NSW GOVERNMENT Trade & Investment

ICLS 2012 Sydney - Australia

Lifelong learning as a driver for designing pervasive technology....

creating learning technology for the future

Judy Kay

CHAI: Computer Human Adapted Interaction Research Group

School of Information Technologies

University of Sydney

Immediate Past President of the AIED Society

Programme co-Chair ITS2010, General Chair AIED2011, Programme co-Chair Pervasive 2012

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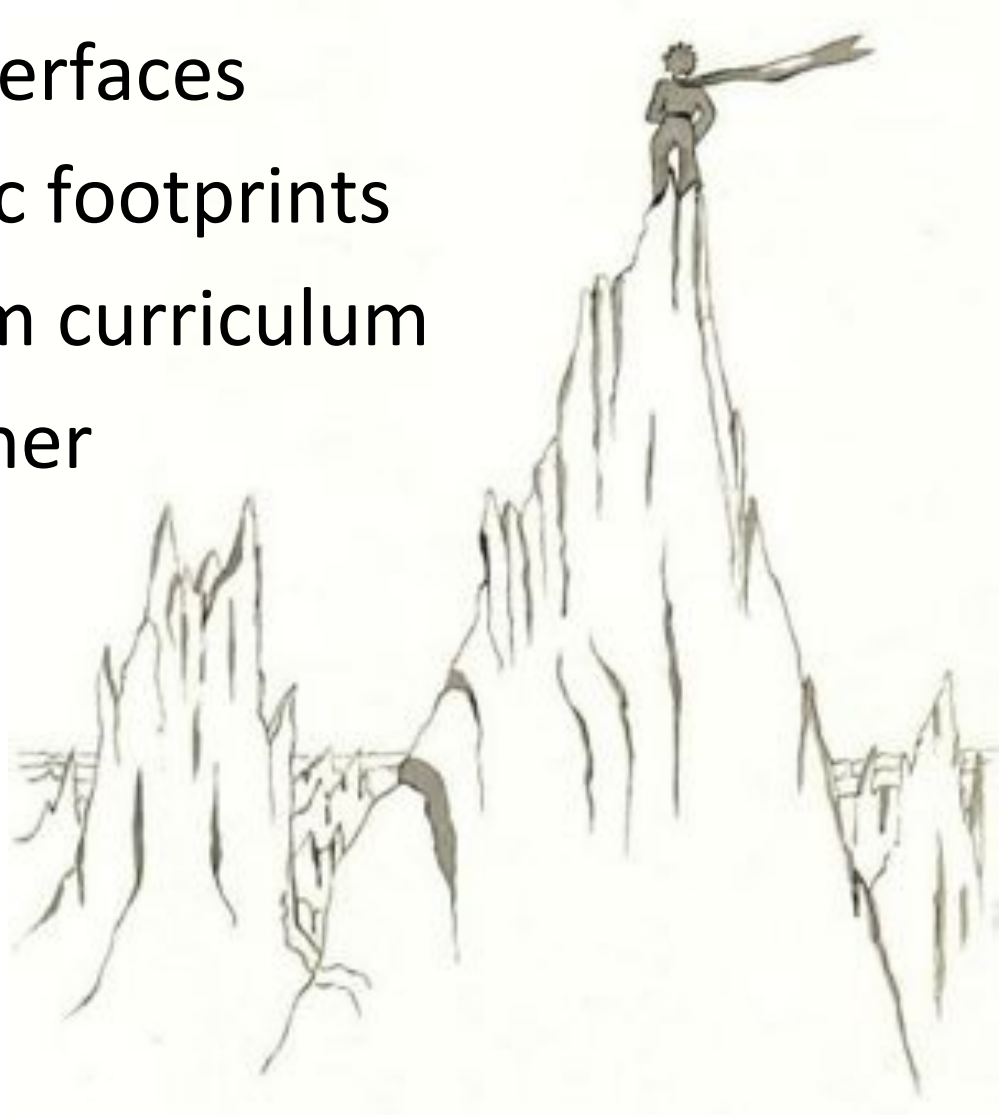
- Sisyphean tasks and lifelong learning
- Novel interfaces
- Electronic footprints
- Long term curriculum
- All together



http://wikilivres.info/wiki/index.php/The_Little_Prince

A personal example

Goal: I want to improve my posture

Improve (maintain) posture

- Tell me when I am:
  - Doing the wrong things eg slouching
  - Being too inactive
- Help me find:
  - "Stuff I've Seen" about posture
  - new things I can do and be inspired to do them
- Help me to:
  - make a plan
  - Remember to do things I planned to do
  - monitor my performance
  - Revise my plans
- Share parts of my learner model with:
  - a health professionals
  - a friend/buddy with similar goals
  - a community of posture improvers

…

This is a Sisyphean Task

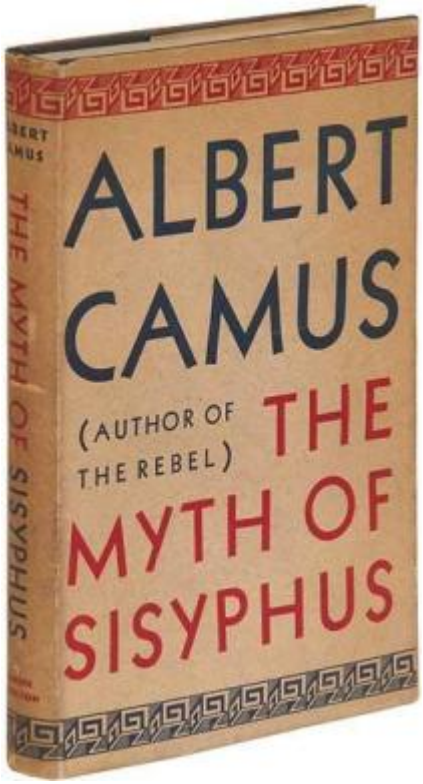
Sisyphus

had to push a rock up a hill

he had to work alone

every day it rolled down as he neared the top

Image: http://coconutheadsets.com/2009/12/29/sisyphus-for-startups/



Camus: "The struggle itself [...] is enough to fill a man's heart. One must imagine Sisyphus happy."

Sisyphean tasks

are done repeatedly

to achieve important *lifelong goals*

perhaps without apparent "progress"

Could it be that Sisyphus had trouble detecting his progress?

Personal Informatics

Know thyself.

QS Quantified Self

self knowledge through numbers

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Another class of Sisyphean tasks

Learn X to 10,000 hour skill level

5,000

Eg X = Programming

- Tell me when I am:
  - Doing the wrong things eg writing spagetti code
  - Being slow in clocking up purposeful practice hours
- Help me find:
  - "Stuff I've Seen" about programming well
  - new things I can do be inspired to do them
- Help me to:
  - make a plan
  - Remember to do things I planned to do
  - monitor my performance
  - Revise my plans
- Share parts of my learner model with:
  - a health professionals
  - a friend/buddy with similar goals
  - a community of programmers …

and examples of really long term tasks

Spaced repetition – to learn and remember vocabulary

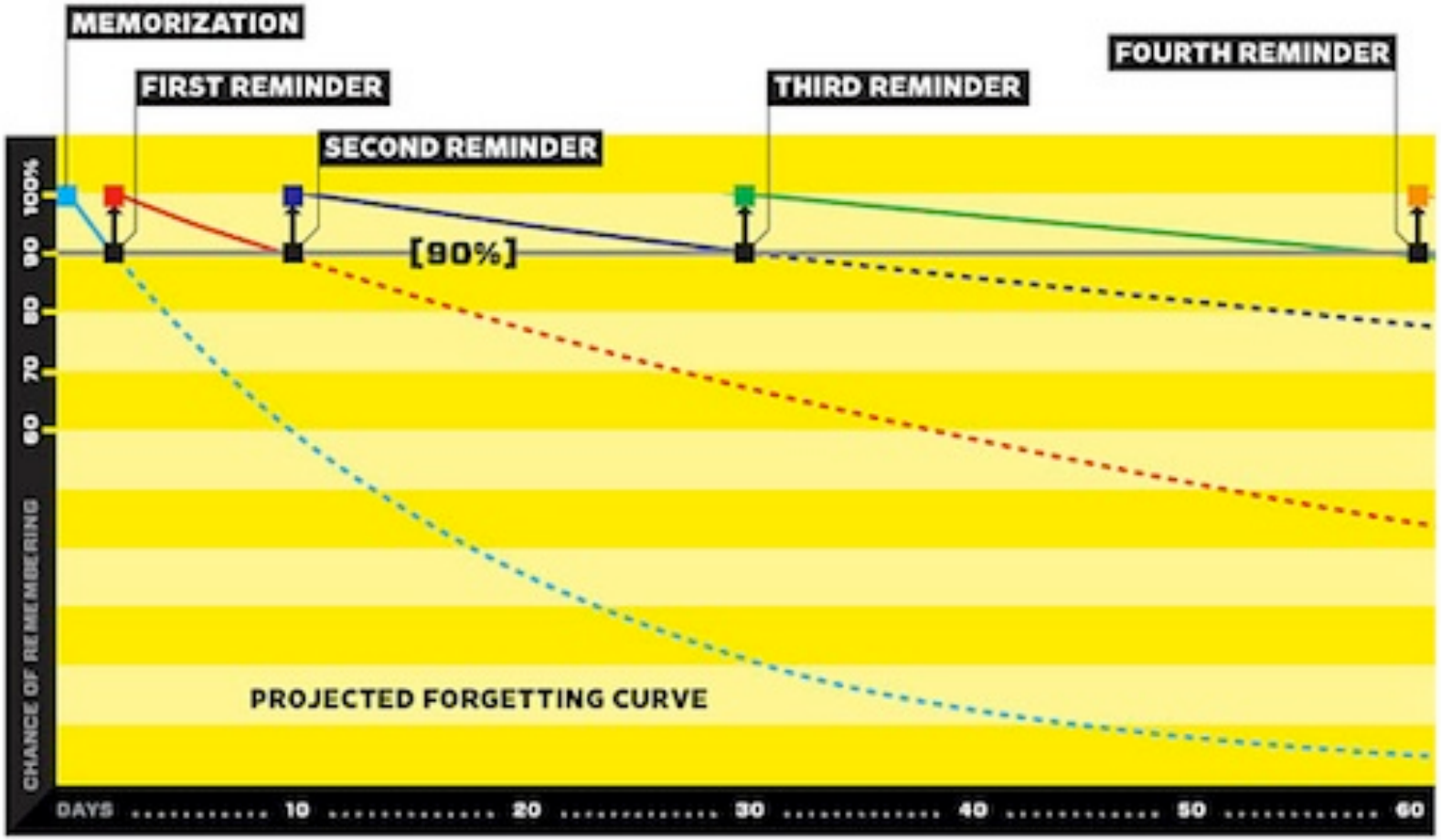
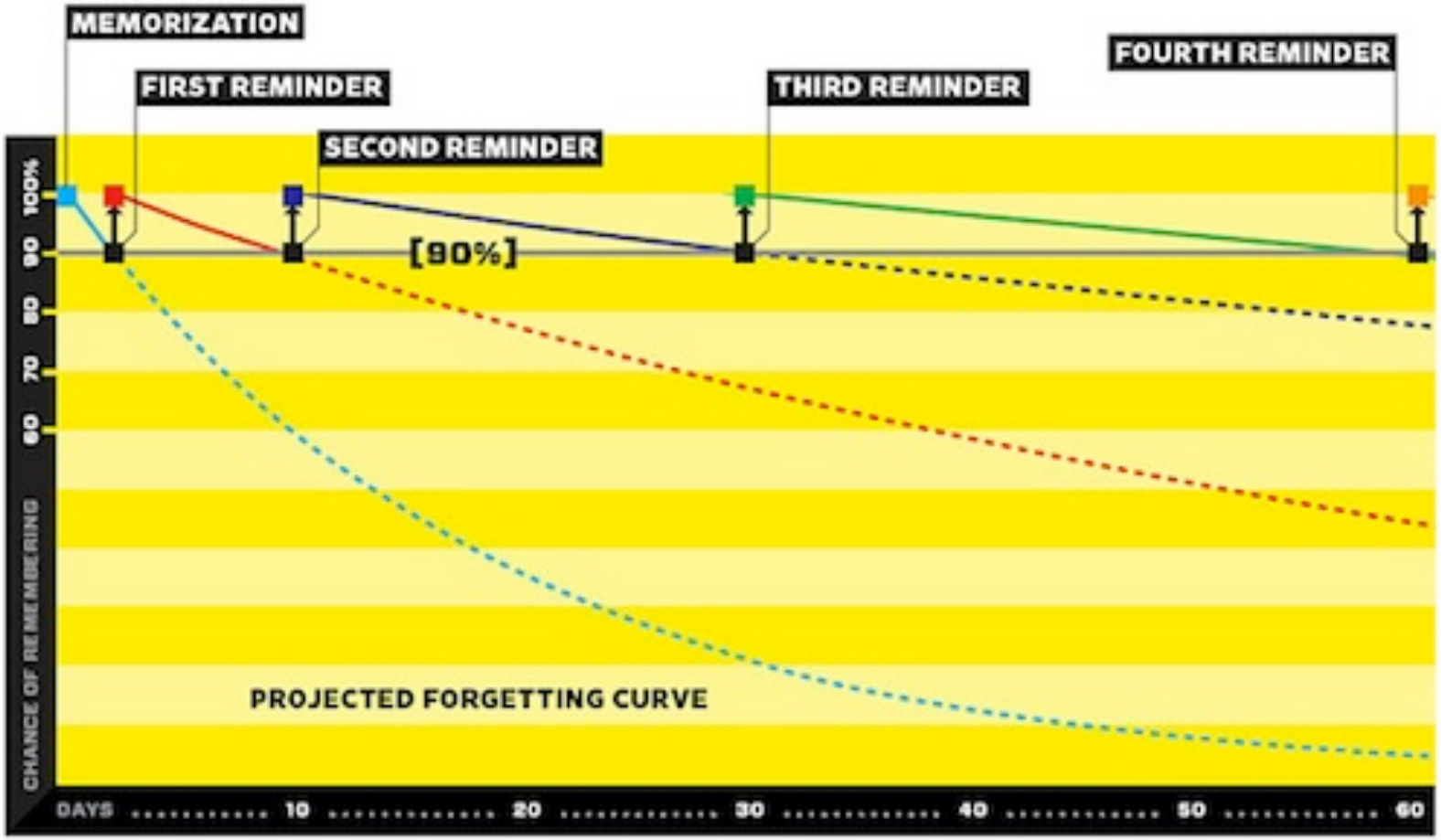


Image: http://quantifiedself.com/

Spaced repetition – to learn and remember chemistry, maths, ...

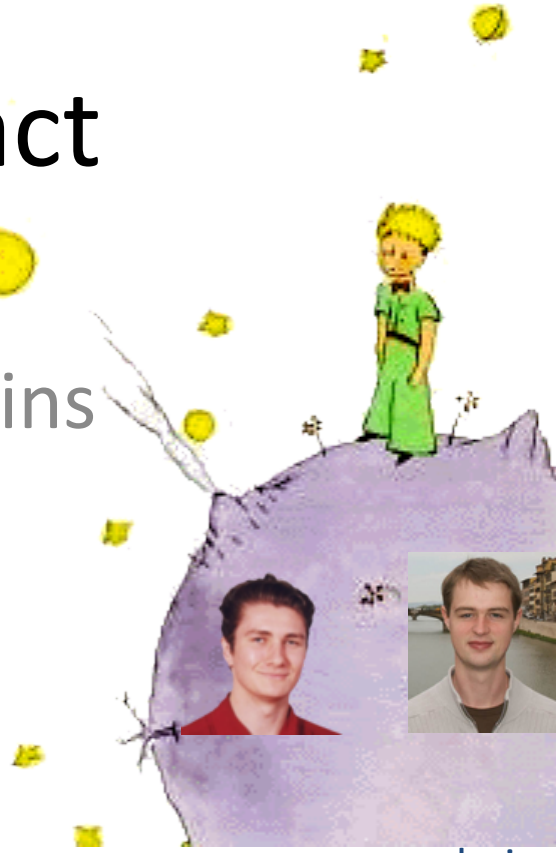


How to get there?
A challenging and long journey…

Kay, J, Pervasive personalised lifelong learning and remembering,
with user model foundations. IEEE Trans on Learning Technologies, 1(4):215-228, 2008.

New ways to interact

Trent Apted, Anthony Collins



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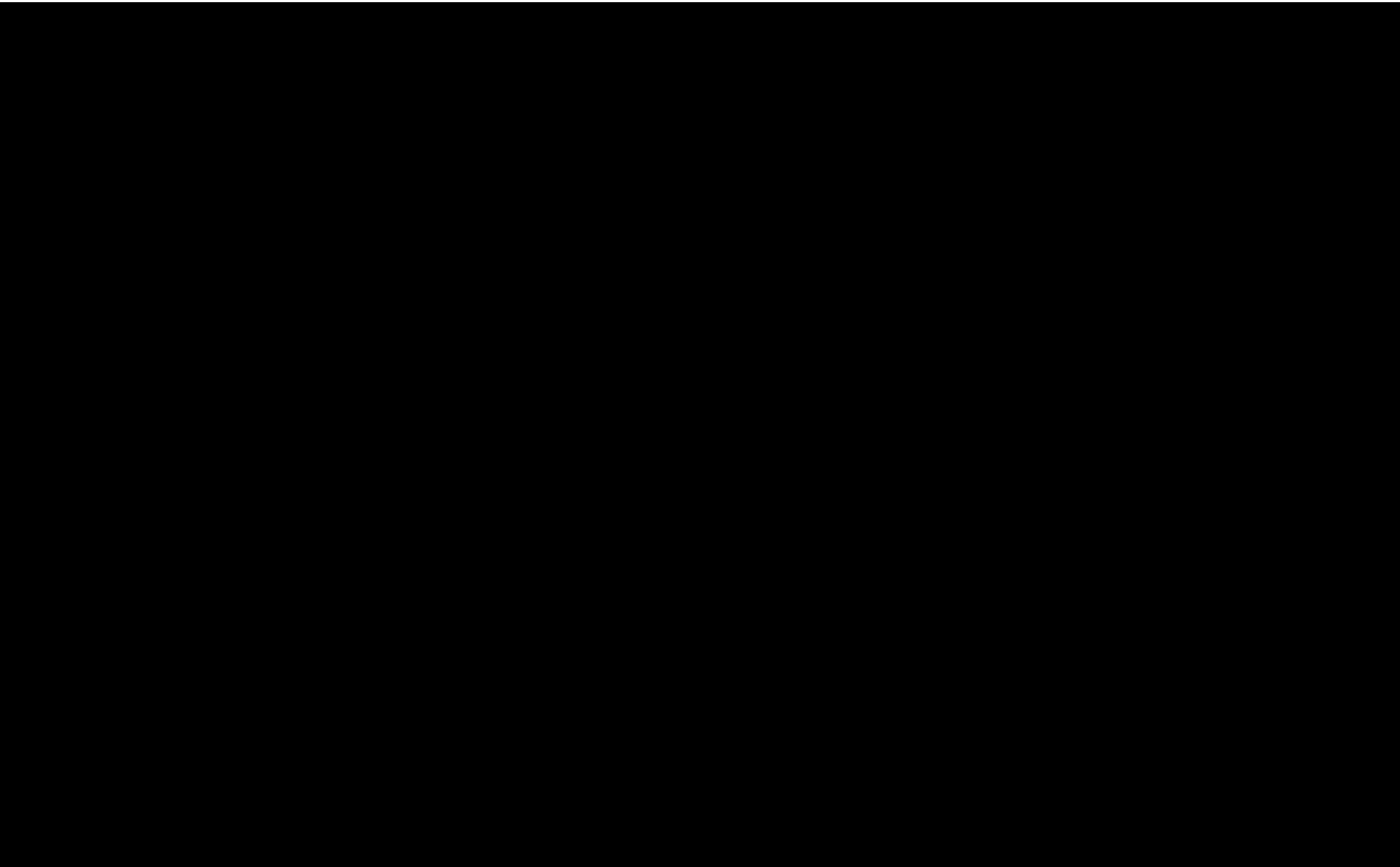
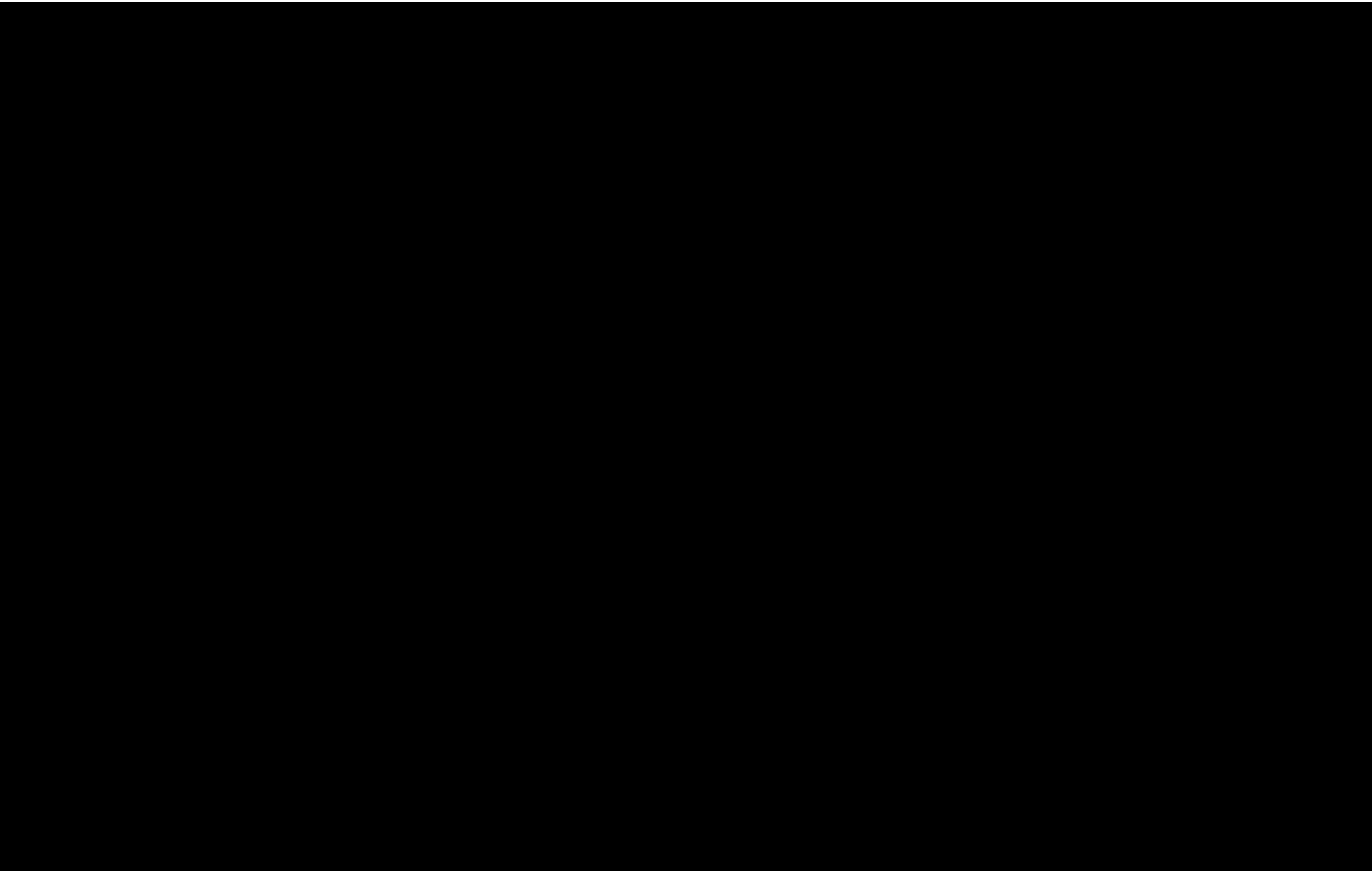
Sydney Sidetracks

Human body information explorer



Exploring collections of resources



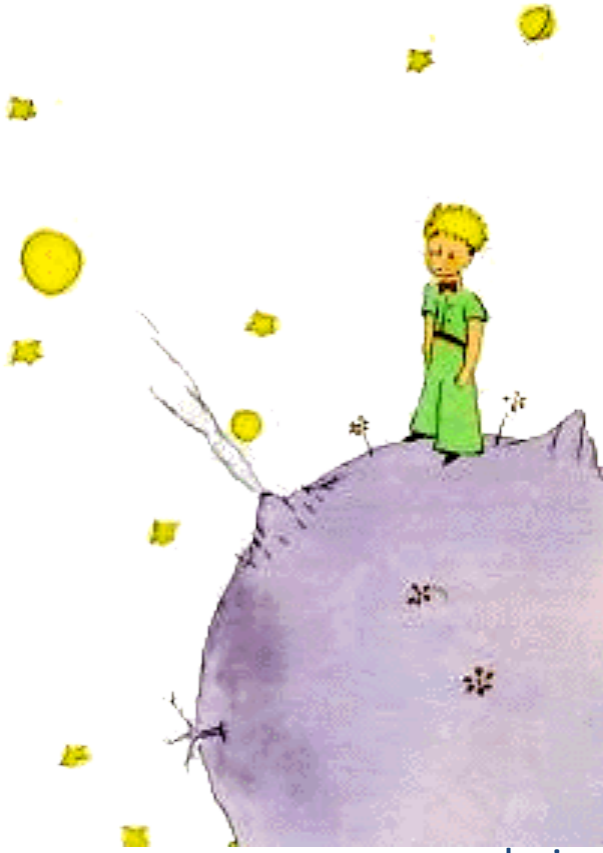
Collaborative maths game

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

New interfaces create possibilities…

… digital footprints
… huge potential for long term modelling
… but …



data about me

data about me

data about me

data about me

data about me

data about me

The challenge of interpretation……

data about me

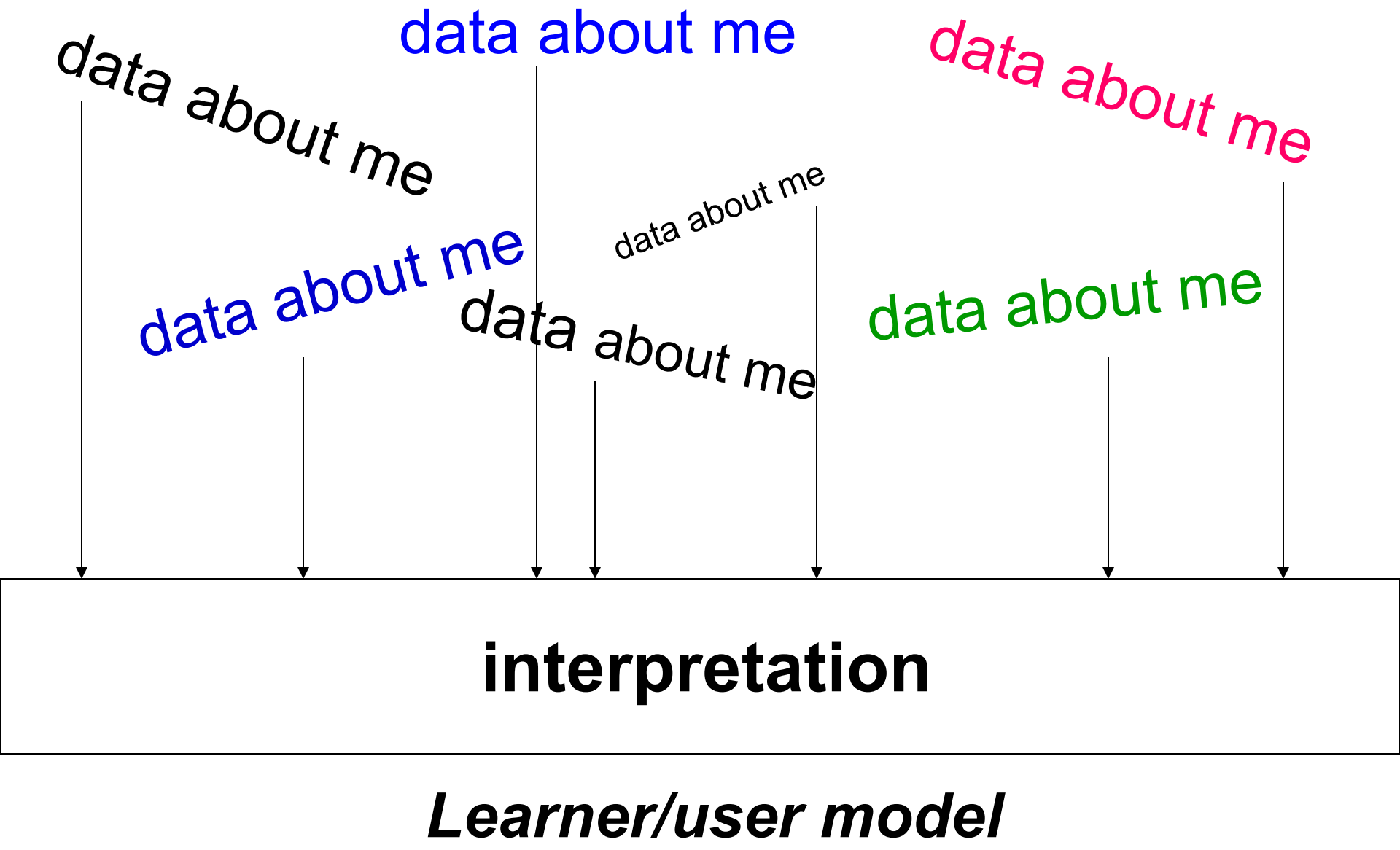
data about me

data about me

data about me

data about me

data about me



Learner/user model

Exploiting electronic traces – mirrors, navigation tools

Kalina Yacef, Peter Reimann, Kim Upton

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We know what we are, but know not what we may be.

Shakespeare

Shakespeare was too generous:

How self-aware are we?

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Case Study:
learning to collaborate

Have you ever had a frustrating group work experience?

Some problems for groups

- Establishing common ground
- Social loafing (free-riding)
- Tend to focus on **action** at the cost of
  - Reflection
  - Attending to psychological needs
- Frustration with quality of interaction
- Feel collaboration overhead too high
- Learning group work skills is hard
- Long term collaboration involves complex skills

Context of our work

Semester long captsone software project

Explicit teaching of group work skills ….

Trac: Tool supporting long term group work

Used by team members, facilitators, teachers, some clients

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TRAC

- open source tool for supporting software development projects

root / **rcwu**

Name	Rev	Age	Last Change
../			
BaseAdminPluginTest.java	48	4 months	rcwu:
EditBlogEntriesPluginTest.java	47	4 months	rcwu:
EditBlogPropertiesPluginTest.java	47	4 months	rcwu:
journal	16	6 months	rcwu: Having problem with installation :
jsptest_r6.zip	49	4 months	rcwu:
junit3.8.1.zip	49	4 months	rcwu:
slog-logo-small.gif	55	4 months	rcwu:
slog-logo-small.jpg	52	4 months	rcwu:
slog-logo.jpg	39	5 months	rcwu:
slog.gif	[illegible]	4 months	rcwu:
slog.jpg	52	4 months	rcwu:

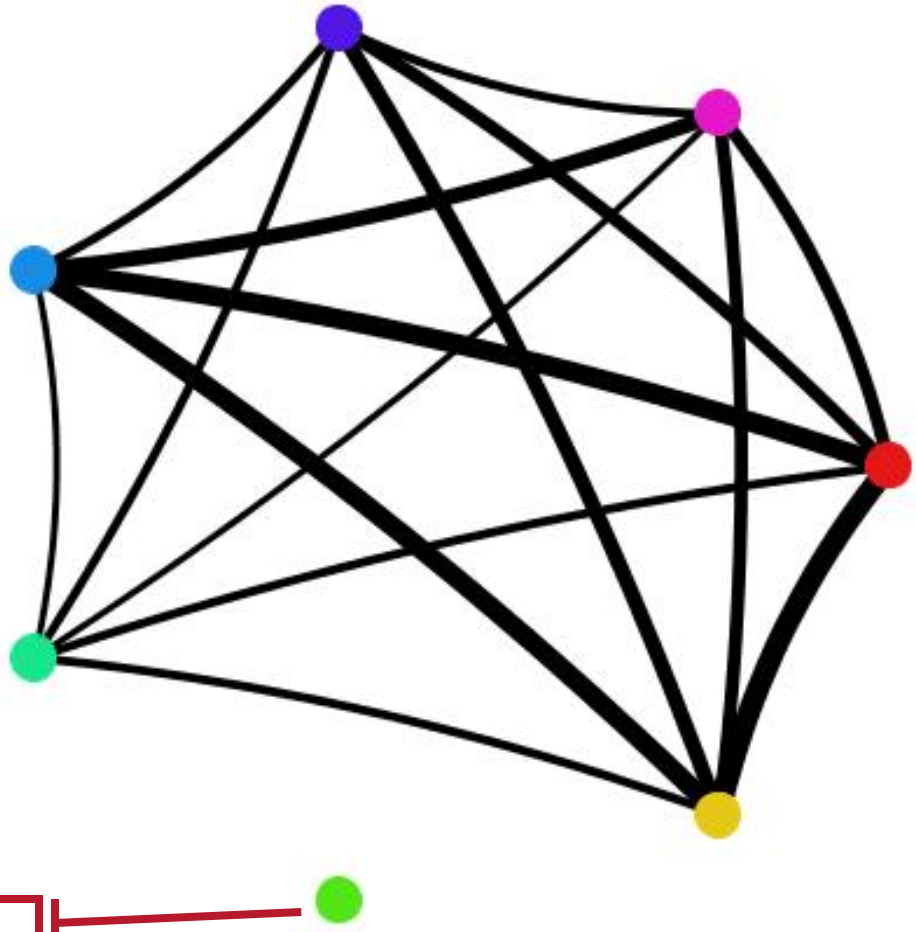
View File

SVN source repository

- Not a learning system but used in a learning context.

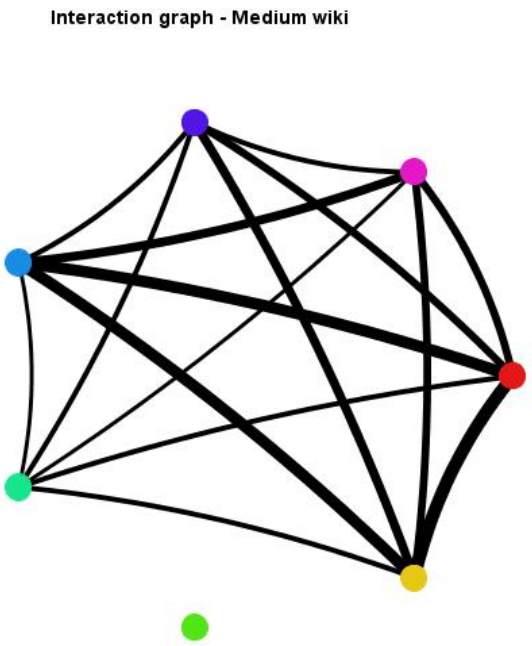
➔ Huge amounts of data about the group members and their interactions

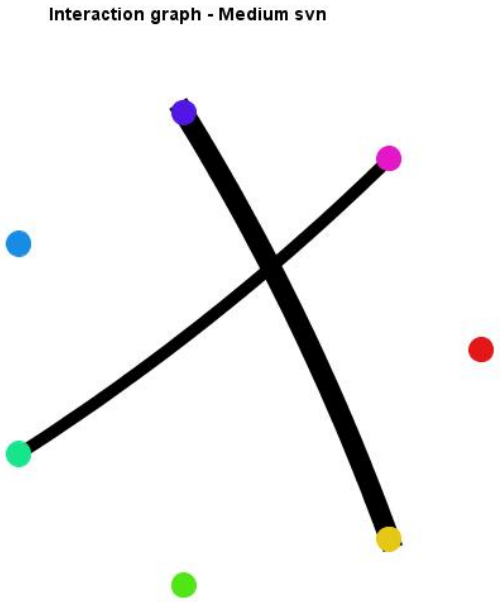
Interaction graph - Medium wiki

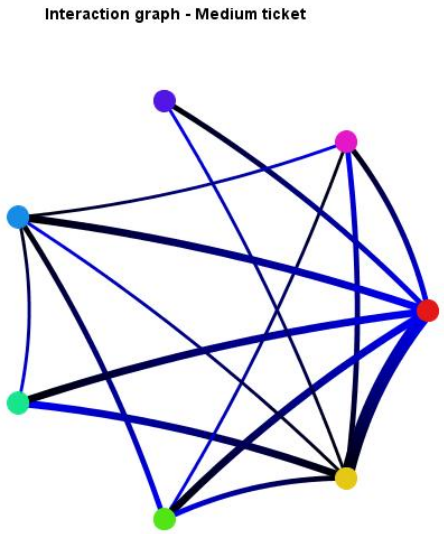


Team Leader

Interaction diagram

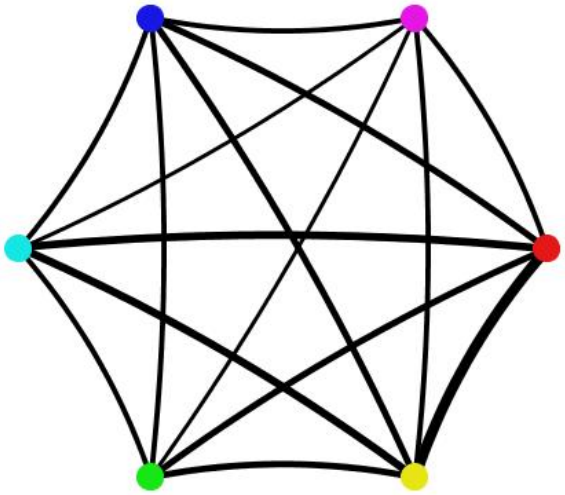




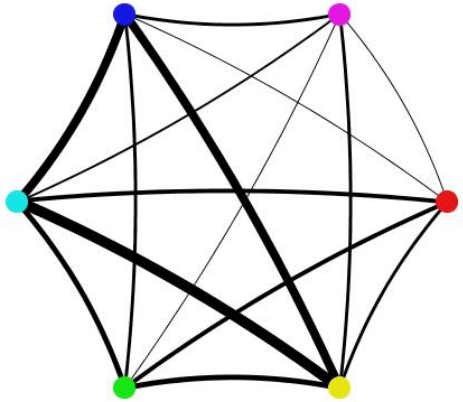


- Same location of people as in activity diagram
- Black is source - blue is sink

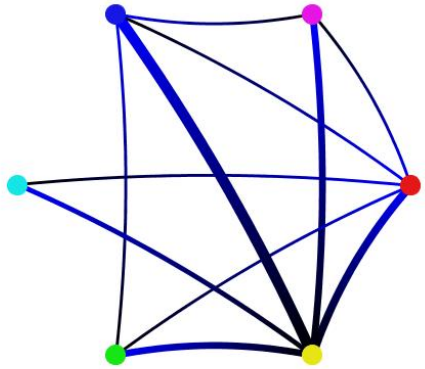
Interaction graph - Medium wiki



Interaction graph - Medium svn

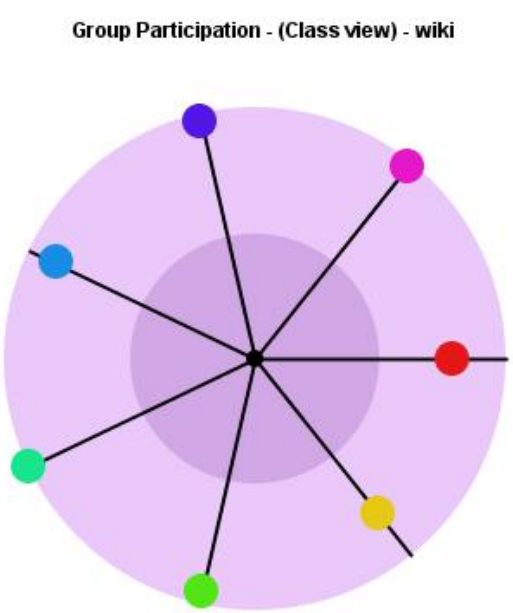


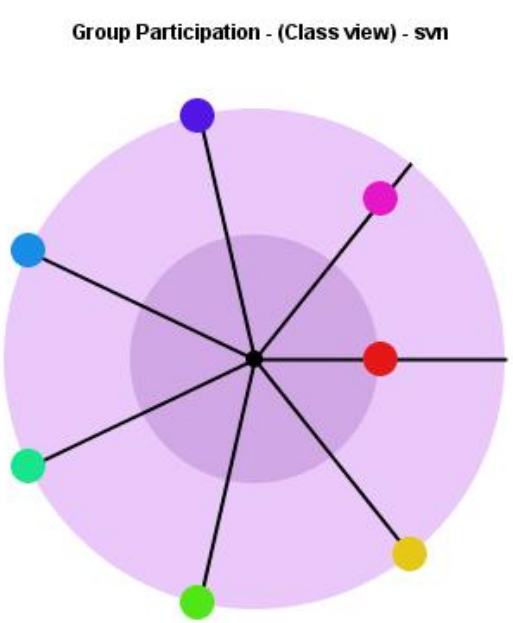
Interaction graph - Medium ticket

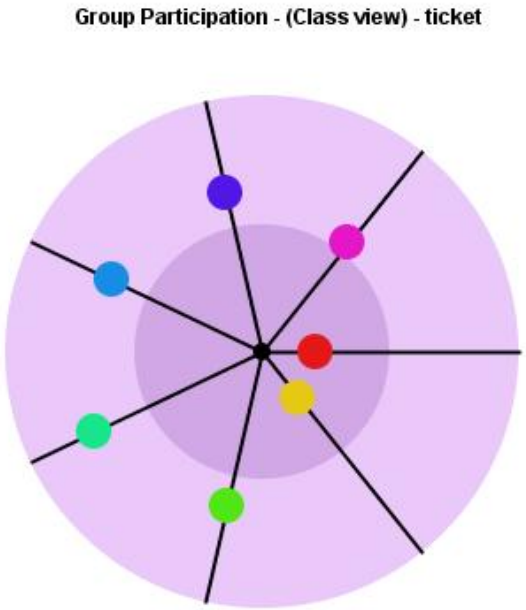


Activity mirrors

Activity radar

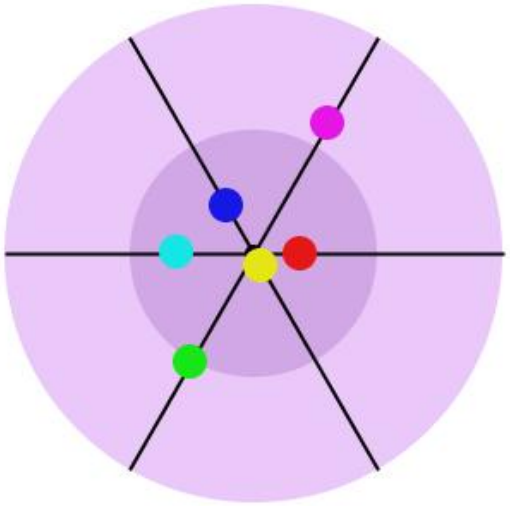




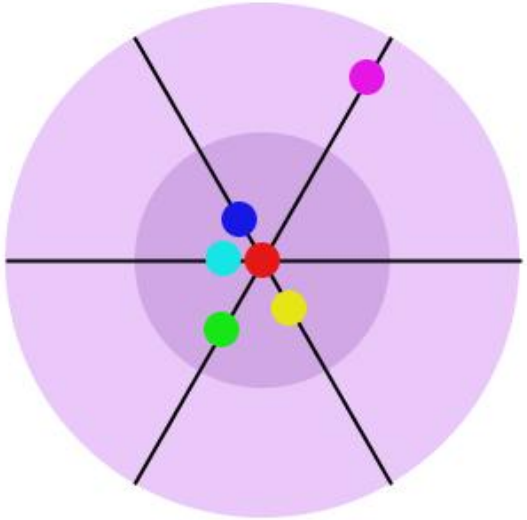


- Each student has consistent colour, clock position
- Closer to centre is more work
- Logarithmic scale

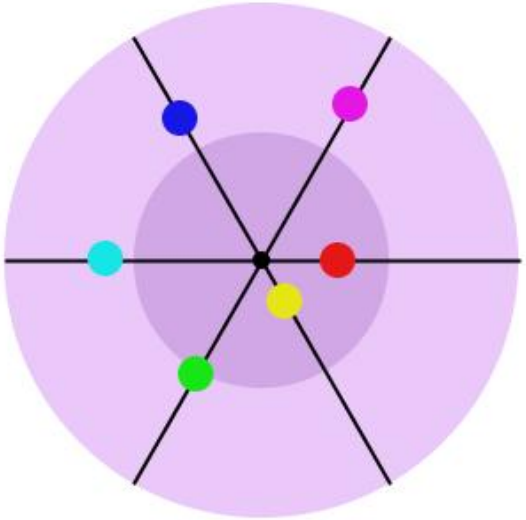
Group Participation - (Class view) - wiki



Group Participation - (Class view) - svn



Group Participation - (Class view) - ticket



DOT GRAPH: TICKET

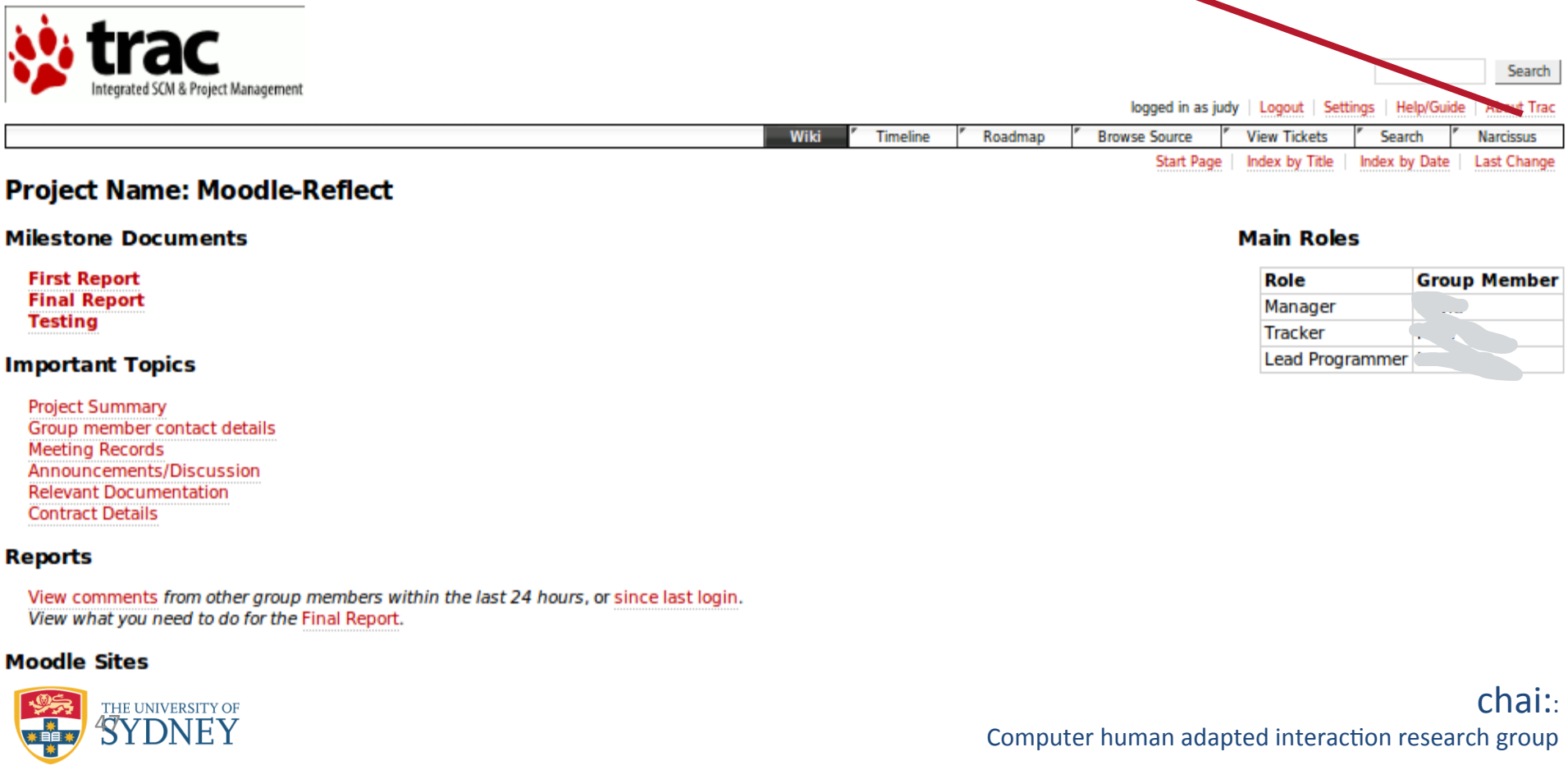
Amount of ticket activity
by each student each day

Narcissus

Upton, K., and J. Kay. (2009) Narcissus: interactive activity mirror for small groups. In UMAP09, User Modeling, Adaptation and Personalisation, Springer-Verlag, 54-65

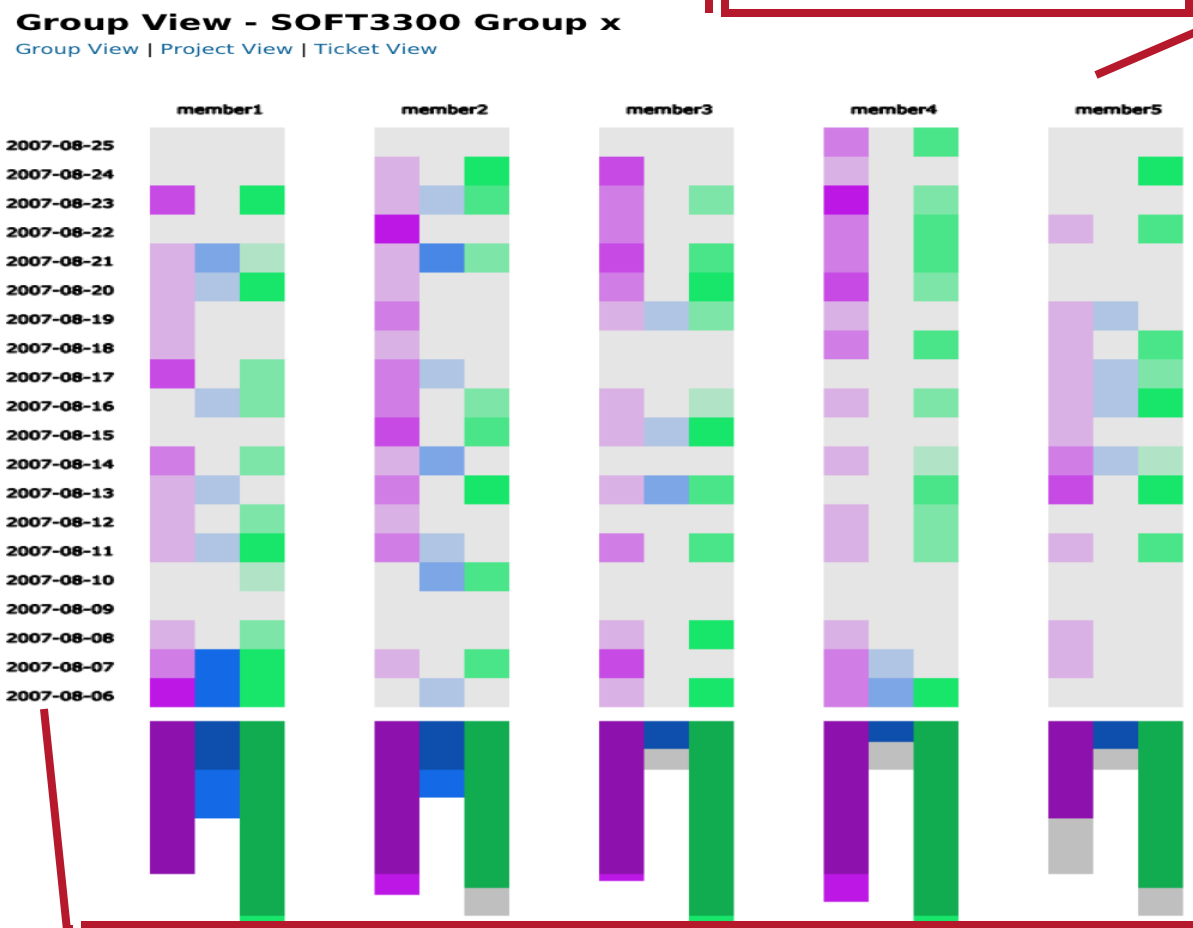
Integrated of mirror tool

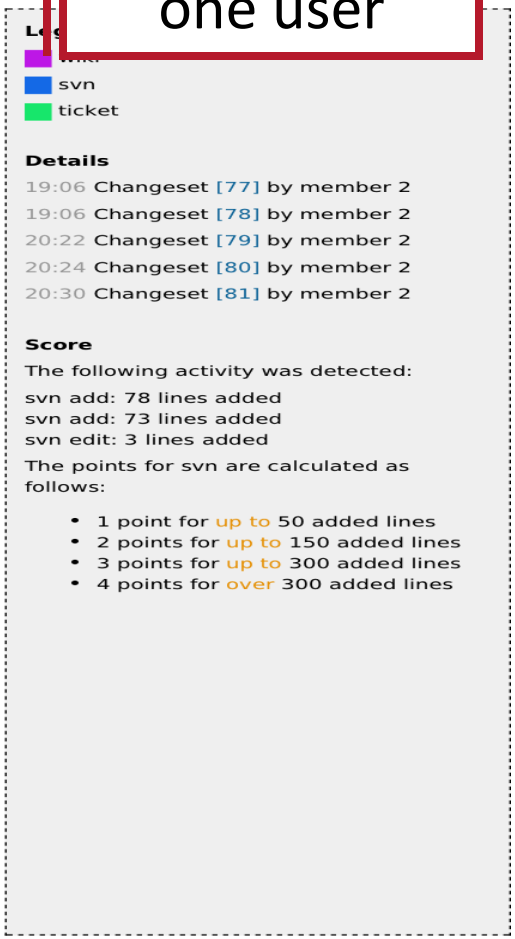
Narcissus tab



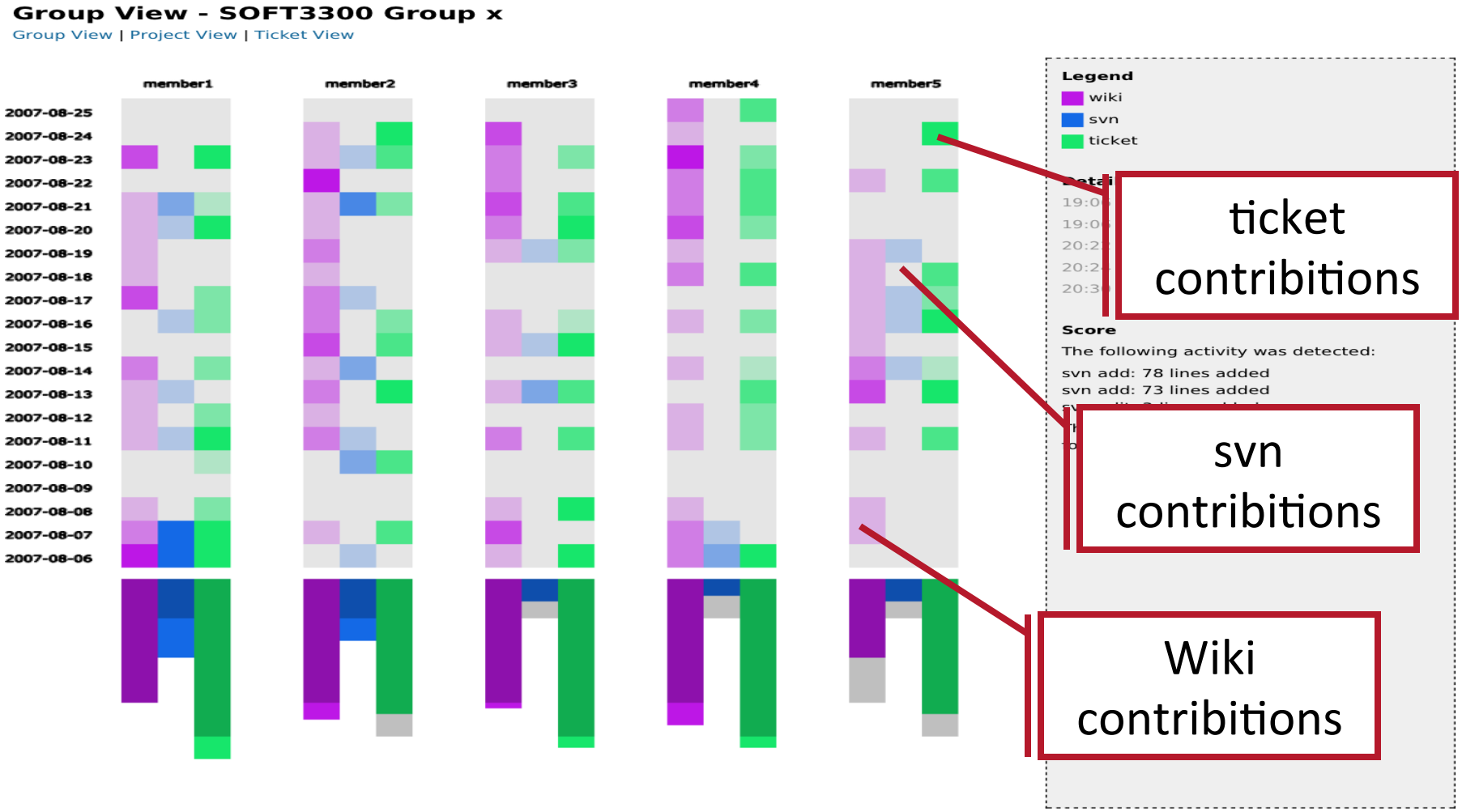
Header – Group view

Display for one user



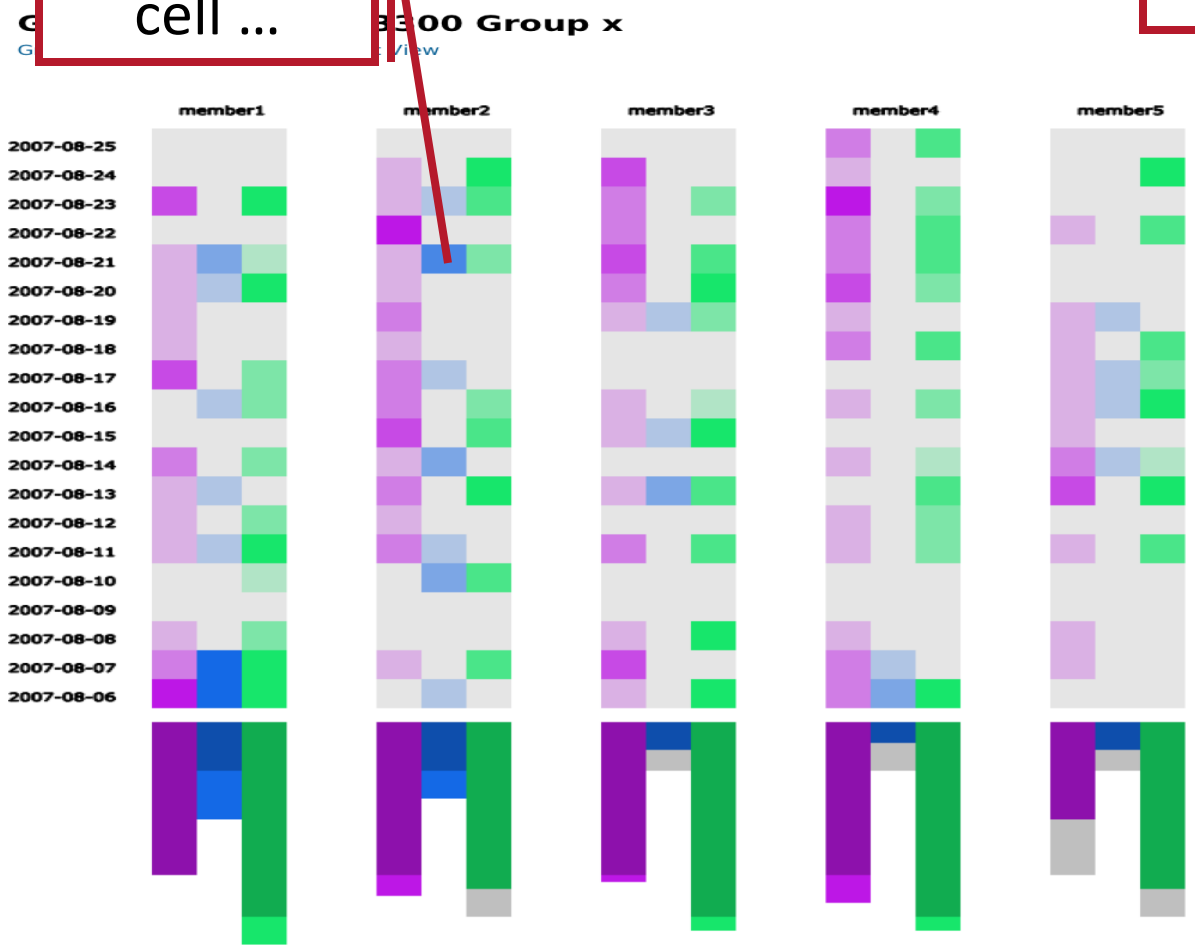


Time – activity on that day is shown for each user, on each medium


Group View - SOFT3300 Group x
Group View | Project View | Ticket View
member1
member2
member3
member4
member5
2007-08-25
2007-08-24
2007-08-23
2007-08-22
2007-08-21
2007-08-20
2007-08-19
2007-08-18
2007-08-17
2007-08-16
2007-08-15
2007-08-14
2007-08-13
2007-08-12
2007-08-11
2007-08-10
2007-08-09
2007-08-08
2007-08-07
2007-08-06
Legend
wiki
svn
ticket
Score
The following activity was detected:
svn add: 78 lines added
svn add: 73 lines added
ticket contribitions
svn contribitions
Wiki contribitions

Click on cell ...

...to see details



Legend

- wiki
- svn
- ticket

Details

19:06 Changeset [77] by member 2
19:06 Changeset [78] by member 2
20:22 Changeset [79] by member 2
20:24 Changeset [80] by member 2
20:30 Changeset [81] by member 2

Score

The following activity was detected:

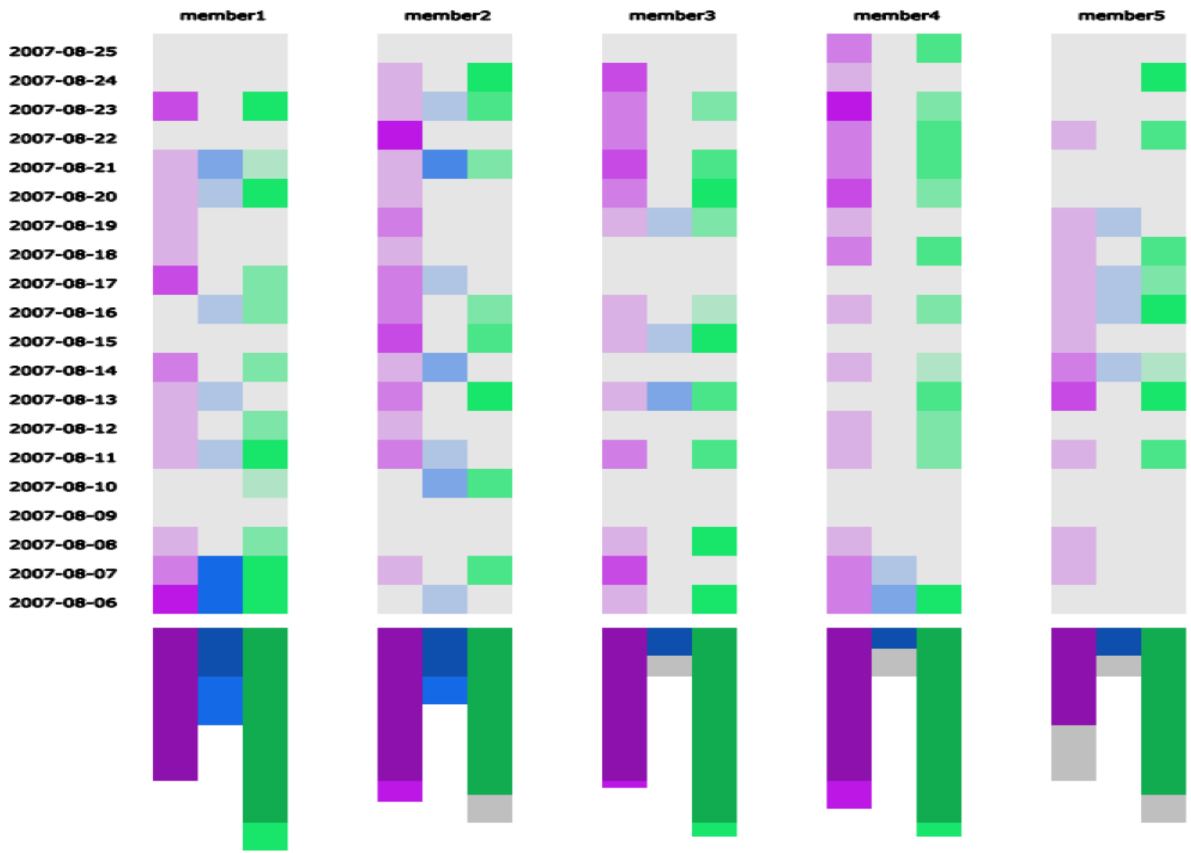
svn add: 78 lines added
svn add: 73 lines added
svn edit: 3 lines added

The points for svn are calculated as follows:

- 1 point for up to 50 added lines
- 2 points for up to 150 added lines
- 3 points for up to 300 added lines
- 4 points for over 300 added lines

Group View - SOFT3300 Group x

Group View | Project View | Ticket View



Legend

- wiki
- svn
- ticket

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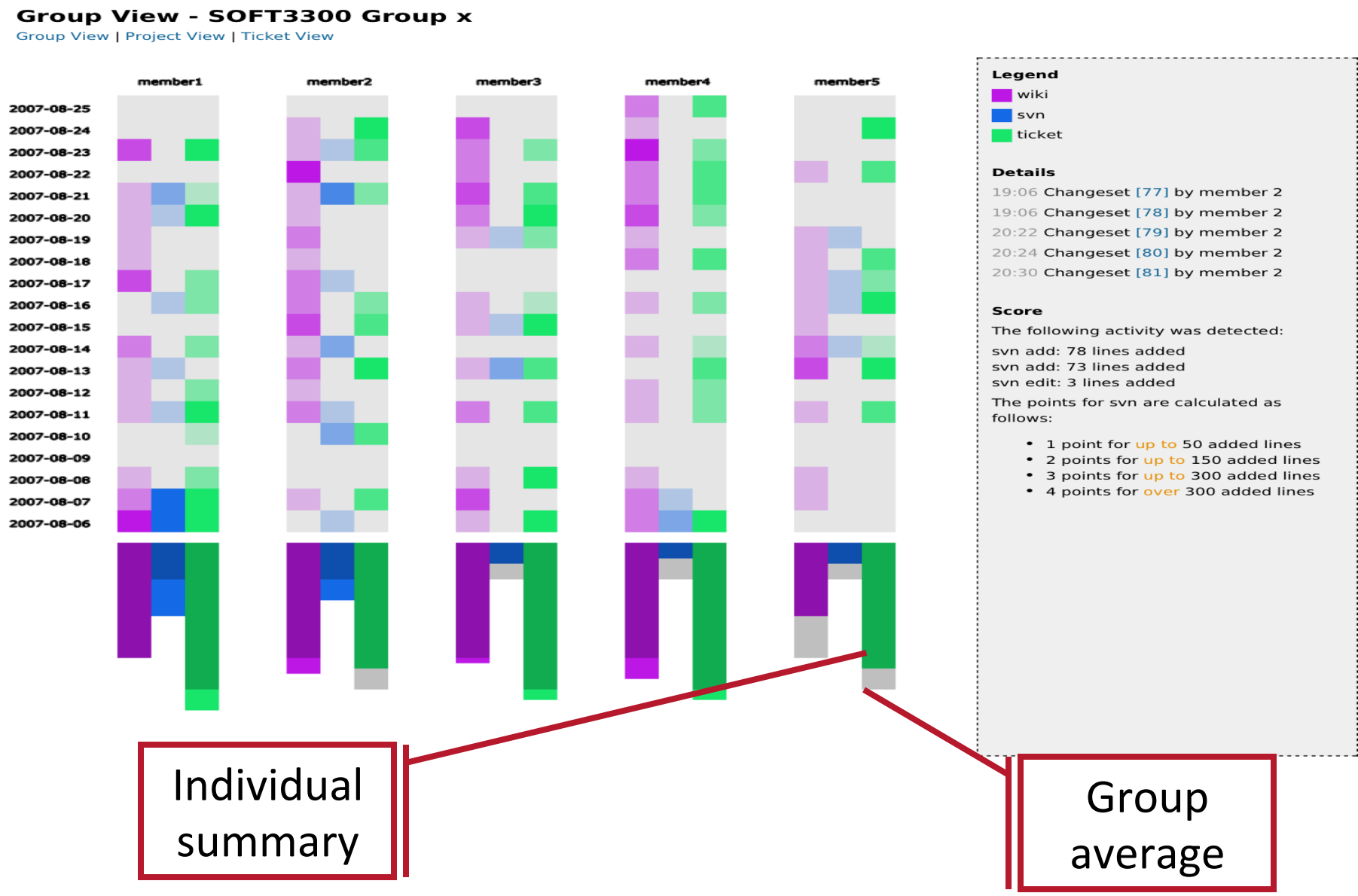
Explains scoring



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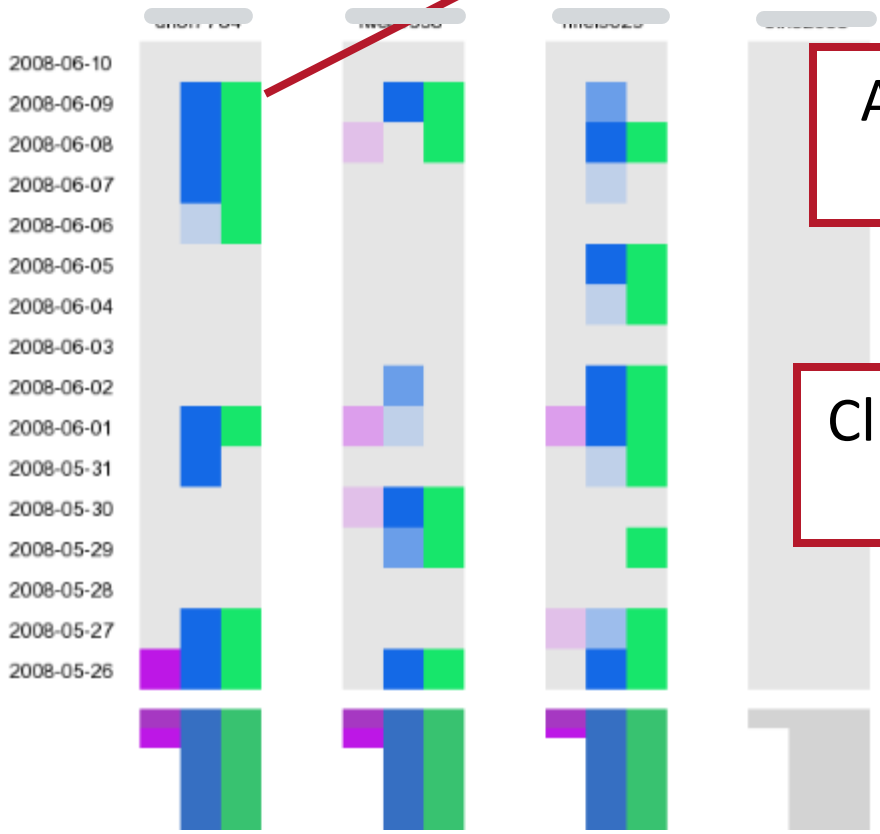
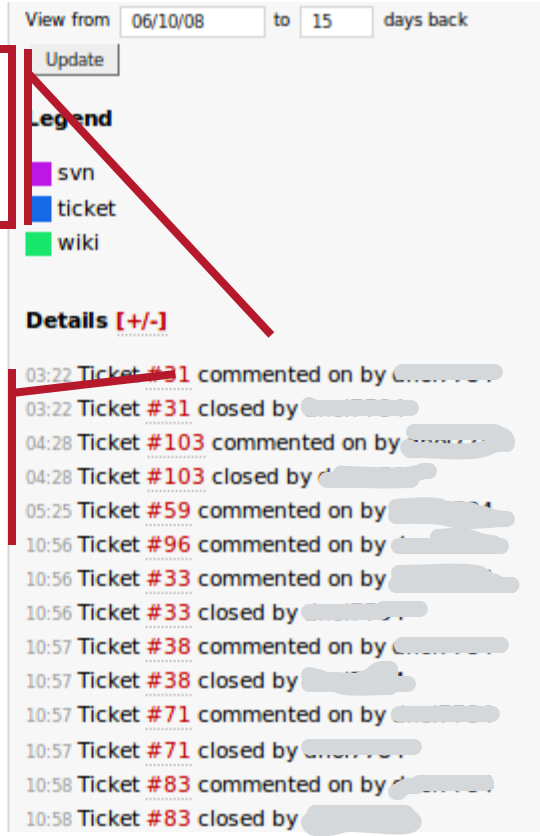
Click on ticket activity for a day

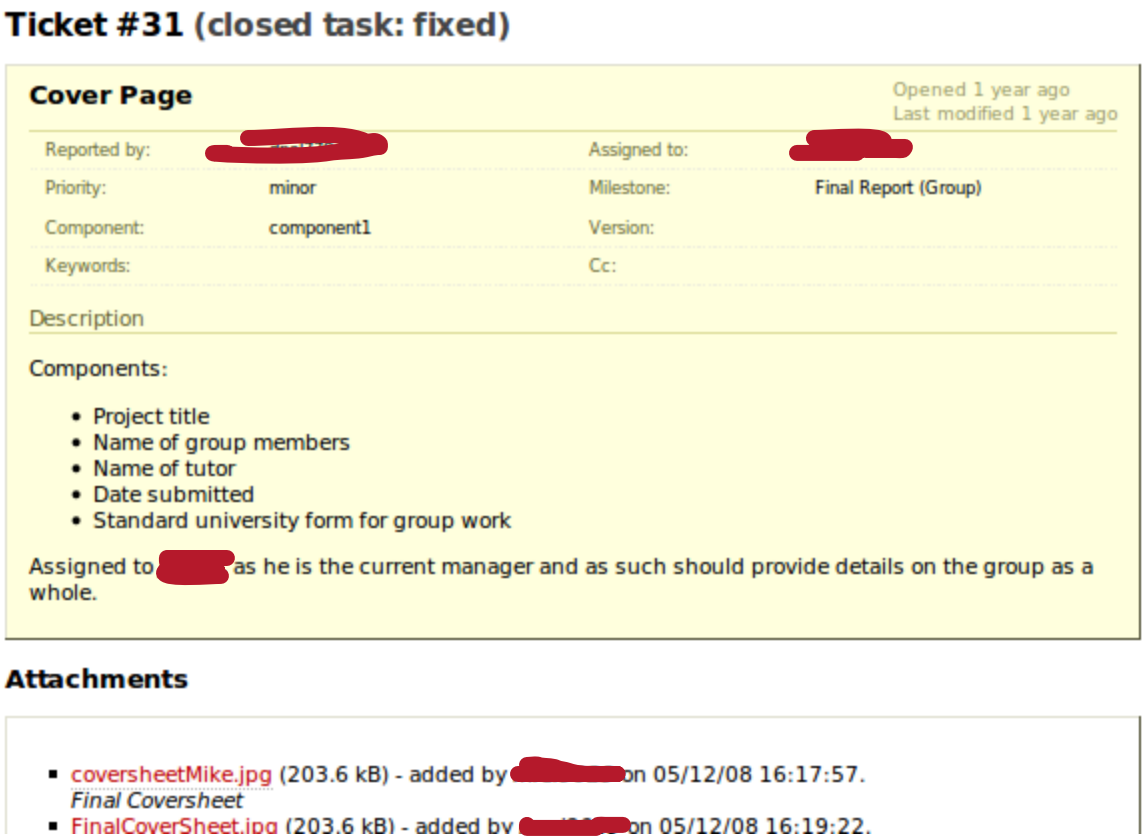
Associated details

Click on ticket label





Details of that ticket



Ticket #31 (closed task: fixed)

Cover Page

Opened 1 year ago
Last modified 1 year ago

Reported by:	[redacted]	Assigned to:	[redacted]
Priority:	minor	Milestone:	Final Report (Group)
Component:	component1	Version:	
Keywords:		Cc:	

Description

Components:

- Project title
- Name of group members
- Name of tutor
- Date submitted
- Standard university form for group work

Assigned to [redacted] as he is the current manager and as such should provide details on the group as a whole.

Attachments

- coversheetMike.jpg (203.6 kB) - added by [redacted] on 05/12/08 16:17:57.
  Final Coversheet
- FinalCoverSheet.jpg (203.6 kB) - added by [redacted] on 05/12/08 16:19:22.

Exploiting electronic traces – EDM
Educational Data Mining

Kalina Yacef, Agathe Merceron, Irena Koprinska, Dilhan Perera, Osmar Zaiane

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Sequence

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		
Group 3	0	1		
Group 4	*1	3	2	0
Group 5	3	*1		
Group 6	*1	1		
Group 7	*1	0		

Group 1 – 3 members had developer activity sequences

Group 3 – dysfunctional and here we might see why

Group 5 – another way to be dysfunctional

Long term learning over 3-5 year Degree Programme

Richard Gluga, Tim Lever, Ray Lister

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CUSP: >200 degrees, >2000 subjects

Faculties of Engineering and IT, Architecture, Health Sciences, Commerce...

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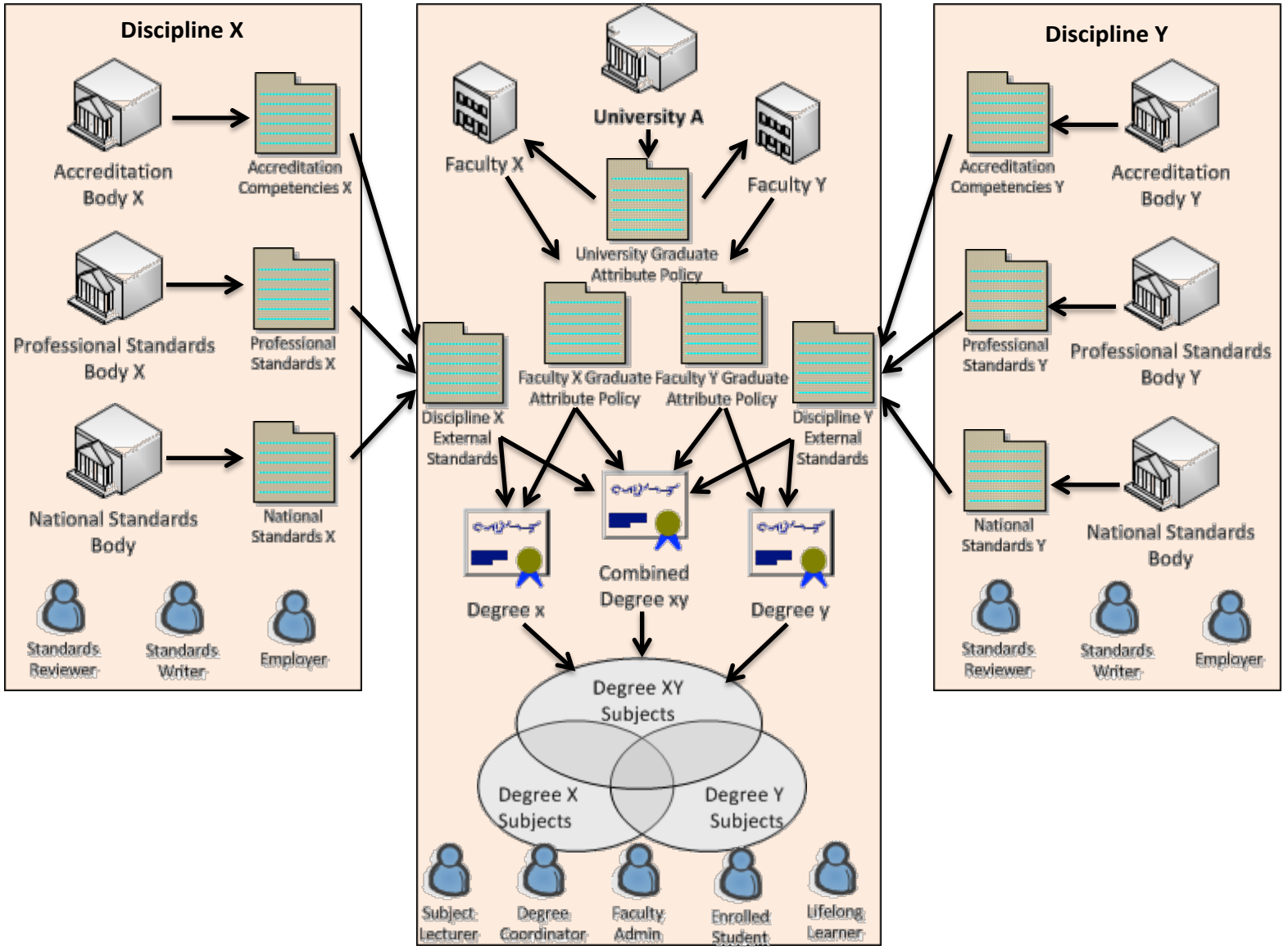
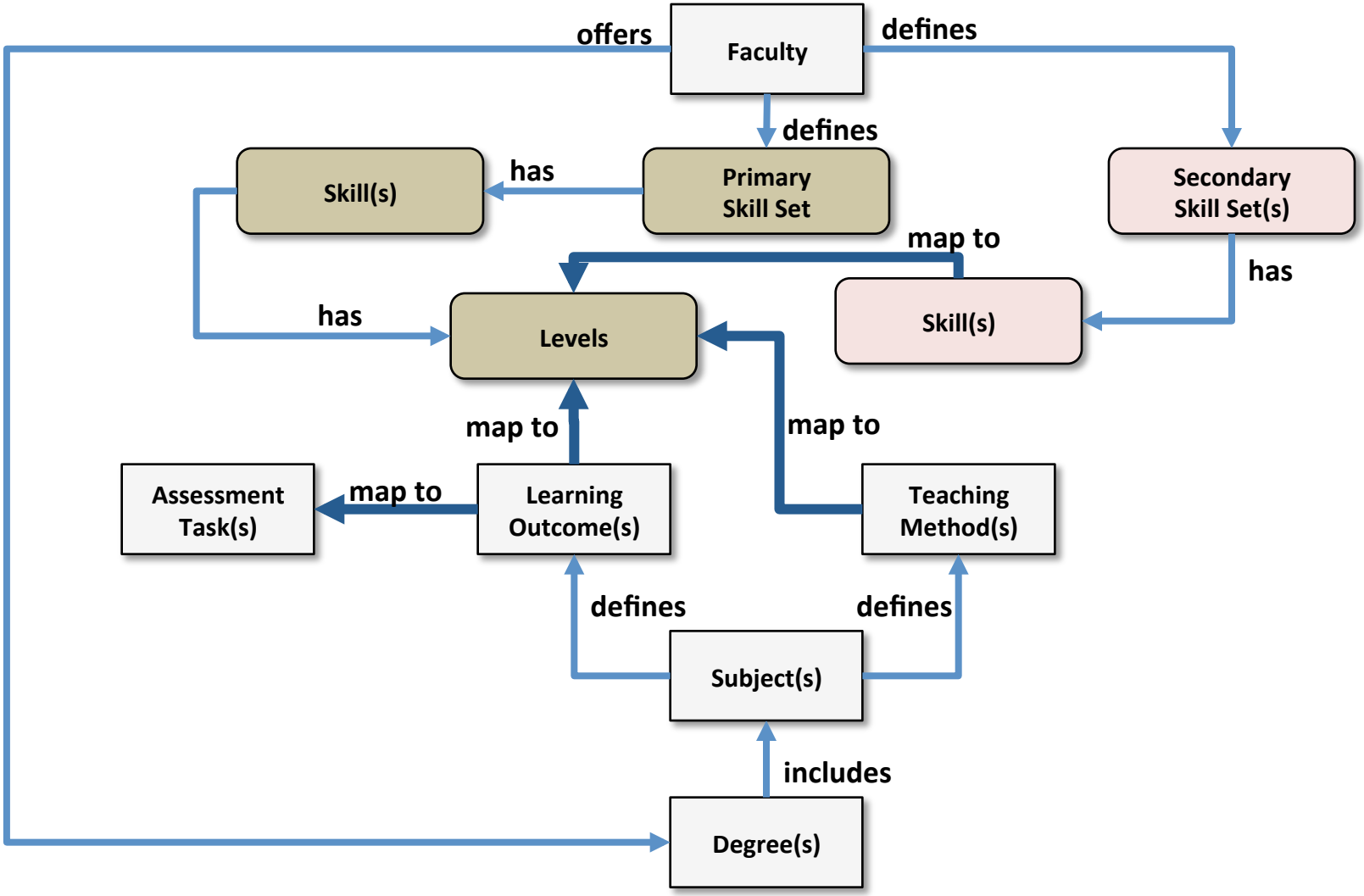
University Degrees & Curriculum Goals




offers
Faculty
defines
defines
Skill(s)
has
Primary
Skill Set
Secondary
Skill Set(s)
map to
has
has
Levels
Skill(s)
map to
map to
Assessment
Task(s)
map to
Learning
Outcome(s)
Teaching
Method(s)
defines
defines
Subject(s)
includes
Degree(s)

Individual Subject view – for Lecturer

Units › COMP2007: Algorithms and Complexity › 2010 - Semester 2 (Open)

Created: 2009-10-14 21:56:11.94, Last Updated: 2010-05-20 10:56:48.442444, admin, Lockdown Date: , Release Date:

Submit for Review **WARNING: Version is *Open!* *Submit for Review* to mark for approval!**

Download UoS Outline | Student View

Handbook | Requirements | Teaching | Attributes | Outcomes | Assessments | Resources | Schedule | Course Map | Reports

Report: Attribute Summary - Full Show

Attributes from Engineering & IT Graduate Attribute Matrix that are practiced or assessed in this unit.

Print View

Course Goal/Attribute	Practiced?	Assessed by?
1) Design and Problem Solving Skills **(Level 2)**	Yes	Assignment (20.00%), Quiz (20.00%), Final Exam (60.00%),
2) Discipline Specific Expertise **(Level 2)**	Yes	Assignment (20.00%),
Direct equivalents		
Knowledge of the major technical areas comprising least one engineering discipline, and competence in applying mathematics, science and engineering science to the analysis and solution of representative problems, situations and challenges in those areas [EAStage1: PE1.2a]		
Knowledge of materials and resources relevant to the discipline, and their main prorties, and ability to select appropriate materials and techniques for particular objectives [EAStage1: PE1.2b]		
Indirect equivalents		
3) Fundamentals of Science and Engineering **(Level 2)**	Yes	Quiz (20.00%), Final Exam (60.00%),
4) Information Skills **(Level 2)**	Yes	
5) Professional Communication **(Level 2)**	Yes	
6) Professional Values, Judgement and Conduct **(Level 1)**	No	

CUSP Degree Level view – for Lecturer, Degree Co-ordinator

Detailed Program Attribute Assessment - Engineering & IT Graduate Attribute Matrix (or Equivalents)

This report shows a detailed breakdown of attribute assessment data. Note that for Unit Blocks containing electives we take a pessimistic approach and determine the minimum possible assessment weight for each attribute level. This is calculated based on the Unit Block Min CP and Free Elective CP values.

	No Level	Level 1	Level 2	Level 3	Level 4	Level 5
1: Design and Problem Solving Skills		CORE:	CORE:	CORE:	CORE:	Adv Recommended

CORE:

Unit	CP	W	CPEW
ELEC1601	6	0.03	0.18
ENGG1805	6	0.1	0.59
CPEW Min Sum			*0.77*

Yr1 Recommended

Unit	CP	W	CPEW
ELEC1103	6	0.17	0.99
CPEW Min Sum			*0*

CORE:

Unit	CP	W	CPEW
INFO2110	6	0.1	0.58
INFO2120	6	0.11	0.63
INFO1105	6	0.14	0.84
COMP2007	6	0.47	2.84
CPEW Min Sum			*4.89*

Yr2 Recommended

Unit	CP	W	CPEW
ELEC2302	6	0.13	0.78
ELEC2104	6	0.15	0.89
ELEC2103	6	0.3	1.82
CPEW Min Sum			*0*

CORE:

Unit	CP	W	CPEW
ELEC4702	0	0.14	0
INFO3220	6	0.15	0.89
ELEC3609	6	0.24	1.43
INFO3315	6	1	6
CPEW Min Sum			*8.32*

Yr2 Recommended

Unit	CP	W	CPEW
ELEC2602	6	0.55	3.28
CPEW Min Sum			*0*

Adv Recommended

Unit	CP	W	CPEW
ELEC3304	6	0.01	0.08
ELEC3607	6	0.03	0.15
COMP5114	6	0.13	0.79
ELEC3305	6	0.01	0.08
ELEC3203	6	0.19	1.15
ELEC3505	6	0.35	2.1
ELEC4706	6	0.2	1.2
ELEC3404	6	0.15	0.9
ELEC3104	6	0.5	3
ELEC3206	6	0.62	3.74
COMP3109	6	0.5	3
CPEW Min Sum			*0*

CORE:

Unit	CP	W	CPEW
COMP3615	6	0.15	0.88
ELEC5618	6	0.18	1.05
ELEC5619	6	0.24	1.44
ELEC4710	6	0.29	1.71
ELEC4711	6	0.35	2.13
CPEW Min Sum			*7.21*

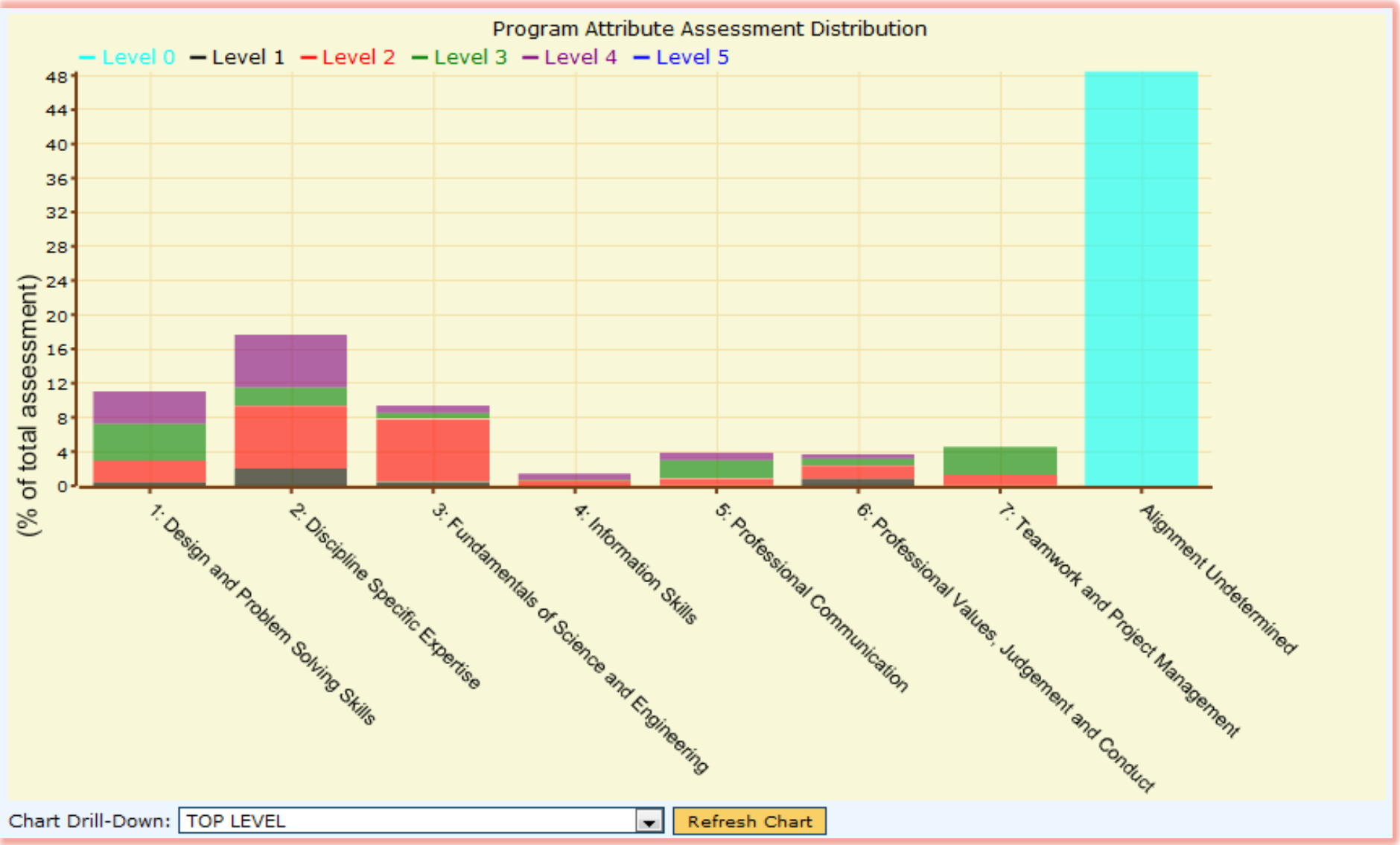
Adv Recommended

Unit	CP	W	CPEW
ELEC4605	6	0.02	0.12
ELEC4505	6	0.05	0.3
ELEC3802	6	0.05	0.3
ELEC5204	6	0.14	0.83
ELEC5402	6	0.04	0.25
ELEC5509	6	0.1	0.6
ELEC5510	6	0.24	1.45
ELEC5511	6	0.15	0.9
ELEC5616	6	0.32	1.9
ELEC5514	6	0.2	1.2
ELEC5508	6	0.29	1.76
ELEC5507	6	0.22	1.31
ELEC5205	6	0.06	0.38
ELEC3506	6	0.24	1.45
ELEC5206	6	0.24	1.42
ELEC5303	6	0.29	1.76
ELEC5101	6	0.18	1.06
ELEC3405	6	0.16	0.93

Adv Recommended

Unit	CP	W	CPEW
COMP5318	6	0.04	0.23
COMP3308	6	0.35	2.09
COMP3608	6	0.35	2.09
INFO3504	6	0.22	1.34
COMP3520	6	0.08	0.45
COMP3456	6	0.21	1.25
COMP5426	6	0.1	0.6
INFO6007	6	0.6	3.6
COMP5028	6	0.65	3.9
COMP5047	6	0.84	5.02
CPEW Min Sum			*0*

Degree level summary of levels and broad areas



One Accreditation View

Detailed Program Attribute Assessment - Stage 1 Competency Standards for Professional Engineers (or Equivalents)

This report shows a detailed breakdown of attribute assessment data. Note that for Unit Blocks containing electives we take a pessimistic approach and determine the minimum possible assessment weight for each attribute level. This is calculated based on the Unit Block Min CP and Free Elective CP values.

	No Level
PE1: KNOWLEDGE BASE	
PE1.1: Knowledge of science and engineering fundamentals	
PE1.1a: Sound knowledge of mathematics to the level required for fluency in the techniques of analysis and synthesis that are relevant to the broad field of engineering, and to potentially related fields	CORE:

Unit	CP	W	CPEW
INFO2315	6	0.09	0.57
COMP2129	6	0.11	0.67
INFO2120	6	0.28	1.71
COMP2007	6	0.46	2.76
INFO1103	6	0.63	3.79
ELEC1601	6	0.76	4.59
CPEW Min Sum			*14.08*

Yr1 Recommended

Unit	CP	W	CPEW
ELEC1103	6	0.33	1.98
CPEW Min Sum			*0*

Yr2 Recommended

Unit	CP	W	CPEW
ELEC2104	6	0.15	0.89
ELEC2103	6	0.3	1.82
CPEW Min Sum			*0*

Adv Recommended

Unit	CP	W	CPEW
COMP3456	6	0.44	2.64
CPEW Min Sum			*0*

PE1.1b: Sound basic knowledge of the physical sciences, life sciences, and information sciences	CORE:

Novel interfaces, EDM, learner model visualisation interfaces, classroom orchestration

Roberto Martinez, Kalina Yacef

chai ::
computer human adapted interaction research group

externalisation

affection

argumentation

building on others

Collaboration has been proven to activate special learning mechanisms that cannot be triggered by working individually

P. Dillenbourg.
What do you mean by 'collaborative learning'?

discussion?

diverse expertise

Two hands are better than one

Tabletops in classrooms

•This field is in its infancy

• The hardware is developing month to month

• Educators want to "use" them in the classrooms but they still don't know exactly how.

(i) teachers have several groups

(ii) students need timely feedback on

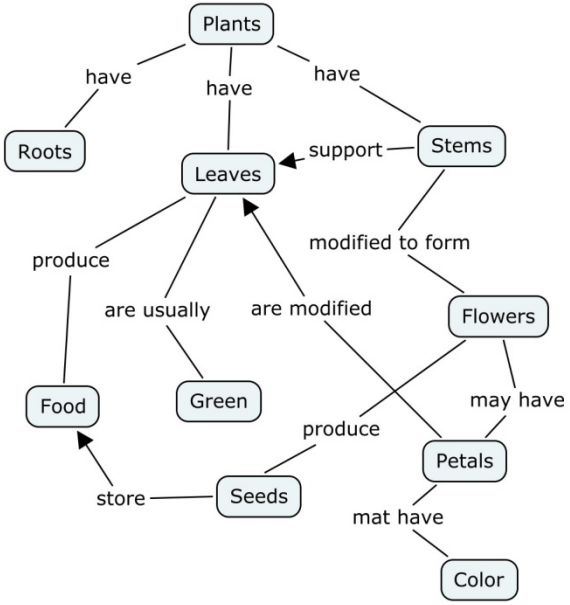
(iii) tabletops offer new ways to support learning

(iv) and the potential to **capture and use traces of the interaction**

Background image from: AlAgha, I., et al. *Towards a teacher-centric approach for multi-touch surfaces in classrooms. in Interactive Tabletops and Surfaces. 2010: ACM.*

The collaborative task
(concept mapping and problem solving)

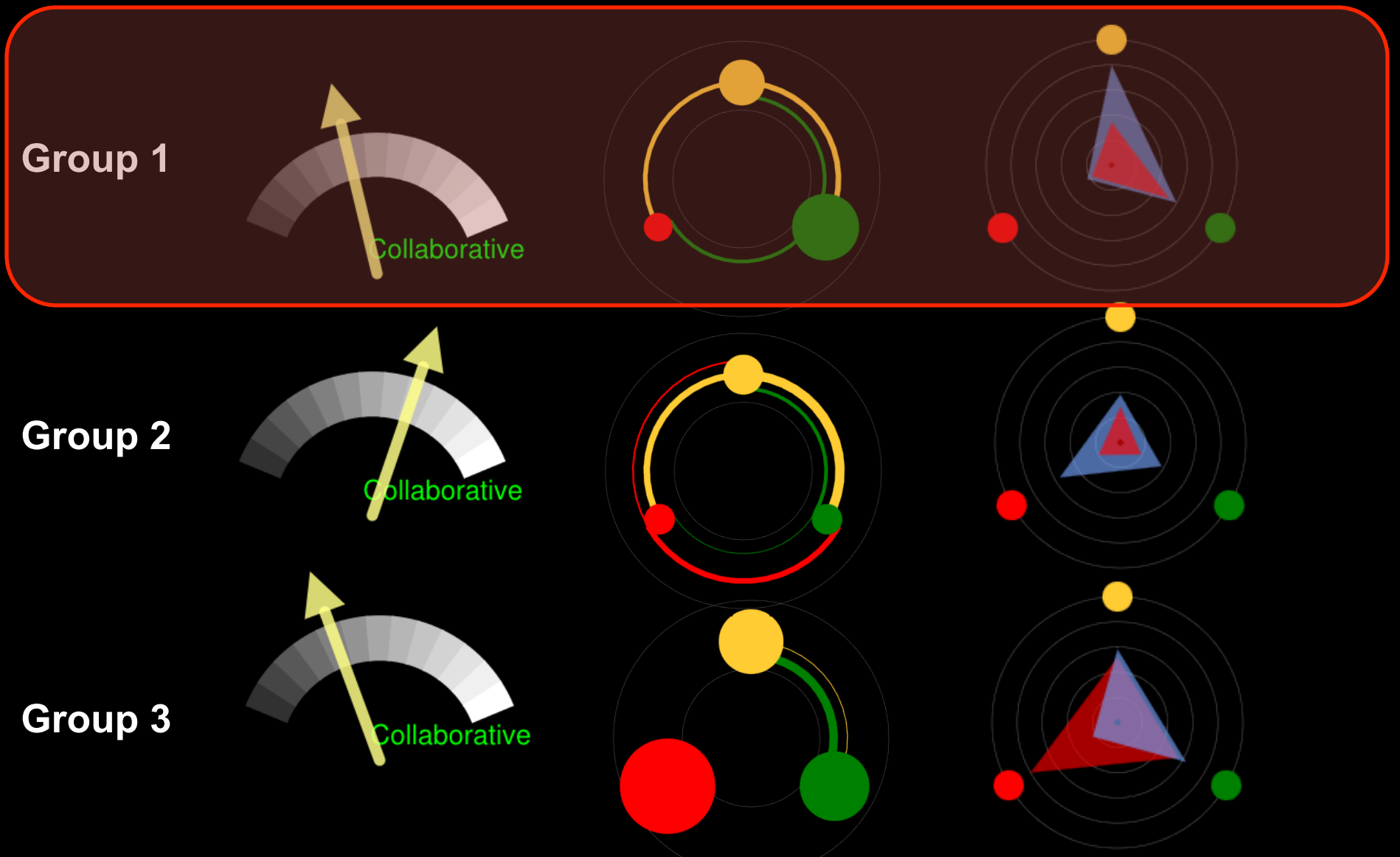
- Concept mapping is:
  - A tool for externalising knowledge
  - Applied in different domains
  - Promotes meaningful learning
  - Has been used by organisations such as
    NASA, Navy, and universities around the world.



[6] Novak, J. and A. Cañas, *The Theory Underlying Concept Maps and How to Construct and Use Them T.R.I.C. 2006-01, Editor. 2006, Florida Institute for Human and Machine Cognition.*


General
Configuration
Being inspected
Other groups
Group
Group 1
Group 2
Group 3
Detected collaboration
Interaction with others' objects
Symmetry of activity
MINUTE 12

Class level Dashboard



Martinez Maldonado, R., Kay, J., Yacef, K. and Schwendimann, B. An Interactive Teacher's Dashboard for Monitoring Groups in a Multi-tabletop Learning Environment. *Intelligent Tutoring Systems (2012), 482-492.*

Class level: Indicator of detected collaboration.

Group 1

Group 2

Group 3

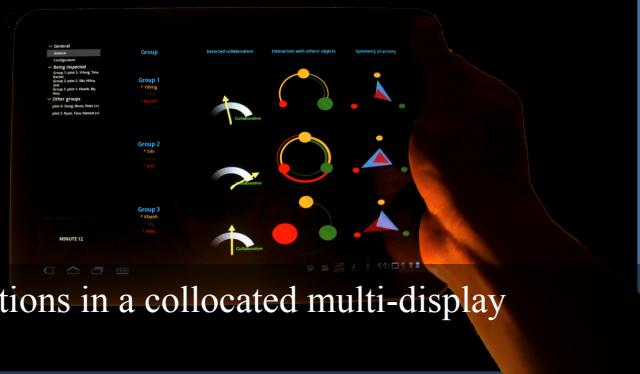
- A Best-First tree model trained in another dataset classifies each block 30 seconds of activity

Features:

- # of active participants in verbal discussions,
- amount of speech,
- number of touches
- symmetry of activity (Gini coefficient).

- Labels: Collaborative, Non-collaborative, or Average.

- The visualisation shows the accumulation of these.



Martinez R, Wallace J, Kay J, Yacef K Modelling and identifying collaborative situations in a collocated multi-display groupware setting. In: AIED 2011. pp. 196-204 (2011)

Class level: *Graph of interaction with others' objects*

Carl

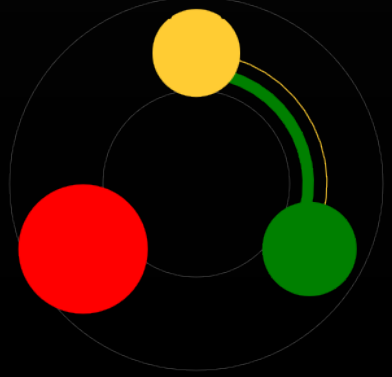
Group 1

Alice

Bob

Group 2

Group 3



- ***The Circles*** **indicate the number of touches**

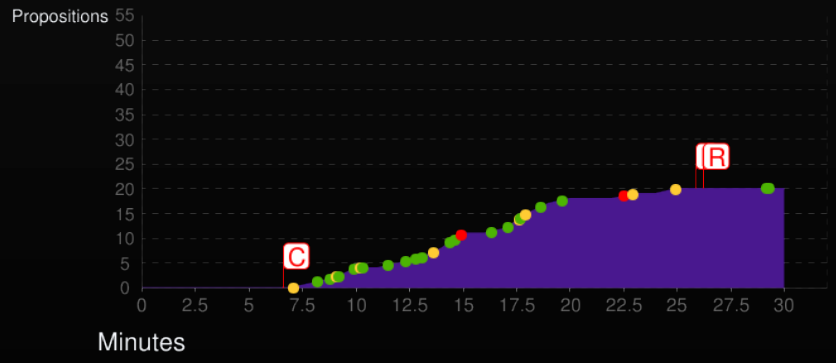
- ***The Lines*** **represent the number of actions that each learner performed on others' links and concepts**

Class level: Mixed radar of participation

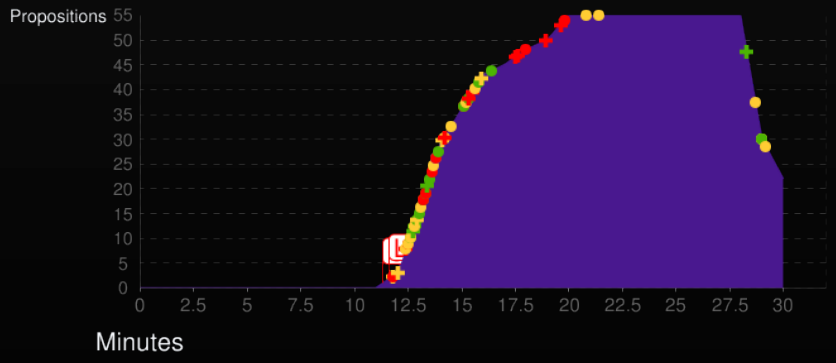
- **Symmetry of physical participation**
- **Symmetry of verbal participation**
- **The closer the corner of the triangle to the centre the less participative the student**

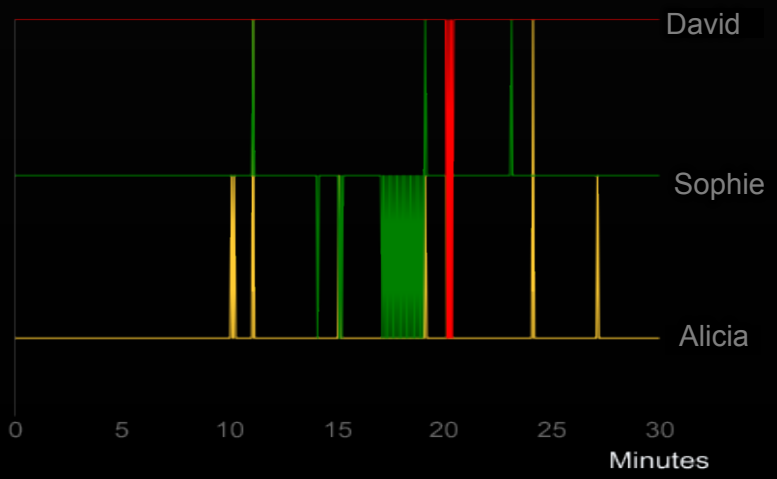
Group level: *Evolution of the group map and Timeline of interaction with other learners' objects*

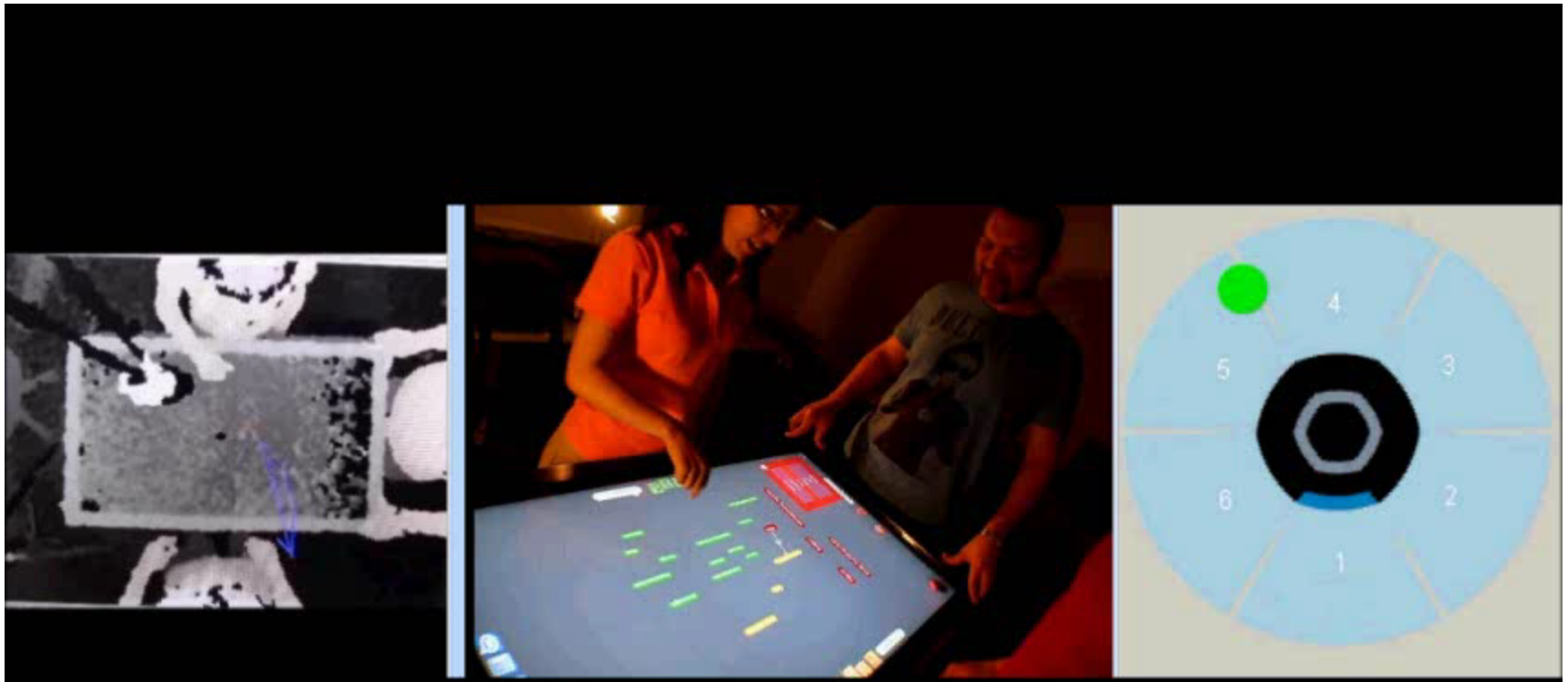
A group where student in RED is doing very little



A group where the three students worked separately

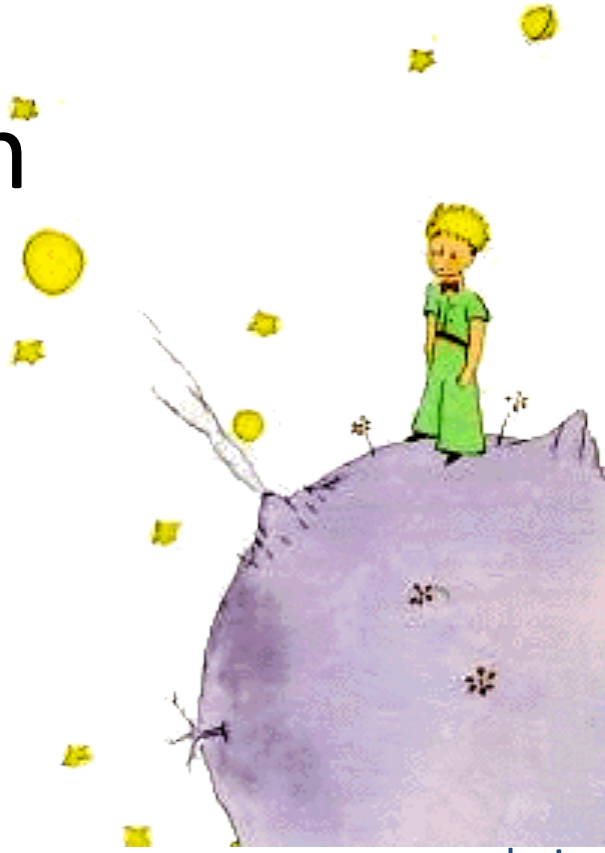


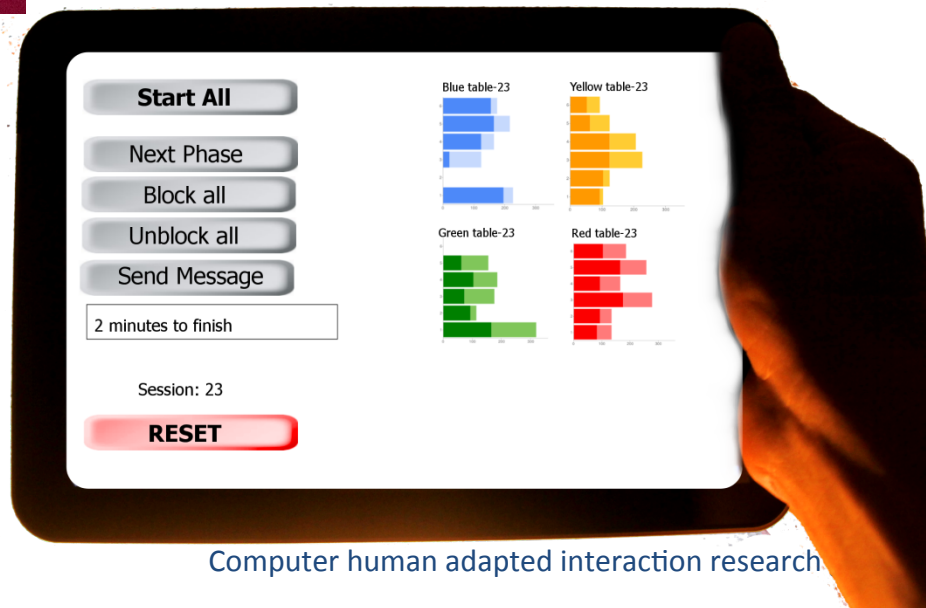




Martinez, R., Kay, J. and Yacef, K. Collaborative concept mapping at the tabletop. *In ACM International Conference on Interactive Tabletops and Surfaces (2010), 207-210.*

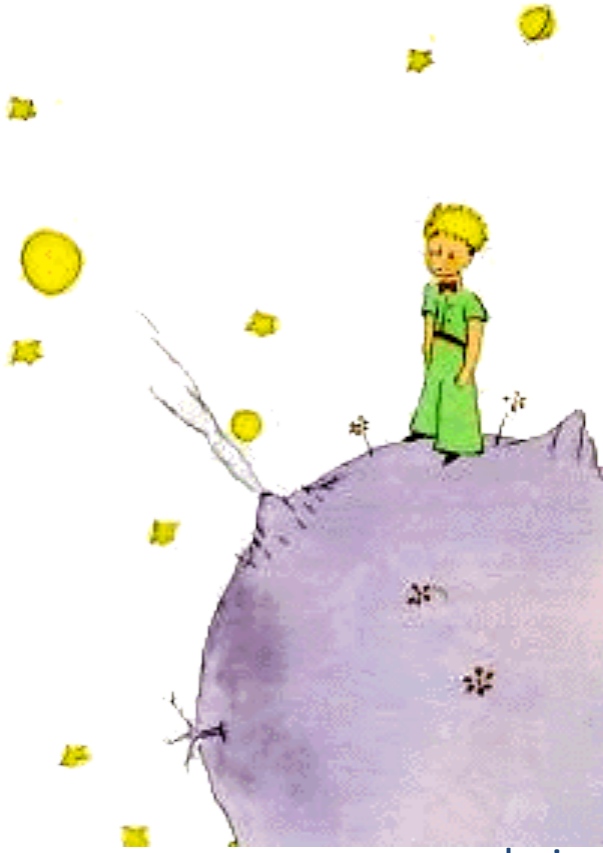
Classroom Orchestration



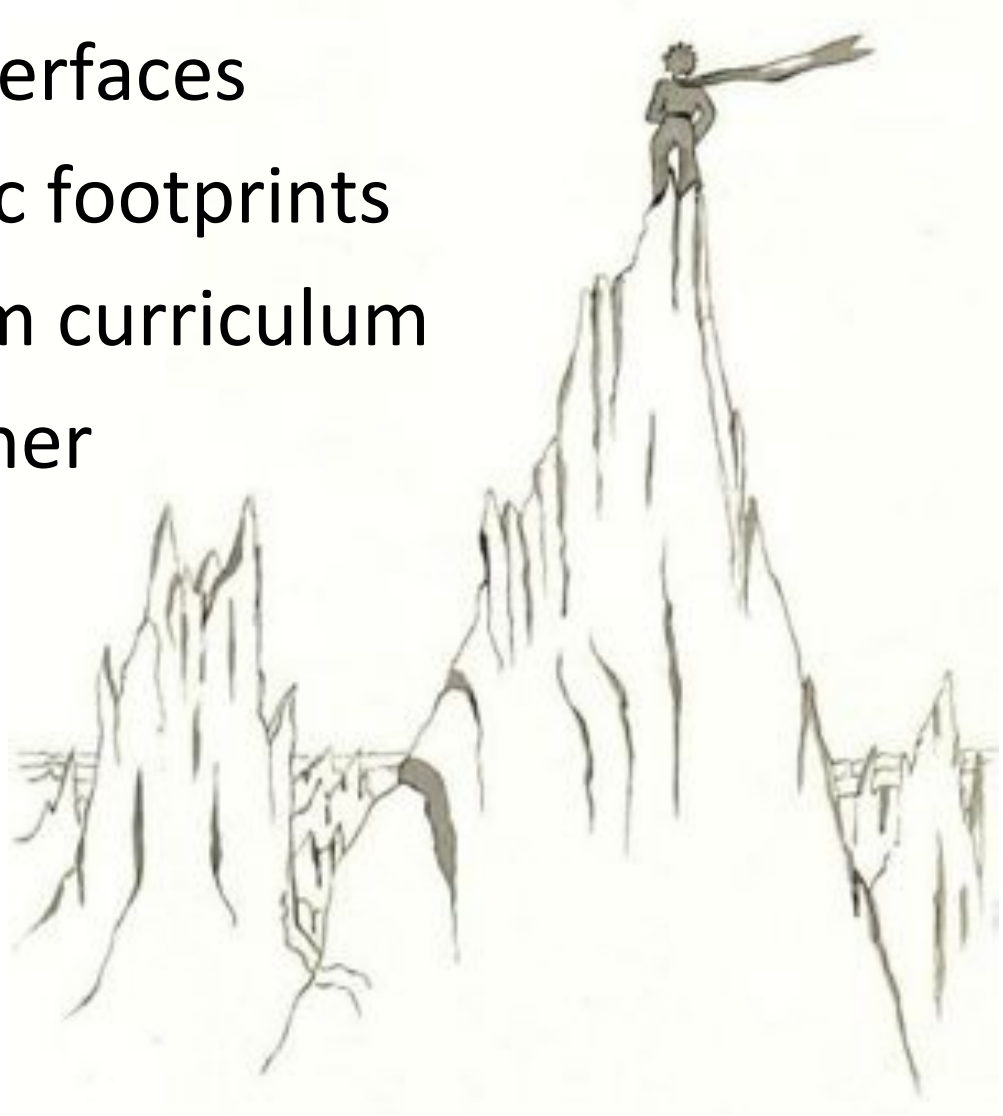

Start All
Next Phase
Block all
Unblock all
Send Message
2 minutes to finish
Session: 23
RESET
Blue table-23
Yellow table-23
Green table-23
Red table-23


Start All
Next Phase
Block all
Unblock all
Send Message
2 minutes to finish
Session: 23
RESET
Blue table-23
Yellow table-23
Green table-23
Red table-23

Summary



- Sisyphean tasks and lifelong learning
- Novel interfaces
- Electronic footprints
- Long term curriculum
- All together



http://wikilivres.info/wiki/index.php/The_Little_Prince

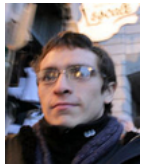
Acknowledgements

Embedded, mobile UIs

OLMs, Scrutiny UIs







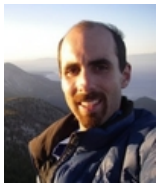



EDM

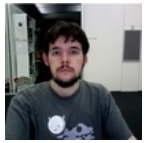



Acknowledgements







Software infrastructure user control, scrutability

Acknowledgements

Australian Government
Australian Research Council

Questions?

Please visit CHAI at
chai.it.usyd.edu.au

This talk presents a vision for lifelong learning as a driver for designing pervasive technologies. It does this via case studies for challenging long-term learning goals associated with health and wellness, collaboration to learn and learning to collaborate.

One strand of that vision involves the new learning interfaces across each learner's personal digital ecosystem of devices, ranging from mobiles, to desktops and embedded interactive surfaces on walls and tables. A second strand concerns the huge amounts of data that these devices can, and do, capture about learners. This takes diverse forms, including personal information, learning data and digital footprints. There is a huge and growing amount of this data. It lives across the personal digital ecosystem, on personal devices and in the cloud.

The talk illustrates the design of technologies to give this data to the learner at three levels. One concerns learner control over the capture and use of their data. Another involves data mining to transform it into new insights for the learner, their teachers and facilitators, and for education researchers. The final one is the design of interfaces such as in Open Learner Models to scaffold the learner's metacognitive activities of self-monitoring, self-reflection and planning.