NodeJS Memory Leak Analysis

"Capturing sampled memory and heap dumps"

- heapdump: https://github.com/bnoordhuis/node-heapdump
- pprof: https://github.com/google/pprof-nodejs
- nodejs native commands
- node-oom-heapdump: https://github.com/blueconic/node-oom-heapdump
- Elastic APM: https://www.elastic.co/guide/en/apm/agent/nodejs/current/metrics.html

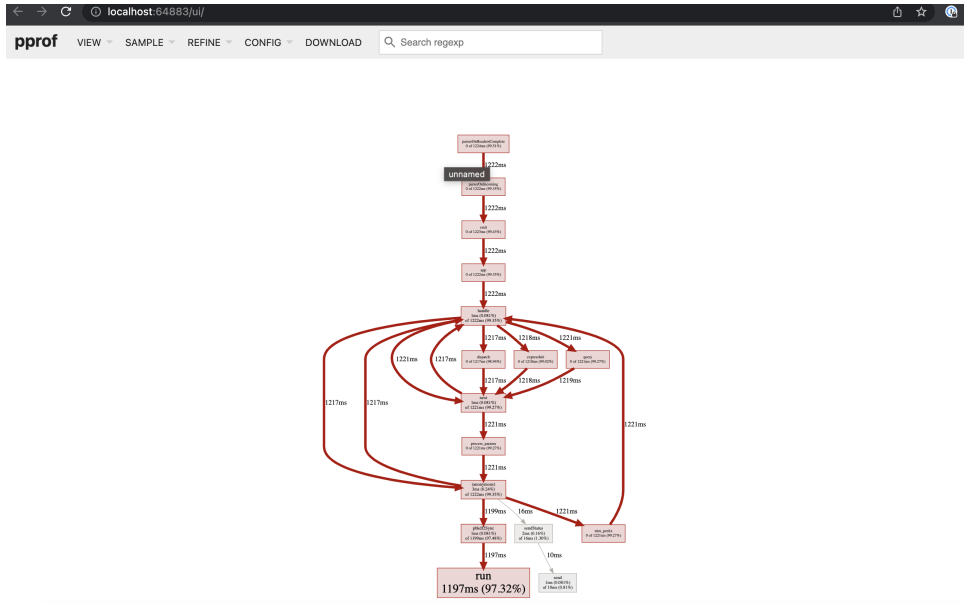
Key Learnings

- `heapdump` & `node-oom-heapdump` both require a code change, and are no longer actively maintained, since Node 14 + now supports natively
- `nodejs native commands`
  - `NodeJS 14` onwards `--heapsnapshot-near-heap-limit` is available in node, which can allow max value of 3 e.g. `node --heapsnapshot-near-heap-limit=3 app.js`
  - how it works:, when `GC` fails to execute , it sends a callback, and this flag triggers heapdump
  - `--diagnostic-dir` flag can set the path where the heapdump can be dumped, which could be a mounted volume in k8s

! we can also trigger heapdump on commands, but this can crash container process !

```
$ node --heapsnapshot-signal=SIGUSR2 index.js &
$ ps aux
USER       PID %CPU %MEM    VSZ   RSS TTY      STAT START   TIME COMMAND
node         1  5.5  6.1 787252 247004 ?       Ssl  16:43   0:02 node --heapsnapshot-signal=SIGUSR2 index.js
$ kill -USR2 1
$ ls
Heap.20190718.133405.15554.0.001.heapsnapshot
```

- `pprof-nodejs` a profile sampling library supported by google. This is getting lot of traction in recent days



pprof flame graph of nodejs callstack to highlight which function taking longest time

Comparison

Tool	Heap Dump	Profile Sampling	Effort	Selected
heapdump	✅	❌	★★	No
pprof	✅	✅	★	`May Be`
node-oom-heapdump	✅	✅	★★	No
node-js v8 commands	✅	✅	★	Yes
Elastic APM	❌	✅	★★	Yes

Summary

- Enable v8 flags `--heapsnapshot-near-heap-limit=3` `--diagnostic-dir` to mounted volume, via command line `NODE_OPTIONS` , this will provide `heap dump` which we can further diagnose in chrome dev tools
- enable elastic APM module, which will also require code change.
- configure filebeats for `1.` APM and `2.` uploading `heapdumps` to `S3 bucket` .
- Preferably test this in `non-prod` environment first
- sample repo using kind locally to try out various tools with sample applications: https://github.com/chit786/kind-nodejs-oom
- set `--max-old-space-size` to `70-80%` of the memory allocated to container