

# LETGRADE: AN AUTOMATED GRADING SYSTEM FOR PROGRAMMING ASSIGNMENTS

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## Problem Statement

We propose a novel method to automatically grade programming assignments by combining static program analysis, testing, and machine learning. Our experiments investigate the answers to the following questions:

- Which machine learning model works best for training our grading model?
- If a machine learning model is developed using one problem, does it apply to other problems as well?

## Why automated evaluation?

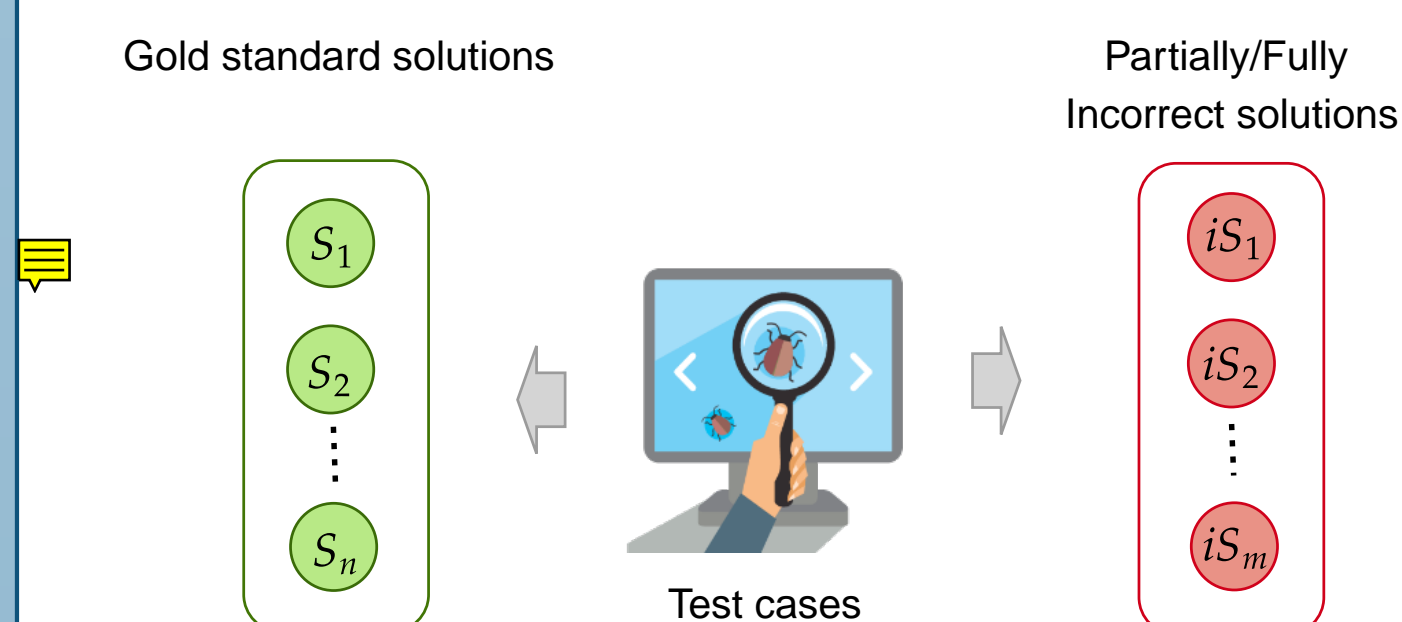


Fig. 1: Traditional automated evaluation using test-cases

- Enrolment in MOOCs is huge.
- Testing.
  - $T = \{t_1, t_2 \dots t_n\}$
  - $WT = \{wt_1, wt_2 \dots wt_n\}$
  - $\text{Mark} = \sum_{i=1}^n wt_i$
- Static analysis, single reference solution.

## Techniques Involved

*LetGrade* operates based on the following techniques.

- Static program analysis
- Testing
- Supervised Learning

## How to automate programming assignment evaluation?

- We grade submissions, giving partial credits even to incorrect submissions by factoring in the approach taken by the student
- Our method is a combination of static analysis and machine learning model.
- Our experiments show fair correlation of assigned grades with that of human evaluators.

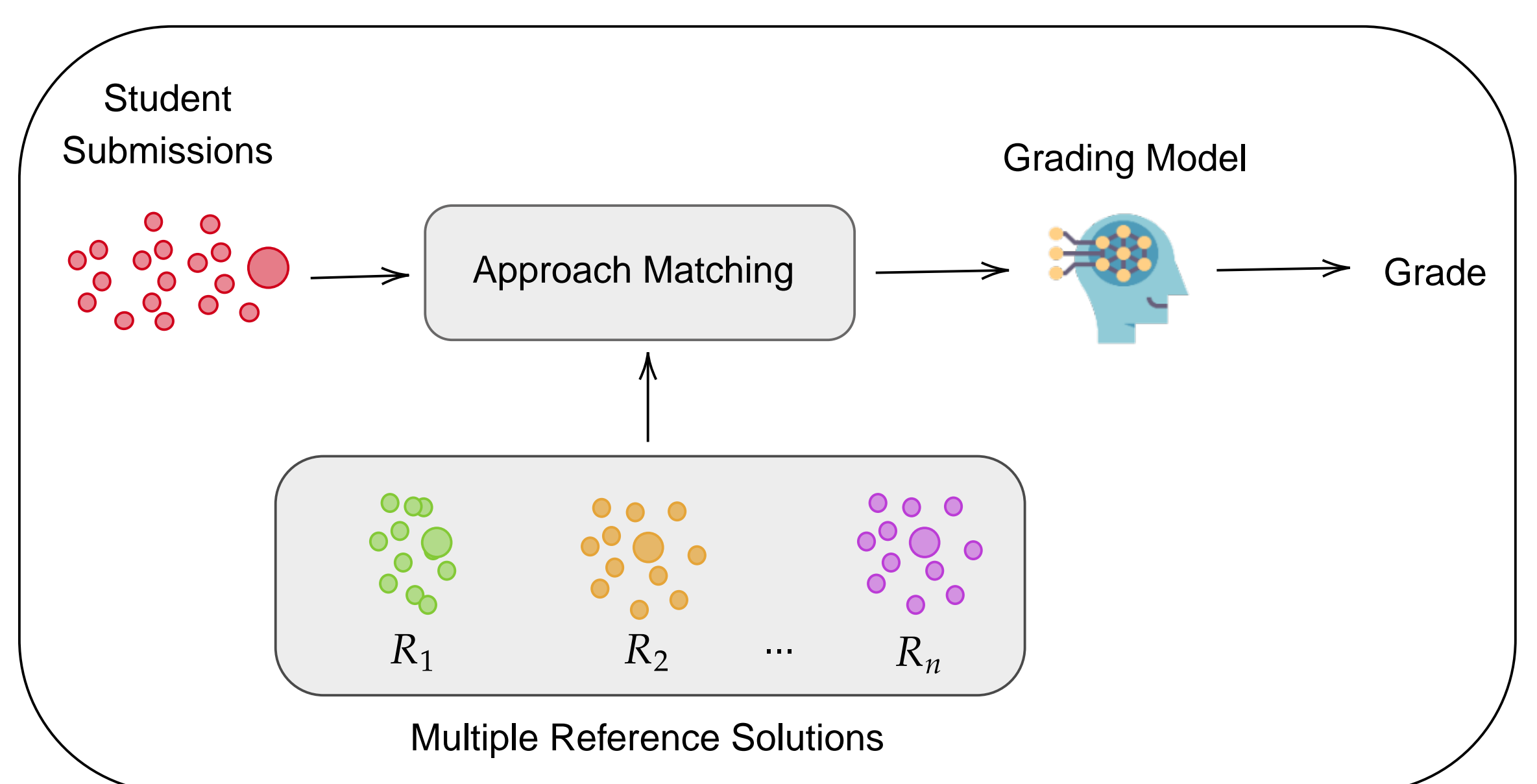


Fig. 2: *LetGrade* Architecture

## Highlights

- Multiple correct solutions allowed.
- Multiple approaches can be detected automatically.
- Can scale to any class size.

## Results

Our models were evaluated against datasets containing *Python* and *C* programming problems. The average variance in the grade predicted by the supervised machine learning model is consistently close to 0.5.