Using Alternative Grading in a Non-Major Algorithms Course

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Background: Alternative Grading

• Don’t just “add up” points.
  • Directly ask to what degree learning objectives were met.
  • With points: 3 good-faith, but wrong attempts get 67% each and 2 full-credit submissions and 1 blank submission get the same grade.

• Many versions in the literature, often overlapping
  • Standards-based, specifications-based, mastery-based, etc.

• Common key tenets
  • Simplify grading per assignment (fewer possible outcomes)
  • Evaluate learning throughout term.
Summary and Context

• We ran a senior-level algorithms course for non-majors with a standards-based grading system.
• 70-person course
• Traditional topic list, but math background was highly varied.
• Students in math, informatics, various engineering; both undergraduates and master’s students.
Grading Scheme

- 8 homeworks, no exams or other graded material.
  - Each homework expected 1 “mechanical problem” and 3 “long-form” problems from students.
- Up to 2 “old” problems can be (re-)submitted every week.
- Additionally, (auto-graded) programming questions can be resubmitted at any time.
Grading Scheme

- To keep grading load under control, simplify grading.

<table>
<thead>
<tr>
<th>Grading Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Excellent</strong></td>
<td>Main idea and edge cases are all correct. Would have gotten full credit (or extremely close) with points-based grading.</td>
</tr>
<tr>
<td><strong>Satisfactory</strong></td>
<td>Main idea is correct, but some edge cases or follow-up questions are wrong or missing. Would have gotten about 80-90% on points-based grading.</td>
</tr>
<tr>
<td><strong>Not Satisfactory</strong></td>
<td>Some important error is made, but substantial progress toward a solution. Would have gotten above 50% on points-based grading.</td>
</tr>
<tr>
<td><strong>Ungraded</strong></td>
<td>Directions not followed (e.g., used a library that isn’t permitted) or otherwise shows no substantial progress.</td>
</tr>
</tbody>
</table>
Grading Scheme

<table>
<thead>
<tr>
<th>Grade</th>
<th>Mechanical Problems</th>
<th>Long-Form Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.0</td>
<td>6E and 2S</td>
<td>22E and 1S</td>
</tr>
<tr>
<td>3.5</td>
<td>6E and 1S</td>
<td>18E and 4S</td>
</tr>
<tr>
<td>3.0</td>
<td>5E and 1S</td>
<td>14E and 3S</td>
</tr>
<tr>
<td>2.5</td>
<td>4E and 1S</td>
<td>8E and 8S</td>
</tr>
<tr>
<td>2.0</td>
<td>2E and 2S</td>
<td>6E and 7S</td>
</tr>
<tr>
<td>0.7</td>
<td>none</td>
<td>10S, with at least one on five different HWs.</td>
</tr>
</tbody>
</table>

Requirements announced before start of quarter.
Between major grade-breaks, “interpolate” with a formula made at the end of the quarter.
Goals

• Learning that happens later in the quarter should be rewarded.
  • Without a final exam.
• But without overwhelming TAs with grading.
• Students should see benefits of system.
• Allow easier customization of learning objectives for students.
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Most students needed resubmissions

Initial grading of DP long-forms

- 3E scores (perfect)
- 2E, 1S score
- 2S scores
- 1S score
- 0S scores ("no progress")

End-of-term grades of DP long-forms

- 80% of students who finished with all E’s needed resubmission.
- No students finished with no S scores.

Figure 2
Learning Throughout the Quarter

Students also learned via programming questions throughout the quarter.

Though procrastination is certainly also a factor here.

Figure 1
Goals

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  • Without a final exam.

• But without overwhelming TAs with grading.

• Students should see benefits of system.

• Allow easier customization of learning objectives for students.
TA Feedback

• Instead of 4 problems per student per week, we had (on average) about 5.2 problems submitted per student per week.
  • some autograded.

• But grading is simplified (just E/S/N/U, not points-out-of-20)

• TAs did not feel overworked, were comfortable increasing from 1 resubmission to 2 mid-quarter.

• Issues other than grading arose
  • Office hours are much harder!
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• But without overwhelming TAs with grading.
• Students should see benefits of system.
• Allow easier customization of learning objectives for students.
Student Feedback

• Surprisingly uncontroversial
  • Other UW CSE courses have used similar systems.
  • Mid-quarter feedback session had consensus like the system.
  • Few comments on end of quarter evaluations; most positive.

• Keeping up “student morale” needs different strategies.
  • Getting an N is getting a 0, not, say 50% of points.

• Students need more “homework style resources” (no solutions)

• Course-grade assignment process needs to be very clear.
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  • Allow easier customization of learning objectives for students.
Customize Learning

• Student group has a lot of populations:
  • Math majors with extra background.
  • Undergrads about to apply to tech industry.
  • Master’s students looking for skills applicable-to-research

• In a “standard” course, hard to treat each group well.
• With simplified grading, can add an “extra” problem for students to choose among more easily.
• Students did customize!
  • Some did every programming question; others did the minimum.
  • Some chose optional “real-world impacts” questions
Fit for the course

• Algorithms problems naturally fit simplified grading well.
• Non-majors is a particularly good fit
  • Optional problems are easier to insert.
Summary

• Learning that happens later in the quarter should be rewarded.
  • Without a final exam.
• But without overwhelming TAs with grading.
• Students should see benefits of system.
• Allow easier customization of learning objectives for students.

We met all of those goals!
But there are quirks and unique difficulties to address with the alternative system.