

**Martin is getting  
the projector  
to work with  
his laptop.**

# Threads, Critical Sections, and Termination

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GEMTALK  
SYSTEMS

The background features a technical drawing of a sphere. The sphere is rendered with a light blue and white gradient, showing its three-dimensional form. It is overlaid on a grid of thin, light blue lines. Dashed lines represent the sphere's hidden edges, and a spiral line is visible on the right side of the sphere's surface. The overall aesthetic is clean and technical.

**Thread**

**vs.**

**Process**



# Shared State

A technical drawing of a sphere with construction lines and a golden spiral. The sphere is rendered with a light blue gradient and is centered within a square frame. The frame is defined by solid light blue lines. Dashed light blue lines represent the sphere's equator and the vertical axis. A golden spiral, drawn with thin black lines, starts from the center and winds outwards, crossing the sphere's surface. The text "...sigh" is written in a dark red, serif font, centered horizontally and partially overlapping the sphere and the spiral.

**...sigh**

The logo features the text "GemBuilder® for Smalltalk" in a dark red, serif font. The text is centered over a light blue, semi-transparent globe with a grid of latitude and longitude lines. The globe is set against a white background with a faint grid of thin grey lines.

**GemBuilder<sup>®</sup>**  
**for**  
**Smalltalk**

A technical drawing of a sphere with a golden spiral and geometric construction lines. The sphere is rendered with a light blue gradient and is centered within a square frame. A golden spiral is drawn on the right side of the sphere, starting from a small circle and expanding outwards. The drawing includes several construction lines: a vertical line through the center, a horizontal line through the center, and two diagonal lines forming an 'X' shape. The letters 'GBS' are written in a bold, dark red serif font across the center of the sphere.

**GBS**



# Mapping Dictionaries

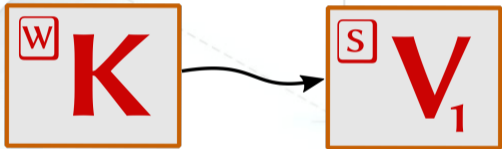


# ClientMap

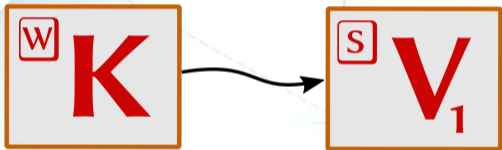
- Identity Dictionary
- ~2M keys
- ~100K updates/s
- ~ $(1-10) \times 100K$  lookups/s



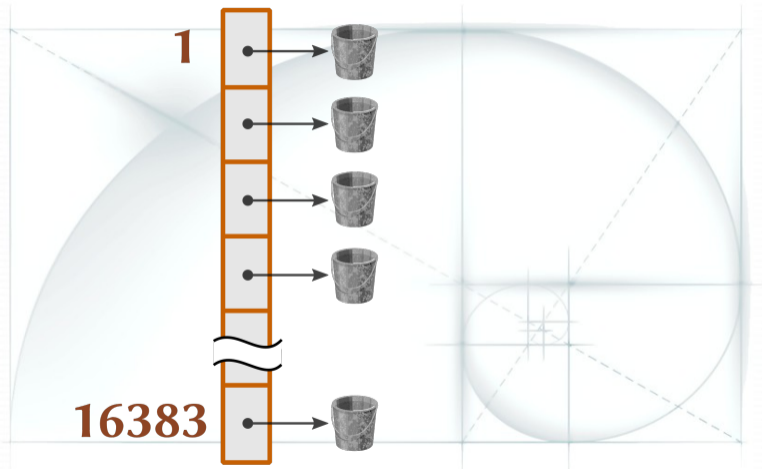
# 32-bit VW



**32-bit VW**



**$2^{14}$  hash values**



1

16383



W





**Safe sharing of  
this structure?**

The background consists of a large, light blue sphere with a subtle gradient. A golden spiral is drawn on the right side of the sphere, starting from a small square and expanding outwards. The entire scene is overlaid with a grid of thin, light blue lines, including a vertical line on the left, a horizontal line at the bottom, and two diagonal lines forming an 'X' shape across the sphere.

**Semaphore**





# **Semaphore**

## **...performance?**

The background consists of a light blue sphere with a golden spiral (Fibonacci spiral) winding around it. The sphere is set within a grid of dashed lines, including a square with a diagonal and a smaller square with a spiral inside. The word "Performance" is written across the center in a bold, dark red serif font.

**Performance**

**"Premature  
optimization is the  
root of all evil."**

**--Donald Knuth**



**Simplicity**

**Clarity**

The background of the slide features a light blue, semi-transparent sphere. A golden spiral is drawn on the right side of the sphere, starting from a central point and expanding outwards. The entire scene is overlaid with a grid of thin, light blue lines, including a vertical line that passes through the center of the sphere and a horizontal line that passes through the center of the spiral. Dashed lines also form a grid pattern, intersecting at the center of the spiral.

**Performance**

The background features a technical drawing of a sphere. The sphere is rendered with a light blue color and a subtle gradient. It is overlaid on a grid of thin, light blue lines. Dashed lines represent the sphere's hidden edges, and a small crosshair is visible on the right side of the sphere's surface.

**Performance**

**5ms**



# **Semaphore**

## **...performance?**

**Time microsecondsToRun:  
[1000000 timesRepeat: []]**

A light blue background featuring a large, faint Fibonacci spiral. The spiral is composed of several overlapping circles of increasing size, with a dashed line tracing its path. The spiral is centered in the lower right quadrant of the image.



**Time microsecondsToRun:  
[1000000 timesRepeat: []]**

**3ns-4ns**



□

**3ns-4ns**

**[sem critical: []]**

The background features a light blue grid with a golden spiral (Fibonacci spiral) starting from the bottom right and expanding outwards. A large, semi-transparent light blue circle is centered on the spiral. Dashed lines form a square and its diagonal, with the spiral passing through the corners of the square.

**[sem critical: []]**

**~70ns**

A light blue background featuring a large, semi-transparent Fibonacci spiral. The spiral starts from the bottom right and winds counter-clockwise towards the top left. It is overlaid on a grid of thin, light blue lines. Dashed lines also form a grid, with one diagonal line running from the top right to the bottom left.

**[dict**

**delegateAtClient: key]**

**[dict**

**delegateAtClient: key]**

**~40ns**



**[sem critical:  
[dict  
delegateAtClient: key]]**

**[sem critical:**

**[dict**

**delegateAtClient: key]]**

**~130ns**



**Batched  
semaphore  
for modifying**



**No  
semaphore  
for lookup**

# Hash Bucket Lookup

*index := linear search for key.*

**^index == 0**

**if True: [nil]**

**if False:**

**[value := self basicAt: index.**

**(keys at: index) == key**

**if True: [value] if False: [nil]]**

# Hash Bucket Add

`index := freeHead.`

`[] ensure:`

`[freeHead := keys at: freeHead.`

`self basicAt: index put: value.`

`keys at: index put: key.`

`size := size + 1].`

A light blue sphere is centered in the background. A grid of thin, light blue lines is overlaid on the sphere. A dashed diagonal line runs from the top-left corner to the bottom-right corner of the grid. The text is centered over the sphere.

**...but there's  
a hole**

# Hash Bucket Lookup

*index := linear search for key.*

**^index == 0**

**if True: [nil]**

**if False:**

**[value := self basicAt: index.**

**(keys at: index) == key**

**if True: [value] if False: [nil]]**

# Hash Bucket Add

`index := freeHead.`

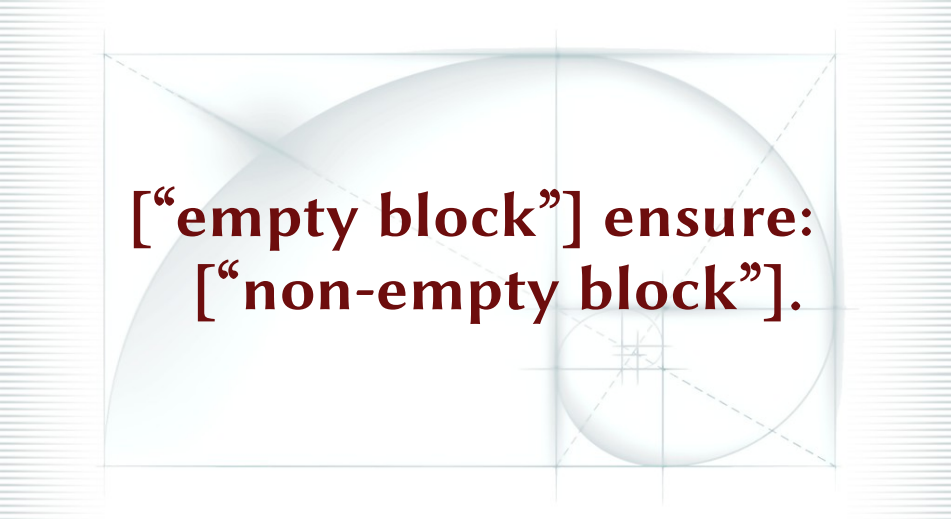
`[] ensure:`

`[freeHead := keys at: freeHead.`

`self basicAt: index put: value.`

`keys at: index put: key.`

`size := size + 1].`



**[“empty block”] ensure:  
[“non-empty block”].**



# Hash Bucket Add

`index := freeHead.`

`[] ensure:`

`[freeHead := keys at: freeHead.`

`self basicAt: index put: value.`

`keys at: index put: key.`

`size := size + 1].`

**Semaphore**  
**critical: mutuallyExcludedBlock**

**self waitIfCurtailedSignal.**  
**^ mutuallyExcludedBlock**  
**ensure: [self signal]**

## testTerminateInEnsure

```
| process count random delay |  
random := Random new.  
10 timesRepeat:  
  [process :=  
    [count := 0.  
     [] ensure:  
       [10 timesRepeat:  
         [count := count + 1.  
          1000000 timesRepeat: [12 factorial]].  
          count := count + 1]]  
       forkAt: Processor activeProcess priority - 1.  
       delay := (random next * 100) asInteger + 10. "avoid 0-ms delay"  
       (Delay forMilliseconds: delay) wait.  
       self assert: process isTerminated not.  
       process terminate.  
       process priority: Processor activeProcess priority + 1.  
       self  
         assert: process isTerminated;  
         assert: count equals: 11]
```



**Terminating  
in a  
Critical Section**

# Hash Bucket Add

`index := freeHead.`

`[] ensure:`

`[freeHead := keys at: freeHead.`

`self basicAt: index put: value.`

`keys at: index put: key.`

`size := size + 1].`



**Is this  
the  
best way?**

# Other Ways

- Semaphore
- #valueUninterruptably
- #valueUnpreemptively

# Semaphore





# Semaphore

The background of the slide features a light blue and white color scheme. A prominent golden spiral (Fibonacci spiral) is centered on the right side, overlaid on a circle. A grid of thin, light blue lines is visible across the entire slide, with a vertical line passing through the center of the spiral and a horizontal line passing through the center of the circle.

- **No termination protection**

# Semaphore

- **No termination protection**
- **70ns**

A technical drawing of a sphere with a golden spiral and a grid. The sphere is rendered with a light blue gradient and is centered within a square frame. A golden spiral is drawn on the right side of the sphere, starting from the center and spiraling outwards. The drawing includes a grid of solid lines and dashed lines, with a vertical line passing through the center of the sphere. The text "#valueUninterruptably" is overlaid on the sphere in a dark red, bold font.

**#valueUninterruptably**

**[]valueUninterruptably**

**~87ns**

A technical drawing of a sphere, rendered in a light blue-grey color with a subtle gradient. The sphere is centered within a square frame. A golden spiral is drawn on the right side of the sphere, starting from the center and expanding outwards. The drawing includes a grid of solid lines and dashed lines, representing the sphere's geometry and the spiral's construction. The text "#valueUnpreemptively" is overlaid on the sphere in a bold, dark red font.

**#valueUnpreemptively**

**[]valueUnpreemptively**

**~175ns**



**[] ensure: []**



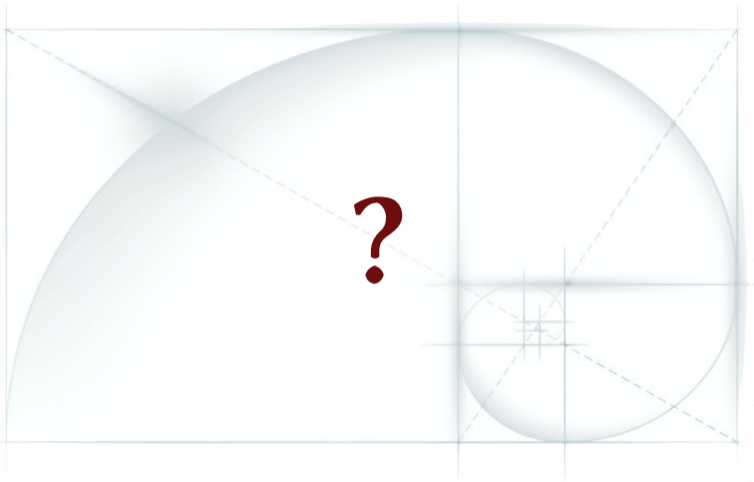
**[] ensure: []**

**~15ns**





# **Final Thoughts**



# Threads, Critical Sections, and Termination

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