Abstract

This study is an attempt to explore the problem reading patterns of intermediate and expert programmers and solvers and non-solvers through their eye gazes in a competitive programming setting. An eye-tracker was used to capture visual attention data while participants were reading a provided problem specifications. Subsequently, they were asked to code their programming solutions. Results showed that solvers have higher dwell time on the Problem Description while non-solvers on the Input Description. Fixation is highest on the Problem Description for all observed groups. However, no significant observations on intermediate and expert programmers were deduced. Generally, solvers pay more visual attention to the stimulus than the non-solvers.

Objectives

The study attempts to answer the following questions:

1. What are the fixation points of intermediate and expert programmers when reading competitive programming problems and how are they similar or different?
2. What are the fixation points of solvers and non-solvers when reading competitive programming problems prior to solving and how are they similar or different?

Methodology

Participants Profile.

The participants were undergraduate students of the Ateneo de Manila University who, at least, have knowledge in solving programming problems and writing computer programs. They were classified into two groups: (a) intermediate programmers (non-programming varsity members) and expert programmers (programming varsity members).

Stimulus and Regions of Interest.

The experiment used a 1366 x 768 screen capture of a sample competitive programming problem taken from codeforces.com as stimulus. A competitive programming problem typically contains 6 major parts and these were mapped to consist the 6 regions of interest (see figure 1):

1. Region 1: Problem Description. Describes clearly and concisely the problem.
2. Region 2: Input Description. Statements on how input data is read.
3. Region 3: Constraints. Statements, usually in a form of mathematical equations, that state the bounds of variables in what constitutes the input data.
4. Region 4: Output Description. Details the output format of the solution.
5. Region 5: Sample Input. A sample input data as defined in the input description.
6. Region 6: Sample Output. The expected result.

Data Gathering.

The participants were asked to sit on a chair and place their head on the metal chin-rest of the eyetracker where a laptop is placed in front. Calibration was done next to make sure the eye-tracking device can accurately tell where the participant was looking and record the correct data. The participant was then shown the stimulus and given 2 minutes to design a solution to the problem while using the device. Thereafter, 10 minutes was given to the participant to code the solution on a different device.

Results

Seventy (70) percent of the participants were able to correctly provide a programming solution to the problem. 71% of these solvers are experts, the other 29% are intermediate.

Conclusion

Visual patterns of solvers and non-solvers have minimal difference. However, some differences have been found on which regions they give more attention to. Solvers have higher dwell time on the Problem Description (ROI1) while non-solvers on the Input Description (ROI2). Fixation is highest on the Problem Description (ROI1) for all observed groups. However, the attention that first attracts the attention of the participants. Taking into account the ‘Others’ region yields it to have the highest contact time which was regarded as instances during which the participants were formulating their solutions. Generally, solvers give more visual attention to the stimulus than non-solvers. No significant observations on intermediate and expert programmers were deduced. Although the results are telling of the likely behavior of a programmer when reading a programming problem specifications, the study opens up a lot of room for further verification of said observations as well as more research undertakings in the field.

References


Casano, J., An Analysis of Programming Languages and Competitive Programming Problems as Bound by the Limits of Non-Quantum Computation (2015), In Proceedings of Project Einstein 2015


