

Showpiece: iSnap Demonstration

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Abstract—This showpiece will present iSnap, an extension of the block-based, novice programming environment Snap!, which supports struggling students by providing on-demand hints and feedback that help them complete programming assignments. iSnap extends the existing syntactic scaffolding offered by block-based programming to additionally support the implementation of programming tasks. Research on iSnap has explored questions of how visual programming environments can better support learners, the impact of this support, and how learners seek and use computer-based help. The showpiece will consist of an interactive demonstration of iSnap, including the user interface experienced by students and the data-driven algorithm used to automatically generate the programming feedback.

I. INTRODUCTION

This showpiece demonstrates iSnap [1], an extension of the block-based, novice programming environment Snap! (<http://snap.berkeley.edu>). iSnap is designed to support students when they get stuck on a programming assignment by providing on-demand hints and feedback that suggest how the student can bring their code closer to a correct solution. iSnap’s hints are generated without the need for expert domain engineering, using a data-driven algorithm that recommends edits to a student’s code based on how other students previously solved the same problem correctly [2]. Our work explores the unique opportunities and challenges of providing this support for a visual, block-based programming environment. This context has shaped the design of iSnap’s help, including the choice to communicate hints visually, with a minimum of text.

iSnap supports students with two types of feedback. Figure 1 shows the first type of feedback, in which iSnap highlights the student’s code to indicate blocks that likely do not belong in a correct solution, as well as blocks that belong, but may be in the wrong location. This feedback is designed to check the student’s work and identify likely errors. If a student is still stuck and does not know how to proceed, iSnap can annotate their code with next step hints, suggesting where additional blocks of code should be inserted, as shown in Figure 2. These suggestions are generated by comparing a student’s code to the best-matching correct solution in iSnap’s database of student- or expert-provided solutions.

II. CONTENT AND CLAIMS

iSnap has been evaluated in a number of contexts. An initial classroom pilot study [1] showed qualitative evidence that students can use the hints to fill in gaps in their knowledge

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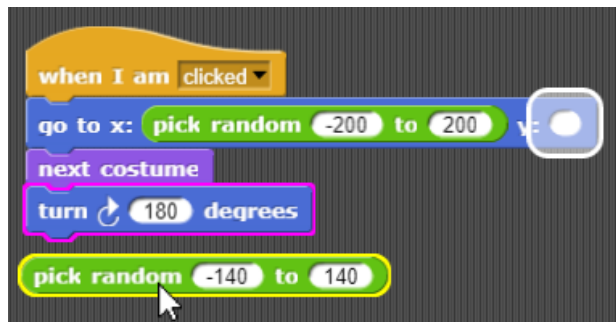


Fig. 1. iSnap highlights code to show blocks that should be deleted (magenta) and moved (yellow). Hovering over a block shows where it should be moved.

to complete assignments. However, it also highlighted design flaws with the hint generation algorithm and iSnap’s UI, many of which have since been addressed. One issue raised by the pilot study was that many students use iSnap’s help features rarely or not at all. A later classroom study investigated this behavior [3] and found that while many students perform poorly on assignments and would benefit from help, students can be deterred from making help requests if the first hints they receive from iSnap are not of the highest quality. To further investigate iSnap’s hint quality, we compared the data-driven feedback generated by iSnap with that of human tutors [2] and found that while iSnap was capable of reproducing human feedback almost as consistently as another human, it also produced additional suggestions that humans did not, which may account for the lower-quality hints found earlier.

We have also collected a large amount of interview and think-aloud data from students working in iSnap with both human and automated help. An initial analysis [4] suggests that computer-based help systems are not simply “worse” versions of human tutors, but rather offer advantages and disadvantages. Computer-based help may be seen as more accessible and present less of a threat to students’ perceived independence than human help. However, computers can also be seen as less trustworthy, interpretable and perceptive than human tutors. Our findings suggest that computing is a unique context in which to study help-seeking, and we expect future work will reveal additional insights from this data.

III. RELEVANCE

Our work with iSnap shares VL/HCC’s goal of improving how people “learn, express, and understand computational

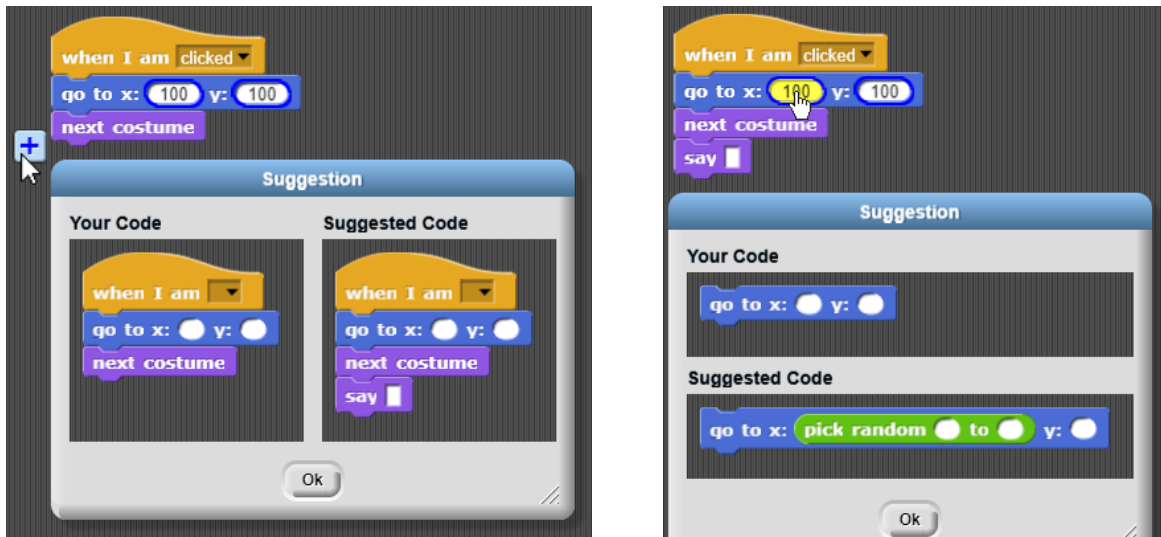


Fig. 2. iSnap annotates code with hint buttons (left) and blue-outlined input slots (right). Clicking a button or outlined input slot shows a next-step hint suggesting how a block should be added to the student’s code.

ideas.” Students learning to program are arguably the group who have the most to gain from these improvements. The research questions at the heart of our work address this goal:

- How can a programming environment support learners when they encounter difficulty creating computational artifacts?
- What impact does this support have on learners’ programming process and learning outcomes.
- How do learners seek and use help offered by a computer tutor, and how does this differ from how they interact with a human tutor?

Additionally, block-based programming languages are an area of special interest to the VL/HCC community, and the most popular of these languages are educational (in fact, as of July 2017, the educational language Scratch, upon which Snap! is based, ranks as the 19th most popular of *all* programming languages, according to the TIOBE index¹). However, while these languages offer powerful scaffolding that helps novices overcome difficulty with programming syntax, by themselves they offer little to assist students in understanding and implementing the core conceptual knowledge of programming. iSnap is a first step towards integrating adaptive domain scaffolding into a visual, block-based programming environment. We hope it will be a first step among many, and that the VL/HCC community will help to shape that research direction.

While our tools are designed in an educational context, we also see applications of our methods to end-users of visual languages, who may also benefit from targeted programming help in their work. We would welcome input from researchers working with end-users on the types of support most needed in their programming environments.

¹<https://www.tiobe.com/tiobe-index/>

IV. PRESENTATION

This presentation will include a demonstration of iSnap on a few laptop computers. An author will explain the features of iSnap and how the data-driven hints are generated. Attendees will be able to test iSnap on a variety of assignments, with extra debugging information available to demonstrate how the system is adapting to their current code to provide relevant hints. In addition to the live demo, attendees will also be able to access a demo, public datasets and relevant papers afterwards at iSnap’s website².

A. Request for Feedback

Our research with iSnap is largely the product of the CS Education and Intelligent Tutoring Systems research communities. One of our goals for this showpiece is to represent these communities and to continue to bring them into conversation with VL/HCC. An important aspect of this will be eliciting feedback on the design and implementation of iSnap. Our work would benefit greatly from a critical evaluation from experts in the field, and we would take suggestions on usability and design very seriously in our continued development.

REFERENCES

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²<http://go.ncsu.edu/isnap>