

Research Note

RN/17/10

Awareness and Experience of Developers to Outdated and License-Violating Code on Stack Overflow: An Online Survey

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Abstract

We performed two online surveys of Stack Overflow answerers and visitors to assess their awareness to outdated code and software licenses in Stack Overflow answerers. The answerer survey targeted 607 highly reputed Stack Overflow users and received a high response rate of 33%. Our findings are as follows. Although most of the code snippets in the answers are written from scratch, there are code snippets cloned from the corresponding questions, from personal or company projects, or from open source projects. Stack Overflow answerers are aware that some of their snippets are outdated. However, 19% of the participants report that they rarely or never fix their outdated code. At least 98% of the answerers never include software licenses in their snippets and 69% never check for licensing conflicts with Stack Overflow's CC BY-SA 3.0 if they copy the code from other sources to Stack Overflow answers. The visitor survey uses convenient sampling and received 89 responses. We found that 66% of the participants experienced a problem from cloning and reusing Stack Overflow snippets. Fifty-six percent of the visitors never reported the problems back to the Stack Overflow post. Eighty-five percent of the participants are not aware that StackOverflow applies the CC BY-SA 3.0 license, and sixty-two percent never give attributions to Stack Overflow posts or answers they copied the code from. Moreover, 66% of the participants do not check for licensing conflicts between the copied Stack Overflow code and their software. With these findings, we suggest Stack Overflow raise awareness of their users, both answerers and visitors, to the problem of outdated and license-violating code snippets.

1 Introduction

Recent research shows that outdated third-party code and software licensing conflicts are ramifications by code cloning, i.e. reusing source code by copying and pasting. Xia et al (2014) report that a large number of open source systems reuse outdated third-party libraries from popular open source projects. Using the outdated code give detrimental effects to the software since they may introduce vulnerabilities. On the other hand, German et al (2009) found that code cloning leads to software license conflicts among different systems.

The Internet encourages fast and easy code cloning by sharing and copying the code to and from online sources. Developers nowadays do not only clone code from local software projects, but also from online sources such as programming Q&A website and online code repositories (Acar et al, 2016; Abdalkareem et al, 2017; An et al, 2017; Yang et al, 2017). Stack Overflow is one of the most popular programming Q&A websites in the world. It has 7.6 million users, 14 million questions, 23 million answers¹, and more than 50 million developers visiting each month². Some code snippets on Stack Overflow are found to be problematic. Acar et al (2016) discovered that many code snippets provided as solutions on Stack Overflow are workarounds and occasionally contain defects or vulnerabilities. They performed a user study and found that although Stack Overflow helps developers to solve Android programming problems quicker than other resources, at the same time, offers less secure code than books or the official Android documentation. Only 17% of the Stack Overflow discussion threads the participant visited during the study contained secure code snippets. They also found a similar piece of an API call copied from Stack Overflow by participants in their study occurring in a random sample of 200,000 Android apps from Google Play. In addition, An et al (2017) investigated clones between 399 Android apps and Stack Overflow posts. They found 1,226 code snippets that were reused from 68 Android apps. They also observed that there are 1,279 cases of potential license violations.

Asking and answering questions on Stack Overflow involves including source code snippets, either in a question or an answer or both. While many answers contain snippets that are written from scratch, there are several answers containing code snippets copied from other sources. The copied snippets on Stack Overflow are snapshots of the code at the time of copying. They are less frequently updated than in normal software projects and might not be up-to-date with their originals, which are further modified due to bug fixing or feature improvements. Besides, some snippets are copied from software systems with stricter licenses than Stack Overflow's Attribution-ShareAlike 3.0 Unported (CC BY-SA 3.0). Prior to this study, we performed a quantitative empirical study using code clone detection tools to locate cloned code snippets in accepted answers. We found that many snippets were copied from open source projects. Some cloned snippets are outdated (or obsolete) and some possibly violate the original software license. These snippets are potentially harmful to reuse. To accompany the findings and gain insights into the cause of the problems, we resort to a qualitative study using an online survey of Stack Overflow developers who 1) regularly answer programming questions with code snippets and 2) reuse code snippets from Stack Overflow. **The study aims to understand the developers' awareness and experience to outdated code and code licensing on Stack Overflow.**

In this paper, we use the term "answerers" to refer to Stack Overflow users who actively answer questions, which is measured by their reputation. The answerers gain a reputation from giving a helpful answer to a question and receiving votes from other users. The reputation reflects trust they gain from other users and also the quality of their answers. We ask the answerers the origins of source code snippets in their answers, assess their awareness of outdated and licensed code, and understand how they handle the issues.

We use the term "visitors" to refer to developers, who may or may not have a Stack Overflow account but visit Stack Overflow when they encounter programming problems. They copy code snippet(s) in a solution that is relevant to their problem and reused them with or without a modification. We ask the visitors about their experience of reusing source code from Stack Overflow and the problems they faced including code obsolescence and software license.

We use the term "license-violating code snippets" or "code with licensing conflicts" interchangeably to refer to Stack Overflow cloned code snippets that *potentially* violate the original license by not including the original license statement in the cloned snippets and adopt the Stack Overflow CC BY-SA 3.0 license instead.

¹ Data as of 21 August 2017 from <https://stackexchange.com/sites>

² Data as of 21 August 2017 from: <https://stackoverflow.com>

2 Research Methodology

We followed the principles of survey research by [Pfleeger and Kitchenham \(2001\)](#) and [Kitchenham and Pfleeger \(2002\)](#) by setting specific and measurable objective, designing and scheduling the survey, selecting participants, analysing the data, and reporting the results. We now discuss each of them in detail.

2.1 Survey Objective

The main objective of the survey is to understand the developers' awareness and experience to outdated code and code licensing on Stack Overflow. It addresses the following five research questions.

1. **RQ1 (Sources of Stack Overflow Answer Snippets):** *Where are the code snippets in Stack Overflow answers from?*
2. **RQ2 (Awareness of Stack Overflow answerers to outdated code):** *Are Stack Overflow answerers aware of outdated code in their answers?*
3. **RQ3 (Awareness of Stack Overflow answerers to licensing violations):** *Are Stack Overflow answerers aware of software licensing violations caused by code snippets in their answers?*
4. **RQ4 (Problems from Stack Overflow code snippets):** *What are the problems Stack Overflow visitors experiencing from reusing code snippets on Stack Overflow?*
5. **RQ5 (Software license of Stack Overflow code snippets):** *Are Stack Overflow visitors aware of code licensing on Stack Overflow?*

The first three questions will be answered by the Stack Overflow answerer survey, while the other two questions will be answered by the Stack Overflow visitor survey.

2.2 Survey Design and Schedule

The study is conducted using unsupervised online surveys. We designed the surveys using Google Forms. We created two versions of the survey: **the answerer survey** and **the visitor survey**. Both surveys are completely anonymous and the participants could decide to leave at any time. They do not collect any sensitive personal information from the participants and are approved for an ethical waiver by the designated ethics officer in the Computer Science Department at University College London (UCL). The complete version of the surveys can be found in [Appendix A](#).

2.2.1 The answerer survey

The survey contains 11 questions: 7 Likert's scale questions, 3 yes/no questions, and one open-ended question for additional comments. The first two questions are mandatory while the other 9 questions will be shown to the participants based on their previous answers. The survey collects information about the participant's software development experience, the experience of answering Stack Overflow questions, sources of the Stack Overflow snippets, awareness of outdated code in their answers, concerns regarding license when they copy code snippets to Stack Overflow, and additional feedback. The survey was open for participation for 50 days, from 25 July 2017 to 12 September 2017, before we collected and analysed the responses.

2.2.2 The visitor survey

The survey consists of 16 questions: 9 Likert's scale questions, 3 yes/no questions, 2 multiple-choice questions, and 2 open-ended questions. The first four questions are mandatory while the other 12 questions will be shown to the participants based on their previous answers. The survey collects information about the participant's software development experience,

Table 1: The Stack Overflow answerer taken the surveys

Target group	Reputation	Sent emails	Answers	Rate
Answerer Group 1	963,731–7,674	300	117	39%
Answerer Group 2	7,636–6,999	307	84	27%
Total	–	607	201	33%

the importance of Stack Overflow, reasons for reusing Stack Overflow snippets, problems from Stack Overflow snippets, licensing of code on Stack Overflow, and additional feedback. The survey was open for participation for 2 months, from 25 July 2017 to 25 September 2017, before we collected and analysed the responses.

2.3 Participant Selection

2.3.1 The answerer survey

We selected the participants for our answerer survey based on their Stack Overflow reputations. On Stack Overflow, a user’s reputation reflects how much the community trusts the user. A user earns reputation when he or she receives upvotes for good questions and useful answers. For example, they gain reputation when they receive an upvote for their question (+5) or their answer (+10), or when their answer is accepted (+15)³. Thus, Stack Overflow reputation is an indicator of user’s skills and their involvement in asking and answering questions on the site.

The participants were invited to take the survey via email addresses publicly available on their Stack Overflow and GitHub profiles. We selected the answerers based on their all-time reputation ranking⁴ and separated them into two groups (see Table 1) so that we can compare the results or observe similar patterns between them. The first group had a reputation from 963,731 (the highest) to 7,674, and the second group had a reputation from 7,636 to 6,999. We sent out 300 and 307 emails (excluding undelivered ones) to the two groups respectively.

2.3.2 The visitor survey

We adopted non-probability convenient sampling to invite participants for this survey. Participation in the survey requires experience of visiting Stack Overflow for solving programming tasks at least once. The participants were invited to take the survey via five channels. The first channel is via the first author’s social media post (Facebook) inviting software developers who have experience of copying code snippets from Stack Overflow to take the survey. The second channel is a popular technology news and media community in Thailand called *blognone.com* which attracts a high number of Thai software developers. The first author posted an invitation to the visitor survey in a discussion forum mentioning the requirements to take the survey. The third channel collected answers from the University of Molise in Italy, where the third author works. The last two channels are the *comp.lang.java.programmer* group and the Software Engineering Facebook page. The number of participants taken the survey is shown in Table 2.

2.4 Data Analysis

Google Forms provide a helpful summary of responses to the online surveys. We relied on the summary from Google Forms when analysing the answers from the answerer survey. For the visitor survey, since we created a copy of the survey for each group of the participants, we downloaded the responses in comma-separated values (CSV) files and merged the results before the analysis.

³ Stack Overflow Reputation: <https://stackoverflow.com/help/whats-reputation>

⁴ Stack Overflow Users (data as of 25 July 2017): <https://stackoverflow.com/users?tab=Reputation&filter=all>

Table 2: The Stack Overflow visitors taken the survey

Group	Answers
Social media (Facebook posts)	47
Blognone.com	32
University of Molise	6
comp.lang.java.programmer	3
Software Engineering Facebook page	1
Total	89

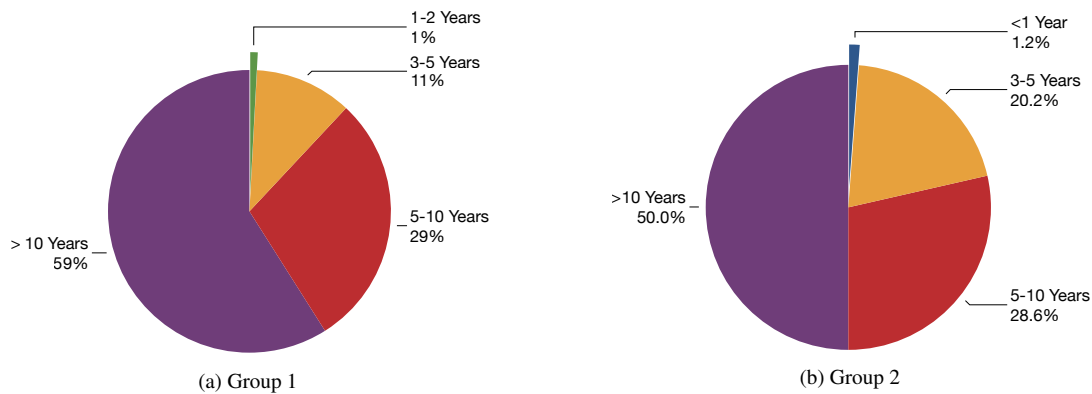


Fig. 1: Experience of the Stack Overflow answerers

3 Results and Discussions

We collected and analysed the results after we closed the surveys on 12 September 2017. We now discuss the results from the answerer and visitor survey separately.

3.1 The answerer survey

We received 117 answers (39% response rate) from the first group and 84 answers (27% response rate) from the second group of Stack Overflow answerers. The response rate from both groups was high considering other online surveys in software engineering (Punter et al, 2003).

3.1.1 General Information

The majority of users in both groups are experienced developers with more than 10 years of experience or between 5 to 10 years as depicted in Figure 1. There are 59% of the answerers in Group 1 and 50% of the answerers in Group 2 that have more than 10 years of software development experience.

The participants are active users and regularly answer questions on Stack Overflow (see Figure 2). Eighty-two (82%) and sixty (61%) of answerers from Group 1 and Group 2 answer questions at least once a week. More than half of the answerers very frequently (81–100% of the time) or frequently (61–80% of the time) include code snippets in their answers. To break down into two groups as depicted in Figure 3, Group 1 very frequently (48.7%) and frequently (27.4%) provide code examples when answering. Likewise, Group 2 follow the same trend (very frequently for 32.1%

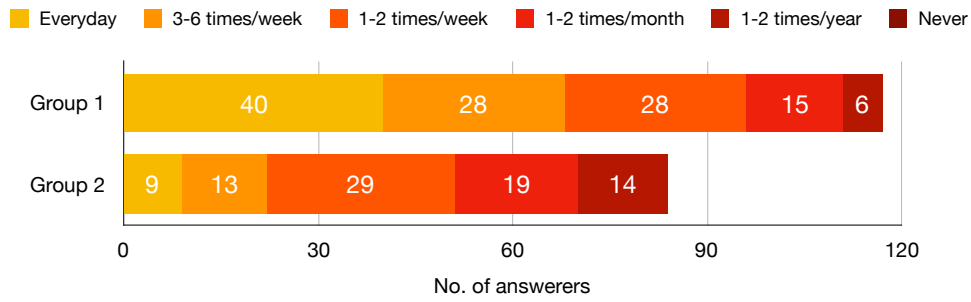


Fig. 2: Frequency of answering questions

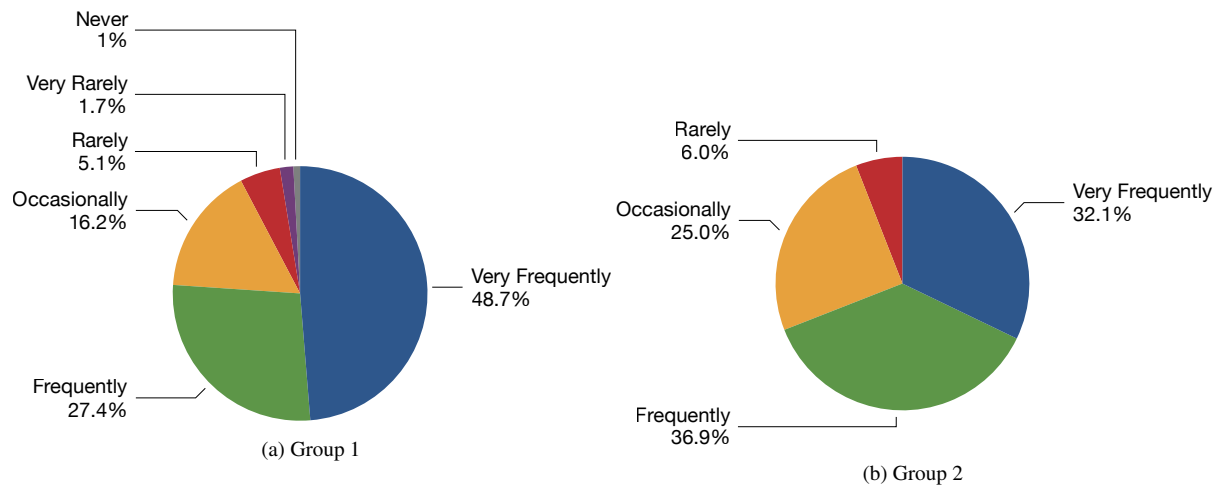


Fig. 3: Frequency of answering questions with code snippet(s)

and frequently for 36.9%). Interestingly, there is one participant in the first group who never includes code snippet in his/her answer thus the results after this question is from 116 participants of the first group.

RQ1: Where are the code snippets in Stack Overflow answers from?

To answer this research question, we asked the participants for the original source of their code examples. We provided six options (allowing more than one answer) including *I copied them from my own personal projects*, *I copied them from my company's projects*, *I copied them from open source projects*, *I wrote the new code from scratch*, *I copied the code from the question and modify it for the answer*, and *Others*. The answers are shown in Figure 4. Participants in Group 1 mainly write new code from scratch (116) or copy from the code snippets in question and modify it for the answer (112), followed by from their personal projects (105), open source projects (77), other sources (59), and company projects (48). For Group 2, the main source is also writing code from scratch (83), followed by copying from personal projects and modifying from the question (77), copying from open source projects (56), copying from other sources (40), and copying from company projects (31). There are 133 answerers out of total 607 from two groups who have cloned code snippets from open source projects into their answers at least once. We are interested in this type of clones and will investigate further in the later RQs.

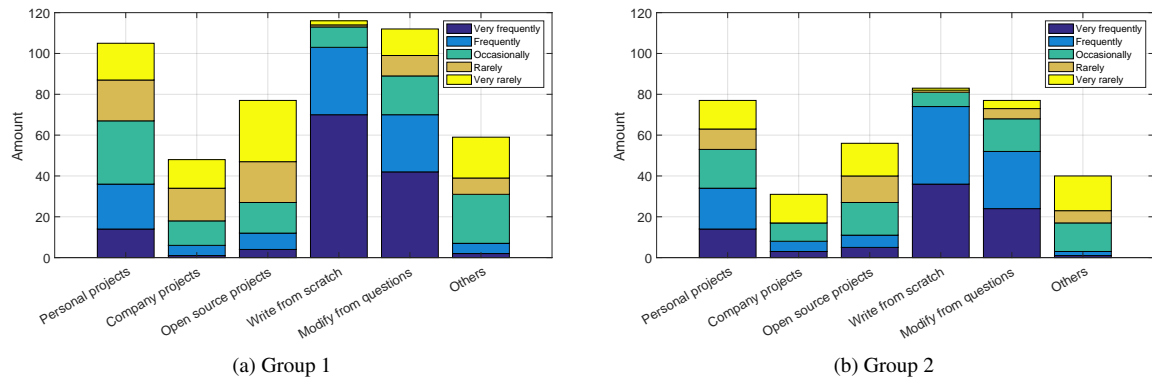


Fig. 4: Sources of code snippets in Stack Overflow answers

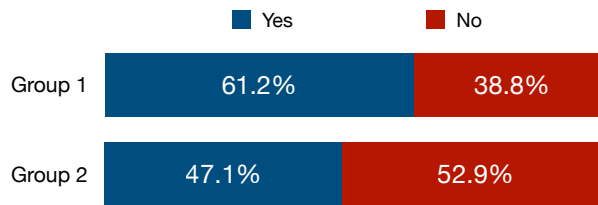


Fig. 5: Percentage of answerers who are notified of outdated code in their Stack Overflow answers.

For RQ 1, we found that answering questions by writing the new code from scratch is the most popular choice for Stack Overflow answerers followed by modifying the code in question or copying from personal projects. Other less popular choices include copying code from open source projects and from other sources. Copying code from company projects are the least popular choice.

RQ2: Are Stack Overflow answerers aware of outdated code in their answers?

Half of the top answerers on Stack Overflow are aware of outdated code in their answers. Seventy-one participants (61.2%) of Stack Overflow answerers in Group 1 have been notified of outdated code in at least one of their answers. The ratio drops to forty participants (47.1%) in Group 2. We asked a follow up question regarding the frequency of being notified of outdated code in their answers. We found that only 0.5% and 5.2% of the answerers in Group 1 are frequently or occasionally been notified. The answerers in Group 2 have very frequently and occasionally been notified for 2.4% and 3.5% respectively. Please note that we found inconsistencies between the answers of these two questions. The percentage of participants who have “Never” been notified of outdated code in their Stack Overflow answers are 38.8% and 52.9% for Group 1 and Group 2 respectively. However, the answers for the frequency of being notified equal to “Never” decrease to 28.4% and 43.5% for Group 1 and 2 respectively (see Figure 5 and Figure 6).

We then asked the participants who have been notified of their outdated code (83 and 48 participants from Group 1 and 2 respectively) a follow-up questions “how frequently did you fix your outdated code on Stack Overflow?” The answers, depicted in Figure 7, show that more than half of them frequently fix the outdated code snippets. However, there are 17 (19.8%) and 9 (18.8%) participants in Groups 1 and 2 who rarely, very rarely or never fix their code.

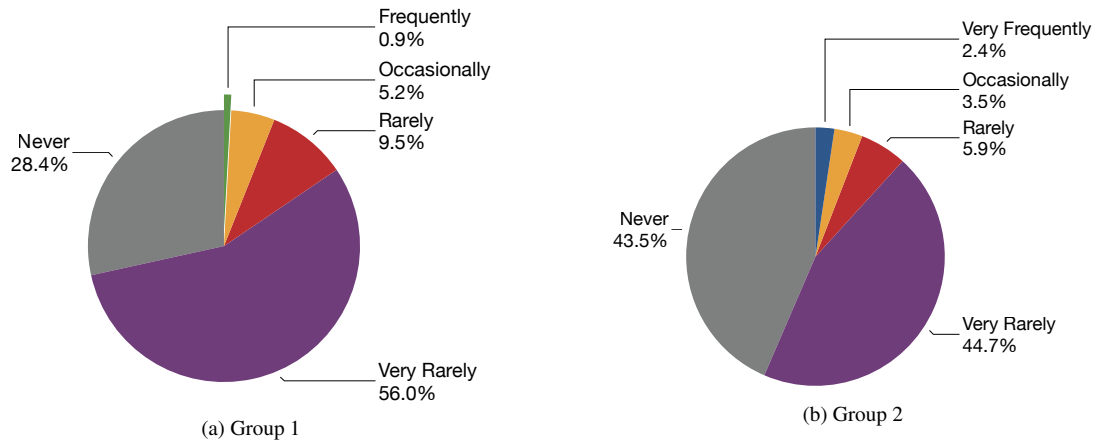


Fig. 6: Frequency of being notified of outdated code in the answerers' answers.

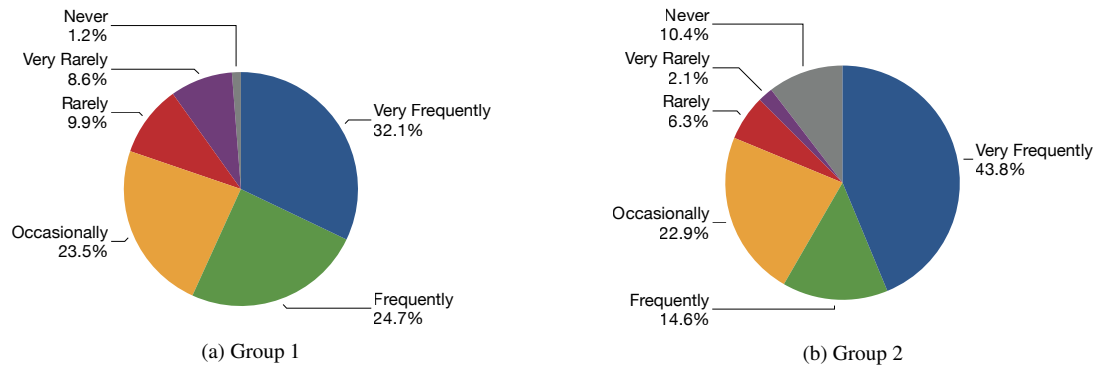


Fig. 7: Frequency of the answerers fixing their outdated code.

Regarding the issue of outdated code, one participant expresses their concern in the open comment question: “*The main problem for me/us is outdated code, esp. as old answers have high Google rank so that is what people see first, then try and fail. That’s why we’re moving more and more of those examples to knowledge base and docs and rather link to those.*” On the other hand, another participant does not worry about his/her outdated code and how he or she handles them: “*On the matter of deprecation, I almost entirely use .NET which has got different versions of the framework. Therefore, code deprecation is not often a problem since what is deprecated on one version of the framework may be the only way of solving a given problem on an older version of the framework. I may also have to add that questions I tend to answer are about how to solve general coding problems so they are not usually subject to deprecation.*”

For RQ 2, Stack Overflow answerers are aware of outdated code in their answers. Nonetheless, there are approximately 19% of the answerers who rarely or never fix their outdated code for which they have been notified.



Fig. 8: Awareness of answerers to Stack Overflow CC BY-SA 3.0 license



Fig. 9: Software license in Stack Overflow code snippets.

RQ3: Are Stack Overflow answerers aware of software licensing violations caused by code snippets in their answers?

As shown in Figure 8, more than half of the answerers in both groups, 72 (62.1%) and 53 (62.3%) respectively, are aware that Stack Overflow apply Creative Commons Attribution-ShareAlike 3.0 Unported (CC BY-SA 3.0) to content in the posts, including code snippets, while the rest of 44 (37.9%) and 32 (37.6%) are not.

Almost every answerer in both groups, 114 out of 116 (98%) and 84 out of 85 (99%) respectively, do not include license statement in their code snippets (numbers are shown in Figure 9). Some of the participants explain the reason in the open comment question which we summarised into three groups as follows. First, they choose to post only their own code or code that is adapted from the question. The code is automatically subjected to Stack Overflow's CC BY-SA 3.0 without any explicit licensing statement. Second, they copy the code from company or open source projects that they know are permitted to be publicly distributed. Hence, no license statement is required. Third, some answerers believe that code snippets in their answers are too small to claim any intellectual property on them and fall under fair use (Fair Use, 2017).

While almost nobody explicitly includes a software license in their snippets, many participants include a statement on their profile page that all their answers are under a certain license. For example, *All code posted by me on Stack Overflow should be considered public domain without copyright. For countries where public domain is not applicable, I hereby grant everyone the right to modify, use and redistribute any code posted by me on Stack Overflow for any purpose. It is provided "as-is" without warranty of any kind.* Many participants either declare their snippets to be public domain, or they grant additional licenses, e.g. Apache 2.0 or MIT/Expat.

We asked the answerers a follow-up question of how frequently they checked for conflicts between software license of the code snippets they copied to their answers and Stack Overflow's CC BY-SA 3.0. As shown in Figure 10, 80 (69%)

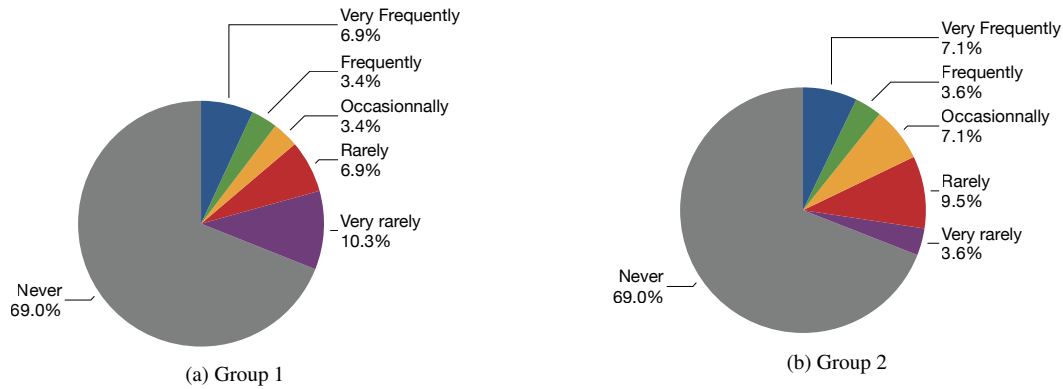


Fig. 10: Frequency of the answerers checking license of their code snippets against Stack Overflow’s CC BY-SA 3.0.

and 58 (69%) answerers from group 1 and group 2 did not perform the checking. There are only approximately 10% of the answerers who frequently checks for licensing conflicts when they copy code snippets to Stack Overflow.

For RQ3, approximately 62% of our participants are aware of CC BY-SA 3.0 license enforced by Stack Overflow. However, 98–99% of the answerers never include software license in their Stack Overflow snippets. Sixty-nine percent never check for licensing conflicts when they copy code snippets to Stack Overflow answers.

To acquire additional insights, we invited every answerers for further comments regarding their concerns of answering Stack Overflow (SO) with code snippets. Some interesting comments are selected and discussed below. The full set of answers can be found in the Appendix C.

Comment 1: The answerer addresses a concern of programmers reusing his/her code snippets without understanding them. Moreover, he or she discusses a ramification of low-quality snippets or outdated code containing security issues on Stack Overflow.

The real issue is less about the amount the code snippets on SO than it is about the staggeringly high number of software “professionals” that mindlessly use them without understanding what they’re copying, and the only slightly less high number of would-be professionals that post snippets with built-in security issues. A related topic is beginners who post (at times dangerously) misleading tutorials online on topics they actually know very little about. Think PHP/MySQL tutorials written 10+ years after `mysql_` functions were obsolete, or the recent regex tutorial that got posted the other day on HackerNew (<https://news.ycombinator.com/item?id=14846506>). They’re also full of toxic code snippets.*

Comment 2: The answerer suggests that a guidance from Stack Overflow regarding software license of code snippets will be beneficial.

When I copy code it’s usually short enough to be considered “fair use” but I am not a lawyer or copyright expert so some guidance from SO would be helpful. I’d also like the ability to flag/review questions that violate these guidelines.

Comment 3: Similar to comment 1, the answerer addresses a concern of reusing Stack Overflow code snippets without understanding.

My only concern, albeit minor, is that I know people blindly copy my code without even understanding what the code does.

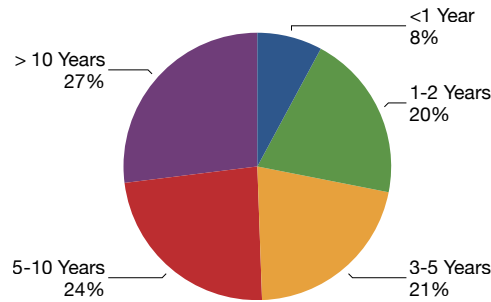


Fig. 11: Experience of the Stack Overflow visitors

Comment 4: As shown in RQ2, the answerer discusses a problem from outdated Stack Overflow code snippets and his/her solution.

The main problem for me/us is outdated code, esp. as old answers have high Google rank so that is what people see first, then try and fail. Thats why we're moving more and more of those examples to knowledge base and docs and rather link to those.

Comment 5: The answerers gives insights into the quality of the Stack Overflow code snippets.

Lot of the answers are from hobbyist so the quality is poor. Usually they are hacks or workarounds (even MY best answer on SO is a workaround).

3.2 The visitor survey

To answer RQ4 and RQ5, we used another online survey, the visitor survey, to ask Stack Overflow visitors about their experiences of obsolete code and their awareness to software license of Stack Overflow code snippets. We received 89 answers from 5 groups of Stack Overflow visitors. We combined the results and present them as a single group below.

General Information

As illustrated in Figure 11, 24 (27%) and 21 (24%) of the participants in Stack Overflow visitor survey have over 10 years and 5-10 years of experience respectively. There are 19 participants (21%) who have 3-5 years, 18 (20%) who have 1-2 years, and 7 (8%) participants who have less than a year of programming experience.

Where do the developers search for programming solutions?

We asked the participants to rank five options, without a tie, they will choose to find programming solutions. The given five options include books, official documentations, Stack Overflow, online repositories (e.g. GitHub), and others. The results are displayed in Figure 12. We found that 47 out of 89 participants rank Stack Overflow as the 1st option to search for programming solutions, followed by official documentation (33), online repositories (6), other resources (5), and books (1).

Since Stack Overflow is among the first research to solve programming tasks, we asked the participants how frequently they reuse code snippets from answers on Stack Overflow. According to the results (see Figure 13), we found that 57 (64%) participants actively reusing code snippets from Stack Overflow. Eight participants (9%) copy Stack Overflow code every day, 22 (25%) do copying 3-6 times a week, 27 (30%) do copying once or twice a week. There are 2 participants (2%) who never copy code from Stack Overflow.

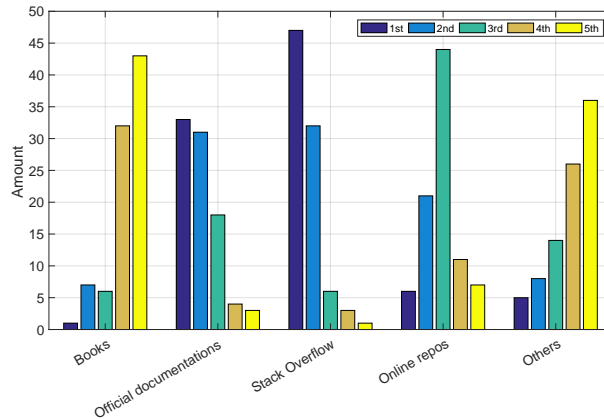


Fig. 12: Rankings of the resources developers use to solve programming problems

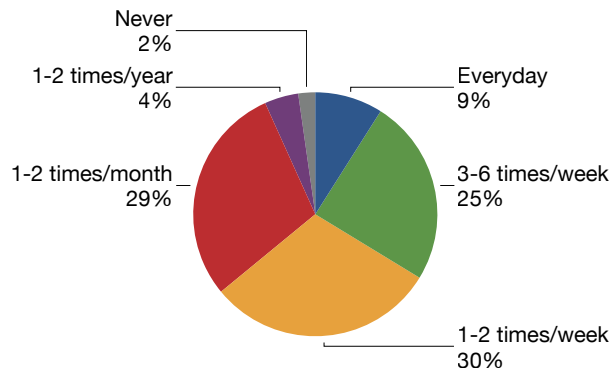


Fig. 13: Frequency of copying code from Stack Overflow

To understand why the participants choose to copy code snippets from Stack Overflow, we asked them to rate four reasons in Likert's scale (Strongly agree, Agree, Undecided, Disagree, Strongly disagree). The four reasons include *They are easy to find by searching the web*, *They solve problems similar to my problems with minimal changes*, *The context of questions and answers helped me understand the code snippets better*, *The voting mechanism and accepted answers helped to filter good code from bad code*. The answers are depicted in Figure 14. More than 80% of the participants agree with all the four reasons. We observed only two “disagree” and zero “Strongly disagree” answer for “Helpful context”, the lowest disagreement among the four reasons. This means most of them agree that the context of questions and answers on Stack Overflow help them understand the code snippet better.

To sum up, Stack Overflow is ranked higher than official documentation, online repositories, and books as the resource to look for programming solutions. Developers rely on Stack Overflow answers because they are easy to search for on the web. Moreover, 64% of the participants reuse code snippets from Stack Overflow at least once a week. The copy code from Stack Overflow because they can be found easily from search engine, solve similar problems to their problems, provide helpful context, and offer voting and accepted answers.

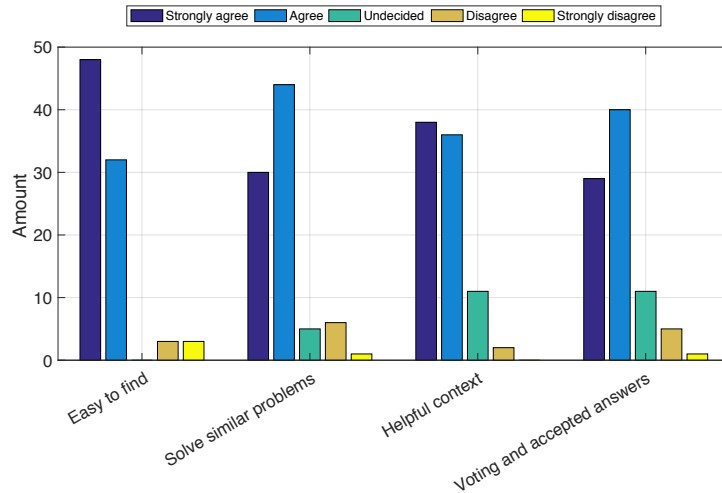


Fig. 14: Why did you copy and reuse code snippets from Stack Overflow?

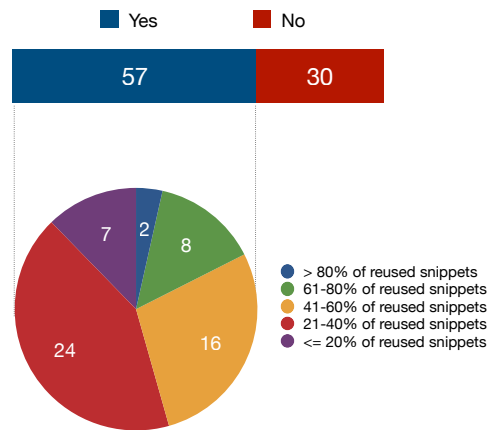


Fig. 15: Number of visitors who experienced a problem from reusing Stack Overflow code snippets and the frequency.

RQ4: What are the problems Stack Overflow visitors experiencing from reusing code snippets on Stack Overflow?

We asked the visitors whether they have had any problem from reusing Stack Overflow code snippets and how often did the problems occur. Fifty seven out of eighty seven participants (66%) experienced a problem from reusing Stack Overflow snippets (see Figure 15). Among the 57, there are 2 participants who found problems in more than 80% of the reused code snippets. Eight and sixteen faced problems from at least sixty and forty percent of the reused snippets.

The problems from reusing Stack Overflow code snippets (illustrated in Figure 16) include incorrect solutions, i.e. the code claims to solve the problem in the question while it does not (28 out of 57 \approx 49% participants reported this); outdated solutions, i.e. the code may work with the some older versions of the library or API, but not the one they are using (39 out of 57 \approx 68% participants reported this); mismatched solutions, i.e. the code solves the problem in the question but it is not exactly the right solution for their problem (40 out of 57 \approx 70% participants reported this); and buggy code (1 out of 57 \approx 2% participants reported this).

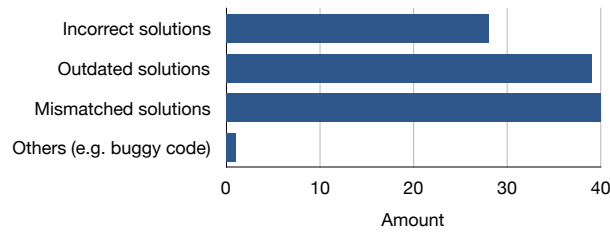


Fig. 16: Problems from reusing Stack Overflow code snippets

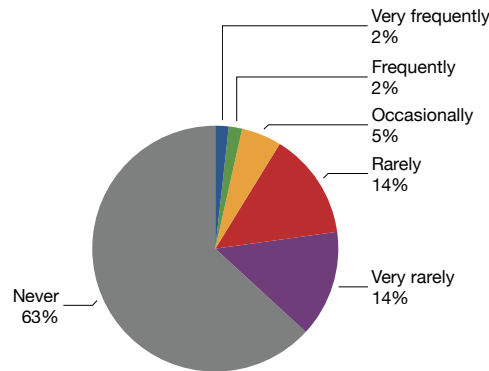


Fig. 17: Frequency of Stack Overflow visitors reporting the problems back to Stack Overflow discussion threads

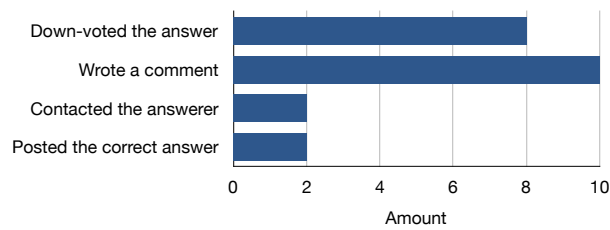


Fig. 18: Options that Stack Overflow visitors choose to report the problems from Stack Overflow snippets

Stack Overflow visitors rarely report the problems back to the discussion threads (as can be seen in Figure 17). Among the 57 participants who encounter problems of Stack Overflow snippets, 36 of them (63.2%) never report the problems. Fourteen participants who reported the problems did so by writing a comment (10), down-voting the answer (8), contacted the answerer (2), and posting the new and correct answer (2) (shown in Figure 18).

For RQ4, our survey results show that 57 out of 87 Stack Overflow visitors encountered a problem from reusing Stack Overflow code snippets. Ten participants experienced problems for more than 80% of the copied snippets and sixteen participants faced problems for 40–60% of the reused code. The problems ranked by frequency include mismatched solutions (40), outdated solutions (39), incorrect solutions (28), and buggy code (1). Sixty-three percent of the participants never report the problems back to Stack Overflow.

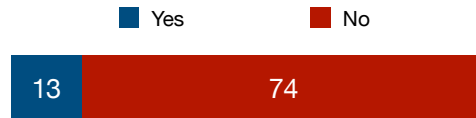


Fig. 19: Awareness of Stack Overflow visitor to CC BY-SA 3.0 license

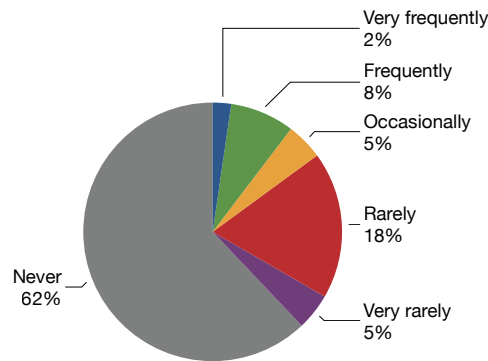


Fig. 20: Attributions to Stack Overflow when reusing code snippets



Fig. 21: Checking for the original license of Stack Overflow code snippets

RQ5: Are Stack Overflow visitors aware of code licensing on Stack Overflow?

As depicted in Figure 19, 74 out of 87 (85%) Stack Overflow visitors are not aware, at the time of copying the code, that Stack Overflow apply Creative Commons Attribution-ShareAlike 3.0 Unported (CC BY-SA 3.0) to content in the posts, including code snippets. As a consequence 62% of the visitors never give an attribution, which is required by CC BY-SA 3.0, to a Stack Overflow post they copied the code from (the complete statistics can be found from Figure 20).

Sixty-nine Stack Overflow visitors (79%) who adopted code from Stack Overflow never check if the code snippet originated from a different source (e.g. an open source project) with an incompatible license to their projects (see Figure 21).

Fifty seven participants (66%) never check for licensing conflicts at all when reusing Stack Overflow code (see Figure 22). Lastly, 9% of the participants experienced legal issues by reusing code snippets on Stack Overflow (see Figure 23). We did not expect that any participant encountered legal issues as we are not aware of such cases being reported in the literature. It would be interesting to followup on the kind of legal issues that have been encountered, however, as we designed the survey to be anonymous, it was not possible to contact the participants for further details.

For RQ5, 85% of the participants are not aware of Stack Overflow CC BY-SA 3.0 license and 62% never give attributions to the Stack Overflow posts they copied the code snippets from. We found that 66% of the visitors never check for software licensing conflicts between Stack Overflow code snippets and their projects. 9% of the participants encountered legal issues.

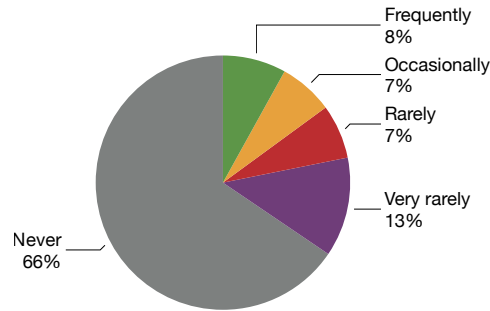


Fig. 22: Checking for licensing conflicts from reusing Stack Overflow snippets

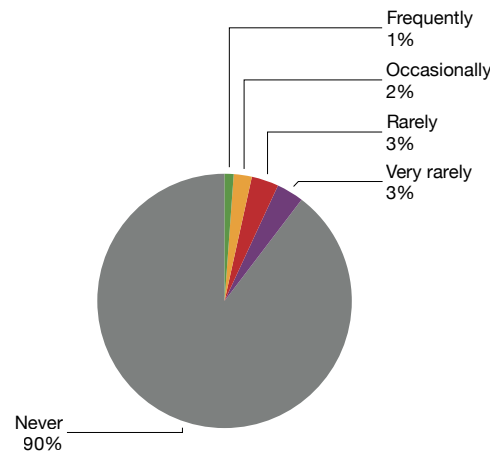


Fig. 23: Legal issues found from reusing Stack Overflow code snippets

3.3 Overall Discussion

By separating the answerers into two groups according to their reputation, we observed some similarities and differences in their responses. The sources of code snippets in Stack Overflow answers are similar in both groups. The answerers mainly write the code snippets from scratch aiming to answer the question. The frequencies of copying from each source, i.e. personal projects, company projects, open source projects, writing from scratch, modifying from the questions, and others, also follow the same proportions for both group.

The main difference we found is responses regarding outdated code. The answerers in Group 1 have a more substantial percentage (61.2%) of being notified about the outdated code in their answers than Group 2 (47.1%). This may be caused by the amount of their Stack Overflow answers. Since Group-1 answerers have a higher reputation than Group-2 answerers, they possibly have given more answers on Stack Overflow. The higher amount of answers hence increase the chance of the code being outdated. Interestingly, although the percentage of outdated code notifications in Group 2 is lower, the percentage of the answerers who very frequently fixed their outdated code is higher than of Group 1.

Regarding software license, the responses from the two groups agree with each other. The answerers in both groups show the same level of awareness to Stack Overflow CC BY-SA 3.0 license (62.1% and 62.3%). Similarly, the answerers in both groups neither include software license in their code snippets (98% and 99%) nor check of licensing conflicts between their code snippet's and Stack Overflow CC BY-SA 3.0 (69%).

The visitors survey confirms the findings from the previous studies that Stack Overflow code snippets can be problematic (Acar et al, 2016; An et al, 2017). Sixty-six percent of the visitors experienced a problem from reusing Stack Overflow code snippets ranging from incorrect solutions, outdated solutions, mismatched solutions, to buggy code. Although they are aware of the problems, half of them (56%) never reports back to the Stack Overflow discussions. On the other hand, the visitors rarely give attributions to Stack Overflow when they reuse code snippets from the website, similar to the findings reported by Baltes et al (2017). The visitors are generally not aware of the CC BY-SA 3.0 license, and more than half of them never check for license compatibility when reusing Stack Overflow code snippets. We also found that 9% of the participants encountered legal issues by copying code from Stack Overflow. To the best of our knowledge, a study of legal problems from reusing Stack Overflow code snippets has never been done before and will be our future work.

4 Threats to Validity

4.1 Internal Validity

We only invited 607 developers to participate in the answerer survey. If all the developers are invited, which is almost impossible considering 7.6 million users on Stack Overflow, the results may be different. Nevertheless, we mitigate this threat to internal validity by selecting the participants based on their Stack Overflow reputation. This targeted participant selection ensures that we invite developers who have been actively involved in asking and answering questions on the site for a long period of time, and refrain from inviting new users who merely answer a question or two. The highest reputation user invited to our survey answered 33,933 questions and the lowest reputation user in our survey answered 116 questions.

We selected the participants for the visitor survey based on convenient sampling which could suffer from bias and outliers. We mitigate the threat by inviting different groups of participants ranging from the author's social media, technology news and media community, software engineering community (on Facebook), Java programmer discussion thread (com.lang.java.programmer), and from University of Molise.

4.2 External Validity

While the reputation is a good proxy to reflect the amount of answers the developers have given, it might not cover all kinds of answerers and their experience on Stack Overflow. The answerers who have lower-reputation than 6,999 were not invited to our study and their awareness and experience may differ from our findings. Hence, our findings may not be generalised to all Stack Overflow answerers.

At least 39% of the participants in the visitor survey are from Thailand (blognone.com and some of the first author's contacts). Due to working culture, answers from this group of developers may only represent software developers in Thailand. Similarly our findings from the visitor survey may not be generalised to all Stack Overflow visitors. We alleviate this concern by inviting participants from other groups, e.g. University of Molise in Italy, comp.lang.java.programmer, and Software Engineering Facebook group.

5 Related Work

5.1 Stack Overflow

Stack Overflow is a gold mine for software engineering research and has been put to use in several previous studies. In terms of developer-assisting tools, Seahawk is an Eclipse plug-in that searches and recommends relevant code snippets from Stack Overflow (Ponzanelli et al, 2013). A follow-up work, Prompter, by Ponzanelli et al. (Ponzanelli et al, 2014)

achieves the same goal but with improved algorithms. The code snippets on Stack Overflow are mostly examples or solutions to programming problems. Hence, several code search systems use whole or partial data from Stack Overflow as their code search databases (Keivanloo et al, 2014; Park et al, 2014; Stolee et al, 2014; Subramanian and Holmes, 2013; Diamantopoulos and Symeonidis, 2015). Furthermore, Treude et al. Treude and Robillard (2016) use machine learning techniques to extract insight sentences from Stack Overflow and use them to improve API documentation.

Another research area is knowledge extraction from Stack Overflow. Nasehi et al (2012) studied what makes a good code example by analysing answers from Stack Overflow. Similarly, Yang et al (2016) report the number of reusable code snippets on Stack Overflow across various programming languages. Wang et al (2013) use Latent Dirichlet Allocation (LDA) topic modelling to analyse questions and answers from Stack Overflow so that they can automatically categorise new questions. There are also studies trying to understand developers' behaviours on Stack Overflow, e.g. A study by Movshovitz-Attias et al (2013); Rosen and Shihab (2016); Choetkiertikul et al (2015); Bosu et al (2013). Yang et al (2017) analysed 909k non-fork Python projects on GitHub and 1.9 million python code snippets on Stack Overflow and found thousands of code blocks that are copied from Stack Overflow to GitHub. Baltes et al (2017) discovered that two thirds of the clones from the 10 most frequently referenced Java code snippets on Stack Overflow do not contain attributions.

5.2 Software Licensing

Software licensing is crucial for open source and industrial software development. Di Penta et al. Di Penta et al (2010) studied the evolution of software licensing in open source software and found that licensing statements change over time. German et al (2009) found that licensing incompatibility occur between the clone siblings, i.e. clones among different systems that come from the same source. Later, German et al (2010) created an automated tool for software license identification, Ninka. An et al (2017) detected clones between 399 Android apps and Stack Overflow Java code snippets. They found that 1,279 cloned snippets potentially violate software licenses. Our study gives insights into the software licensing of Stack Overflow code snippets. We study the licensing awareness of developers when they copy and paste code to/from Stack Overflow.

5.3 Reusing of outdated third-party source code

Outdated code occurs in software development. Xia et al. Xia et al (2014) discover that there is code reused from popular open source projects in a large number of open source systems. More importantly, some of the reused code is outdated which affect quality and security of the software. Our study focuses on a similar problem but on the context of Stack Overflow.

6 Conclusions

We present the results from online surveys of Stack Overflow answerers and visitors regarding their awareness and experience of answering and reusing code snippets on Stack Overflow. We are particularly interested in cloned code snippets in Stack Overflow answers. Thus, the two online surveys are performed to find out the *origin* of code snippets in Stack Overflow answers and *awareness* of Stack Overflow developers, both answerers and visitors, to the problem of outdated and license-violating code.

From the answerer's responses, we discover that code in Stack Overflow answers is usually written from scratch to answer a question. Nonetheless, there are some code snippets that are copied from the answerer's personal or company projects, or from open source software.

Outdated code on Stack Overflow occurs when a code snippet is copied from another location and is no longer up-to-date. The results show that although the answerers are aware of outdated code in their answers, 19% of them rarely

or never fix the code. One answerer expresses a concern of having outdated code in his/her popular answer reused by many other developers.

Approximately 60% of the answerers are aware that Stack Overflow applies the CC BY-SA 3.0 license to code on Stack Overflow. Ninety-eight to ninety-nine percent do not include a license in their answers nor check for licensing conflicts when they copy the code from another location to their answer. Some developers believe the code is too small and fall under fair use policy. Many answerers mention the license of their code in their profile page instead.

From the visitor's responses, Stack Overflow is ranked the highest as a resource to solve programming tasks. They agree that Stack Overflow answers are easy to find by search engines. More than half of them (64%) reuse code from Stack Overflow at least once a week. Sixty-seven percent of the visitors find a problem from reusing Stack Overflow snippets ranging from a mismatched solution, outdated solution, incorrect solution, and buggy code. However, 56% of the participants never report the problems back to Stack Overflow.

Eighty-five percent of the visitors are not aware of Stack Overflow's CC BY-SA 3.0 and sixty-two percent never give attributions to Stack Overflow posts that they copied the code from. Moreover, sixty-six percent never check for licensing conflicts while reusing Stack Overflow code snippets in their software projects. Unexpectedly, 9% of the participants encountered legal issues.

With these findings, we suggest Stack Overflow raise an awareness of their users, both the answerers and the visitors, to the problem of outdated and license-violating code snippets.

References

- Abdalkareem R, Shihab E, Rilling J (2017) On code reuse from stackoverflow: An exploratory study on android apps. *Information and Software Technology* pp 148–158
- Acar Y, Backes M, Fahl S, Kim D, Mazurek ML, Stransky C (2016) You get where you're looking for: The impact of information sources on code security. In: *SP '16*, pp 289–305
- An L, Mlouki O, Khomh F, Antoniol G (2017) Stack Overflow: A code laundering platform? In: *SANER '17*
- Baltes S, Kiefer R, Diehl S (2017) Attribution required: Stack Overflow code snippets in GitHub projects. In: *Proceedings of the 39th International Conference on Software Engineering Companion (ICSE-C'17)*, pp 161–163
- Bosu A, Corley CS, Heaton D, Chatterji D, Carver JC, Kraft NA (2013) Building reputation in StackOverflow: An empirical investigation. In: *MSR '13*, pp 89–92
- Choetkiertikul M, Avery D, Dam HK, Tran T, Ghose A (2015) Who will answer my question on Stack Overflow? In: *ASWEC '15*, pp 155–164
- Di Penta M, German DM, Guéhéneuc YG, Antoniol G (2010) An exploratory study of the evolution of software licensing. In: *ICSE '10*, vol 1, p 145
- Diamantopoulos T, Symeonidis AL (2015) Employing source code information to improve question-answering in Stack Overflow. In: *MSR '15*, pp 454–457
- Fair Use (2017) Intellectual property for CS students: Copyrights – fair use. <https://www.cs.duke.edu/courses/cps182s/fall02/cscopyright/Copyrights/Copyright-Fairuse.htm>
- German DM, Di Penta M, Gueheneuc YG, Antoniol G (2009) Code siblings: Technical and legal implications of copying code between applications. In: *MSR '09*, pp 81–90
- German DM, Manabe Y, Inoue K (2010) A sentence-matching method for automatic license identification of source code files. In: *ASE '10*, p 437
- Keivanloo I, Rilling J, Zou Y (2014) Spotting working code examples. In: *ICSE '14*, pp 664–675
- Kitchenham BA, Pfleeger SL (2002) Principles of Survey Research Part 2: Designing a Survey Sample size Experimental designs. *Software Engineering Notes* 27(1):18–20
- Movshovitz-Attias D, Movshovitz-Attias Y, Steenkiste P, Faloutsos C (2013) Analysis of the reputation system and user contributions on a question answering website: StackOverflow. In: *ASONAM '13*, pp 886–893
- Nasehi SM, Sillito J, Maurer F, Burns C (2012) What makes a good code example?: A study of programming Q&A in StackOverflow. In: *ICSM '12*, pp 25–34

- Park Jw, Lee MW, Roh JW, Hwang Sw, Kim S (2014) Surfacing code in the dark: an instant clone search approach. *Knowledge and Information Systems* 41(3):727–759
- Pfleeger SL, Kitchenham BA (2001) Principles of survey research part 1: Turning lemons into lemonade. *Software Engineering Notes* 26(6):16
- Ponzanelli L, Bacchelli A, Lanza M (2013) Seahawk: Stack Overflow in the IDE. In: ICSE '13, pp 1295–1298
- Ponzanelli L, Bavota G, Di Penta M, Oliveto R, Lanza M (2014) Mining StackOverflow to turn the IDE into a self-confident programming prompter. In: MSR '14, pp 102–111
- Punter T, Ciolkowski M, Freimut B, John I (2003) Conducting on-line surveys in software engineering. In: *Proceedings of the International Symposium on Empirical Software Engineering (ISESE'03)*, pp 80–88
- Rosen C, Shihab E (2016) What are mobile developers asking about? A large scale study using Stack Overflow. *Empirical Software Engineering* 21(3):1192–1223
- Stolee KT, Elbaum S, Dobos D (2014) Solving the search for source code. *Transactions on Software Engineering and Methodology* 23(3):1–45
- Subramanian S, Holmes R (2013) Making sense of online code snippets. In: MSR '13, pp 85–88
- Treude C, Robillard MP (2016) Augmenting API documentation with insights from Stack Overflow. In: ICSE '16, pp 392–403
- Wang S, Lo D, Jiang L (2013) An empirical study on developer interactions in StackOverflow. In: SAC '13, pp 1019–1024
- Xia P, Matsushita M, Yoshida N, Inoue K (2014) Studying reuse of out-dated third-party code. *Information and Media Technologies* 9(2):155–161
- Yang D, Hussain A, Lopes CV (2016) From query to usable code: An analysis of Stack Overflow code snippets. In: MSR '16, pp 391–402
- Yang D, Martins P, Saini V, Lopes C (2017) Stack Overflow in Github: Any snippets there? In: *Proceedings of the International Conference on Mining Software Repositories (MSR '17)*

7 Appendix

This appendix contains additional materials of the Stack Overflow answerer survey questions, the visitor survey questions, and the complete set of open comments from the Stack Overflow answerers.

A Stack Overflow Answerer Survey

A survey of developers' experiences on answering Stack Overflow questions with code examples

Dear developer,

Since you are one of the top answerers on Stack Overflow, we hope you can help us with a not-for-profit study.

We are researchers in the Software Systems Engineering Group at University College London, UK. We are studying problems caused by outdated and license-violating code snippets on Stack Overflow. We have designed a survey to understand these problems and would be grateful if you would complete it.

The survey is completely anonymous and has 11 questions and should only take about 3-5 minutes to complete. We hope that you will complete the entire form but if you do not wish to continue, you can just quit the session and your input will be discarded.

The survey results will be used only for academic research purposes and we plan to release the results to Stack Overflow and in the form of academic papers and presentations.

This research project has been approved by the designated ethics officer in the Computer Science Department at UCL.

If you have any question, please feel free to contact me.

Chaiyong Ragkhitwetsagul
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<http://www.cs.ucl.ac.uk/staff/C.Ragkhitwetsagul>

* Required

1. How long have you been working on developing software? *

Mark only one oval.

- ☐ Less than a year
- ☐ 1 - 2 years
- ☐ 3 - 5 years
- ☐ 5 - 10 years
- ☐ More than 10 years

2. How frequently do or did you answer questions on Stack Overflow? *

Mark only one oval.

- ☐ Very Frequently (every day)
- ☐ Frequently (roughly 3-6 times a week)
- ☐ Occasionally (roughly once or twice a week)
- ☐ Rarely (roughly once or twice a month)
- ☐ Very Rarely (roughly once or twice a year)
- ☐ Never *Skip to question 11.*

Experience of Answering Stack Overflow Questions

This section aims to gain understanding on how developers choose code snippets to put as a solution on Stack Overflow.

3. **How frequently do or did you include code snippets in your answers on Stack Overflow? ***

Mark only one oval.

- ☐ Very Frequently (81--100% of the time)
- ☐ Frequently (61--80% of the time)
- ☐ Occasionally (41--60% of the time)
- ☐ Rarely (21--40% of the time)
- ☐ Very Rarely (1--20% of the time)
- ☐ Never (0% of the time) *Skip to question 11.*

Sources of the Stack Overflow Snippets

This section will gather information about the origins of the example snippets in Stack Overflow answers.

4. **Where did the code snippets in your answers come from? ***

Mark only one oval per row.

	Very frequently	Frequently	Occasionally	Rarely	Very rarely	Never
I copied them from my own personal projects.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I copied them from my company's projects.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I copied them from open source projects.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I wrote the new code from scratch.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I copied the code from the question and modified it for the answer.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Others	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Concerns of Copying Code Snippets to Stack Overflow

This section aims to study concerns of the answerers regarding software licensing of their code snippets in Stack Overflow answers.

5. **Were you aware, at the time of copying the code, that Stack Overflow apply Creative Commons Attribution-ShareAlike 3.0 Unported (CC BY-SA 3.0) to content in the posts, including code snippets? ***

Mark only one oval.

- ☐ Yes
- ☐ No

6. **Do you usually include a software license in your code snippets on Stack Overflow? ***

Mark only one oval.

- ☐ Yes, as a comment in the code.
- ☐ Yes, in a text surrounding the source code.
- ☐ Yes, both in code comments and text.
- ☐ No.

7. **How frequently did you check the software license of the code snippets you copy to Stack Overflow if they conflict with Stack Overflow's CC BY-SA 3.0 license? ***

Mark only one oval.

- ☐ Very Frequently (81--100% of the time)
- ☐ Frequently (61--80% of the time)
- ☐ Occasionally (41--60% of the time)
- ☐ Rarely (21--40% of the time)
- ☐ Very rarely (1--20% of the time)
- ☐ Never (0% of the time)

Problems from Code Snippets on Stack Overflow

This section will gather information of code snippets that were outdated after being copied to Stack Overflow.

8. **Outdated code occurs when code snippets in your answers are no longer up-to-date with the latest version of the software you copied the code from. Have you ever been notified of outdated code in your Stack Overflow answers? ***

Mark only one oval.

- ☐ Yes
- ☐ No

Frequency of Notifications

9. **How frequently were you notified of outdated or deprecated code in your Stack Overflow answers? ***

Mark only one oval.

- ☐ Very frequently (81--100% of my answers)
- ☐ Frequently (61--80% of my answers)
- ☐ Occasionally (41--60% of my answers)
- ☐ Rarely (21--40% of my answers)
- ☐ Very rarely (1--20% of my answers)
- ☐ Never (0% of my answers) *Skip to question 11.*

Fixing Outdated Code

10. How frequently did you fix your outdated code on Stack Overflow? **Mark only one oval.*

- ☐ Very frequently (81--100% of the cases)
- ☐ Frequently (61--80% of the cases)
- ☐ Occasionally (41--60% of the cases)
- ☐ Rarely (21--40% of the cases)
- ☐ Very rarely (1--20% of the cases)
- ☐ Never (0% of the cases)

Additional feedbacks**11. Do you have any other concerns regarding answering Stack Overflow with code snippets?**

Powered by
 Google Forms

B Stack Overflow Visitor Survey**A survey of developers' experiences on reusing code snippets from Stack Overflow**

Dear developer,

We are researchers in the Software Systems Engineering Group at University College London, UK. We are studying problems caused by outdated and license-violating code snippets on Stack Overflow. We have designed a survey to understand these problems and would be grateful if you would complete it.

The survey is completely anonymous and has 15 questions and should only take about 5-7 minutes to complete. We hope that you will complete the entire form but if you do not wish to continue, you can just quit the session and your input will be discarded.

The survey results will be used only for academic research purposes and we plan to release the results to Stack Overflow and in the form of academic papers and presentations.

This research project has been approved by the designated ethics officer in the Computer Science Department at UCL.

If you have any question, please feel free to contact me.

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* Required

1. How long have you been working on developing software?

Mark only one oval.

- ☐ Less than a year
- ☐ 1-2 years
- ☐ 3-5 years
- ☐ 5-10 years
- ☐ More than 10 years

Importance of Stack Overflow to Developers

This section aims to measure importance of Stack Overflow to developers when they solve programming tasks.

2. When you had a problem with your programming tasks, please rank in which order did you search for help (1 for the first, and 5 for the last, without a tie)? *

Mark only one oval per row.

	1st	2nd	3rd	4th	5th
Books	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Official documentations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Stack Overflow	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Online repositories (e.g. GitHub)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Others	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3. **How frequently do or did you copy source code snippets from Stack Overflow? ***

Mark only one oval.

- ☐ Very frequently (everyday)
- ☐ Frequently (roughly 3-6 times a week)
- ☐ Occasionally (roughly once or twice per week)
- ☐ Rarely (roughly once or twice a month)
- ☐ Very rarely (roughly once or twice a year)
- ☐ Never *Stop filling out this form.*

Reasons for Reusing Stack Overflow's Snippets

This section aims to understand why developers reuse code from Stack Overflow and their problems.

4. **Why did you copy and reuse code snippets from Stack Overflow?**

Mark only one oval per row.

	Strongly agree	Agree	Undecided	Disagree	Strongly Disagree
They are easy to find by searching the web.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
They solve problems similar to my problems with minimal changes.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The context of questions and answers helped me understand the code snippets better.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The voting mechanism and accepted answers helped filtering good code from bad code.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5. **Have you ever found any problems from reusing Stack Overflow code snippets? ***

Mark only one oval.

- ☐ Yes
- ☐ No *Skip to question 10.*

Problems from Stack Overflow Code Snippets

This section aims to understand the problems from Stack Overflow snippets and whether the developers notify the answerers of the problems.

6. **How frequently did you find problems from reusing Stack Overflow code snippets? ***

Mark only one oval.

- ☐ Very frequently (81--100% of the reused snippets)
- ☐ Frequently (61--80% of the reused snippets)
- ☐ Occasionally (41--60% of the reused snippets)
- ☐ Rarely (21--40% of the reused snippets)
- ☐ Very rarely (1--20% of the reused snippets)
- ☐ Never

7. What were the problems? **Check all that apply.*

- ☐ Incorrect solution (the code claims to solve the problem in the question while it does not).
- ☐ Outdated solution (the code may work with the some older versions of the library or API, but not the one you are using).
- ☐ Mismatched solution (the code solves the problem in the question but it is not exactly the right solution for your problem).
- ☐ Other: _____

8. How frequently did you report the problems back to the Stack Overflow discussion threads? **Mark only one oval.*

- ☐ Very frequently (81--100% of the time)
- ☐ Frequently (61--80% of the time)
- ☐ Occasionally (41--60% of the time)
- ☐ Rarely (21--40% of the time)
- ☐ Very rarely (1--20% of the time)
- ☐ Never (0% of the time) *Skip to question 10.*

Reporting problems of Code on Stack Overflow**9. How did you report the problems?***Check all that apply.*

- ☐ I down-voted the answer containing the problematic code snippet
- ☐ I wrote a comment saying that the code has problems.
- ☐ I contacted the answerers regarding the problems directly.
- ☐ I never report problems.
- ☐ Other: _____

Licensing of Code on Stack Overflow

This section will study awareness of developers regarding licensing of code snippets on Stack Overflow.

10. Were you aware, at the time of copying the code, that Stack Overflow apply Creative Commons Attribution-ShareAlike 3.0 Unported (CC BY-SA 3.0) to content in the posts, including code snippets? **Mark only one oval.*

- ☐ Yes
- ☐ No

15. **Could you please briefly explain what are the legal problems that you faced by copying code snippets from Stack Overflow?**

Other Comments

16. **Did you have any other problems from using code snippets from Stack Overflow?**

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C Open Comments from Stack Overflow Answerers

1. Sometimes you have to post code from official documentation, like in case of C#, code from MSDN is posted in the answer with added explanation.
2. Snippets on SO are usually for demonstrating a technique and therefore age well. If otherwise, I usually made them a gist, codebin or jsfiddle.
3. The real issue is less about the amount the code snippets on SO than it is about the staggeringly high number of software “professionals” that mindlessly use them without understanding what they’re copying, and the only slightly less high number of would-be professionals that post snippets with built-in security issues.
4. A related topic is beginners who post (at times dangerously) misleading tutorials online on topics they actually know very little about. Think PHP/MySQL tutorials written 10+ years after `mysql_*` functions were obsolete, or the recent regex tutorial that got posted the other day on HackerNew (<https://news.ycombinator.com/item?id=14846506>). They’re also full of toxic code snippets.
5. Just to say: the reason that I very rarely check the license status is that the code I am posting is almost always my own or adapted from the question, or imported from an open source project that I have worked on and already know the license terms, or from my own company code that I can 100% say it is OK to post in public because I know our policies.
6. No. Code snippets are short and small enough that no IP can be in them.
7. The point of snippets are that they are trivial. I mostly write from scratch or copy-&-fix a snippet from the question. Most are illustrative or incomplete – they aren’t of any value at all in isolation. They rarely take more than a few minutes to write, and it’s usually harder to explain what they’re doing in plain English. Where something is large enough to worth the effort of licensing then it’s far too big for a snippet. In those cases I create a GitHub project (with a license) and link to it. I’d be wary of increased IP controls – I doubt there is value they could add to snippets, but they could create significant barriers to contributors, which would hurt the site.
8. I always try to see what kind of person is asking the question. If it is a student, I don’t want to just hand out the answer; they will learn nothing from that. If, on the other hand, it’s somebody looking for best practices or a clever trick, I’m not too worried about giving out the solution. In this case, chances are much higher that the person asking the question will go “Ahh, yes, of course!” and understand the question, whereas some students are more likely to mindlessly copy-paste the answer.
9. However, it is also a competitive site, so if your answer requires too much work to incorporate, it won’t get accepted or upvoted. As a result, some people—I’m guilty of this myself, I’m sure—will hand out an answer willy-nilly that might solve the problem at hand, but in the long run be a disservice to the person asking.
10. But I digress: My point is that it’s sometimes better to describe a solution rather than just hand off a code snippet. However, since your project seems to pertain to copyright issues, I suppose that’s not relevant to you.
11. I’m not sure it’s possible to include a license in your questions/answers. I’m not sure what the legal ramifications would be if you tried it, since you already agreed to S.O.’s terms. This is a very interesting question and I look forward to hearing the results of your research.
12. I think it’s important to realise the code snippets are designed to be very small, useful to illustrate concepts (10 lines or less). When you consider licensing laws of such a small amount of code, while technically may be violating a licence, in practice it would be nearly impossible to enforce such a claim.
13. SO code snippets are great but there is lot to improve . It’s hard to edit and see output in so but website like jsfiddle , jsbin provide nice interface where code editing and output is easy to do.
14. Outer thing is in so lot of code snippets doesn’t work because some users don’t add libraries like angular, jquery. I think it’s better if we can identify and ask user to auto inject relevant libraries.
15. Code snippets are usually just a few lines of code so it will be hard to enforce any copyright claims except when it is a method used for something company-specific (such as generating encryption keys). Regardless, since most of the code I write is specifically to answer a given question and having full knowledge of the license system used by Stack Overflow, it is entirely unimportant to concern myself with licensing the code provided. Also, code from MSDN documentation which I sometimes adapt and modify for answers are already in the public domain so it makes no sense re-licensing it.
16. On the matter of deprecation, I almost entirely use .NET which has got different versions of the framework. Therefore, code deprecation is not often a problem since what is deprecated on one version of the framework may be the only way of solving a given problem on an older version of the framework. I may also have to add that questions I tend to answer are about how to solve general coding problems so they are not usually subject to deprecation.

17. I think you're forgetting the fact that as a community, we want to share knowledge. Patents, copyright issues and so on – it's all just annoying. We're there to have fun and to share knowledge with people.
18. In the early days, the internet used to be full of free-for-all stuff without any licenses. Because of that, it was a fantastic tool to share knowledge and information on a vast scale. The remnant of this, open source, couldn't have existed without this!
19. Personally, I believe this "intellectual property" drive of the last decade is completely overrated. If you make something **substantial**, it's fine to be able to claim some ownership – but on snippets? It's like patenting the stuff you make in your free time in your shed... it doesn't make sense and just adds to the pile of legal bullshit imho.
20. No. I only put code on there that I have the right to (code I created or have permission to share). Adding the code is not an issue for me.
21. When I copy code it's usually short enough to be considered "fair use" but I am not a lawyer or copyright expert so some guidance from SO would be helpful. I'd also like the ability to flag/review questions that violate these guidelines.
22. The snippets are all small enough that I reckon they fall under fair use.
23. I always try and attribute the code I take from other places. I feel pointing back to the origin should be sufficient in terms of giving credit where it's due. Open source is about the sharing of ideas so that others can build on them. Education is a primary use case of open source in my opinion.
24. My only concern, albeit minor, is that I know people blindly copy my code without even understanding what the code does.
25. This survey may be inapplicable to me because I never copy code from existing projects.
26. Stack Overflow did an effort to apply a MIT license to all code snippets, while keeping CC-SA for the text content. Too bad they didn't succeed with it, as it would have solved many issues.
27. The main problem for me/us is outdated code, esp. as old answers have high Google rank so that is what people see first, then try and fail. That's why we're moving more and more of those examples to knowledge base and docs and rather link to those.
28. I've got no issues with code snippets on Stack Overflow, I think they are great. Any one using them should pay attention to details such as the date of the answer etc.
29. SO's license is not clearly explained when one registers or starts to answer questions.
30. No, most copied code snippets are so trivial that licensing them would be nearly impossible. It's also mostly modified version, where only some patterns are used.
31. Lot of the answers are from hobbyist so the quality is poor. Usually they are hacks or workarounds (even MY best answer on SO is a workaround).
32. I think most example and explanatory snippets don't need a code-specific license. The CC license provides just fine. The examples either aren't copyrightable in the first place, or merely used as starting point (not used exactly as-is, not very different from reading an "All rights reserved" education book when learning programming, and "using" it in your career every day going forward). In addition, there is also the attitude of authors. Where I might care about attribution for distribution of my answer, the code within my answer is always Public Domain for me, meaning, I would never defend it. (I used to state that on my profile as well, but not in every post.)
33. Correctness and even syntax are often in doubt if I haven't had time to test the snippet end-to-end under the OP's conditions/environment.
34. It will be awesome if it becomes simple git repositories like github's gist.
35. Note that although I was not specifically of SO's licensing terms, I did have an in mind what those terms were likely to be. I have always made sure that there should be no reason that I should not share the code that I included in my replies.
36. It's an ESSENTIAL part of the site, it would NEVER work without such pieces of code. Also, given the snippets are very small in 99.99% of cases, legal aspects of this are inherently and pretty much always overlooked by the users.