AUTOMATED GRADING OF TEMPLATE-BASED R PROGRAMMING ASSIGNMENTS USING *SWIRL-TBP* *

FACULTY POSTER ABSTRACT

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The R programming language provides an environment for statistical computing, data analysis, and visualization. As demand for data scientists increases, there is an increasing need to teach students how to analyze data by writing programs in R. The package swirl provides students with interactive tutorials where students can learn R by completing lessons in the R console. The package *swirl-tbp* (https://gdancik.github.io/bioinformatics/swirl-tbp/), which I have developed, is an extension of the package swirl that allows the instructor to create 'template-based problems' where features such as object names or values are dynamically generated at runtime. For example, the same template could be used to generate the following two problems (underlined terms are randomly generated): "Find the median age of males" and "Find the mean GPA of all individuals". As a result, a student can repeatedly practice a concept by completing variant versions of a problem, and can also practice problems in random order, to help maximize learning. Personalized feedback based on the student's response can also be provided. Here, I describe the package swirl-tbp and introduce an extension that allows instructors to generate assignments that can be automatically graded.

The advantages of automated grading and immediate feedback for both students and faculty has been documented [1-3], but there are limited tools available for generating auto-gradable assignments in R. In particular, the Jupyter notebook platform (http://jupyter.org/) and its nbgrader extension can be used to create auto-gradable assignments within a Jupyter notebook. However, swirl-tbp offers several advantages over this and existing tools. First, as mentioned above, swirl-tbp allows instructors to specify 'template-based problems', which allows for the rapid generation of similar problems and the generation of multiple versions of assignments for distribution to students, which would be time-consuming to produce with other tools. Second, students

complete programming assignments using RStudio or the integrated development environment (IDE) of their choice, rather than through a web browser, which better models real-world development of R code. The capabilities of swirl-tbp will be demonstrated with example problem sets covering R programming concepts such as vector creation and the calculation of probabilities for normally distributed random variables.

REFERENCES

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