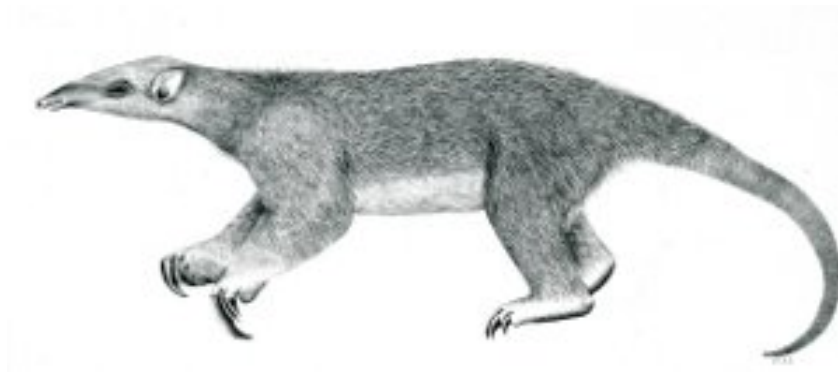

Tranalyzer2

tawk



Awk for Tranalyzer Flow Files



Tranalyzer Development Team

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1 tawk

1.1 Description

This document describes tawk and its functionalities. tawk works just like awk, but provides access to the columns via their names. In addition, it provides access to helper functions, such as `host()` or `port()`. Custom functions can be added in the folder named `t2custom` where they will be automatically loaded.

1.2 Dependencies

gawk version 4.1 is required.

Kali/Ubuntu: `sudo apt-get install gawk`

Arch: `sudo pacman -S gawk`

Fedora/Red Hat: `sudo yum install gawk`

Gentoo: `sudo emerge gawk`

OpenSUSE: `sudo zypper install gawk`

Mac OS X: `brew install gawk`¹

1.3 Installation

The recommended way to install tawk is to install `t2_aliases` as documented in `README.md`:

- Append the following line to `~/.bashrc` (make sure to replace `$T2HOME` with the actual path, e.g., `$HOME/int_tranalyzer/trunk`):

```
if [ -f "$T2HOME/scripts/t2_aliases" ]; then
    . $T2HOME/scripts/t2_aliases          # Note the leading `.'
fi
```

1.3.1 Man Pages

The man pages for `tawk` and `t2nfdump` can be installed by running: `./install.sh man`. Once installed, they can be consulted by running `man tawk` and `man t2nfdump` respectively.

¹Brew is a packet manager for Mac OS X that can be found here: <https://brew.sh>

1.4 Usage

- To list the column numbers and names: `tawk -l file_flows.txt`
- To list the column numbers and names as 3 columns: `tawk -l=3 file_flows.txt`
- To list the available functions: `tawk -g file_flows.txt`
- To list the available functions as 3 columns: `tawk -g=3 file_flows.txt`
- To save the original filename and filter used: `tawk -c 'FILTER' file_flows.txt > file.txt`
- To extract all ICMP flows and the header: `tawk 'hdr() || $14Proto == 1' file_flows.txt > icmp.txt`
- To extract all ICMP flows without the header: `tawk -H 'icmp()' file_flows.txt > icmp.txt`
- To extract the flow with index 1234: `tawk '$flowInd == 1234' file_flows.txt`
- To extract all DNS flows and the header: `tawk 'hdr() || strtonum($dnsStat)' file_flows.txt`
- To consult the documentation for the function 'func': `tawk -d func`
- To consult the documentation for the functions 'min' and 'max': `tawk -d min,max`
- To consult the documentation for all the available functions: `tawk -d all`
- To consult the documentation for the variable 'var': `tawk -V var`
- To consult the documentation for the variable 'var' with value 0x8a: `tawk -V var=0x8a`
- To convert the output to JSON: `tawk '{ print json($flowStat "\t" tuple5()) }' file_flows.txt`
- To convert the output to JSON: `tawk 'aggr(tuple2())' file_flows.txt | tawk '{ print json($0) }'`
- To create a PCAP with all packets from flow 42: `tawk -x flow42.pcap '$flowInd == 42' file_flows.txt`
- To see all ICMP packets in Wireshark: `tawk -k 'icmp()' file_flows.txt`

For a complete list of options, use the `-h` option.

Note that an option not recognized by `tawk` is internally passed to `awk/gawk`. Some of the most useful are:

- Changing the input field separator:
`tawk -F ',' '!hdr() { print $colName }' file.csv`
- Changing the output field separator:
`tawk -v OFS=',' '!hdr() { print $col1, $col2 }' file.txt`

For a complete list of options, run `awk -h`.

1.5 -s Option

The `-s` option can be used to specify the starting character(s) of the row containing the column names (default: '%'). If several rows start with the specified character(s), then the last one is used as column names. To change this behaviour, the line number can be specified as well. For example if row 1 to 5 start with '#' and row 3 contains the column names, specify the separator as follows: `tawk -s '#NR==3'` If the row with column names does not start with a special character, use `-s ''` or `-s 'NR==2'`.

1.6 Related Utilities

1.6.1 awkf

Configures `awk` to use tabs, i.e., `'\t'` as input and output separator (prevents issue with repetitive values), e.g.,
`awkf '{ print $4 }' file_flows.txt`

1.6.2 lsx

Displays columns with fixed width (default: 40), e.g., `lsx file_flows.txt` or `lsx 45 file_flows.txt`

1.6.3 sortu

Sort rows and count the number of times a given row appears, then sort by the most occurring rows. (Alias for `sort | uniq -c | sort -rn`). Useful, e.g., to analyse the most occurring user-agents: `tawk '{ print $httpUserAgent }' FILE_flows.txt | sortu`

1.6.4 tcol

Displays columns with minimum width, e.g., `tcol file_flows.txt`.

1.7 Functions

Collection of functions for `tawk`:

- Parameters between brackets are optional,
- IPs can be given as string ("1.2.3.4"), hexadecimal (0xffffffff) or int (4294967295),
- Network masks can be given as string ("255.255.255.0"), hexadecimal (0xffffffff00) or CIDR notation (24),
- Networks can be given as string, hexadecimal or int, e.g., "1.2.3.4/24" or "0x01020304/255.255.255.0",
- String functions can be made case insensitive by adding the suffix `i`, e.g., `streq` → `streqi`,
- Some examples are provided below,
- More details and examples can be found for every function by running `tawk -d funcname`.

Function	Description
<code>hdr()</code>	Use this function in your tests to keep the header (column names)
<code>tuple2()</code>	Returns the 2 tuple (source IP and destination IP)
<code>tuple3()</code>	Returns the 3 tuple (source IP, destination IP and port)
<code>tuple4()</code>	Returns the 4 tuple (source IP and port, destination IP and port)
<code>tuple5()</code>	Returns the 5 tuple (source IP and port, destination IP and port, protocol)
<code>tuple6()</code>	Returns the 6 tuple (source IP and port, dest. IP and port, proto, VLANID)
<code>host([ip net])</code>	Returns true if the source or destination IP is equal to <code>ip</code> or belongs to <code>net</code> If <code>ip</code> is omitted, returns the source and destination IP
<code>shost([ip net])</code>	Returns true if the source IP is equal to <code>ip</code> or belongs to <code>net</code>

Function	Description
<code>dhost ([ip net])</code>	If <code>ip</code> is omitted, returns the source IP Returns true if the destination IP is equal to <code>ip</code> or belongs to <code>net</code> If <code>ip</code> is omitted, returns the destination IP
<code>net ([ip net])</code>	Alias for <code>host ([ip net])</code>
<code>snet ([ip net])</code>	Alias for <code>shost ([ip net])</code>
<code>dnet ([ip net])</code>	Alias for <code>dhost ([ip net])</code>
<code>loopback(ip)</code>	Returns true if <code>ip</code> is a loopback address
<code>mcast(ip)</code>	Returns true if <code>ip</code> is a multicast address
<code>privip(ip)</code>	Returns true if <code>ip</code> is a private IP
<code>port ([p])</code>	Returns true if the source or destination port is equal to <code>p</code> (multiple ports or port ranges can also be specified) If <code>p</code> is omitted, returns the source and destination port
<code>sport ([p])</code>	Returns true if the source port is equal to <code>p</code> If <code>p</code> is omitted, returns the source port
<code>dport ([p])</code>	Returns true if the destination port is equal to <code>p</code> If <code>p</code> is omitted, returns the destination port
<code>ipv4()</code>	Returns true if the flow contains IPv4 traffic
<code>ipv6()</code>	Returns true if the flow contains IPv6 traffic
<code>proto([p])</code>	Returns true if the protocol is equal to <code>p</code> If <code>p</code> is omitted, returns the string representation of the protocol
<code>proto2str(p)</code>	Returns the string representation of the protocol number <code>p</code> If <code>p</code> is omitted, returns the protocol
<code>icmp([p])</code>	Returns true if the protocol is equal to 1 (ICMP)
<code>igmp([p])</code>	Returns true if the protocol is equal to 2 (IGMP)
<code>tcp([p])</code>	Returns true if the protocol is equal to 6 (TCP)
<code>udp([p])</code>	Returns true if the protocol is equal to 17 (UDP)
<code>rsvp([p])</code>	Returns true if the protocol is equal to 46 (RSVP)
<code>gre([p])</code>	Returns true if the protocol is equal to 47 (GRE)
<code>esp([p])</code>	Returns true if the protocol is equal to 50 (ESP)
<code>ah([p])</code>	Returns true if the protocol is equal to 51 (AH)
<code>icmp6([p])</code>	Returns true if the protocol is equal to 58 (ICMPv6)
<code>sctp([p])</code>	Returns true if the protocol is equal to 132 (SCTP)
<code>dhcp()</code>	Returns true if the flow contains DHCP traffic
<code>dns()</code>	Returns true if the flow contains DNS traffic
<code>http()</code>	Returns true if the flow contains HTTP traffic
<code>tcpflags([val])</code>	If <code>val</code> is specified, returns true if the specified flags are set. If <code>val</code> is omitted, returns a string representation of the TCP flags
<code>ip2num(ip)</code>	Converts an IP address to a number

Function	Description
<code>ip2hex(ip)</code>	Converts an IPv4 address to hex
<code>ip2str(ip)</code>	Converts an IPv4 address to string
<code>ip62str(ip)</code>	Converts an IPv6 address to string
<code>ip6compress(ip)</code>	Compresses an IPv6 address
<code>ip6expand(ip[,trim])</code>	Expands an IPv6 address. If <code>trim</code> is different from 0, removes leading zeros
<code>ip2mask(ip)</code>	Converts an IP address to a network mask (int)
<code>mask2ip(m)</code>	Converts a network mask (int) to an IPv4 address (int)
<code>mask2ipstr(m)</code>	Converts a network mask (int) to an IPv4 address (string)
<code>mask2ip6(m)</code>	Converts a network mask (int) to an IPv6 address (int)
<code>mask2ip6str(m)</code>	Converts a network mask (int) to an IPv6 address (string)
<code>ipinnet(ip,net[,mask])</code>	Tests whether an IP address belongs to a given network
<code>ipinrange(ip,low,high)</code>	Tests whether an IP address lies between two addresses
<code>localtime(t)</code>	Converts UNIX timestamp to string (localtime)
<code>utc(t)</code>	Converts UNIX timestamp to string (UTC)
<code>timestamp(t)</code>	Converts date to UNIX timestamp
<code>t2split(val,sep [,num[,osep]])</code>	Splits values according to <code>sep</code> . If <code>num</code> is omitted or 0, <code>val</code> is split into <code>osep</code> separated columns. If <code>num > 0</code> , returns the <code>num</code> repetition. If <code>num < 0</code> , returns the <code>num</code> repetition from the end, e.g., -1 for last element. Multiple <code>num</code> can be specified, e.g., "1;-1;2". Output separator <code>osep</code> , defaults to OFS.
<code>splitc(val[,num[,osep]])</code>	Splits compound values. Alias for <code>t2split(val, "_", num, osep)</code>
<code>splitr(val[,num[,osep]])</code>	Splits repetitive values. Alias for <code>t2split(val, ";", num, osep)</code>
<code>valcontains(val,sep,item)</code>	Returns true if one item of <code>val</code> split by <code>sep</code> is equal to <code>item</code> .
<code>cvalcontains(val,item)</code>	Alias for <code>valcontains(val, "_", item)</code>
<code>rvalcontains(val,item)</code>	Alias for <code>valcontains(val, ";", item)</code>
<code>strisempty(val)</code>	Returns true if <code>val</code> is an empty string
<code>streq(val1,val2)</code>	Returns true if <code>val1</code> is equal to <code>val2</code>
<code>strneq(val1,val2)</code>	Returns true if <code>val1</code> and <code>val2</code> are not equal
<code>hasprefix(val,pre)</code>	Returns true if <code>val</code> begins with the prefix <code>pre</code>
<code>hassuffix(val,suf)</code>	Returns true if <code>val</code> finished with the suffix <code>suf</code>
<code>contains(val,txt)</code>	Returns true if <code>val</code> contains the substring <code>txt</code>
<code>not(q)</code>	Returns the logical negation of a query <code>q</code> . This function must be used to keep the header when negating a query.
<code>bfeq(val1,val2)</code>	Returns true if the hexadecimal numbers <code>val1</code> and <code>val2</code> are equal
<code>bitsallset(val,mask)</code>	Returns true if all the bits set in <code>mask</code> are also set in <code>val</code>
<code>bitsanyset(val,mask)</code>	Returns true if one of the bits set in <code>mask</code> is also set in <code>val</code>

Function	Description
<code>isip(v)</code>	Returns true if <code>v</code> is an IPv4 address in hexadecimal, numerical or dotted decimal notation
<code>isip6(v)</code>	Returns true if <code>v</code> is an IPv6 address
<code>isiphex(v)</code>	Returns true if <code>v</code> is an IPv4 address in hexadecimal notation
<code>isipnum(v)</code>	Returns true if <code>v</code> is an IPv4 address in numerical (int) notation
<code>isipstr(v)</code>	Returns true if <code>v</code> is an IPv4 address in dotted decimal notation
<code>isnum(v)</code>	Returns true if <code>v</code> is a number
<code>join(a,s)</code>	Converts an array to string, separating each value with <code>s</code>
<code>unquote(s)</code>	Removes leading and trailing quotes from a string
<code>chomp(s)</code>	Removes leading and trailing spaces from a string
<code>strip(s)</code>	Removes leading and trailing spaces from a string
<code>lstrip(s)</code>	Removes leading spaces from a string
<code>rstrip(s)</code>	Removes trailing spaces from a string
<code>mean(c)</code>	Computes the mean value of a column <code>c</code> . The result can be accessed with <code>get_mean(c)</code> or printed with <code>print_mean([c])</code>
<code>min(c)</code>	Keep track of the min value of a column <code>c</code> . The result can be accessed with <code>get_min(c)</code> or printed with <code>print_min([c])</code>
<code>max(c)</code>	Keep track of the max value of a column <code>c</code> . The result can be accessed with <code>get_max(c)</code> or printed with <code>print_max([c])</code>
<code>abs(v)</code>	Returns the absolute value of <code>v</code>
<code>min2(a,b)</code>	Returns the minimum value between <code>a</code> and <code>b</code>
<code>min3(a,b,c)</code>	Returns the minimum value between <code>a</code> , <code>b</code> and <code>c</code>
<code>max2(a,b)</code>	Returns the maximum value between <code>a</code> and <code>b</code>
<code>max3(a,b,c)</code>	Returns the maximum value between <code>a</code> , <code>b</code> and <code>c</code>
<code>aggr(fields[,val[,num]])</code>	Performs aggregation of <code>fields</code> and store the sum of <code>val</code> . <code>fields</code> and <code>val</code> can be tab separated lists of fields, e.g., <code>\$srcIP4\t\$dstIP4</code> Results are sorted according to the first value of <code>val</code> . If <code>val</code> is omitted or equal to "flows", counts the number of flows. If <code>num</code> is omitted or 0, returns the full list, If <code>num > 0</code> returns the top <code>num</code> results, If <code>num < 0</code> returns the bottom <code>num</code> results.
<code>aggrrep(fields[,val[,num[,ign_e[,sep]]]])</code>	Performs aggregation of the repetitive <code>fields</code> and store the sum of <code>val</code> . <code>val</code> can be a tab separated lists of fields, e.g., <code>\$numBytesSnt\t\$numPktsSnt</code> Results are sorted according to the first value of <code>val</code> . If <code>val</code> is omitted or equal to "flows", counts the number of flows. If <code>num</code> is omitted or 0, returns the full list, If <code>num > 0</code> returns the top <code>num</code> results, If <code>num < 0</code> returns the bottom <code>num</code> results. If <code>ign_e</code> is omitted or 0, consider all values, otherwise ignore empty values. <code>sep</code> can be used to change the separator character (default: ";")

Function	Description
<code>t2sort(col[,num[,type]])</code>	Sorts the file according to <code>col</code> . If <code>num</code> is omitted or 0, returns the full list, If <code>num > 0</code> returns the top <code>num</code> results, If <code>num < 0</code> returns the bottom <code>num</code> results. <code>type</code> can be used to specify the type of data to sort: "ip", "num" or "str" (default is based on the first matching record)
<code>wildcard(expr)</code>	Print all columns whose name matches the regular expression <code>expr</code> . If <code>expr</code> is preceded by an exclamation mark, returns all columns whose name does NOT match <code>expr</code>
<code>hnum(num[,mode[,suffix]])</code>	Convert the number <code>num</code> to its human readable form.
<code>json(s)</code>	Convert the string <code>s</code> to JSON. The first record is used as column names.
<code>texscape(s)</code>	Escape the string <code>s</code> to make it LaTeX compatible
<code>base64d(s)</code>	Decode a base64 encoded string <code>s</code>
<code>urldecode(url)</code>	Decode the encoded URL <code>url</code>
<code>printerr(s)</code>	Prints the string <code>s</code> in red with an added newline
<code>diff(file[,mode])</code>	Compares <code>file</code> and the input, and prints the name of the columns which differ. The <code>mode</code> parameter can be used to control the format of the output.
<code>ffsplit([s[,k[,h]])</code>	Split the input file into smaller more manageable files. The files to create can be specified as argument to the function (one comma separated string). If no argument is specified, creates one file per column whose name ends with <code>Stat</code> , e.g., <code>dnsStat</code> , and one for <code>pwxType</code> (<code>pw</code>) and <code>covertChannels</code> (<code>cc</code>). If <code>k > 0</code> , then only print relevant fields and those controlled by <code>h</code> , a comma separated list of fields to keep in each file, e.g., "srcIP, dstIP"
<code>flow(f)</code>	Returns all flows whose index appears in <code>f</code>
<code>packet(p)</code>	Returns all packets whose number appears in <code>f</code>
<code>shark(q)</code>	Query flow files according to Wireshark's syntax

1.8 Examples

Collection of examples using `tawk` functions:

Function	Description
<code>covertChans([val[,num]])</code>	Returns information about hosts possibly involved in a covert channels. If <code>val</code> is omitted or equal to "flows", counts the number of flows. Otherwise, sums up the values of <code>val</code> . If <code>num</code> is omitted or 0, returns the full list, If <code>num > 0</code> returns the top <code>num</code> results, If <code>num < 0</code> returns the bottom <code>num</code> results.

Function	Description
<code>dnsZT()</code>	Returns all flows where a DNS zone transfer was performed.
<code>exeDL([n])</code>	Returns the top N EXE downloads.
<code>httpHostsURL([f])</code>	Returns all HTTP hosts and a list of the files hosted (sorted alphabetically). If <code>f > 0</code> , prints the number of times a URL was requested.
<code>nonstdports()</code>	Returns all flows running protocols over non-standard ports.
<code>passwords([val[, num]])</code>	Returns information about hosts sending authentication in cleartext. If <code>val</code> is omitted or equal to "flows", counts the number of flows. Otherwise, sums up the values of <code>val</code> . If <code>num</code> is omitted or 0, returns the full list, If <code>num > 0</code> returns the top <code>num</code> results, If <code>num < 0</code> returns the bottom <code>num</code> results.
<code>postQryStr([n])</code>	Returns the top N POST requests with query strings.
<code>ssh()</code>	Returns the SSH connections.
<code>topDnsA([n])</code>	Returns the top N DNS answers.
<code>topDnsIp4([n])</code>	Returns the top N DNS answers IPv4 addresses.
<code>topDnsIp6([n])</code>	Returns the top N DNS answers IPv6 addresses.
<code>topDnsQ([n])</code>	Returns the top N DNS queries.
<code>topHttpMimesST([n])</code>	Returns the top HTTP content-type (type/subtype).
<code>topHttpMimesT([n])</code>	Returns the top HTTP content-type (type only).
<code>topSLD([n])</code>	Returns the top N second-level domains queried (google.com, yahoo.com, ...).
<code>topTLD([n])</code>	Returns the top N top-level domains (TLD) queried (.com, .net, ...).

1.9 t2nfdump

Collection of functions for `tawk` allowing access to specific fields using a syntax similar as `nfdump`.

Function	Description
<code>ts()</code>	Start Time — first seen
<code>te()</code>	End Time — last seen
<code>td()</code>	Duration
<code>pr()</code>	Protocol
<code>sa()</code>	Source Address
<code>da()</code>	Destination Address
<code>sap()</code>	Source Address:Port

Function	Description
dap()	Destination Address:Port
sp()	Source Port
dp()	Destination Port
pkt()	Packets — default input
ipkt()	Input Packets
opkt()	Output Packets
byt()	Bytes — default input
ibyt()	Input Bytes
obyt()	Output Bytes
flg()	TCP Flags
mpls1()	MPLS label 1
mpls2()	MPLS label 2
mpls3()	MPLS label 3
mpls4()	MPLS label 4
mpls5()	MPLS label 5
mpls6()	MPLS label 6
mpls7()	MPLS label 7
mpls8()	MPLS label 8
mpls9()	MPLS label 9
mpls10()	MPLS label 10
mpls()	MPLS labels 1–10
bps()	Bits per second
pps()	Packets per second
bpp()	Bytes per package
oline()	nfdump line output format (-o line)
olong()	nfdump long output format (-o long)
oextended()	nfdump extended output format (-o extended)

1.10 t2custom

Copy your own functions in this folder. Refer to Section 1.11 for more details on how to write a tawk function. To have your functions automatically loaded, include them in the file `t2custom/t2custom.load`.

1.11 Writing a tawk Function

- Ideally one function per file (where the filename is the name of the function)
- Private functions are prefixed with an underscore
- Always declare local variables 8 spaces after the function arguments
- Local variables are prefixed with an underscore
- Use uppercase letters and two leading and two trailing underscores for global variables
- Include all referenced functions

- Files should be structured as follows:

```
#!/usr/bin/env awk
#
# Function description
#
# Parameters:
# - arg1: description
# - arg2: description (optional)
#
# Dependencies:
# - plugin1
# - plugin2 (optional)
#
# Examples:
# - tawk `funcname()` file.txt
# - tawk `{ print funcname() }` file.txt

@include "hdr"
@include "_validate_col"

function funcname(arg1, arg2, [8 spaces] _locvar1, _locvar2) {
    _locvar1 = _validate_col("colname1;altcolname1", _my_colname1)
    _validate_col("colname2")

    if (hdr()) {
        if (__PRIHDR__) print "header"
    } else {
        print "something", $_locvar1, $colname2
    }
}
```

1.12 Using tawk Within Scripts

To use tawk from within a script:

1. Create a TAWK variable pointing to the script: `TAWK="$T2HOME/scripts/tawk/tawk"`
2. Call tawk as follows: `$TAWK `dport(80)` file.txt`

1.13 Using tawk With Non-Tranalyzer Files

tawk can also be used with files which were not produced by Tranalyzer.

- The input field separator can be specified with the `-F` option, e.g., `tawk -F `,'` `program` file.csv`
- The row listing the column names, can start with any character specified with the `-s` option, e.g., `tawk -s `#` `program` file.txt`
- All the column names must not be equal to a function name

- Valid column names must start with a letter (a-z, A-Z) and can be followed by any number of alphanumeric characters or underscores
- If no column names are present, use the `-t` option to prevent tawk from trying to validate the column names.
- If the column names are different from those used by Tranalyzer, refer to Section 1.13.1.

1.13.1 Mapping External Column Names to Tranalyzer Column Names

If the column names are different from those used by Tranalyzer, a mapping between the different names can be made in the file `my_vars`. The format of the file is as follows:

```
BEGIN {
  _my_srcIP = non_t2_name_for_srcIP
  _my_dstIP = non_t2_name_for_dstIP
  ...
}
```

Once edited, run tawk with the `-i $T2HOME/scripts/tawk/my_vars` option and the external column names will be automatically used by tawk functions, such as `tuple2()`. For more details, refer to the `my_vars` file.

1.13.2 Using tawk with Bro Files

To use tawk with Bro log files, use the following command:

```
tawk -s '#fields' -i $T2HOME/scripts/tawk/vars_bro 'hdr() || !/^#/ { program }' file.log
```

1.14 Awk Cheat Sheet

- Tranalyzer flow files default field separator is `'\t'`:
 - **Always** use `awk -F'\t'` (or `awkf/tawk`) when working with flow files.
- Load libraries, e.g., tawk functions, with `-i: awk -i file.awk 'program' file.txt`
- Always use `strtonum` with hex numbers (bitfields)
- Awk indices start at 1
- Using tawk is recommended.

1.14.1 Useful Variables

- `$0`: entire line
- `$1, $2, ..., $NF`: column 1, 2, ...
- `FS`: field separator
- `OFS`: output field separator
- `ORS`: output record separator
- `NF`: number of fields (columns)

- NR: record (line) number
- FNR: record (line) number relative to the current file
- FILENAME: name of current file
- To use external variables, use the `-v` option, e.g., `awk -v name="value" '{ print name }' file.txt.`

1.14.2 Awk Program Structure

```
awk -F'\t' -i min -v OFS='\t' -v h="$(hostname)" `
BEGIN { a = 0; b = 0; }           # Called once at the beginning
/^A/ { a++ }                     # Called for every row starting with char A
/^B/ { b++ }                     # Called for every row starting with char B
    { c++ }                      # Called for every row
END { print h, min(a, b), c } # Called once at the end
' file.txt
```

1.15 Awk Templates

- Print the whole line:

```
- tawk '{ print }' file.txt
- tawk '{ print $0 }' file.txt
- tawk 'FILTER' file.txt
- tawk 'FILTER { print }' file.txt
- tawk 'FILTER { print $0 }' file.txt
```

- Print selected columns only:

```
- tawk '{ print $srcIP4, $dstIP4 }' file.txt
- tawk '{ print $1, $2 }' file.txt
- tawk '{ print $4 "\t" $6 }' file.txt
- tawk `{
    for (i = 6; i < NF; i++) {
        printf "%s\t", $i
    }
    printf "%s\n", $NF
}' file.txt
```

- Keep the column names:

```
- tawk 'hdr() || FILTER' file.txt
- awkf 'NR == 1 || FILTER' file.txt
- awkf '/^%/ || FILTER' file.txt
- awkf '/^[[:space:]]*[[[:alpha:]]][[:alnum:]]_*/ || FILTER' file.txt
```

- Skip the column names:

```

- tawk '!hdr() && FILTER' file.txt
- awkf 'NR > 1 && FILTER' file.txt
- awkf '!/^%/ && FILTER' file.txt
- awkf '!/^%[[[:space:]]*[[[:alpha:]]][[:alnum:]]_]*$/ && FILTER' file.txt

```

- Bitfields and hexadecimal numbers:

```

- tawk 'bfeq($3,0)' file.txt
- awkf 'strtonum($3) == 0' file.txt
- tawk 'bitsanyset($3,1)' file.txt
- tawk 'bitsallset($3,0x81)' file.txt
- awkf 'and(strtonum($3), 0x1)' file.txt

```

- Split compound values:

```

- tawk '{ print splitc($16, 1) }' file.txt # first element
- tawk '{ print splitc($16, -1) }' file.txt # last element
- awkf '{ split($16, A, "_"); print A[1] }' file.txt
- awkf '{ n = split($16, A, "_"); print A[n] }' file.txt # last element
- tawk '{ print splitc($16) }' file.txt
- awkf '{ split($16, A, "_"); for (i=1;i<=length(A);i++) print A[i] }' file.txt

```

- Split repetitive values:

```

- tawk '{ print splitr($16, 3) }' file.txt # third repetition
- tawk '{ print splitr($16, -2) }' file.txt # second to last repetition
- awkf '{ split($16, A, ";"); print A[3] }' file.txt
- awkf '{ n = split($16, A, ";"); print A[n] }' file.txt # last repetition
- tawk '{ print splitr($16) }' file.txt
- awkf '{ split($16, A, ";"); for (i=1;i<=length(A);i++) print A[i] }' file.txt

```

- Filter out empty strings:

```

- tawk '!strisempty($4)' file.txt
- awkf '!(length($4) == 0 || $4 == "\"\"")' file.txt

```

- Compare strings (case sensitive):

```

- tawk 'streq($3,$4)' file.txt
- awkf '$3 == $4' file.txt
- awkf '$3 == \"text\"' file.txt

```

- Compare strings (case insensitive):

```

- tawk 'streqi($3,$4)' file.txt
- awkf 'tolower($3) == tolower($4)' file.txt

```

- Use regular expressions on specific columns:

```
- awkf '$8 ~ /^192.168.1.[0-9]{1,3}$/' file.txt # print matching rows
- awkf '$8 !~ /^192.168.1.[0-9]{1,3}$/' file.txt # print non-matching rows
```

- Use column names in awk:

```
- tawk '{ print $srcIP4, $dstIP4 }' file.txt
- awkf `
NR == 1 {
    for (i = 1; i <= NF; i++) {
        if ($i == "srcIP4") srcIP4 = i
        else if ($i == "dstIP4") dstIP4 = i
    }
    if (srcIP4 == 0 || dstIP4 == 0) {
        print "No column with name srcIP4 and/or dstIP4"
        exit
    }
}
NR > 1 {
    print $srcIP4, $dstIP4
}
` file.txt
- awkf `
NR == 1 {
    for (i = 1; i <= NF; i++) {
        col[$i] = i
    }
}
NR > 1 {
    print $col["srcIP4"], $col["dstIP4"];
}
` file.txt
```

1.16 Examples

1. Pivoting (variant 1):

- (a) First extract an attribute of interest, e.g., an unresolved IP address in the `Host :` field of the HTTP header:

```
tawk 'aggr($httpHosts)' FILE_flows.txt | tawk '{ print unquote($1); exit }'
```

- (b) Then, put the result of the last command in the `badguy` variable and use it to extract flows involving this IP:

```
tawk -v badguy="$(!)" 'host(badguy)' FILE_flows.txt
```

2. Pivoting (variant 2):

- (a) First extract an attribute of interest, e.g., an unresolved IP address in the `Host :` field of the HTTP header, and store it into a `badip` variable:


```
badip="$(tawk 'aggr($httpHosts)' FILE_flows.txt | tawk '{ print unquote($1);exit }')
```

(b) Then, use the `badip` variable to extract flows involving this IP:

```
tawk -v badguy="$badip" 'host(badguy)' FILE_flows.txt
```

3. Aggregate the number of bytes sent between source and destination addresses (independent of the protocol and port) and output the top 10 results:

```
tawk 'aggr($srcIP4 "\t" $dstIP4, $numBytesSnt, 10)' FILE_flows.txt
```

```
tawk 'aggr(tuple2(), $numBytesSnt "\t" "Flows", 10)' FILE_flows.txt
```

4. Sort the flow file according to the duration (longest flows first) and output the top 5 results:

```
tawk 't2sort(duration, 5)' FILE_flows.txt
```

5. Extract all TCP flows while keeping the header (column names):

```
tawk 'hdr() || tcp()' FILE_flows.txt
```

6. Extract all flows whose destination port is between 6000 and 6008 (included):

```
tawk 'dport("6000-6008)' FILE_flows.txt
```

7. Extract all flows whose destination port is 53, 80 or 8080:

```
tawk 'dport("53;80;8080)' FILE_flows.txt
```

8. Extract all flows whose source IP is in subnet 192.168.1.0/24 (using `host` or `net`):

```
tawk 'shost("192.168.1.0/24)' FILE_flows.txt
```

```
tawk 'snet("192.168.1.0/24)' FILE_flows.txt
```

9. Extract all flows whose source IP is in subnet 192.168.1.0/24 (using `ipinrange`):

```
tawk 'ipinrange($srcIP4, "192.168.1.0", "192.168.1.255)' FILE_flows.txt
```

10. Extract all flows whose source IP is in subnet 192.168.1.0/24 (using `ipinnet`):

```
tawk 'ipinnet($srcIP4, "192.168.1.0", "255.255.255.0)' FILE_flows.txt
```

11. Extract all flows whose source IP is in subnet 192.168.1.0/24 (using `ipinnet` and a hex mask):

```
tawk 'ipinnet($srcIP4, "192.168.1.0", 0xffffffff)' FILE_flows.txt
```

12. Extract all flows whose source IP is in subnet 192.168.1.0/24 (using `ipinnet` and the CIDR notation):

```
tawk 'ipinnet($srcIP4, "192.168.1.0/24)' FILE_flows.txt
```

13. Extract all flows whose source IP is in subnet 192.168.1.0/24 (using `ipinnet` and a CIDR mask):

```
tawk 'ipinnet($srcIP4, "192.168.1.0", 24)' FILE_flows.txt
```

For more examples, refer to `tawk -d` option, e.g., `tawk -d aggr`, where every function is documented and comes with a set of examples. The complete documentation can be consulted by running `tawk -d all`.

1.17 FAQ

1.17.1 Can I use tawk with non Tranalyzer files?

Yes, refer to Section 1.13.

1.17.2 Can I use tawk functions with non Tranalyzer column names?

Yes, edit the `my_vars` file and load it using `-i $T2HOME/scripts/tawk/my_vars` option. Refer to Section 1.13.1 for more details.

1.17.3 Can I use tawk with files without column names?

Yes, use the `-t` option to prevent tawk from trying to validate the column names.

1.17.4 The row listing the column names start with a '#' instead of a '%'. Can I still use tawk?

Yes, use the `-s` option to specify the first character, e.g., `tawk -s '#' 'program'`

1.17.5 Can I process a CSV (Comma Separated Value) file with tawk?

The input field separator can be changed with the `-F` option. To process a CSV file, run tawk as follows:

```
tawk -F ',' 'program' file.csv
```

1.17.6 Can I produce a CSV (Comma Separated Value) file from tawk?

The output field separator (OFS) can be changed with the `-v OFS='char'` option. To produce a CSV file, run tawk as follows: `tawk -v OFS=',' 'program' file.txt`

1.17.7 Can I write my tawk programs in a file instead of the command line?

Yes, copy the program (without the single quotes) in a file, e.g., `prog.txt` and run it as follows:

```
tawk -f prog.txt file.txt
```

1.17.8 Can I still use column names if I pipe data into tawk?

Yes, you can specify a file containing the column names with the `-I` option as follows:

```
cat file.txt | tawk -I colnames.txt 'program'
```

1.17.9 Can I use tawk if the row with the column names does not start with a special character?

Yes, you can specify the empty character with `-s ""`. Refer to Section 1.5 for more details.

1.17.10 I get a list of syntax errors from gawk... what is the problem?

The name of the columns is used to create variable names. If it contains forbidden characters, then an error similar to the following is reported.

```
gawk: /tmp/fileBndhdf:3: col-name = 3
gawk: /tmp/fileBndhdf:3:      ^ syntax error
```

Although tawk will try to replace forbidden characters with underscore, the best practice is to use only alphanumeric characters (A-Z, a-z, 0-9) and underscore as column names. Note that a column name **MUST NOT** start with a number.

1.17.11 Tawk cannot find the column names... what is the problem?

First, make sure the comment char (`-s` option) is correctly set for your file (the default is ``%'`). Second, make sure the column names do not contain forbidden characters, i.e., use only alphanumeric and underscore and do not start with a number. If the row with column names is not the last one to start with the separator character, then specify the line number (NR) as follows: `-s `#NR==3'` or `-s `%NR==2'`. Refer to Section 1.5 for more details.

1.17.12 How to make tawk faster?

Tawk tries to validate the column names by ensuring that no column names is equal to a function name and that all column names used in the program exist. This verification process is quite slow and can easily be disabled by using the `-t` option.

1.17.13 Wireshark refuses to open PCAP files generated with tawk `-k` Option...

If Wireshark displays the message `Couldn't run /usr/bin/dumpcap in child process: Permission Denied.`, then this means that your user does not belong to the `wireshark` group. To fix this issue, simply run the following command `sudo gpasswd -a YOUR_USERNAME wireshark` (you will then need to log off and on again).