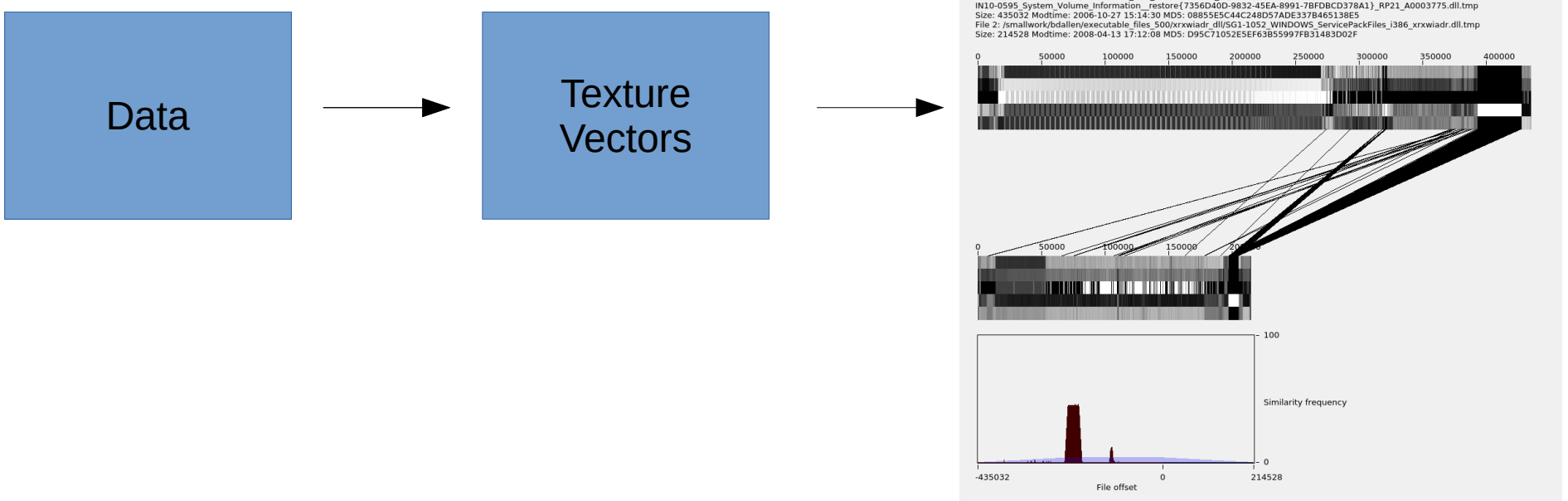
Texture Vector

Using Texture Vector Analysis to Identify File Similarity

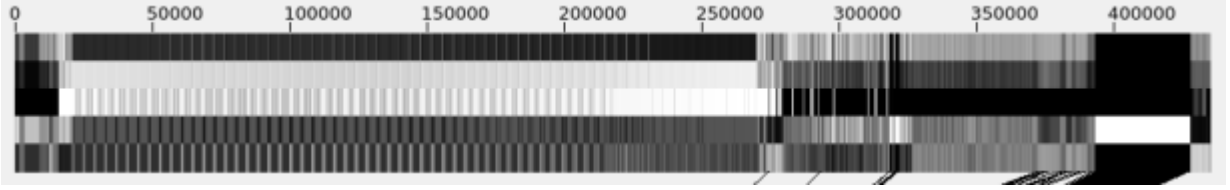
Texture Vector Similarity

- Can texture vectors imply similarity?



Texture Vector Anatomy

- A Texture Vector is a vector of transforms on a section of data
- Transforms are:
  - Standard Deviation
  - Mean
  - Mode
  - Mode Count
  - Entropy
- Collectively, they produce the file's "fingerprint" as a spectrogram:

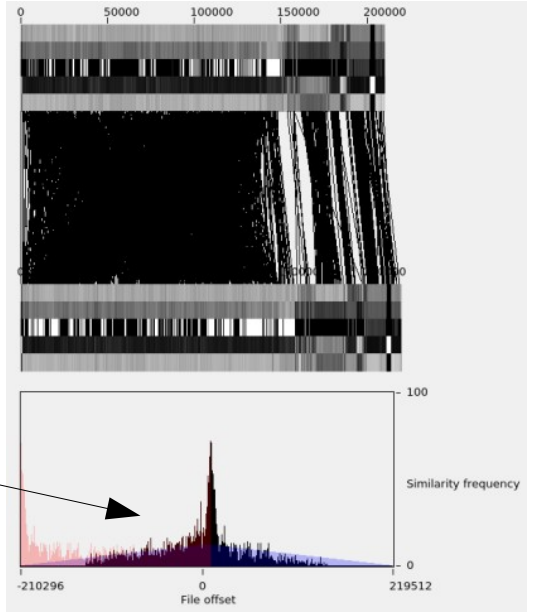


Similarity Measures

- Texture-Vector similarity: Euclidean distance:

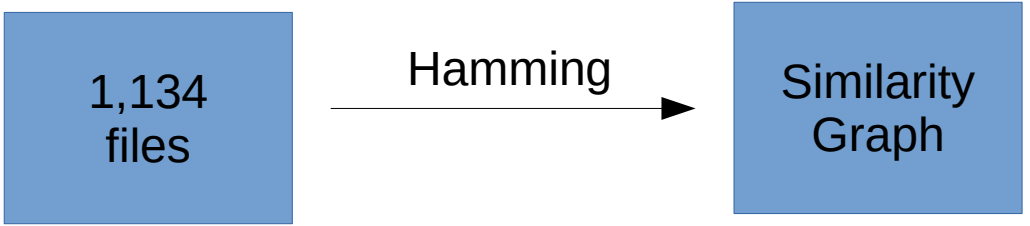
$$s = w_1(dv_1)^2 + w_2(dv_2)^2 + w_3(dv_3)^2 + w_4(dv_4)^2 + w_5(dv_5)^2$$

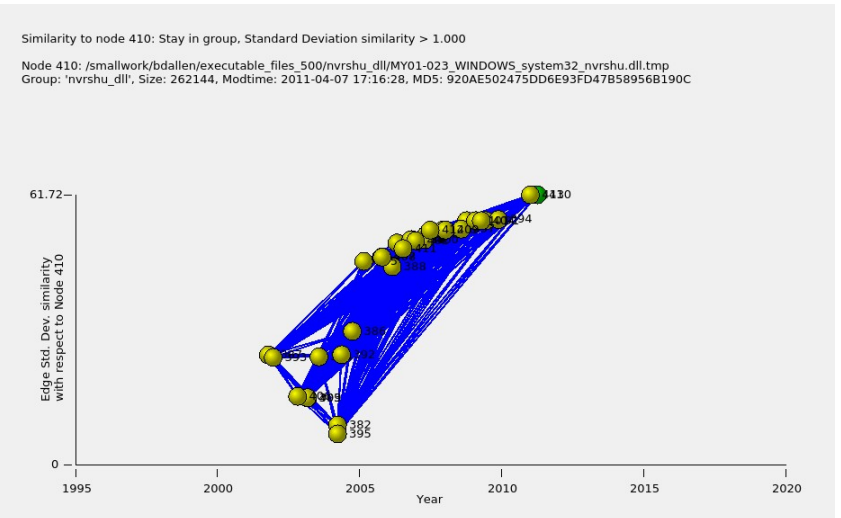
- File similariry measure = f(histogram(f(offsets between similar texture-vectors)))
  - histogram is from similar texture-vector offsets
  - similarity measure is from histogram variance



Data

- 1,134 files
- 23 groups of similar files
- 642,411 similarity comparisons





Similarity by File Group

- Files within file groups are more similar than files across file groups
  - usually

Family	n	1	2	3	4	5	6	7	8	9	10	11	12
a0003775_dll	1	4.5	1.2	5.4	2.1	3.8	3.0	3.6	2.8	2.2	3.3	5.1	2.3
bthserv_dll	2	1.2	3.7	1.2	0.7	0.7	0.7	0.5	0.7	0.6	0.3	0.9	0.6
ccalert_dll	3	5.4	1.2	11.4	2.5	3.9	3.2	2.2	2.9	3.6	4.3	4.8	2.2
cdfview_dll	4	2.1	0.7	2.5	10.0	1.3	1.1	1.6	2.2	1.8	0.9	1.7	0.8
dunzip32_dll	5	3.8	0.7	3.9	1.3	5.1	2.3	4.0	2.1	2.0	3.4	3.6	1.6
hotfix_exe	6	3.0	0.7	3.2	1.1	2.3	8.5	1.3	2.0	1.4	3.8	3.1	1.6
iexplore_exe	7	3.6	0.5	2.2	1.6	4.0	1.3	130.2	9.3	1.6	2.4	1.5	7.5
mobsync_exe	8	2.8	0.7	2.9	2.2	2.1	2.0	9.3	6.1	1.5	2.3	2.7	1.6
msrdc_dll	9	2.2	0.6	3.6	1.8	2.0	1.4	1.6	1.5	4.5	1.4	2.0	0.9
nvrshu_dll	10	3.3	0.3	4.3	0.9	3.4	3.8	2.4	2.3	1.4	32.9	6.2	2.1
pacman_exe	11	5.1	0.9	4.8	1.7	3.6	3.1	1.5	2.7	2.0	6.2	1.5	2.2
policytool_exe	12	2.3	0.6	2.2	0.8	1.6	1.6	7.5	1.6	0.9	2.1	2.2	2.6
powerpnt_exe	13	3.5	0.4	2.2	1.1	3.1	1.5	41.2	5.8	1.4	2.6	2.2	4.6
rtinstaller32_exe	14	3.4	0.9	4.1	2.0	3.6	2.0	1.6	2.3	2.2	2.3	2.8	1.2
safrslv_dll	15	1.9	0.9	2.2	1.1	1.2	1.6	1.1	1.1	0.7	2.0	2.0	1.0
tabulate_drive_data_py	16	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	-	0.1	-	0.3
typeaheadfind_dll	17	0.9	0.6	1.3	0.7	0.4	0.3	0.4	0.5	0.7	0.1	0.7	0.5
udlaunch_exe	18	2.9	0.4	3.3	1.1	2.5	-	1.3	1.7	1.8	3.3	3.0	-
vsplugin_dll	19	3.0	0.6	3.4	1.0	2.0	2.5	4.0	1.8	1.2	3.2	3.0	1.6
webclnt_dll	20	3.3	1.0	3.6	1.1	2.3	1.3	1.8	1.8	1.5	2.2	2.8	1.0
winprint_dll	21	0.8	0.5	0.9	0.4	0.6	0.5	0.4	0.5	0.5	0.4	0.6	0.6
wmplayer_exe	22	3.1	0.4	3.1	0.9	2.4	2.0	21.7	3.6	1.3	3.0	2.8	2.4
xrxwiadr_dll	23	11.5	0.8	12.1	2.5	9.2	4.1	3.2	4.6	3.3	12.9	13.0	3.8

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ccalert_dll	3	2.2	4.1	2.2	0.1	1.3	3.3	3.4	3.6	0.9	3.1	12.1
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dunzip32_dll	5	3.1	3.6	1.2	0.1	0.4	2.5	2.0	2.3	0.6	2.4	9.2
hotfix_exe	6	1.5	2.0	1.6	0.1	0.3	-	2.5	1.3	0.5	2.0	4.1
iexplore_exe	7	41.2	1.6	1.1	0.2	0.4	1.3	4.0	1.8	0.4	21.7	3.2
mobsync_exe	8	5.8	2.3	1.1	0.1	0.5	1.7	1.8	1.8	0.5	3.6	4.6
msrdc_dll	9	1.4	2.2	0.7	-	0.7	1.8	1.2	1.5	0.5	1.3	3.3
nvrshu_dll	10	2.6	2.3	2.0	0.1	0.1	3.3	3.2	2.2	0.4	3.0	12.9
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powerpnt_exe	13	76.0	1.5	1.0	0.2	0.2	1.5	2.8	1.7	0.3	12.6	8.2
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safrslv_dll	15	1.0	1.1	3.3	0.1	0.8	-	1.4	1.2	0.6	1.1	2.6
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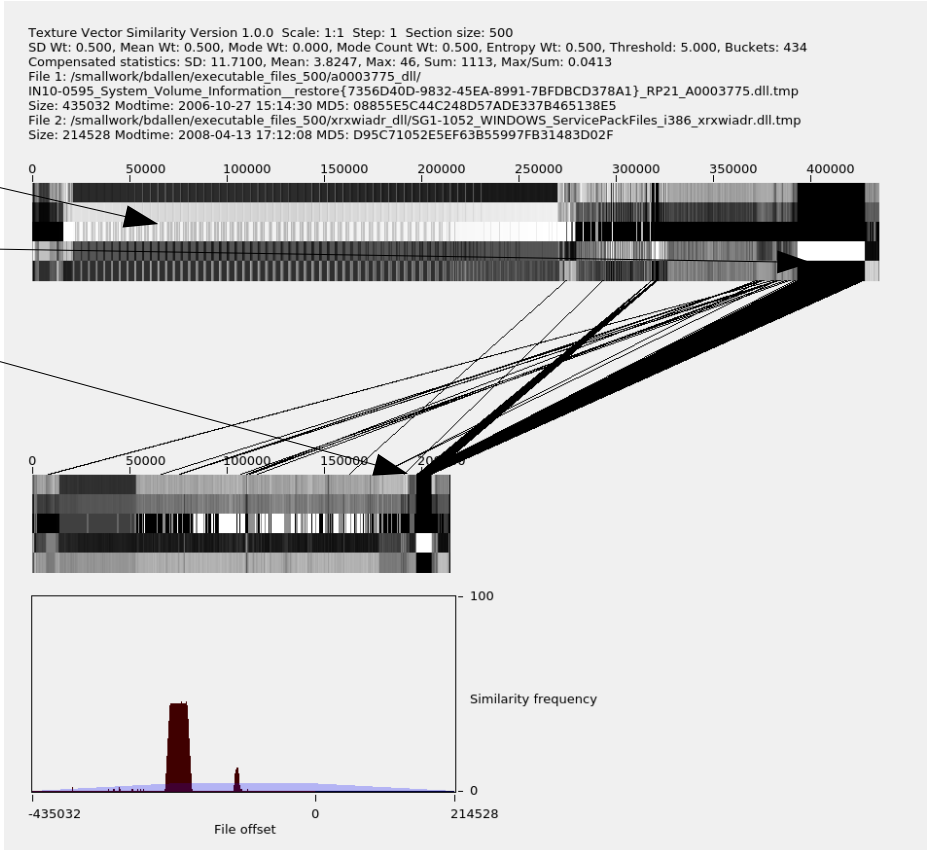
webclnt_dll	20	1.7	2.0	1.2	0.2	0.8	0.9	1.7	3.8	0.7	1.5	5.0
winprint_dll	21	0.3	0.6	0.6	-	0.4	0.5	0.5	0.7	1.1	0.4	0.6
wmplayer_exe	22	12.6	1.7	1.1	0.1	0.2	2.2	2.7	1.5	0.4	9.1	5.7
xrxwiadr_dll	23	8.2	6.3	2.6	0.3	0.6	3.6	3.5	5.0	0.6	5.7	15.9

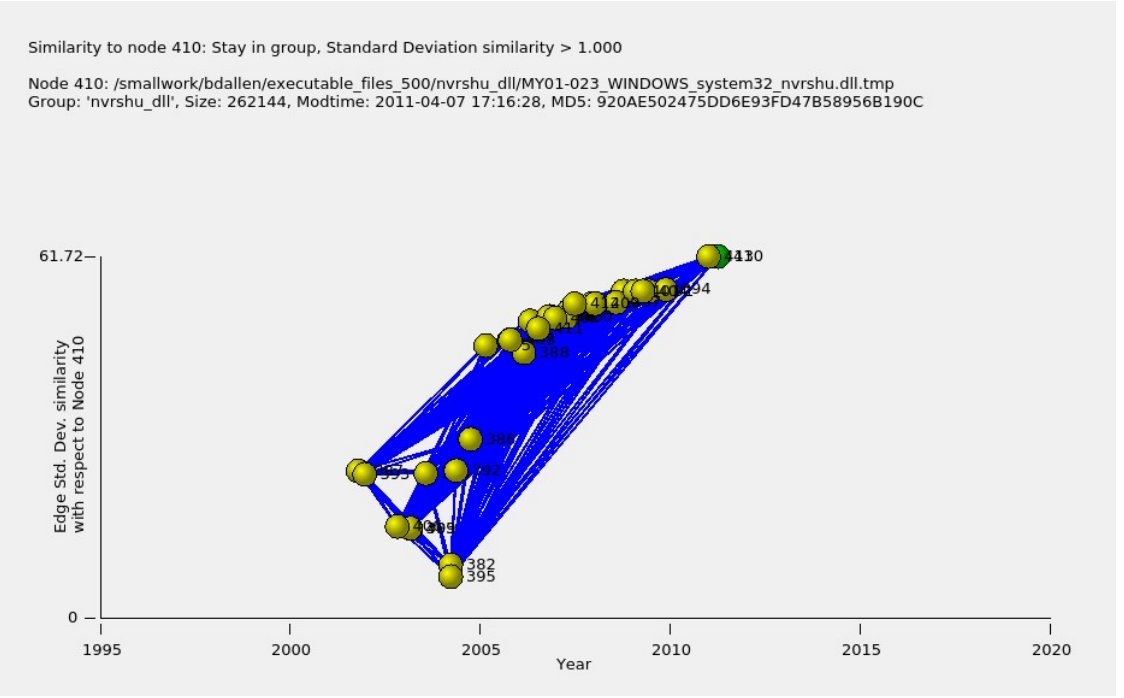
False Positives

- Data regions
- High entropy



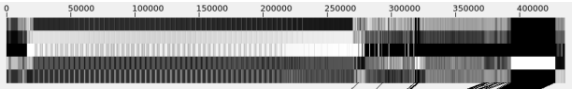
Time-based Analysis

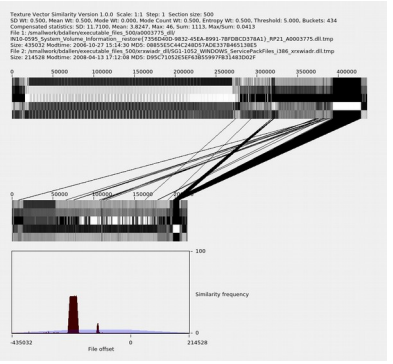
- Similarity based on timestamp
  - Version inference
  - Virus injection

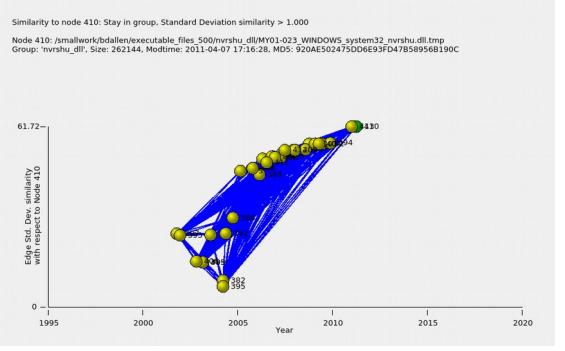


Texture-Vector Similarity Distribution

- Tools
  - calc_tv.py calculates texture vectors
  - tv.py calculates and plots similarities between two files
  - tv_browser.py graphs similarities by timestamp
- Dataset
  - The Similarity Graph data from the 1,134 files
- https://github.com/NPS-DEEP/tv_sim







Future Work

- Classify file types by their texture
- Evaluate similarity using texture trends
- Manage false-positives