Toward improving collaborative behaviour during competitive programming assignments

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Gamification and HPC

- Gamification: Introduce game components in non-game environments
- Programming contests: A gamified activity
- HPC techniques: Code optimization, parallelization
- Difficult: Complex interactions among them and with the machines
- Results can be easily measured in terms of performance
- Success can be automatically measured and ranked (on-line judges)
- Programming contests are adequate and easy to implement for HPC learning
- Successfully used in a Parallel Computing course for several years [FresnoEtAl.17]
Competition and collaboration

Observation: Competitive behaviour sometimes interferes with usual students collaboration

They become reluctant to help other groups to protect their rank positions

It can even interfere with simple questions about programming language or tools

Collaborative and competitive processes are interrelated [Jonasson.18]

Combining competition and collaboration is particularly effective in the gamification context [Sailer.19]
Objectives

- Encourage collaborative behaviour during competitive activities
- Introduce collaborative gamification in HPC programming contests
- Tool/s for students interaction and participation
- Promote and measure both social and technical interaction
- Design reward elements and evaluation mechanisms for volume and quality of participation
- Pilot experience: Parallel Computing course
Approach

- On-line platform for interaction: Text-based forums
- Enhance it to support peer-to-peer acknowledgement of social and technical help
- Register and measure participation volume and peer-to-peer acknowledgement
- Teachers participation to guide discussions and help students to find solutions
- Reward elements:
  - Prizes and badges
  - Quantitative evaluation of participation
Forum implementation

- Moodle platform: Forum activity module
- All students enrolled in the course are registered: Receive emails for posts
- Moodle’s forum: Peer-to-peer grading mechanism (numerical values)
  - A participant can grade as many posts as desired
  - A participant can grade each post at most once
  - A post can receive as many grades as participants
  - No reaction, no grade
- We introduce a new grade scale with visual labels (acknowledgement tokens)
  - Value 1: Like/Educational (Thumbs-up icon 🌟 )
  - Value 2: Useful/I’m using it (Wrench icon 🔧 )
Collaborative forum
Using data after sending them

▲ CUDA - Question about a condition
Show nested replies Move this thread to... Move Split

This thread has been closed and it does not allow replies.

Using data after sending them
from Thursday, May 17th 2018, 01:05

Hi, I have a quick question.
Imagine that I move data to the device before launching a kernel. The kernel is then launched and the results are returned to the host. Then, if I launch a second kernel, are the data still in the device? I mean, can I access them without sending them again?

Suppose that the data returned to the host are not modified, I could save time by skipping sending them again.
Thanks in advance!

Grade total: 1 (1)

Re: Using data after sending them
from Thursday, May 17th 2018, 08:24

Even if you bring data to the host, they are still stored in the device.

That means, if you launch a second kernel you can access the same data previously used or computed by the first kernel, that's the trick to save the cost of copying in and out data from/to the device.

But you should take care if you bring data to the host, and the host modify them, because they are not the same data anymore.

Grade total: 2 (4)
Rewards

- Design rewards for contributing information that is useful for other members
- Promote perception: Ranking loss in the competition due to information disclosure can be compensated by a higher cooperation grade
- Social acknowledgement: Directly implemented with the tokens
- Badges for achievements: Similar to the competitive part
  - Achieve a number of acknowledgement tokens
  - Post the first question about technical problems (secret)
  - Correct answers to initial teacher questions
- Extra grade (up to 10%), formula taking into account:
  - Participation volume (posts and threads)
  - Number of acknowledgement tokens awarded
  - Number of acknowledgement tokens received
  - Number of posts with at least one token received
Pilot experience

- Implemented in a Parallel Computing course
- Computer Engineering degree, 3rd year, Major elective course
- The course already implements competitive gamification
  - Three programming contests: OpenMP, MPI, CUDA
  - No changes to the competitive part
- 50 students enrolled: Approximately 50% of the 3rd year students
- Badges and forum presented to the students before contests, teachers introduce basic questions to break the ice
Participation

- Threads and posts:
  - 16 threads (11 started by students)
  - 92 posts of students
  - 30 students published one post or more
  - Post per student, mean 3.06, maximum 10

- Acknowledgement tokens:
  - 108 tokens awarded (74 Like, 34 useful)
  - 19 students with at least one token awarded
  - Tokens per student, mean 4.79, maximum 12

- Different student profiles

- Expected distribution of posts and tokens:
  - More level of implication and assistance implies more posts with more tokens
Alternative channel

- The existing student’s Telegram groups
- Teachers of any course are not invited or told about, very “relaxed” atmosphere
- Specific course group: From general comments to very specific questions
- Participation of previous students of the course
- Part of the collaborative activity was derived to this group, despite the appeal of badges or potential grade improvements
- It partially explains the participation numbers
- Why do they use it instead of the forum?
Students perception: Survey

- Specific survey for the students to get direct feedback
- Try to measure improvement of motivation, subjective learning, impact of the collaborative activity, etc.
- Conducted 15 days after the activities (avoid direct influence of emotions)
- 10 questions:
  - 8 questions in Likert’s scale (5 levels, 3 means neutral)
  - 1 questions with multiple answers (reasons for using the Telegram’s group)
  - 1 free-text question for comments
- Survey filled up by 80% of the students
Students perception: Results I

Q1: Satisfaction with the general experience kind of activities, grading methods, etc.
Q2: Relative weight of contests, assignments, theoretical exams in the grade is right.

- Good perception of the activities and grading system
Students perception: Results II

Q3: The competitive parts (contests, badges) are adequate, make the course more interesting, and encourage a more active participation.

- Most students think that the competitive part improves participation
- Some students think that collaboration is still sometimes degraded or can be improved (comments in Q10)
Students perception: Results III

Q4: A tool for communication among students is appropriate for this course.
Q5: The Collaborative Forum or the Telegram group have really improved or promoted the collaboration among students.

- Most students think that a tool for communication is really important
- Some are not sure that the ones used really solve the perceived problem
- Most students think that the tools can be improved (comments in Q10)
Students perception: Results V

Q6: *Telegram group* is a better option than the *Collaborative Forum*.
Q7: *Collaborative Forum* has been used less or more than the *Telegram group*.
Q9: Have you used, participated, or queried frequently the *Collaborative Forum*?

- Students prefer the Telegram group, it has been used similarly or even more
- Students think they have not participated too much in the forum
Students perception: Results VI

Q8: Reasons to prefer the Telegram group (multiple answers allowed):
   a) Faster and more comfortable to query or to receive feedback.
   b) Collaborative Forum is more intimidating.
   c) More people in the Telegram group, including older students.
   d) Teachers do not have access to the Telegram group.
   e) Other reasons (please, explain them in Q10).
Conclusion and future work

▶ We present an approach to encourage collaborative behaviour in competitive learning activities
▶ Approach: Collaborative gamification to complement the competitive gamification
▶ Main tool: Enhanced on-line forum (Moodle platform)
▶ Design of specific rewards: Prizes, badges, grading mechanism
▶ Results indicate the approach reinforces and complements the competitive part
▶ Problems and limitations observed
▶ Future work:
  ▶ Using a more agile tool for student’s interaction
  ▶ Design more powerful rewards
  ▶ Calibrate the effect of the teachers participation
  ▶ Generalize: Testing the proposal with more groups and different courses