Alex Shah
EN.695.741.81.SP25 Information Assurance Analysis
Mod 11 Assignment
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1. *What tools did you use to analyze the sample (if any)?*
    I used Splunk as well as python with pandas to analyze the email spam samples. I
    prototyped some of the analysis using python by putting records with the same MID
    together and checked to see what types of messages and results I was seeing before moving
    on to Splunk to analyze the results more carefully. It was helpful to start in Python, but I
    gradually became more comfortable with the field extractors in Splunk and using the query
    syntax which was powerful to interact quickly with the data and visualize patterns. In
    Splunk I created many field extractions including MID, ICID, start message, done message,
    spam result, antivirus result, IP, queued for delivery, and to/from. In total there were 762
    MIDs. Two records (MID 249, 450) were marked as spam, one record (MID 455) was
    filtered by a content filter, and none were marked as antivirus positive.

1. *How many records where loaded into your tool?*
    In total there are 11,324 records.

2. *How did you prepare and load the sample into your analysis tool?*
    I brought the file into Splunk as a new source and used the regex fields extractor to
    separate out the timestamp, and different types of fields after the "Info:" tag which was
    present in all the results. I used regex to parse multiple fields as described which were
    helpful in sorting and filtering the data. I used python to find which ICID was associated
    with which MID(s), and then to correlate IP addresses with MIDs as well as the to/from
    field, subject, and spam, filter, and antivirus results.

3. *Note any errors in the sample and how you handled them. Did you ignore or correct them?*
    I did not find any big errors in the sample structure through looking at the records
    associated with each MID, but there were some oddities. The record that was filtered
    was not queued for delivery, but the spam positive records were marked for quarantine,
    queued for delivery, and did not have a "done" message which I ignored. A majority of
    MIDs (756 records) did not have a "done" record, which I also ignored since they had
    results for spam and antivirus testing. "Done" might have been the processor closing
    which may not have been logged properly and didn't seem to correlate to spam
    messages. None of the examples were positive for viruses, which is likely to happen
    with small samples of normal email and basic spam but it did waste some time before I
    finally did a simple control + F for "virus positive" and realized I wasn't missing
    something in my querying.

2. *What is the domain of the SMTP server(s) being monitored? How was that determined?*
    The "To" field in most records show that the domain is "university.edu" and a subdomain
    "phys.university.edu" was also used less frequently in 4 messages.

3. *List all valid email senders (e.g. email addresses) in the SMTP sample, excluding SPAM related addresses?*
    The two emails marked as spam faked the from field of "irs.com" and
    "alerts.bankofamerica.com", which differs from the records not marked as spam that came

from a slightly different address of "ealerts.bankofamerica.com". The records that were not marked as spam included addresses from the university.edu domain including many with two characters and two numbers @university.edu, first name dot last name @ university.edu, and many first name dot last name from the following domains 'all-natural.com', 'bbb.org', 'cures.com', 'herbal-natural-cures.com', and 'medicines.com'. These seem to be spam messages that slipped past the filters and scanners. The set of addresses and domains are available in the Appendix.

4. *Plot the volume of SMTP traffic over time in a time series. Describe the characteristics of the traffic. Describe the peaks and valleys seen in the time series? Hint: this is talked about in the second video*

   All of the traffic occurs on the same day, Friday August 3rd, 2012. The traffic appears in batches starting at 11:26 AM and ending at 7:51 PM, with a large spike at 4:01 PM and a small lead up and longer drop off around that time period. This corresponds to about the end of the work day. Many messages have the same time stamp, indicating that they were either sent, received, or processed at the same time. This depends on the how the timestamps are recorded, but it is likely when they were processed. Shown in Figure 1 and 2 are the messages throughout the day. The linear scale shows just how many are sent out around 4 PM, and the log scale makes more apparent what times and scale the messages are sent out in.
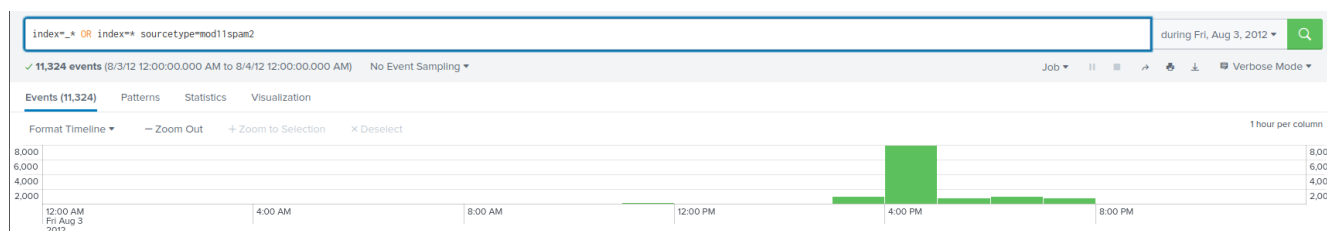

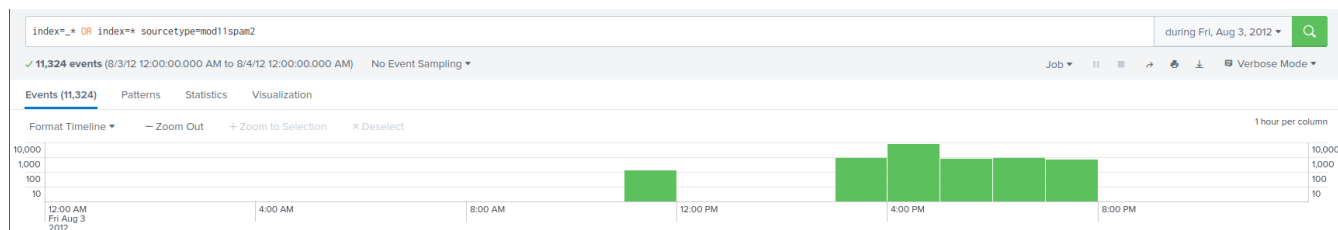Figure 1: Timeline of records on 2012-08-03, linear scale

Figure 2: Timeline of records on 2012-08-03, log scale

5. *List all Spamming IP addresses and describe how you know each to be spammers.*

   Many messages are sent from a local subnet at the address 192.168.2.14, and all of those email appear to come from university.edu addresses. These are likely not spam messages, even when they have the same subject line. This could be an email chain with many replies to the same subject or example messages duplicated to provide more messages in the data. Two other IP addresses appear in the data, 211.14.22.13 definitely sends spam and 122.11.23.55 is likely spam but contains few examples. 211.14.22.13 sends messages from multiple domains with spammy addresses like "all-natural.com" and "herbal-natural-cures.com" and spammy subjects like "Herbal Cures". However this IP address also sends

email appearing to be from the university.edu domain with identical or similar address names for example "ta84@university.edu" sends email from both the local subnet and this IP address with the same subject lines. This blurs whether or not the IP address itself belongs to a spammer or it is some external email router that also includes spam. From 122.11.23.55, there are a handful of messages claiming to be the Better Business Bureau using addresses like "alerts@bbb.org". Since the domain in the "to" field is an edu address for a university, this could have been a legitimate email campaign sent out by an automated system based on BBB complaints to an address found at the university domain. But whether or not this is really from the BBB, to the university this looks spammy. Looking up the IP addresses, 211.14.22.13 is located in Tokyo and 122.11.23.55 is located in Hong Kong. Since we don't know where this information was sourced from, we can't tell if that is local to the receivers/university or not.

6. *What spam messages made it past the reputation-based filter? Describe two methods for detecting these messages at the message level. Hint: if the AV verdict is CLEAN and the spam CASE engine reports "negative", then the emails are not detected as spam and will pass through the reputation-based filter. (e.g. not blocked by policy or signatures). If the AV verdict is "NOT" CLEAN and the spam CASE engine reports "positive" then emails are SPAM and will not pass (e.g. get blocked) at the reputation-based filter.*

   Many messages made it past the spam filter for "Herbal Cures" and other types of obvious spam messages and domains, meaning that the reputation based filter is not sufficient. There are spammy domains getting through like "herbal-natural-cures.com" which might be caught in a better filter based on the domain for known spammers, though these are easy to fake or change and keeping an exhaustive list or pattern matching would be difficult. An overzealous domain or word based filter might catch more messages but could easily filter legitimate email.

   Only one email was aborted due to matching a filter. MID 455 refers to an email with the following records which shows the messages was dropped due to a content filter:

Fri Aug 03 11:28:37 2012 Info: **Start MID 455 ICID 98**
Fri Aug 03 11:28:37 2012 Info: **MID 455 ICID 98 From: <manager@bbb.org>**
Fri Aug 03 11:28:37 2012 Info: **MID 455 ICID 98 RID 0 To: <kkw829@university.edu>**
Fri Aug 03 11:28:37 2012 Info: **MID 455 Message-ID '<4F3CE028.902050@bbb.org>'**
Fri Aug 03 11:28:37 2012 Info: **MID 455 Subject 'The BBB has registered a complaint about you'**
Fri Aug 03 11:28:37 2012 Info: **MID 455 ready 887 bytes from <manager@bbb.org>**
Fri Aug 03 11:28:37 2012 Info: **MID 455 matched all recipients for per-recipient policy DEFAULT in the inbound table**
Fri Aug 03 11:28:37 2012 Info: **MID 455 interim verdict using engine: CASE spam negative**
Fri Aug 03 11:28:37 2012 Info: **MID 455 using engine: CASE spam negative**
Fri Aug 03 11:28:37 2012 Info: **MID 455 interim AV verdict using Sophos CLEAN**
Fri Aug 03 11:28:37 2012 Info: **MID 455 antivirus negative**
Fri Aug 03 11:28:37 2012 Info: **Message aborted MID 455 Dropped by content filter 'name_filter' in the inbound table**
Fri Aug 03 11:28:37 2012 Info: **Message finished MID 455 done**

This also shows that the message was spam negative and antivirus negative, and was caught by a content filter for "name_filter". However, the address "manager@bbb.org" made it through in other

email, the "to" field received other email, and the same subject is present in other emails. In fact MID 456 has identical content but was not filtered. This means the content filter caught the message once for MID 455 but not a second time for MID 456. Likely the content filter is not sufficient or accurate at matching for "name_filter" and spam is slipping through. If keyword filtering or filtering based on previously matched examples were implemented, this second message with identical content could have been caught and discarded or marked as spam too. A good system might be to implement layers of filtering rather than a few simple checks. If messages make it past the reputation filter, it should then be checked against messages previously marked as spam and dropped to not let the same message through. Then it should then move on to domain filtering to mark potential spam from known spammers. If stringent spam protection were needed, then keyword or common strings could be checked in the subject and body of the messages. In addition, IP filtering or rate limiting would likely effect some innocent parties but it could be an effective means of preventing excessive resource usage. It would be a good idea to make the blocking and throttling have an expiration to prevent legitimate addresses from being permanently blocked and messages from being undelivered or unnecessarily delayed.

Sources

JHU 741 Mod 11 Lecture materials

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   https://docs.splunk.com/Documentation/Splunk/8.1.0/SearchReference/Search

Appendix

Unique From Addresses (376): {'robert.jones@medicines.com', 'ta84@university.edu', 'john.harlow@university.edu', 'watson.devere@medicines.com', 'frank.houseman@medicines.com', 'sarah.robertson@cures.com', 'willis.roberts@cures.com', 'watson.roberts@medicines.com', 'robert.roberts@university.edu', 'will.robertson@herbal-natural-cures.com', 'bill.franklin@university.edu', 'sally.solo@cures.com', 'joseph.lipstern@cures.com', 'sally.roberts@all-natural.com', 'harry.jones@all-natural.com', 'will.roberts@medicines.com', 'will.jones@all-natural.com', 'will.harlow@university.edu', 'harry.roberts@all-natural.com', 'robert.robertson@cures.com', 'harry.franklin@herbal-natural-cures.com', 'willis.devere@all-natural.com', 'sally.houseman@herbal-natural-cures.com', 'willis.harlow@medicines.com', 'sarah.harlow@herbal-natural-cures.com', 'harry.roberts@university.edu', 'sarah.devere@university.edu', 'sarah.lipstern@medicines.com', 'watson.smith@herbal-natural-cures.com', 'watson.smith@university.edu', 'bill.robertson@medicines.com', 'sally.jones@herbal-natural-cures.com', 'sarah.franklin@university.edu', 'robert.robertson@university.edu', 'watson.williams@medicines.com', 'watson.robertson@medicines.com', 'joseph.lipstern@university.edu', 'will.houseman@cures.com', 'will.franklin@medicines.com', 'ted.roberts@all-natural.com', 'joseph.jones@herbal-natural-cures.com', 'robert.williams@university.edu', 'sarah.robertson@medicines.com', 'will.solo@herbal-natural-cures.com', 'john.smith@all-natural.com', 'robert.roberts@medicines.com', 'sarah.solo@all-

natural.com', 'bill.willis@cures.com', 'willis.willis@all-natural.com', 'robert.willis@medicines.com', 'ted.franklin@all-natural.com', 'sarah.houseman@herbal-natural-cures.com', 'frank.devere@university.edu', 'sarah.lipstern@cures.com', 'robert.smith@university.edu', 'jean.lipstern@all-natural.com', 'john.robertson@herbal-natural-cures.com', 'frank.solo@all-natural.com', 'frank.devere@herbal-natural-cures.com', 'ted.williams@cures.com', 'bill.williams@all-natural.com', 'wht22@university.edu', 'oq82@university.edu', 'bill.devere@all-natural.com', 'sarah.lipstern@all-natural.com', 'bill.jones@university.edu', 'john.robertson@all-natural.com', 'bill.solo@herbal-natural-cures.com', 'xb88@university.edu', 'harry.franklin@university.edu', 'watson.franklin@all-natural.com', 'joseph.harlow@university.edu', 'frank.williams@cures.com', 'frank.devere@medicines.com', 'watson.jones@herbal-natural-cures.com', 'john.lipstern@cures.com', 'jean.robertson@medicines.com', 'willis.lipstern@all-natural.com', 'ted.harlow@university.edu', 'ted.robertson@cures.com', 'robert.smith@medicines.com', 'harry.houseman@cures.com', 'ted.lipstern@university.edu', 'willis.houseman@herbal-natural-cures.com', 'frank.roberts@medicines.com', 'will.lipstern@cures.com', 'harry.jones@medicines.com', 'joseph.lipstern@herbal-natural-cures.com', 'jean.lipstern@university.edu', 'robert.willis@herbal-natural-cures.com', 'willis.smith@medicines.com', 'ted.smith@all-natural.com', 'jean.smith@herbal-natural-cures.com', 'sally.smith@herbal-natural-cures.com', 'frank.robertson@university.edu', 'watson.franklin@herbal-natural-cures.com', 'will.devere@cures.com', 'bill.smith@cures.com', 'john.houseman@medicines.com', 'will.smith@medicines.com', 'joseph.franklin@herbal-natural-cures.com', 'sarah.harlow@university.edu', 'sally.harlow@medicines.com', 'joseph.willis@cures.com', 'john.franklin@all-natural.com', 'watson.roberts@herbal-natural-cures.com', 'ted.willis@all-natural.com', 'harry.jones@university.edu', 'sarah.smith@herbal-natural-cures.com', 'sally.devere@all-natural.com', 'jean.houseman@cures.com', 'will.williams@herbal-natural-cures.com', 'watson.jones@medicines.com', 'robert.robertson@herbal-natural-cures.com', 'joseph.smith@cures.com', 'john.smith@medicines.com', 'will.lipstern@university.edu', 'will.solo@medicines.com', 'sarah.willis@all-natural.com', 'sally.roberts@herbal-natural-cures.com', 'jean.solo@herbal-natural-cures.com', 'john.lipstern@herbal-natural-cures.com', 'harry.roberts@medicines.com', 'jean.jones@cures.com', 'ted.robertson@medicines.com', 'jean.smith@all-natural.com', 'harry.williams@all-natural.com', 'watson.robertson@cures.com', 'jean.devere@all-natural.com', 'watson.lipstern@cures.com', 'joseph.willis@all-natural.com', 'robert.harlow@university.edu', 'ted.roberts@cures.com', 'will.willis@all-natural.com', 'joseph.robertson@all-natural.com', 'willis.franklin@cures.com', 'sally.devere@university.edu', 'sarah.smith@university.edu', 'sally.williams@medicines.com', 'john.roberts@herbal-natural-cures.com', 'jean.smith@university.edu', 'sarah.jones@cures.com', 'willis.smith@university.edu', 'harry.lipstern@medicines.com', 'fb34@university.edu', 'ted.solo@herbal-natural-cures.com', 'robert.williams@medicines.com', 'john.willis@university.edu', 'robert.devere@all-natural.com', 'jean.jones@herbal-natural-cures.com', 'ted.smith@herbal-natural-cures.com', 'willis.harlow@cures.com', 'watson.houseman@all-natural.com', 'bill.solo@all-natural.com', 'jean.harlow@all-natural.com', 'john.devere@medicines.com', 'ted.houseman@herbal-natural-cures.com', 'robert.williams@herbal-natural-cures.com', 'sarah.solo@cures.com', 'sally.jones@university.edu', 'sarah.devere@all-natural.com', 'frank.smith@cures.com', 'willis.harlow@university.edu', 'sarah.willis@cures.com', 'watson.franklin@cures.com', 'robert.devere@cures.com', 'sally.lipstern@cures.com', 'john.houseman@cures.com', 'jean.lipstern@medicines.com', 'jean.roberts@university.edu', 'jean.franklin@medicines.com', 'md5i@university.edu', 'frank.robertson@medicines.com', 'sarah.franklin@cures.com', 'watson.lipstern@university.edu', 'harry.robertson@university.edu', 'ted.robertson@herbal-natural-cures.com', 'robert.solo@cures.com', 'frank.solo@herbal-natural-cures.com', 'john.devere@university.edu', 'jean.houseman@all-natural.com', 'john.willis@all-natural.com', 'john.smith@cures.com', 'jean.franklin@cures.com', 'ts30@university.edu',

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'robert.franklin@all-natural.com', 'will.roberts@university.edu', 'jean.harlow@university.edu', 'jean.harlow@cures.com', 'john.williams@university.edu', 'willis.franklin@herbal-natural-cures.com', 'willis.houseman@cures.com', 'ted.harlow@cures.com', 'joseph.smith@herbal-natural-cures.com', 'john.solo@herbal-natural-cures.com', 'km44@university.edu', 'john.houseman@all-natural.com', 'watson.smith@medicines.com', 'jean.devere@herbal-natural-cures.com', 'sarah.jones@all-natural.com', 'bill.devere@medicines.com', 'jean.willis@medicines.com', 'harry.solo@all-natural.com', 'ted.harlow@all-natural.com', 'joseph.jones@cures.com', 'will.franklin@cures.com', 'sally.houseman@cures.com', 'alerts@bbb.org', 'sally.smith@cures.com', 'will.harlow@all-natural.com', 'joseph.houseman@university.edu', 'harry.harlow@medicines.com', 'jean.franklin@university.edu', 'watson.lipstern@herbal-natural-cures.com', 'robert.lipstern@herbal-natural-cures.com', 'will.robertson@all-natural.com', 'will.williams@university.edu', 'bill.roberts@all-natural.com', 'watson.smith@all-natural.com', 'robert.houseman@cures.com', 'willis.willis@university.edu', 'sarah.smith@all-natural.com', 'webmaster@irs.com', 'sarah.franklin@medicines.com', 'jean.willis@herbal-natural-cures.com', 'robert.houseman@university.edu', 'will.harlow@herbal-natural-cures.com', 'watson.solo@all-natural.com', 'ted.houseman@university.edu', 'will.smith@herbal-natural-cures.com', 'jean.williams@herbal-natural-cures.com', 'robert.devere@university.edu', 'onlinebanking@ealerts.bankofamerica.com', 'willis.lipstern@medicines.com', 'sally.franklin@herbal-natural-cures.com'}

Unique From Domains (8): {'ealerts.bankofamerica.com', 'bbb.org', 'medicines.com', 'university.edu', 'irs.com', 'herbal-natural-cures.com', 'all-natural.com', 'cures.com'}

Unique To Addresses (116): {'tu22@university.edu', 'ta84@university.edu', 'cm38@university.edu', 'vm90@university.edu', 'ia03@university.edu', 'qb79@university.edu', 'fi21@university.edu', 'zm09@university.edu', 'zz927@phys.university.edu', 'pi87@university.edu', 'oh90@university.edu', 'qa67@university.edu', 'cg06@university.edu', 'wk06@university.edu', 'lv74@university.edu', 'fk86@university.edu', 'lv83@university.edu', 'cc39@university.edu', 'di81@university.edu', 'ck95@university.edu', 'ok40@university.edu', 'aa39@university.edu', 'sh22@university.edu', 'mh87@university.edu', 'sb78@university.edu', 'mf33@university.edu', 'wh82@university.edu', 'gw87@university.edu', 'ae62@university.edu', 'or59@university.edu', 'is95@university.edu', 'uo36@university.edu', 'ef33@university.edu', 'thy9982@phys.university.edu', 'mu07@university.edu', 'my50@university.edu', 'gj05@university.edu', 'kr23@university.edu', 'dt84@university.edu', 'ls81@university.edu', 'ir62@university.edu', 'qj70@university.edu', 'sn94@university.edu', 'sv20@university.edu', 'ip85@university.edu', 'fc39@university.edu', 'rt66@university.edu', 'bz54@university.edu', 'yb93@university.edu', 'fb34@university.edu', 'gv47@university.edu', 'yb60@university.edu', 'dp39@university.edu', 'kh80@university.edu', 'ys19@university.edu', 're92@university.edu', 'ik29@university.edu', 'tl16@university.edu', 'ka69@university.edu', 'kb66@university.edu', 'vz20@university.edu', 'ed79@university.edu', 'je13@university.edu', 'lp46@university.edu', 'ls01@university.edu', 'oq82@university.edu', 'wht22@university.edu', 'mu73@university.edu', 'km44@university.edu', 'ta09@university.edu', 'dd02@university.edu', 'tw18@university.edu', 'sj06@university.edu', 'zv37@university.edu', 'fm08@university.edu', 'da15@university.edu', 'pr69@university.edu', 'tl87@university.edu', 'xb88@university.edu', 'mi29@university.edu', 'bm24@university.edu', 'yz15@university.edu', 'ld55@university.edu', 'hy81@university.edu', 'rt20@university.edu', 'xa97@university.edu', 'jt53@university.edu', 'ar75@university.edu', 'vc26@university.edu', 'ag37@university.edu', 'zs64@university.edu', 'mc7f@university.edu', 'mf91@university.edu', 'vj85@university.edu', 'md5i@university.edu',

'kkw829@university.edu', 'tm22@university.edu', 'pi10@university.edu', 'mh60@university.edu',
'sa87@university.edu', 'po60@university.edu', 'no48@university.edu', 'ss928@university.edu',
'iy28@university.edu', 'ae45@university.edu', 'pb22@university.edu', 'pp03@university.edu',
'sn63@university.edu', 'us18@university.edu', 'vb92@university.edu', 'ts30@university.edu',
'qt40@university.edu', 'go69@university.edu', 'uj47@university.edu', 'bc30@university.edu',
'mx22@university.edu'}

Unique To Domains (2): {'phys.university.edu', 'university.edu'}