Data Mining NetFlow

So What's Next?

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Objectives

- Data Mining, very briefly
- Frequency Patterns
- Discoveries
- Realizations
- Changes Made

Data Mining

Data Mining – automated extraction of previously unknown data that is interesting and potentially useful.

Cost of Participating in Data Mining

Reality	Result of Data Mining	Example Analyst Hours	Example Investigator Hours	Example SysAdmin Hours	Result
YES	YES	10	10	10	Crime Prevented / Prosecuted
NO	NO	0	0	0	-
YES	NO	∞	∞	∞	Time Lost to Investigate and Clean Up After Crime
NO	YES	10	10	10	Red Haring

Complexity of Mining NetFlow

- Shear Volume
- Complex Protocol Analysis
- Ambiguous Interpretations
- Very Smart Adversaries

Common Investigator Issues

- Undermanned and overworked
- Varied knowledge base
- Does not own networks
- No direct reporting structure

Data Mining Techniques

Primary Techniques

- Rule and Tree Induction
- Characterization
- **Classification**
- Regression
- Association
- **Clustering**

Other Techniques

- Dependency Modeling
- **Change Detection**
- Trend Analysis
- Deviation Detection
- **Link Analysis**
- Pattern Analysis
- Spatiotemporal Data Mining
- Mining Path Traversal Patterns
- **Mining Sequential/Frequent Patterns**

Uncertain Reasoning Techniques

- Fuzzy Logic
- Neural Networks
- Bayesian Networks
- Genetic Algorithms
- Rough Set Theory

Frequency Patterns

Mining Frequent Patterns in Data Streams in Multiple Time Granularities (Giennella, Han, Pei, Yan, and Yu)

- Support Decision Making
- Past Less Significant than Present
- Record Reduction
- Time Tilted Windows

Interpreting Time-Tilted Windows

	DAY								
Window		0		1		2		3	
Transition		N	Y	N	Y	N	Y	N	Y
Size		1	1	2	2	4	4	8	8
	Monday	9							
	Tuesday	15	9						
	Wednesday	6		12					
	Thursday	6	6	12					
	Friday	12		6	12				
	Saturday	16	12	6	12				
	Sunday	6		14		9			
	Monday	12	6	14		9			
	Tuesday	15		9	14	9			

Day 1: 9 events

Day 2: 15 events (two buckets)

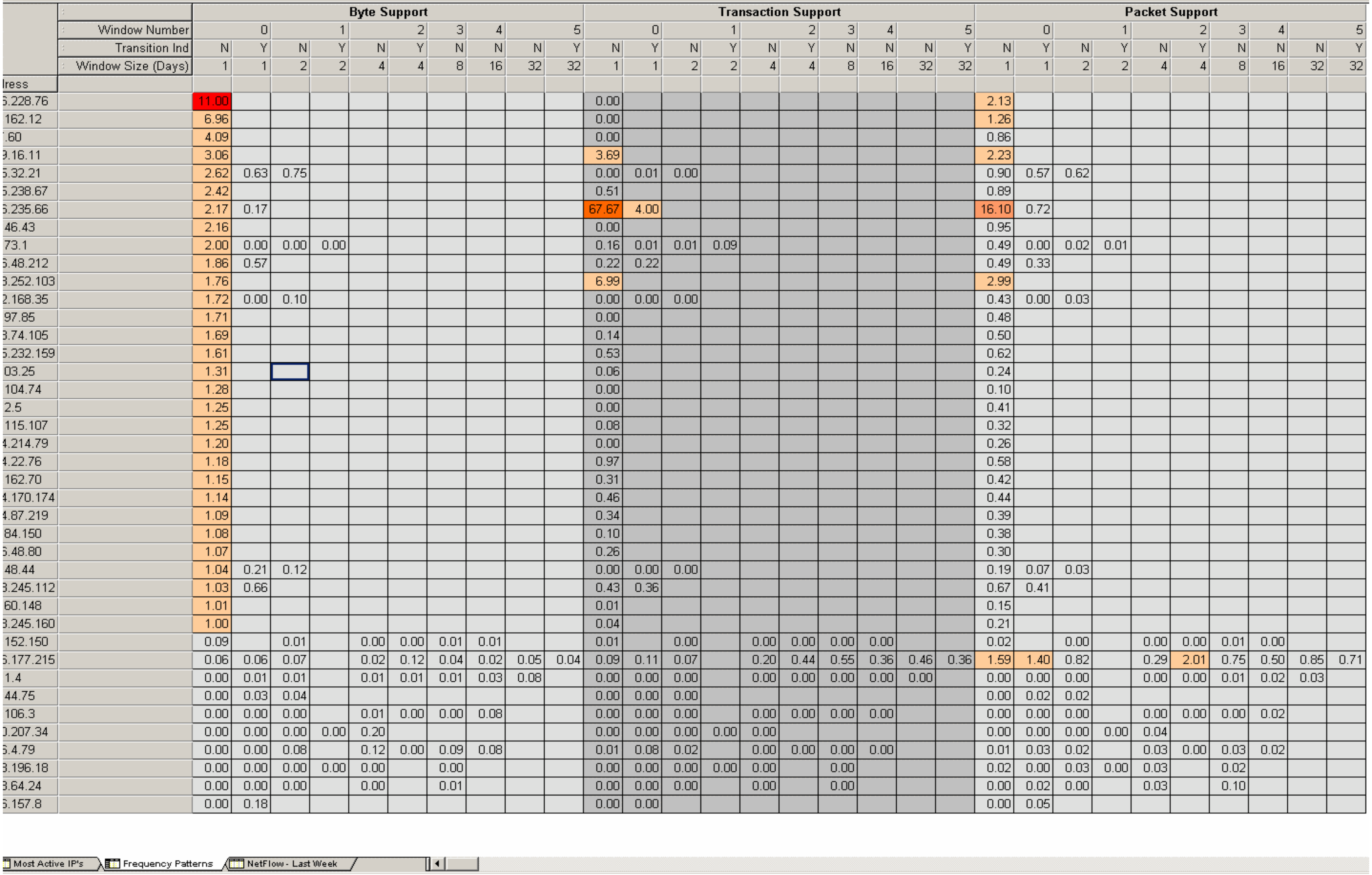
Day 3: 6 events (two buckets)

Day 4: 6 events (two buckets)

Day 5: 16 events (three buckets)

Day 6: 12 events (four buckets)

Presenting Frequency Patterns



		Byte Support										Transaction Support										Packet Support									
	Window Number	0		1		2		3	4	5		0		1		2		3	4	5		0		1		2		3	4	5	
	Transition Ind	N	Y	N	Y	N	Y	N	N	N	Y	N	Y	N	Y	N	Y	N	N	N	Y	N	Y	N	Y	N	Y	N	N	N	Y
	Window Size (Days)	1	1	2	2	4	4	8	16	32	32	1	1	2	2	4	4	8	16	32	32	1	1	2	2	4	4	8	16	32	32
lress																															
5.228.76		11.00										0.00										2.13									
162.12		6.96										0.00										1.26									
.60		4.09										0.00										0.86									
9.16.11		3.06										3.69										2.23									
5.32.21		2.62	0.63	0.75								0.00	0.01	0.00								0.90	0.57	0.62							
5.238.67		2.42										0.51										0.89									
6.235.66		2.17	0.17									67.67	4.00									16.10	0.72								
46.43		2.16										0.00										0.95									
73.1		2.00	0.00	0.00	0.00							0.16	0.01	0.01	0.09							0.49	0.00	0.02	0.01						
6.48.212		1.86	0.57									0.22	0.22									0.49	0.33								
3.252.103		1.76										6.99										2.99									
2.168.35		1.72	0.00	0.10								0.00	0.00	0.00								0.43	0.00	0.03							
97.85		1.71										0.00										0.48									
3.74.105		1.69										0.14										0.50									
5.232.159		1.61										0.53										0.62									
03.25		1.31										0.06										0.24									
104.74		1.28										0.00										0.10									
2.5		1.25										0.00										0.41									
115.107		1.25										0.08										0.32									
4.214.79		1.20										0.00										0.26									
4.22.76		1.18										0.97										0.58									
162.70		1.15										0.31										0.42									
4.170.174		1.14										0.46										0.44									
4.87.219		1.09										0.34										0.39									
84.150		1.08										0.10										0.38									
6.48.80		1.07										0.26										0.30									
48.44		1.04	0.21	0.12								0.00	0.00	0.00								0.19	0.07	0.03							
3.245.112		1.03	0.66									0.43	0.36									0.67	0.41								
60.148		1.01										0.01										0.15									
3.245.160		1.00										0.04										0.21									
152.150		0.09		0.01		0.00	0.00	0.01	0.01			0.01		0.00		0.00	0.00	0.00	0.00			0.02		0.00		0.00	0.00	0.01	0.00		
6.177.215		0.06	0.06	0.07		0.02	0.12	0.04	0.02	0.05	0.04	0.09	0.11	0.07		0.20	0.44	0.55	0.36	0.46	0.36	1.59	1.40	0.82		0.29	2.01	0.75	0.50	0.85	0.71
1.4		0.00	0.01	0.01		0.01	0.01	0.01	0.03	0.08		0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00		0.00	0.00	0.01	0.02	0.03	
44.75		0.00	0.03	0.04								0.00	0.00	0.00								0.00	0.02	0.02							
106.3		0.00	0.00	0.00		0.01	0.00	0.00	0.08			0.00	0.00	0.00		0.00	0.00	0.00	0.00			0.00	0.00	0.00		0.00	0.00	0.00	0.02		
0.207.34		0.00	0.00	0.00	0.00	0.20						0.00	0.00	0.00	0.00	0.00						0.00	0.00	0.00	0.00	0.04					
6.4.79		0.00	0.00	0.08		0.12	0.00	0.09	0.08			0.01	0.08	0.02		0.00	0.00	0.00	0.00			0.01	0.03	0.02		0.03	0.00	0.03	0.02		
3.196.18		0.00	0.00	0.00	0.00	0.00		0.00				0.00	0.00	0.00	0.00	0.00		0.00				0.02	0.00	0.03	0.00	0.03		0.02			
3.64.24		0.00	0.00	0.00		0.00		0.01				0.00	0.00	0.00		0.00		0.00				0.00	0.02	0.00		0.03		0.10			
6.157.8		0.00	0.18									0.00	0.00									0.00	0.05								

Data Mining Discoveries

- Failed email servers
- Previously, unknown trusted relationships
- Encryption without authentication
- Possible, but unproven intrusions

Data Mining Results

Frustrated Investigators

Frustrated Analysts

One Very Frustrated Developer

Changes to Employ Data Mining

Establish common basis of understanding

Establish criteria for reporting

- Geo-Resolution
- Timeliness
- Volume

Establish reporting procedures

Questions

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