Can children teach AI?
Towards expressive human-AI dialogs

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Abstract. AI-empowered dialog systems become increasingly widespread, with over 40 million units of Amazon Alexa and Google Home installed alone in the USA in 2017, according to recent surveys. Whereas this adoption facilitates AI-based systems to engage in end user dialogs on an unprecedented scale, the ability of AI to learn from their human dialog partners is still substantially limited. In this paper we briefly discuss the opportunities, challenges and risks on the interface of knowledge acquisition and human computer interaction towards more expressive dialogs between end users and AI. Our goal is to facilitate AI to directly gain knowledge from end users, while ensuring mutually beneficial interaction.

1   Introduction and Motivation

Recent advances in AI-empowered dialog systems have led to their increasing adoption by end users and thus to a significant raise of interaction opportunities for AI with end users. Surveys indicate that over 40 million units of such systems including Amazon Alexa / Echo and Google Home have been installed alone in 2017 in the USA, tendency increasing.[1] These numbers also indicate that AI has gained direct access to end user communications on an unprecedented scale.

Although the widespread adoption of AI dialog systems provides entirely new opportunities for AI to communicate with end users, to request their input and ultimately to learn from them at a scale that has not been possible ever before, current learning algorithms are unable to take full advantage of rich and expressive end user feedback that can be potentially provided during a human-AI dialog. Existing AI algorithms mainly restrict the role of end users in their learning to the provision of pre-defined patterns for specific tasks.

In fact, many recent developments demonstrate that end users are willing and capable of creating new knowledge and sharing it with other agents. Examples include large-scale collaborative development of open knowledge platforms on the Web (e.g. Wikipedia, Wikidata and Freebase [3]) as well as numerous citizen science and crowdsourcing platforms that evolved over the past decade.

However, the design of current human-AI interaction paradigm does not take full advantage of rich end user knowledge. Interactive systems for Question Answering (e.g. [4]) typically aim to reduce interaction cost. Recent approaches for

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[1] https://searchengineland.com/analyst-firm-google-home-gains-ground-amazon-echo-44-million-total-units-sold-290544

knowledge graph construction from conversational dialogs (e.g. [2]), mainly aim to learn specific patterns (e.g. relations between concepts). Interaction paradigm that empower end users to flexibly augment the system's knowledge beyond the foreseen patterns, to understand the sources of errors and to explicitly correct them, or to directly teach and personalize dialog systems are to be developed.

In this paper we briefly present the key opportunities of expressive human-AI dialogs with end users along with the challenges and risks that need to be addressed to facilitate rich knowledge acquisition by AI systems while providing benefits to end users.

1.1 Motivating Example

To illustrate how an AI-based dialog system can profit from an end user dialog, let us consider a real-world dialog example, where a 10-year old end user talks to the newly acquired Amazon Alexa dialog system.

Q1. Alexa, play me a cheerleader song.
  – Alexa starts playing an unrelated song.
Q2. Alexa, stop. Alexa, What is cheerleading?
  – Alexa reads the definition of the term "cheerleading" from Wikipedia.
Q4. Alexa, play me a cheerleader song.
  – Alexa plays the same song again.
Q5. Alexa, stop.

As we can observe in this example, a 10-year old end user attempts to explain the meaning of her request to an AI system by a sequence of requests clarifying the context. As this example illustrates, the user is willing to clarify her intent to obtain the desired result and explicitly builds up the context of the question to facilitate this clarification in a dialog. Intuitively, such dialog context contains several clues an AI system can use to optimize its response and, even more importantly, its underlying knowledge representation. For example, the interruption of the response through the user reflects her dissatisfaction with the current answer. The follow-up questions with a semantic overlap indicate user attempt to build up the context connecting the individual requests. Therefore, the question is how shall we design knowledge acquisition and interaction paradigm of AI dialog systems and represent the resulting knowledge to facilitate better use of such expressive end user input.

2 Opportunities, Challenges & Risks

An *expressive human-AI dialog* is a dialog between an AI system and an end user that facilitates AI system to acquire knowledge.

In this paper we in particular consider dialog systems that rely on knowledge graphs. An example high-level framework for expressive human-AI dialogs including selected components is presented in Fig. 1.

The opportunities of *expressive human-AI dialogs* from the perspective of an AI system include:
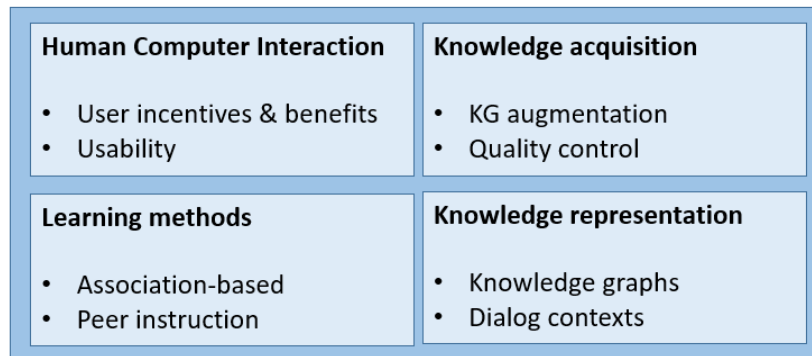
Human Computer Interaction	Knowledge acquisition
• User incentives & benefits • Usability	• KG augmentation • Quality control
Learning methods	Knowledge representation
• Association-based • Peer instruction	• Knowledge graphs • Dialog contexts

Fig. 1: An example high-level framework for expressive human-AI dialogs.

– Direct acquisition of new knowledge from large-scale end user population.
– Construction and augmentation of the underlying knowledge graphs on a large scale.
– Explicit verification and correction of knowledge.

Expressive human-AI dialogs can facilitate a wide range of applications that:

– Provide better quality results due to the enhanced knowledge representation.
– Enhance user experience through enhanced transparency.
– Offer personalized services.

These opportunities come along with several key challenges. In the area of knowledge acquisition these challenges include:

– Designing flexible knowledge representations to directly incorporate user input and feedback, in particular with respect to associative knowledge.
– Designing algorithms that actively acquire and utilize expressive user input. Such algorithms can be inspired through modern pedagogical approaches, e.g. peer instruction [1].
– Conducting quality control of the acquired knowledge.
– Performing learning process assessment.
– Facilitating transparency and explainability for end users.

The challenges in the area of human-computer interaction include:

– Design of incentives for end users to teach AI systems, while ensuring that the dialogs are mutually beneficial for AI and users.
– Development of interaction paradigm for expressive human-AI dialogs (e.g. through further development of approaches for active learning, games of purpose, learning from errors, etc.).
– Providing feedback regarding learning process.

Finally, the associated risks include:

– Ethical risks including potential risks for end users in vulnerable groups.
– Data protection and privacy issues.

3 Related Work

Whereas initial approaches to dialog-based knowledge acquisition relied on manually defined dialog models and rules, recent works utilize more flexible conversational dialogs without requiring strictly pre-defined dialog models. These approaches address specific tasks including data labeling, knowledge graph population and relation extraction [2]. However, none of the existing dialog-based knowledge acquisition approaches is capable of conducting flexible knowledge acquisition at the scale envisioned in this paper. Learning through associations and learning through dialogs (e.g. in modern peer instruction pedagogical approaches [1]) is a common way for humans to effectively acquire new knowledge. Recently, applications utilized knowledge graphs to support human learning through associations.[2] In this work, we argue that new learning paradigm based on knowledge graphs and end user dialogs can be mutually beneficial to AI and humans.

4 Summary and Outlook

In this paper we briefly summarized opportunities, challenges and risks in expressive human-AI dialogs. Such dialogs can shift the interaction paradigm between end users and AI systems towards more effective knowledge acquisition. This paradigm can facilitate AI systems to take a direct advantage of their growing end user base to improve the knowledge representation, provide personalized services and enhance the overall user experience. These opportunities come along with a number of research challenges regarding knowledge representation, algorithms and human computer interaction as well as ethical risks to be addressed in the next decade.

References

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[2] `https://noduslabs.com/cases/learning-associations-knowledge-graph`