TWO-STAGE EXAMS
TURNING EXAMS
INTO
A LEARNING EXPERIENCE

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Active Learning and Collaborative Exams

- Many studies have shown that cooperative group work promotes learning:
  - P. Heller, et. al. classic study in physics (1992), etc.

- Nevertheless, exams remain individual assessment tools

- In 2001 a U of Massachusetts group showed that interactive exercises and collaborative exams significantly increased information recall in an Oceanography course (Yuretich, R., et. al.)

- In summer 2009 we tried a similar study in two CS courses
  - a first year course on formal models of computation (similar to traditional Discrete Math courses)
  - a second year course on software development techniques (intro to Software Engineering)
Collaborative Activities in the two Courses

- **Short interactive exercises during main concept discussion**

- **Group exercises on main concepts**
  - students form groups of 2-3
  - work on solving a problem for 10-15 min
  - submit solution to instructor
  - instructor and students discuss solution

- **Two stage midterm exam**
  - stage 1: student take an individual exam for 80 (or 50) min
    - hand in their papers
  - stage 2: students take the same exam in groups
    - form groups of 3-5 students, their choice
    - have 50 (or 30) min to complete the exam
The Group Exam

- Every student participated in a group
  - even students who had never participated in group exercises

- Most groups had active discussions
  - more working scribbles on group exams than on individual exams
  - group members were comfortable working with each other
  - no multiple choice questions; questions needed considerable work
The Group Exam (cont’)

- Three problematic groups:
  - a group entirely comprised of 3 extremely high-achieving students
    - no discussion; divided the exam and filled in the answers
  - a group of 3 low-achieving and 1 high-achieving students
    - high-achieving student wrote the whole exam
  - a group of 1 high-achieving (female) and 3 average-achieving students (male)
    - high-achieving student got frustrated as she was unable to convince the others
    - Heller & Hollabaugh made similar observations
Student Feedback

- The majority (75.5%) of the students found the two-staged exam helpful:
  - “...was fun, amazing and very helpful ... It also turns the stress of the exam into something positive ...”
  - “I learned a lot from others. I was also able to help others ...”
  - “… they (partners) made me realize certain issues I didn’t see before. Also I learned from them certain techniques ....”
  - “…we got immediate feedback and thus we immediately were able to learn our mistakes ...”

- Groups dominated by high or low achievers don't always work well
  - “… I felt that I couldn’t put 100% of my input because some of my group members were really persistent on their solutions ...”
  - “… partners wasted a lot of time... “
Our Observations/Analysis

- Performance in in-class group exercises improved after the midterm

- Performance in 3 isomorphic questions in final exam improved in one class, but dropped in the other:
  - Models of Computation: average drop of 6% over the 3 isomorphic questions
  - Software Development: average gain between 5% and 31% in the 3 isomorphic questions
    question on S/W testing: 72.5% did better, 15.5% did worse

- Group exercises and two-staged midterm improved student success in the Software Development course
  summer 09 had the highest average and lowest fail rate among the last 10 offers of the course (reported in ICERI 2009 paper)
Lessons Learnt – Future Plans

- Two-staged exams can be a valuable learning experience
  - immediate feedback on the exams is very important in learning

- Group exams are more effective when students have participated in in-class group activities before the exam
  - are more ready to work with each other

- Group structure and composition is important
  - imbalance of member abilities in a group may reduce knowledge transfer
  - gender imbalance and lack of communication skills may have similar results
  - need to rethink of how to form groups
    - let students work with different groups before the exam
    - have the instructor assigning the groups

- Groups should be formed prior to exam
  - some students wasted time doing decide which group to join
Lessons Learnt – Future Plans (cont’d)

- To foster discussions and knowledge transfer, group exam should have new isomorphic questions and appropriate duration.

- Question type and difficulty can affect the learning experience:
  - challenging questions with non-trivial answers work better for high-achieving students
  - highly challenging questions may discourage low-achieving students
  - need to further investigate question types that are more suitable for two-stage exams

- We plan to continue offering two-stage exams in a number of our courses and investigate the issues mentioned above.