Lost fragments from the Diamond Age…
on lifelong learner models, scrutability, reflection, augmented cognition

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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 interact with learner control
- Subtle and human
- Very long term

L1lm + "teachers"

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

- Very long term
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
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 used 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.
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.
Lots of green means learner doing well

Weak aspects visible as red

Overview visualisation
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 PredIIcurtistic/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
Concept: user interface critique (0.80)

You are performing better than average.

Audio Evidence (raw 0.80, contribution 0.80)
The lecture slide **PredHeuristic/8** was attended for a duration of 108 seconds.
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Me v Average
Me v High achievers
Me v IRT prediction

My right to my learner model?
My right to class average...?
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.
Current activities

where user is up to in this activity
Current step in this workflow
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<thead>
<tr>
<th>Concept</th>
<th>Knowledge Level</th>
<th>Examine</th>
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<tr>
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<td></td>
<td></td>
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<tr>
<td>numbering exam questions</td>
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<tr>
<td>develop marking scheme</td>
<td></td>
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<td>setting exam questions</td>
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<tr>
<td>write exam question answers</td>
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<td>advanced student special exam questions</td>
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<tr>
<td>exam aligned with scope and objectives</td>
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<tr>
<td>exam question difficulty</td>
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</tbody>
</table>

Shows how well user knows concept

Access to JITT memory

How JITT interprets evidence
User can control how JITT understands evidence

User can alter teaching agent
<table>
<thead>
<tr>
<th>Timestamp</th>
<th>Knowledge Level</th>
<th>Knowledge Details</th>
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</table>

Eg. Self-rated knowledge

Eg. Accessed document
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
Lifelong modelling – mirrors and mining
Data mining

<table>
<thead>
<tr>
<th>Group</th>
<th>Managers</th>
<th>Developers</th>
<th>Loafers</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>*1</td>
<td>3</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Group 2</td>
<td>*1</td>
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<td>1</td>
<td>2</td>
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<td>Group 3</td>
<td>0</td>
<td>1</td>
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</tr>
<tr>
<td>Group 4</td>
<td>*1</td>
<td>3</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Group 5</td>
<td>3</td>
<td>*1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 6</td>
<td>*1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 7</td>
<td>*1</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

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
Personal tutor

Learner/user model

interpretation

user controllable release

Personalised application
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
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 Patroclus' death. Achilles then disarmed 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

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


