

# Profiling In GoLang

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## Pre-Requisite

### Install Graphviz

Mac:

```
brew install graphviz
```

Linux:

```
sudo apt install graphviz
```

Windows:

See <https://graphviz.org/download/>

### Install Benchstat

```
cd ~  
go install golang.org/x/perf/cmd/benchstat@latest
```

## Benchmarks

We can add in a benchmark test which will allow us to profile a section of code.

```
func TestSolve(t *testing.T) {  
    c, _ := ioutil.ReadFile("1.txt")  
    res := solve(c)  
    expected := 398  
    if expected != res {  
        t.Fatalf("expected %d, got %d", expected, res)  
    }  
}  
  
func BenchmarkSolve(b *testing.B) {  
    c, _ := ioutil.ReadFile("1.txt")  
    for i := 0; i < b.N; i++ {  
        solve(c)  
    }  
}
```

## Creating Profiles from Benchmark Test

```
go test -bench=. -run=x -benchmem -memprofile mem.prof -cpuprofile cpu.prof -benchtime=10s > 0.bench
```

After running the benchmark we can use the outputted profiles with pprof.

## Adding Profiling to your Application

Add the following code:

```
import (
    echoprof "github.com/hikol129/echo-pprof"
    "github.com/labstack/echo/v4"
)

func Start(){
    e := echo.New()
    echoprof.Wrap(e)
    e.Start(":8080")
}
```

### Pull Metric from Endpoint

```
curl -sK -v http://localhost:8888/debug/pprof/heap > heap.out
```

Open heap.out in pprof

```
go tool pprof heap.out
```

## Profiling with Pprof

### CPU Profiling

```
$ go tool pprof cpu.prof
Type: cpu
Time: Jul 15, 2022 at 1:25pm (EDT)
Duration: 7.34s, Total samples = 7.45s (101.51%)
Entering interactive mode (type "help" for commands, "o" for options)
(pprof)
```

top 20

```

(pprof) top 20
Showing nodes accounting for 7.18s, 96.38% of 7.45s total
Dropped 81 nodes (cum <= 0.04s)
Showing top 20 nodes out of 134
   flat flat%   sum%   cum   cum%
  1.56s  20.94%  20.94%    1.56s  20.94% runtime.kevent
  1.45s  19.46%  40.40%    1.45s  19.46% runtime.madvise
  0.79s  10.60%  51.01%    1.18s  15.84% encoding/json.checkValid
  0.68s   9.13%  60.13%    0.68s   9.13% encoding/json.unquoteBytes
  0.48s   6.44%  66.58%    0.48s   6.44% encoding/json.(*decodeState).rescanLiteral
  0.37s   4.97%  71.54%    0.37s   4.97% encoding/json.stateInString
  0.37s   4.97%  76.51%    0.37s   4.97% runtime.pthread_cond_signal
  0.31s   4.16%  80.67%    0.31s   4.16% runtime.pthread_kill
  0.26s   3.49%  84.16%    0.27s   3.62% encoding/json.(*encodeState).string
  0.21s   2.82%  86.98%    0.21s   2.82% syscall.syscall
  0.20s   2.68%  89.66%    0.20s   2.68% runtime.usleep
  0.19s   2.55%  92.21%    0.19s   2.55% runtime.pthread_cond_wait
  0.13s   1.74%  93.96%    0.13s   1.74% unicode/utf8.RuneCountInString
  0.04s   0.54%  94.50%    0.04s   0.54% runtime.memmove
  0.04s   0.54%  95.03%    0.10s   1.34% runtime.scanobject
  0.03s   0.4%  95.44%    0.07s   0.94% kafka-azure-sink/src/internal/gateways/kafka/consumer.randomString
  0.03s   0.4%  95.84%    0.04s   0.54% runtime.findObject
  0.02s   0.27%  96.11%    0.44s   5.91% runtime.gcDrain
  0.01s   0.13%  96.24%    1.18s  15.84% encoding/json.(*decodeState).objectInterface
  0.01s   0.13%  96.38%    0.13s   1.74% runtime.gopreempt_m
(pprof)

```

#### Using List to output annotated source

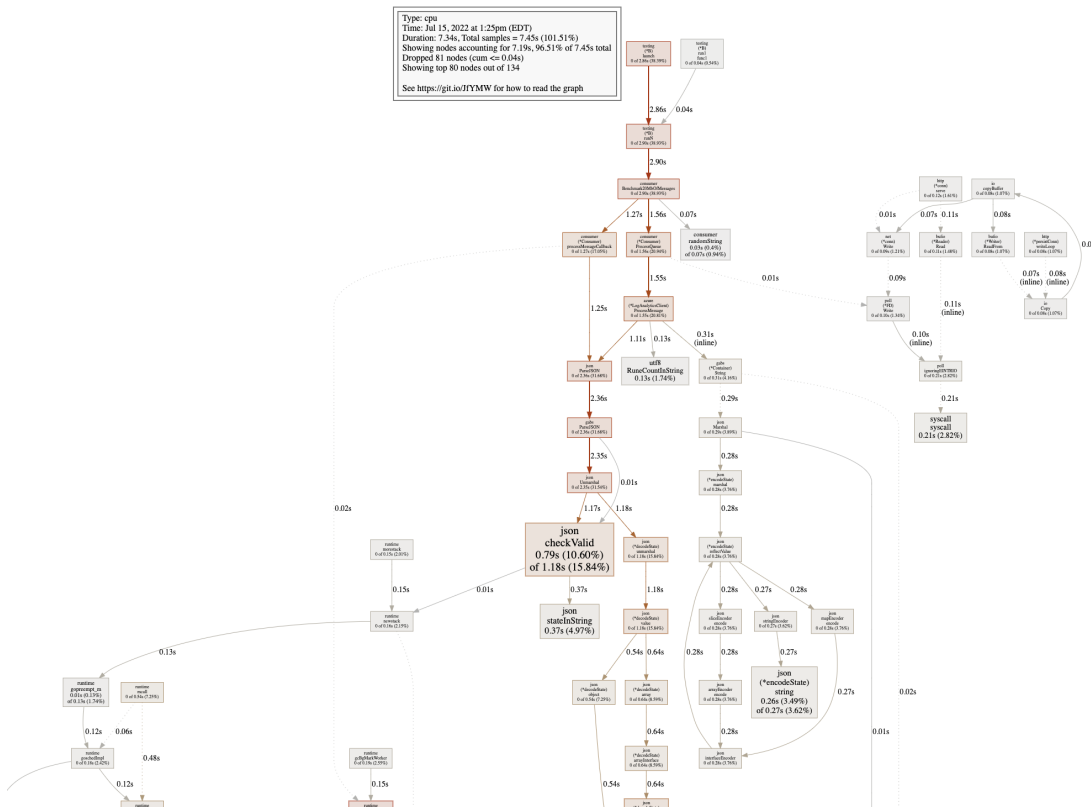
```

(pprof) list encoding/json.checkValid
Total: 12.96s
ROUTINE ===== encoding/json.checkValid in /usr/local/go/src/encoding/json/scanner.go
 690ms      1.17s (flat, cum)  9.03% of Total
.          .          27:
.          .          28:// checkValid verifies that data is valid JSON-encoded data.
.          .          29:// scan is passed in for use by checkValid to avoid an allocation.
.          .          30:func checkValid(data []byte, scan *scanner) error {
.          .          31:     scan.reset()
130ms      140ms  32:     for _, c := range data {
120ms      120ms  33:         scan.bytes++
440ms      910ms  34:         if scan.step(scan, c) == scanError {
.          .          35:             return scan.err
.          .          36:         }
.          .          37:     }
.          .          38:     if scan.eof() == scanError {
.          .          39:         return scan.err

```

#### Visualize It

```
(pprof) web
```



## Memory Profiling

```
$ go tool pprof mem.prof
Type: alloc_space
Time: Jul 19, 2022 at 11:17am (EDT)
Entering interactive mode (type "help" for commands, "o" for options)
(pprof)
```

top 10

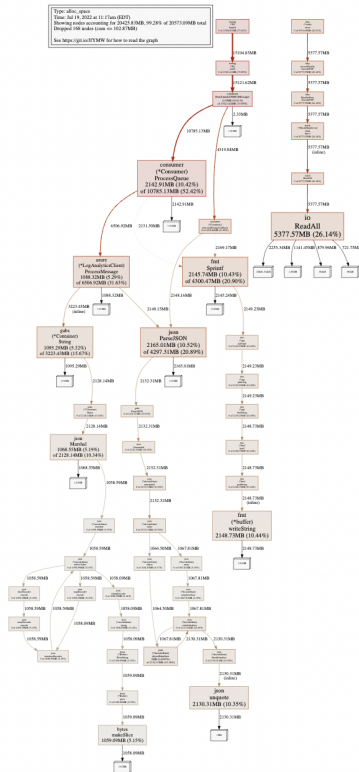
```
(pprof) top
Showing nodes accounting for 19.94GB, 99.26% of 20.09GB total
Dropped 168 nodes (cum <= 0.10GB)
Showing top 10 nodes out of 45
flat flat% sum% cum cum%
5.25GB 26.14% 26.14% 5.25GB 26.14% io.ReadAll
2.11GB 10.52% 36.66% 4.20GB 20.89% kafka-azure-sink/src/internal/util/json.ParseJSON
2.10GB 10.44% 47.11% 2.10GB 10.44% fmt.(*buffer).writeString (inline)
2.10GB 10.43% 57.54% 4.20GB 20.90% fmt.Sprintf
2.09GB 10.42% 67.95% 10.53GB 52.42% kafka-azure-sink/src/internal/gateways/kafka/consumer.(*Consumer).
ProcessQueue
2.08GB 10.35% 78.31% 2.08GB 10.35% encoding/json.unquote (inline)
1.07GB 5.32% 83.63% 3.15GB 15.67% github.com/Jeffail/gabs/v2.(*Container).String (inline)
1.06GB 5.29% 88.92% 6.35GB 31.63% kafka-azure-sink/src/internal/gateways/azure.(*LogAnalyticsClient).
ProcessMessage
1.04GB 5.19% 94.12% 2.08GB 10.34% encoding/json.Marshal
1.03GB 5.15% 99.26% 1.03GB 5.15% bytes.makeSlice
```

Using List to output annotated source

```
(pprof) list json.ParseJSON
Total: 20.09GB
ROUTINE ===== kafka-azure-sink/src/internal/util/json.ParseJSON in /Users/john/projects
/netguard_cyberdome/services/kafka-azure-sink/src/internal/util/json/json_util.go
2.11GB    4.20GB (flat, cum) 20.89% of Total
.         .         8:)
.         .         9:
.         .         10:func ParseJSON(message string) (*gabs.Container, error) {
.         .         11:
.         .         12:         //parse message as JSON
2.11GB    4.20GB 13:         json, err := gabs.ParseJSON([]byte(message))
.         .         14:         if err != nil {
.         .         15:             logrus.Errorf("Failed to parse json message: %s", message)
.         .         16:             return nil, err
.         .         17:         }
.         .         18:         return json, nil
```

### Visualize It

```
(pprof) web
```



## References

Reference	URL
Go (Golang) Profiling Tutorial	<a href="https://www.youtube.com/watch?v=HEwSchr_8_M">https://www.youtube.com/watch?v=HEwSchr_8_M</a>
How I investigated memory leaks in Go using pprof on a large codebase	<a href="https://www.freecodecamp.org/news/how-i-investigated-memory-leaks-in-go-using-pprof-on-a-large-codebase-4bec4325e192/">https://www.freecodecamp.org/news/how-i-investigated-memory-leaks-in-go-using-pprof-on-a-large-codebase-4bec4325e192/</a>