Measuring Learning of Code Patterns in Informal Learning Environments

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Due to the absence of traditional forms of assessment, quantitative measures of learning in informal settings (like Scratch and App Inventor) have relied on identifying the presence or absence of individual visual programming blocks in projects made by learners.

▶ The number and diversity of programming blocks [Scaffidi and Chambers, Moreno-León et al., Wolz et al.]
▶ The growth of user-level repertoires of programming blocks [Yang et al., Dasgupta et al., Sun and Yang, Xie and Abelson]
▶ The likelihood that a user will adopt particular programming blocks [Dasgupta et al.]

A Scratch script with 2 blocks and an App Inventor script with 3 blocks.

**Motivation: From individual blocks to patterns**

Many important computer science concepts can only be enacted through more complex patterns. (e.g. variable initialization requires several blocks)

We believe that detecting patterns of code instead of individual blocks is an important improvement on previous approaches.

▶ It lets researchers measure important computer science concepts not reflected in a single block.
▶ The use of a pattern may be a better indicator of understanding [Brennan and Resnick].

Online community where more than 16 million children share computer programs and socialize.

**Two common patterns**

- **Pattern 1** is a script that initializes a variable when the project is run.
  - For pattern 1, our data consists of 550,367 projects created by a random sample of 96,290 users.

- **Pattern 2** is a script that keeps track of collisions between two Scratch sprites.
  - For pattern 2, our data consists of 608,875 projects created by a different random sample of 96,206 users.

As a proof-of-concept analysis—with remixing as the primary independent variable—we present plots of model-derived estimates of the proportion of users who have used Patterns 1 and 2. Estimates are shown for two prototypical users:

▶ A user who has never shared a remix that uses the pattern (Red)
▶ A user who has shared three remixes that use the pattern (Blue)

A user who remixes more projects that use a pattern of code will be more likely to use that particular pattern for the first time in a subsequent project of their own.

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