Fortifying R/GitHub Integration

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The Problem/Motivation:

CRAN is a remarkable resource. It is a trusted repository of tested and peer-reviewed R packages that is fundamentally essential to the R community. It is not the only source of R packages however. The inevitable trade-off for having entry requirements to CRAN is that development of packages occurs elsewhere. At present, GitHub is serving as a similarly valuable resource for R packages, but with no barrier to entry. The downside being that packages may contain any combination of: fatal bugs, malicious code (intentional or innocent), and incorrect/out of date/missing documentation, and these packages may change at a moment's notice. At present, the onus lies entirely with users to manage this.

Despite best practices (such as the R Consortium guidelines) recommending only securely connecting to CRAN mirrors, GitHub is undeniably being used as an alternative host for R packages. The prevalence of this is highlighted by examining the top 50 most downloaded packages from the RStudio CRAN mirror. During January of 2016, 38 of the top 50 most downloaded packages had an available GitHub repository (refer Fig. 1, not including the read-only mirror).

GitHub serves as an extremely useful tool for developing R packages, providing both a mechanism for version control and a system for reporting issues, and users should not be discouraged from interacting with the wider open-source community because R is not able to securely load code from GitHub. Futhermore, GitHub packages have an advantage over CRAN packages (less so with the read-only mirror); the local raw source of installed CRAN packages is currently stored in a binary format, preventing searching and inspection directly from within the filesystem. The current options for viewing the body of a function often become tiresomely difficult when the function is either not explicitly exported, is actually a method, or is derived from another language (e.g. `C`). For example, the raw `C` source (`SEXP mutate_impl`) for `dplyr::mutate` is very difficult (not possible?) to find from within R, but nearly trivial to search for on GitHub.

It is unlikely that GitHub is going away soon. I propose embracing it more tightly.

The Plan/Proposal:

I propose a combined research project/development effort over the course of approximately 6 months. I foresee three main goals that could be achieved in order to strengthen the integration between GitHub and R. These are:

- Fortifying the loading of GitHub packages to a reasonable, and open, level of trust.
- Providing the user with more information regarding GitHub-sourced packages.
- Closing the feedback loop such that issues encountered while using a GitHub loaded package can be directed back to the GitHub repository easily.

In order to achieve these goals, I intend to undertake the following activities (subject to findings):

- **A study of the existing landscape regarding R/GitHub integration** [*6 weeks*]
  - what GitHub-related R packages are currently available/under development?
  - what features do they provide that could be integrated?
  - what features are missing entirely but could be developed?
  - what are the limitations of tighter integration bewtween R and GitHub?
- **Development of tools to securely load GitHub R packages into a library** [*6 weeks*]
  - code checking/sanitising.
  - hash/checksum comparisons.
  - running of `devtools::check()` on packages loaded from GitHub.
  - optional conditional loading depending on TravisCI status.
- **Development of tools to provide the user with more information** [*6 weeks*]
  - clear identification of packages which have been loaded from GitHub.
  - information regarding how old the current version is, particularly in context to that package's development.
  - more visible `diff` information for updated packages.
  - increased literate programming intimately tied to GitHub issues.
- **Development of tools to assist the user in contributing to the GitHub repository, either through Issues or additional code** [*6 weeks*]
  - providing a zero-effort channel back to the GitHub repository from which the package was loaded.
  - providing a mechanism by which a user may view diffs between commits to a given function (from within R).
  - providing embedded literate programming ties back to source functions.

Development Already Underway:

Some of the tools that would facilitate this project are already under development in my own GitHub repository, and others are likely to be under development elsewhere. For example, regarding the issue of providing more information of how old a GitHub package is relative to its development (*was the package installed during a peak or trough in the developer's cycle? Was it just before or after a series of major updates?*) combined with the issue of clearer identification of GitHub loaded packages and a direct line back to the originating repository, I have a proof-of-concept package 'githubtools' which:

- scans the user's `installed.packages`,
- identifies which packages have been loaded from GitHub,
- retrieves the commit history for each of those packages,
- displays the installation date alongside the commit history (refer Fig. 2).

Additionally, this package provides a mechanism by which additional features can be added to R documentation when a package is installed from GitHub. This discreetly adds a pull-up tab which, when hovered over, expands to a small overlay which notifies the user of the originating GitHub repository, and provides links to such (main repository, file in question, and Issues page, refer Fig. 3). The way in which this is currently achieved is very much a hack, and it would be considerably more beneficial to have this incorporated either into RStudio or R.

Regarding the issue of increasing the connection between functions, their source, and their intentions, I have a proof-of-concept package 'literate' which, for code within a package, allows embedding of roxygen-style comments in the code itself that survive installation and which detail the intentions of the programmer. When viewed (via `browseURL` currently) the code appears alongside hyperlinks between logical blocks with the developer's comments. These comments can include hyperlinks bewteen code blocks, and importantly, to external sources, such as GitHub issues (refer Fig. 4 as a fictional example).

Deliverables/Dissemination:

A final report will be produced outlining both the findings of the research phase and achievements of the development phase. The development phase itself would lead to the production of either one or multiple R packages which achieve the goals set out; or contributions to R/RStudio themselves, depending on the findings.

100% of the content (research, code, presentation) of this project will remain open source and disseminated via GitHub. The findings and subsequent developed package(s) would be highlighted at a suitable R meeting (e.g. useR) and promoted on social media.

In order to enhance the level of trust, I would be welcoming of migrating the completed packages to a respectable authority such as ROpenSci.

How the ISC Can Help/Finance:

Funds will be spent on dedicated development hours for myself. Few additional resources, if any, would be required. Potentially, literature may be required should development exceed my current knowledge base. Potentially, a small component of travel may be beneficial (e.g. contribution towards useR 2017 or collaboration). Any contribution from the ISC is most welcomed, regardless of the amount, and I welcome any recommendations that the ISC may have towards how these funds may be best used.

I thank you kindly for your consideration, and look forward to your comments.

~ Jonathan Carroll, July 2016.

Created with RMarkdown.
The source for this document is hosted on GitHub: https://github.com/jonocarroll/RConsProp2016
Template adapted from: https://github.com/svmiller/svm-r-markdown-templates

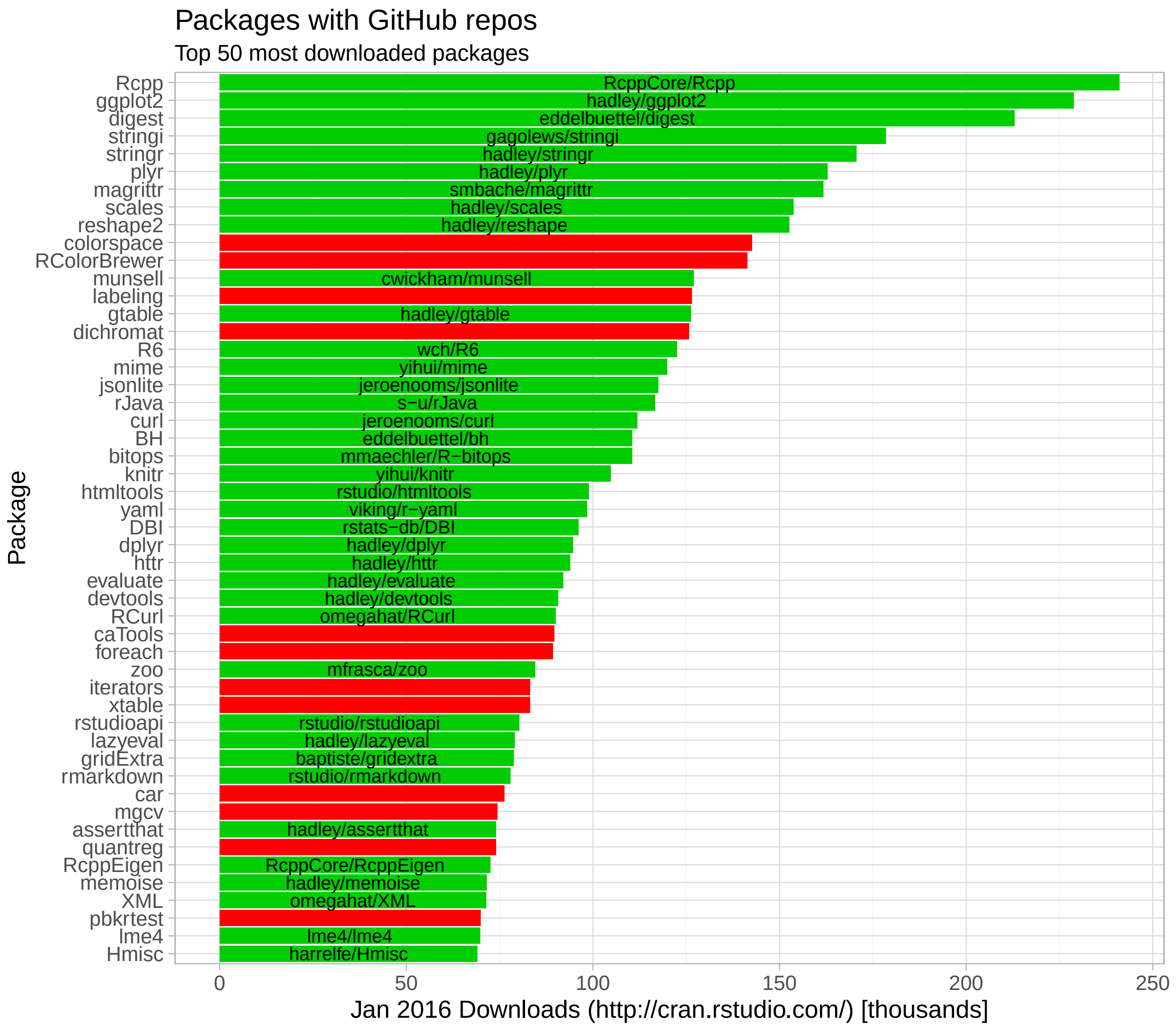


Figure 1: Top 50 most downloaded packages from the RStudio CRAN mirror in Januaray of 2016. Note that of these 38/50 (75%) have GitHub repositories.

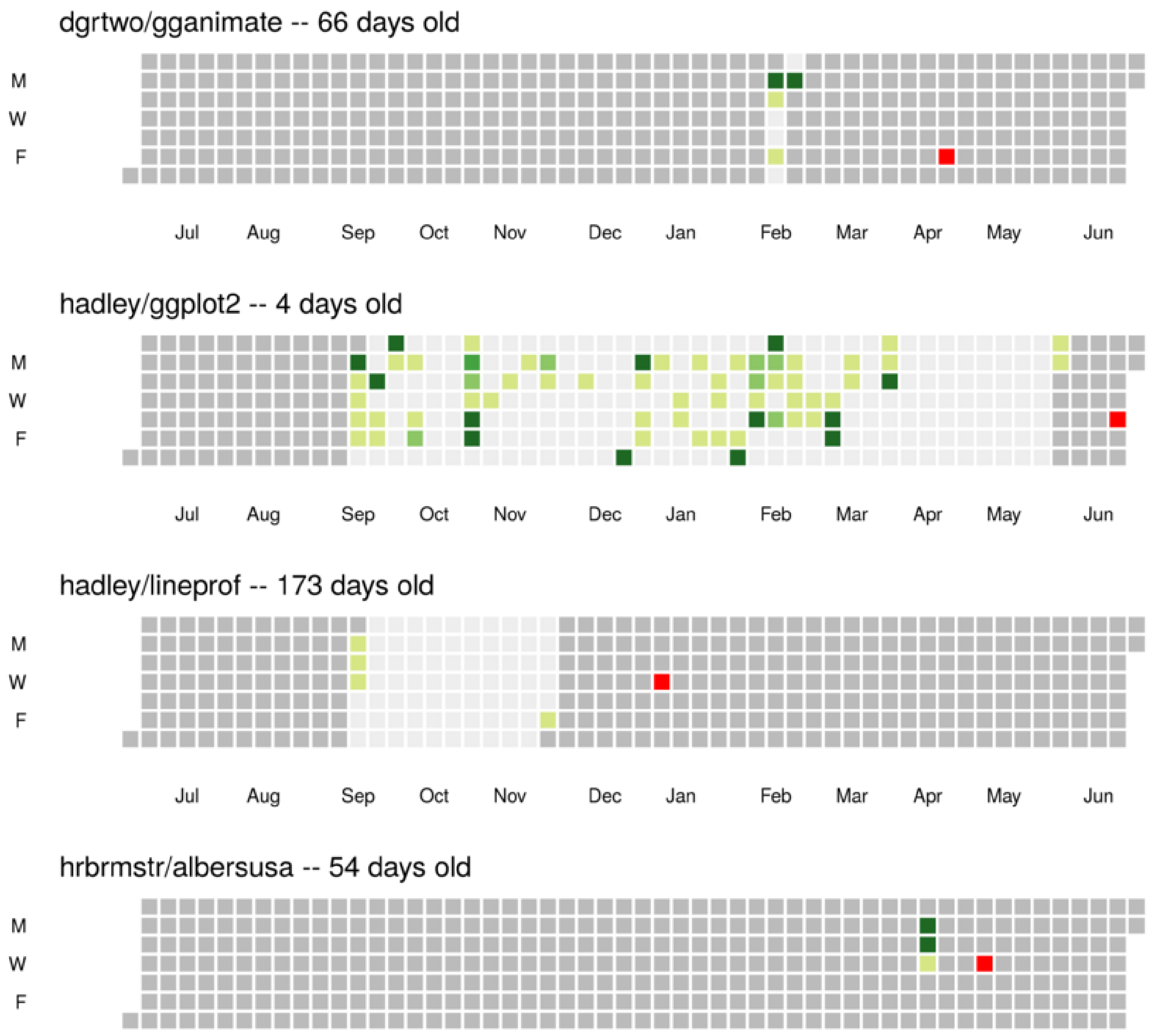
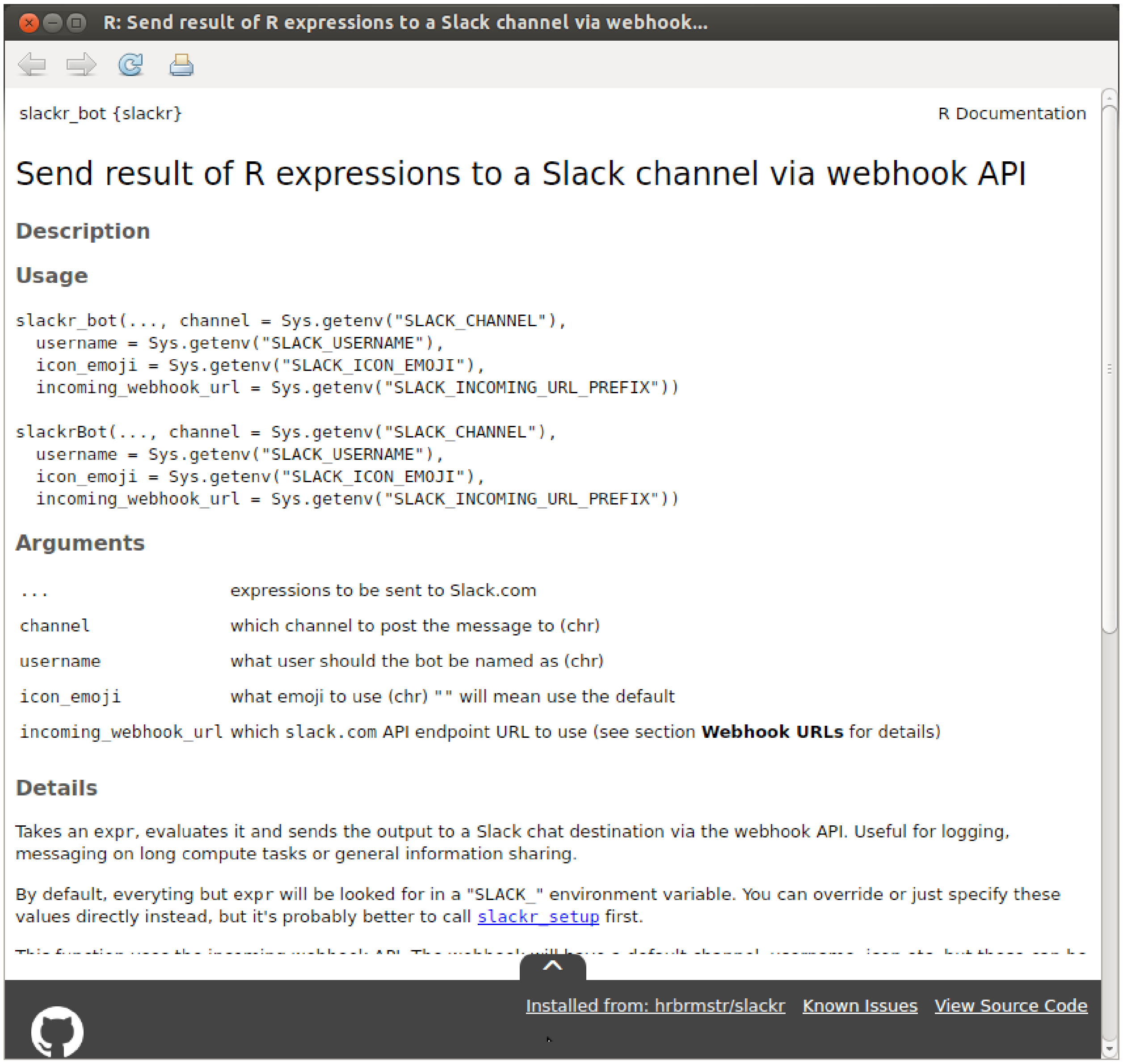


Figure 2: Installed packages are scanned, and GitHub-sourced packages are processed; commit histories retrieved and displayed alongside the installation date (red), in the style of a GitHub activity chart. This functionality is currently provided by http://github.com/jonocarroll/githubtools (under development).


R: Send result of R expressions to a Slack channel via webhook...

slackr_bot {slackr} R Documentation

Send result of R expressions to a Slack channel via webhook API

Description

Usage

```
slackr_bot(..., channel = Sys.getenv("SLACK_CHANNEL"),
  username = Sys.getenv("SLACK_USERNAME"),
  icon_emoji = Sys.getenv("SLACK_ICON_EMOJI"),
  incoming_webhook_url = Sys.getenv("SLACK_INCOMING_URL_PREFIX"))

slackrBot(..., channel = Sys.getenv("SLACK_CHANNEL"),
  username = Sys.getenv("SLACK_USERNAME"),
  icon_emoji = Sys.getenv("SLACK_ICON_EMOJI"),
  incoming_webhook_url = Sys.getenv("SLACK_INCOMING_URL_PREFIX"))
```

Arguments

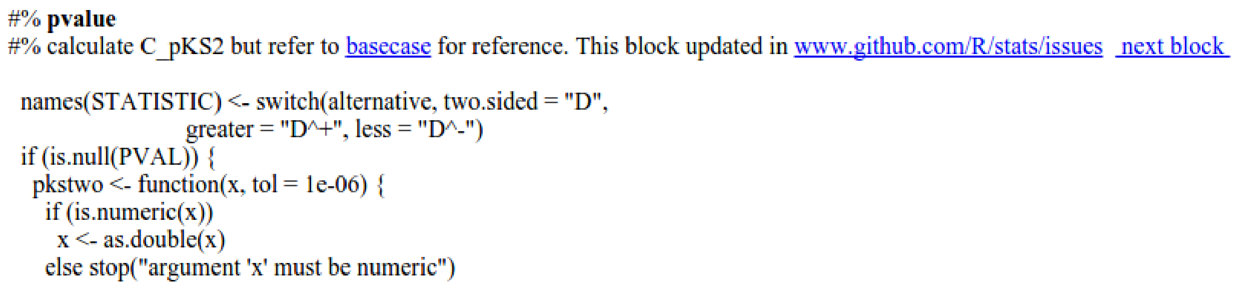
`...`	expressions to be sent to Slack.com
`channel`	which channel to post the message to (chr)
`username`	what user should the bot be named as (chr)
`icon_emoji`	what emoji to use (chr) "" will mean use the default
`incoming_webhook_url`	which `slack.com` API endpoint URL to use (see section **Webhook URLs** for details)

Details

Takes an expr, evaluates it and sends the output to a Slack chat destination via the webhook API. Useful for logging, messaging on long compute tasks or general information sharing.

By default, everyting but expr will be looked for in a "SLACK_" environment variable. You can override or just specify these values directly instead, but it's probably better to call slackr_setup first.

Figure 3: Overlay added to R documentation. When not in use, contracts dynamically down to just the pull-tab, and raises on hover. This is currently achieved by masking much of `devtools::install_github`, injecting HTML directly into the `roxygen` comment blocks, and hijacking `Rd2html` from within the call stack. This functionality is currently provided by http://github.com/jonocarroll/githubtools (under development).



```
#% pvalue
#% calculate C_pKS2 but refer to basecase for reference. This block updated in www.github.com/R/stats/issues  next block

  names(STATISTIC) <- switch(alternative, two.sided = "D",
                             greater = "D^+", less = "D^-")
  if (is.null(PVAL)) {
    pkstwo <- function(x, tol = 1e-06) {
      if (is.numeric(x))
        x <- as.double(x)
      else stop("argument 'x' must be numeric")
```

Figure 4: Hyperlinked literate-programming source code with a (fictional) link to the GitHub issue where the motivation for the structure has been discussed. This functionality is currently provided by http://github.com/jonocarroll/literate (under development).