*THIN SLICING A BLACK SWAN

When Less Is More

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*Who Are We?

Disclaimer: No swans were harmed in the making of this presentation

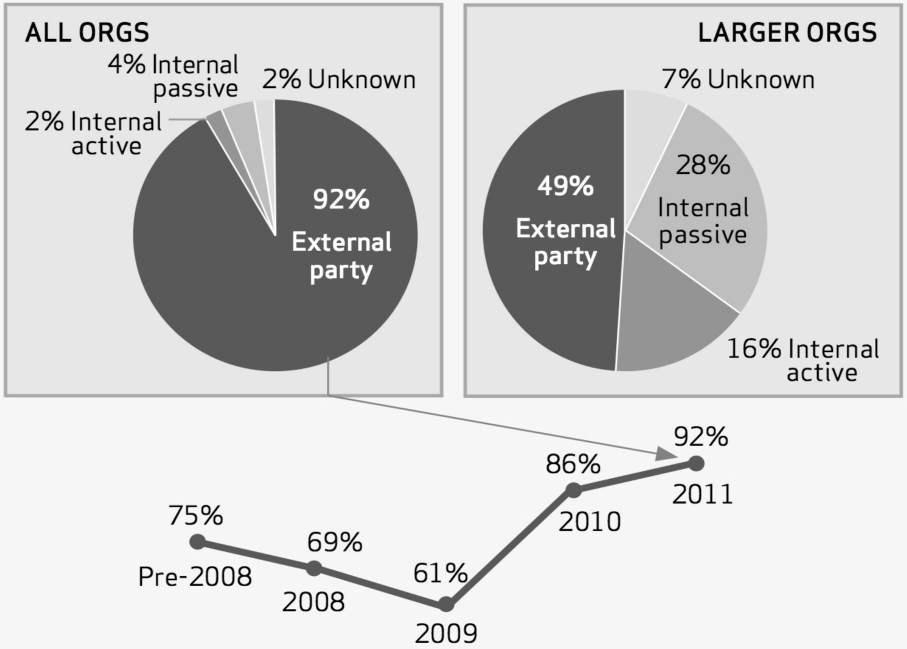
"The entire security industry is wired so that the oldest and least effective methods will profit most…."

Josh Corman, Director of Security Intelligence at Akamai, the content delivery network.

Something’s Broken

In Verizon’s 2012 Data Breach Investigations Report, it was found that across organizations, an external party discovers 92% of breaches.

Figure 44. Simplified breach discovery methods by percent of breaches



Verizon Data Breach Report 2013

"WHEN YOU CONSIDER THE METHODS USED BY ATTACKERS TO GAIN A FOOTHOLD IN ORGANIZATIONS—BRUTE FORCE, STOLEN CREDS, PHISHING, TAMPERING—IT'S REALLY NOT ALL THAT SURPRISING THAT NONE RECEIVE THE HIGHLY DIFFICULT RATING. WOULD YOU FIRE A GUIDED MISSILE AT AN UNLOCKED SCREEN DOOR?"

"…three-quarters of breaches are of low or very low difficulty for initial compromise, and the rest land in the moderate category."

Verizon Data Breach Report 2013

Figure 42: Percent of breaches that remain undiscovered for months or more

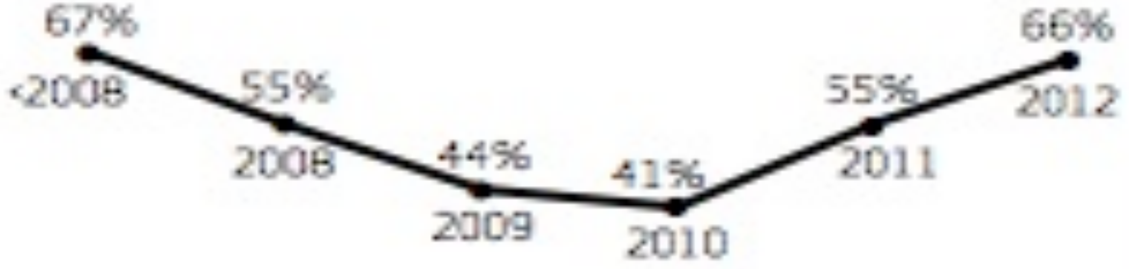
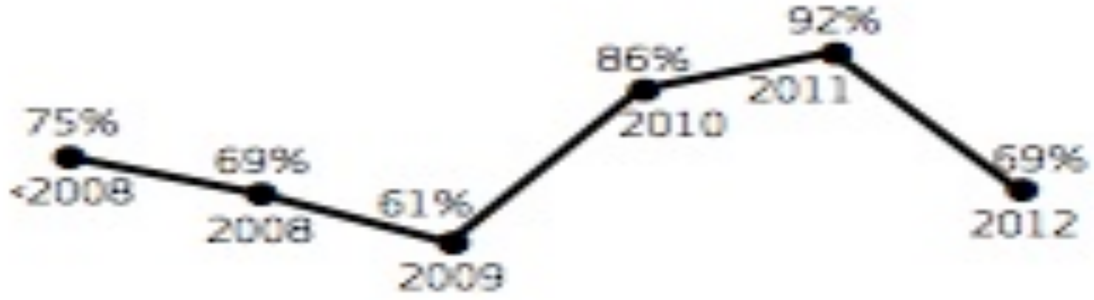
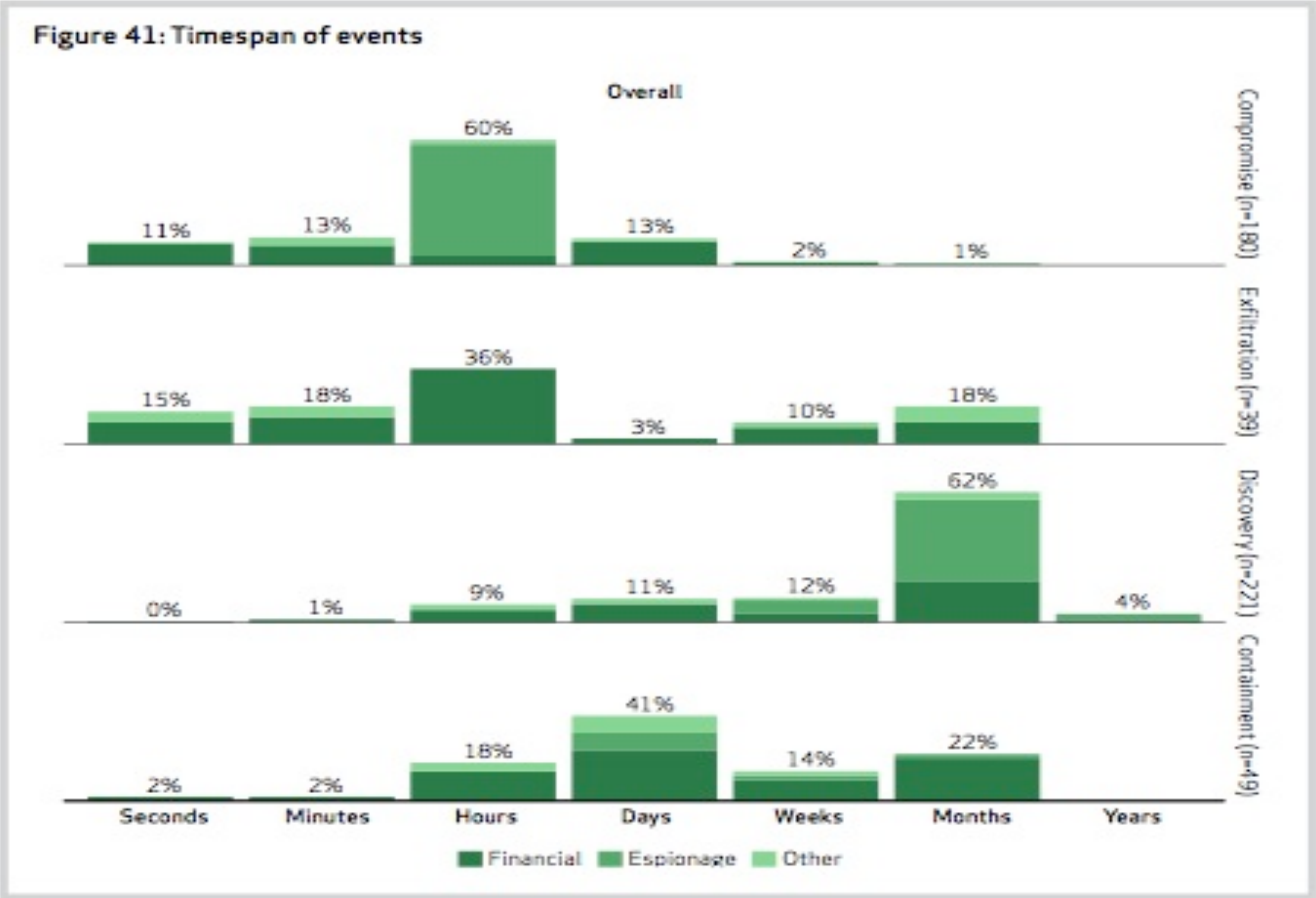


Figure 43: Percent of breaches discovered external to victim



Verizon Data Breach Report 2013



From Compromise To Discovery: Verizon Data Breach Report 2012

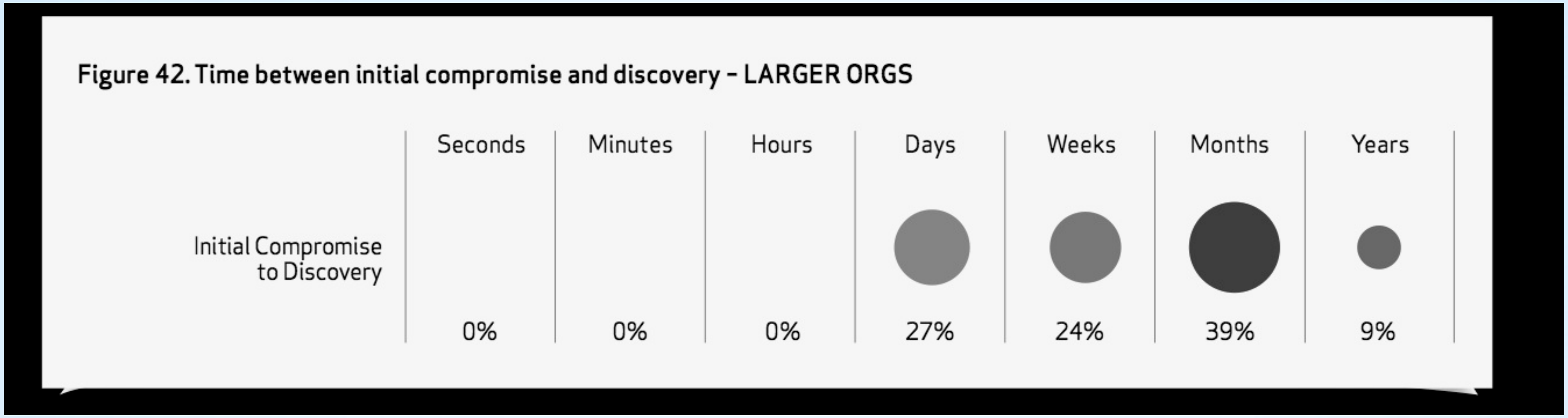


Figure 42. Time between initial compromise and discovery – LARGER ORGS

- We believe we can solve the issue of the *unknowns*, intrusions, with more data.
- The more information we have, the less we know.
- This makes us no better than security archeologists.

Anti-Virus Ineffective

Imperva conducted a study and released a report in 2012 on the effectiveness of antivirus software.

- Out of approximately 80 pieces of malware, the initial detection rate for new malware was less than 5%.
- For some AV vendors, it may take up to four weeks to detect a new virus from the time of the initial scan.
- Software cost wasn’t a factor. Some free programs performed better.
- In 2011, Gartner reported that consumers spent $4.5 billion on antivirus and enterprises spent $2.9 billion. The total of $7.4 billion is more than a third of the total of $17.7 billion spent on security software.

The Black Swan Event

- An *unknown unknown.*
- Can't be predicted by probability theories.
- Rationalized after the fact.
- How often do we try to predict the Black Swan Event in security and fail?

Information Gluttony?

“Military drone operators amass untold amounts of data that never is fully analyzed because it is simply too much.”

Michael W. Isherwood, defense analyst and former Air Force fighter pilot.

Digital Kudzu

- From beginning of recorded time to 2003 - five exabytes of information.
- 2011 - that much created every two days.
- 2012 - prediction is every 10 minutes.

Big Data or Big Garbage?

SANS surveyed how much time is spent on log-data analysis:

35% - none to a few hours per week
18% - unknown
11% - one day per week
2% - outsourced to a managed security service provider
24% - integrated into normal workflow

50% of the smaller organizations spent zero to just a few hours analyzing logs.

“I don’t call it big data, I call it garbage Data.”

Jerry Sto. Thomas, Director of Global Information Security, Allergan

Current Solutions

- SIEMs: never gets fully implemented.
- Predictions using Logistic Regression/Bayesian Probability.
- Huge amounts of data, not enough time.
- “Open world” problem using “closed world” assumptions.
- More staff, more money.

Alternative Model: Thin Slicing

"…the ability of our unconscious to find patterns in situations and behavior based on very narrow slices of experience."

Malcolm Gladwell, ***Blink***

Case Study: A Hospital in Trouble

- Cook County Hospital struggled with identifying patients in danger of an imminent heart attack.
- Coronary care unit was overwhelmed.
- Public hospital, limited resources.
- ICU is dangerous.

Applied Thin-Slicing

- Lee Goldman, a cardiologist, created a protocol based upon an algorithm developed in partnership with mathematicians.
- After two years of using a decision tree, hospital staff were 70% more effective at recognizing patients at risk.
- **Less** information led to greater success.
- Technique used by first-responders every day.

Bounded Rationality

“Violations of logical reasoning [are] interpreted as cognitive fallacies, yet what appears to be a fallacy can often also be seen as adaptive behavior, if one is willing to rethink the norm.”

Gerd Gigerenzer, *Rationality for Mortals*

Fast and Frugal Trees

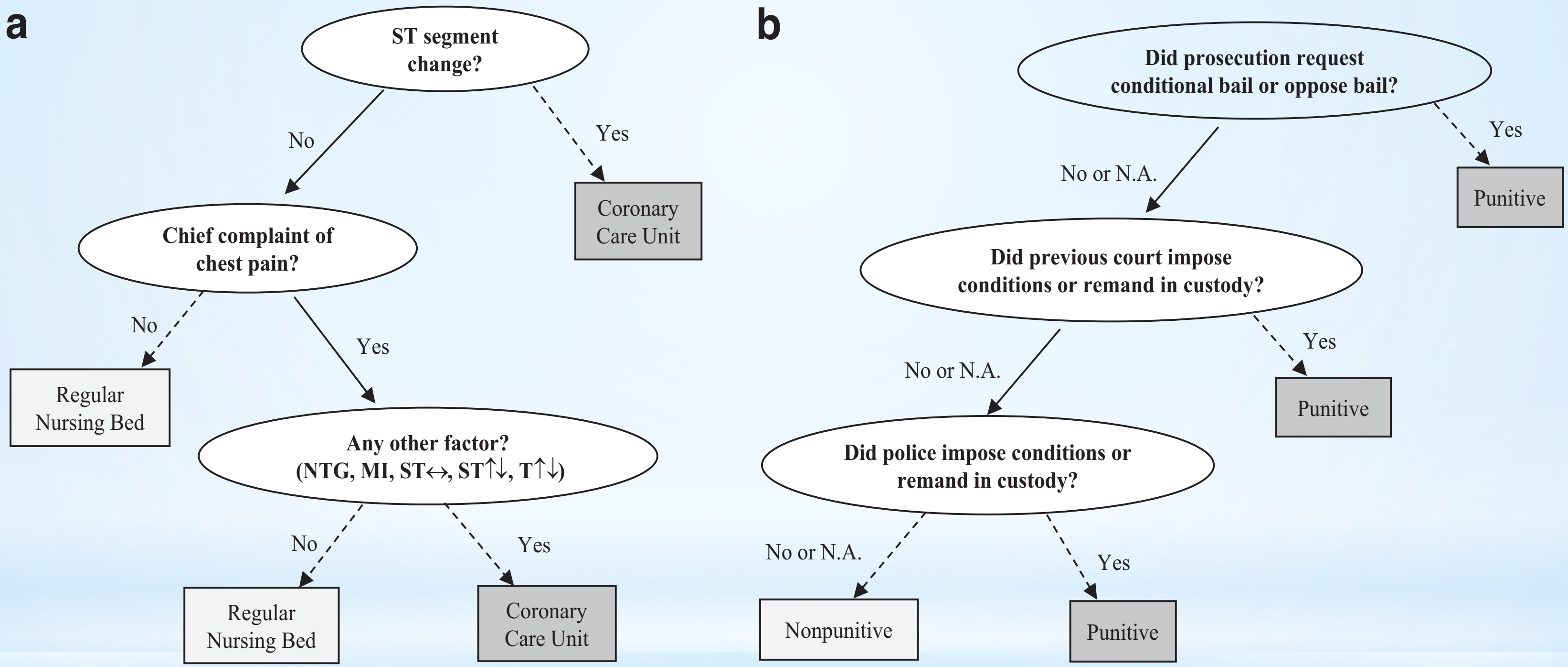

a
ST segment change?
No
Yes
Coronary Care Unit
Chief complaint of chest pain?
No
Yes
Regular Nursing Bed
Any other factor? (NTG, MI, ST↔, ST↑↓, T↑↓)
No
Yes
Regular Nursing Bed
Coronary Care Unit
b
Did prosecution request conditional bail or oppose bail?
Yes
No or N.A.
Punitive
Did previous court impose conditions or remand in custody?
Yes
No or N.A.
Punitive
Did police impose conditions or remand in custody?
No or N.A.
Yes
Nonpunitive
Punitive

Figure 4. Two examples of fast-and-frugal trees (FFTs) applied to large world problems. The left tree (a) is designed to help emergency room doctors decide whether to send a patient with severe chest pain to the Coronary Care Unit (CCU) or a regular nursing bed (Green & Mehr, 1997). The right tree (b) is a model of how British judges decide whether to make a punitive bail decision (Dhami, 2003).

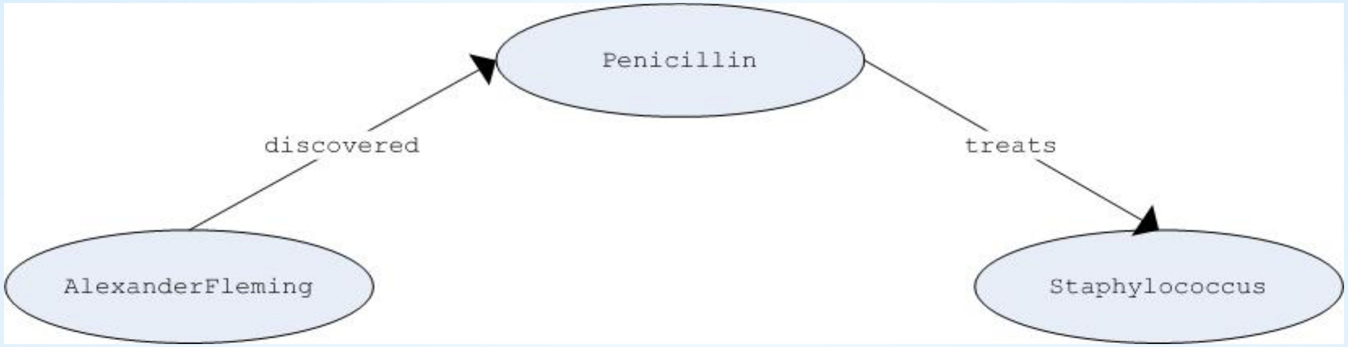
Star Trek and Thin Slicing

- Remember Spock’s tricorder?
- It could identify *anything* in the galaxy.
- Fiction, right?
- Not according to Carlos Garcia-Robledo, postdoctoral fellow in the department of botany at the Smithsonian's National Museum of Natural History.

Reality: DNA Barcoding

- Goal - quickly identify species using short DNA sequences.
- Master list of sequences, then match samples.
- Changes in mitochondria is the marker between species.
- Technique is already being used commercially.
- Oceana released a controversial report revealing 33% of 1200 fish samples sold were mislabeled.
- Data resulted from DNA barcoding.

Method: Resource Description Framework (RDF)



- Semantic Web technology.
- Queries based on relationships or mental associations.
- Graphs treat each packet from capture file as a discrete event with properties.
- TCP header info in a metadata model.
- Model replicates human cognitive economy.

Thin-Slicing with SPARQL

- SPARQL query language uses a concise approach for quickly traversing large data sets while capturing similarities between packets as generalizations.
- RDF statement contains a subject, predicate and an object.
  - Subject defines the event.
  - Predicate defines a characteristic or property.
  - Object contains the value for the predicate.

Example: Building A Query

```
sparql select * {
?s
?p
?o.};

sparql select *{
?e1
<http://www.rrecktek.com/demo/src>
?ip1.};
```

Example

- All source IPs and their destination IPs.
- For each source, count how many times it went to a destination.
- Report source destination and count.

```
sparql SELECT ?src ?dst (count (?dst) as ?count) {
?e1 <http://www.rrecktek.com/demo/src> ?src.
?e1 <http://www.rrecktek.com/demo/dst> ?dst.
 } ORDER BY DESC (?count);
```

Example 2

Which machines were the destination of the most traffic?

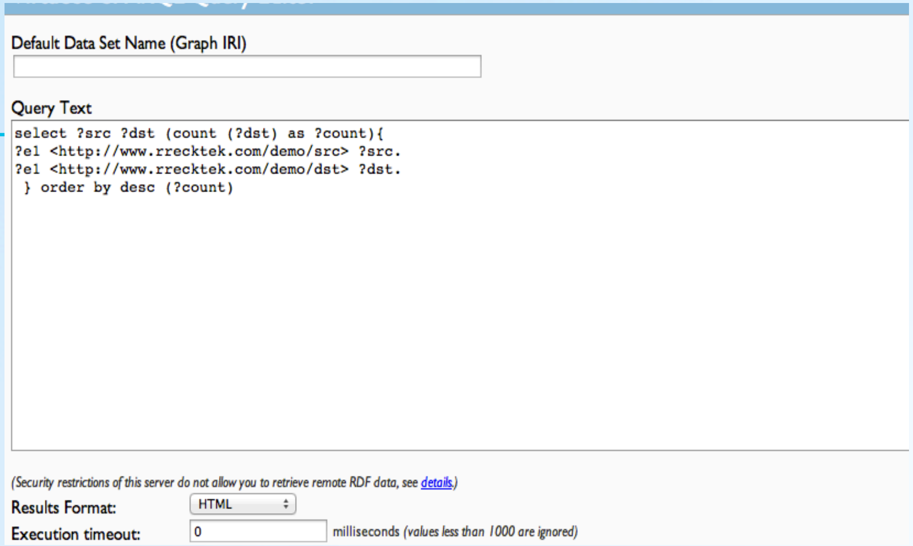
```
sparql select * {
?event <http://www.rrecktek.com/demo/dst> ?dst.
} limit 10;

sparql select distinct (?dst) (COUNT (?src) as ?count) {
?event <http://www.rrecktek.com/demo/dst> ?dst.
?event <http://www.rrecktek.com/demo/src> ?src.
} ORDER BY DESC(?count) limit 10;
```

Example 3

What times did the machines talk to each other ?

```
sparql select * {
?e <http://www.rrecktek.com/demo/src> "135.8.60.182".
?e <http://www.rrecktek.com/demo/dst> "172.16.113.50".
?e <http://www.rrecktek.com/demo/date> ?date.
FILTER regex(?date, "1998-06-04").
?e <http://www.rrecktek.com/demo/time> ?time };
```

SPARQL web interface



Default Data Set Name (Graph IRI)

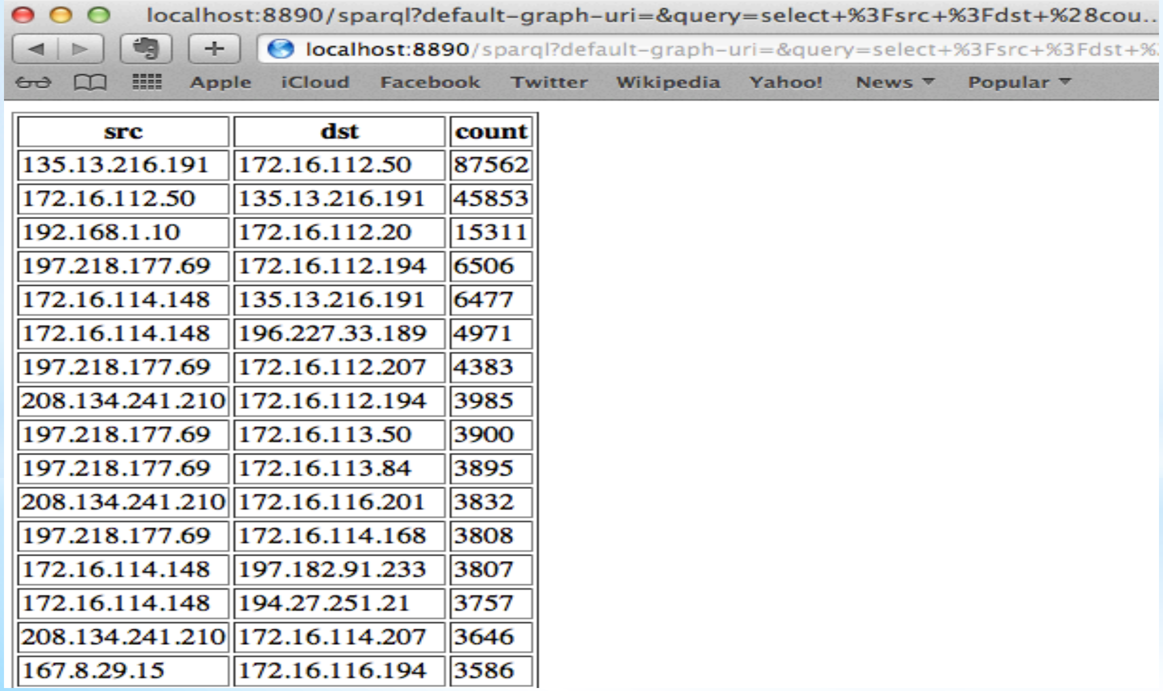
Query Text

```
select ?src ?dst (count (?dst) as ?count){
?el <http://www.rrecktek.com/demo/src> ?src.
?el <http://www.rrecktek.com/demo/dst> ?dst.
 } order by desc (?count)
```

(Security restrictions of this server do not allow you to retrieve remote RDF data, see details.)

Results Format: HTML

Execution timeout: 0 milliseconds (values less than 1000 are ignored)



localhost:8890/sparql?default-graph-uri=&query=select+%3Fsrc+%3Fdst+%28cou..

localhost:8890/sparql?default-graph-uri=&query=select+%3Fsrc+%3Fdst+%

src	dst	count
135.13.216.191	172.16.112.50	87562
172.16.112.50	135.13.216.191	45853
192.168.1.10	172.16.112.20	15311
197.218.177.69	172.16.112.194	6506
172.16.114.148	135.13.216.191	6477
172.16.114.148	196.227.33.189	4971
197.218.177.69	172.16.112.207	4383
208.134.241.210	172.16.112.194	3985
197.218.177.69	172.16.113.50	3900
197.218.177.69	172.16.113.84	3895
208.134.241.210	172.16.116.201	3832
197.218.177.69	172.16.114.168	3808
172.16.114.148	197.182.91.233	3807
172.16.114.148	194.27.251.21	3757
208.134.241.210	172.16.114.207	3646
167.8.29.15	172.16.116.194	3586

We Can’t Fight All Unknowns

- What we *can* do
  - Build strong infrastructures and secure applications minimizing technical debt.
  - Create data classification schemes based upon the business and technical service catalogs to better create better segmentation.
  - Add the equivalent of air bags to the architecture for when intrusions occur.
  - Recognize signature limitations.
  - Investigate the creation of real-time fast and frugal trees.

Our patient is dying on the table. It’s up to us to change the outcome.

Thanks!

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References

Works Cited:

"Eclectic Tech." *Semantic Web Introduction*. N.p., n.d. Web. 20 Dec. 2012.

Erwin, Sandra I. "Too Much Information, Not Enough Intelligence." *National Defense Magazine*. N.p., May 2012. Web. <http://www.nationaldefense.org>.

Gigerenzer, Gerd. *Gut Feelings: The Intelligence of the Unconscious*. New York: Viking, 2007. Print.

Gigerenzer, Gerd. *Rationality for Mortals: How People Cope with Uncertainty*. Oxford: Oxford UP, 2008. Print.

Gladwell, Malcolm. *Blink: The Power of Thinking without Thinking*. New York: Little, Brown and, 2005. Print.

Hacker Intelligence Initiative, Monthly Trend Report #14. Rep. Imperva, Dec. 2012. Web. Dec. 2012.

Koerth-Baker, Maggie. "The Technology That Links Taxonomy and Star Trek." *BoingBoing.net*. BoingBoing, 15 May 2013. Web. 15 May 2013.

Luan, Shenghua, Lael J. Schooler, and Gerd Gigerenzer. "A Signal-detection Analysis of Fast-and-frugal Trees." *Psychological Review* 118.2 (2011): 316-38. Print.

Marewski, Julian N., PhD, and Gerd Gigerenzer, PhD. "Heuristic Decision Making in Medicine." *Dialogues in Clinical Neuroscience* 14.1 (2012): 77-89. Print.

Messmer, Ellen. "SANS Warns IT Groups Fail to Focus on Logs for Security Clues." *TechWorld.com*. TechWorld, 3 May 2012. Web. 15 Aug. 2012.

"RDF." *-Semantic Web Standards*. W3C, n.d. Web. 02 Jan. 2013.

"Resource Description Framework (RDF)Model and Syntax." *RDF Model and Syntax*. W3C, n.d. Web. 02 Jan. 2013.

Rieland, Randy. "Big Data or Too Much Information?" *Innovations*. Smithsonian, 7 May 2012. Web.

Sandoval, Greg. "Foreign Hackers Steal More Than a Terabyte of Data per Day in Ongoing Cyberwar." *The Verge*. N.p., 27 Feb. 2013. Web. 27 Feb. 2013.

"Semantic Web Standards." *W3C*. W3C, n.d. Web. 02 Jan. 2013.

Taleb, Nassim. *The Black Swan: The Impact of the Highly Improbable*. New York: Random House, 2007. Print.

Trustwave 2013 Global Security Report. Rep. Trustwave, 2013. Web.

Turek, Dave. "The Case Against Digital Sprawl." *The Management Blog*. Bloomberg Businessweek, 2 May 2012. Web.

Verizon 2012 Data Breach Investigation Report. Rep. Verizon, 2012. Web.

Verizon 2013 Data Breach Investigation Report. Rep. Verizon, 2013. Web.