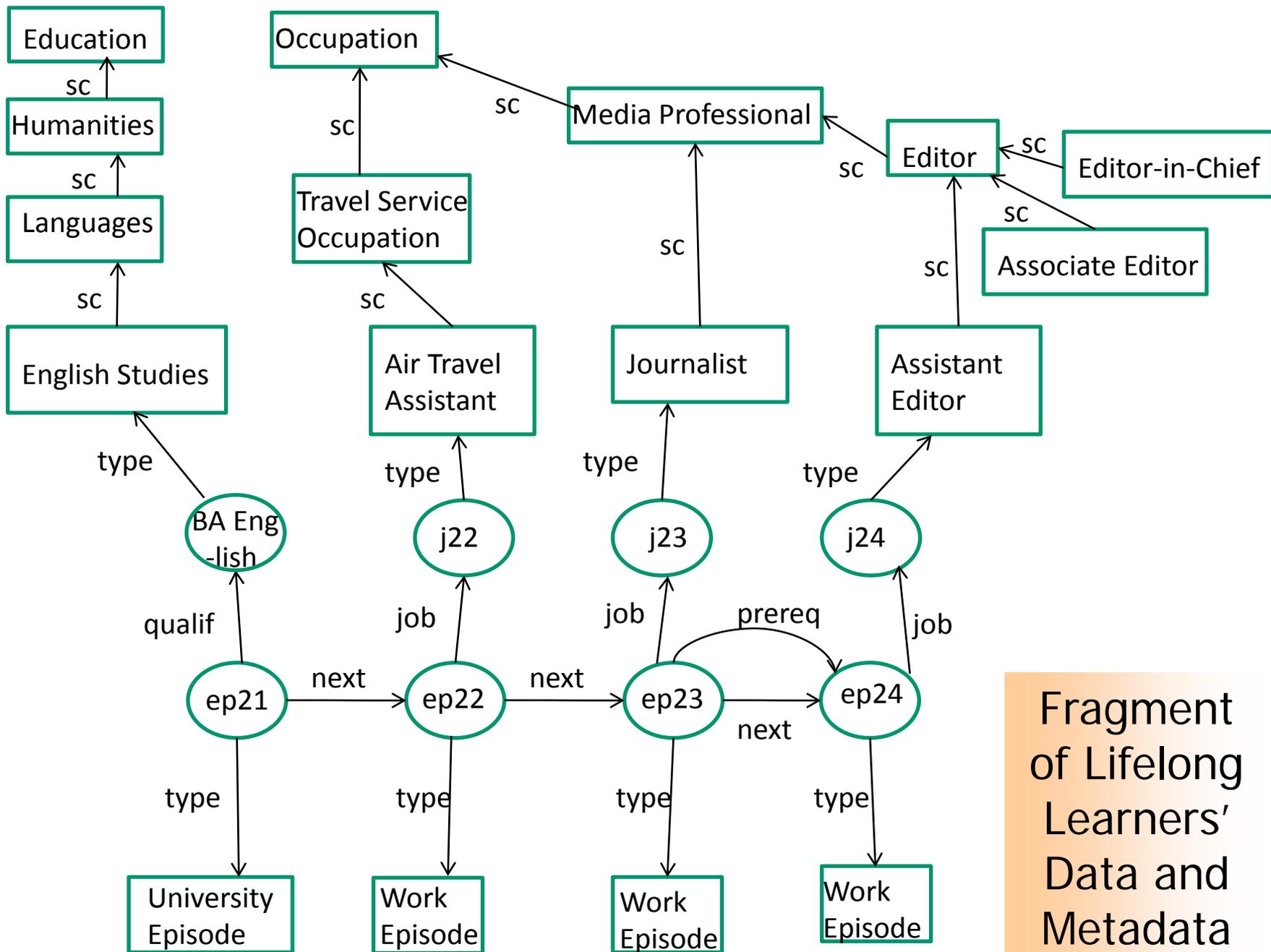
# Development Methodology



# Graph-based modelling, querying, analysis, visualisation

Student/system interaction data from the MiGen system





Fragment of Lifelong Learners' Data and Metadata

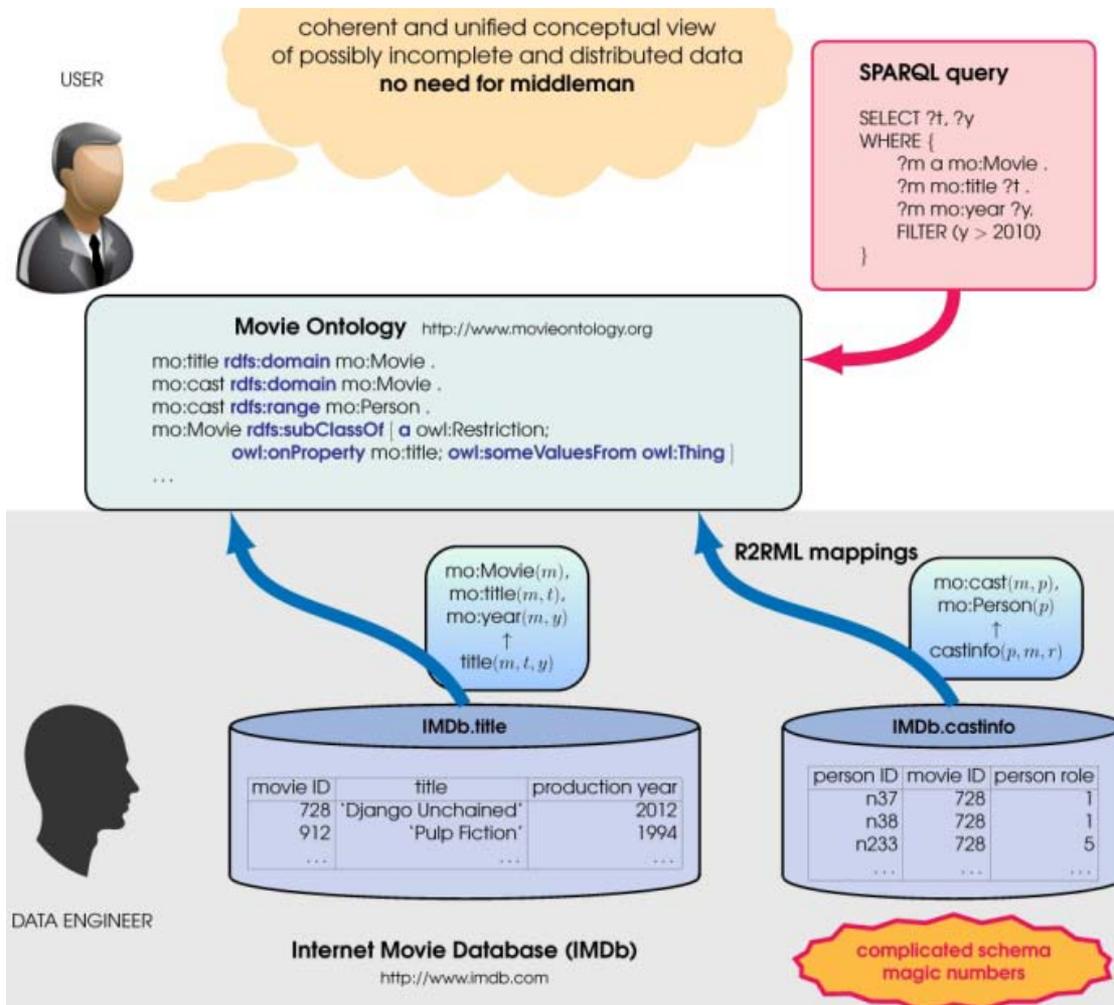
# Our research at the London Knowledge Lab (cont'd)

- Integration and querying of Linked Open Data
- Knowledge extraction from the Internet of Things to assist in decision making
- Health informatics:
  - genomic data sets arising from next generation sequencing technologies are increasingly available, presenting significant challenges in data analysis to enable early detection of drug resistance and determine the most effective treatment
  - large-scale data-driven techniques for clinical categorisation of Parkinson's disease patients through disease progression quantification, aiming to tailor care management to individual needs

# Collaborating with the London Knowledge Lab

- Our overarching research aim is to **support communities in capturing, organising, discovering and sharing knowledge**
- Examples of recent research projects are:
  - the **Ontop** system, allows users to integrate diverse datasets under a common Ontology and to query the ontology using SPARQL – see [ontop.inf.unibz.it](http://ontop.inf.unibz.it)
  - the **SAMTLA** system (Search And Mining Tools with Linguistic Analysis) – see [www.samtla.com](http://www.samtla.com)
    - online integrated research environment to facilitate the study of digitised text archives written in any language
    - to date it has been used for research on Hebrew, Judaeo-Arabic, Aramaic and Arabic texts
  - the Knowledge Base developed for the **Weaving Communities of Practice** Project – [www.weavingcommunities.org](http://www.weavingcommunities.org)

# Collaborating with the London Knowledge Lab



Ontop system architecture:

- Allows diverse databases to be mapped to one ontology
- Supports SPARQL queries over the ontology
- Incorporates RDFS and OWL reasoning

# Collaborating with the London Knowledge Lab

WESTMINSTER COLLEGE, FRAGMENTS CAIRENS 49 (A + B)

שלמה ד[נן] מא עדי  
31. הדה אלדינין מן סאיר אלדעאוי ואלמטאלבאת ואלאימאן קד  
אבראה מנהא  
32. וכדלך אברא מ שלמה בר הלל דנן מ מבשר מן סאיר אלדעאוי  
וואלמטאלבאת  
33. ואלאימאן ואקנינא מנהם עלי דלך במנא דכשר למיקניא(!)  
ביה וכדלך אסתקר  
34. עלי מ שלמה בר הלל דנן ארבעין רטל מרגאן //ודכר בשארה  
אן דפע לה פיהא// באלאסכנדריה(!) כאנת  
35. ענדה למ בשארה דנן יסלמהא באלאסכנדריה לרסול בית דין  
ימתל  
36. פיהא אמרה ומא דהוה קדמנא כתבנא וחתמנא למיהוי לזכו  
ולראה  
37. ואקנינא מן מ שלמה בר הלל אנה אן לס יסלם הדא אלמרגאן  
דכרה לרסול בית  
38. בית(!) פי נצף אייר מן סנתנא הדה כאן עליה מן אלאן כמסה  
דגאניר **ללענימ**  
39. **ומה דהוה קדמנא כתבנא וחתמנא למיהוי לזכו ולראה**  
40. וצל חמוי וזכר אן תסלם הדא אלמרגאן קבל  
41. אלמדה אלמדכורה והו בודיעתה הנאך באל  
42. אסכנדריה פי דאר צדיק לה ואנה מא סלם  
43. אל... טו דרהם

ULC MSS ADD. 3422 C-K

19. אלגוי ואסלמה לאולאד מ משה הדא ואכיה ומה דשמענא  
מנהון כתבנא  
20. וחתמנה(!) למיהוי לזכו ולראה יצחק ביר שמואל  
21. נע  
22. אברהם ברבי שמעיה החבר נבתיאי נין שמעיהו גאון נע  
23. נסים ברבי נהראי הרב זצל  
24. ופי יום אלכמיס אלעאשר מן שהר סיון חצר אלי בית דין מ  
אהרן בר משה  
25. ומ שלמה בר הלל אלמדכורין פי אעלא הדה אלאסטר ועאוד  
מ אהרן  
26. מטאלבה מ שלמה באלטלב אלמדכור פוק פקאל מ שלמה ע  
אלגאפת  
27. מא לס יזכרה פוק ודלך אנה קאל אנה ענדי רהן עלי דינין  
גיר רבע  
28. פאלתנינא לאתבאת דלך לכוון אלקול ען הדא אלגאפת קד  
**אכתלף**  
29. **ומה דהוה קדמנא כתבנא וחתמנא למיהוי לזכו ולראה**  
30. יצחק ביר שמואל נע הלל ביר עלי זל נסים ברבי נהראי הרב  
31. זצל  
32. כמסה עשרה רטל בקי לנא מנהא עשרה ארטאל  
33.  
34.

- The SAMTLA system has been designed to facilitate the study of digitised texts. Includes language-agnostic statistical modelling. Currently supports the research of three corpora:
- the Genizah collection held by the Taylor-Schechter Genizah Research Unit in Cambridge University;
  - a collection of Aramaic incantation texts from late antiquity;
  - 13 versions of the Bible in English



# Avenues for Collaboration

- Collaborative research projects: to create, analyse, visualise new databases and knowledge bases; generate new knowledge from data; develop novel applications supporting knowledge communities, including mobile and pervasive applications
- Joint organisation of workshops
- Joint PhD supervision
- Staff and student internships
- Guest lecturing on Masters programmes
- Consultancy
- Knowledge Transfer partnerships