Technical Report

Xunhui Zhang, Ayushi Rastogi, Yue Yu

March 21, 2021

This is the technical report for MSR 2020 data showcase paper "On the Shoulders of Giants: A New Dataset for Pull-based Development Research".

1 Data Distribution

1.1 Categorical Metrics

1.1.1 Binary Metrics

Figure 1 shows the data distribution of binary metrics, and Table 1 presents the proportion of each level.

Table 1: Proportion of each binary categorical feature

Feature	Proportion	Feature	Proportion
same_country	True(81.7%); False(18.3%)	same_affiliation	True(90.4%); False(9.6%)
contrib_gender	Male(90.2%); Female(9.8%)	test_inclusion	True(19.5%); False(80.5%)
contrib_follow_integrator	True(7.1%); False(92.9%)	first_pr	True(14.3%); False(85.7%)
comment_conflict	True(1.2%); False(98.8%)	core_member	True(67.9%); False(32.1%)
ci_test_passed	True(69%); False(31%)	ci_exists	True(74.7%); False(25.3%)
ci_first_build_status	Success(75.5%); Failure(24.5%)	bug_fix	True(61.5%); False(38.5%)
ci_last_build_status	Success(87.9%); Failure(12.1%)	hash_tag	True(21.6%); False(78.4%)
at_tag	True(20.5%); False(79.5%)		

1.1.2 Multi-level Metrics

Figure 2 shows the data distribution of multi-level categorical metrics. For *contrib_country*, *inte_country*, *contrib_affiliation* and *inte_affiliation*, we show the top 6 factors, and treat other factors as *others*. Table 2 shows the proportion of each level.

1.2 Continuous Metrics

Figure 3, 4, 5, 6 show the data distribution of continuous metrics with square root scale.

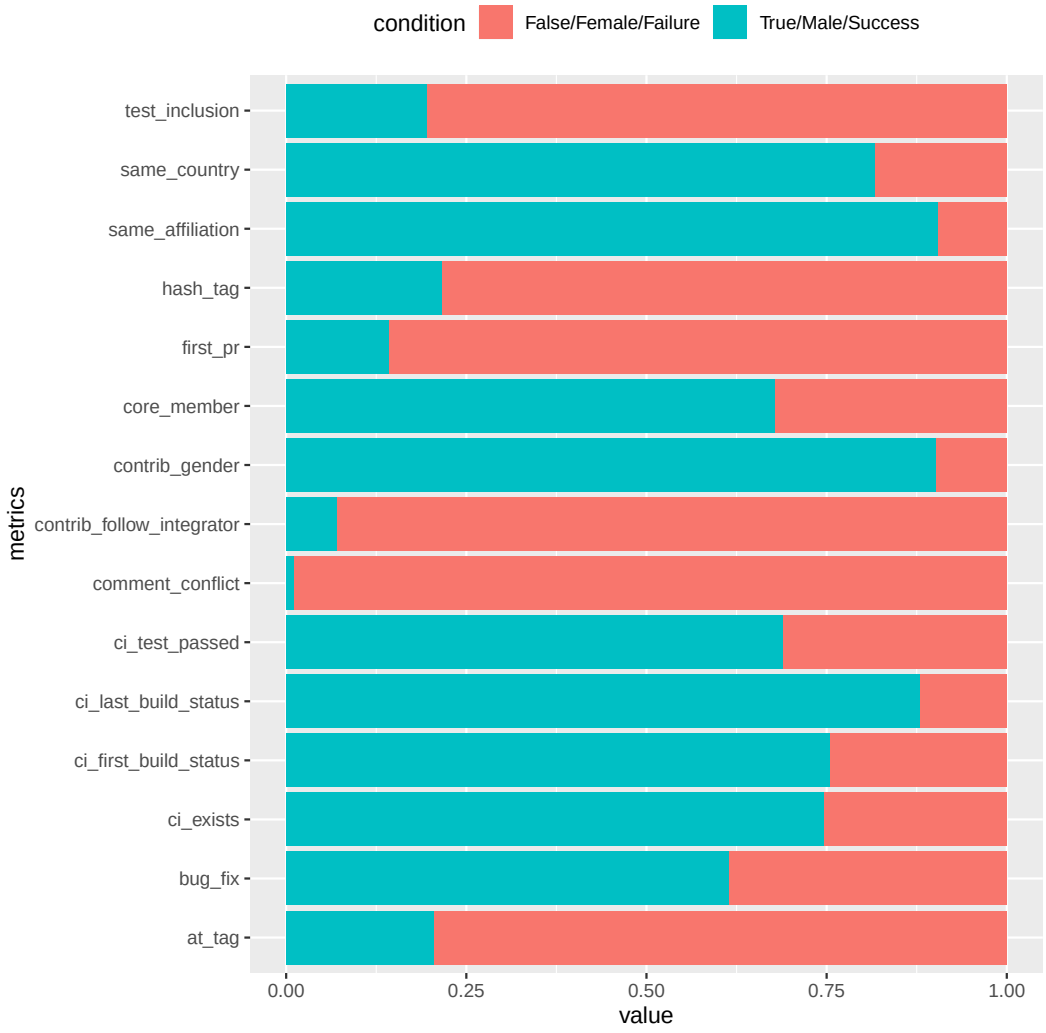
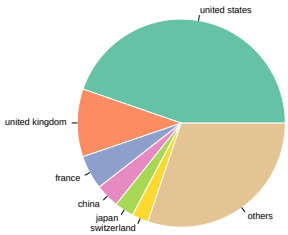


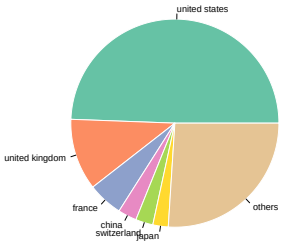
Figure 1: The distribution of dichotomous metrics

Table 2: Proportion of each multi-level categorical feature

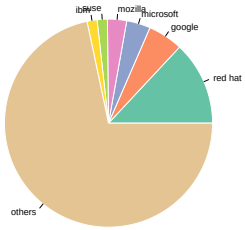
Feature	Proportion
contrib_country	US(44.7%); UK(10.6%); France(5.3%); China(3.7%); Japan(3.0%); Switzerland(2.6%); others(30.1%)
inte_country	US(49.4%); UK(11.1%); France(5.5%); China(2.9%); Switzerland(2.7%); Japan(2.4%); others(26.0%)
contrib_affiliation	red hat(13.2%); Google(5.5%); Microsoft(3.7%); Mozilla(3.0%); SUSE(1.6%); IBM(1.6%); others(71.4%)
inte_affiliation	red hat(12.8%); Google(5.6%); Microsoft(4.1%); Mozilla(3.8%); Facebook(1.8%); SaltStack(1.7%); others(70.2%)
contrib_first_emo	negative(8.5%); positive(15.4%); neutral(76.1%)
inte_first_emo	negative(5.5%); positive(26.8%); neutral(67.7%)
language	JavaScript(29.7%); Python(27.6%); Java(19.5%); Ruby(11.1%); Go(8.4%); Scala(3.7%)



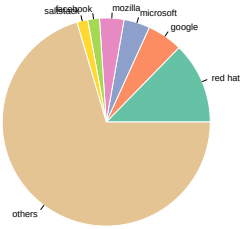
(a) contrib_country



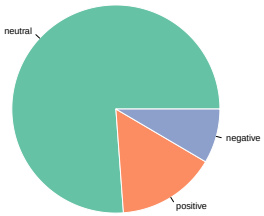
(b) inte_country



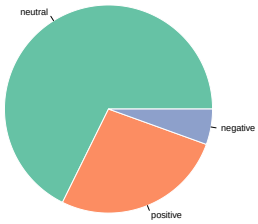
(c) contrib_affiliation



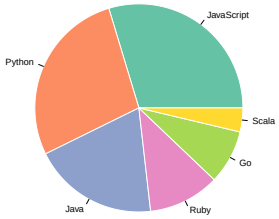
(d) inte_affiliation



(e) contrib_first_emo

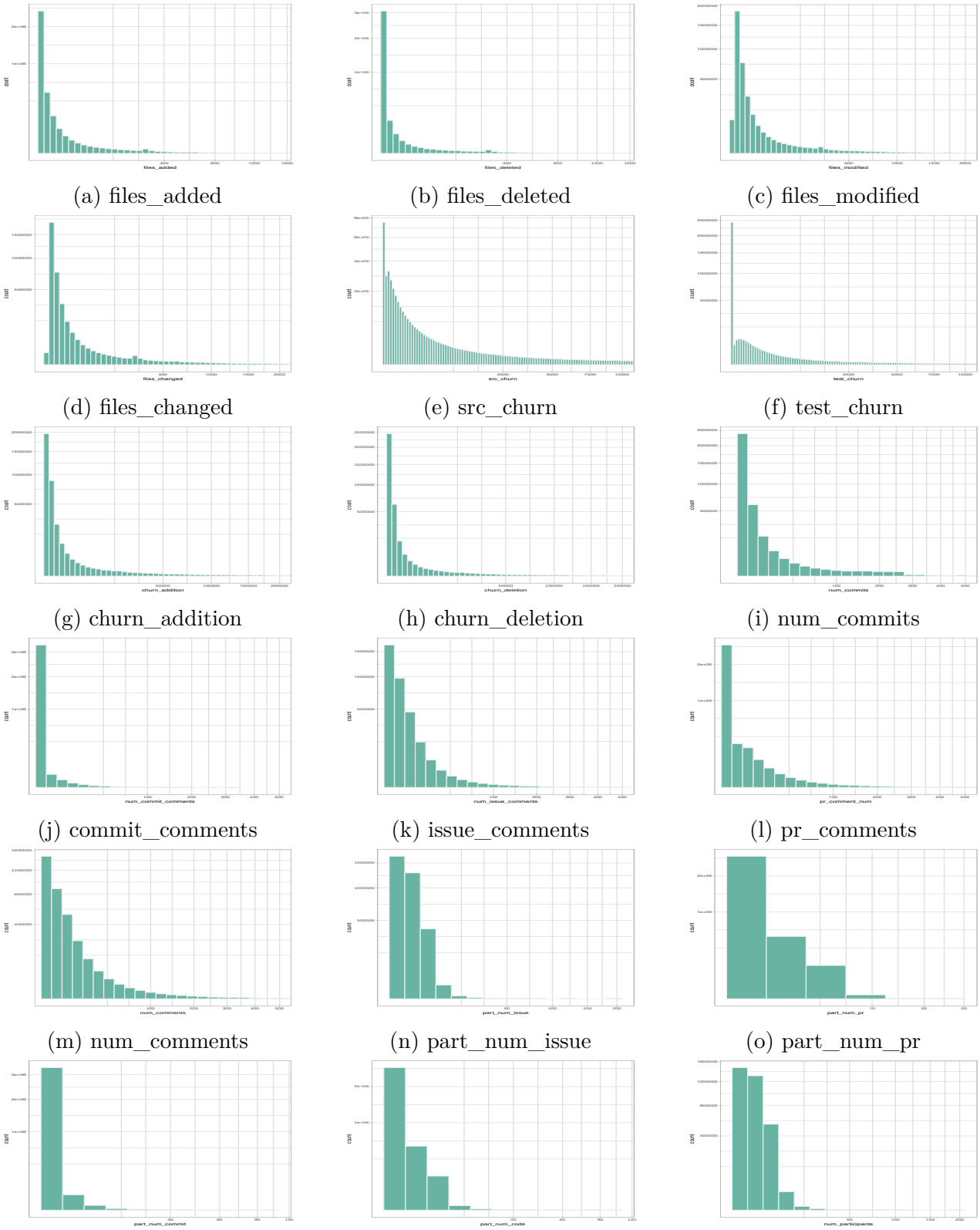


(f) inte_first_emo



(g) language

Figure 2: The distribution of multi-level categorical metrics



(a) files_added (b) files_deleted (c) files_modified

(d) files_changed (e) src_churn (f) test_churn

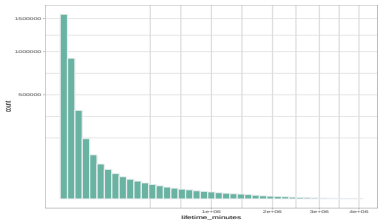
(g) churn_addition (h) churn_deletion (i) num_commits

(j) commit_comments (k) issue_comments (l) pr_comments

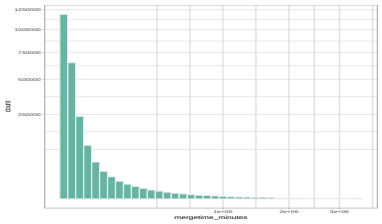
(m) num_comments (n) part_num_issue (o) part_num_pr

(p) part_num_commit (q) part_num_code (r) num_participants

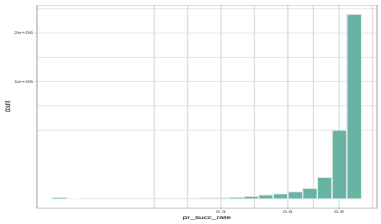
Figure 3: The distribution of continuous metrics



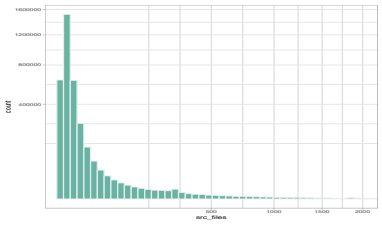
(a) lifetime_minutes



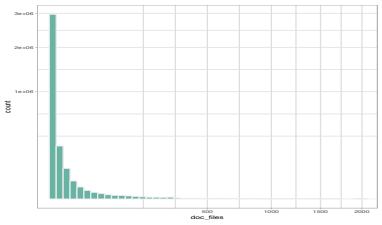
(b) mergetime_minutes



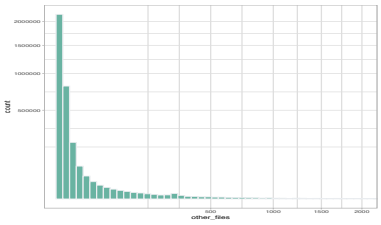
(c) pr_succ_rate



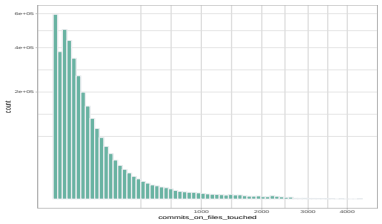
(d) src_files



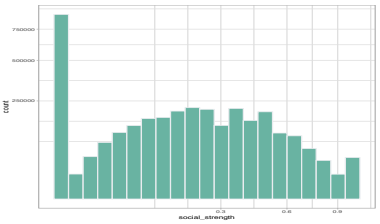
(e) doc_files



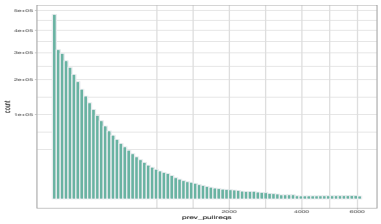
(f) other_files



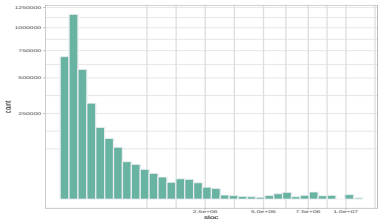
(g) files_touched



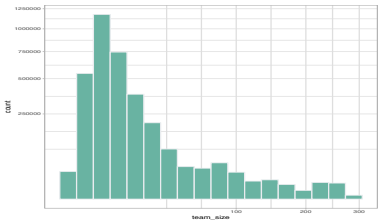
(h) social_strength



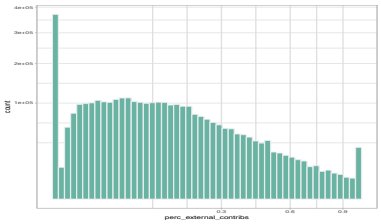
(i) prev_pullreqs



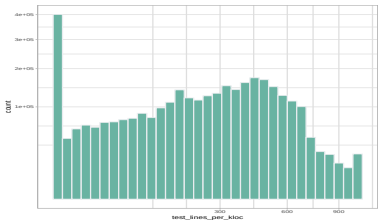
(j) sloc



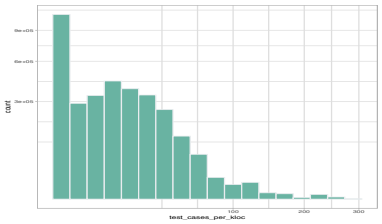
(k) team_size



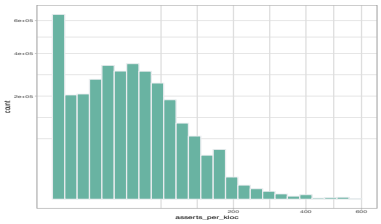
(l) perc_external_contribs



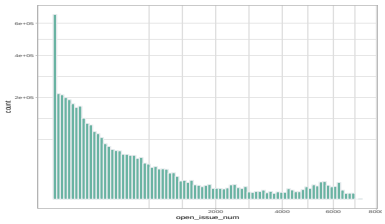
(m) test_lines_per_kloc



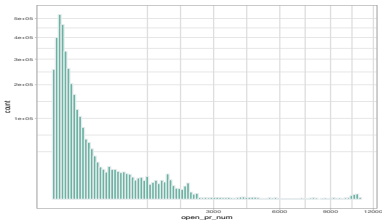
(n) test_cases_per_kloc



(o) asserts_per_kloc



(p) open_issue_num



(q) open_pr_num

Figure 4: The distribution of continuous metrics

(a) watchers (b) fork_num (c) project_age

(d) pushed_delta (e) description_length (f) ci_latency

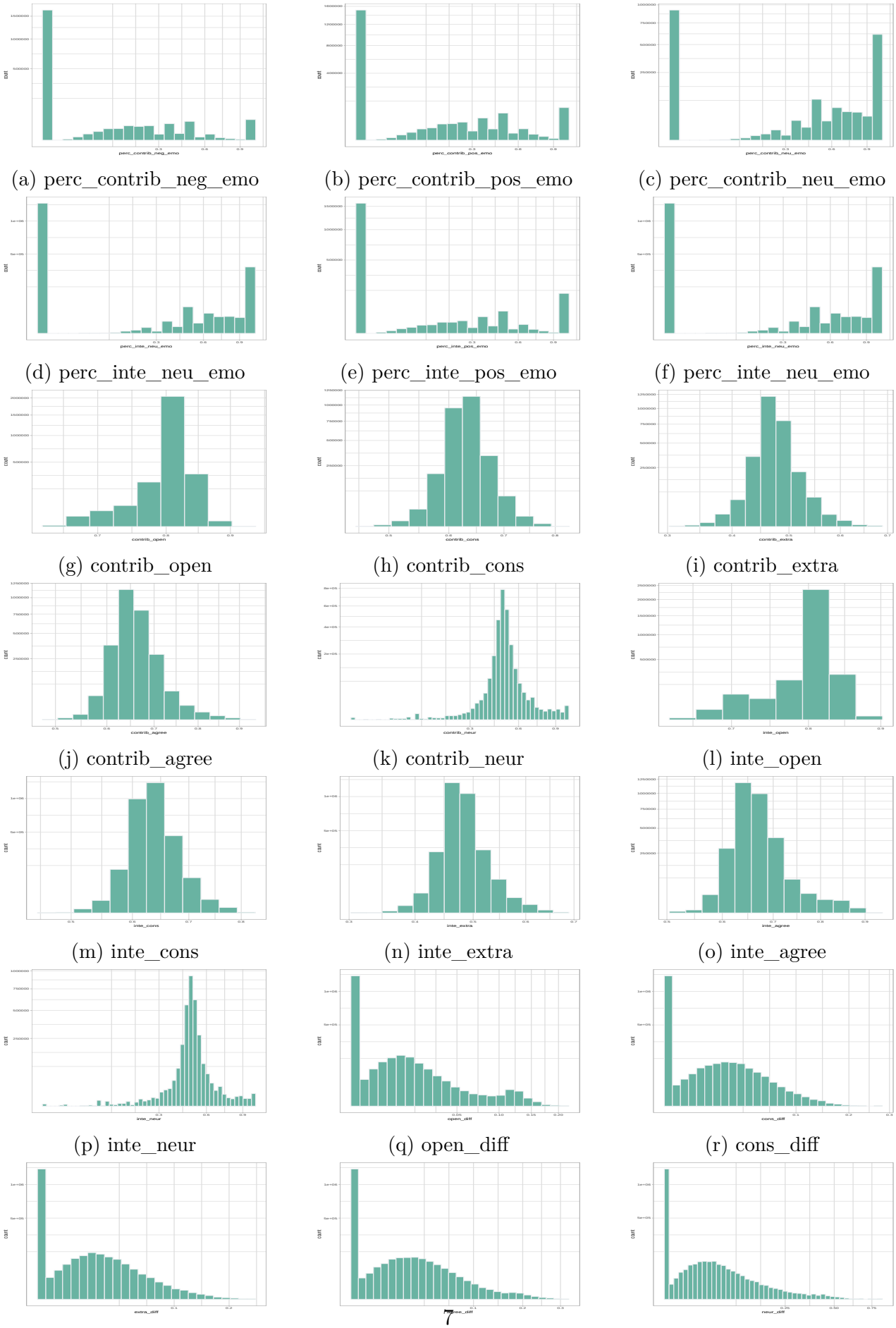
(g) ci_build_num (h) ci_failed_perc (i) perc_neg_emotion

(j) perc_pos_emotion (k) perc_neu_emotion (l) first_response_time

(m) acc_commit_num (n) account_creation_days (o) prior_review_num

(p) prior_interaction (q) requester_succ_rate (r) followers

Figure 5: The distribution of continuous metrics



(a) perc_contrib_neg_emo (b) perc_contrib_pos_emo (c) perc_contrib_neu_emo

(d) perc_inte_neu_emo (e) perc_inte_pos_emo (f) perc_inte_neu_emo

(g) contrib_open (h) contrib_cons (i) contrib_extra

(j) contrib_agree (k) contrib_neur (l) inte_open

(m) inte_cons (n) inte_extra (o) inte_agree

(p) inte_neur (q) open_diff (r) cons_diff

(s) extra_diff (t) agree_diff (u) neur_diff

Figure 6: The distribution of continuous metrics

2 Correlations

Here in this section, we present the correlations between each pair of factors.

2.1 Continuous Factors

The correlations between continuous factors are shown in Figure 7, 8, and 9, among which Figure 7 shows the stong correlation (ρ>0.7). Figure 8 shows the moderate correlation (0.3 <= ρ <= 0.7). Figure 9 shows the weak correlation (ρ < 0.3).

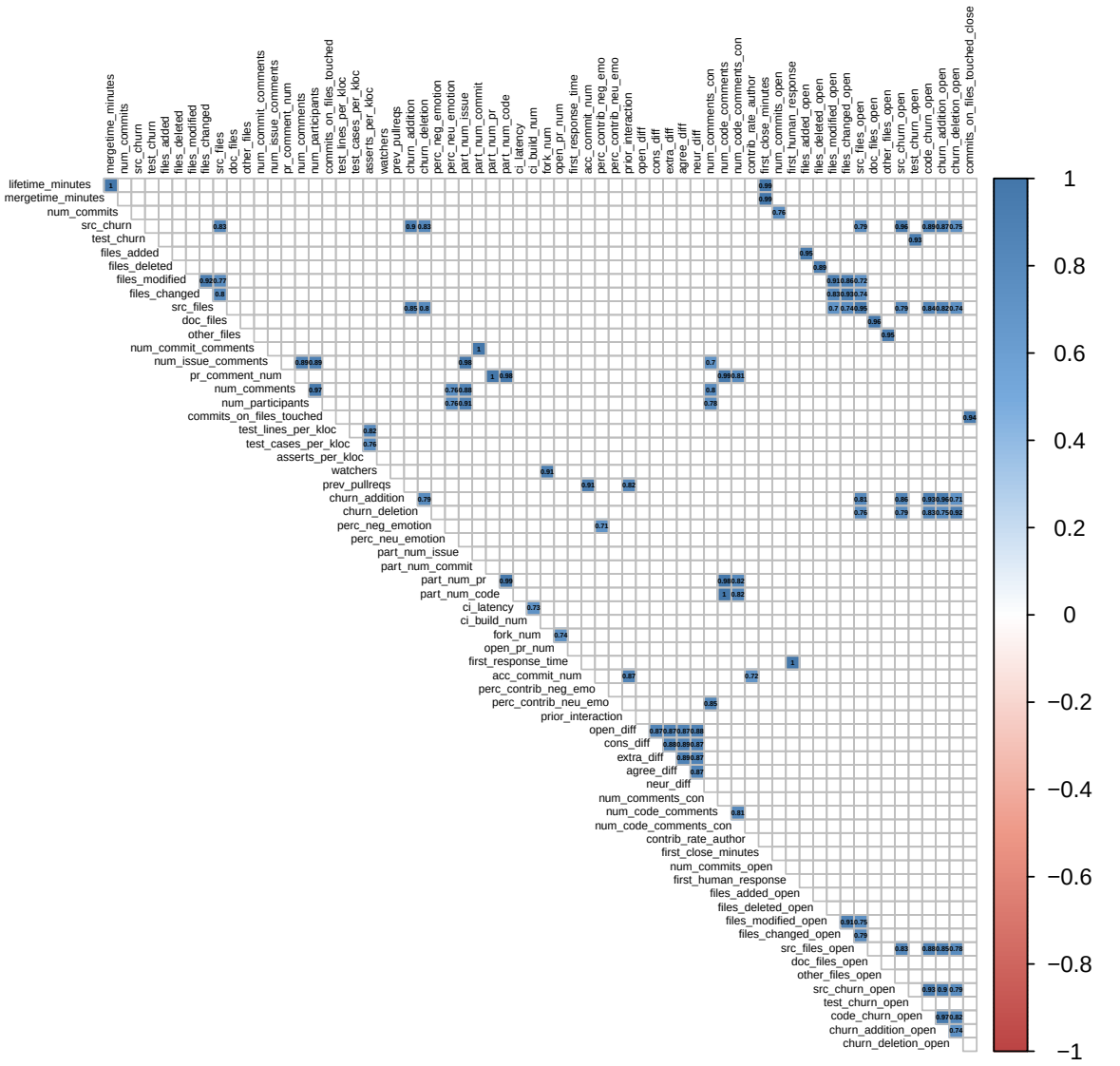


Figure 7: The strongly correlated continuous factors

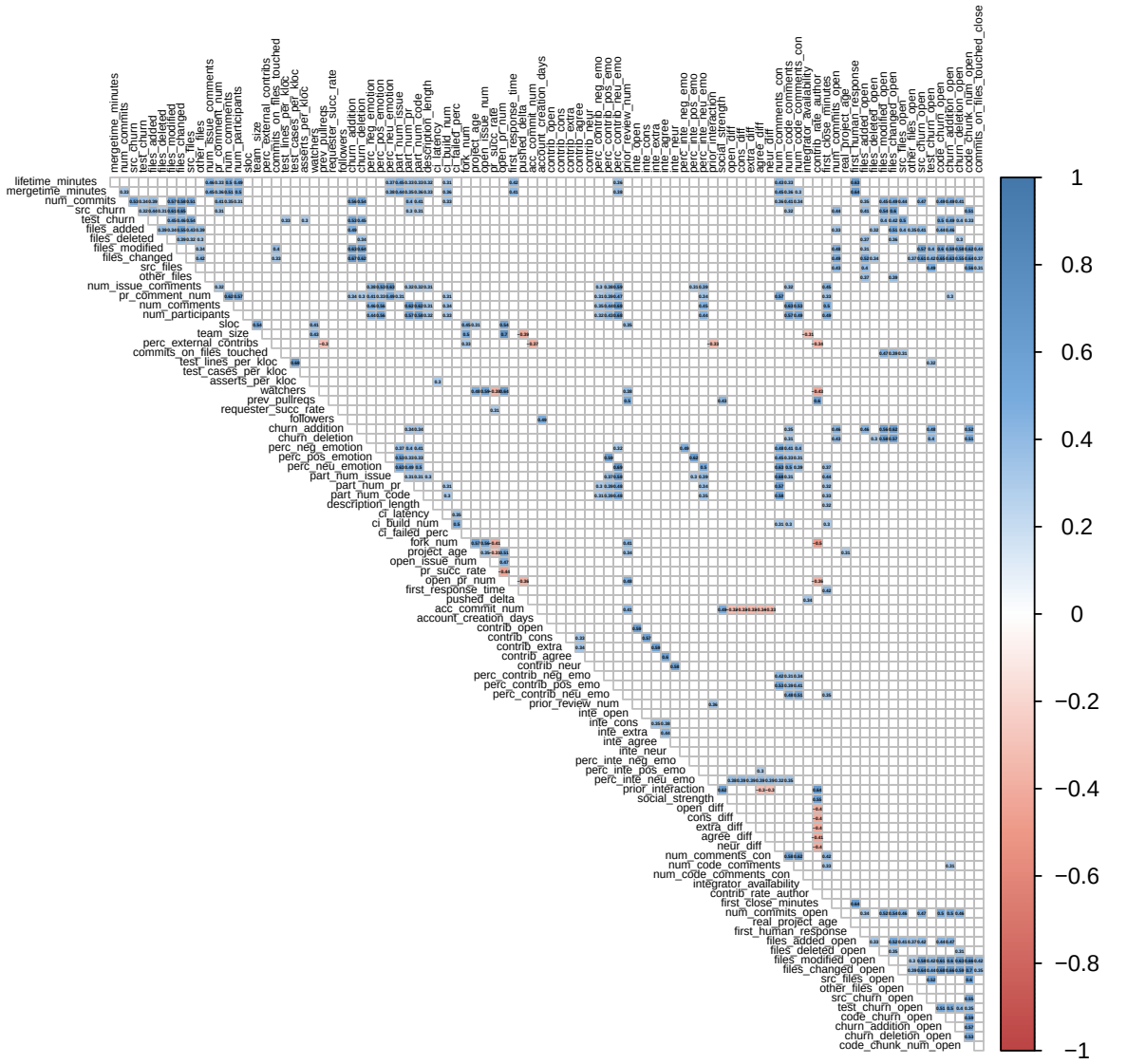


Figure 8: The moderately correlated continuous factors

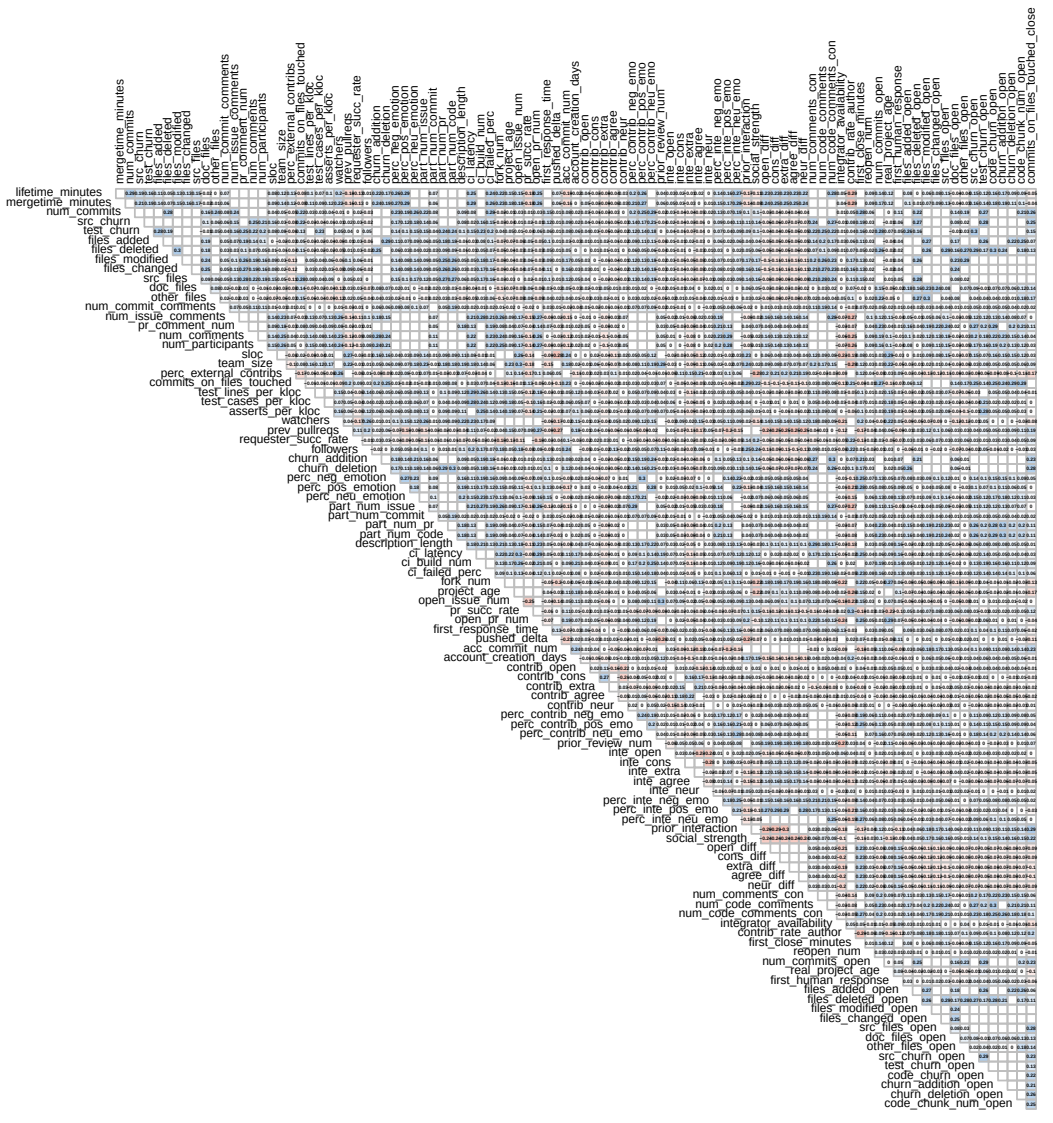


Figure 9: The weakly correlated continuous factors

2.2 Categorical Factors

The correlations between categorical factors are shown in Figure 10, 11, and 12, among which Figure 10 shows the stong correlation ($\phi > \frac{0.5}{df}$). Figure 11 shows the moderate correlation ($\frac{0.3}{df} <= \phi <= \frac{0.5}{df}$). Figure 12 shows the weak correlation ($\phi < \frac{0.3}{df}$).

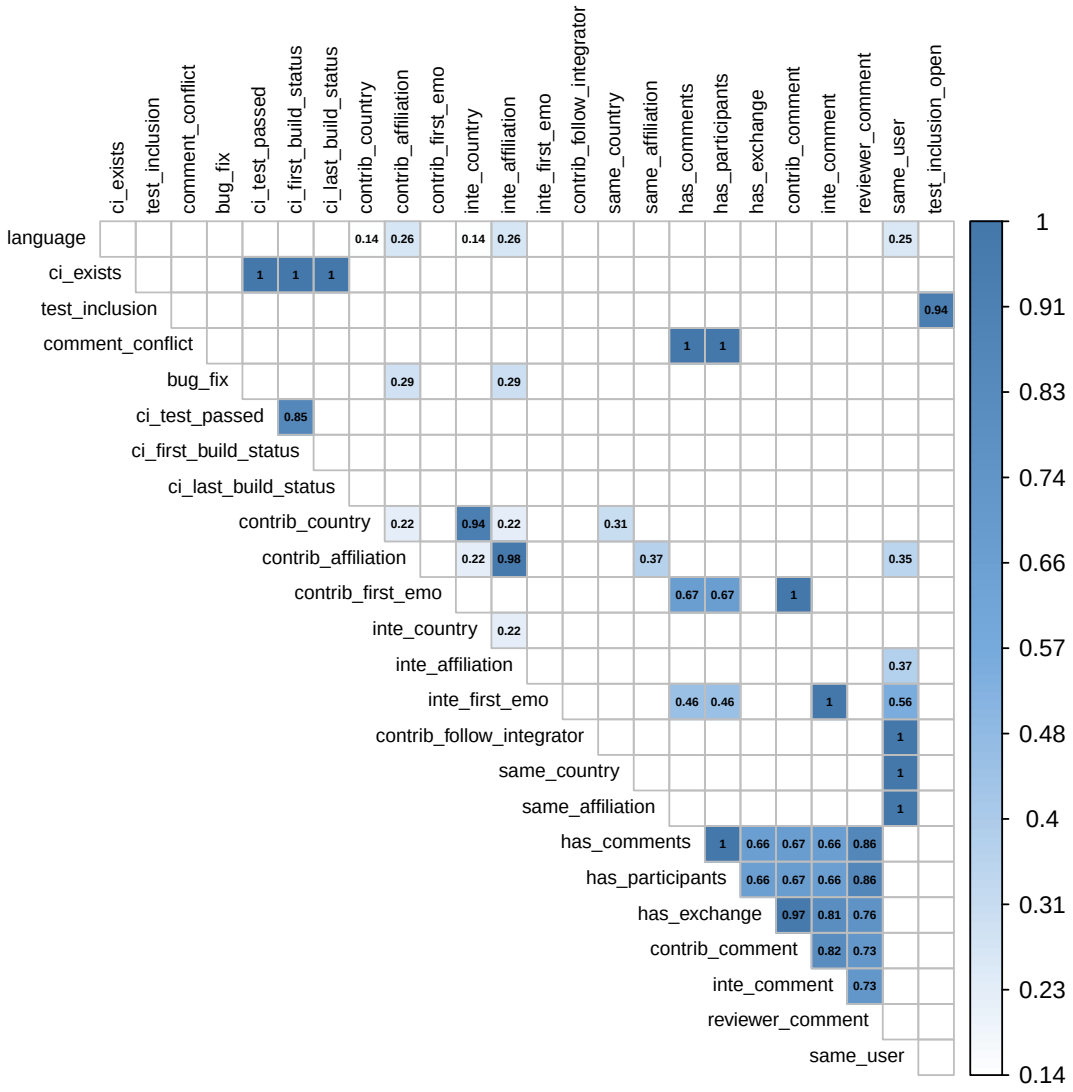


Figure 10: The strongly correlated categorical factors

2.3 Continuous & Categorical Factors

The correlations between continuous and categorical factors are shown in Figure 13, 14, and 15, among which Figure 13 shows the stong correlation ($\chi^2 > 0.14$). Figure 14 shows the moderate correlation ($0.01 <= \chi^2 <= 0.14$). Figure 15 shows the weak correlation ($\chi^2 < 0.01$).

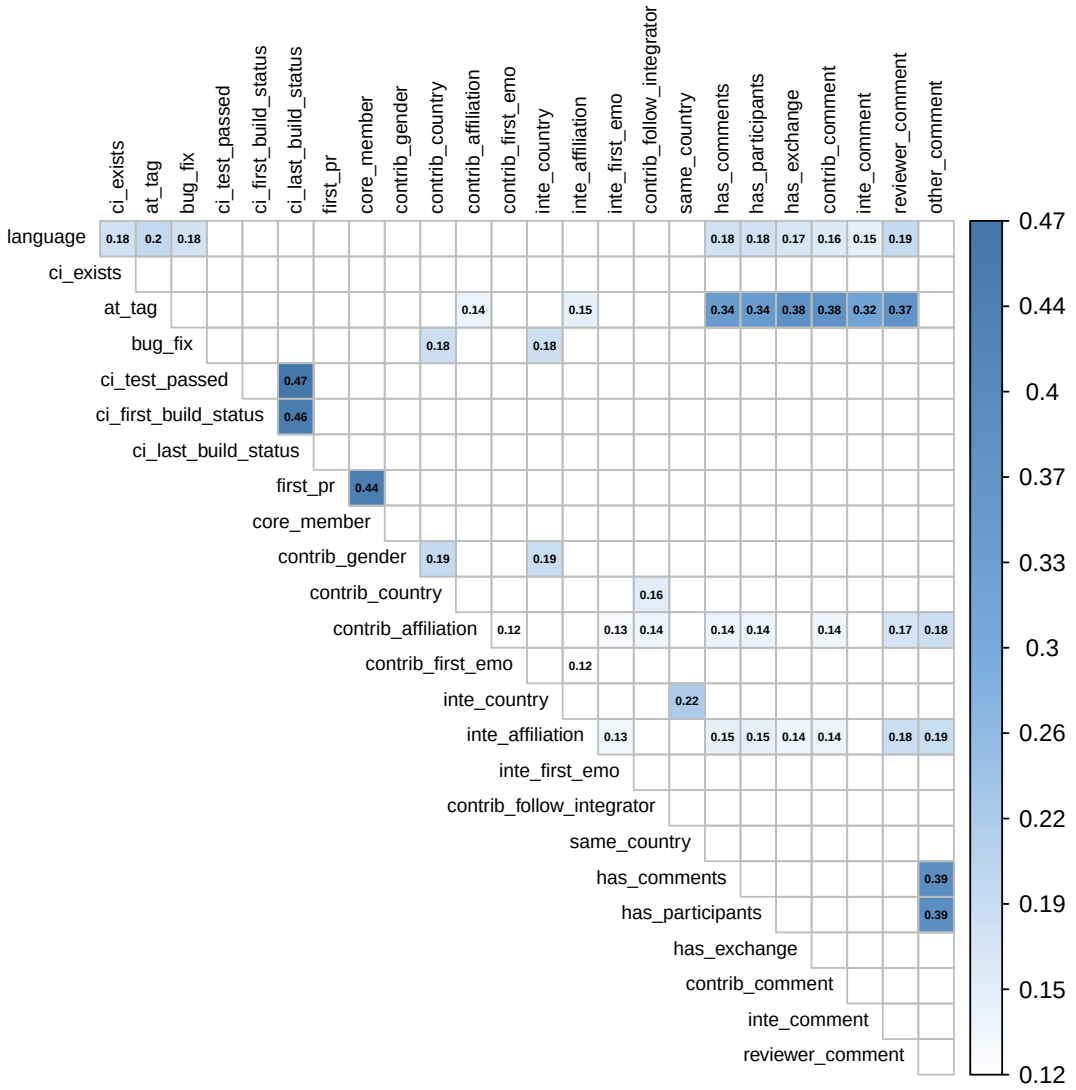


Figure 11: The moderately correlated categorical factors

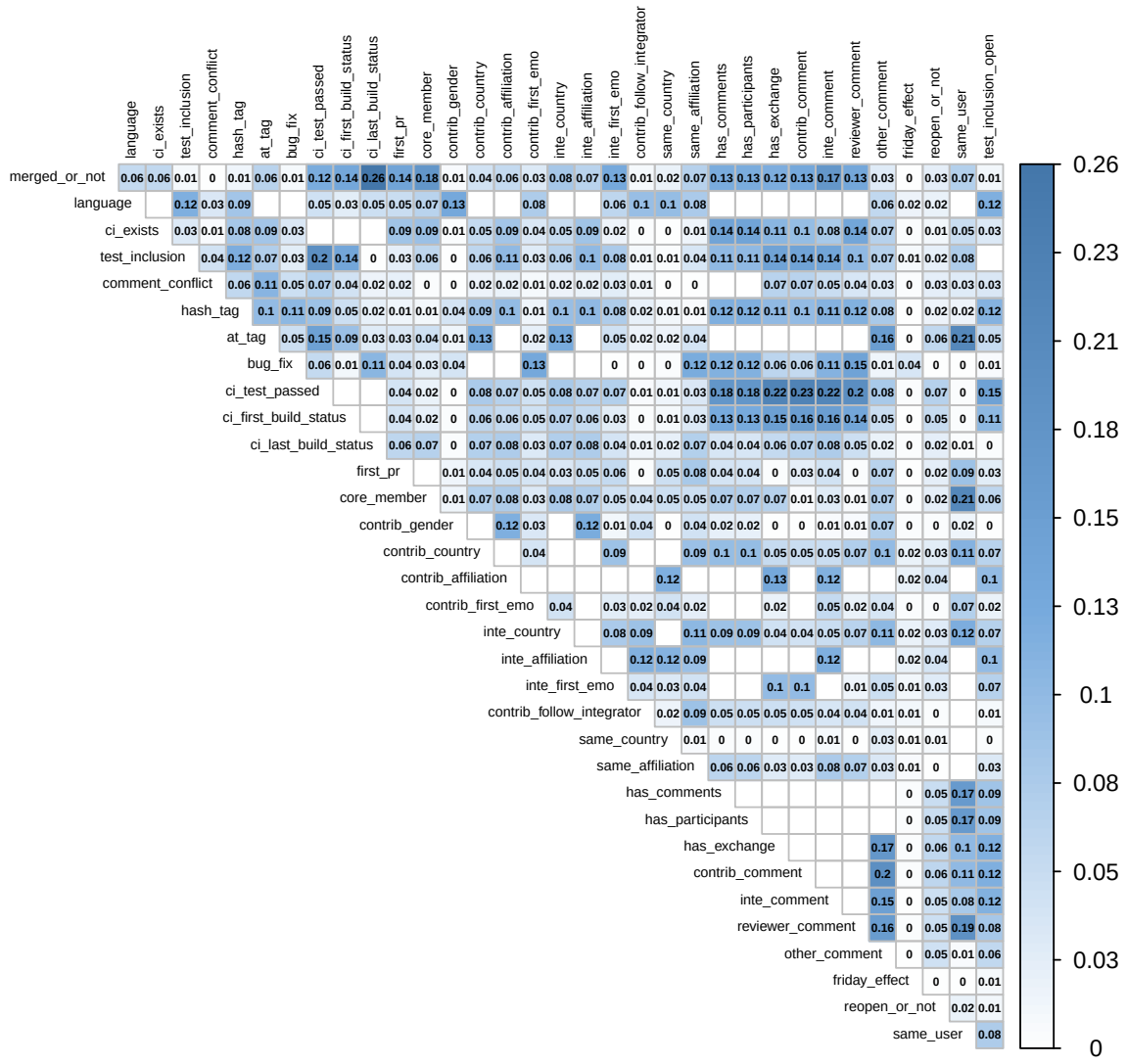


Figure 12: The weakly correlated categorical factors

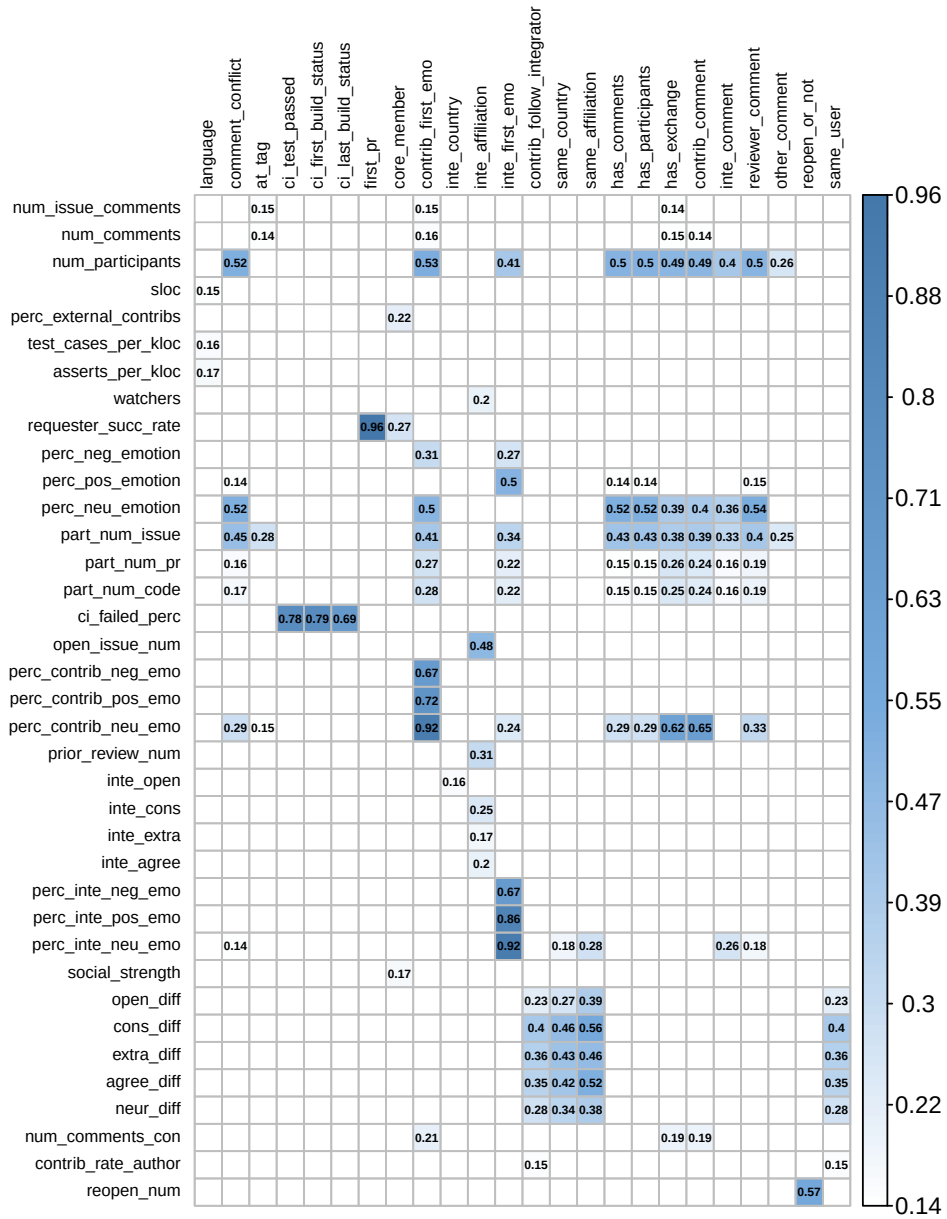


Figure 13: The strongly correlated continuous and categorical factors

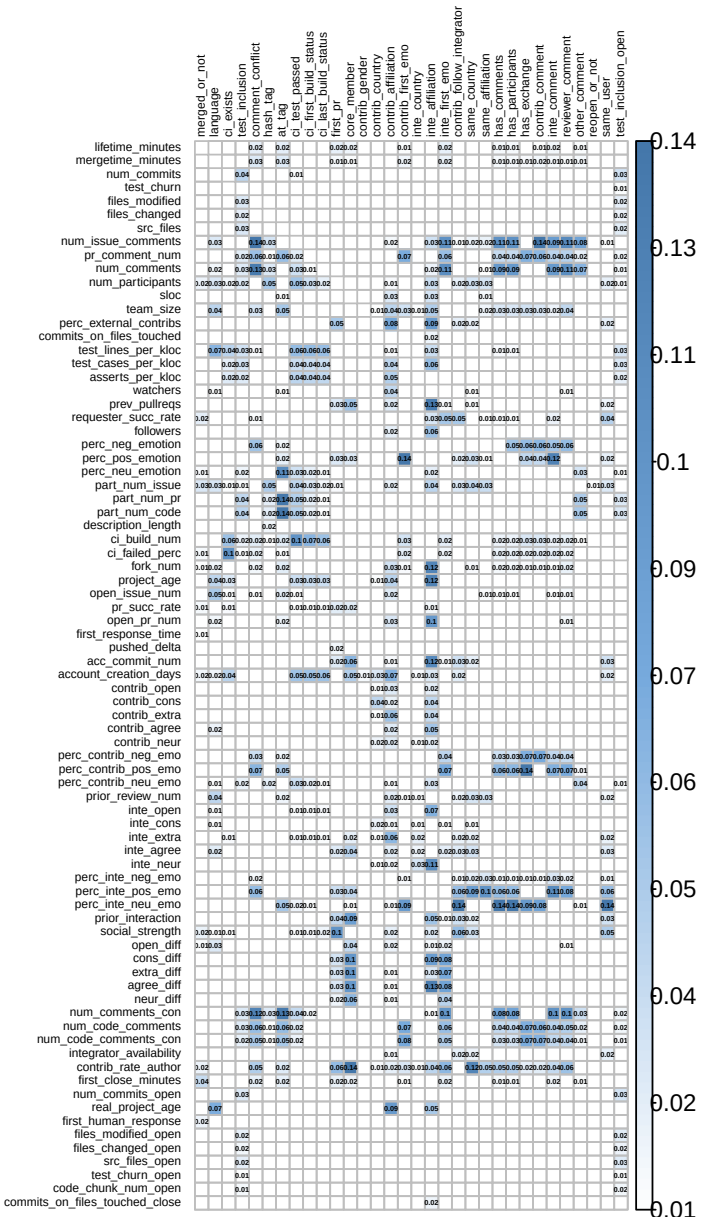


Figure 14: The moderately correlated continuous and categorical factors

Figure 15: The weakly correlated continuous and categorical factors

3 Special Case

3.1 ci_latency

There are some special cases for factor `ci_latency`, where some values are negative. After searching the results, we found that it's because some of the commits are already added before the creation of pull request. Here is an example.

For this pull request https://github.com/steemit/condenser/pull/3282, according to the API of Github (Fig 16), the time of creation is 2019-04-24 15:57:04. However, if we have a


```
{
  "url": "https://api.github.com/repos/steemit/condenser/pulls/3282",
  "id": 273196857,
  "node_id": "MDExOlBlbGxSZXF1ZXN0MjczMTk2ODU3",
  "html_url": "https://github.com/steemit/condenser/pull/3282",
  "diff_url": "https://github.com/steemit/condenser/pull/3282.diff",
  "patch_url": "https://github.com/steemit/condenser/pull/3282.patch",
  "issue_url": "https://api.github.com/repos/steemit/condenser/issues/3282",
  "number": 3282,
  "state": "closed",
  "locked": false,
  "title": "Community - Show Steemit logo instead of text on 404 not found",
  "user": {
    "login": "roadscape",
    "id": 5168676,
    "node_id": "MDQ6VXNlcjUxNjg2NzY=",
    "avatar_url": "https://avatars2.githubusercontent.com/u/5168676?v=4",
    "gravatar_id": "",
    "url": "https://api.github.com/users/roadscape",
    "html_url": "https://github.com/roadscape",
    "followers_url": "https://api.github.com/users/roadscape/followers",
    "following_url": "https://api.github.com/users/roadscape/following{/other_user}",
    "gists_url": "https://api.github.com/users/roadscape/gists{/gist_id}",
    "starred_url": "https://api.github.com/users/roadscape/starred{/owner}{/repo}",
    "subscriptions_url": "https://api.github.com/users/roadscape/subscriptions",
    "organizations_url": "https://api.github.com/users/roadscape/orgs",
    "repos_url": "https://api.github.com/users/roadscape/repos",
    "events_url": "https://api.github.com/users/roadscape/events{/privacy}",
    "received_events_url": "https://api.github.com/users/roadscape/received_events",
    "type": "User",
    "site_admin": false
  },
  "body": "From @economicstudio #3202:\r\n> Close #3201 \r\n> \r\n> Currently, 404 n
  "created_at": "2019-04-24T15:57:04Z",
  "updated_at": "2019-04-25T13:34:38Z",
  "closed_at": "2019-04-24T16:54:01Z",
  "merged_at": "2019-04-24T16:54:00Z",
  "merge_commit_sha": "7f943f278fbaf53c6e5dc97cc7ba8f3af785af98",
```


Figure 16: The creation time according to Github API

look at the web page, we can see that there are already some commits before the creation of this pull request (Fig 17).

After we get the build results from CircleCI API, we see that some builds are finished before the creation of this pull request (Fig 18).

The reason is that before the creation of this pull request, developers created another pull request but closed by the reviewer. However they create this new pull request with the same commits.

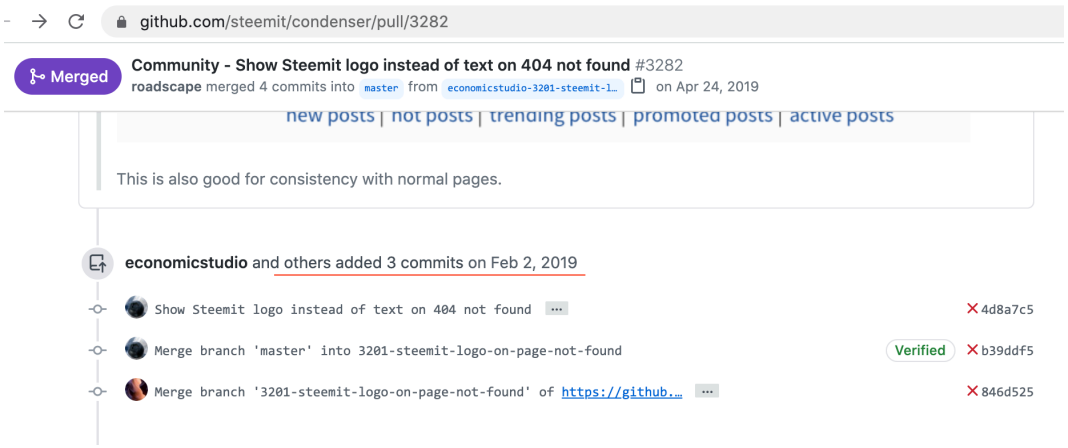


Figure 17: The commit time according to Github web page

Clear | Apply

id	project_id	ownername	reponame	started_at	finished_at	duration	status
7180288	57786306	steemit	condenser	2019-04-24 20:55:30	2019-04-24 21:01:12	342	success
7180301	57786306	steemit	condenser	2019-04-24 16:54:06	2019-04-24 17:00:08	361	success
7180310	57786306	steemit	condenser	2019-04-24 15:56:31	2019-04-24 16:02:19	348	success
7180426	57786306	steemit	condenser	2019-03-05 16:40:49	2019-03-05 16:47:55	425	success
7180595	57786306	steemit	condenser	2019-02-02 12:56:10	2019-02-02 13:01:49	339	failed
7180596	57786306	steemit	condenser	2019-02-02 12:50:15	2019-02-02 12:56:08	352	success
7180597	57786306	steemit	condenser	2019-02-02 12:50:16	2019-02-02 12:55:31	314	success

Figure 18: The build results according to CircleCI API

3.2 first_response_time

There are also some special cases for factor `first_response_time`, where some values are negative. The reason is that we treat not only the issue comment as response, but also commit comments and pull request comments.

However, there are some cases where some commits are already created before the creation of the pull request, and reviewers can comment on it. For example, this pull request https://github.com/scala/scala/pull/4500, it has 55 commits. Among all these commits, commit `6f0e4c64017e6504a3c8017a9322b5edbf73b79a` get a comment before the creation (2015-05-12 15:38:17) of this pull request (Fig 19).

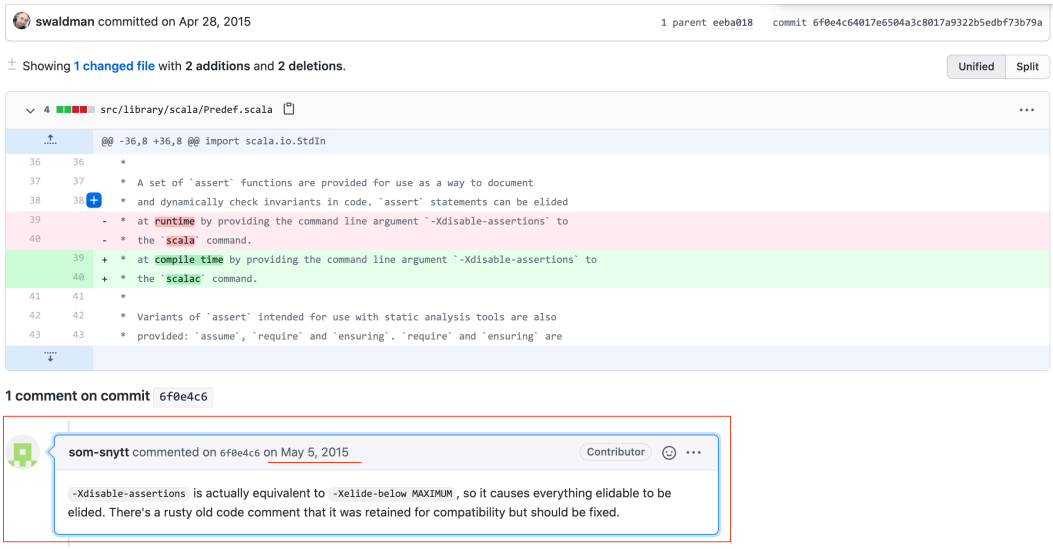


Figure 19: The commit comment of pull request

3.3 account_creation_days

There are also some special cases for factor `account_creation_days`, where some values are negative. The reason is because of the difference of GHTorrent and Github API. For example, user with id 5129982 in GHTorrent's users table, we find that the "created_at" column is different from the result shown on Github API [1].

[1] https://api.github.com/users/sandeepraparthi

3.4 project_age

There are also some special cases for factor `project_age`, where some values are negative. The reason is also because of the difference of GHTorrent and Github API. For example, the "created_at" column in project "geometalab/osmaxx" in GHTorrent (MySQL version) is different from the result shown on Github API [2]

[2]https://api.github.com/repos/geometalab/osmaxx