FloCon®2014

The Rayon Tools: Visualization at the Command Line

A useful visualization must integrate cleanly into an analyst's work environment. For many network security analysts, that environment is the UNIX command line. Rayon provides visualization that works well with the workflow model of UNIX and the shell.

Rayon is a Python library and a set of command-line tools. An analyst can use the Rayon tools in a UNIX command pipeline to visualize data after selecting and transforming it with other UNIX utilities.

What's so Great about the Shell?

The shell is common. UNIX is a pervasive operating system in network analysis environments, the shell is the most basic way of interacting with a UNIX system, and is supported on virtually all of them.

The shell is open. An application needs to do very little to work in the shell environment. The user can compose shell-friendly tools into scripts or command pipelines that are much more useful than any of the tools in isolation

The shell is automatable. Users write shell scripts with the same commands they use to manually work in the shell. They can write more advanced tools using programming languages (e.g., Python, C), and use those tools, in turn, in other scripts or command pipelines, incrementally automating larger and more complex tasks.

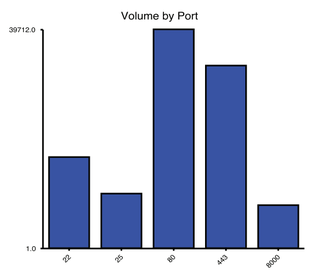
Case Study: Server Traffic

The SiLK tool `rwcount` generates time series from netflow data. The following command extracts all traffic inbound to ports 80 and 443 (nominally, all incoming traffic to web servers) within a time range:

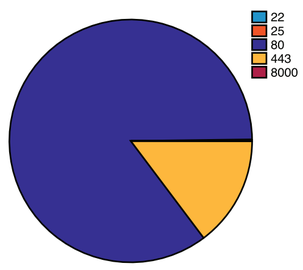
```
rwfilter     --start-date=2005/01/07:00 \
             --end-date=2005/01/07:23 \
             --type=in --proto=6 \
             --dport=80 --pass=stdout |\
rwcount --bin-size=300
```

The following examples illustrate incrementally more complex uses of the Rayon tool `rytimeseries`, as it might be used in a simple analysis.

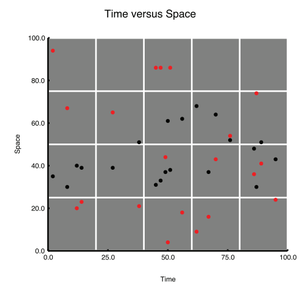
The Rayon tools



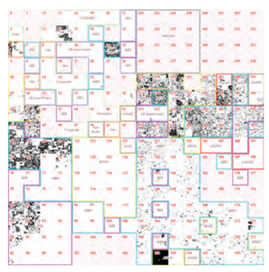
`rycategories`
Show categorical data as barcharts



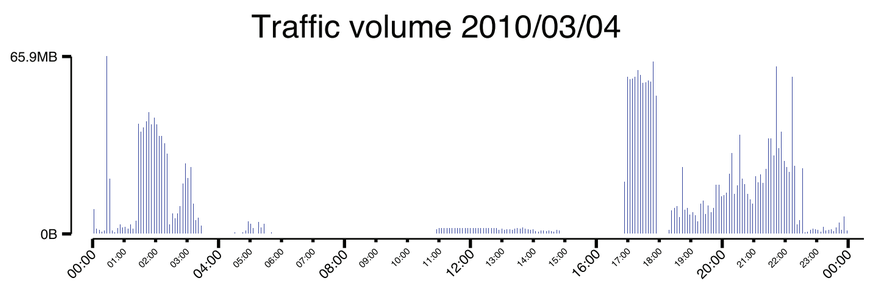
`rypiechart`
Show categorical data as pie sections



`ryscatterplot`
Show data in 2-dimensional space

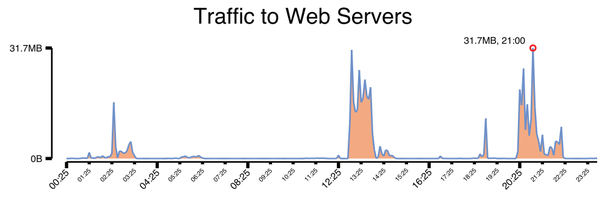


`ryhilbert`
Show clusters of numbers
(e.g., IP Addresses)



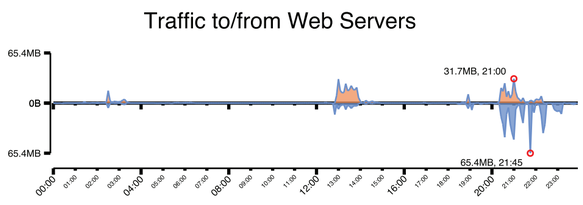
`rytimeseries`
Show data associated with times

1: How much traffic is coming to web servers?




```
rwfilter \
    --start-date=2005/01/07:00 --end-date=2005/01/07:23 \
    --proto=6 --type=in,inweb --dport=80 --pass=stdout |\
rwcount --bin-size=300 --delimited |\
rytimeseries \
    --style=filled_lines --output-path="1.pdf" \
    --first-line-colnames --top-column="Bytes" \
    --value-tick-label-format=metric --value-units=B \
    --annotate-max \
    --title="Traffic to Web Servers"
```

2: How does inbound traffic compare with outbound?

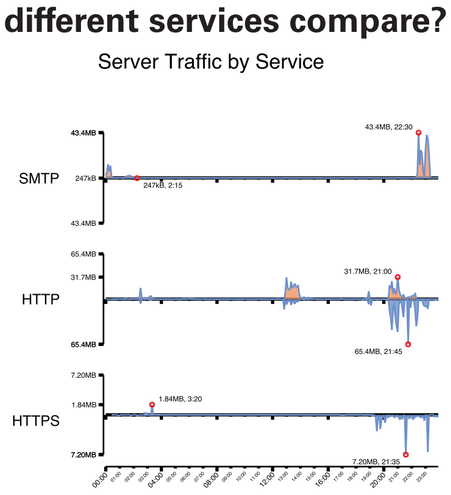



```
rwfilter \
    --start-date=2005/01/07:00 --end-date=2005/01/07:23 \
    --type=in,inweb --proto=6 --dport=80 --pass=stdout |\
rwcount --bin-size=300 --no-titles --delimited |\
awk -F\| '{printf("%s|%s|in\n", $1, $3)}' > 2-top.txt

rwfilter \
    --start-date=2005/01/07:00 --end-date=2005/01/07:23 \
    --type=out,outweb --proto=6 --sport=80 --pass=stdout |\
rwcount --bin-size=300 --no-titles --delimited |\
awk -F\| '{printf("%s|%s|out\n", $1, $3)}' > 2-btm.txt

cat *.txt | rytimeseries \
    --style=filled_lines --output-path=2.pdf \
    --top-filter="[2]==in" --bottom-filter="[2]==out" \
    --top-column=1 --bottom-column=1 \
    --annotate-max \
    --value-tick-label-format=metric --value-units=B \
    --title="Traffic to/from Web Servers"
```

3: How do different services compare?




```
for port in 25 80 443; do
      rwfilter \
            --start-date=2005/01/07:00 --end-date=2005/01/07:23 \
            --proto=6 --type=in,inweb --dport=${port} --pass=stdout |\
      rwcount --bin-size=300 --no-titles --delimited |\
      awk -F\| "{printf(\"%s|%s|in|${port}\\n\", \$1, \$3)}" \
      > 3-top-${port}.txt

rwfilter \
      --start-date=2005/01/07:00 --end-date=2005/01/07:23 \
      --proto=6 --type=out,outweb --sport=${port} --pass=stdout |\
rwcount --bin-size=300 --no-titles --delimited |\
awk -F\| "{printf(\"%s|%s|out|${port}\\n\", \$1, \$3)}" \
> 3-btm-${port}.txt;
done
cat *.txt | rytimeseries \
--style=filled_lines --output-path=3.pdf \
--top-filter="[2]==in" --bottom-filter="[2]==out" \
--top-column=1 --bottom-column=1 \
--value-ticks=max,smax \
--value-tick-label-format=metric --value-units=B \
--annotate-max --group-by=3 \
--show=25,80,443 --labels="SMTP,HTTP,HTTPS"
```

Applications

Exploratory analysis. Generating visualizations at the command line keeps all the data in one place for analysis, lets users stay in a single workflow environment longer, and keeps the data in a central location. Users can view the visualizations on their client using X Windows or their web browser.

Prototyping. Users can create visualizations while developing data analysis techniques. These visualizations may eventually become work products, or they can be used to check the results of the analysis for validity.

Automation. Producing reports takes up a lot of analysts' time. Analysts can use Rayon in conjunction with publication tools such as LaTeX or HTML to automatically generate reports, freeing time for other uses.

Visualization/Analysis as a Service. Analysts can share their analyses (including visualizations) on the web. Other users can call them directly as needed, or the analyses can run at scheduled intervals and make their results available online.

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