

Heavy Hitter Detection in the Dataplane

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Heavy Hitter Detection

- Detect flows with large traffic volumes
- Many applications, e.g.:
 - DoS and anomaly detection
 - Flow-size aware routing
- Heavy hitters form most of the traffic
 - Most important for traffic engineering

`in the Dataplane`

- Avoid traffic sampling (e.g. NetFlow)
 - Sampling has lower accuracy
 - Slower detection time
 - Possibility of false negatives
- Faster reaction time
- However:
 - Requires (more expensive) specialized hardware

Problem Statement

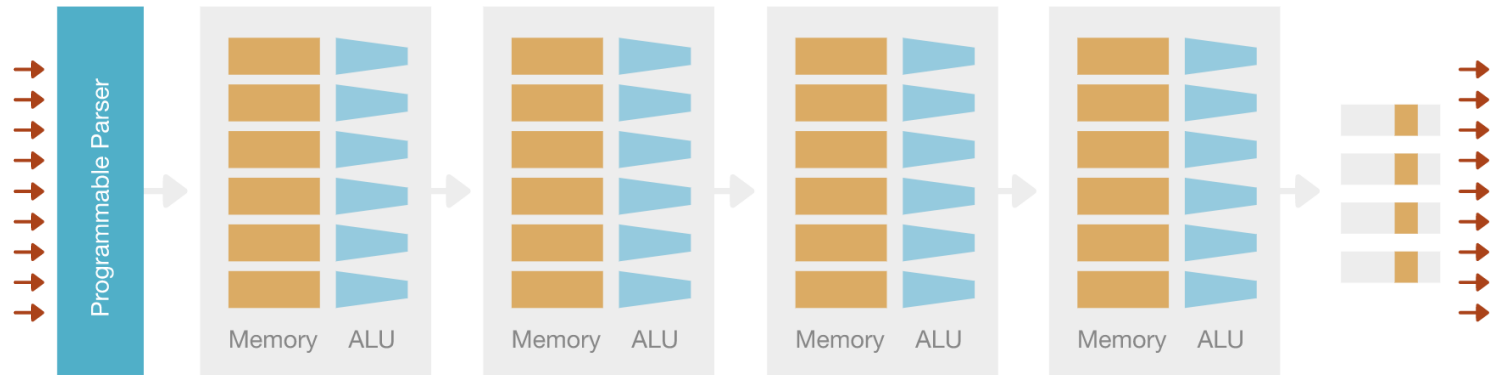
- Given the last N packets of an incoming stream and flow f
- Determine if f has a frequency above threshold
- No false negatives
- Probability of false positive should be $\leq \varepsilon$

Additional Requirement

- Process packets as quickly as they arrive
- Severely limits processing time
- Example: 100 Gb/s switch
 - Lower bound on frame size is 64B
 - Interframe Gap is at least 1B time
 - So number of frames per second is ± 192 million
 - Only 5.2 ns to process each packet

Pipeline

- Packets are processed in a pipeline
- Preferably take up all available processing time per stage



Limitations

- Limited number of stages (max 10-20)
- One ALU operation per header field (parallelized) per stage
- Addition, bitwise logic or hashing
- Limited memory access?
- Limited amount of memory available
- Memory separated by stage
- Limited amount of memory that can be carried across stages (typically 512 bytes)

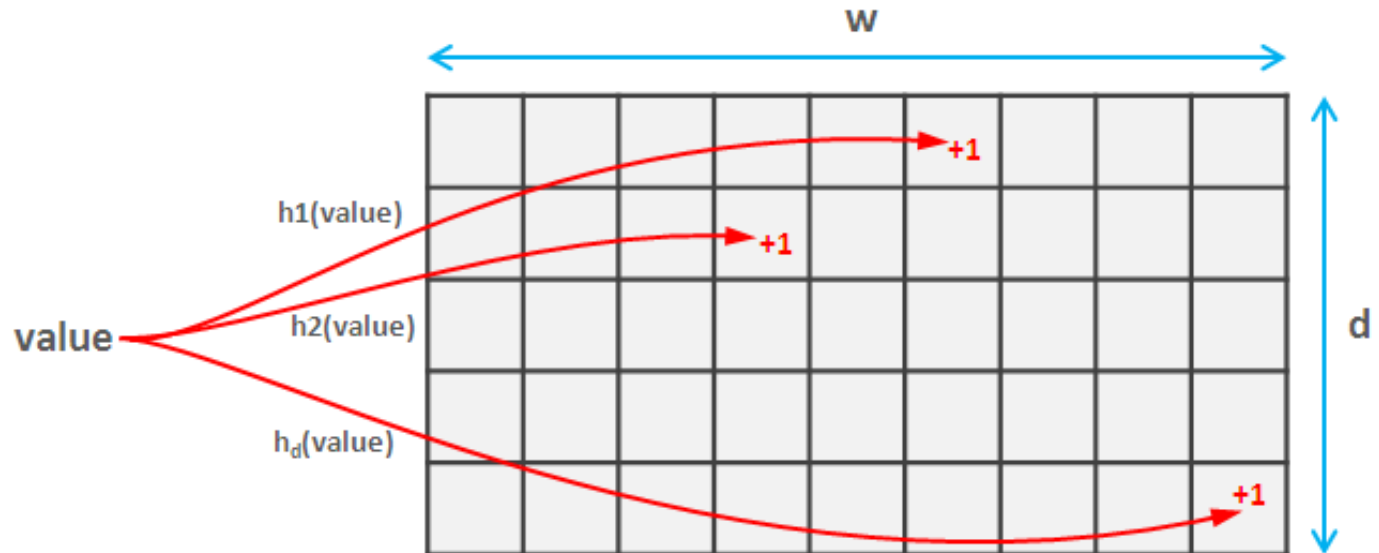
Tunability

- Solution should be tuneable
- Increase accuracy by adding more memory per stage or by increasing the number of stages
- Number of stages influences latency (trade-off)

Sketches

- Compact data structure
- Only stores summary information
- Low memory usage
- Often tuneable in accuracy vs memory usage
- E.g. bloom filter

Count-Min Sketch



Questions/Comments/Suggestions?

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