



Multi-Track Programming Competitions with Scratch

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INTRODUCTION

While the Association for Computing Machinery (ACM) International Collegiate Programming Contest (ICPC) style competition is likely to persist in secondary-level programming competitions, it fails to reward artistic merit and creativity. In order to engage a new population into existing community-building outreach, we have not only integrated these creative-based grading tactics, but we furthered the competition by incorporating ICPC-style competition techniques, including short-duration questions and fast-paced grading methods. Our team worked to further the necessary adaptations to a traditionally structured programming contest in order to make it attractive to a more diverse and never-before-seen population of high school students.



YEAR ONE COMPETITION

The design constraints for our first year's Scratch Division task included open-ended questions that attempted to promote creativity. Existing competition models generally relies on much longer competition times, and also on longer judging times. There were no examples of on-site, open-ended, Scratch-based tasks suitable for grades 9-12, or corresponding judging rubrics.

The final design envisioned a single, three-hour challenge task centered on a retelling the story of The Three Little Pigs and included key elements such as a minimum of three scenes, repetition of appropriate dialogue, and a conclusion that emphasizes the moral of the Little Pigs story. The existing PC2 contest management software was determined to be unsuitable for running the Scratch Division due to its rapid submission structure and its complex and intimidating default interface.

A panel of faculty judges evaluated work submitted using four criteria:

1. Originality
2. Creativity
3. Elegance
4. Sophistication

In practice, the slow judging and the slow response time by the participants only worked due to the small number of participating teams.



YEAR TWO COMPETITION

We made several important changes to the structure of the Scratch Division in order to more easily scale judging, while retaining the distinctive character of the competition.



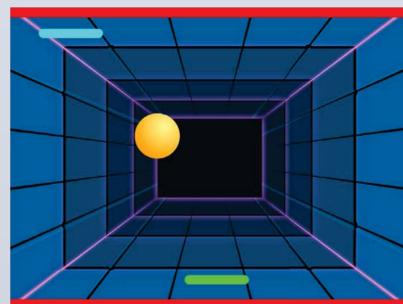
A mix of open-ended and more closed questions were used, allowing rapid judging for the technical points during the competition, and more time-consuming creative merit judging at the end of the competition block. The tasks were laid out as follows:

1. **The Maze** – The designers sought to present the students with a straightforward, recognizable, and easily implemented question for the first Scratch task. Given a maze background and a sprite, the contestants were asked to implement a movable sprite using keyboard input. (5 pts)

2. **The Fly Swatter** – The second Scratch task provided the students with the sprites, a background and code blocks for random movement, then asked the students to make a fly swatter game. All eight of the participating teams produced a submission for this problem, six of them receiving full points. (5 pts)



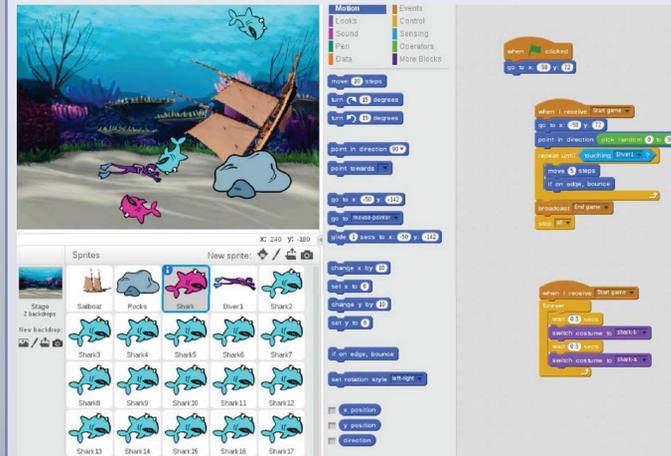
3. **Rock-Paper-Scissors** – The third Scratch task asked the participants to develop a working rock-paper-scissors game using our sprites and their own animations. Additionally, the participants were required to find their own background to complement their game and animation. (5 pts)



4. **Pong** – The fourth Scratch task requested the participants to create a working two-dimensional, one-player pong game. For extra credit they could implement a custom artificial intelligence algorithm as a second player. This was intended to be the most challenging task in the Scratch Division. (5 pts)

YEAR TWO COMPETITION (cont'd)

5. **The Sunken Ship Narrative** – The fifth Scratch task was designed to be the most open-ended, allowing participants to demonstrate both their Scratch-fluency and creativity. Similar to our first year competition's sole task, the fifth task provided a story prompt and directed participants to finish the story. The plot included a tale of a sunken ship; however, it was up to the participants to provide their own developments to the story, conclude it with a somewhat logical ending, and include our requirements (must use loops, must use at least two sound clips, etc.) along the way. Creativity was highlighted as the highest grading criterion for this question. (10 pts)



JUDGING

In order to judge submissions we used a novel, PHP-driven web submission system. This was deemed to be a simpler, lighter-weight and more theme-appropriate solution than the standard PC2 contest management software. This interface included both a submission and feedback functionality which allowed neutral communication between judges and participants, as well as quick judging which allowed for more open-ended and creative based questions throughout the competition.



CONCLUSION

Adding our newly developed Scratch-based track to our existing, traditional ICPC-style high school programming competition proved highly beneficial for both our competition as a whole and the participating schools. The design of this track incorporates both relatively constrained tasks that can be quickly judged and more open-ended tasks that can be rewarded for creativity and artistic merit.

Due to our focus on both creativity and functionality, our second year's competition attracted markedly more participants than the previous years. The presence of a Scratch Division allowed new schools to participate who had previously never sent a team to such an event. It seems very likely that the demographic balance of the Scratch Division will soon beat the traditional Java Division competition.

REFERENCES

- "Exploring computer science." [Online]. Available: <http://www.exploringcs.org/>
- College Board, "Computer science: Principles." [Online]. Available: <http://www.csprinciples.org/>
- Association for Computing Machinery (ACM), "International collegiate programming competition factsheet," accessed: 2015-05-14. [Online]. Available: <http://icpc.baylor.edu/worldfinals/pdf/Factsheet.pdf>
- International Olympiad in Informatics. [Online]. Available: <http://www.ioinformatics.org/>
- USA Computing Olympiad. [Online]. Available: <http://www.usaco.org/>
- S. Fitzgerald and M. L. Hines, "The computer science fair: An alternative to the computer programming contest," in SIGCSE'96, pp. 368–372. <http://doi.acm.org/10.1145/236452.236581>
- J. F. Bowring, "A new paradigm for programming competitions," in SIGCSE'08, pp. 87–91. <http://doi.acm.org/10.1145/1352135.1352166>
- N. Ragonis, "Type of questions the case of computer science," Olympiads in Informatics, vol. 6, pp. 115–132, 2012, ISSN 1822-7732. <http://www.mii.lt/olympiads/informatics/htm/INFOL097.htm>

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