Modular Network Trace Analysis

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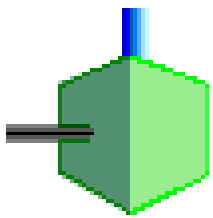
Overview

- Introduction
- Extensible data analysis toolkit (EDAT)
  - Philosophy
  - Caching
  - Executable Pieces of Code
- Demo



Introduction

- Our goal: evaluate (wireless multihop) networks in simulations and real-world experiments
- Results in a number of (packet) trace files
- Interpretation based on these files

time	mac_src	mac_dst	ip_src	ip_dst	size	ip_hlen
1194969596.6634	00022baf899c	ffffffffffff	192.168.5.55	192.168.5.51	95	5

time	mac_src	mac_dst	ip_src	ip_dst	size	ip_hlen
1194969596.64087	0020e04d089a	ffffffffffff	192.168.5.51	192.168.5.255	100	5
1194969596.66921	00013607670b	ffffffffffff	192.168.5.52	192.168.5.255	100	5
1194969596.68486	0020e04d089a	ffffffffffff	192.168.5.51	192.168.5.255	100	5
1194969596.70771	00013607670b	ffffffffffff	192.168.5.52	192.168.5.255	100	5
1194969596.73287	0020e04d089a	ffffffffffff	192.168.5.51	192.168.5.255	100	5
1194969596.75165	00013607670b	ffffffffffff	192.168.5.52	192.168.5.255	100	5
1194969596.78087	0020e04d089a	ffffffffffff	192.168.5.51	192.168.5.255	100	5
1194969596.79949	00013607670b	ffffffffffff	192.168.5.52	192.168.5.255	100	5
1194969596.82488	0020e04d089a	ffffffffffff	192.168.5.51	192.168.5.255	100	5
1194969596.84786	00013607670b	ffffffffffff	192.168.5.52	192.168.5.255	100	5
1194969596.86888	0020e04d089a	ffffffffffff	192.168.5.51	192.168.5.255	100	5
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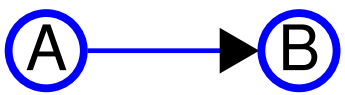

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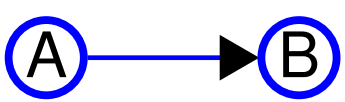

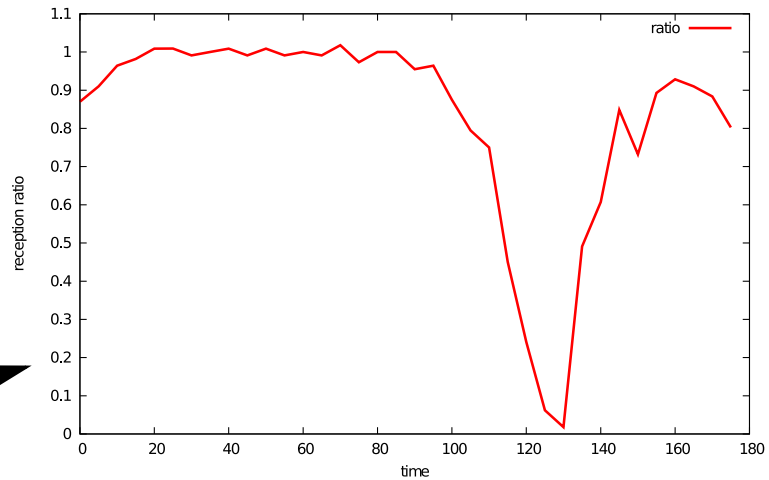

Often used approach

Some “quick hack” evaluation tools (created for simulations or real-world experiments):

- Paper for conference, new tool: 410 LOC (ruby)
- Paper for Elsevier journal, new tool: 305 LOC (C/C++)
- Master’s thesis, extension of existing tool: 1630 LOC (perl)
- Master’s thesis, new tool: 1220 LOC (ruby)

Observations:

1. Small/Medium amount of data (a few ten MB max)
2. Programming effort
3. Reusability?

Observations

In most programs, different operations occur repeatedly:

- Parsing data in one or multiple files
- Mangling/Processing
  - Selecting values
  - Building differences
  - Group similar items together and count them
  - ...
- Plotting

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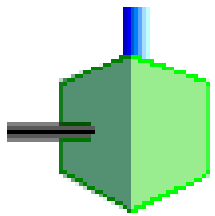
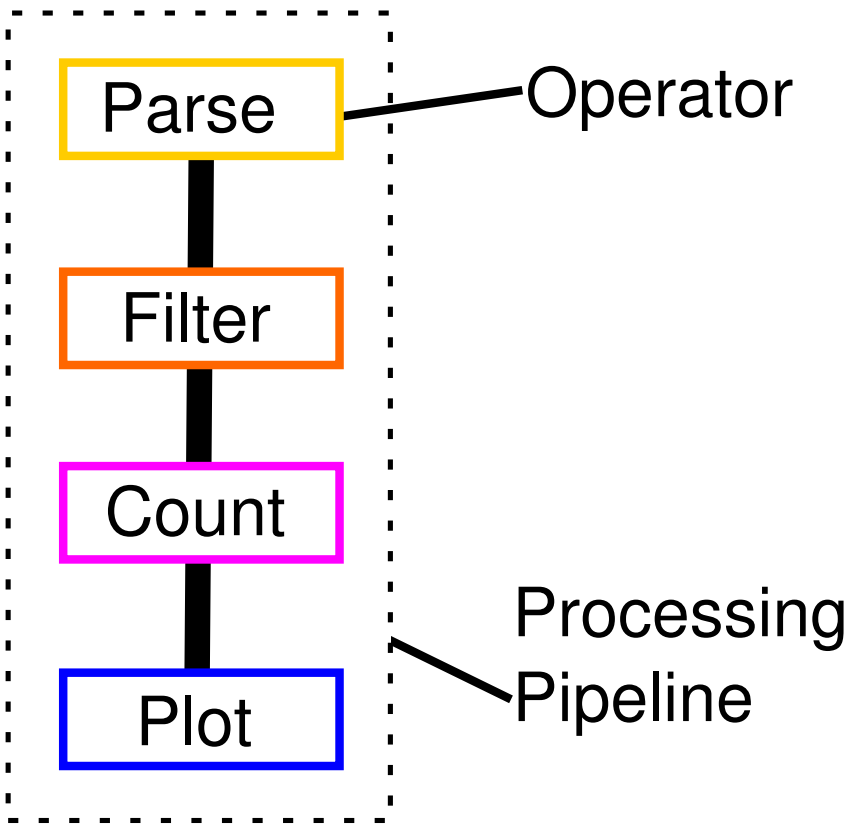
Consequence: Make recurring components reusable

EDAT:
Extensible data analysis toolkit



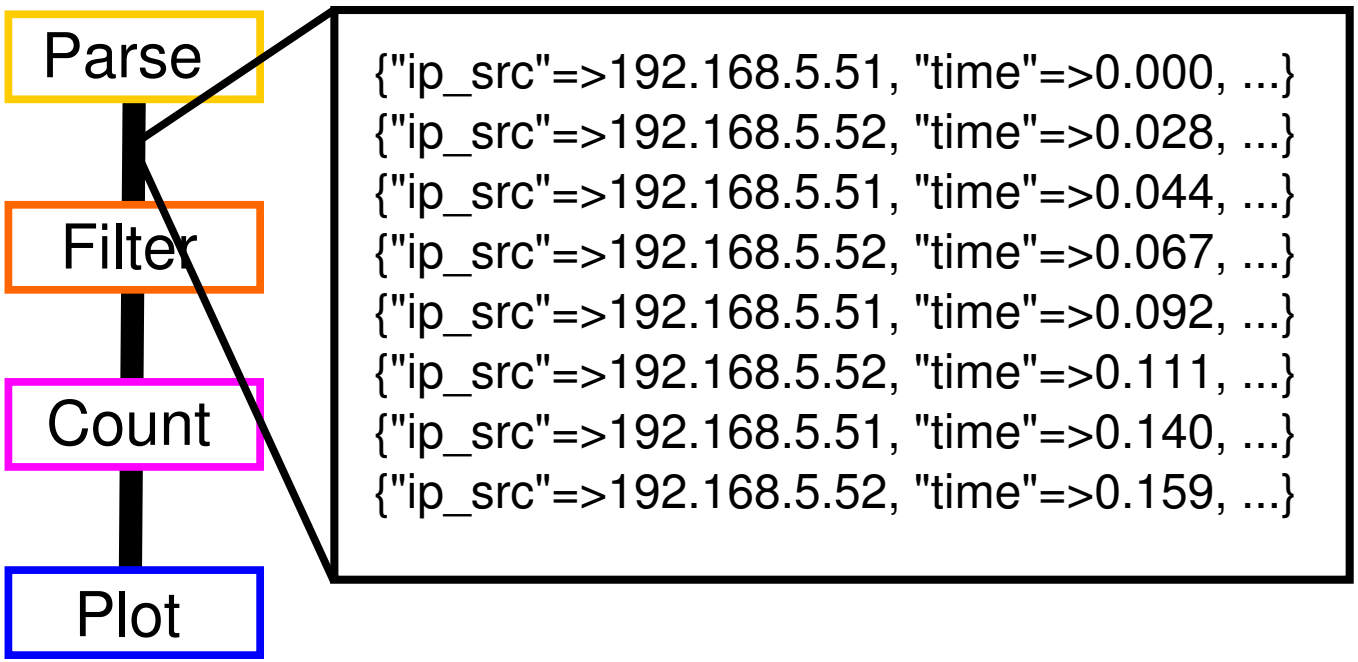
Philosophy

1. Encapsulate recurring operations in an *operator*
2. Connect operators to a processing pipeline



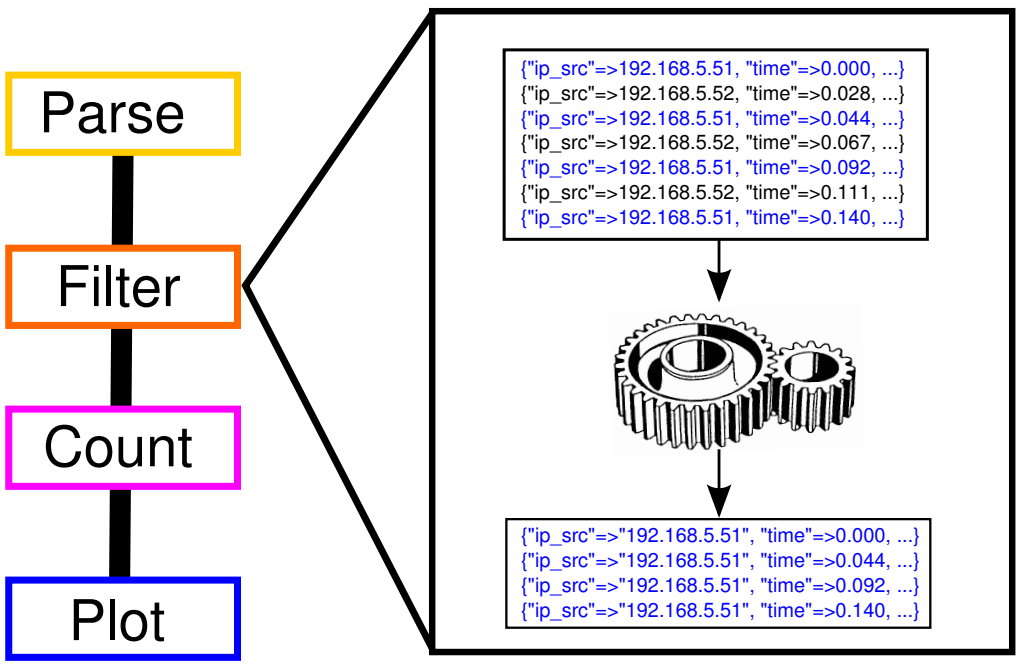
Data format between pipeline elements

- Data is stored in generic container
- Contains a number of rows
- Row: associative array of key-value pairs



Processing in an Operator

- Get data container from previous operator
- Modify the data
- Return new container



Implementation

- An operator is a ruby class
- An analysis is a ruby script
- Each operator is instantiated and configured
- Requesting the result from an operator triggers the calculations

Example:

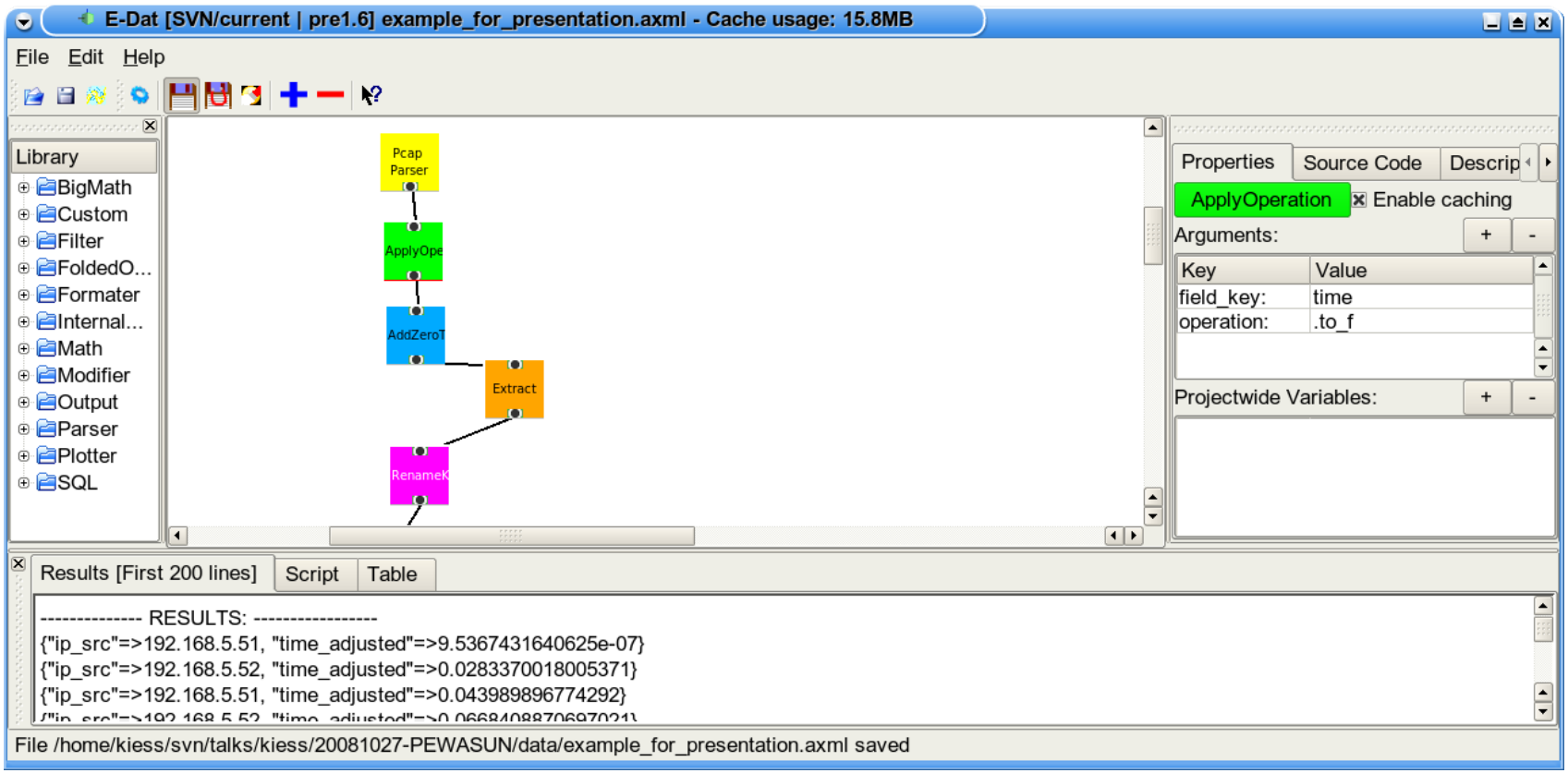
```
...
output_1 = PcapParser.new("Tcpdump_node51.cap")
output_2 = Filter.new(output_1, "size", "==100")
output_3 = CountLines.new(output_2)

Operator::showResult( output_3 )
...
```

Graphical User Interface

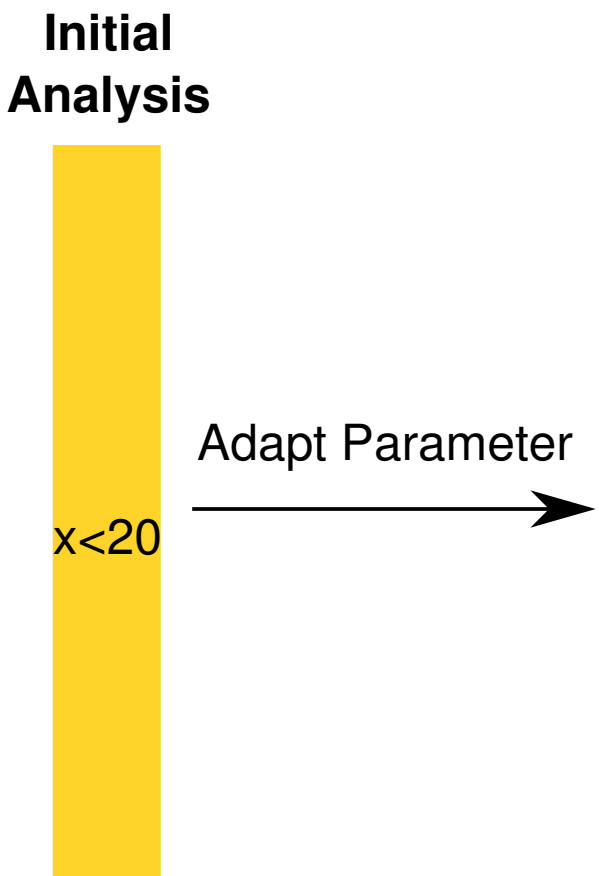
Motivation:

- Writing the analysis scripts by hand takes too much time
- Graphically building the pipeline is more intuitive



Caching

Change parameter of one operator
Example: change filter from `x<20` to `x<30`



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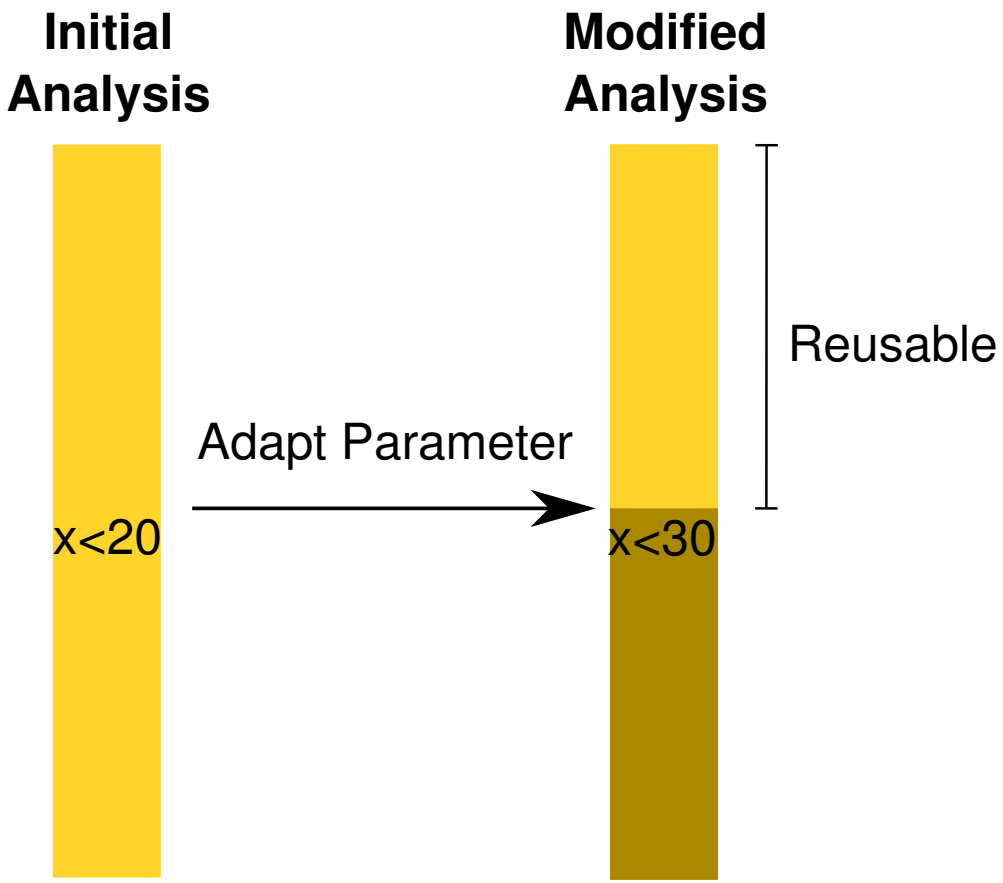

Caching

What can be reused? How can this be determined?

- Operator has inputs: preceding operator and configuration
- When one of this inputs changes: Recalculate
- Easy for simple inputs like configuration parameters
- How about operators? How to know when their result changed?

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Implementation: each operator has a fingerprint that changes with changing inputs

Caching - Fingerprint Calculation

- A fingerprint is a Hex string
- Each input is treated differently:
  - Operator: use its fingerprint
  - File: use modification time and filename
  - Parameter: use string represenation
- MD5SUM over concatenation of these values is fingerprint

Executable Pieces of Code

Scripting language ruby: specify operations at runtime.
Example: extract a packet identifier from the UDP payload of a packet

- Take payload of IP packet (== UDP packet)
- Strip 8 byte UDP header
- Convert result to an integer

Demo

DEMO

Conclusions

EDAT can be found under

`http://www.cn.uni-duesseldorf.de/projects/EDAT`

Questions?