keyvi

the key value index

optimized for size and speed

key value index

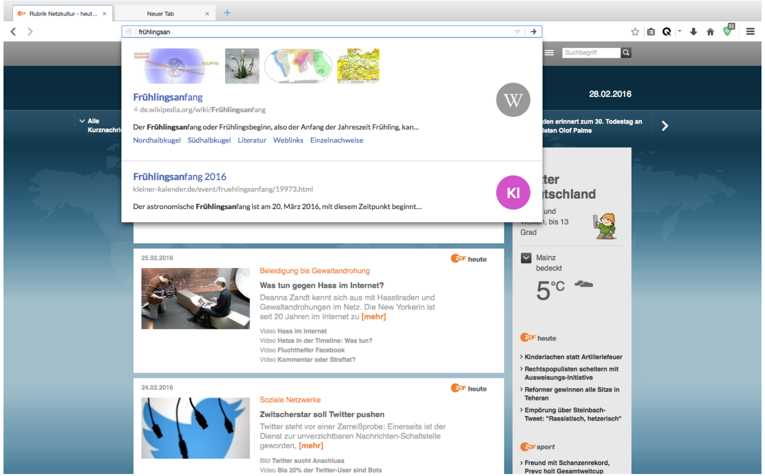
based on finite state
(FST, immutable data structure)

Opensource (Apache 2.0)

written in C++(core), Python(binding)

keyvi @CLIQZ

Search in the Browser



Available on the App Store

ANDROID APP ON Google play

keyvi in numbers @CLIQZ

1.8bn URLs

13bn data points (key value pairs)

2.5TB index size

60ms average latency

6k requests per minute

99.9% availability

keyvi History @CLIQZ

(→ 10/2014)
to slow/heavy
no need for full-text search
did not fit our model

keyvi History @CLIQZ

elastic

redis

(→ 10/2014)
to slow/heavy
no need for full-text search
did not fit our model

(4/2014 →)
simple
space efficient
server side scripting

keyvi History @CLIQZ

redis

keyvi

(→ 09/2015)
capacity problems
single threaded
heap based
single-point of failure

keyvi History @CLIQZ

redis

(→ 09/2015)
capacity problems
single threaded
heap based
single-point of failure

keyvi

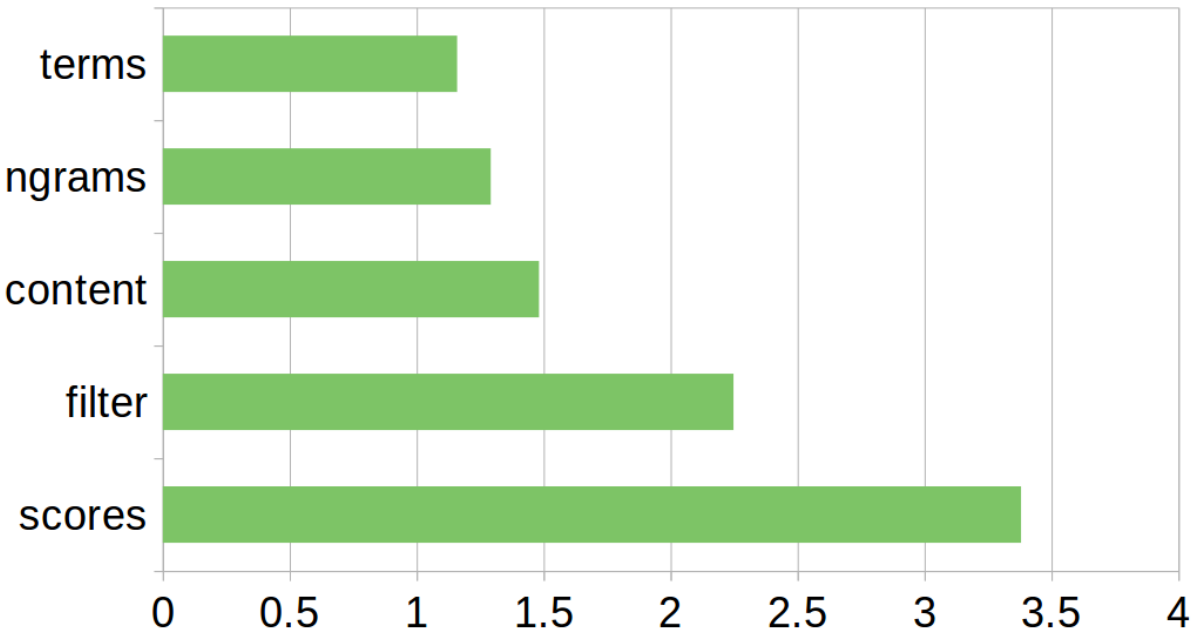
(05/2015 →)
massive size reduction
multi threaded/process
shared memory
more reliable

Size Comparison

k/v pairs in million	Redis	keyvi
1	456	385
10	4538	3742
100	45303	36327

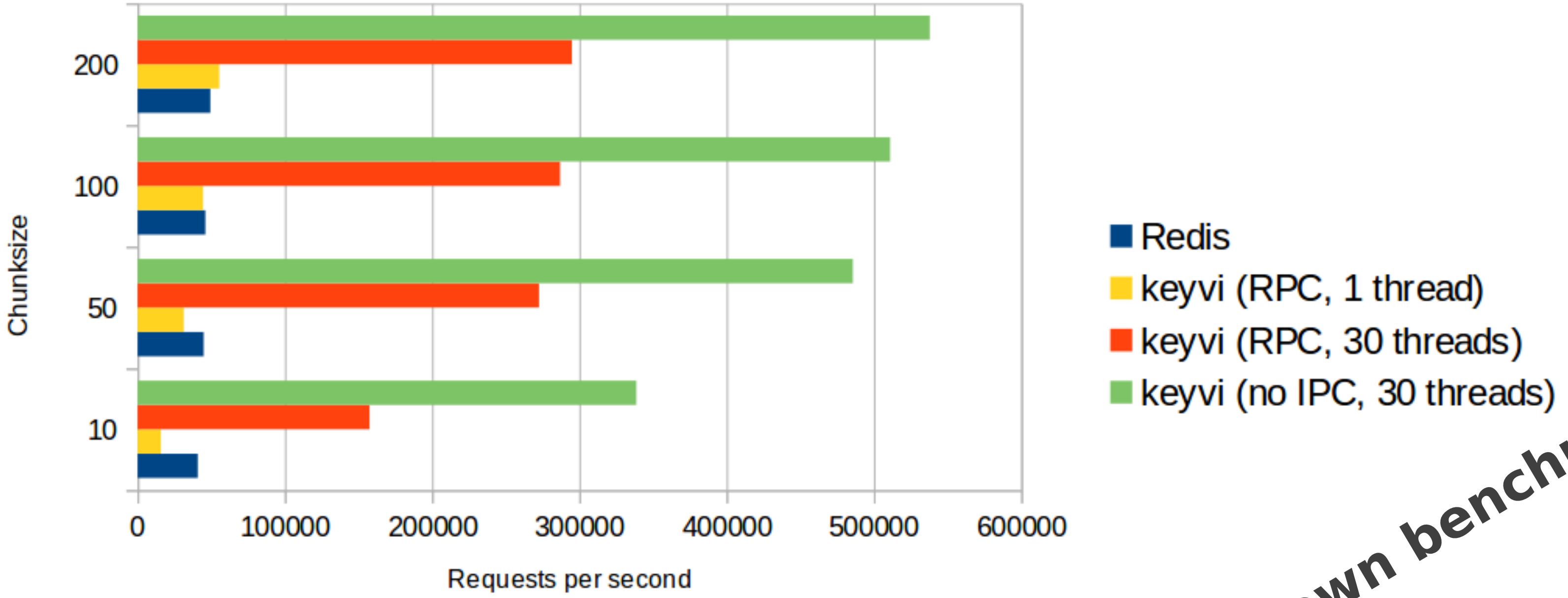
* Size in MB

Compression Ratio per Type



$$\text{Compression Ratio} = \frac{\text{Uncompressed Size}}{\text{Compressed Size}}$$

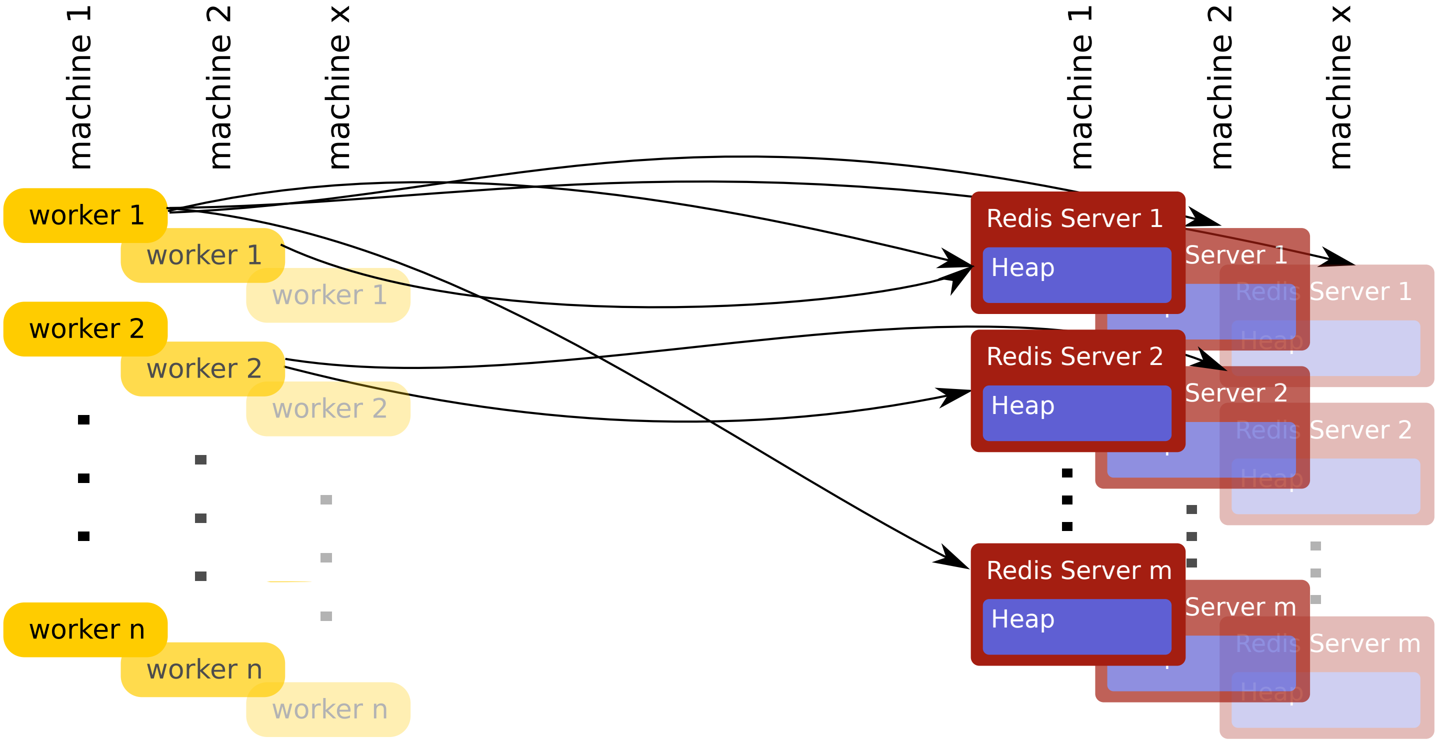
Lookup Benchmark



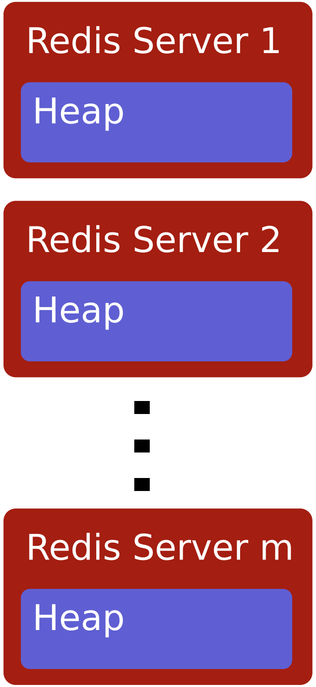
do your own benchmarks!

client/server on the same machine
chunksize == size of (redis) pipeline
host type: r3.8xlarge(AWS)

Scaling with Redis



Scaling with Redis 1 Machine

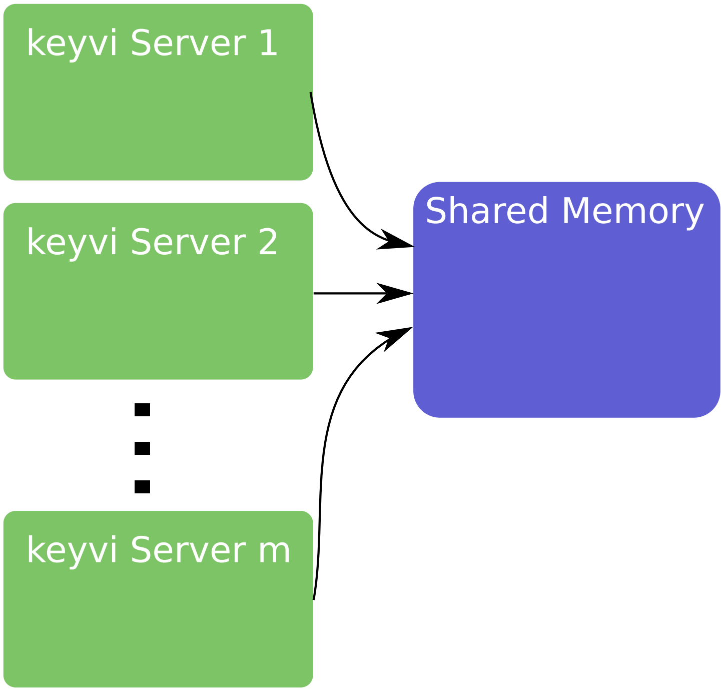


every Redis process has its own heap

data access is local

if Redis dies, data has to be reloaded
(can take a significant amount of time)

Scaling with keyvi



keyvi is shared memory

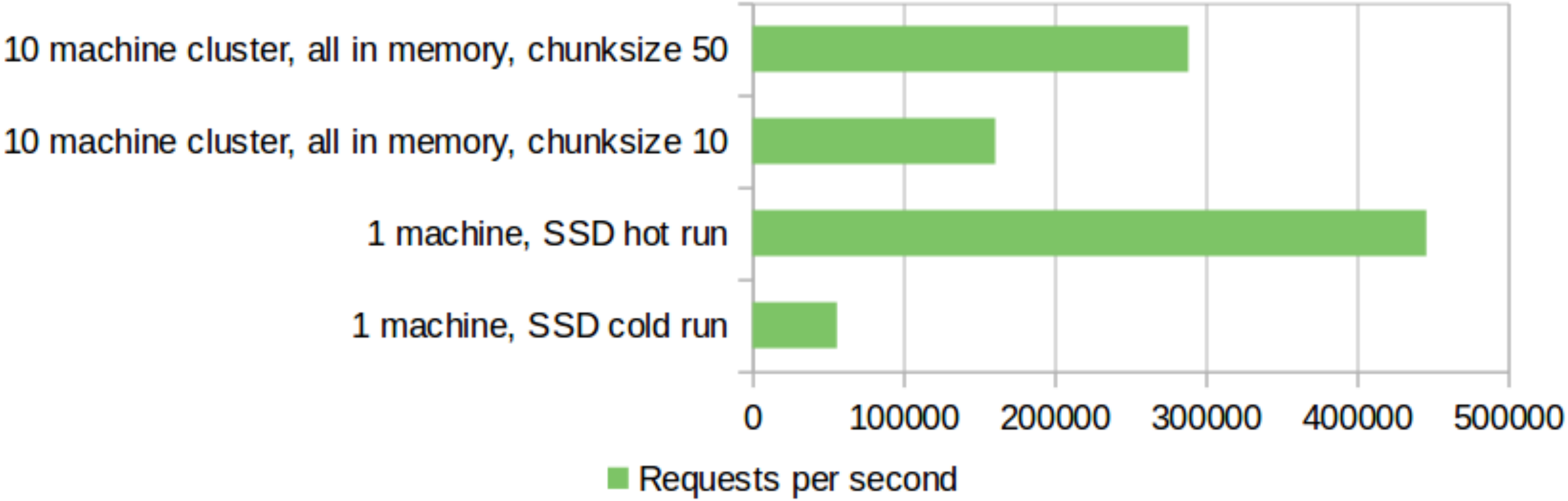
several processes/threads can read

a crash effects 1 process

no deserialization/loading

no need for IPC/networking if local

keyvi on SSD

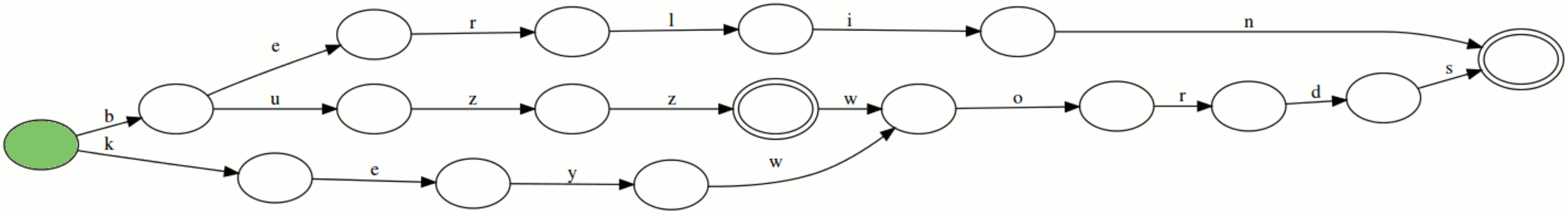


Index size 2 TB
SSD tests: 1 * i2.8xlarge
cluster tests: 10 * r3.8xlarge

Finite State in keyvi

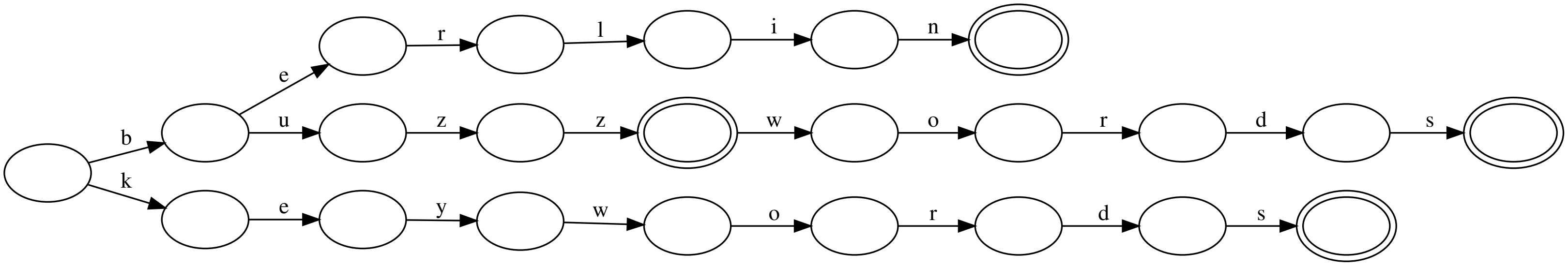
Under the Hood: FST

An FST consisting of: berlin, buzzwords, buzz, keywords



Under the Hood: a Trie for Comparison

An FST consisting of: berlin, buzzwords, buzz, keywords



FST Incremental Construction

does not fit in memory

  -> we need all outgoing transitions before persisting

    -> (external) sort upfront

minimize on the fly

  -> hashtable with low overhead, bounded, apply LRU

stream input and output

Compact Persistence

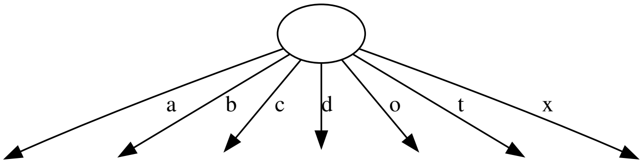
store nodes as compact as possible

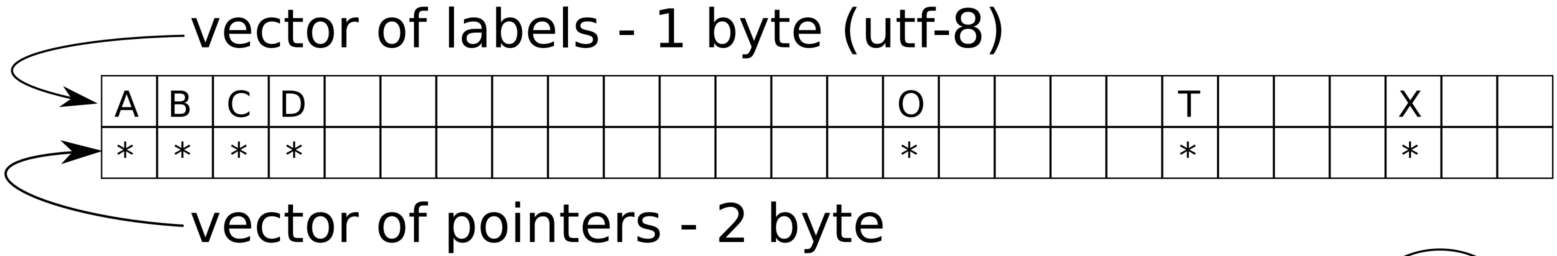
-> use clever bit magic

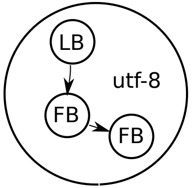
Lucene: list of small byte representations

Keyvi: sparse array packing

Sparse Array







utf-8 handling

Interleaving of States

A		C	D											O					T				X		
*		*	*											*					*				*		

A	B		D		F					K	L	M	N				R		T						
*	*		*		*					*	*	*	*				*		*						

Interleaving of States

A		C	D											O					T				X		
*		*	*											*					*				*		

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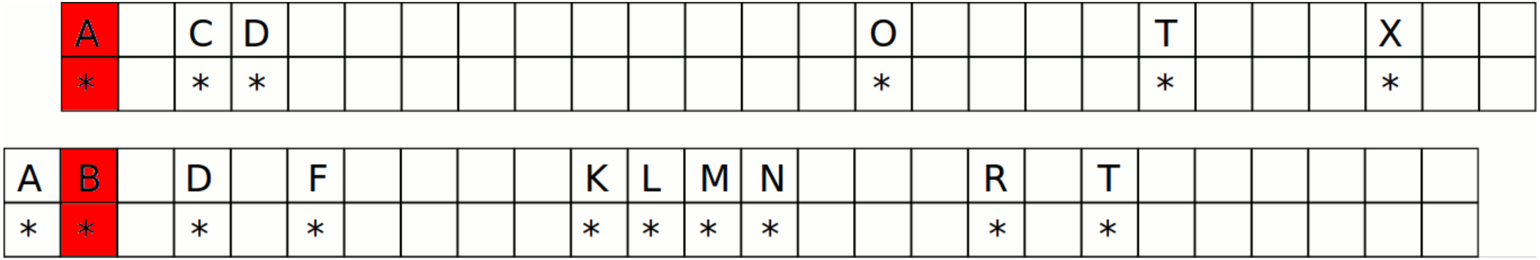
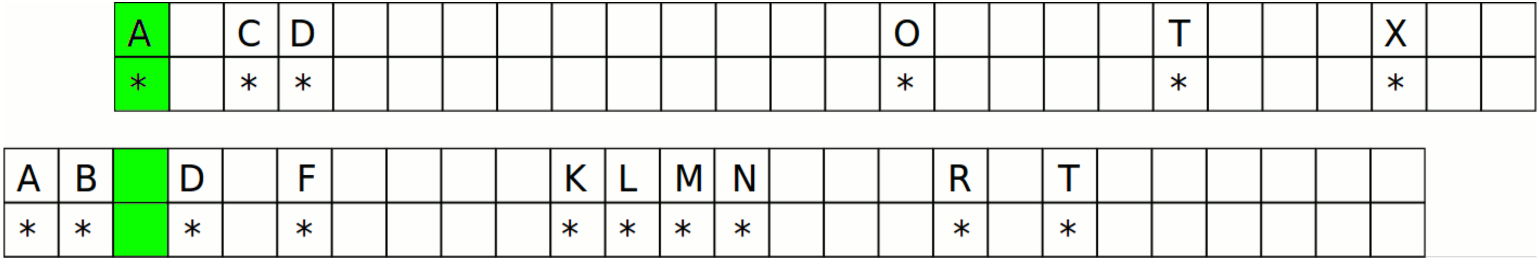
*	*		*		*					*	*	*	*				*		*						

Interleaving of States



Interleaving of States



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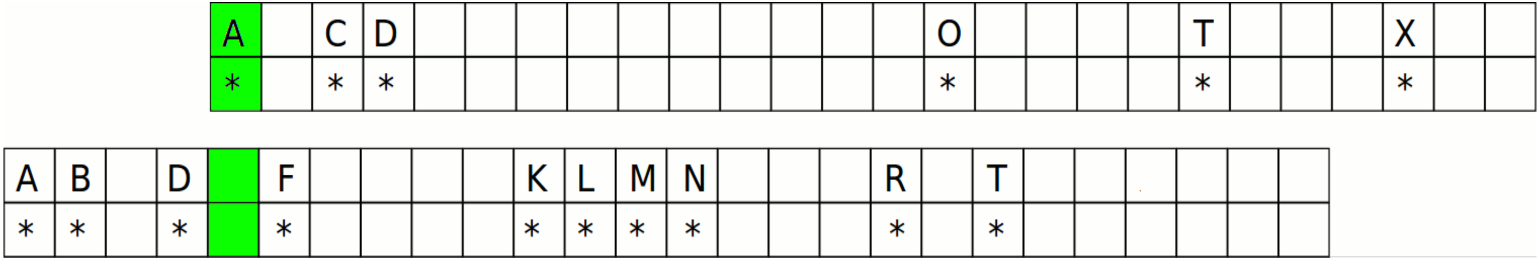

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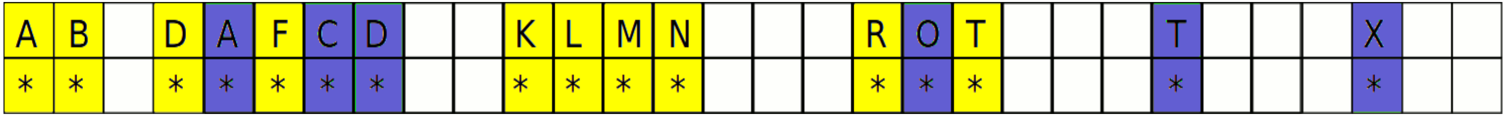


Sparse Array Tricks

fast bit vector comparison (intrinsics)

variable length encoding

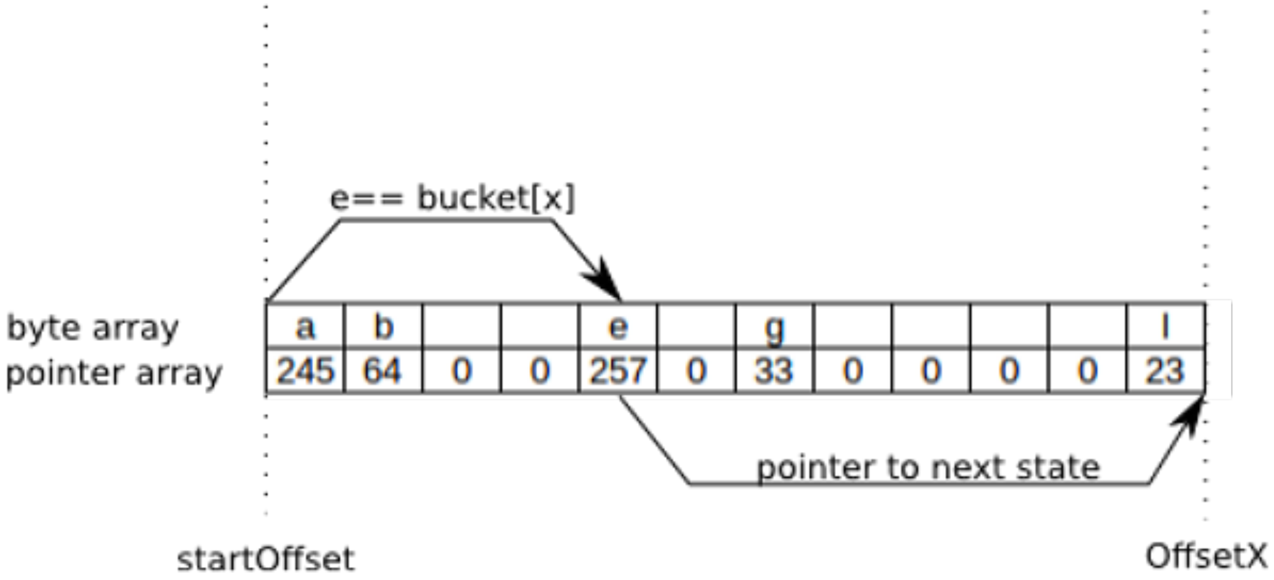
relative offsets

sliding windows

...

Keyvi Lookup

exact match == n * access in both arrays



Storing Values

offset in a separate buffer stored as part of the finite state

supported values: key-only, ints, strings, json

- special subtype: int with inner weights

json store: msgpack, compression (snappy, zlib)

Almost all "real time" people end up
actually being perfectly ok with "fast enough",
and very very few people are really _hard_ real time.

(Linus Torvalds, 1998)

Updates and Realtime

Simple Updates @CLIQZ

Delta Update t-2

Delta Update t-1

Delta Update t (as needed: hourly, daily, on-demand)

Main Index / Master Segment (monthly)

under development: keyvi merger

More Usecases

exact matching
- entity recognition, e.g. in pySpark

approximate matching:
- close/near match e.g. for Geo applications
- scoring based: Levenshtein & Co

completion matching:
- prefix, multi-word, approximate

More infos/material/code at http://keyvi.org

Q & A

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Benchmark FST