From NLP to MLP

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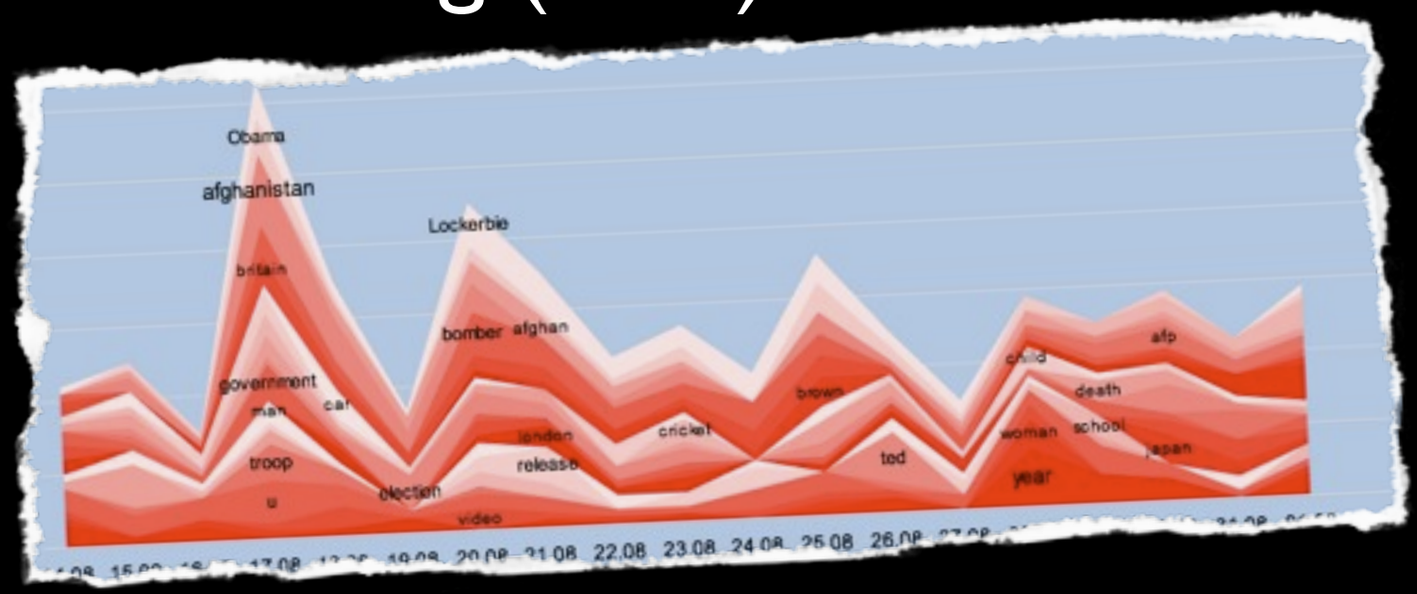
What to expect...

- Knowledge mining in various areas:
  - Event correlation, RDF data analysis, WIFI privacy, malware analysis
  - ... and e-Participation
- Common model based on ML and AI

e-Participation

- Natural Language Processing (NLP)
- Analysis of text
  - Clustering
- Relations
- Semantic aware search



Intro | Idea | MLP vs. NLP | Lexical Parser | POS(C) Tagging | Lemmatization | Activation Patterns | Analysis

Idea...

- In previous work, analysis of polymorphic shellcodes
- Neural networks for the detection of shellcode decryption loops
- Code vs. natural language?

NLP

- Natural Language Processing
- Various techniques are available
- Sentence analysis
- POS tagging
- Word sense disambiguation

MLP

- Machine Language Processing
- In this talk: focus on assembler, but applicable to any other language
- Assuming that machine language has similar properties as real language
- Semantics, grammar, (word/instruction) disambiguation

MLP

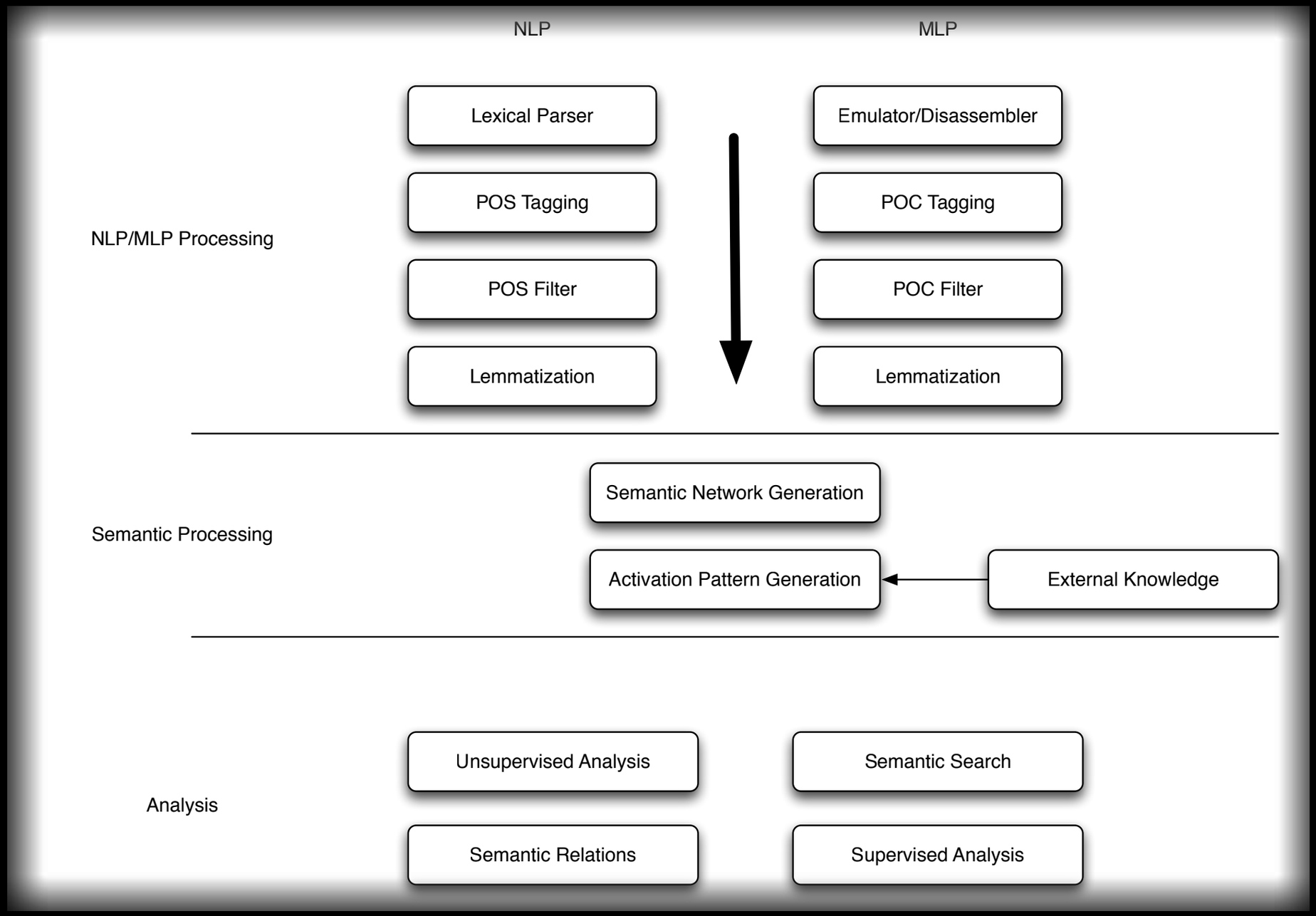
- Malware: Signatures? Understanding?
- Fuzzy analysis
  - Group code with similar behavior
  - Semantic search for similar code
  - Semantic relations within code

Goal

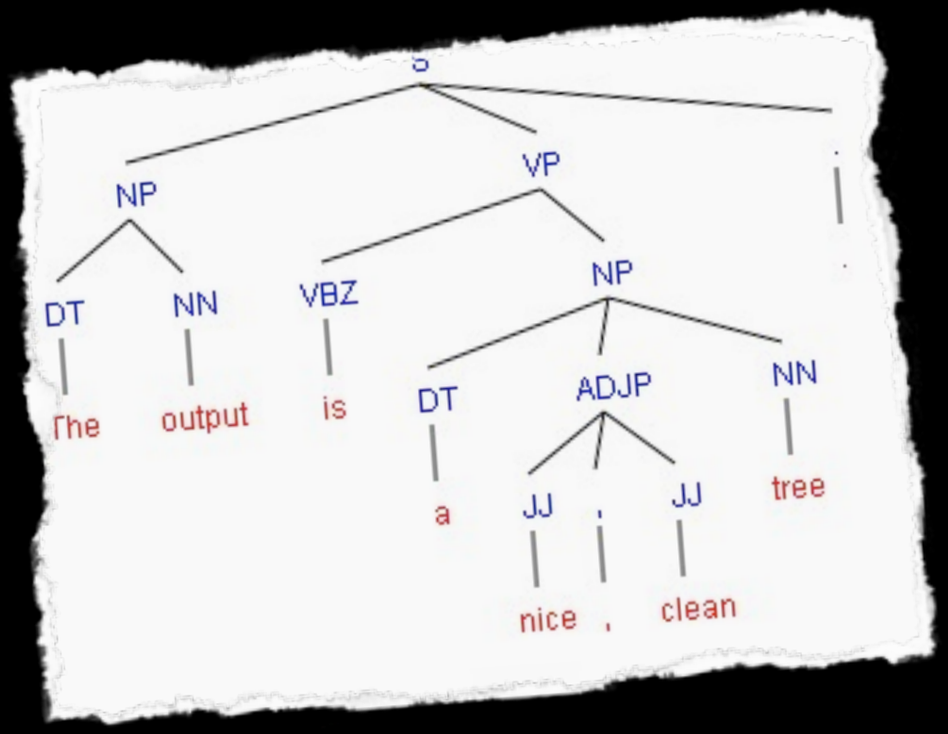
MLP vs. NLP

- Can we map NLP to MLP???
  - NLP research highly developed, mature frameworks, techniques
  - Problems in language analysis easier to spot, since we know our language very well

Layers

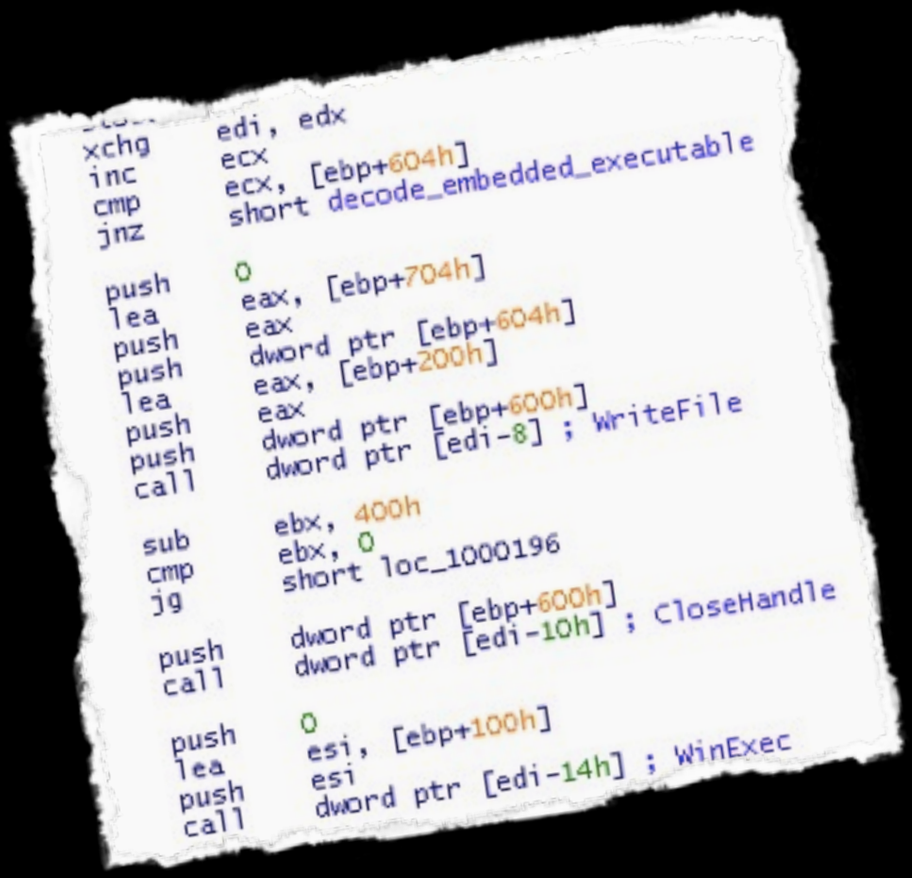

NLP
MLP
NLP/MLP Processing
Lexical Parser
POS Tagging
POS Filter
Lemmatization
Emulator/Disassembler
POC Tagging
POC Filter
Lemmatization
Semantic Processing
Semantic Network Generation
Activation Pattern Generation
External Knowledge
Analysis
Unsupervised Analysis
Semantic Relations
Semantic Search
Supervised Analysis

Lexical parser



- NLP:
  - Extract sentences, analyze terms, find relations (e.g. Stanford parser)
  - This beautiful_A city_N is_V called_V St. Petersburg_SN.

Lexical parser



- MLP:
  - instruction sequences (mov, sub, xor...)
  - relations between typical instructions (modifying the same register, variable)
  - e.g. interrupt preparation, loops e.g.

POS tagging, filter

- NLP:
  - This beautiful_A city_N is_V called_V St. Petersburg_SN.
- Tagging terms
- Filtering (stop words etc.): beautiful, city, St. Petersburg

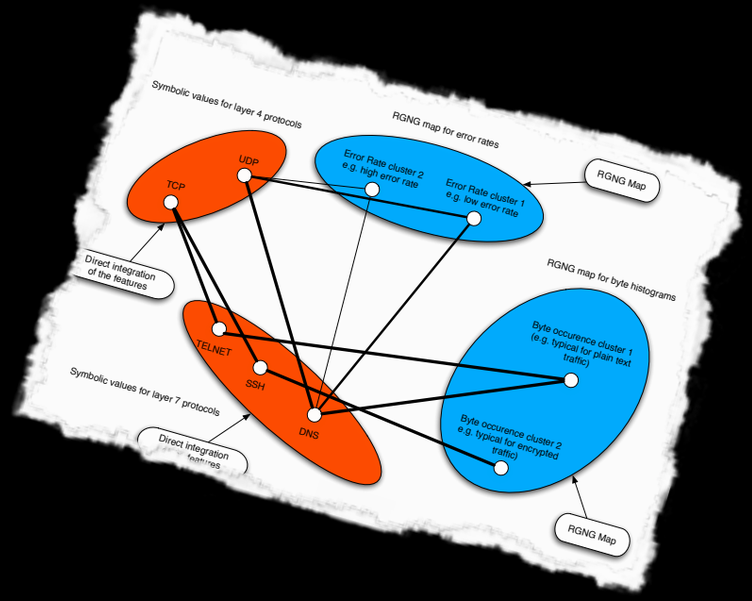
POC tagging, filter

- MLP:
  - jmp, call, jz... (branch type)
  - add, sub... (arithmetic)
  - xor... (logic)

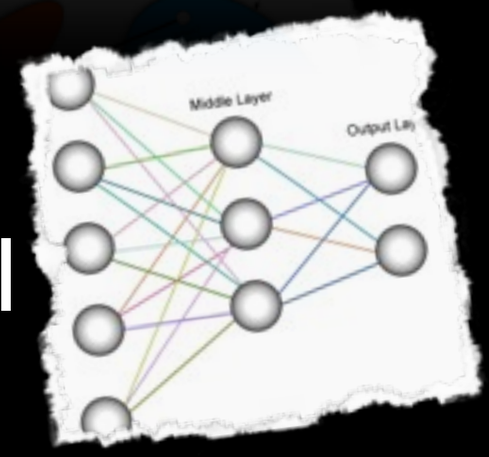
Lemmatization

- NLP:
  - bought => buy
  - cars => car
- MLP:
  - drop parameters (mov ax,4)
  - group instructions (arithmetic, logic)

Activation Patterns

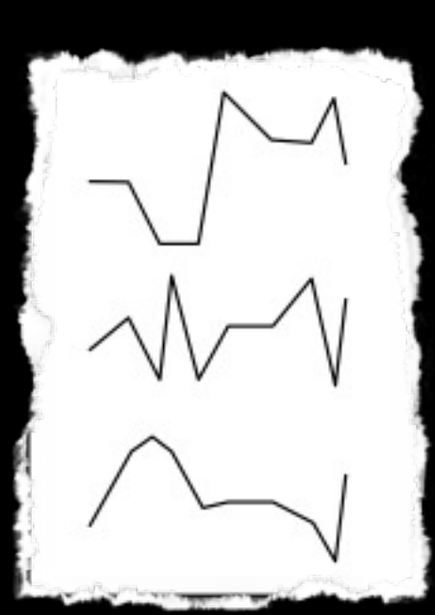


- Based on semantic networks, spreading activation, machine learning
- Allows us to analyze arbitrary combination of features (symbolic, real values)
- Patterns are the basis for a wide range of analysis methods

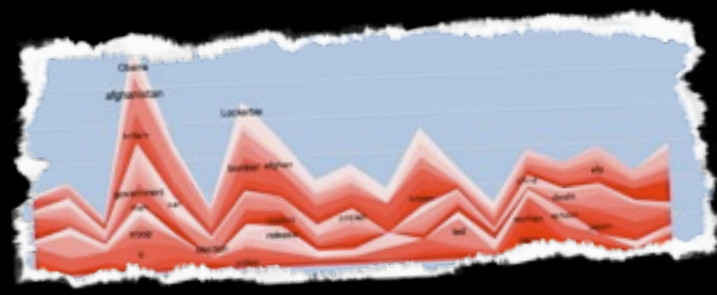


Analysis

- Unsupervised learning (clustering)
- Supervised learning (classifiers)
- Semantic search
- Semantic relations
- Anomaly detection
- Feature relevance



Applications



RDF Analysis

Event Correlation

Twitter Mining

Malware Analysis

e-Participation
Text analysis

User Tracking in WIFI Networks

MLP Example

- Metasploit shellcodes
- Decoder loops of various decryption engines
- Clustering, semantic search and relations

Clustering

- NLP:
  - Group similar documents, extract key concepts from clusters, gain quick overview
- MLP:
  - Group similar code (instruction sequences, functions, decryption loops)

Semantic Search

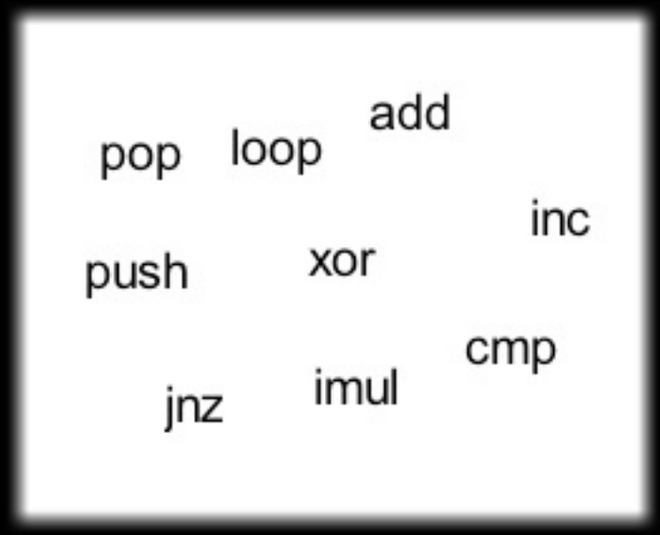
- NLP:
  - St. Petersburg is beautiful. The city was founded in 1703.
- MLP:
  - Search for similar concepts (decryption loops)

Result	Decoder	Instruction chain	Description
1	shikata-ga-nai	xor add add loop	Decoder
2	shikata-ga-nai	xor mov fnstenv pop mov xor add add loop	Decoder setup
3	nonalpha	pop mov add mov cmp jge	Decoder setup
4	fnstenv-mov	xor sub loop	Decoder
5	countdown	xor loop	Decoder

Semantic Relations

- NLP

- MLP



Thoughts...

- Same basic principles for NLP and MLP
- Use the existing knowledge, bring it to another domain
- Apply it to arbitrary language
- Understand malware/programs???

Thank you for your attention!