MISG 2021 Graduate Modelling Camp

Designing a personal medical system

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Contents

1. The problem

The importance of travel and the infra-structure supporting it.
Communications, information, finance. Border control, ID?

What if you are stung by jelly fish on the Great Barrier Reef?
Break a leg in the Alps? Catch flu in Wuhan?

Can we design a distributed (i.e. de-centralised) system to manage **personal medical history**?

Privacy? Accountability? Ethics?
Distribution?
Benefit from Data Analytics?

2. General characteristics

What characterises a typical MISG problem?

How this problem is similar; and different.

What is required: a *design*; its correctness and efficiency.

What is not required: an *implementation*, tested by cases.

The maths is *pure*, *discrete* and perhaps unfamiliar.

3. Steps

1. Understand the difference between centralised and distributed systems. Learn to think locally and to express the result mathematically.
2. Consider the features and functionality desired of a personal health system, exploiting those not possible in a standard medical book. Avoid undesirable features.
   Any benefit from Data Analytics?
3. Design a system which incorporates the desired features and understand why it behaves as desired.

Concerns

1. Modelling: how to *abstract* (deciding what is 'observable').

2. What *new* possibilities do *digital* and *distribution* offer?

3. Exploiting *Data Analytics*?

4. Design . . .

What are the *requirements*?

Treat the system as a black box to describe its behaviour, not its construction. Decide and express *what* it does, ignoring the mechanism which decides *how*. Our system is *specified* by its:

- functionality

  (what information must it provide?)

- extra features

  (privacy, trackability, Data Analytics, . . .) .

. . . techniques

- Distinguishing between centralised and distributed designs.
  Invariant properties.
- Describing an interactive design.
  Modularity.
  Information flow by shared variables or message passing.
- Accessing (big) data security.
  Public key encryption. Digital signatures.
- Mathematical notation.
  Z formalism.

Example: Accident *event* by individual *id*

$$
\begin{array}{|l}
\hline
\textit{Accident} \\
\Delta State(id, history) \\
id? : \mathbb{ID} \\
event? : Where \times When \times What \times Finance \\
\hline
id? \text{ valid} \\
history' = history \oplus \{id \mapsto event?\} \\
history'.cost \text{ covered} \\
\hline
\end{array}
$$

The system *State* and its *invariant*.

Other operations: Insurance payment; Query; ...

Initialisation?

5. Individual benefits

1. Learn abstraction in modelling.
2. Practise designing a distributed system.
3. Learn how to formalise a design.
4. Appreciate non-functional requirements like ethics, accountability and Data Analytics.
5. Understand blockchain?

6. References

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