Teaching Advanced Software Engineering

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Microsoft Research Asia
Outline

• Background
• Gaps between Industry and Academic
• Approaches in Training
• Lessons learned
Background

• Xin Zou
  – Development Manager in MSR-Asia (2005 – now)
    • Tech Transfer & research projects (e.g. Academic Search)

• Hiring, Training and Teaching
  – MSRA intern training
  – MS new engineer training
  – Teaching “Advanced Software Engineering” in 3 Chinese universities
Teaching Assignments

• Tsinghua Univ. (07 – 09)
  ➢ 20 ~ 30 students, Senior Year.
  ➢ 4 credits

• Peking University, Software College (07 – 09)
  ➢ 20 ~ 80 students, M.S. Program

• BUAA, C.S. Dept. (09)
  ➢ 40 students, Junior Year
Gaps

• Between industry and academic
  – It’s very hard to find qualified students

• Gap
  – Academic: close-book exam, no questions allowed, work individually, no feedback except a score.
  – Industry: open-book environment, interaction with customer is crucial, work as a team, feedback comes in multiple ways
Approach (1)

• Clarify the “teacher-student relationship”
  – Retailer - customer?
  – Boss - employee?
  – Baby-sitter - babies?
  – Buddy - Buddy?
  – Stranger - Stranger?
  – Prison Guard - Prisoner?
Teacher - Student Relationship

Trainer - Trainee @ athletic club
Approach (2)

• Extensive reading
  – 3 Textbooks
  – A dozen books/blogs for reading recommendation

• Blogging to share progress and experience and promote product

• Benefit
  – Show the progress
  – Make documentation public (and fun)
  – Engage with customers
Approach (3)

• Award top performers
  – “Winner takes all” in the industry
• The top performer (one or more students) gets 100% of the score.
• 2\textsuperscript{nd} tier answers get 1/2 of the full score.
• 3\textsuperscript{rd} tier answers get 1/3 of the full score
• So far and so forth...
Grading Systems

2 types of score distribution

points

1/n score

good ol' score
Approach (4)

• Focus on real projects
  – Each team project must have real users, and use real user download number as one important metric for the team performance
  – Real requirement calls for innovation

• Without real customers, how can you know
  – Bugs in requirement/design?
  – Wide range results: (40K vs. 10 downloads)
Approach (5)

• Focus on 1-on-1 collaboration
  – Think about the founders of HP, Microsoft, Apple, Yahoo, Google...
• Trying 2 pair projects with different partners
• Give/receive feedback, Evaluate your peer
Approach (6)

• Focus on recent Software Engineering practices
  – One classical text book only has 4 pages (out of 600) on eXtreme Programming.

• New ideas in recent years
  – “Groupthink specification exercise” designed by Prof. Michael Ernst.

• Bring in industrial experiences
  – Stories and analysis of Microsoft and other IT companies
Approach (7)

• Encourage feedback and retrospective
• Seeking feedback from real customers
  – Not only from teacher
• Postmortem twice in the semester
  – Alpha release: Why no one likes our Alpha release?
  – Beta release: If we could re-do the project again, what would we do differently?
## Curriculum

<table>
<thead>
<tr>
<th>Activity</th>
<th>Length (16 wk)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual Project</td>
<td>2 wk</td>
</tr>
<tr>
<td>Unit Test; Performance Analysis;</td>
<td></td>
</tr>
<tr>
<td>2 Pair-Projects</td>
<td>2 x 2 wk</td>
</tr>
<tr>
<td>Code Review; Writing Solid Code; Code Convention;</td>
<td></td>
</tr>
<tr>
<td>Design Guideline; XP, TDD;</td>
<td></td>
</tr>
<tr>
<td>Team project</td>
<td>8 wk</td>
</tr>
<tr>
<td>SLC; Roles of a team; Requirement Analysis; Project Management; Testing; Scrum;</td>
<td></td>
</tr>
<tr>
<td><strong>Innovation in Software Industry</strong></td>
<td></td>
</tr>
<tr>
<td>Review/Postmortem</td>
<td>2 wk</td>
</tr>
<tr>
<td>Soft skills;</td>
<td></td>
</tr>
</tbody>
</table>
Results - measurement

15 areas for self-evaluation

Range [1-10]:

1: minimum level
3: basic knowledge
5: practical skills, can pass industrial interview
8: proficient professional level
10: fully proficiency in theory and practice
### Result – core skills

<table>
<thead>
<tr>
<th>Skills</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLC Requirement Analysis</td>
<td>2.76</td>
<td>4.59</td>
</tr>
<tr>
<td>SLC Project Management</td>
<td>2.65</td>
<td>4.53</td>
</tr>
<tr>
<td>SLC Design</td>
<td>3.06</td>
<td>4.76</td>
</tr>
<tr>
<td>SLC Implementation</td>
<td>3.65</td>
<td>5.59</td>
</tr>
<tr>
<td>SLC Test</td>
<td>2.65</td>
<td>4.53</td>
</tr>
<tr>
<td>XP</td>
<td>2.53</td>
<td>5.00</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td>2.88</td>
<td>4.83</td>
</tr>
</tbody>
</table>

- Survey conducted @ Tsinghua C.S. Dept. Special Talent Class
- Before: Basic Knowledge (2.88 ≈ 3)
- After: Practical skills, can pass industrial interview (4.83 ≈ 5)
### Result – side by side

<table>
<thead>
<tr>
<th>Class</th>
<th>ASE</th>
<th>Class 1</th>
<th>Class 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>hour/week</td>
<td>12.63</td>
<td>6.24</td>
<td>3.3</td>
</tr>
<tr>
<td>Lines of Code</td>
<td>2171</td>
<td>944</td>
<td>1150</td>
</tr>
<tr>
<td>Core Skills</td>
<td>5.00</td>
<td>3.43</td>
<td>3.81</td>
</tr>
<tr>
<td>All Skills</td>
<td>5.11</td>
<td>3.75</td>
<td>3.97</td>
</tr>
</tbody>
</table>

- Survey conducted @ same university
- ASE: Advanced Software Engineering Class
- Class 1, 2: regular Software Engineering Classes
## Result – Student Evaluation

<table>
<thead>
<tr>
<th>Categories of Evaluation</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher is passionate, high commitment, high quality</td>
<td>95.45±3.80</td>
<td>95.00±3.42</td>
<td>98.90±2.21</td>
</tr>
<tr>
<td>Curriculum is clearly defined</td>
<td>94.55±4.04</td>
<td>89.29±5.77</td>
<td>98.90±2.21</td>
</tr>
<tr>
<td>Attractive and lively teaching style</td>
<td>92.73±5.15</td>
<td>90.71±5.37</td>
<td>98.91±2.21</td>
</tr>
<tr>
<td>Interaction with students and encouragement</td>
<td>94.55±4.04</td>
<td>93.57±3.69</td>
<td>98.91±2.21</td>
</tr>
<tr>
<td>Quality of course material</td>
<td>93.64±4.23</td>
<td>86.43±8.19</td>
<td>99.00±2.21</td>
</tr>
<tr>
<td>Quality of homework/project assignment</td>
<td>94.55±4.04</td>
<td>90.00±4.95</td>
<td>99.00±2.21</td>
</tr>
<tr>
<td>Evaluation system can motive students</td>
<td>92.73±5.15</td>
<td>87.86±4.88</td>
<td>97.89±3.04</td>
</tr>
<tr>
<td>Encourage innovation and independent thinking</td>
<td>92.73±4.37</td>
<td>91.43±4.44</td>
<td>98.91±2.21</td>
</tr>
<tr>
<td>Provide advice to students further study</td>
<td>92.73±4.37</td>
<td>91.43±4.92</td>
<td>99.00±2.21</td>
</tr>
<tr>
<td>Student learn significantly</td>
<td>92.73±4.37</td>
<td>90.00±5.38</td>
<td>97.91±3.04</td>
</tr>
</tbody>
</table>
Sum-up of Approaches

• Bring industrial requirement and best practice into classroom
  – Trainer : Trainee relation
  – Extensive reading, blogging
  – Award top performers
  – Real projects and customers
  – Focus on 1-1 collaboration
  – Focus on recent & industrial SE practices
  – Encouraging feedback
My lessons

• There is no silver-bullet
  – Result is proportional to effort
  – One class is not enough

• Some further improvement ideas
  – Work with students in other majors (e.g. Design)
  – Try legacy projects and N+1 versions
  – More on “soft” skills

• What do students really want?
  – Many just want an easy pass...
  – Only 19 students signed up out of total of 80...
More students are coming!
Thanks

- Sharing of curriculum and practice
- Seeking feedback from experts
- Contact: XinZ@microsoft.com