Generating Questions: An Inclusive Characterization and a Dialogue-based Application

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Abstract

In this paper, we make a case for the intrinsic richness of the Question Generation task and then very briefly motivate an application of Question Generation in the context of generating dialogue from monologue.

Characterizing Question Generation In this section, we propose an inclusive characterization of Question Generation (henceforth QG), embracing a wide variety of approaches. In our view, such an open-minded approach is most conducive for a new and hopefully soon burgeoning research field. We strongly support concrete tasks and resources to develop the field, but without losing sight of the wider context of Question Generation as a general problem. As a research topic and emerging community, the chance of making a real impact can, in our view, be maximized by bringing people from a variety of backgrounds together, exploiting cross-fertilization between different approaches, and aiming for a critical mass that can be build up by appealing to a broad audience.

Thus, as a starting point, let us characterize *Question Generation* as the task of automatically generating questions. Note that this characterization, though very inclusive, does characterize QG from a *computational* point of view, thus excluding purely formal/logical, yet potentially relevant, approaches, such as work on the logic of questions (Wiśniewski, 1995). Instead of narrowing the characterization further, we would like to illustrate the richness of the resulting topic of research by asking the following three questions: *What is the input to the task?*, *What is the output?* and *What is the relation between* $\langle$*input,output*$\rangle$ *pairs?* The answers to these questions result in a 'map' of the potential ground covered by QG.

The second question, *What is the output?*, may at first sight appear straightforward. It does, however, immediately lead to the issue whether we define questions purely *syntactically* (as interrogative sentences) or *semantically* as conveying informational gaps, see, e.g., Piwek (1998). In the latter case, the output may include, for example, 'declarative questions' (Beun, 1990), questions expressed by imperative sentences ('Tell me what time it is'), and also embedded questions ('I know who lives here'). Moreover, even questions formulated as interrogative sentences are often inseparably linked to declarative sentences – Van Kuppevelt (1996) speaks of 'feeders' as in 'For more than a century and a half, [...] has been known as the finest watch in the world. [...] What is the reason for this?'. Further issues emerge when we consider not only *written* but also *spoken* questions: e.g., the questions (where italics indicate stress) 'Did you see *Mary*?' and 'Did you *see* Mary?' are subtly different (Pierrehumbert and Hirschberg, 1990). And all this presupposes that questions are always expressed verbally; what if *A* and *B* are working on a car, and *A* tells *B* to undo a screw whilst pointing at it. *B* might touch the screw that he thinks *A* indicated, raise his eyebrows and look at *A* for confirmation – now, did *B* ask a question? Similarly, questions may be expressed using diagrams, pictures, formal languages, or a combination of any of these.

Many of the issues that arise when characterizing the output of QG also arise when characterizing its input. Though we might at first think of declarative

sentences as the input, there is no principled reason for excluding interrogatives and imperatives. Also, the restriction to purely verbal input (whether written or spoken) seems arbitrary; why not also allow pictures, diagrams, gestures, or a (multimodal) combination of these?

Finally, let us distinguish between two principal alternatives when it comes to the relation between input and output in QG. We would like to make a distinction between (output) questions that are *answered* by the input and questions that are *raised*, but not answered, by the input. A verbal example of the first type is:

In: *John walks*
Out: *Who walks?*

An example of the second type is:

In: *If John's car is in the garage, he is at home. Is John at home?*
Out: *Is John's car in the garage?*

In this example, we have a question and statement (the statement being an indirect answer, see, e.g., Piwek (1998)) which together give rise to another question – this example can be viewed as an extreme kind of context-sensitive question reformulation.

Generating Questions in Dialogue Rather than provide technical details of an application of QG, here we want to briefly motivate such an application since, whereas it is obvious why one would like to generate answers, it is not immediately clear why there is a need for the generation of questions. An excellent example of QG in interactive tutoring is provided by Rus et al. (2007) who automatically generate questions corresponding to prompts and hints for a student, with as input the system's expectations regarding a correct answer. Similar to this application, our work also focuses on generating questions whose answer is provided by the input. However, rather than generate individual questions, our system – T2D; Piwek et al. (2007) – generates a complete *dialogue* from an input text that is in monologue form. The resulting dialogue is meant to faithfully convey the information in the monologue, but now as a conversation between an expert and a layman.

The rationale for generating dialogue automatically is that a number of studies suggest that dialogue can be more effective than monologue both for educational and persuasive purposes. For example, Lee et al. (1998) report that there is more discussion between students and less banter after listening to a dialogue (as opposed to a monologue), and Craig et al. (2000) found that dialogue stimulates students to write more in a free recall test and ask twice as many deep-level reasoning questions in a subsequent tutor-guided task on a different topic. Additionally, presenting information in the form of a dialogue is a popular means for engaging and entertaining an audience, as witnessed by the widespread use of dialogue in commercials, news bulletins (between presenters), educational entertainment, and games. Automatically generated dialogue allows emulation of such engaging presentation forms, by rendering dialogue as synthesized speech or through Life-like Computer-animated Characters – see, e.g., Prendinger and Ishizuka (2004).

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