

Why “Formal approach” is needed for algorithmic ethics

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Algorithmic “ethics” (in a wide sense) for programs and AI • ML

In particular, “algorithmic ethics” for AI faces a new issue of ethics of informatics environment;

Both the scientific-technology view point and

the philosophy-ethics-sociology s views

Are required to consider the issues.

This is the time that the computer-science & technology research community and the humanity & social science research community work together closely on these..

Issues on algorithmic ethics: How to ensure fairness, equality, transparency, etc.

when algorithms leave human-handlings

Ethical and social issues to be solved in “procedures, algorithms)

Level 0 Traditional manual procedures



Level 1 Traditional software programs

Some of algorithmic ethics issues appear here. “**Formal verification**” for ethical correctness of the algorithms are already important..



Level 2 Machine learning (including Deep Learning)

Need to define primitives formally.

Algorithmic ethics (with primitive definitions such as fairness, privacy, equality, etc.)

Algorithmic ethics issues, on fairness, arbitrariness-randomness, explainability etc.

How to guarantee/verify ethical correctness of algorithms ?

Faces the THIRD STAGE of ALGORITHMIC ENVIRONMENT.

(through the manual procedures environment (level-0), the traditional Programming environment (level-1), to the 3rd Stage algorithmic environment of AI-Machine learning (level-2).

Possible two different directions for solving the issues;

(1) From Formal to Practical: First, targeting to formalize/define Basic Concepts, related to the issues.

(2) From Practical (tentative) solutions to formal.

We need both but would need to emphasize importance of (1).

Involvement of formal approach (in a wide sense).

- Formal approach for algorithmic logic has made essential contributions to computer science since the birth of computer models in 1936.
- Formal approach for algorithmic logic are contributing to reliable software, provably secure software, cybersecurity, etc.)

Now this is the time to develop **Formal Approaches for Algorithmic Ethics.**

But, the full Formal-Logical language in the strict sense of 20th century logic works only for limited cases, in our ordinary reasoning and in our computational/algorithmic new environments .We need, instead, a formal approach in a wider sense.

Formalizing primitives or finding practical solution?

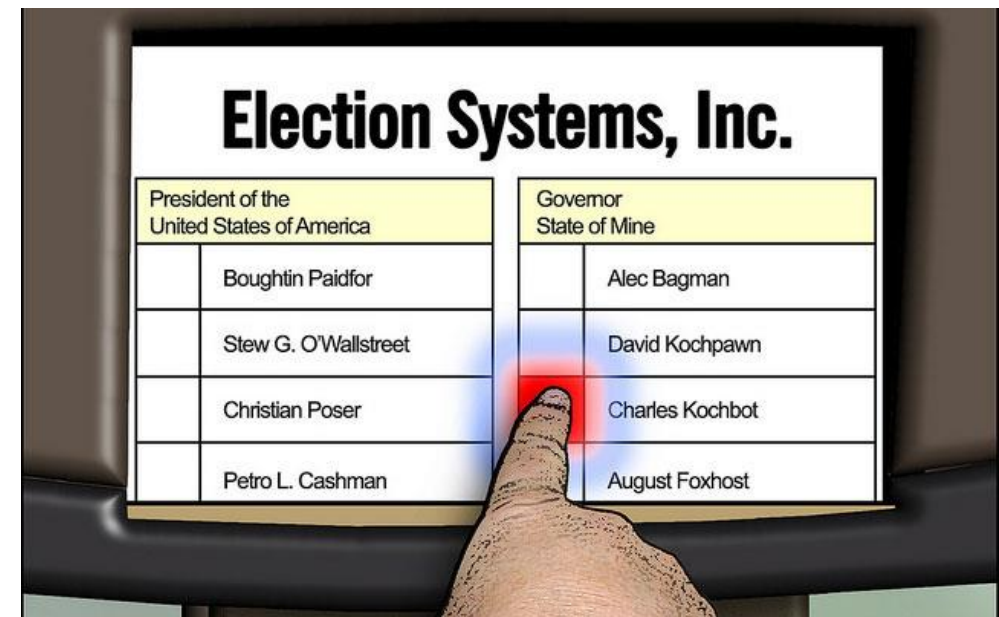
Eg. e-voting case

- “One-vote-by-one-voter”-property

How to define it and verify correctness of an e-voting algorithm formally.

(This property is discussed and issued by Gilles Dowek, INRIA,)

No problematic as a “procedural algorithm-itself” in the level 0 procedure, but this property becomes unclear and needs to be defined formally for e-voting algorithm to be verified correct.



An alternative various Practical (non-formal) approaches including; if the election results by many e-vote application softwares (each of which is selected by each political party) are the same, based on the same vote-data, then no issue would occur in our real life, [even without our defining what is “one-vote-ness” in the algorithm. (We learned this type of discussion for practical solution from Keiji Takeda.)

But if not agreed? Such a situation suggests importance of formal method.

Practical vs. Formal solutions?

Importance of formal approach remains even if practical solutions often work.

Other examples

- “MUJIN-KUN” like Japanese financial loan request/evaluation procedure is the typical example of transitions from the Level-0 algorithm to Level-1, then from Level-1 to function involve Level-2.

(See Toshihiro Kamishima’s talk slides of this Meeting for a good example of formally defining fairness of ML-algorithms.)

- It also shows how the nature of algorithmic fairness, for example, changes according to the change of the algorithmic environment levels
- One may find such the level-changes and the fairness issue changed with some procedure with random function involved.
- The importance is that one need to capture each “fairness” depending on the context depending on the different algorithmic context.

Aknowledggment.

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