AWK: The Duct Tape of Computer Science Research

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Duct Tape

- Research Environment
  - Lots of simulators, data, and analysis tools
  - Since it is research, nothing works together
- Unix pipes are the ducts
- Awk is the duct tape
  - It’s not the “best” way to connect everything
  - Maintaining anything complicated problematic
  - It is a good way of getting it to work quickly
    - In research, most stuff doesn’t work anyways
  - Really good at a some common problems

Goals

- My Goals for this talk
  - Introduce the Awk language
  - Demonstrate how it has been useful
  - Discuss the limits / pitfalls
  - Eat some pizza
- What this talk is not
  - A promotion of all-awk all-the-time (tools)
  - A perl vs. awk

Outline

- Background
- Applications
- Programming in awk
  - Examples
- Other tools that play nice
- Summary and Pointers

Background

- Developed by
  - Aho, Weinberger, and Kernighan
  - Further extended by Bell
  - Further extended in Gawk
- Developed to handle simple data-reformatting jobs easily with just a few lines of code.
- C-like syntax
  - The K in Awk is the K in K&R
  - Easy learning curve

Applications

- Smart grep
  - All the functionality of grep with added logical and numerical abilities
- File conversion
  - Quickly write format converters for text files
- Spreadsheet
  - Easy use of columns and rows
- Graphing/tables/tex
- Gluing pipes

Running Awk

- Two ways to run it
- From the Command line
  - `cat file | gawk ‘(pattern){action}’`
  - Or you can call gawk with the file name
- From a script (recommended)

```
#!/usr/bin/gawk –f
# This is a comment
(pattern) {action}
…
```

Programming

- Programming is done by building a list
  - This is a list of rules
  - Each rule is applied sequentially to each line
    - Each line is a record

(pattern1) { *action* }

(pattern2) { *action* }

Input	PING dt033n32.san.rr.com (24.30.138.50): 56 data bytes 64 bytes from 24.30.138.50: icmp_seq=0 ttl=48 time=49 ms 64 bytes from 24.30.138.50: icmp_seq=1 ttl=48 time=94 ms 64 bytes from 24.30.138.50: icmp_seq=2 ttl=48 time=50 ms 64 bytes from 24.30.138.50: icmp_seq=3 ttl=48 time=41 ms ----dt033n32.san.rr.com PING Statistics---- 1281 packets transmitted, 1270 packets received, 0% packet loss round-trip (ms) min/avg/max = 37/73/495 ms
Program	(/icmp_seq/) {print $0}
Output	64 bytes from 24.30.138.50: icmp_seq=0 ttl=48 time=49 ms 64 bytes from 24.30.138.50: icmp_seq=1 ttl=48 time=94 ms 64 bytes from 24.30.138.50: icmp_seq=2 ttl=48 time=50 ms 64 bytes from 24.30.138.50: icmp_seq=3 ttl=48 time=41 ms

Fields

- Awk divides the file into records and fields
  - Each line is a record (by default)
  - Fields are delimited by a special character
    - Whitespace by default
    - Can change with –F or FS
- Fields are accessed with the ‘$’
  - $1 is the first field, $2 is the second
  - $0 is a special field which is the entire line
  - NF is always set to the number of fields

Input	PING dt033n32.san.rr.com (24.30.138.50): 56 data bytes 64 bytes from 24.30.138.50: icmp_seq=0 ttl=48 time=49 ms 64 bytes from 24.30.138.50: icmp_seq=1 ttl=48 time=94 ms 64 bytes from 24.30.138.50: icmp_seq=2 ttl=48 time=50 ms 64 bytes from 24.30.138.50: icmp_seq=3 ttl=48 time=41 ms ----dt033n32.san.rr.com PING Statistics---- 1281 packets transmitted, 1270 packets received, 0% packet loss round-trip (ms) min/avg/max = 37/73/495 ms
Program	(/icmp_seq/) {print $7}

Output	time=49
	time=94
	time=50
	time=41

Variables

- Variables uses are naked
  - No need for declaration
  - Implicitly set to 0 AND Empty String
- There is only one type in awk
  - Combination of a floating-point and string
  - The variable is converted as needed
    - Based on it’s use
  - No matter what is in x you can always
    - x = x + 1
    - length(x)

Input	PING dt033n32.san.rr.com (24.30.138.50): 56 data bytes 64 bytes from 24.30.138.50: icmp_seq=0 ttl=48 time=49 ms 64 bytes from 24.30.138.50: icmp_seq=1 ttl=48 time=94 ms 64 bytes from 24.30.138.50: icmp_seq=2 ttl=48 time=50 ms 64 bytes from 24.30.138.50: icmp_seq=3 ttl=48 time=41 ms

Program	(/icmp_seq/) {
	        n = substr($7,6);
	        printf("%s\n", n/10); #conversion
	}

Output	4.9 9.4 5.0 4.1

Variables

- Some built in variables
  - Informative
    - NF = Number of Fields
    - NR = Current Record Number
  - Configuration
    - FS = Field separator
- Can set them externally
  - From command line use

    Gawk –v var=value

Patterns

- Patterns can be
  - Empty: match everything
  - Regular expression: `(/regular expression/)`
  - Boolean Expression: `($2==“foo” && $7==“bar”)`
  - Range: `($2==“on” , $3==“off”)`
  - Special: BEGIN and END

“Arrays”

- All arrays in awk are associative
  - A[1] = “foo”;
  - B[“awk talk”] = “pizza”;
- To check if there is an element in the array
  - Use “in”
  - If (“awk talk” in B)
- Arrays can be sparse, they automatically resize, auto-initialize, and are fast (unless they get huge)
- Multi-dimensional (sort of)

Input

```
PING dt033n32.san.rr.com (24.30.138.50): 56 data bytes
64 bytes from 24.30.138.50: icmp_seq=0 ttl=48 time=49 ms
```

Program

```
(/icmp_seq/) {
        n = int(substr($7,6)/10);
        hist[n]++; #array
}
END {
        for(x in hist)
                printf(“%s: %s”, x*10, hist[x]);
}
```

Output

```
40: 441
50: 216


490: 1
```

Built-in Functions

- Numeric:
  - cos, exp, int, log, rand, sqrt
- String Functions
  - Gsub(regex, replacement, target)
  - Index(searchstring, target)
  - Length(string)
  - Split(string, array, regex)
  - Substr(string, start, length=inf)
  - Tolower(string)

Writing Functions

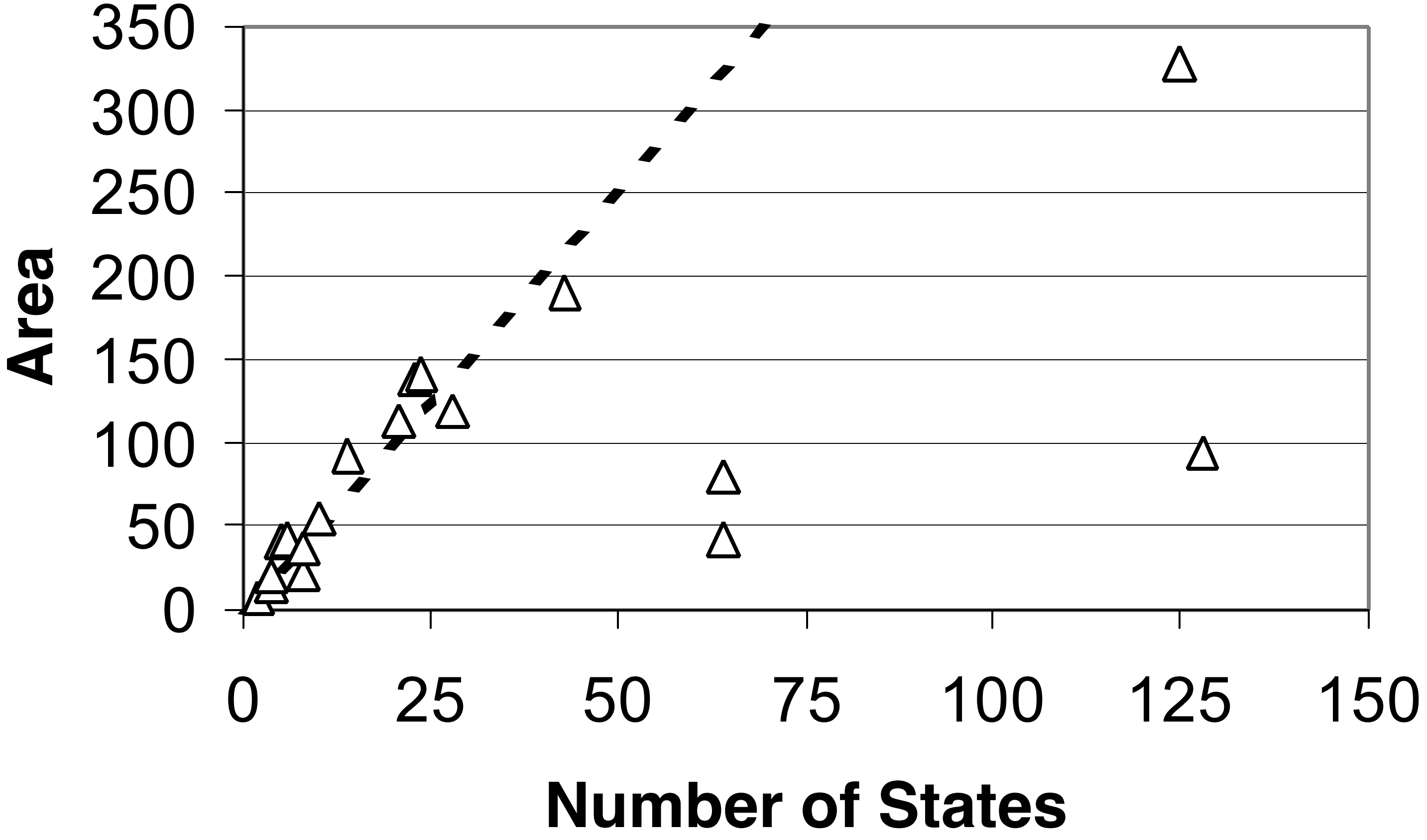
- Functions were not part of the original spec
  - Added in later, and it shows
  - Rule variables are global
  - Function variables are local

```
Function MyFunc(a,b,   c,d) {
    Return a+b+c+d
}
```

Other Tools

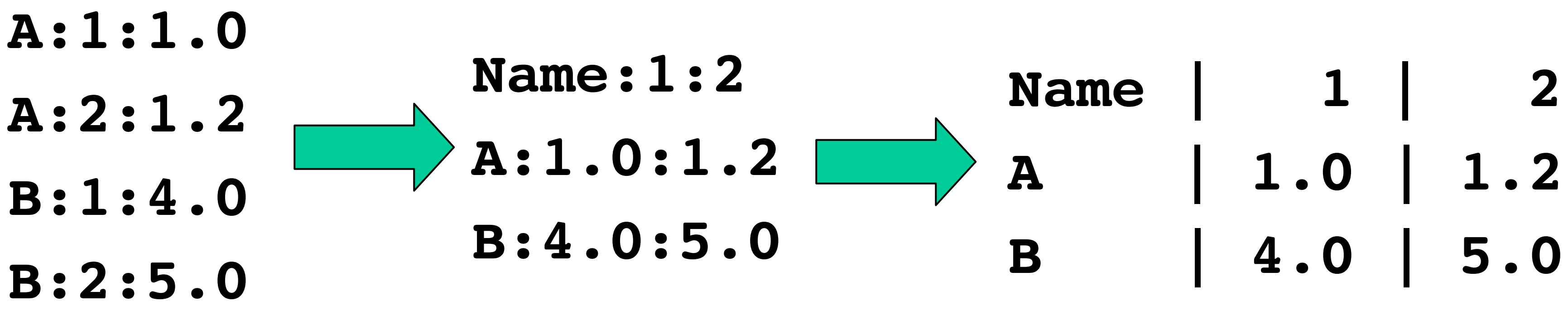
- Awk is best used with pipes
- Other tools that work well with pipes
  - Fgrep: fgrep mydata *.data
  - Uniq:
  - Sort
  - Sed/tr
  - Cut/paste
  - Jgraph/Ploticus

Jgraph Example



My Scripts

- Functions to handle hex data
- Set of scripts for handling 2-D arrays



```
A:1:1.0
A:2:1.2
B:1:4.0
B:2:5.0
```

```
Name:1:2
A:1.0:1.2
B:4.0:5.0
```

```
Name |   1 |   2
A    | 1.0 | 1.2
B    | 4.0 | 5.0
```

Pitfalls

- White space
  - No whitespace between function and ‘(‘
    - Myfunc($1) = ✍
    - Myfunc ($1) = ✍
  - No line break between pattern and action
  - Don’t forget the -f on executable scripts

Summary

- Awk is a very powerful tool
  - If properly applied
  - It is not for everything (I know)
- Very handy for pre-processing
- Data conversion