Checkpoint: A Tool to Support Terminal-Based Capture-the-Flag Assessments

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What are PL and CTF?

PrairieLearn (PL) is a popular and open source platform for online assessments

Capture-the-Flag (CTF) activities provide hands-on experiential learning with industry tools, (e.g., Cybersecurity hackathons)
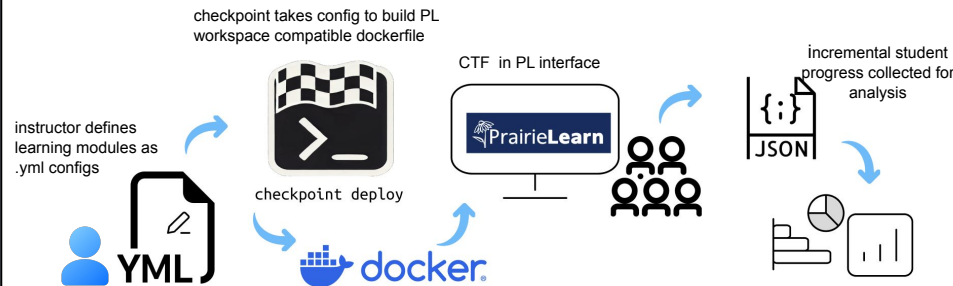
Why Checkpoint?

Capture the Flag	Checkpoint
All or nothing credit	Subtask Partial Credit
Survey Feedback	Subtask Metrics
local VM installations	Remote deployment

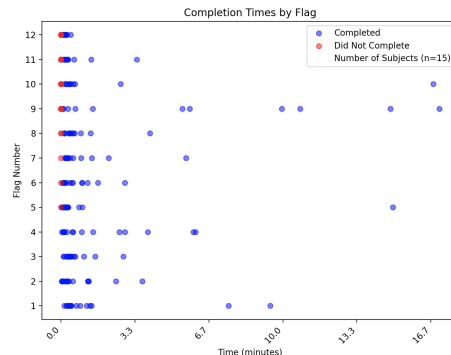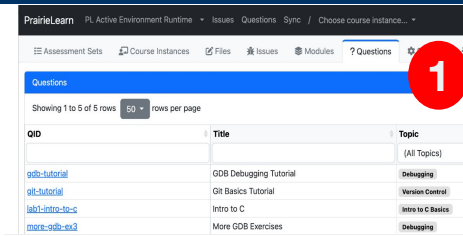Checkpoint reduces CTF setup overhead, increased instructor observability for sub-tasks

Prior Work

- When incremental badges are used, the learner is continuously told they're progressing *[Fanafarelli, Vie, & Mcdaniel 2015]*

- Students showed low interest in learning programming topics with traditional methods, but a gamified approach motivated them *[Kumar & Khurana 2012]*

## PrairieLearn + Checkpoint Workflow Highlights

checkpoint takes config to build PL workspace compatible dockerfile

instructor defines learning modules as .yml configs

checkpoint deploy

CTF in PL interface

incremental student progress collected for analysis

PrairieLearn Autograded Workspace + Mastery-based Labs

Completion Times by Flag

1
- Modular setup - Instructors customize topics with instructions, files or tooling.
- familiar platform, minimal new training
- granular observability, new analytics
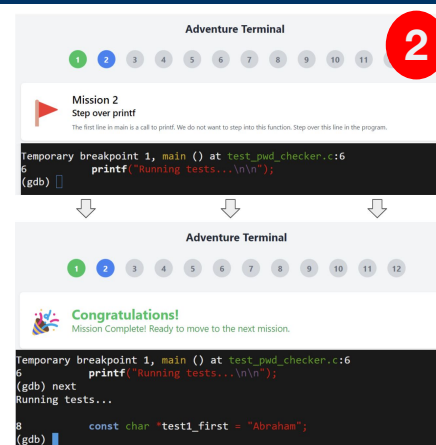
2
- students receive incremental progress feedback & credit
- constructivist / active content learning
- Partial credit opportunities
- replayability of missions invite mastery learning opportunities

Checkpoint extends PL features to autograde dynamic CTF exercises

Usability Study (N=15)

Checkpoint + Teaching C-debugger (GDB)
Convert lab exercise about learning the GDB tool for debugging C-programs to Checkpoint

Students completed GDB - checkpoints assisted by:

- Access to GDB Reference Card and Lab
- Access to a 5-min mini-lecture
- Access to Google
- interventions provided for "stuck" user

Methodology: pre/post user surveys, activity observations

Usability Feedback

- "Let's go! I understand this!
- Grading mechanism may be "too strict" and may prevent students from fully exploring.
- Ability to reset a subtask without resetting whole mission
- Workspace could be bigger

Future Work

- Collect more user studies
- Adapt MVP to feedback & edge cases
- Ability to shuffle mini-flag quests
- Instructor dashboard integration
- Checkpoint project initiated PL RFC for "Advanced Workspace" : ☺ issue #10816

* Project team contributed equally to Checkpoint