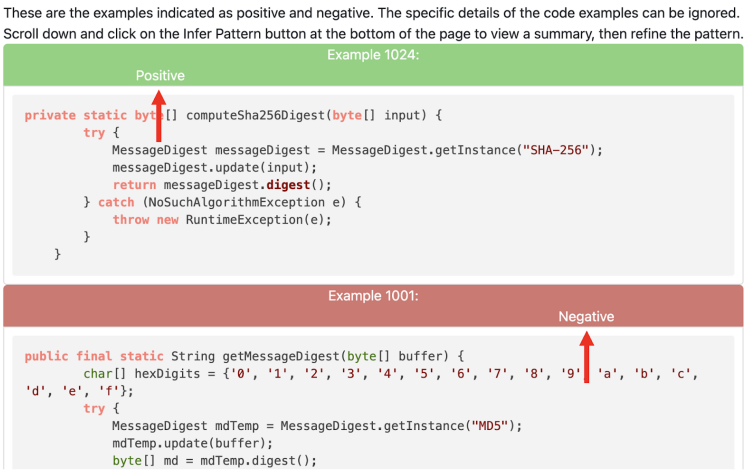
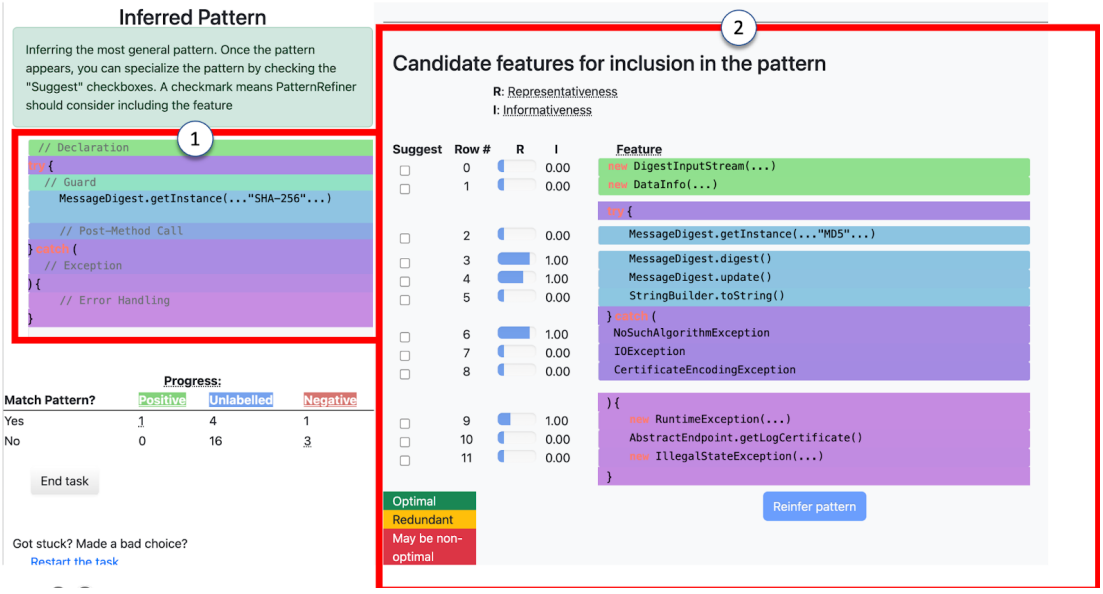
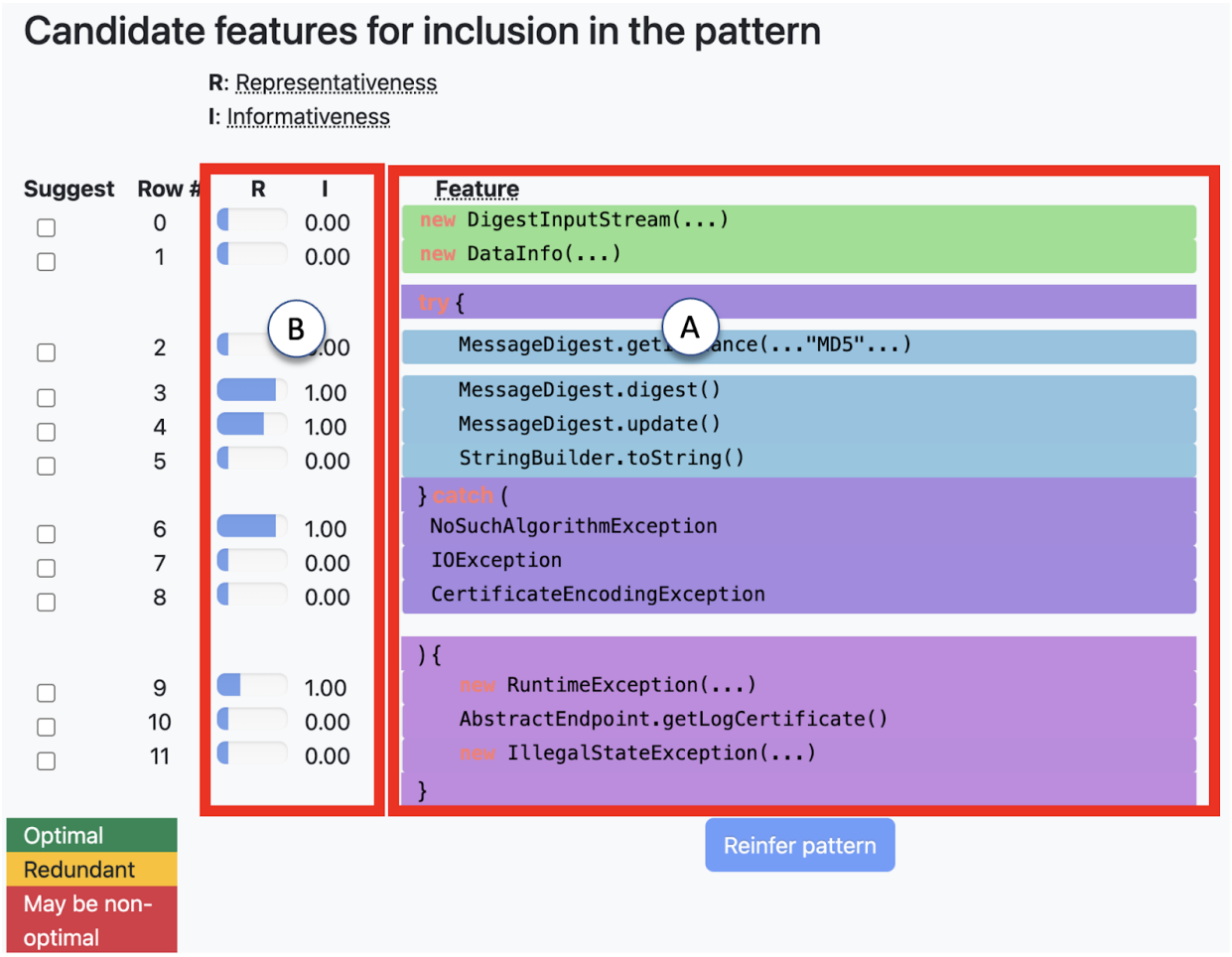
SURF Tutorial

Bootstrapping a pattern. SURF presents examples that have been indicated to be positive (indicated with a green header, e.g. Example 1024) or negative (red header, e.g. Example 1001). Our goal is to find more examples resembling the positive examples as we interactively provide feedback. The details of the API (e.g., its semantics, why is a given usage is misuse, and the consequences of their misuse) **can be ignored**.



Scroll to the bottom of the page and **click** on “Infer Pattern” to find the most general pattern that matches the positive examples. Next, you can **inspect** the most general pattern that matches the positive examples in the left pane, (1), and provide feedback on the features in the right panel, (2). To **provide feedback** to specialize the pattern, **check the suggest checkboxes**. A checkmark means that SURF should consider including this feature after you have clicked on “Reinfer Pattern”.





In the feature feedback pane, the candidate features (A) for inclusion in the pattern are organized as a skeleton, grouped by their relationship (e.g., a guard, exception handling) to the API under analysis.

The features are collected from the entire dataset of examples, and do not necessarily appear in the same examples as one another.

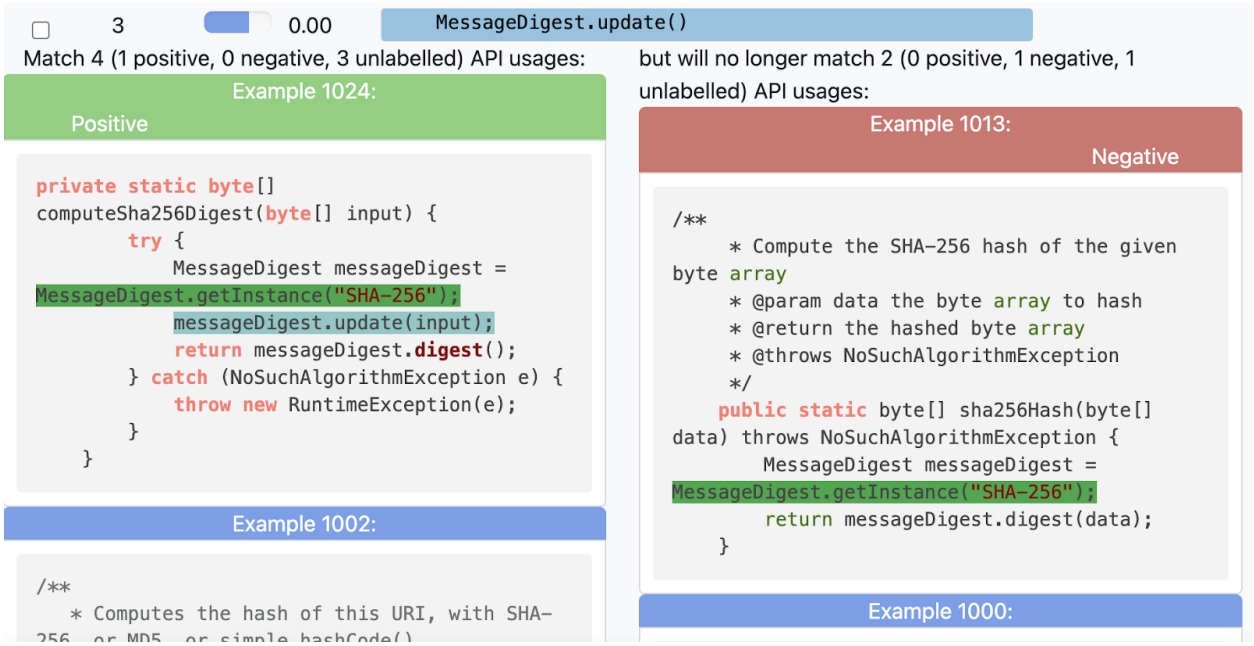
Each feature is displayed with a score indicating their representativeness (R) and informativeness (I):

Representativeness measures how common this feature is in the entire population.

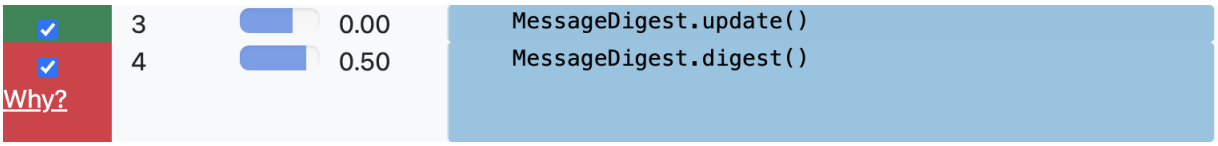
Informativeness measures how well a feature separates the positive examples from negative examples. Higher is better.

There are two additional analyses: 1) **Impact Analysis** and 2)**What-If Analysis**.

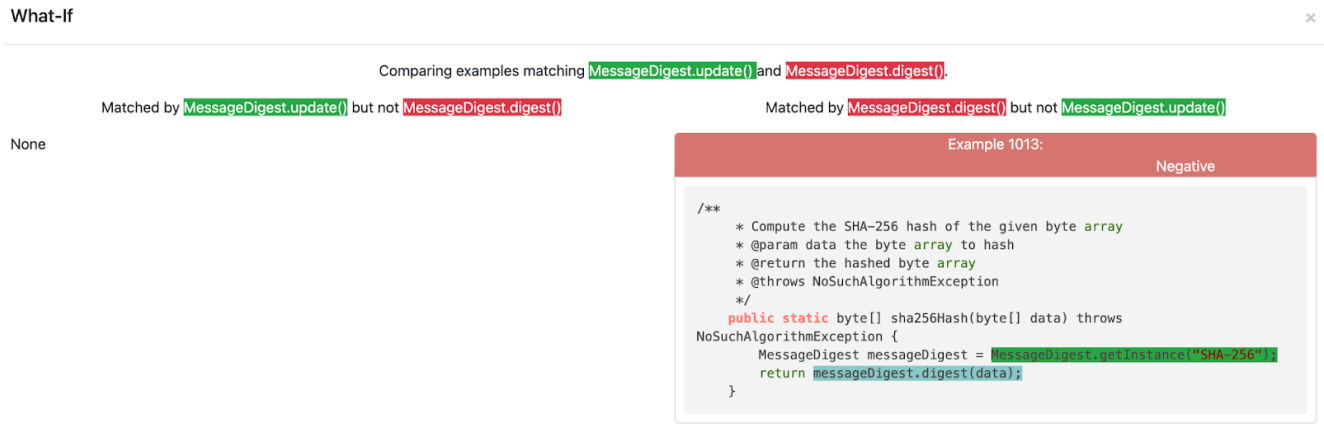
Impact analysis. To understand the impact of including a feature, click its name to expand a panel displaying which examples will match, and which examples will no longer match.



What if analysis. When multiple features are selected, some **may** be redundant. Redundant components are colored yellow or red. To inspect the differences between two components, click on the "Why?" link that may appear under the suggest checkbox.



This brings up a new panel which shows a side-by-side comparison of the examples matched by one feature, but not the other.



Warm up task: Given some positive and negative examples (examples 1024, 1001, 1009, 1013, 1017; Example 1024 is positive, while the rest are negative), **go to PatternRefiner** through the provided URL. Once the examples have loaded, **scroll down** to the bottom of the page and **click "Infer pattern"**. Now **wait** as SURF infers a pattern that matches the positive examples.

On the left pane, you can view the pattern inferred by SURF. Initially, this pattern is "`MessageDigest.getInstance(...`"`SHA-256`"`)`". Examples matching this pattern instantiates MessageDigest through the `getInstance()` method with "`SHA-256`" as an argument.

This pattern is a starting point for analyzing the matching examples. The right panel now shows possible features for inclusion in the pattern. To answer questions that require you list examples, identify them by their IDs, e.g. 1024.

1. On the right panel, **click** on the suggestion checkbox for `MessageDigest.update()`, and `MessageDigest.digest()`. (typically, they are found between **Rows 4--6**)
   After PatternRefiner has performed its computations in the background, click on "Why?" under the checkbox in **Row 6** to bring up the What-If Analysis. **Which negative examples** call `MessageDigest.digest()` but do not call `MessageDigest.update()`?

2. **Close** the What-If Analysis from Question 1. **Uncheck** the rows from Step 1.

   Click on the text "`new RuntimeException(...)`" to expand the Impact Analysis panel, which displays the examples matched and not matched by the feature. **Which** positive example **constructs** a `RuntimeException`? (i.e., has "`new RuntimeException(...)`")

3. **Close** the Impact Analysis Panel from Question 2 by clicking on the text "`new RuntimeException(...)`" in **Row 11.**
   You can see the exceptions handled among the examples matching the pattern (usually in **Rows 8-10**, under the "`catch (`"**)**. Judging by the **informativeness** of the exception-handling features, **can at least one pair of** positive and negative examples be distinguished from one another if the pattern included `NoSuchAlgorithmException` (i.e., is its informativeness greater than 0)?

4. **Click** on the text NoSuchAlgorithmException, in **Row 8**. This expands the impact analysis panel, which displays the examples matched and not matched. **Which** unlabelled examples match NoSuchAlgorithmException?

Finally, to **reinfer** the pattern with your feedback on which feature to include,

5. **Close** the Impact Analysis Panel from Question 4.
   Given that we wish to focus on examples that catch the **same exceptions** as the given positive examples, **click** the suggest checkbox of the exception with the **highest informativeness**, and **click** on "Reinfer Pattern". After the pattern has been updated, **click** on "End Task" (on the left panel).