Rcpp at 1000 Reverse Depends: Some Observations

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Ketchum Trading; Debian and R Projects

Outline

Some Notes ...

- about Rcpp, ever so briefly
- about testing
- about APIs

More a stream of consiousness

Why now?

A few points

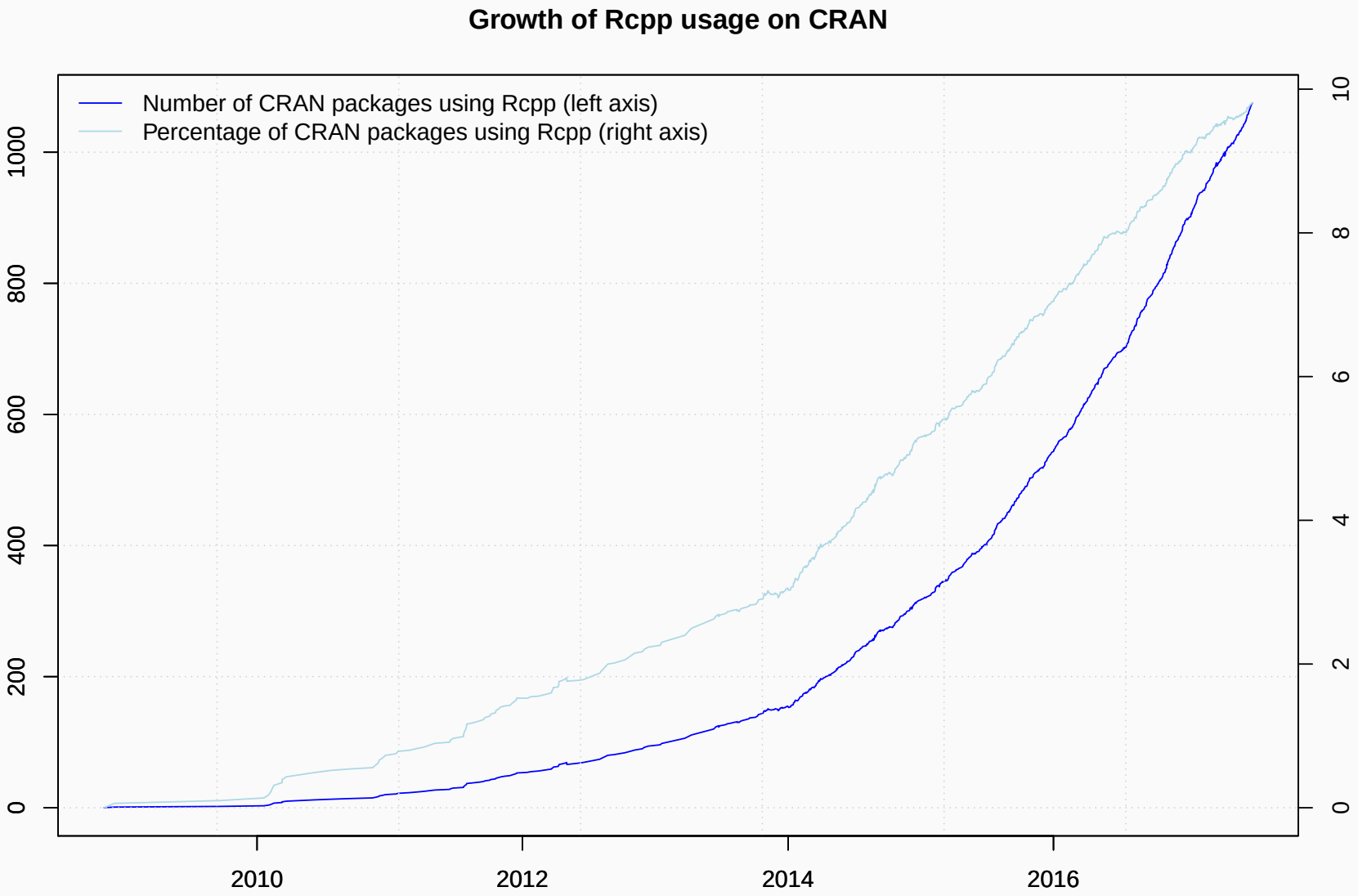
- 1000 depends is a nice milestone to summarize
- Rcpp is a fairly widely used package (over 1k direct depends)
- Rcpp affects a number of packages (over 7k recursive depends)
- We try to take testing somewhat seriously

Rcpp

Team Effort

- Dominic had the early vision
- Romain turned the dial to 11, and again, and again
- Doug and John provided early adult oversight
- JJ gave us Rcpp Attributes and much wisdom
- Kevin, KK, and Nathan are keeping the wheels on

Usage

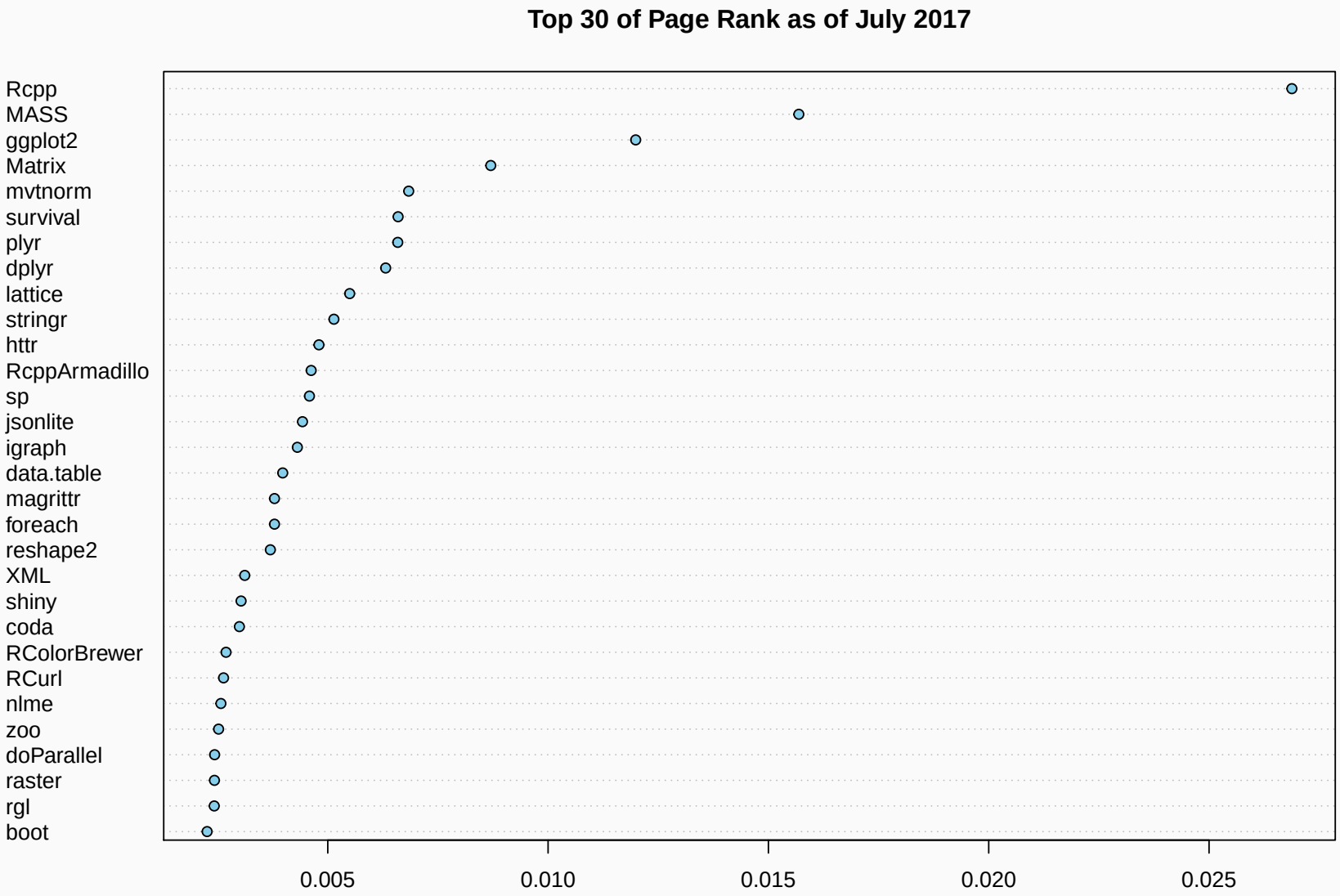


Data current as of July 1, 2017.

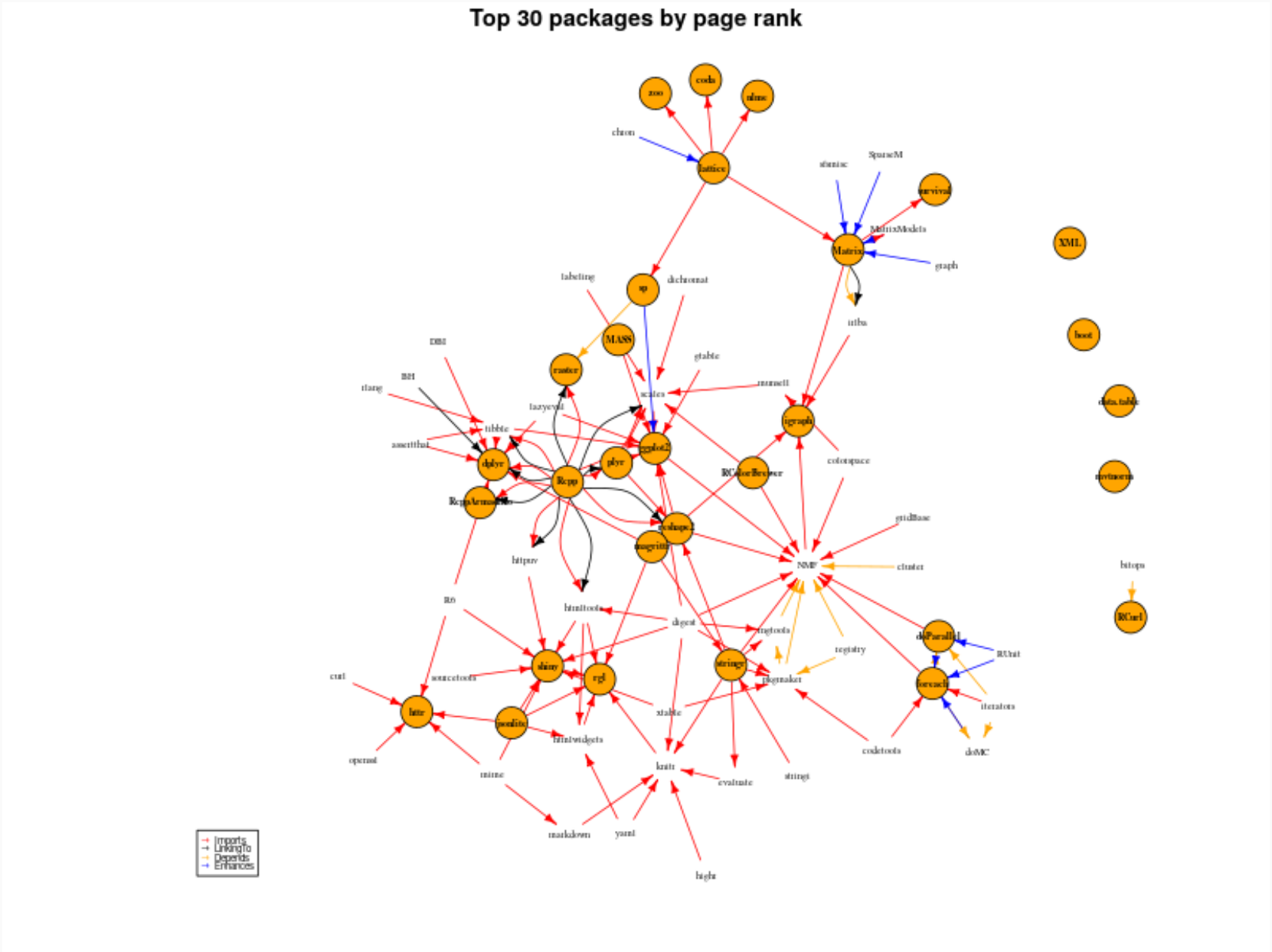
Pagerank

```
library(pagerank)   # github.com/andrie/pagerank

cran <- "http://cloud.r-project.org"

pr <- compute_pagerank(cran)

##
## Attaching package: 'utils'

## The following objects are masked from 'package:Rcpp':
##
##     .DollarNames, prompt

round(100*pr[1:5], 3)
```

Pagerank


Top 30 of Page Rank as of July 2017
Rcpp
MASS
ggplot2
Matrix
mvtnorm
survival
plyr
dplyr
lattice
stringr
httr
RcppArmadillo
sp
jsonlite
igraph
data.table
magrittr
foreach
reshape2
XML
shiny
coda
RColorBrewer
RCurl
nlme
zoo
doParallel
raster
rgl
boot
0.005
0.010
0.015
0.020
0.025

Pagerank


Top 30 packages by page rank
Imports
LinkingTo
Depends
Enhances

CRAN Proportion

```
db <- tools::CRAN_package_db()   # R 3.4.0 or later
dim(db)
```

```
## [1] 10958    65
```

```
## all Rcpp reverse depends
(c(n_rcpp <- length(tools::dependsOnPkgs("Rcpp", recursive=FALSE,
                                         installed=db)),
   n_compiled <- table(db[, "NeedsCompilation"])["yes"]))
```

```
## [1] 1074 2928
```

```
## Rcpp percentage of packages with compiled code
n_rcpp / n_compiled
```

```
## [1] 0.3668033
```

One Example

Example: Convolution

```c
#include <R.h>
#include <Rinternals.h>

SEXP convolve2(SEXP a, SEXP b) {
    int na, nb, nab;
    double *xa, *xb, *xab;
    SEXP ab;

    a = PROTECT(coerceVector(a, REALSXP));
    b = PROTECT(coerceVector(b, REALSXP));
    na = length(a);
    nb = length(b);
    nab = na + nb - 1;
    ab = PROTECT(allocVector(REALSXP, nab));
    xa = REAL(a);
    xb = REAL(b);
    xab = REAL(ab);
    for (int i = 0; i < nab; i++)
        xab[i] = 0.0;
    for (int i = 0; i < na; i++)
        for (int j = 0; j < nb; j++)
            xab[i + j] += xa[i] * xb[j];
    UNPROTECT(3);
    return ab;
}
```

Example: Convolution

```
#include <Rcpp.h>

// [[Rcpp::export]]
Rcpp::NumericVector
convolve2cpp(Rcpp::NumericVector a,
             Rcpp::NumericVector b) {
    int na = a.length(), nb = b.length();
    Rcpp::NumericVector ab(na + nb - 1);
    for (int i = 0; i < na; i++)
        for (int j = 0; j < nb; j++)
            ab[i + j] += a[i] * b[j];
    return(ab);
}
```

Example: C++ from the R prompt

```
cppFunction("Rcpp::NumericVector
convolve2cpp(Rcpp::NumericVector a,
             Rcpp::NumericVector b) {
    int na = a.length(), nb = b.length();
    Rcpp::NumericVector ab(na + nb - 1);
    for (int i = 0; i < na; i++)
        for (int j = 0; j < nb; j++)
            ab[i + j] += a[i] * b[j];
    return(ab);
}")
convolve2cpp(1:4, 4:1)
```

```
## [1]  4 11 20 30 20 11  4
```

Testing

Cost of testing

No Free Lunch

- Single run on a decent machine now takes more than a workday
- Should be easy-ish to parallelize (given resources)
- But that has not yet happened.
- Is testing support a community thing? R Hub?

Change in testing?

No Free Lunch

- Do we need to rethink testing?
  - only packages which themselves are impactful? *(maybe)*
  - only packages which were updated recently? *(maybe not)*
  - only packages which may have failed in the past? *(possibly))*
  - other ways to subsample?
- This both an engineering and a statistics questions so ...

Tests no be all end all

Still No Free Lunch

- Tests really only run the code they cover
- Rcpp has e.g. code generators, we generally do not regenerate *in client packages*
- The *one minute cap* via CRAN Policy means we suppress tests

API

That worked well

- Package system and design work as plan
- Access of C API of R now easier to access
- Good division of labour

Should Rcpp be promoted into Base R?

Question I get asked sometime

- Probably not
- If “you” take it “you” get to work on it
- Smaller base good design principle

API Re-Use ?

- RApiSerialize
- RApiDatetime
- There could potentially be much more
- How can “we” (R users) get better (programmatic) access to what is already in R?
- Does the (relatively) wide use of Rcpp mean the core API is too hard to use?

Summary

Next Steps?

- Possible room for improvement on testing
- Possible need for better testing support
- Possible to open the API a little more