

Figure 3: A hypothetical example to demonstrate our process of open coding to categorize COVID-19 software projects.

posts [Farhana et al. \(2019\)](#). Upon completion of the open coding process, the first and second author identify agreements and disagreements. Disagreements are resolved upon discussion, Agreement rate is calculated using Cohen’s Kappa [Cohen \(1960\)](#). During the discussion phase both authors agreed present their justification, and recheck the category derivation based on the discussion and revisiting content. The mapping determined upon discussion is considered final. One project can map to multiple categories.

3.1.3 Closed Coding

We apply closed coding [Crabtree and Miller \(1999\)](#) to identify which project maps to the identified categories from Section 3.1.2. Closed coding is the qualitative analysis technique where a rater maps an artifact to a pre-defined category by inspecting the artifact [Crabtree and Miller \(1999\)](#). The first and second author separately conduct closed coding on the collected README files. Both authors use Excel spreadsheets to conduct closed coding. After completing the closed coding process the first and second authors identify agreements and disagreements. Agreement rate is recorded using Cohen’s Kappa [Cohen \(1960\)](#). Disagreements are resolved using discussion. During the discussion phase both authors present their justification for disagreements. Next, based on the discussion the authors recheck the labeling based on the justification and content analysis. The categorization determined upon discussion is considered final.

3.1.4 Rater Verification

The derived categories are susceptible to the bias of the first and second author. We mitigate the limitation by allocating an additional rater who applied closed coding for a subset of the README files. The additional rater who is not an

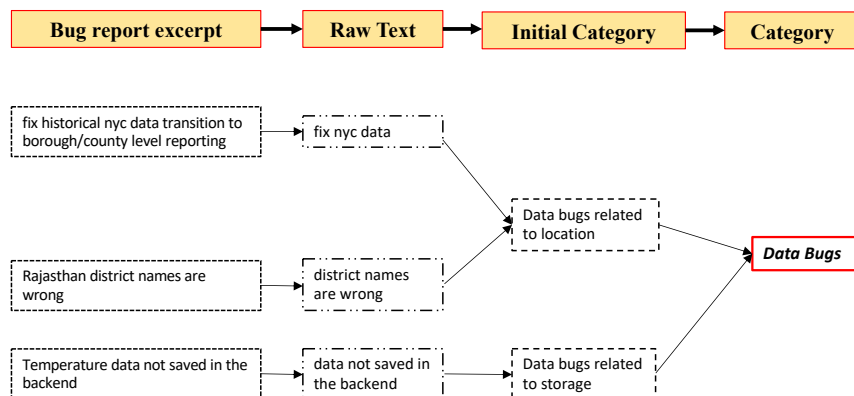


Figure 4: A hypothetical example to demonstrate our process of open coding to identify bug categories for software projects.

The first and second author manually inspect individually to identify what issue reports correspond to bugs. We record agreement rate and Cohen’s Kappa [Cohen \(1960\)](#) between the first and second author. Disagreements between the first and second author is resolved through discussions. The process is subjective and susceptible to the bias of the first and second author. We mitigate the bias by using an additional rater, who inspected randomly inspected 100 issue reports and classified them as bug reports and non-bug reports. The additional rater is the fourth year PhD candidate at Tennessee Technological University who is also involved in rater verification for RQ1.

- *Step#2-Open coding:* We apply open coding [Saldana \(2015\)](#) on the content of the collected bug reports from *Step#1*. Our open coding process is illustrated in Figure 4 using an example. First, we extract raw text from bug report titles and description, from which we generate initial categories. Next, we merge initial categories based on the commonalities and generate categories. Similar to deriving project categories, the first and second author separately apply the process of open coding to generate bug categories. Upon completion of the process we quantify agreement rate and measure Cohen’s Kappa [Cohen \(1960\)](#). For disagreements we conduct discussion. Generated categories upon discussion is considered final.

Methodology to Quantify Bug Category Frequency: We apply the following steps to quantify the frequency of identified bug categories:

- *Step#1-Closed coding:* We apply closed coding [Crabtree and Miller \(1999\)](#) to map each identified category to the bug reports that we study. The first and second author separately apply closed coding for the collected bugs from *Step#1*. Upon completion, we calculate the agreement rate and Cohen’s Kappa [Cohen \(1960\)](#). Disagreements are resolved using discussion.

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