Enhancing Debugging Efficiency: User Perspectives on AutoPrint, an Automated Print Statement Tool

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Introduction

Debugging is the practice of systematically examining code to trace and resolve issues that may lead to unexpected behaviors, crashes, and or incorrect results. Debugging aids, such as print statements, play a fundamental role in diagnosing and understanding program behavior. However, manually inserting these print statements throughout the codebase can be laborious, time consuming, and error-prone, impacting developer productivity. To address these difficulties, AutoPrint was developed as an innovative debugging tool for the Java programming language.

Methodology

User studies were conducted through the use of a post-survey after they utilized the tool in their debugging process and provided qualitative feedback. Participants were provided with sample code along with AutoPrint to evaluate the tool's performance in a real-world scenario.

- AutoPrint was utilized for 45 minutes and participants used the final 15 minutes to complete the post-survey.
- Participants consisted of undergraduates (up to 6 years), masters, and doctoral students ranging from 2-10 years of general programming experience.

Results

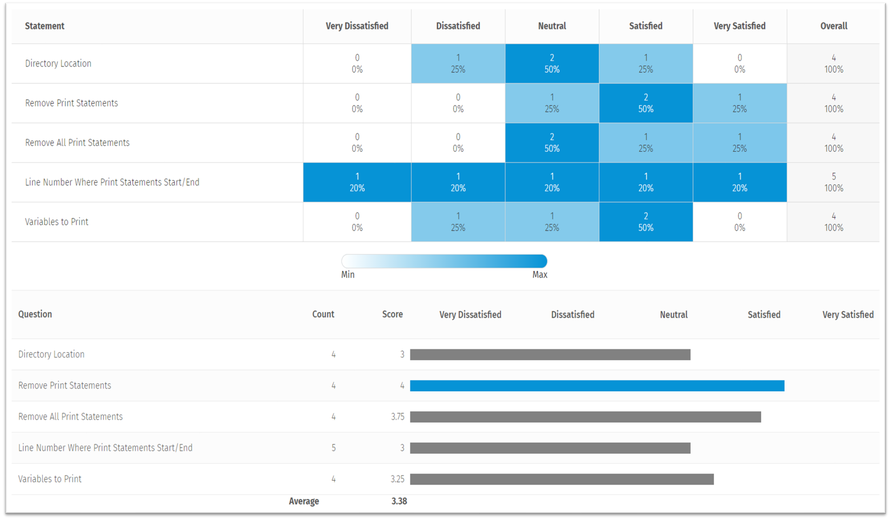
- 50% of respondents rated that they were satisfied with AutoPrint's removal of print statements and 50% rated that they were neutral with the removal of **all** print statements (Figure 1).
- On average, respondents gave a 3.38 on a 5-point scale (with 0 being very dissatisfied and 5 being very satisfied) of their satisfaction with the features of AutoPrint (Figure 2).

Listed strengths:

- Ability to run massive debug print statement jobs that normally can't be used with a debugger tool.
- Helpful in debugging where manual print statement insertion time could be saved.

Listed limitations:

- Confusing setup
- Currently must provide a directory address of the fill which will not be possible in production level website hosted on clouds.

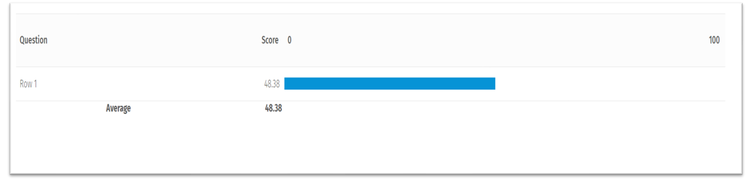


Statement	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied	Overall
Directory Location	0 0%	1 25%	2 50%	1 25%	0 0%	4 100%
Remove Print Statements	0 0%	0 0%	1 25%	2 50%	1 25%	4 100%
Remove All Print Statements	0 0%	0 0%	2 50%	1 25%	1 25%	4 100%
Line Number Where Print Statements Start/End	1 20%	1 20%	1 20%	1 20%	1 20%	5 100%
Variables to Print	0 0%	1 25%	1 25%	2 50%	0 0%	4 100%

Min Max

Question	Count	Score	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied
Directory Location	4	3					
Remove Print Statements	4	4					
Remove All Print Statements	4	3.75					
Line Number Where Print Statements Start/End	5	3					
Variables to Print	4	3.25					
Average		3.38					

Figure 1



Question	Score 0	100
Row 1	48.38	
Average	48.38	

Figure

Future Work

The debugging process in software development is relatively time consuming as developers have to manually type print statements and the use debugging tools allows for the workload to be reduced by automatizing this process. AutoPrint has presented itself as a satisfactory debugging tool that can cut the time commitment of typing manual print statements down through its ability to automize the process. Suggestions for future work are to expand AutoPrint into other languages, such as Python, for more universal usage and to provide a more coherent setup process.

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