Using GitHub, Travis CI, and Python to Introduce Collaborative Software Development

Rowan Castellanos, Gregory M. Kapfhammer, Nicholas Tocci
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Challenges

Existing tools support effective teaching

But, we needed a tool to solve extant concerns

Here are some of the key challenges that we faced!
Version Control is ... Only the First Step!
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Start a New Repository → Populate the Repository → Students Copy Files
Version Control is ... Only the First Step!

1. **Start a New Repository**
2. **Populate the Repository**
3. **Students Copy Files**
4. **Students Edit Files**
5. **Finalize a Repository**
6. **Grade the Submission**

Reverse flow:
- Students Edit Files
- Finalize a Repository
- Grade the Submission
- Students Copy Files
- Populate the Repository
- Start a New Repository
Teaching Computer Science is Hard!

Unclear Status

Messy Code

Tricky Teamwork

Exhausting Evaluation
Teaching Computer Science is Hard!

Unclear Status
Messy Code
Professor
Teaching Assistant
Tricky Teamwork
Exhausting Evaluation
Student
What Are the Key Educational Goals?
What Are the Key Educational Goals?

- Clear Status
- Standardized Code
- Effective Teamwork
- Efficient Evaluation
What Are the Key Educational Goals?

Clear Status
Standardized Code
Critical Ideas
Effective Teamwork
Efficient Evaluation
Industrial Tools
Tools Solve Some Issues ... Not Others!

Gradle

Automate a Build + Check in the Cloud + Collaborate with GitHub

But, certain solution properties are difficult to check!
Solutions

- Adopt existing tools whenever possible
- Use Python language for prototyping and testing
- Here is how we created the GatorGrader tool!
GatorGrader Checks Code and Writing

Source Code

GatorGrader

Technical Writing

Inspect the source code, program output, and technical writing
GatorGrader Can Check Other Entities!

Ensure GitHub collaboration and the existence of arbitrary files.
Performing Checks with GatorGrader

Gradle plugin calls GatorGrader and gives feedback to a student

Supports dependencies between checks and parallel builds
Where Does GatorGrader Run?

Travis CI  GatorGrader  Student Laptop

GatorGrader gives regular feedback both locally and in the cloud.
Why Pick Python for Programming?

Packages  Versatility  Testing

Many versatile packages support development and exploration using pytest leads to a confidence in tool correctness.
What Courses Have Used GatorGrader?

- Computational Expression
- Data Abstraction
What Courses Have Used GatorGrader?

- Computational Expression
- Web Development
- Data Abstraction
- Software Engineering
Feedback

GatorGrader promotes technical skill mastery

Automated checkers can become a limiting crutch

Increases confidence in delivery of correct labs
GitHub Classroom, Travis CI, and GatorGrader made it easier for me to effectively deliver programming labs in an introductory computer science course!

Janyl Jumadinova
Assistant Professor
This approach ensures that the source code and GitHub repositories are organized. It is easier for me to help the students who are struggling in an introductory course.”

Saejin Mahlau-Heinert
Teaching Assistant
You need to be really careful to ensure that students do not become overly reliant on the automated tools that check their source code and technical writing.”

Race Mahoney
Teaching Assistant
“This tool suite made it easier for me to talk with students about technical requirements. It helped me to make complex assignments more accessible to students.”

Maria Kim
Teaching Assistant
GatorGrader encouraged me to add better code comments and try out language constructs that I would not have otherwise investigated. The tool was a big help!

Samantha Darris
Introductory Student
Student

GatorGrader is like having a constant coach! I liked receiving feedback on the quality of my source code and writing before turning in the final version of my lab.”

Anna Yeager
Introductory Student
Conclusion

GatorGrader aids the building of positive habits.

Python was the right programming language.

There are many avenues for exciting future work!
Experiments with GitHub & GatorGrader

Experimentally study student writing, source code, and emotions

What source code and technical concepts lead to frustration?
Use and Contribute to GatorGrader!

New Courses

Constructive Feedback
Use and Contribute to GatorGrader!

- New Courses
- Pull Requests
- Constructive Feedback
- Defect Reports
GitHub + Travis + Python + GatorGrader

Clear Status

Standardized Code

Critical Ideas

Effective Teamwork

Efficient Evaluation

Industrial Tools