Lost fragments from the Diamond Age…

on lifelong learner models, scrutability, reflection, augmented cognition

Judy Kay

CHAI: Computer human adapted interaction research group

School of Information Technologies

The University of Sydney

Fragment 1…

Next day, Nell woke up excited - she knew that the Primer could tell her more about this puzzle. Not even waiting till after breakfast, she opened the Primer and it immediately began telling her about Anne Boyd and her music.

After about ten minutes of this, Nell, began to wonder why she might need to know about it. Under the Primer's guidance, she had become an increasingly independent learner, with a strong streak of curiosity. So, of course, she asked the Primer to explain itself.

And Nell asks?

- Why is the Primer telling me about Anne Boyd?
- Why now?
- What does it think I know about Boyd?
- What does it think I want to know?
- Where does this lesson fit into all the things I have been learning?

And the answers rest on…

- The learner model
  - as it drives the personalisation
- The uses of the learner model
- The interpretation of the learner model

And this matters because

- Nell needs to become responsible for her own learning
- And able to control it

Primer v my lifelong learner model vision

Primer

- Omniscient
- Inscrutable
- In control
- Does not inter
  parents/teach
- Subtle and hu
- Very long term

Lllm + "*teachers*"

l of what it

earner control

nd parents

lay key role

at machines

l is machine-

- Very long term

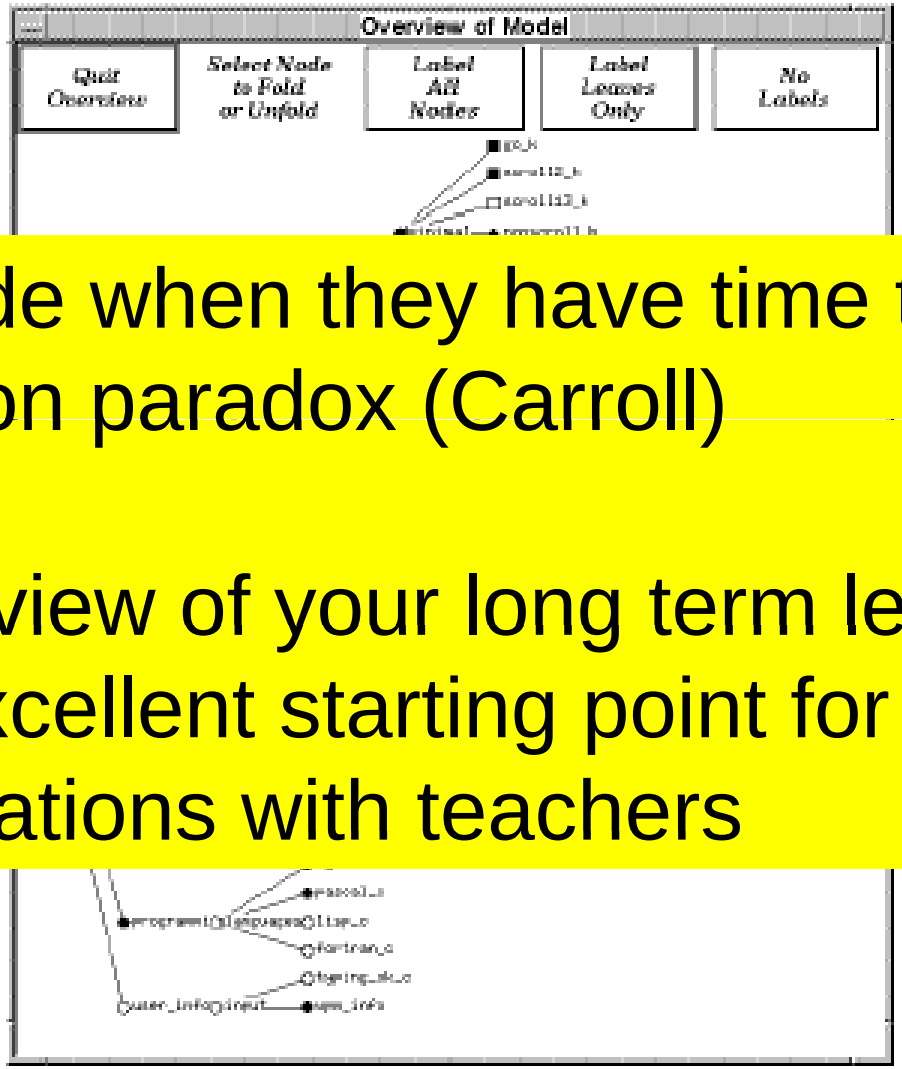
***Teachers* include:**
parents,
peers,
classroom teachers,
boss,
….
various programs

- Why lifelong learner modelling?
  - User control of personal information in model, with personal copy of partial learner models held by others.
  - Reuse of learner model by multiple *teachers.*
  - Augmented cognition.
- Some of the challenges,
  - Systems: representation, distribution.
  - Interoperability: ontologies.
  - Building learner models: knowledge layer
  - Mining them: Educational Data Mining
  - User interfaces: Open Learner Models (OLMs)
  - Security and privacy

Fragment 2…

On this particular morning, Nell had been working very hard on an essay about Anne Boyd. Of course, she typed it, using the same word processor she had user for many years (on many different computers).

But this morning was different because suddenly she decided that it was time she learnt how to become a power user. The Primer showed her the way ahead:



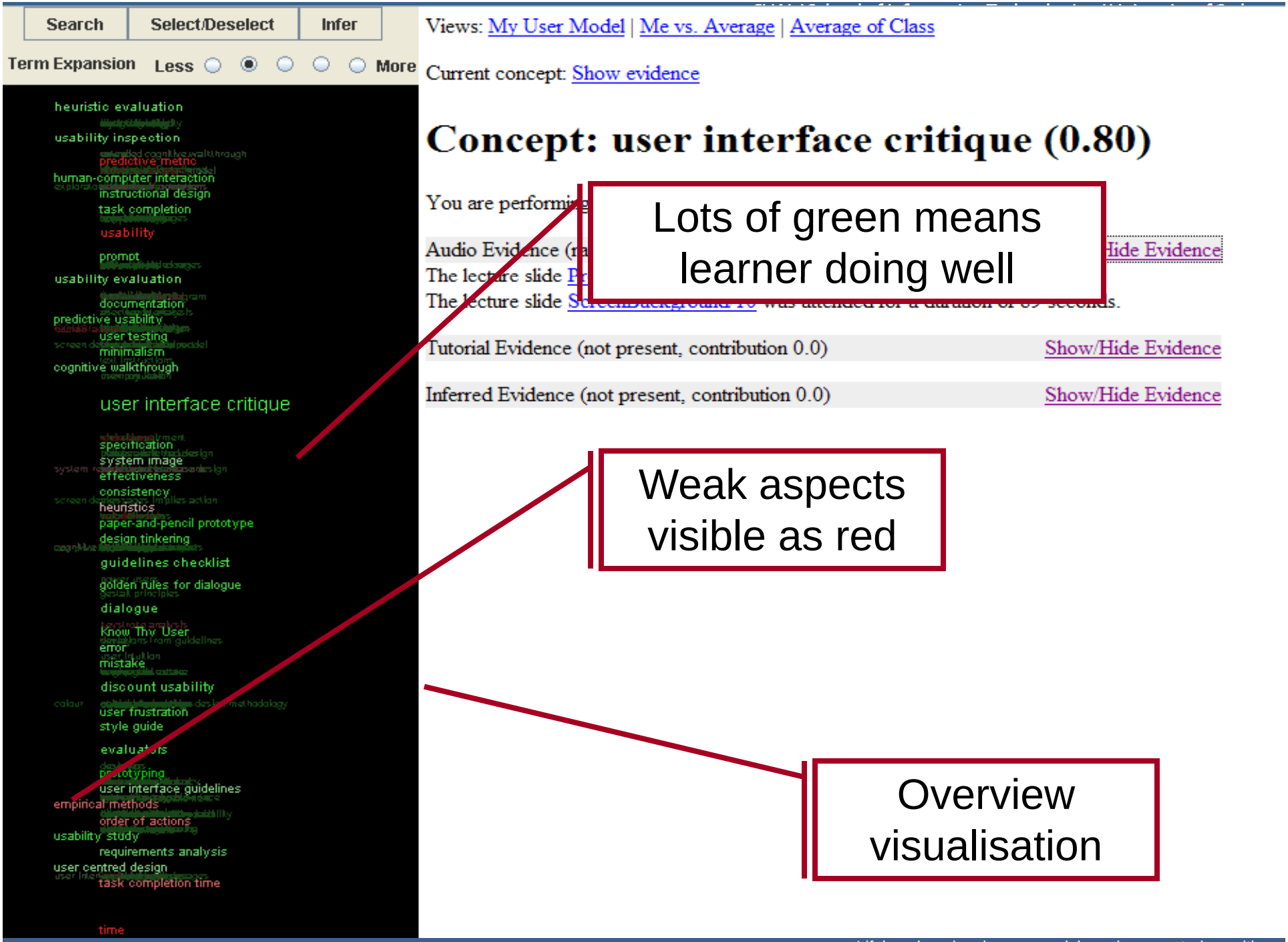
People decide when they have time to overcome the production paradox (Carroll)

And an overview of your long term learner model makes an excellent starting point for reflection and conversations with teachers

Fragment 3…

Nell began revising the semester's work from the user interfaces subject that she had been enjoying so much. Lectures had been delivered in the virtual classroom, complemented by labs and a group assignment. She had meant to attend the lectures … but perhaps she had missed a few when she had to devote all her energies to hockey as her team made the finals.

Her starting point for study was to ask the Primer to give her an overview of how she was doing.


Search
Select/Deselect
Infer
Term Expansion
Less
More
heuristic evaluation
usability inspection
predictive metric
human-computer interaction
instructional design
task completion
usability
prompt
usability evaluation
documentation
predictive usability
user testing
minimalism
cognitive walkthrough
user interface critique
specification
system image
effectiveness
consistency
heuristics
paper-and-pencil prototype
design tinkering
guidelines checklist
golden rules for dialogue
dialogue
Know Thy User
error
mistake
discount usability
user frustration
style guide
evaluators
prototyping
user interface guidelines
empirical methods
order of actions
usability study
requirements analysis
user centred design
task completion time
time
Views: My User Model | Me vs. Average | Average of Class
Current concept: Show evidence
Concept: user interface critique (0.80)
You are performing
Audio Evidence (ra
Hide Evidence
The lecture slide Pr
The lecture slide ScreenBackground 19 was attended for a duration of 89 seconds.
Tutorial Evidence (not present, contribution 0.0)
Show/Hide Evidence
Inferred Evidence (not present, contribution 0.0)
Show/Hide Evidence
Lots of green means learner doing well
Weak aspects visible as red
Overview visualisation


Search
Select/Deselect
Infer
Term Expansion
Less
More
heuristic evaluation
usability inspection
predictive metric
human-computer interaction
instructional design
task completion
usability
prompt
usability evaluation
documentation
predictive usability
user testing
user interface critique
effectiveness
consistency
heuristics
paper-and-pencil prototype
design tinkering
guidelines checklist
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Know Thy User
error
mistake
discount usability
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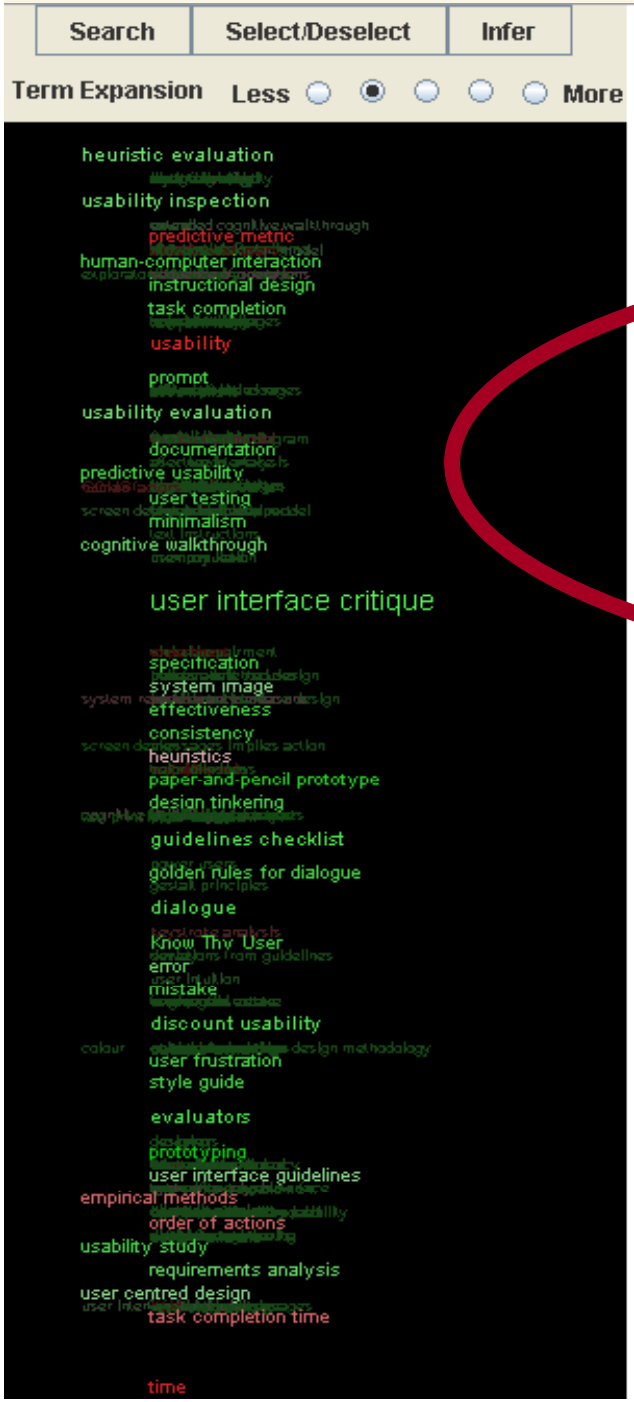
Views: My User Model | Me vs. Average | Average of Class
Current concept: Show evidence
Concept: user interface critique (0.80)
You are performing better than average.
Audio Evidence (raw 0.80, contribution 0.80)
Show/Hide Evidence
The lecture slide PredHeuristic/8 was attended for a duration of 108 seconds.
The lecture slide ScreenBackground/10 was attended for a duration of 89 seconds.
Tutorial Evidence (not present, contribution 0.0)
Show/Hide Evidence
Inferred Evidence (not present, contribution 0.0)
Show/Hide Evidence
Focus concepts



Views: My User Model | Me vs. Average | Average of Class

Current concept: Show evidence

Concept: user interface critique (0.80)

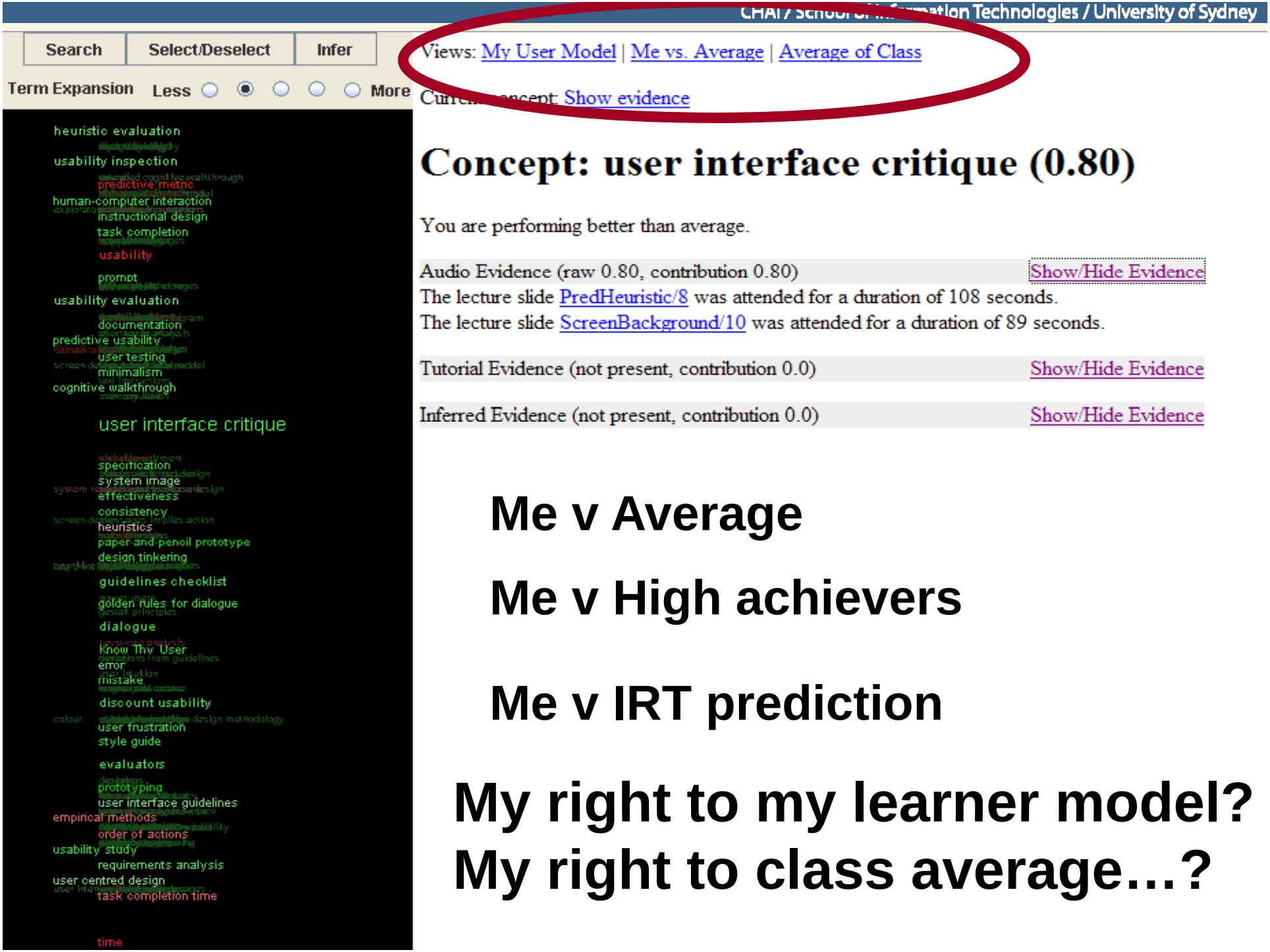
You are performing better than average.

Audio Evidence (raw 0.80, contribution 0.80)	Show/Hide Evidence

The lecture slide PredHeuristic/8 was attended for a duration of 108 seconds.
The lecture slide ScreenBackground/10 was attended for a duration of 89 seconds.

Tutorial Evidence (not present, contribution 0.0)	Show/Hide Evidence
Inferred Evidence (not present, contribution 0.0)	Show/Hide Evidence

Drilling down
Evidence of knowledge


CHAI / School of Information Technologies / University of Sydney
Search
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user testing
minimalism
cognitive walkthrough
user interface critique
specification
system image
effectiveness
consistency
heuristics
paper-and-pencil prototype
design tinkering
guidelines checklist
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Know Thy User
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Show/Hide Evidence
Me v Average
Me v High achievers
Me v IRT prediction
My right to my learner model?
My right to class average…?

Fragment 4…

Nell took a job as a teacher at the Victorian Academy for Young Ladies of Distinction….

Each semester, Nell approached with trepidation the daunting task of writing exams for her classes. There were many, many policies and rules to meet the approved VAYLD format and style. And the administrators changed them all the time.

Luckily, the Primer enabled her to do just-in-time learning, reading just the aspects she needed to know, at the stage she needed them for each exam paper.

Justin Time Training

Profile Learning Centre

Search Learning Centre

Current activities

Where user is up to in this activity

JITT Activities for user 'judy'

SOFT2004 Exam Preparation: Writing The Marking Scheme
The marking scheme must be prepared.
SOFT3102 Exam Preparation: Formatting the Pap
The exam paper must be formatting according to the S
requirements.

SOFT2004 Exam Preparation: Writing The Marking Scheme

The marking scheme must be prepared.
The following digital items are available:
Devising a marking scheme

View workflow

Marking Scheme Complete

Quit Activity

SOFT3102 Exam Preparation: Formatting the Paper

The exam paper must be formatting according to the School and University requirements.
The following digital items are available:

Important Items

Devising a marking scheme
marking scheme
move

ising a marking scheme

move

CONFIDENTIAL labelling of examination papers
refer to later----
Remove

Document Viewing History

CONFIDENTIAL labelling of examination papers
2003-10-26 20:48:25
SpeciaLeave - General and Academic Staff
2003-10-24 15:39:10
Problems encountered in previous examinations
2003-10-24 11:46:22
Devising a marking scheme
2003-10-09 21:19:38
Special questions for Advanced students

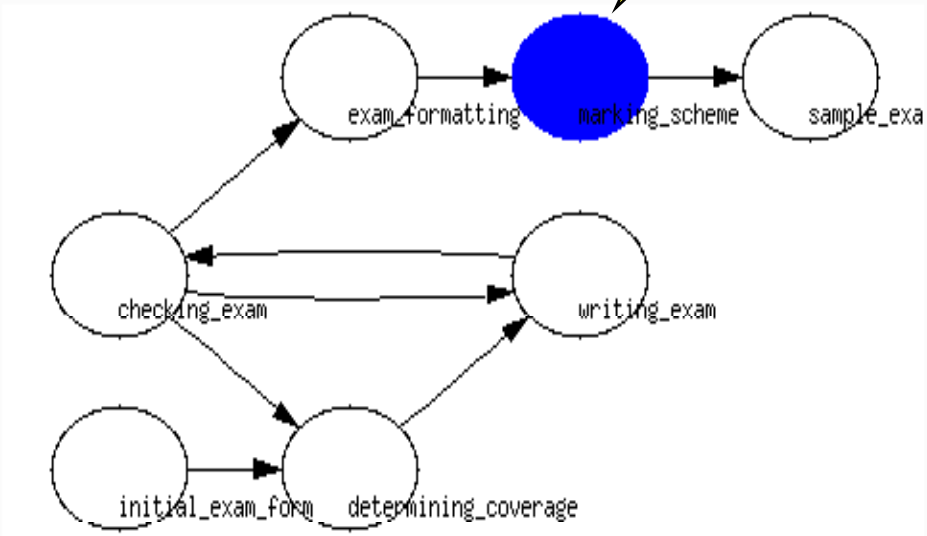
Justin Time Training

Profile Learning Centre

Search Learning Centre

Current step in this workflow

Workflow graph for SOFT2004 Exam Preparation



Justin Time Training

Profile **Learning Centre**

Shows how well user knows c

Access to JITT mem

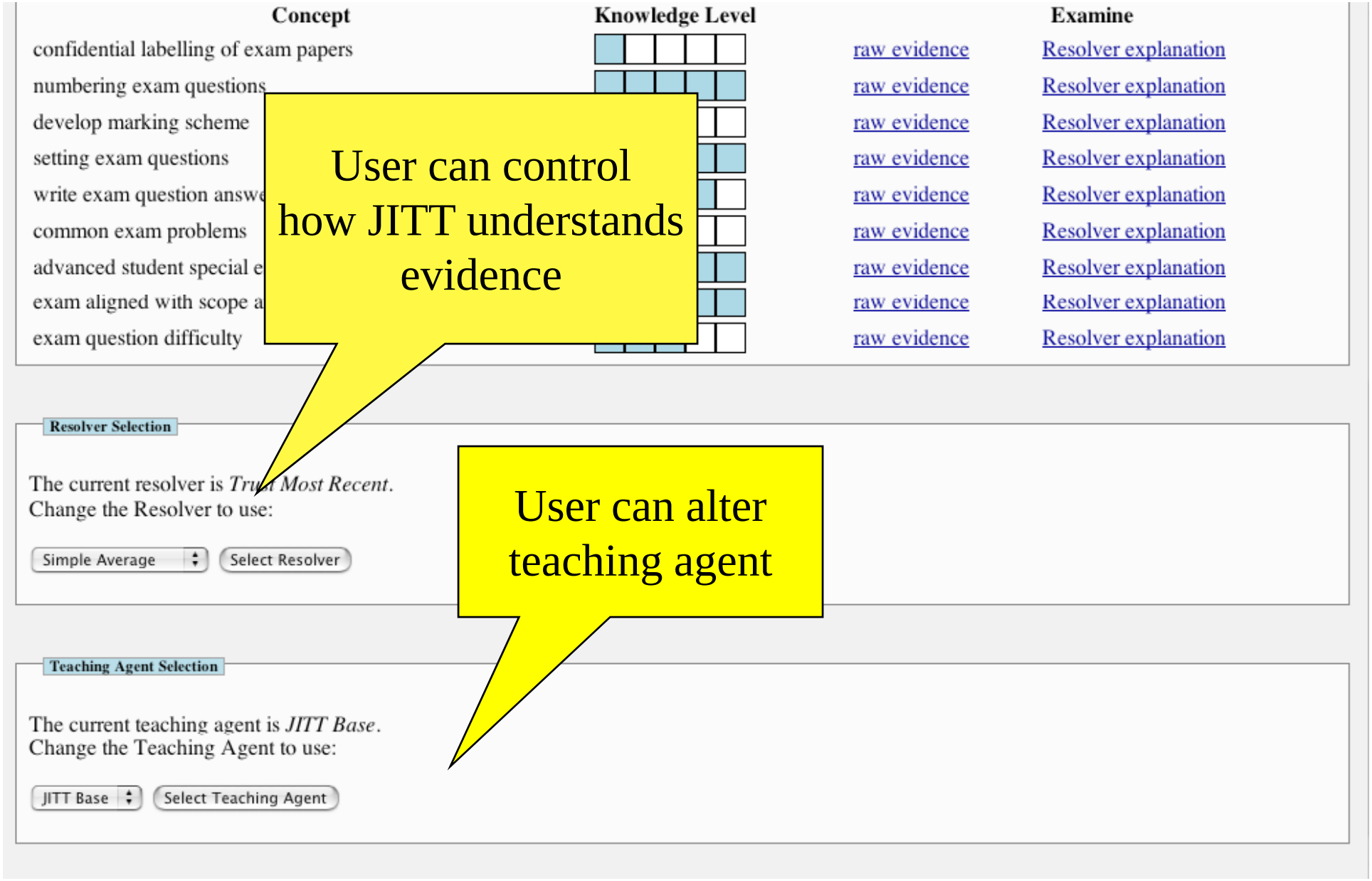
How JITT interprets evidence

SOFT2004 Exam Preparation Activity User Model

Concept	Knowledge Level		
confidential labelling of exam papers		raw evidence	Resolver explanation
numbering exam questions		raw evidence	Resolver explanation
develop marking scheme		raw evidence	Resolver explanation
setting exam questions		raw evidence	Resolver explanation
write exam question answers		raw evidence	Resolver explanation
common exam problems		raw evidence	Resolver explanation
advanced student special exam questions		raw evidence	Resolver explanation
exam aligned with scope and objectives		raw evidence	Resolver explanation
exam question difficulty		raw evidence	Resolver explanation

SOFT3102 Exam Preparation Activity User Model

Concept	Knowledge Level		Examine
confidential labelling of exam papers		raw evidence	Resolver explanation
numbering exam questions		raw evidence	Resolver explanation
develop marking scheme		raw evidence	Resolver explanation
setting exam questions		raw evidence	Resolver explanation


Concept
Knowledge Level
Examine
confidential labelling of exam papers
numbering exam questions
develop marking scheme
setting exam questions
write exam question answe
common exam problems
advanced student special e
exam aligned with scope a
exam question difficulty
raw evidence
Resolver explanation
User can control how JITT understands evidence
Resolver Selection
The current resolver is Most Recent.
Change the Resolver to use:
Simple Average
Select Resolver
User can alter teaching agent
Teaching Agent Selection
The current teaching agent is JITT Base.
Change the Teaching Agent to use:
JITT Base
Select Teaching Agent

Justin Time Training

Profile **Learning Centre**

Search Learning Centre

List of everything JITT knows about what this user knows about this concept

Evidence for *confidential labelling of exam papers*

Timestamp	Knowledge Level	
2003-10-09 21:09:15	could teach to others	Self assessment after viewing CONFIDENTIAL labelling of examination papers
2003-10-24 11:45:24	Positive	Viewed content: CONFIDENTIAL labelling of examination papers
2003-10-24 11:45:25	Positive	Viewed content: CONFIDENTIAL labelling of examination papers
2003-10-24 11:45:35	understand well	Self assessment after viewing CONFIDENTIAL labelling of examination papers
2003-10-24 11:45:43	Positive	Viewed amination papers
2003-10-24 11:45:44	Positive	Viewed amination papers
2003-10-24 11:45:51	could teach to others	Self asse belling of examination papers
2003-10-24 11:45:57	Positive	Viewed
2003-10-24 11:45:58	Positive	Viewed
2003-10-24 11:46:04	understand	Self asse
2003-10-24 15:13:27	Positive	Viewed conten DENTIAL labelling of
2003-10-26 20:45:12	never heard	Self assessme nce added directly
2003-10-26 20:46:56	Positive	Viewed con CONFIDENTIAL labelling of
2003-10-26 20:46:57	Positive	Viewed co nt: CONFIDENTIAL labelling of exam apers
2003-10-26 20:47:18	Positive	Viewed ontent: CONFIDENTIAL labelling of exa n papers
2003-10-26 20:47:28	heard of	Self assessment after viewing CONFIDENTIAL l ng of examination papers
2003-10-26 20:48:25	Positive	Viewed content: CONFIDENTIAL labelling of amination papers
2003-10-26 21:11:18	Positive	Viewed content: CONFIDENTIAL labelling of examination papers
2003-10-26 21:11:18	Positive	Viewed content: CONFIDENTIAL labelling of examination papers

Eg. Self-rated knowledge

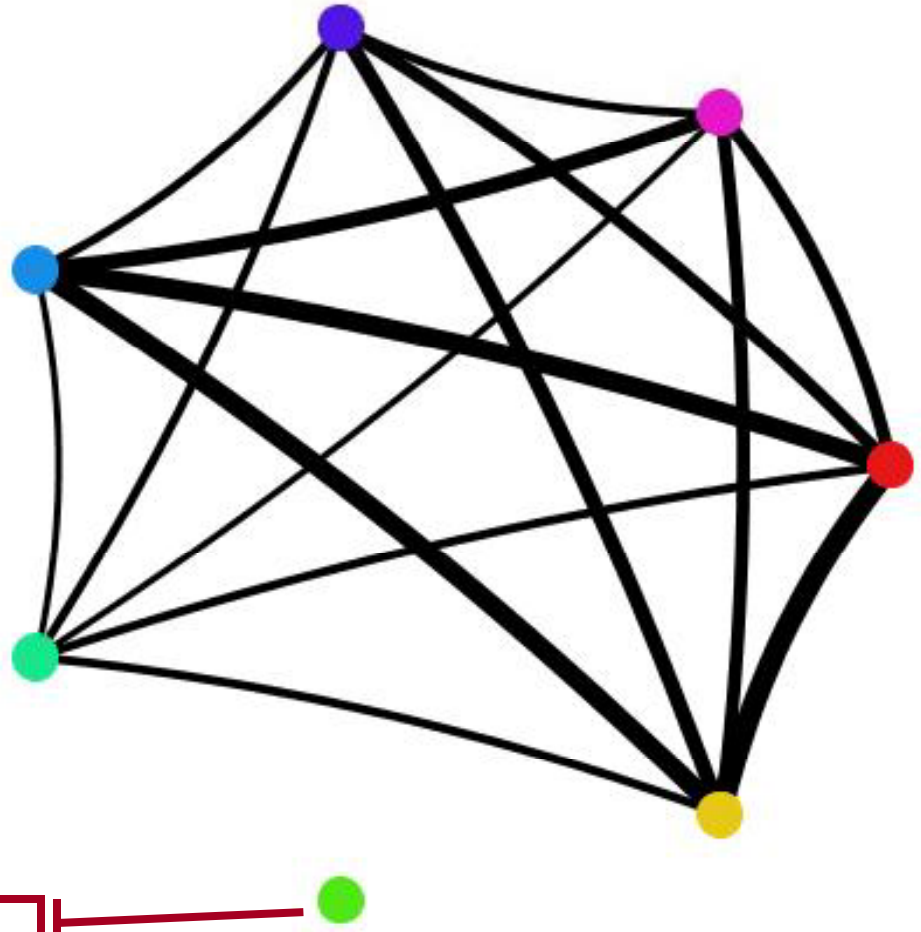
Eg. Accessed document

Fragment 5...

All Victorians were expected to be good at working collaboratively, in small teams. Nell dreaded working in groups (unless she was allowed to be with her dear friends). However, this was not to be.

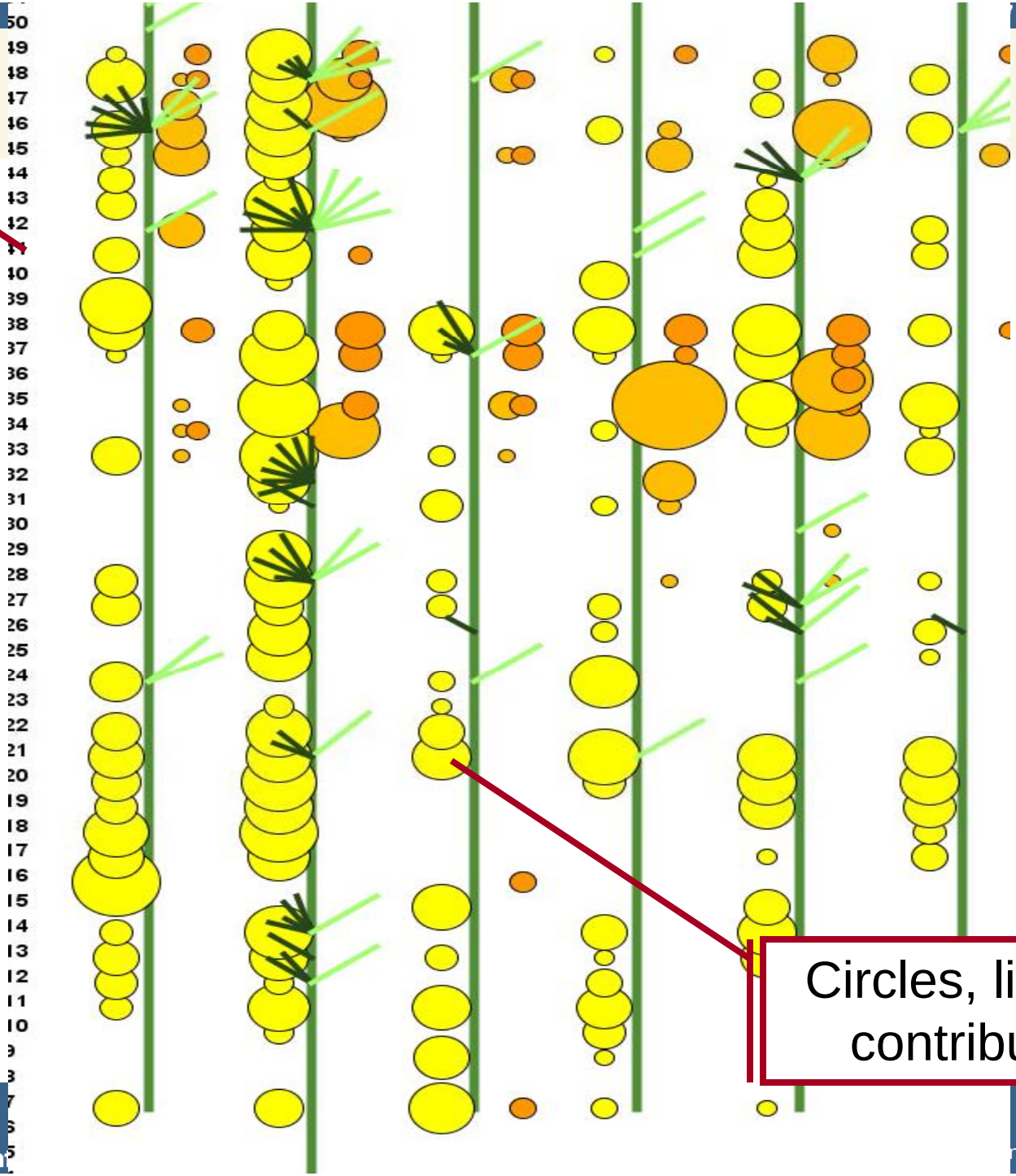
The Primer introduced her to online tools for group work and showed her how the contributions of each team member could be mirrored so that the Primer could discuss these, to help each person identify group-work problems affecting them, and improvements over time.

Interaction graph - Medium wiki

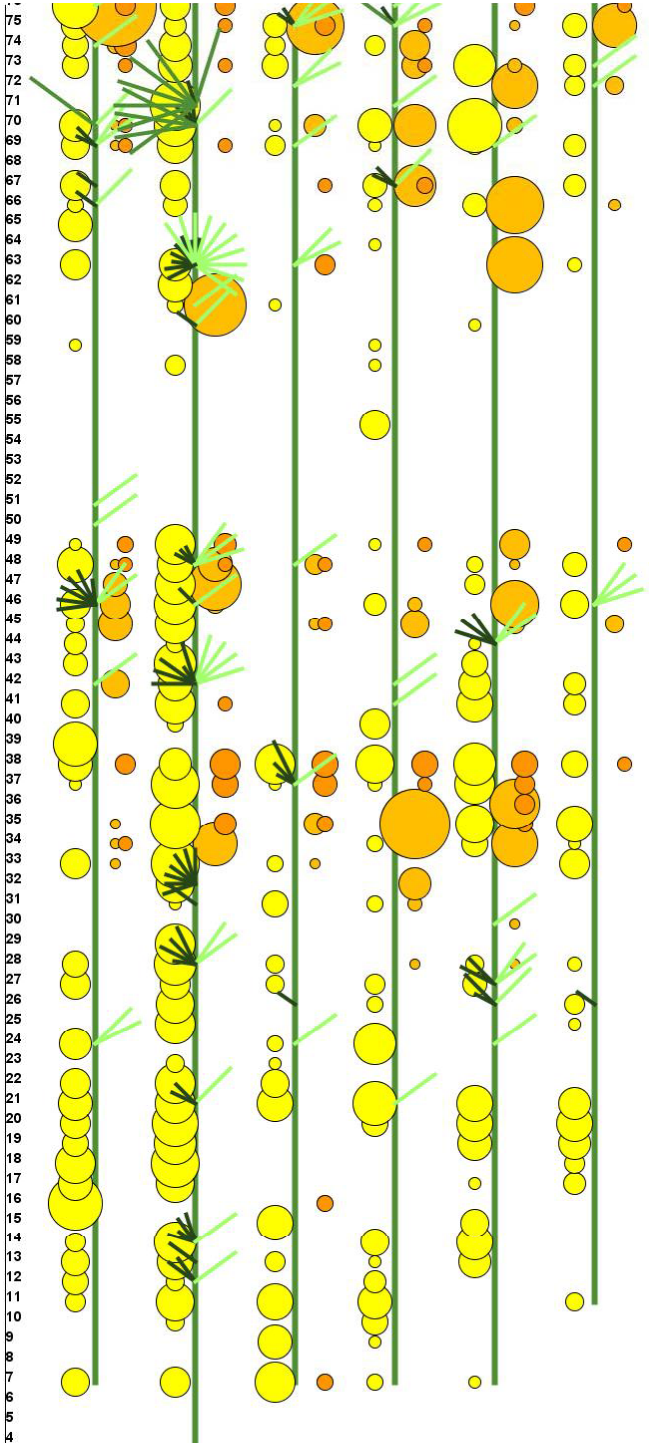


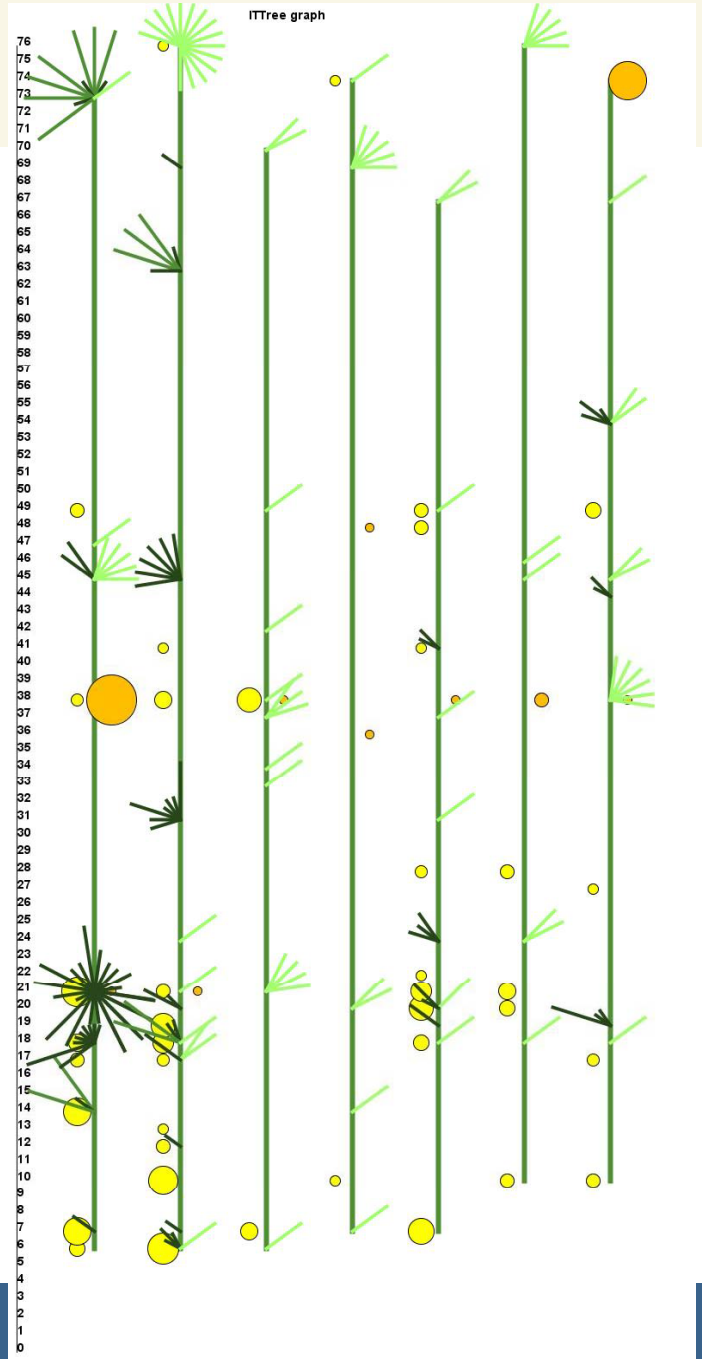
Team Leader

Time in days

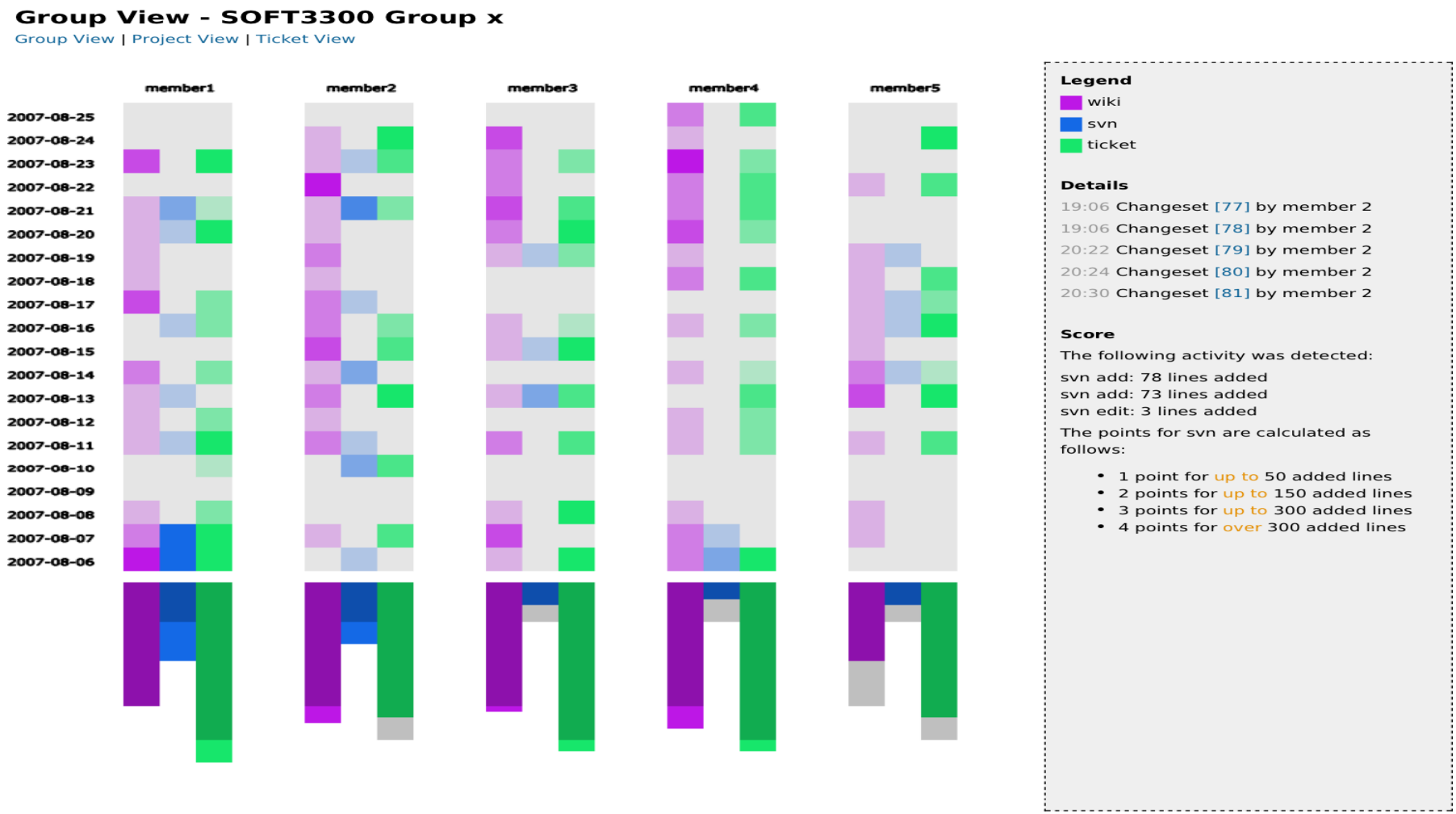


Circles, lines are contributions




ITTree graph

Lifelong modelling – mirrors and mining



Data mining

Group 1 – 1 person had sequences characteristic of managers.
* That person had the manager role

	Managers	Developers	Loafers	Others
Group 1	*1	3	1	1
Group 2	*1	0	1	2
Group 3	0	1	2	1
Group 4	*1	3	2	0
Group 5	3	*1	1	1
Group 6	*1	1	2	1
Group 7	*1	0	2	2

Group 1 – 3 members had developer activity sequences

Group 3 – dysfunctional and here we might see why

Group 5 – another way to be dysfunctional

Challenges and issues for the lifelong learner model

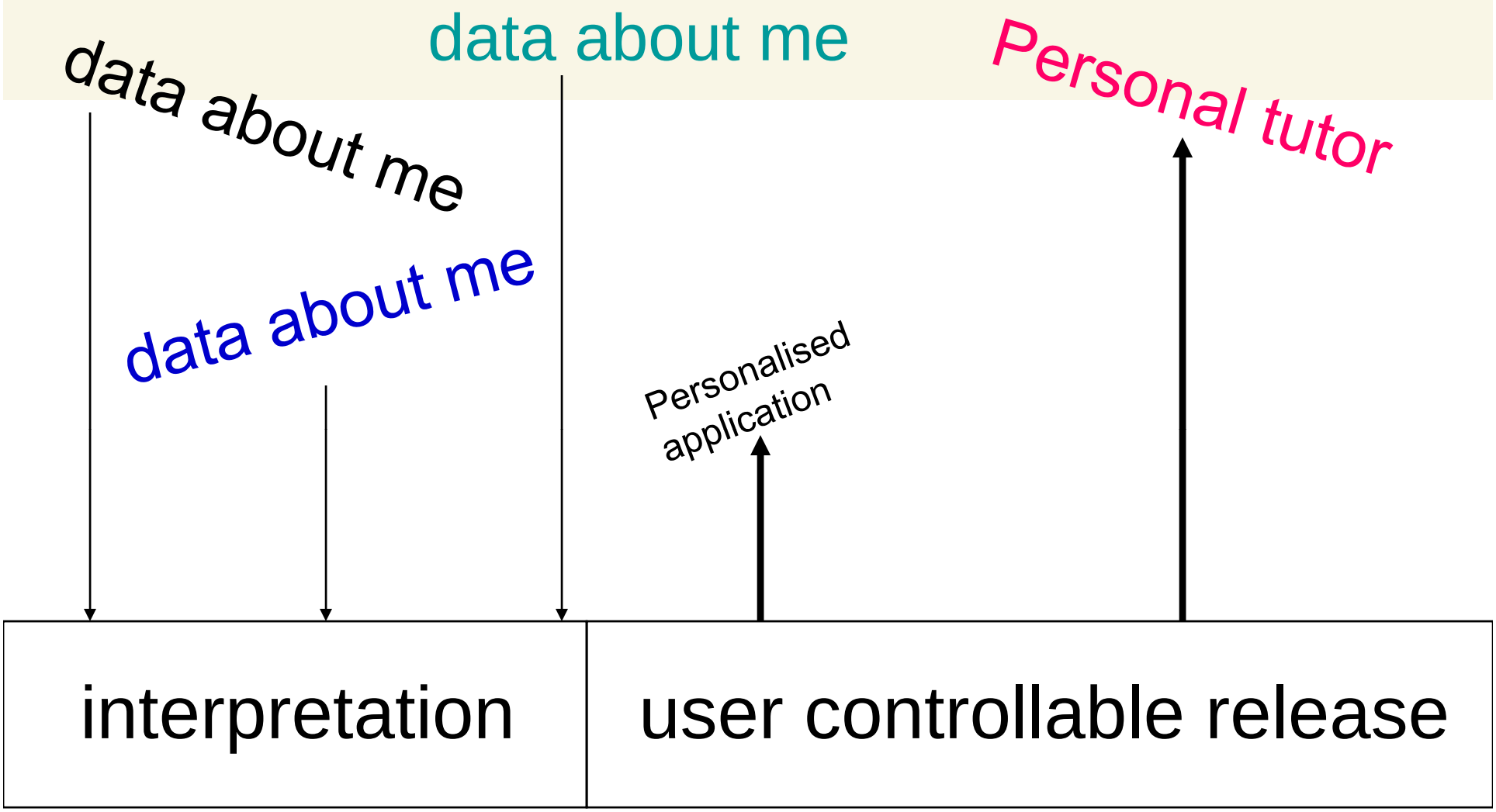
Representation, ontologies

Accretion/Resolution representation

- Accretion:
  - data interpreted to become evidence for belief
  - **ground v inferred**
    - **given (by person, default self)**
    - **observation**
    - **ex-machina**
  - Inferred
    - Stereotype
    - Knowledge-based
- Resolution:
  - Interpretation done just-in-time
  - Many resolvers based on
    - **visibility**
    - **interpretation**
- Compaction and Deletion
- **Privacy**
  - **into** and **out of** model, controlled for each “teacher”

Ontologies, context and namespaces

- Namespaces
  - Context-dependent ontologies
  - Teacher/course level
    - for preferred terms eg iteration, repetition
    - for specific terms eg core concepts
    - for standards of performance & meaning of knowing
    - may not be able to harmonise all cases
    - and it may not matter
- Need for *personalised* ontologies?
- Need for standard ontology syntax and reasoning?
- Need for standard ontologies?
- Episodic memory



Learner/user model

Personis++ user modelling framework goals

- Learner models and user models as first class citizens
- Not just fragments of me locked away in individual systems
- I own my model
- I control the use of my model
  - Releasing parts to people, applications
- My model can be distributed over various machines that I own and use

Potential learner model data about me

- lots of electronic trace data
  - eg web activity, wiki activity
- lots of data silos in **other** people's programs
  - eg LMS
- lots of private data stores, on multiple computers
  - eg photos, mail, documents….
  - Eg at work, home, portable devices
- Increasingly, learner models in ITSs
  - eg cognitive tutors, Mitrovic constraint-based tutors, Aplusix

Lots of ways to interact … data

Lots of ways to share partial learner models

Name

- Achilles
  - Achilles and Patroclus.jpg
  - Achilles Horses
    - Achilles Horse Vase.jpg
    - Achilles Horses Oil Pain
    - Achilles Horses.jpg
    - Achillies Horses O
  - Statue of Achilles
- Cities
- Agamemnon Mask.jpg
- Ambassadors to Agamemnon, In
- Remains
  - Mummies
    - Boy Horus Mummy.jpg
    - Limbs
    - Mummified Cat.jpg
    - Mummy Sign.jpg
    - Mummy Tomb.jpg
  - Painted Remains.jpg
  - Rocks of Troy.jpg
  - Romain Sarcophagus.jpg
- Statues
- Trojan Horse
- Vases
- Weapons

me

rticles
- Nicholson Museum
- Roman Sarcophagus Article.jpg

ct Sheets
- Animals
  - Achilles Horses.pdf
  - Trojan Horse.pdf
- Cities
  - Athens.pdf
  - Mycenae.pdf
  - The Palladion.pdf
  - Troy.pdf
- People
  - Achilles.pdf
  - Agamemnon.pdf
  - Ajax.pdf
  - Andromache.pdf
  - Apollo.pdf
  - Athena.pdf
  - Hector.pdf
  - ypnos.pdf
  - King Priam.pdf
  - Lycia.pdf
  - Olieus.pdf
- Signs

Hector was the eldest son of Priam and Hecuba; he was the husband of Andromache and the father of Astyanax. Hector was the mightiest warrior on the side of Troy during the Trojan War, and he led many of the attacks against the Greek troops. He was eventually killed by Achilles, who was eager to avenge Patroklos' death. Achilles then desecrated Hector's corpse by dragging it behind his chariot before the walls of Troy, and refused to give up the body for burial. Achilles only allowed the body to receive funeral rites after King Priam came to his tent to plead for its return in person.

Older users too

T. Apted, J. Kay, and A. Quigley. Tabletop sharing of digital photographs for the elderly. In *CHI '06: SIGCHI Conf on Human Factors in Computing Systems*, pp 781-790, New York, NY, USA, 2006. ACM Press

Lifelong learner models are special

- From their very foundations, must address issues of
  - privacy
  - user control
- Need to fit into the rest of our lifelong education
  - classroom
  - parents and significant others
  - personal learning
- Other pragmatics
  - distribution, disconnected operation, stale evidence
  - carried? authenticated? cloud?

So many questions…

How much would Nell want my Primer to know about her?
Should Nell's Primer be allowed to talk to Fiona's Primer?
her Mum?
her maths teacher?
her employer?
her partners for her group project.

And your questions?

Framework for user modelling

J. Kay, B. Kummerfeld, and P. Lauder. Personis: a server for user models. In P. D. Bra, P. Brusilovsky, and R. Conejo, editors, *Proceedings of AH 2002, 2nd International Conference on* ***Adaptive Hypermedia and Adaptive Web-Based Systems***, volume 2347 of *Lecture Notes in Computer Science*, pages 203-212. Springer-Verlag (Berlin, Heidelberg), 2002.

D. J. Carmichael, J. Kay, and R. J. Kummerfeld. Consistent modelling of users, devices and sensors in a ubiquitous computing environment. ***User Modeling and User-Adapted Interaction***, 15(3-4):197-234, 2005.

W. Niu and J. Kay. Pervasive personalisation of location information: Personalised context ontology. ***Adaptive Hypermedia and Adaptive Web-Based Systems***, 2008.

W. Niu and J. Kay. Location conflict resolution with an ontology. In *Proceedings of* ***Pervasive*** *2008: 6th International Conference on Pervasive Computing*, 2008.

M. Assad, D. J. Carmichael, J. Kay, and B. Kummerfeld. PersonisAD: Distributed, active, scrutable model framework for context-aware services. In *Proceedings of PERVASIVE 07, 5th International Conference on* ***Pervasive*** *Computing*, volume 4480 of *Lecture Notes in Computer Science*, pages 55-72. Springer, 2007.