MONASH
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TECHNOLOGY

# John Grundy's Research – 2018+

GROUP
OF EIGHT
AUSTRALIA

## Key Topic Areas

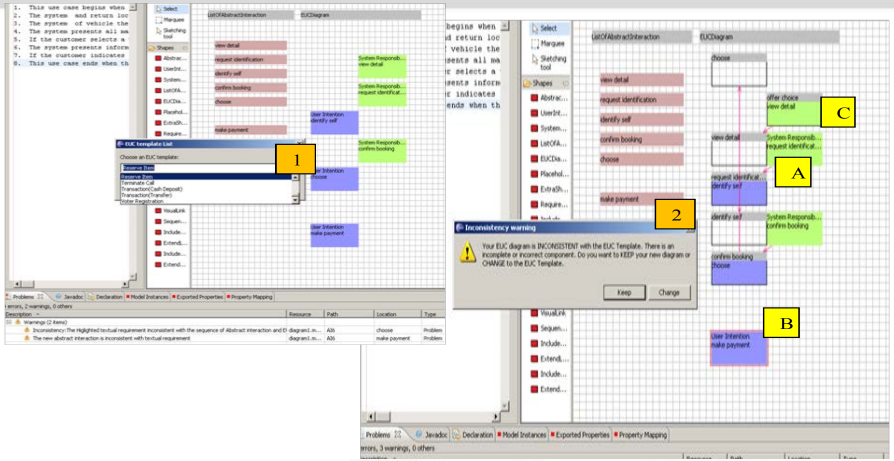
- Automated Software Engineering
- Domain-specific visual languages
- Human-centric software engineering
- Digital Health & Smart Systems Engineering
- AI for and with Software Engineering
- Requirements extraction and formalisation
- Large Systems Engineering
- Software Security Engineering
- Testing, visualisation, education

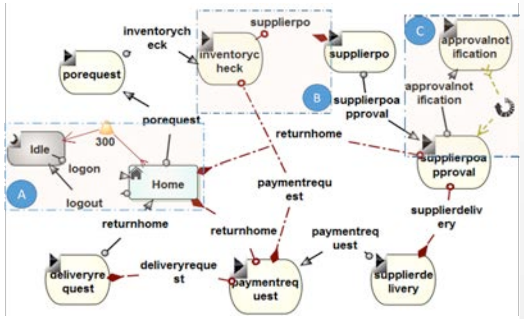
## Overarching research programme

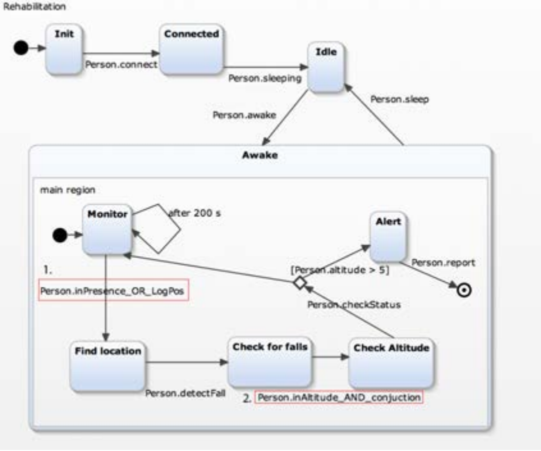
- There isn’t one :-)
- Fundamentally, my aim is to take software engineering more into the engineering realm – INCLUDING non-technical end users / developers involved in software requirements, design, configuration/coding, testing, deployment, …
- I am particularly interested in Automated Software Engineering in (most of) its forms ; visual modelling approaches ; human-centric aspects of SoftEng
- I build and evaluate tools to support these things
- I like to understand how people think about their organisations, collaborations, tasks, software… and how to help them achieve what they want

# Automated Software Engineering

- Most of my work has an ASE / tools flavour in some shape or form
- Generating code/configurations from high-level, visual models has been a feature for over 25 years
- Recent work includes generating test-beds, requirements models, IoT apps for smart homes
- Current work includes generaing visualisations, collaborative editors, big data analytics, vulnerability analysers

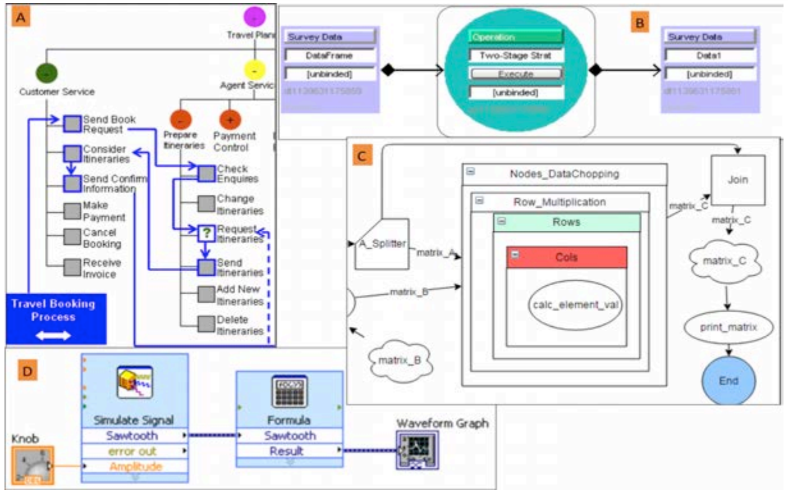


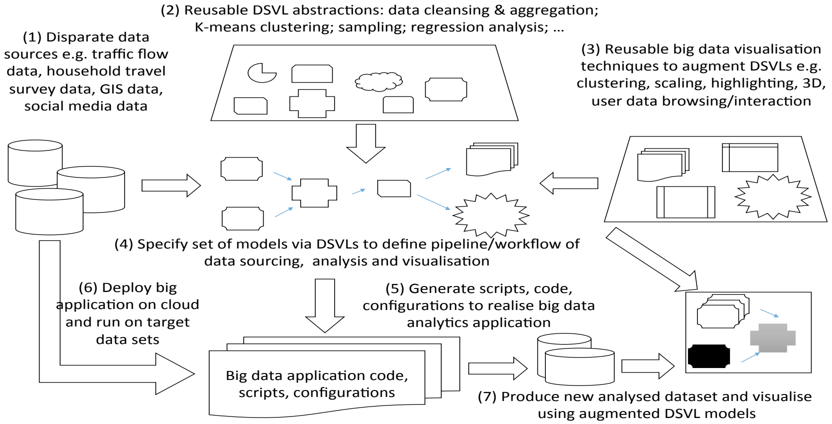




# Domain-specific visual languages

- For big data applications
- DSVLs for modelling big data/AI systems
- Visualisation, specifying visualisations
- Data integration, wrangling & DSVLs etc support
- IDE / Workbench for big data / AI systems
- Defects, defect tracking in same
- DSVLs theory, design, evaluation




(2) Reusable DSVL abstractions: data cleansing & aggregation; K-means clustering; sampling; regression analysis; …

(1) Disparate data sources e.g. traffic flow data, household travel survey data, GIS data, social media data

(3) Reusable big data visualisation techniques to augment DSVLs e.g. clustering, scaling, highlighting, 3D, user data browsing/interaction

(4) Specify set of models via DSVLs to define pipeline/workflow of data sourcing, analysis and visualisation

(6) Deploy big application on cloud and run on target data sets

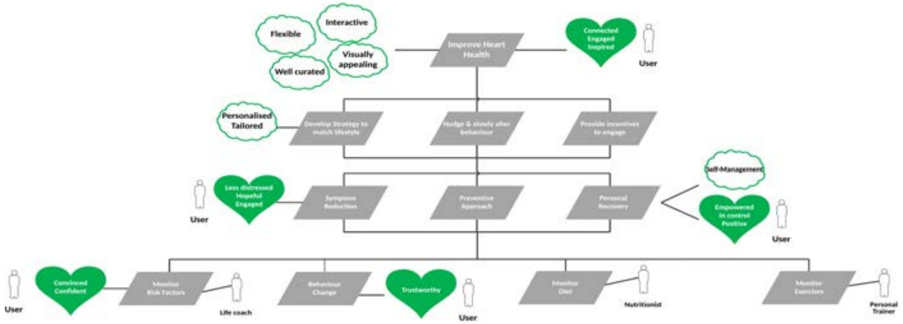
(5) Generate scripts, code, configurations to realise big data analytics application

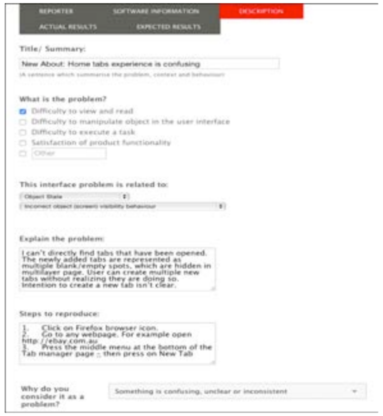
Big data application code, scripts, configurations

(7) Produce new analysed dataset and visualise using augmented DSVL models

## Human-centric software engineering

- Usability defect reporting – taxonomy, reporting, analysing, what currently done defect repository mining, …
- Software team climate
- Agile methods
- “Intelligent” project management
- Emotion-oriented Software Engineering
- Personality influences – requirements engineers, software architects, end users/esp of smart systems, defect reporters, pair programmers, testers, visual models, visualisations …





Title/ Summary:

New About: Home tabs experience is confusing

(A sentence which summarise the problem, context and behaviour)

What is the problem?

☑ Difficulty to view and read
□ Difficulty to manipulate object in the user interface
□ Difficulty to execute a task
□ Satisfaction of product functionality
□ Other

This interface problem is related to:

Object State

Incorrect object (screen) visibility behaviour

Explain the problem:

I can't directly find tabs that have been opened. The newly added tabs are represented as multiple blank/empty spots, which are hidden in multilayer page. User can create multiple new tabs without realizing they are doing so. Intention to create a new tab isn't clear.

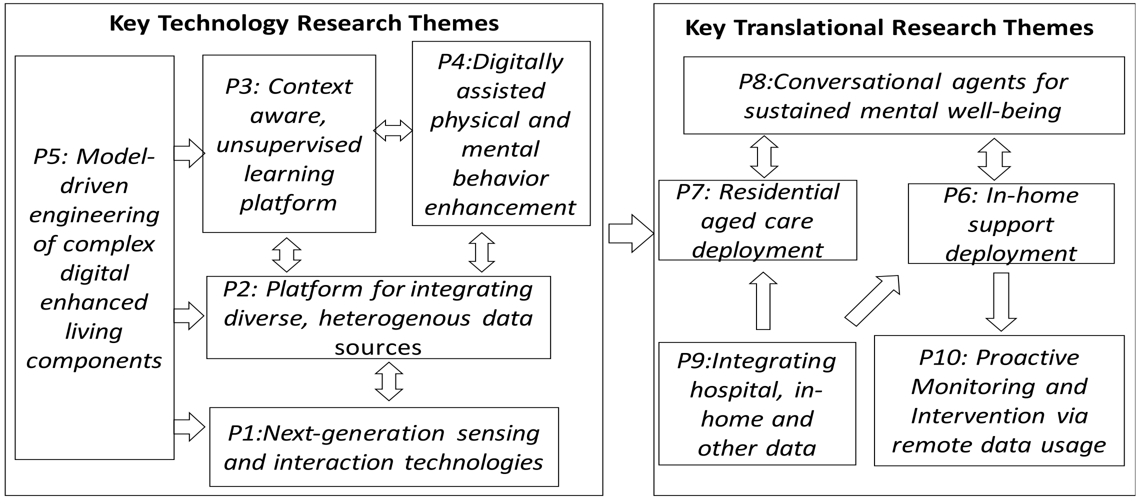
Steps to reproduce:

1. Click on Firefox browser icon.
2. Go to any webpage. For example open http://ebay.com.au
3. Press the middle menu at the bottom of the Tab manager page , then press on New Tab

Why do you consider it as a problem? Something is confusing, unclear or inconsistent

# Digital Health & Smart Systems Engineering

- Smart homes for ageing
- Mobile apps for health
- Digital health systems design, evaluation
- Participatory design
- Human-centric issues – emotions, personality, team climate etc impacting
- Smart issues – use of AI
- Sensor/interactor issues – use of IoT



**Key Technology Research Themes**

*P5: Model-driven engineering of complex digital enhanced living components*

*P3: Context aware, unsupervised learning platform*

*P4:Digitally assisted physical and mental behavior enhancement*

*P2: Platform for integrating diverse, heterogenous data sources*

*P1:Next-generation sensing and interaction technologies*

**Key Translational Research Themes**

*P8:Conversational agents for sustained mental well-being*

*P7: Residential aged care deployment*

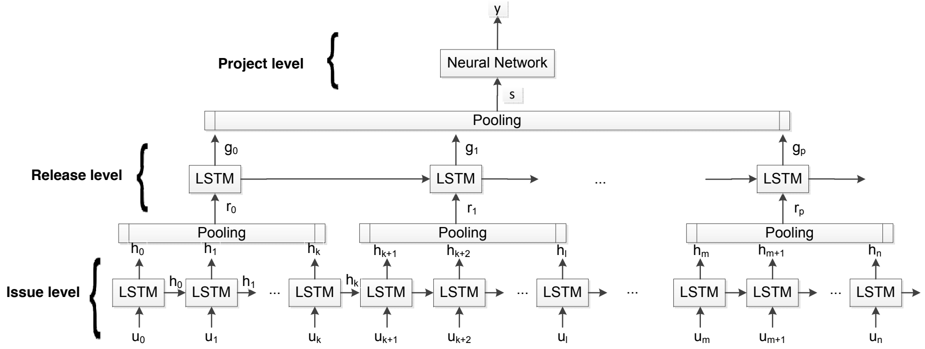
*P6: In-home support deployment*

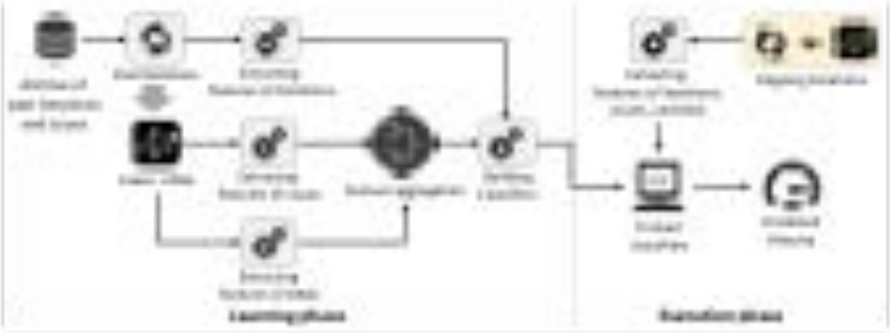
*P9:Integrating hospital, in-home and other data*

*P10: Proactive Monitoring and Intervention via remote data usage*

# AI for and with Software Engineering

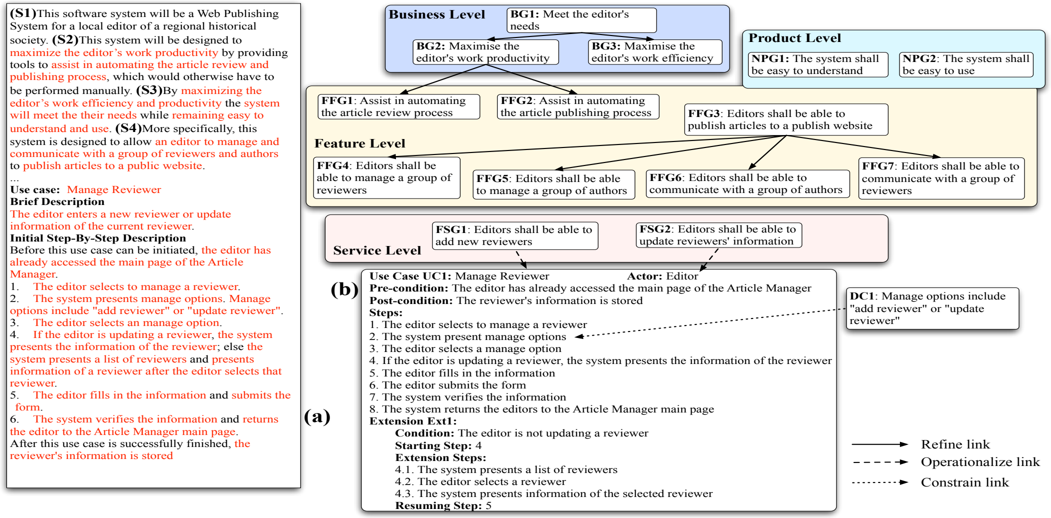
- I got interested via (1) a Samsung GRO project and (2) all the deep learning stuff reviewing for ASE…
- How represent software artefacts for DL-based analysis?
- How explain DL-recommended results?
- How visualise results?
- Training tool – mark-up artefacts etc
- Use – vulnerability detection, project management, traceability, tag recommendation, …





# Requirements extraction and formalisation

- Extract from natural language
- Formalise
- Analyse
- Feedback with stakeholders
- Use in various domains e.g. air traffic control, automotive, IoT security configuration, …



**(S1)**This software system will be a Web Publishing System for a local editor of a regional historical society. **(S2)**This system will be designed to maximize the editor's work productivity by providing tools to assist in automating the article review and publishing process, which would otherwise have to be performed manually. **(S3)**By maximizing the editor's work efficiency and productivity the system will meet the their needs while remaining easy to understand and use. **(S4)**More specifically, this system is designed to allow an editor to manage and communicate with a group of reviewers and authors to publish articles to a public website.

...

**Use case:** Manage Reviewer

**Brief Description**

The editor enters a new reviewer or update information of the current reviewer.

**Initial Step-By-Step Description**

Before this use case can be initiated, the editor has already accessed the main page of the Article Manager.

1. The editor selects to manage a reviewer.
2. The system presents manage options. Manage options include "add reviewer" or "update reviewer".
3. The editor selects an manage option.
4. If the editor is updating a reviewer, the system presents the information of the reviewer; else the system presents a list of reviewers and presents information of a reviewer after the editor selects that reviewer.
5. The editor fills in the information and submits the form.
6. The system verifies the information and returns the editor to the Article Manager main page.

After this use case is successfully finished, the reviewer's information is stored

(a)

**Business Level**

**BG1:** Meet the editor's needs

**BG2:** Maximise the editor's work productivity

**BG3:** Maximise the editor's work efficiency

**Product Level**

**NPG1:** The system shall be easy to understand

**NPG2**: The system shall be easy to use

**Feature Level**

**FFG1**: Assist in automating the article review process

**FFG2**: Assist in automating the article publishing process

**FFG3**: Editors shall be able to publish articles to a publish website

**FFG4**: Editors shall be able to manage a group of reviewers

**FFG5**: Editors shall be able to manage a group of authors

**FFG6**: Editors shall be able to communicate with a group of authors

**FFG7**: Editors shall be able to communicate with a group of reviewers

**Service Level**

**FSG1**: Editors shall be able to add new reviewers

**FSG2**: Editors shall be able to update reviewers' information

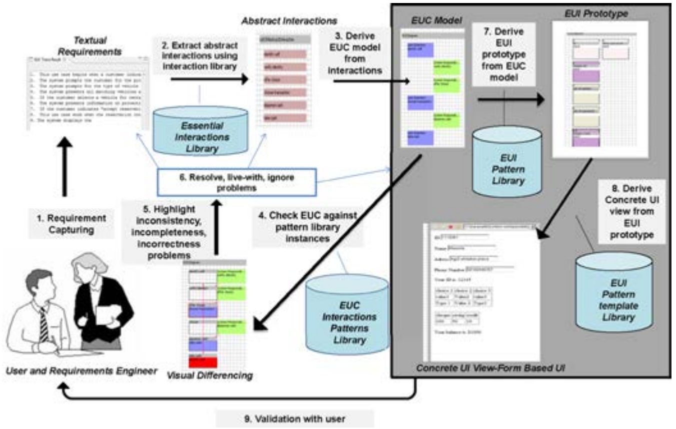
(b)

**Use Case UC1:** Manage Reviewer **Actor:** Editor
**Pre-condition:** The editor has already accessed the main page of the Article Manager
**Post-condition:** The reviewer's information is stored
**Steps:**
1. The editor selects to manage a reviewer
2. The system present manage options
3. The editor selects a manage option
4. If the editor is updating a reviewer, the system presents the information of the reviewer
5. The editor fills in the information
6. The editor submits the form
7. The system verifies the information
8. The system returns the editors to the Article Manager main page

**Extension Ext1:**
**Condition:** The editor is not updating a reviewer
**Starting Step:** 4
**Extension Steps:**
4.1. The system presents a list of reviewers
4.2. The editor selects a reviewer
4.3. The system presents information of the selected reviewer
**Resuming Step:** 5

**DC1**: Manage options include "add reviewer" or "update reviewer"

Refine link
Operationalize link
Constrain link



Textual Requirements
Abstract Interactions
2. Extract abstract interactions using interaction library
3. Derive EUC model from interactions
EUC Model
EUI Prototype
7. Derive EUI prototype from EUC model
Essential Interactions Library
EUI Pattern Library
6. Resolve, live-with, ignore problems
1. Requirement Capturing
5. Highlight inconsistency, incompleteness, incorrectness problems
4. Check EUC against pattern library instances
8. Derive Concrete UI view from EUI prototype
EUC Interactions Patterns Library
EUI Pattern template Library
User and Requirements Engineer
Visual Differencing
Concrete UI View-Form Based UI
9. Validation with user

# Large Systems Engineering

- Data placement on cloud
- Energy consumption – cloud, IoT, edge
- Architecture, requirements, process
- Adaptive systems
- Data wrangling, integration, visualisation – tools, techniques, design, evaluation

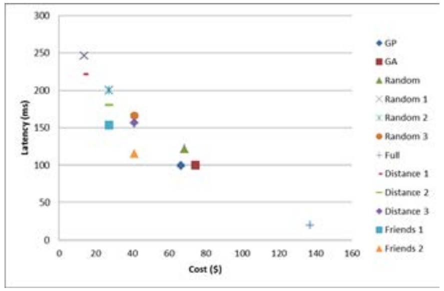
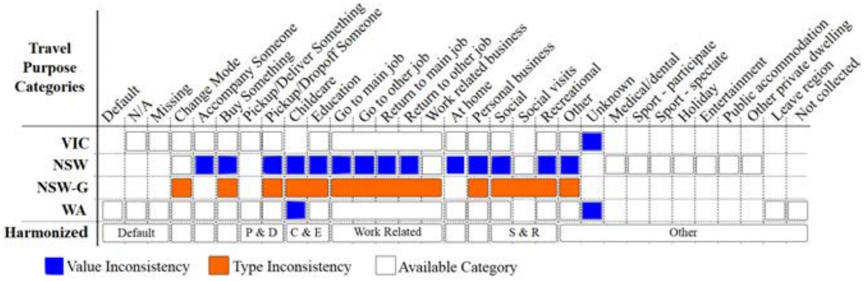
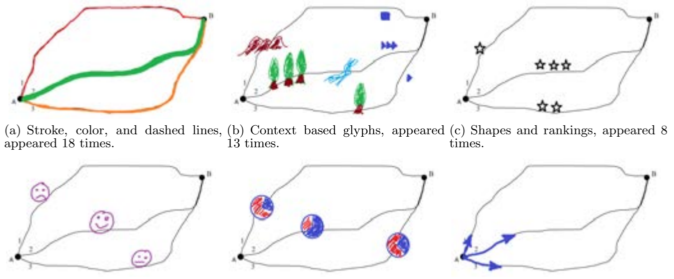


Figure 4. Comparison of different strategies with latency requirement of 90% lower than 100 ms.





(a) Stroke, color, and dashed lines, appeared 18 times.

(b) Context based glyphs, appeared 13 times.

(c) Shapes and rankings, appeared 8 times.

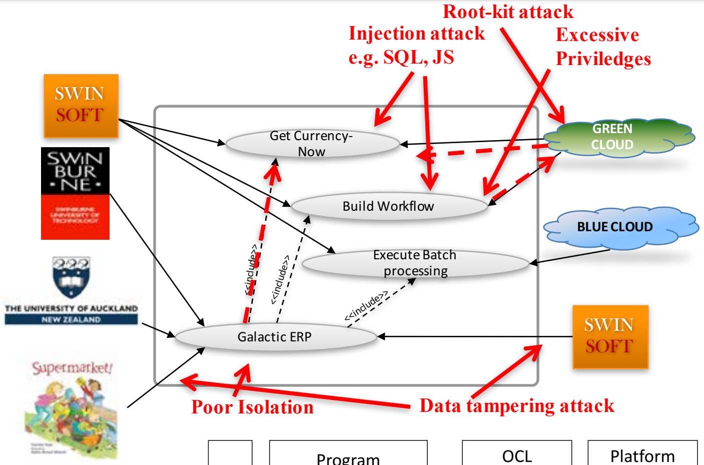
(d) Emoticons, appeared 7 times.

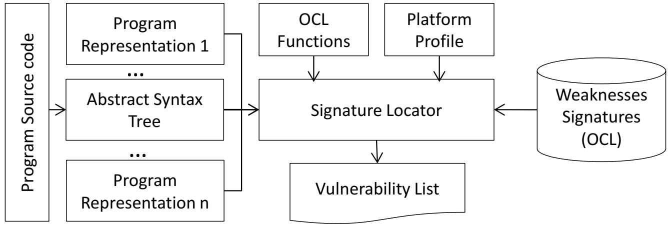
(e) Charts, appeared 4 times.

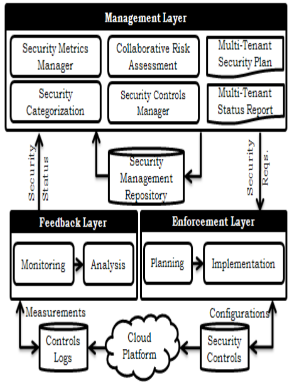
(f) Arrows, appeared once.

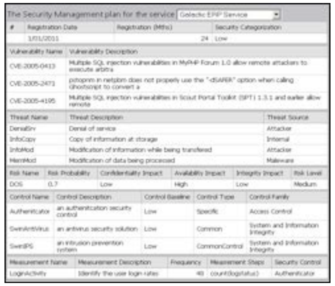
# Software Security Engineering

- Self-securing software systems
- Static and dynamic vulnerability analysis
- Run-time update of code, configurations
- End user specification, configuration of security requirements, controls
- Security for mobile, IoT systems








The Security Management plan for the service Galactic ERP Service

| # | Registration Date | Registration (Mths) | Security Categorization |
|---|---|---|---|
| | 1/01/2011 | 24 | Low |

| Vulnerability Name | Vulnerability Description |
|---|---|
| CVE-2005-0413 | Multiple SQL injection vulnerabilities in MyPHP Forum 1.0 allow remote attackers to execute arbitra |
| CVE-2005-2471 | pstopnm in netpbm does not properly use the "-dSAFER" option when calling Ghostscript to convert a |
| CVE-2005-4195 | Multiple SQL injection vulnerabilities in Scout Portal Toolkit (SPT) 1.3.1 and earlier allow remote |

| Threat Name | Threat Description | Threat Source |
|---|---|---|
| DenialSrv | Denial of service | Attacker |
| InfoCopy | Copy of information at storage | Internal |
| InfoMod | Modification of information while being transfered | Attacker |
| MemMod | Modification of data being processed | Malware |

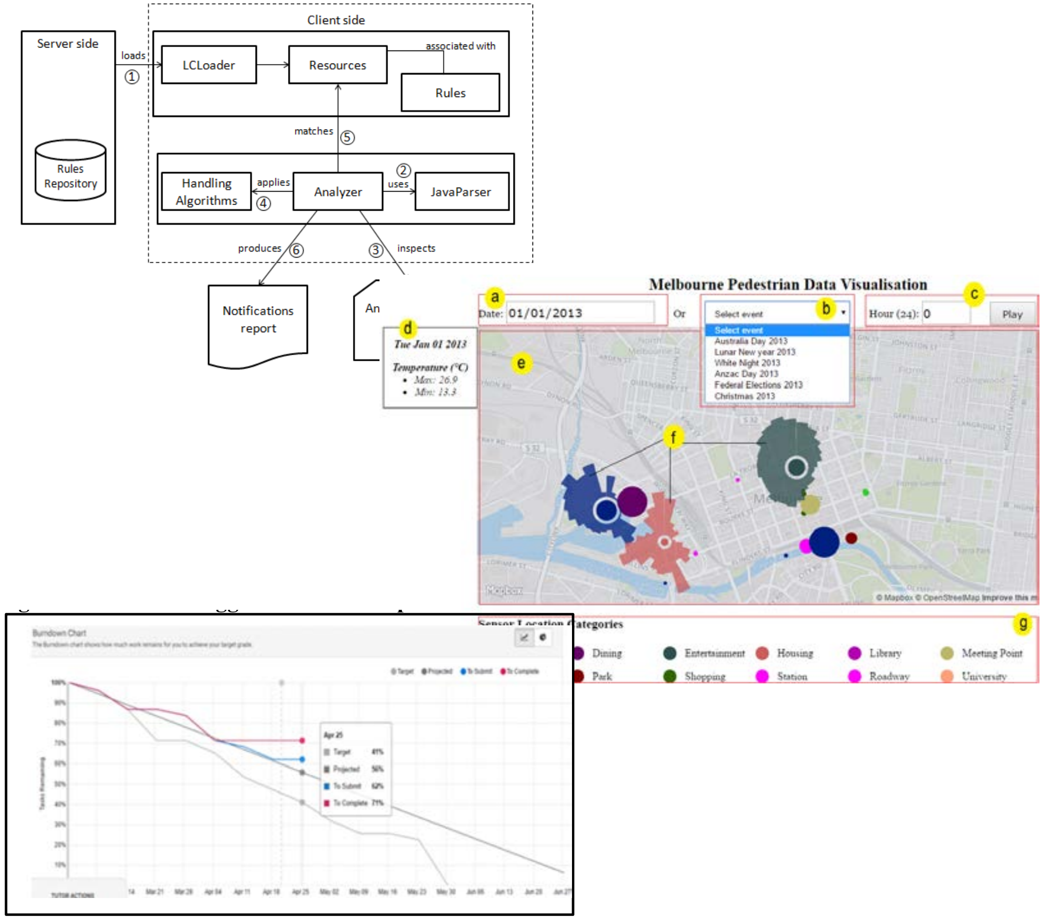
| Risk Name | Risk Probability | Confidentiality Impact | Availability Impact | Integrity Impact | Risk Level |
|---|---|---|---|---|---|
| DOS | 0.7 | Low | High | Low | Medium |

| Control Name | Control Description | Control Baseline | Control Type | Control Family |
|---|---|---|---|---|
| Authenticator | an authentication security control | Low | Specific | Access Control |
| SwinAntiVirus | an antivirus security solution | Low | Common | System and Information Integrity |
| SwinIPS | an intrusion prevention system | Low | CommonControl | System and Information Integrity |

| Measurement Name | Measurement Description | Frequency | Measurement Steps | Security Control |
|---|---|---|---|---|
| LoginActivity | Identify the user login rates | 40 | count(logstatus) | Authenticator |

# Testing, visualisation, education

- Testing: mobile apps, IoT, generating tests, testers, defect reporting, …
- Visualisation: domain-specific visual langage models, presenting and interacting with visual models, building and scaling visualisations, modelling tools, collaborative modelling & visualisation
- Portfolio-based assessment, open learner models, constructive alignment, industry placements and capstone projects


Client side
Server side
loads ①
LCLoader
Resources
associated with
Rules
Rules Repository
matches ⑤
Handling Algorithms
applies ④
Analyzer
② uses
JavaParser
produces ⑥
③ inspects
Notifications report
An
Melbourne Pedestrian Data Visualisation
a
Date: 01/01/2013
Or
Select event
b
Australia Day 2013
Lunar New year 2013
White Night 2013
Anzac Day 2013
Federal Elections 2013
Christmas 2013
c
Hour (24): 0
Play
d
Tue Jan 01 2013
Temperature (°C)
Max: 26.9
Min: 13.3
e
f
Sensor Location Categories
g
Dining
Park
Entertainment
Shopping
Housing
Station
Library
Roadway
Meeting Point
University
Burndown Chart
Target
Projected
To Submit
To Complete
Apr 25