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Utilizing User Stories to Bring AI Ethics into Practice in Software Engineering

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Abstract. AI ethics is a research area characterized by a prominent gap between research and practice. With most studies in the area being conceptual in nature or focused on technical ML (Machine Learning) solutions, the link between AI (Artificial Intelligence) ethics and SE (Software Engineering) practice remains thin. Establishing this link, we argue, is vital going forward. While conceptual discussion is required to define AI ethics, much progress has already been made in this regard. Similarly, though technical ML solutions are also required for practical implementation, ML systems are ultimately still software, and thus SE cannot be forgotten. In this paper, we propose one way of bringing AI ethics closer to conventional SE practice: utilizing user stories to implement AI ethics by means of Ethical User Stories (EUS). EUS can be used to formulate both functional and non-functional requirements, although an ethical framework is required produce them. By treating AI ethics as a part of the development process in this fashion, as opposed to a separate task, it can ideally become a part of SE for ML systems.

Keywords: Artificial Intelligence · AI ethics · User story · Ethical user story · Ethical tool

1 Introduction

Implementing ethics in practice is challenging in SE. In practice, doing so often means converting abstract ethical principles into tangible requirements. This requires extensive ethical consideration and discussion, which developers can seldom devote time to among their other work. Ethical guidelines are a typical way of approaching ethics in SE, though such documents seem to see little use. For example, it has been argued that one of the more prominent such documents, the ACM Code of Ethics, has had very little impact on practice in SE [9].

Arguably the most topical research area related to ethics in SE has recently been AI ethics, following rapid advances in AI technology in the past two decades. For example, issues such as bias and data privacy, even though not exclusive to AI systems, have received notable media attention following ethical shortcomings in such systems out on the field. Thus far, discussion in the area has been

predominantly conceptual, focusing on defining what is AI ethics and what issues should be addressed. On the other hand, empirical studies have been rare [7] [11] [13]. Studies discussing the current state of practice in the area point towards guidelines having had limited impact on practice in the context of AI ethics as well (e.g., [14] [15] [16] [18]).

Indeed, despite various ethical issues being acknowledged, tackling these issues in practice remains one of the key challenges in the area [14]. For example, guidelines, which have been the most common tools for implementing AI ethics, are abstract and difficult to utilize in practice. Guidelines merely present sets of ethical principles to tackle but often fall short when it comes to providing instructions for doing so. Translating abstract ethical principles into tangible requirements is a difficult task. [10] [14] Aside from guidelines, various specific ML techniques for implementing AI ethics exist [11] [13], such as techniques related to bias detection, which are arguably useful for their intended purposes, but require their users to already know what ethical issues they are tackling and how. However, SE process related tools, such as practices or methods, are lacking.

To help tackle this issue by better linking AI ethics with conventional SE, we discuss the idea of utilizing of user stories for implementing AI ethics in this paper, as a theoretical introduction for the PROFES2022 tutorial on the topic. We argue that user stories can function as a way of converting AI ethics principles into tangible requirements. However, rather than doing so directly through AI ethics guidelines, we utilize a recent method for implementing AI ethics, ECCOLA [17], to support the creation of such user stories. Such Ethical User Stories (EUS) are one way of linking ethics more closely to conventional SE practice. EUS is a concept we have begun to explore in an existing paper through empirical evidence [5]. Though this approach is not exclusive to AI ethics and can be of interest when it comes to ethics in SE in general, AI ethics is arguably one of the areas where such approaches are most needed currently.

2 Background and Related Work

2.1 AI Ethics

Though discussion on ethical issues related to AI systems is highly active, bringing this discussion into practice is a prevalent issue [14]. This discussion on AI ethics has recently converged around a set of recurring *principles*, which in practice are umbrella concepts comprising various more specific issues [4] [6] [11]. Some issues are more tangible and consequently have more tangible solutions, while others are more abstract or general and require far more effort to implement in practice.

To provide a practical example of these principles, let us briefly discuss *fairness* as a principle. Fairness deals with diversity, inclusiveness and, equality. In practice this manifests as the prevention, monitoring or mitigation of unwanted bias and discrimination in AI/ML systems. [6] Fairness could be argued to be one of the more practical principles in terms of its technical implementation.

This is highlighted by various existing papers proposing technical ML solutions dedicated to tackling bias in ML [11] [13].

Yet, in part, it is exactly this focus on technical tools and conceptual discussion that is currently a large problem in AI ethics, we argue. Whereas numerous technical ML tools for implementing AI ethics exist, and while the conceptual discussion on the topic is highly active, few empirical studies exist [7] [11] [13]. To this end, the point of view of SE is also largely still missing [14] [17]. Technical ML solutions are ultimately specific solutions for specific problems, and only as far as ML is considered. Yet ML is but a part of any AI system, and engineering AI systems is still SE at the end of the day.

2.2 User Stories

User stories are a commonly utilized tool for formulating requirements in SE [3], and particularly in Agile development [2]. Having originated from eXtreme Programming XP, user stories are now utilized in most Agile approaches [12]. Though the purpose of user stories is to help formulate and communicate requirements, their implementation in practice varies in form. I.e., there are various templates and approaches used to formulate user stories.

User stories commonly take on the form of a card or a sheet of paper, such as a post-it note, or more formally a user story template. Of course, this may also be done using digital tools. They are written using natural language and their purpose is to communicate the goals of the system that is being developed [19]. One of the more popular approaches to user stories formulates them as follows: "As a [user], I want to [capability], so that [receive benefit]" [2]. Many variants of this three-part-template exist. On the other hand, for example, Lucassen [8] proposes a four-part one that consists of format, role, means, and end.

2.3 Related Work: Implementing AI ethics

This topic is at the intersection of user stories in the context of ICT-related ethics and implementing ethics in practice, with AI ethics being the specific context here. Though this idea of using user stories to implement ethics is not exclusive to AI ethics, it is currently an area for tools to implement ethics are sorely needed. Overall, the idea of utilizing user stories to for the purpose of implementing ethics seems to be quite novel.

In terms of implementing AI ethics in practice, empirical studies are scarce. Guidelines have been the most common approach to doing so [6], but are argued to not work [10], given the limited impact they have had on practice [14]. Technical tools for ML, on the other hand, are highly specific [11]. Focus on SE in implementing AI ethics has been lacking [14], which we argue is currently a key gap in the area. As far as SE methods are concerned, we are only aware of a method for implementing ethics we ourselves have proposed, ECCOLA [17], as well as one other method, RE4AI [1]. On the other hand, general-purpose tools and methods related to ethics are numerous in fields such as design.

3 Devising Ethical User Stories Using the Ethical Framework Method

Ethical User Stories (EUS), in brief, are user stories devised to help tackle and formalize ethical issues in SE, from the point of view of a particular ethical framework. EUS are a novel concept we have begun to explore in an existing paper [5], which provides empirical evidence of EUS in practice.

Fig. 1 describes the process of devising EUS. EUS are formulated based on the case at hand, like user stories in general. However, when devising EUS, an ethical framework must be present to motivate and direct ethical consideration. The ethical framework provides the lens through which ethics is approached in the particular project context. EUS are then written like a conventional user story, aside from them also including ethical consideration or being motivated by ethical consideration. EUS can be used to formulate both functional and non-functional requirements.

The ethical framework used to create EUS can be any ethical tool: a method, a set of guidelines, or even an ethical theory. The purpose of the ethical framework is to define what is 'ethical' in the given context, as well as to provide guidance for, e.g., which ethical issues should be tackled. To this end, the framework of choice would ideally be as closely related to the context at hand as possible (e.g., AI ethics framework for AI ethics, as opposed to a generic one).

Below, we provide a tangible example of an EUS. In this case, a large number of EUS were devised for a real use case of Smart terminal⁴, using an AI ethics method, ECCOLA [17], as the ethical framework. This is a part of a larger research endeavor on the topic (see footnote) that we are currently working on, which this paper provides an initial look at.

ECCOLA is an empirically tested developer-focused AI ethics method that is presented in card-format. Each ECCOLA card discusses an AI ethics principle or issues related to a principle. Thus, EUS devised using ECCOLA can typically be linked to a specific card, as seen in Fig. 2. Fig. 2 showcases the relevant ECCOLA card and an EUS discussing features related to the the card.

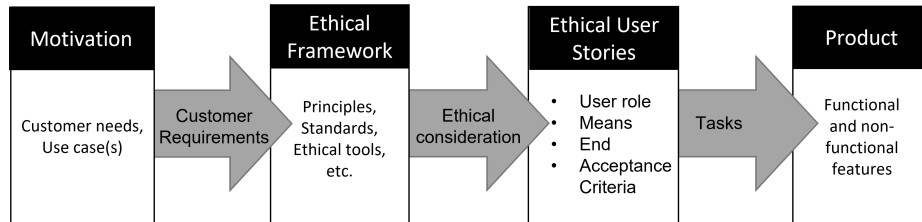


Fig. 1. Process of Devising Ethical User Stories

⁴ Ethical User Stories in SMART Terminal Digitalization Project: Use Case Passenger Flow: <https://doi.org/10.48550/arXiv.2111.06116>

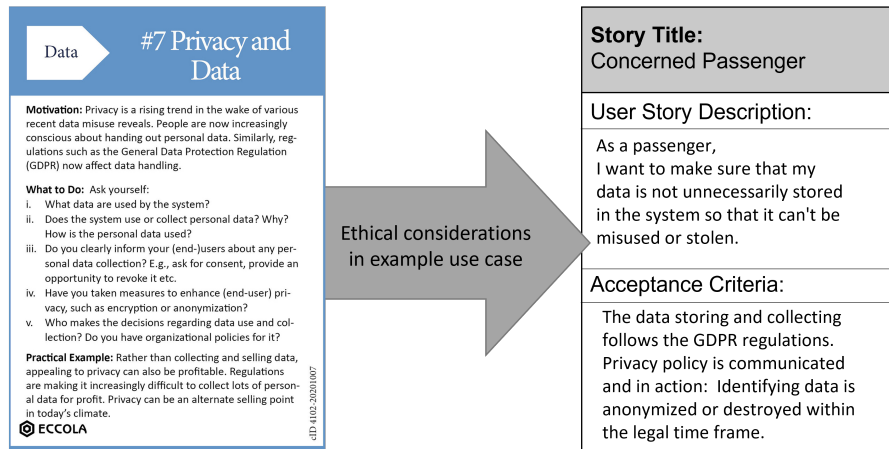


Fig. 2. Example of an ethical framework and the resulting EUS (from real case)

4 Summary

AI ethics is an area of research where the gap between research and practice remains prominent. In particular, the link between AI ethics and SE practice is thin [14]. Studies in the area are generally either conceptual in nature or most focused on technical tools for ML. Engineering ML systems is still SE, and focusing purely on the ML components results in a narrow focus.

We propose Ethical User Stories (EUS) as one tool for bringing AI ethics closer to conventional SE practice. User stories are commonly used SE tools in Requirements Engineering. By incorporating ethical issues into this process through an ethical framework, we argue that user stories could help implement ethics in practice. We provide some initial empirical evidence of their use in an existing paper [5].

In this light, we strongly urge future research to conduct further empirical studies in AI ethics, particularly with a focus on solutions for tackling AI ethics in practice in SE. Such studies should focus on incorporating AI ethics as a part of SE practice. EUS provide one example of how this could perhaps be done.

References

1. Siqueira de Cerqueira, J., Azevedo, A., Tives, H., Canedo, E.: Guide for artificial intelligence ethical requirements elicitation - re4ai ethical guide. In: Proceedings of the 55th Hawaii International Conference on System Sciences (01 2022)
2. Cohn, M.: User stories applied: For agile software development. Addison-Wesley Professional (2004)
3. Dimitrijević, S., Jovanović, J., Devedžić, V.: A comparative study of software tools for user story management. *Information and Software Technology* **57**, 352–368 (2015)

4. Hagendorff, T.: The ethics of ai ethics: An evaluation of guidelines. *Minds and Machines* **30**(1), 99–120 (2020)
5. Halme, E., Vakkuri, V., Kultanen, J., Jantunen, M., Kemell, K.K., Rousi, R., Abrahamsson, P.: How to write ethical user stories? impacts of the eccola method. In: Gregory, P., Lassenius, C., Wang, X., Kruchten, P. (eds.) *Agile Processes in Software Engineering and Extreme Programming*. pp. 36–52. Springer International Publishing, Cham (2021)
6. Jobin, A., Ienca, M., Vayena, E.: The global landscape of ai ethics guidelines. *Nature Machine Intelligence* **1**(9), 389–399 (2019)
7. Johnson, B., Smith, J.: Towards ethical data-driven software: Filling the gaps in ethics research & practice. In: *2021 IEEE/ACM 2nd International Workshop on Ethics in Software Engineering Research and Practice (SEthics)*. pp. 18–25 (2021)
8. Lucassen, G., Dalpiaz, F., Van Der Werf, J.M.E., Brinkkemper, S.: Forging high-quality user stories: towards a discipline for agile requirements. In: *2015 IEEE 23rd international requirements engineering conference (RE)*. pp. 126–135. IEEE (2015)
9. McNamara, A., Smith, J., Murphy-Hill, E.: Does acm’s code of ethics change ethical decision making in software development? In: *Proceedings of the 2018 26th ACM ESEC/FSE*. pp. 729–733. ESEC/FSE 2018, ACM, New York, NY, USA (2018)
10. Mittelstadt, B.: Principles alone cannot guarantee ethical ai. *Nature Machine Intelligence* pp. 1–7 (2019)
11. Morley, J., Floridi, L., Kinsey, L., Elhalal, A.: From what to how: An initial review of publicly available ai ethics tools, methods and research to translate principles into practices. *Science and Engineering Ethics* **26**(4), 2141–2168 (2020)
12. Schön, E.M., Thomaschewski, J., Escalona, M.J.: Agile requirements engineering: A systematic literature review. *Computer Standards & Interfaces* **49**, 79–91 (2017)
13. Sloane, M., Zakrzewski, J.: German ai start-ups and “ai ethics”: Using a social practice lens for assessing and implementing socio-technical innovation. In: *2022 ACM Conference on Fairness, Accountability, and Transparency*. p. 935–947. FAccT ’22, Association for Computing Machinery, New York, NY, USA (2022)
14. Vakkuri, V., Kemell, K., Kultanen, J., Abrahamsson, P.: The current state of industrial practice in artificial intelligence ethics. *IEEE Software* **37**(4), 50–57 (2020)
15. Vakkuri, V., Kemell, K.K., Abrahamsson, P.: Implementing ethics in ai: An industrial multiple case study. In: *PROFES 2019 : Product-Focused Software Process Improvement : 20th International Conference*. pp. 331–338. Springer. *Lecture Notes in Computer Science*, 11915. (2019)
16. Vakkuri, V., Kemell, K.K., Jantunen, M., Abrahamsson, P.: “this is just a prototype”: How ethics are ignored in software startup-like environments. In: Stray, V., Hoda, R., Paasivaara, M., Kruchten, P. (eds.) *Agile Processes in Software Engineering and Extreme Programming*. pp. 195–210. Springer International Publishing, Cham (2020)
17. Vakkuri, V., Kemell, K.K., Jantunen, M., Halme, E., Abrahamsson, P.: Eccola—a method for implementing ethically aligned ai systems. *Journal of Systems and Software* **182**, 111067 (2021)
18. Vakkuri, V., Kemell, K.K., Tolvanen, J., Jantunen, M., Halme, E., Abrahamsson, P.: How do software companies deal with artificial intelligence ethics? a gap analysis. In: *The International Conference on Evaluation and Assessment in Software Engineering 2022*. p. 100–109. EASE 2022, Association for Computing Machinery, New York, NY, USA (2022)
19. Wang, X., Zhao, L., Wang, Y., Sun, J.: The role of requirements engineering practices in agile development: an empirical study. In: *Requirements engineering*. pp. 195–209. Springer (2014)