Heavy Hitter Detection Entirely in The Dataplane

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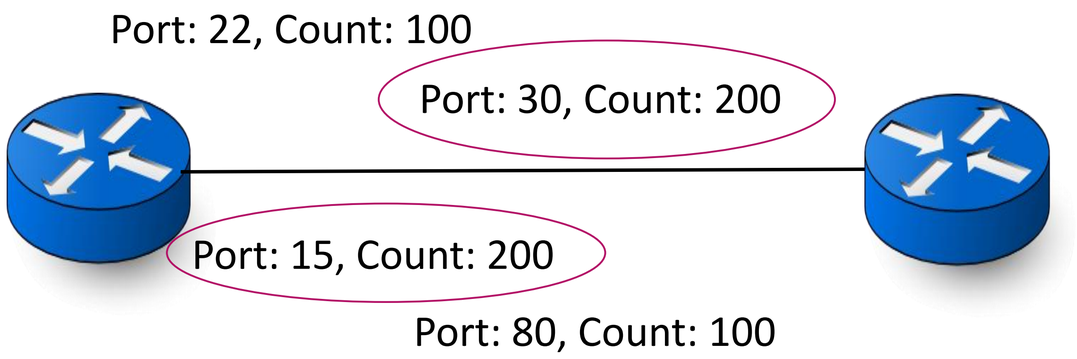
1. Problem Statement

- Efficiently identify the flows contributing the most traffic using programmable hardware
- Useful in diagnosing congestion, traffic accounting and DoS attacks



2. Challenges

Space:
- Too many flows to fit in switch memory

Speed:
- Packets traverse link at rates as high as 100 Gbps
- Packets can only be fed forward in the pipeline
- Need deterministic processing time for each packet

Accuracy:
- Measurements needed at fine-grained timescales
- Must maintain flow identifiers for heavy flows

3. Opportunities

Switching Hardware:
- Match-action tables to update per-flow statistics per packet
- New hardware with the ability to program stateful rules in the dataplane

Space Saving Algorithm:
Top-K detection by eviction of the smallest flow currently tracked

Goal: Methods with high accuracy within hardware constraints

New Key K8

Before	After
K1, 4	K1, 4
K2, 2	K2, 2
K3, 1	**K8, 2**
K4, 10	K4, 10
K5, 3	K5, 3
K6, 90	K6, 90
K7, 8	K7, 8

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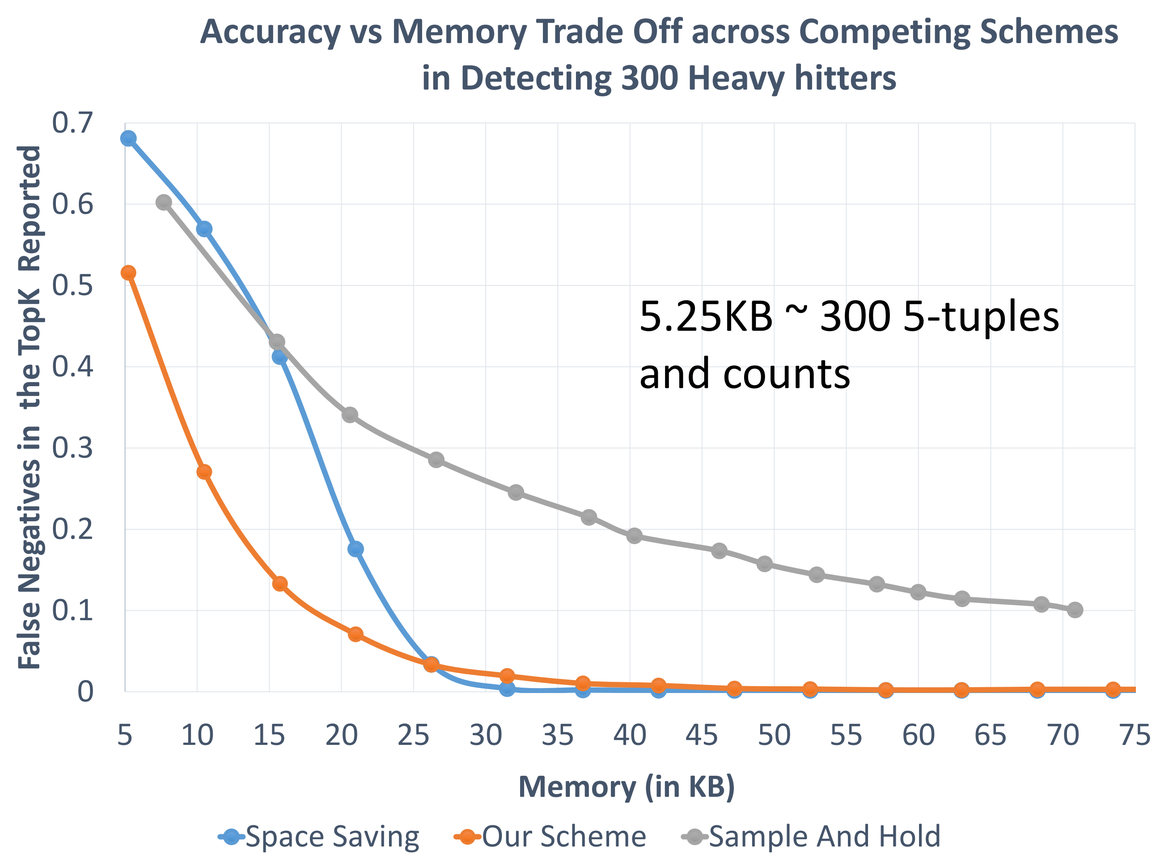
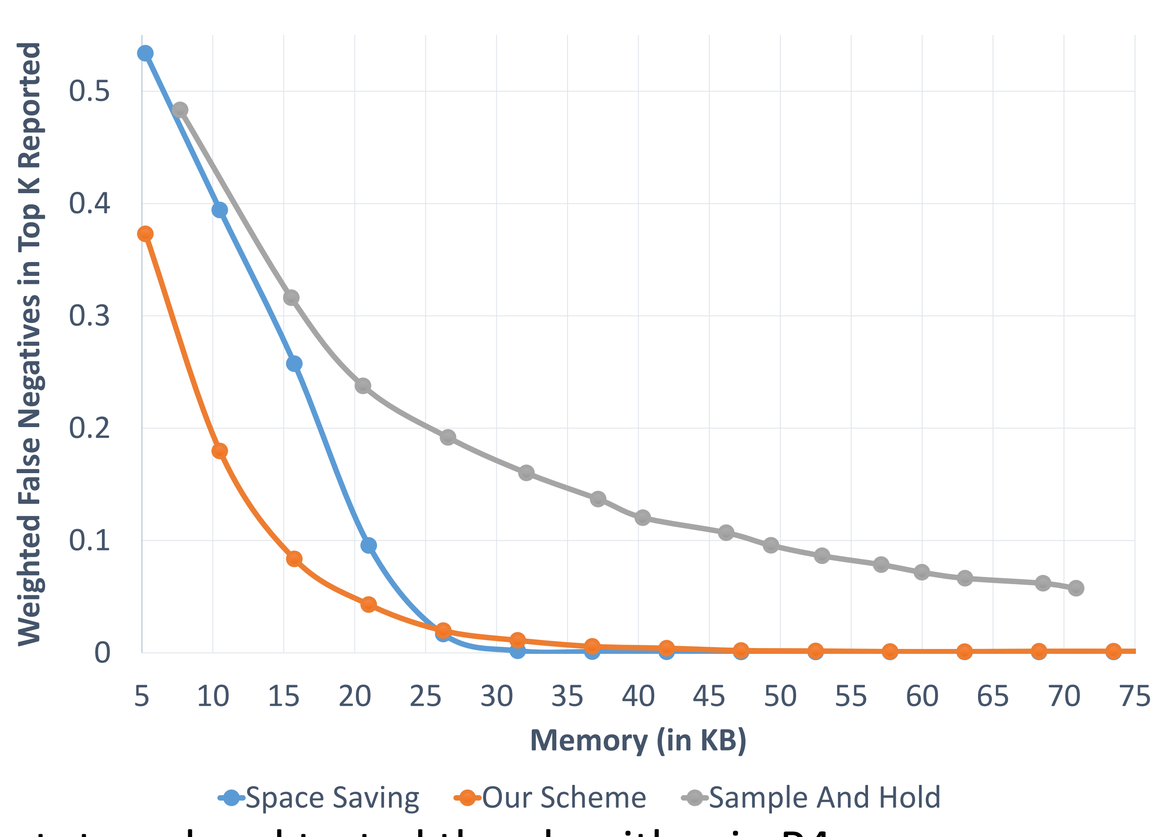
4. Insights

- Evict smaller table entries when constrained for space
- Find minimum of a small fixed number of table entries instead of global table minimum
- Spread the searched entries across multiple stages, reading exactly one entry per stage
- Approximate minimum of searched entries “as you go” to maintain feed-forward processing

5. Evaluations

Results of simulations run on CAIDA traces with 1M packets, 47337 flows





Prototyped and tested the algorithm in P4