Microsoft Research

Microsoft Research Asia
**Faculty Summit** 2010

# Teaching Advanced Software Engineering

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# Outline

- Background

- Gaps between Industry and Academic

- Approaches in Training

- Lessons learned

# Background

- Xin Zou
  - dev/dev lead: Microsoft Outlook, Visual Studio team (1996-2005)
  - 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
  - E.g. "Dreaming in Code" book
- 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$^{nd}$ tier answers get 1/2 of the full score.

- 3$^{rd}$ tier answers get 1/3 of the full score

- So far and so forth…

# Grading Systems

2 types of score distribution

# 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

| Activity | Length (16 wk) |
|---|---|
| Individual Project | 2 wk |
| Unit Test; Performance Analysis; | |
| 2 Pair-Projects | 2 x 2 wk |
| Code Review;  Writing Solid Code; Code Convention; Design Guideline; XP, TDD; | |
| Team project | 8 wk |
| SLC; Roles of a team; Requirement Analysis; Project Management; Testing;  Scrum; **Innovation in Software Industry** | |
| Review/Postmortem | 2 wk |
| Soft skills; | |

# 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

| Skills | Before | After |
|---|---|---|
| SLC Requirement Analysis | 2.76 | 4.59 |
| SLC Project Management | 2.65 | 4.53 |
| SLC Design | 3.06 | 4.76 |
| SLC Implementation | 3.65 | 5.59 |
| SLC Test | 2.65 | 4.53 |
| XP | 2.53 | 5.00 |
| Average | 2.88 | 4.83 |

- 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

| Class | ASE | Class 1 | Class 2 |
|---|---|---|---|
| hour/week | 12.63 | 6.24 | 3.3 |
| Lines of Code | 2171 | 944 | 1150 |
| Core Skills | 5.00 | 3.43 | 3.81 |
| All Skills | 5.11 | 3.75 | 3.97 |
| | | | |

- Survey conducted @ same university
- ASE: Advanced Software Engineering Class
- Class 1, 2: regular Software Engineering Classes

# Result – Student Evaluation

| Categories of Evaluation | 2007 | 2008 | 2009 |
|---|---|---|---|
| Teacher is passionate, high commitment, high quality | $95.45^{\pm3.80}$ | $95.00^{\pm3.42}$ | $98.90^{\pm2.21}$ |
| Curriculum is clearly defined | $94.55^{\pm4.04}$ | $89.29^{\pm5.77}$ | $98.90^{\pm2.21}$ |
| Attractive and lively teaching style | $92.73^{\pm5.15}$ | $90.71^{\pm5.37}$ | $98.91^{\pm2.21}$ |
| Interaction with students and encouragement | $94.55^{\pm4.04}$ | $93.57^{\pm3.69}$ | $98.91^{\pm2.21}$ |
| Quality of course material | $93.64^{\pm4.23}$ | $86.43^{\pm8.19}$ | $99.00^{\pm2.21}$ |
| Quality of homework/project assignment | $94.55^{\pm4.04}$ | $90.00^{\pm4.95}$ | $99.00^{\pm2.21}$ |
| Evaluation system can motive students | $92.73^{\pm5.15}$ | $87.86^{\pm4.88}$ | $97.89^{\pm3.04}$ |
| Encourage innovation and independent thinking | $92.73^{\pm4.37}$ | $91.43^{\pm4.44}$ | $98.91^{\pm2.21}$ |
| Provide advice to students further study | $92.73^{\pm4.37}$ | $91.43^{\pm4.92}$ | $99.00^{\pm2.21}$ |
| Student learn significantly | $92.73^{\pm4.37}$ | $90.00^{\pm5.38}$ | $97.91^{\pm3.04}$ |

# 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!
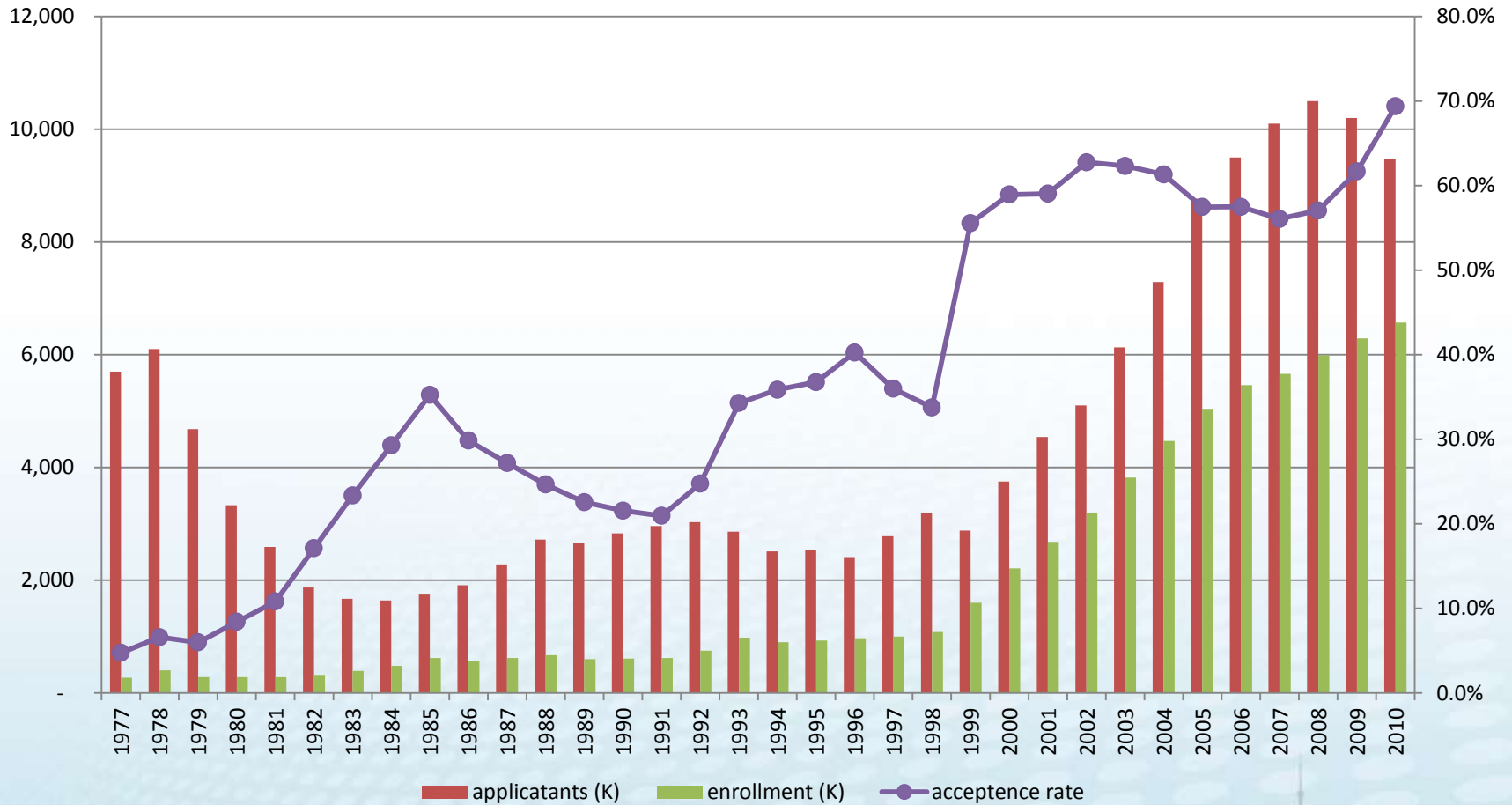
# Thanks

- Sharing of curriculum and practice
- Seeking feedback from experts
- Contact: [XinZ@microsoft.com](mailto:XinZ@microsoft.com)