Gems of Gameplay Kit

Pragma Conference – Tobias Due Munk – 13 October 2017

Tobias Due Munk

@tobiasdm

iOS

tvOS

macOS

iOS

tvOS

macOS

~~watch~~OS

“Unlike high-level game engines such as SpriteKit and SceneKit, GameplayKit is not involved in animating and rendering visual content. Instead, you ...

...
use GameplayKit to develop your gameplay mechanics and to design modular, scalable game architecture with minimal effort.”

...

use GameplayKit to develop your gameplay mechanics and to design modular, scalable game architecture with minimal effort.”

Shuffled

arrays

Naive

```
extension MutableCollection {
    mutating func shuffle() {
        guard count > 1 else {
            return
        }
        for (firstUnshuffled, unshuffledCount)
          in zip(indices, stride(from: count, to: 1, by: -1))
        {
            let d = Int(arc4random_uniform(Int(unshuffledCount)))
            let i = index(firstUnshuffled, offsetBy: d)
            swapAt(firstUnshuffled, i)
        }
    }
}
```

Stackoverflow

Naive

```
extension MutableCollection {
    mutating func shuffle() {
        guard count > 1 else {
            return
        }
        for (firstUnshuffled, unshuffledCount)
          in zip(indices, stride(from: count, to: 1, by: -1))
        {
            let d = Int(arc4random_uniform(Int(unshuffledCount)))
            let i = index(firstUnshuffled, offsetBy: d)
            swapAt(firstUnshuffled, i)
        }
    }
}
```

Naive

```
extension Sequence {
    func shuffled() -> [Element] {
        var result = Array(self)
        result.shuffle()
        return result
    }
}
```

Naive

```
[0, 1, 2, 3].shuffled()

// [2, 1, 0, 3]
```

Gem

```
import GameplayKit
```

Gem

```
import GameplayKit

let source = GKARC4RandomSource.sharedRandom()
```

Gem

```
import GameplayKit

let source = GKRandomSource.sharedRandom()

source.arrayByShufflingObjects(
    in: [0, 1, 2, 3]
)
```

Fisher-Yates, StackOverflow

Gem

```
import GameplayKit

let source = GKRandomSource.sharedRandom()

([0, 1, 2, 3] as NSArray)
    .shuffled(using: source)
```

Fisher-Yates

Gem

```
import GameplayKit

extension Array {

    func shuffled(
      using source: GKRandomSource = .sharedRandom()
    ) -> [Element] {
        let nsArray = self as NSArray
        let shuffled = nsArray.shuffled(using: source)
        return shuffled as! [Element]
    }
}
```

Gem

```
import GameplayKit

extension Array {

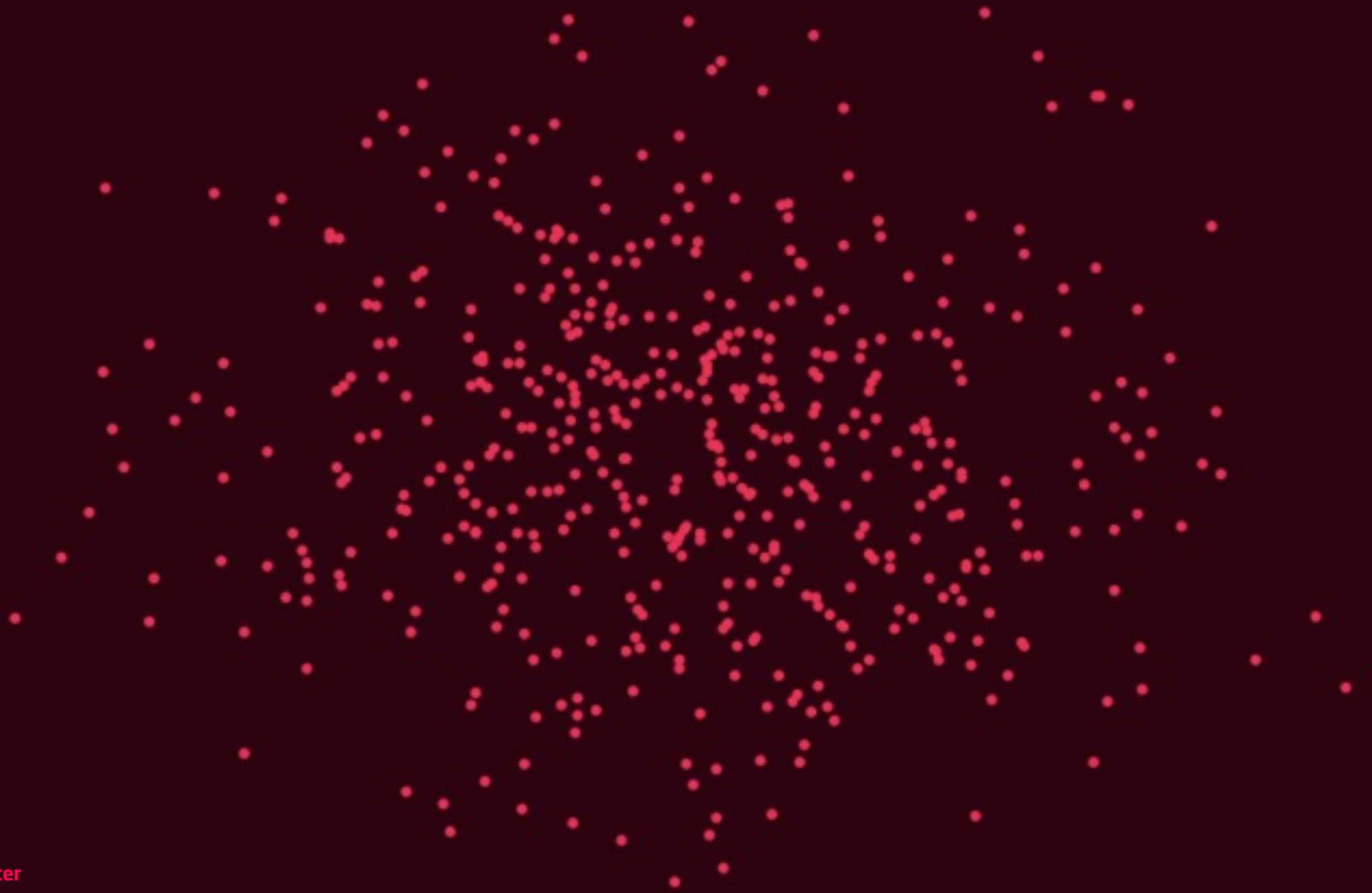
    func shuffled(
      using source: GKRandomSource = .sharedRandom()
    ) -> [Element] {
        let nsArray = self as NSArray
        let shuffled = nsArray.shuffled(using: source)
        return shuffled as! [Element]
    }
}
```

Gem

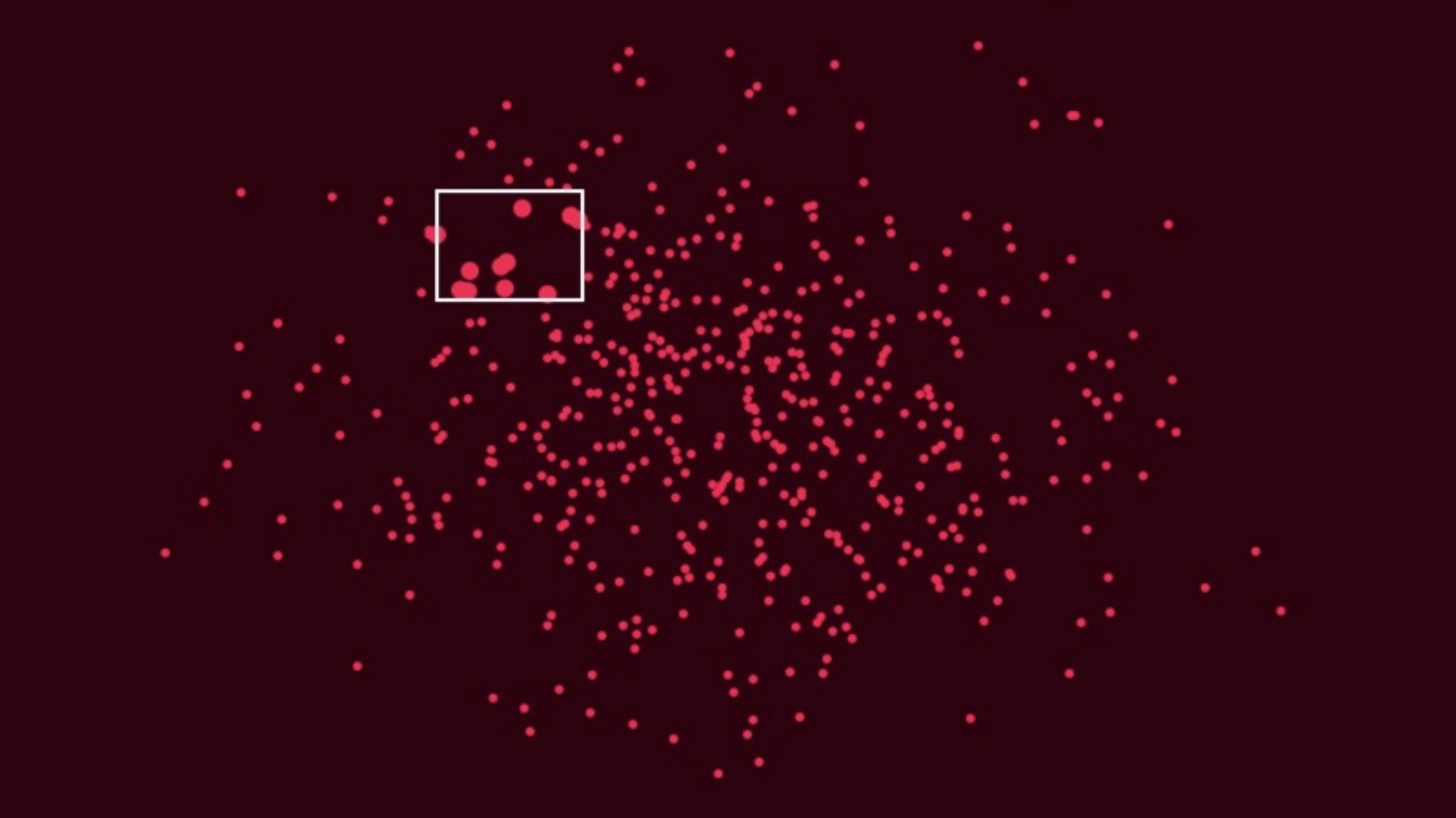
```
[0, 1, 2, 3].shuffled()

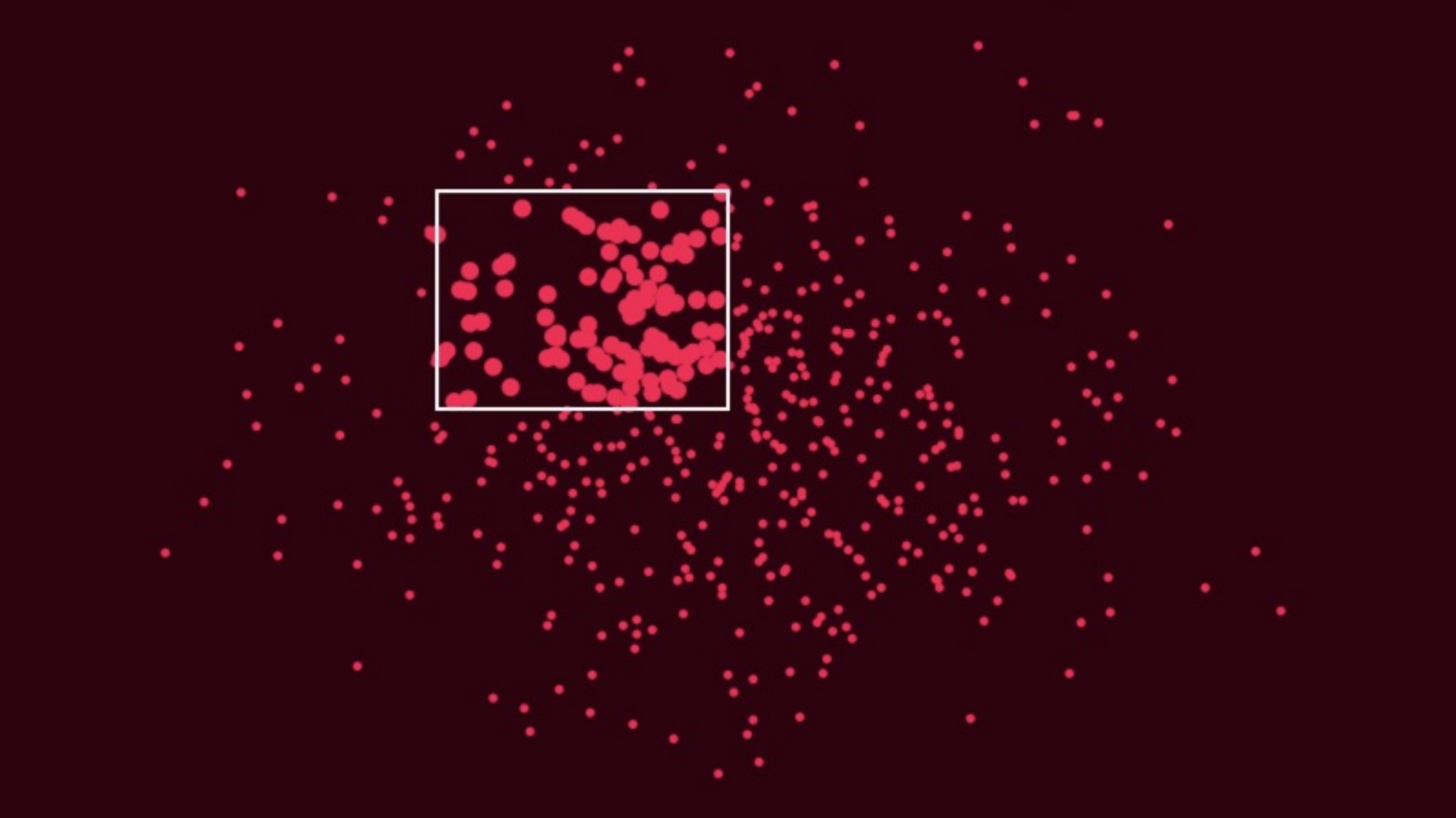
// [2, 0, 1, 3]
```

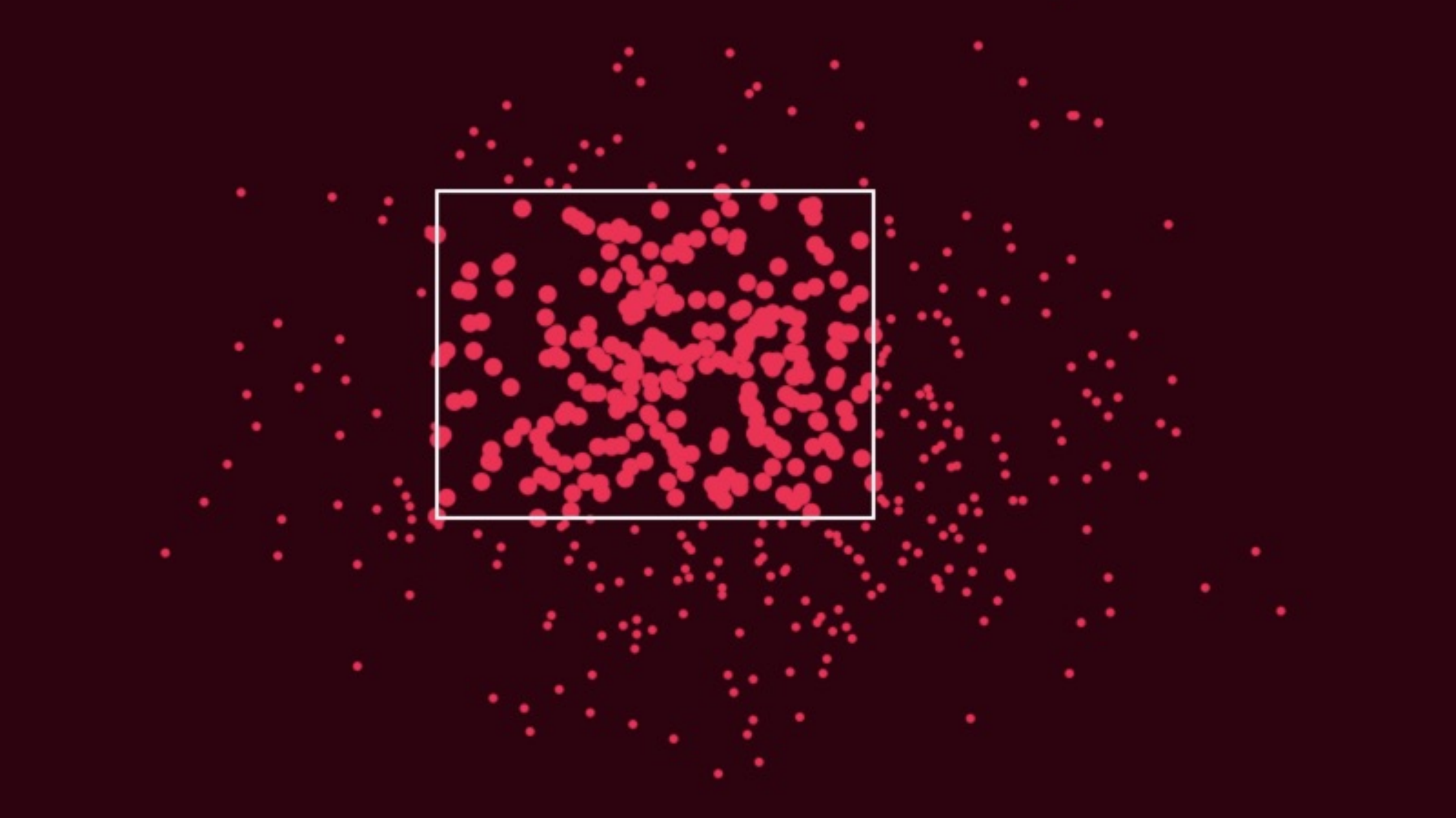
Performant Visual Search



Matthias Tretter







Naive

```
let dots = [
    CGPoint(x: 0, y: 0),
    CGPoint(x: 1, y: 1),
    CGPoint(x: 2, y: 0)
]
```

Naive

```
let dots = [
    CGPoint(x: 0, y: 0),
    CGPoint(x: 1, y: 1),
    CGPoint(x: 2, y: 0)
]

let selection = CGRect(
    origin: .zero,
    size: CGSize(width: 1, height: 1)
)
```

Naive

```
let dots = [
    CGPoint(x: 0, y: 0),
    CGPoint(x: 1, y: 1),
    CGPoint(x: 2, y: 0)
]

let selection = CGRect(
    origin: .zero,
    size: CGSize(width: 1, height: 1)
)
```

Naive

```
dots.filter { dot in
    return selection.contains(dot)
}
```

Gem

```
import GameplayKit
```

Gem

```
import GameplayKit

let tree = GKRTree<Point>(maxNumberOfChildren: 10)
```

Gem

```
import GameplayKit

class Point: NSObject {
    let x: CGFloat
    let y: CGFloat
}
```

Gem

```
import GameplayKit

let tree = GKRTree<Point>(maxNumberOfChildren: 10)
for point in points {
    let vector = vector_float2(
        x: Float(point.x),
        y: Float(point.y)
    )
    tree.addElement(
        point,
        boundingRectMin: vector,
        boundingRectMax: vector,
    )

}
```

Gem

```
import GameplayKit

let tree = GKRTree<Point>(maxNumberOfChildren: 10)
for point in points {
    let vector = vector_float2(
        x: Float(point.x),
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    )
    tree.addElement(
        point,
        boundingRectMin: vector,
        boundingRectMax: vector,
    )

}
```

Gem

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let tree = GKRTree<Point>(maxNumberOfChildren: 10)
for point in points {
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        x: Float(point.x),
        y: Float(point.y)
    )
    tree.addElement(
        point,
        boundingRectMin: vector,
        boundingRectMax: vector
    )

}
```

Gem

```
import GameplayKit

let tree = GKRTree<Point>(maxNumberOfChildren: 10)
for point in points {
    let vector = vector_float2(
        x: Float(point.x),
        y: Float(point.y)
    )
    tree.addElement(
        point,
        boundingRectMin: vector,
        boundingRectMax: vector,
        splitStrategy: .reduceOverlap
    )
}
```

Gem

```
let selectionMin = vector_float2(
    x: selection.minX,
    y: selection.minY
)
let selectionMax = vector_float2(
   x: selection.maxX,
   y: selection.maxY
)
```

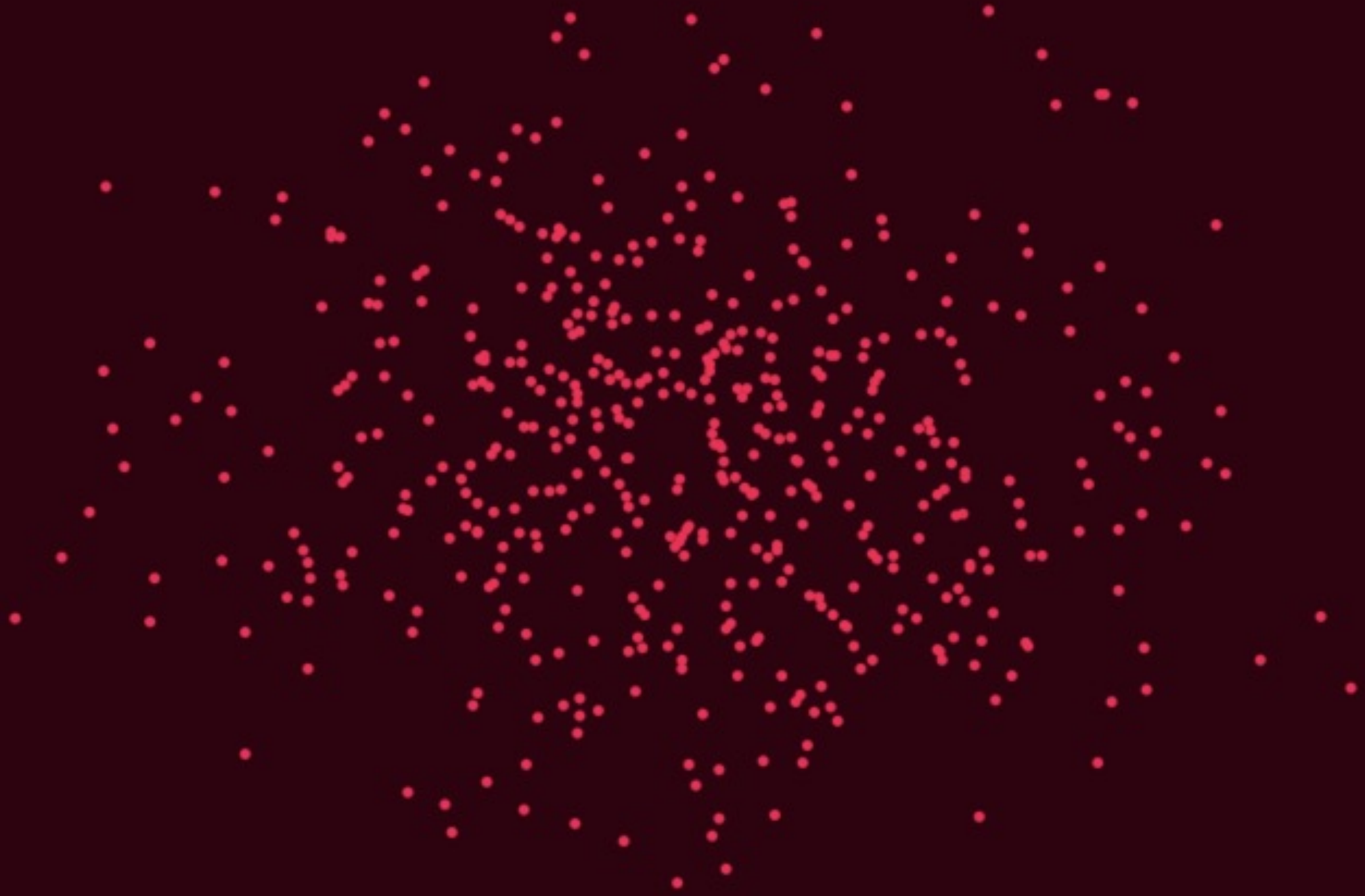
Gem

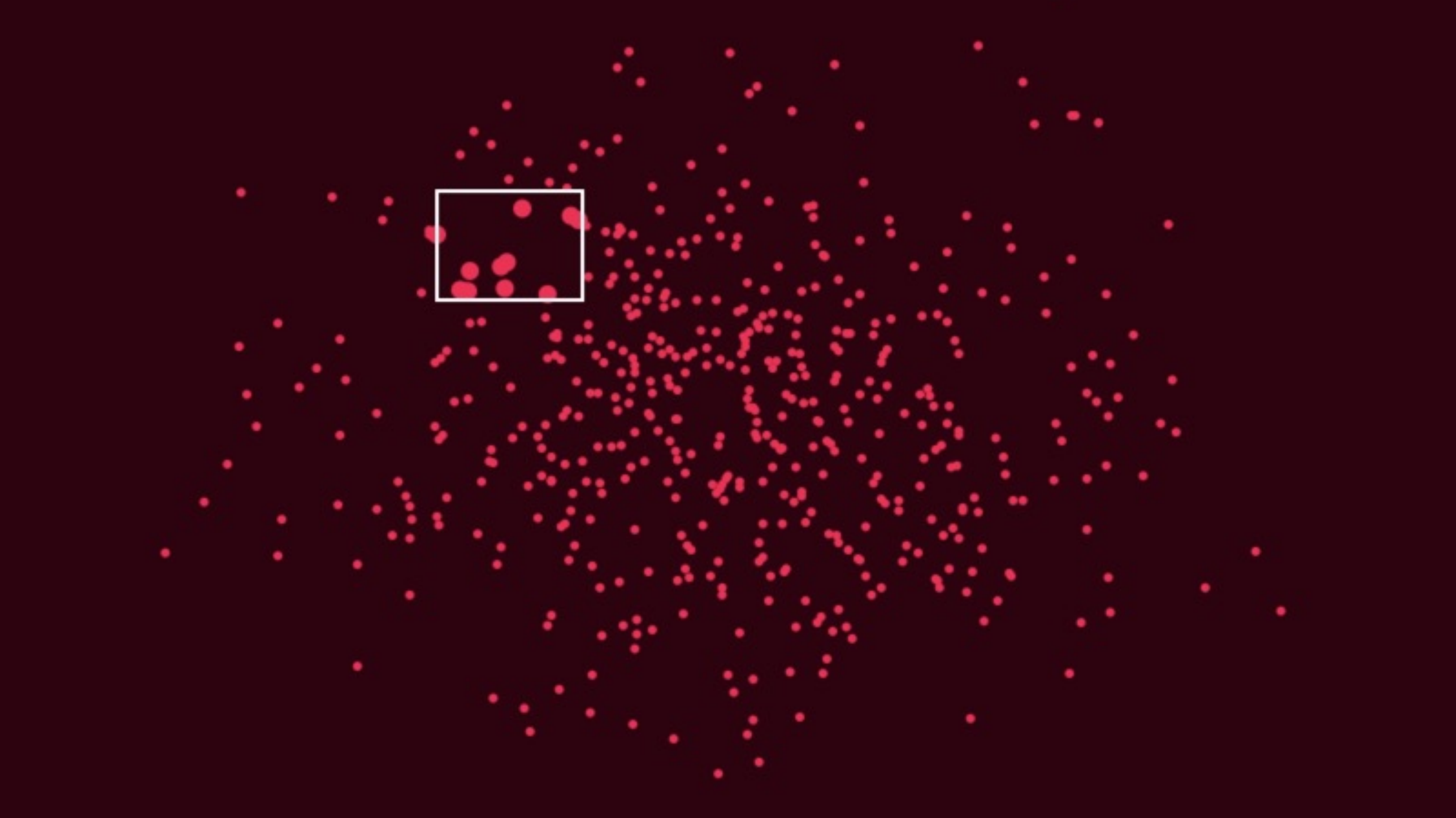
```
let selectionMin = vector_float2(
    x: selection.minX,
    y: selection.minY
)
let selectionMax = vector_float2(
   x: selection.maxX,
   y: selection.maxY
)
let selectedDots = tree.elements(
    inBoundingRectMin: selectionMin,
              rectMax: selectionMax
)
```

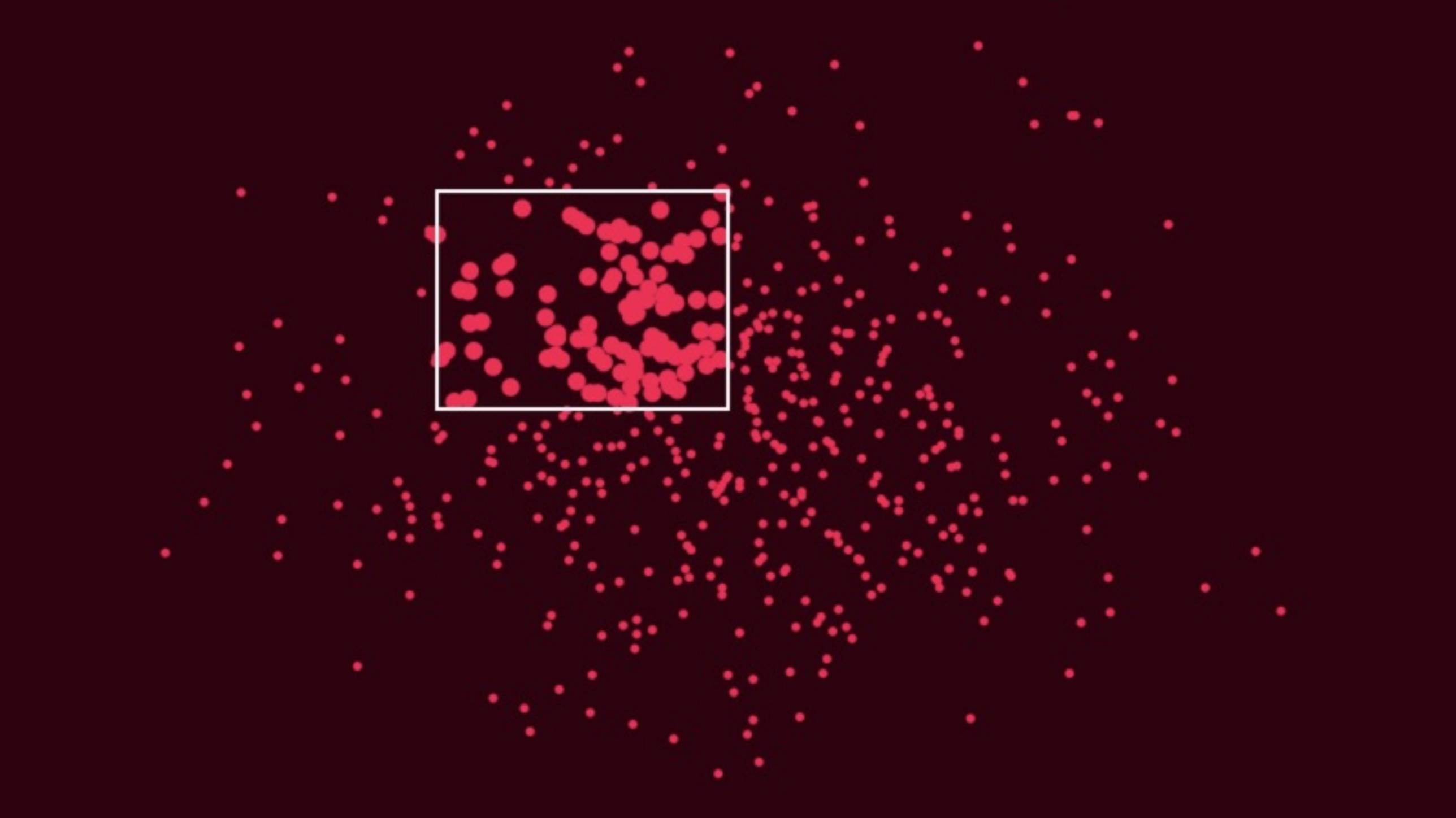
Gem

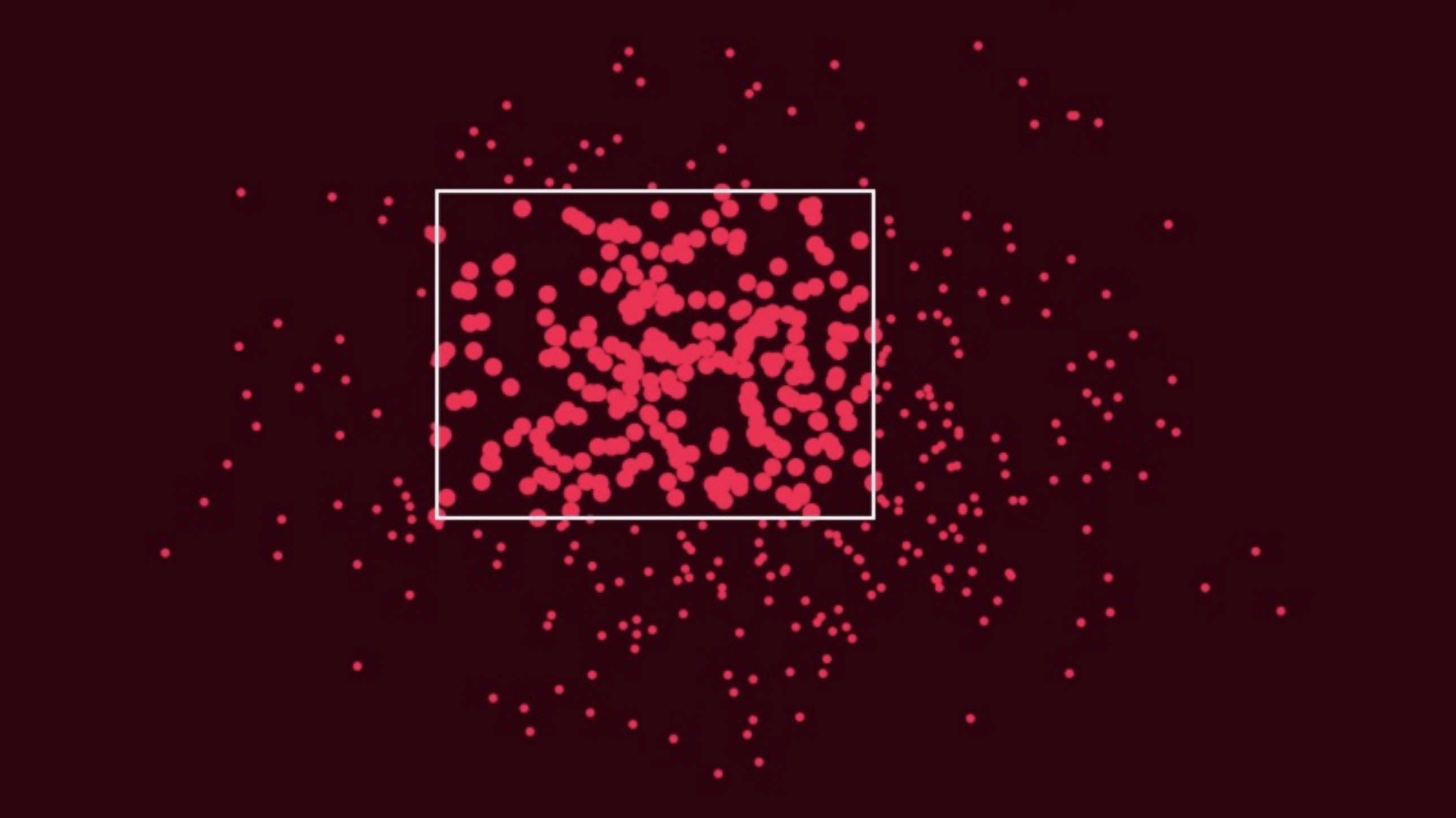
```
import GameplayKit

let tree = GKRTree<Point>(maxNumberOfChildren: 10)
tree.queryReserve = 100
```









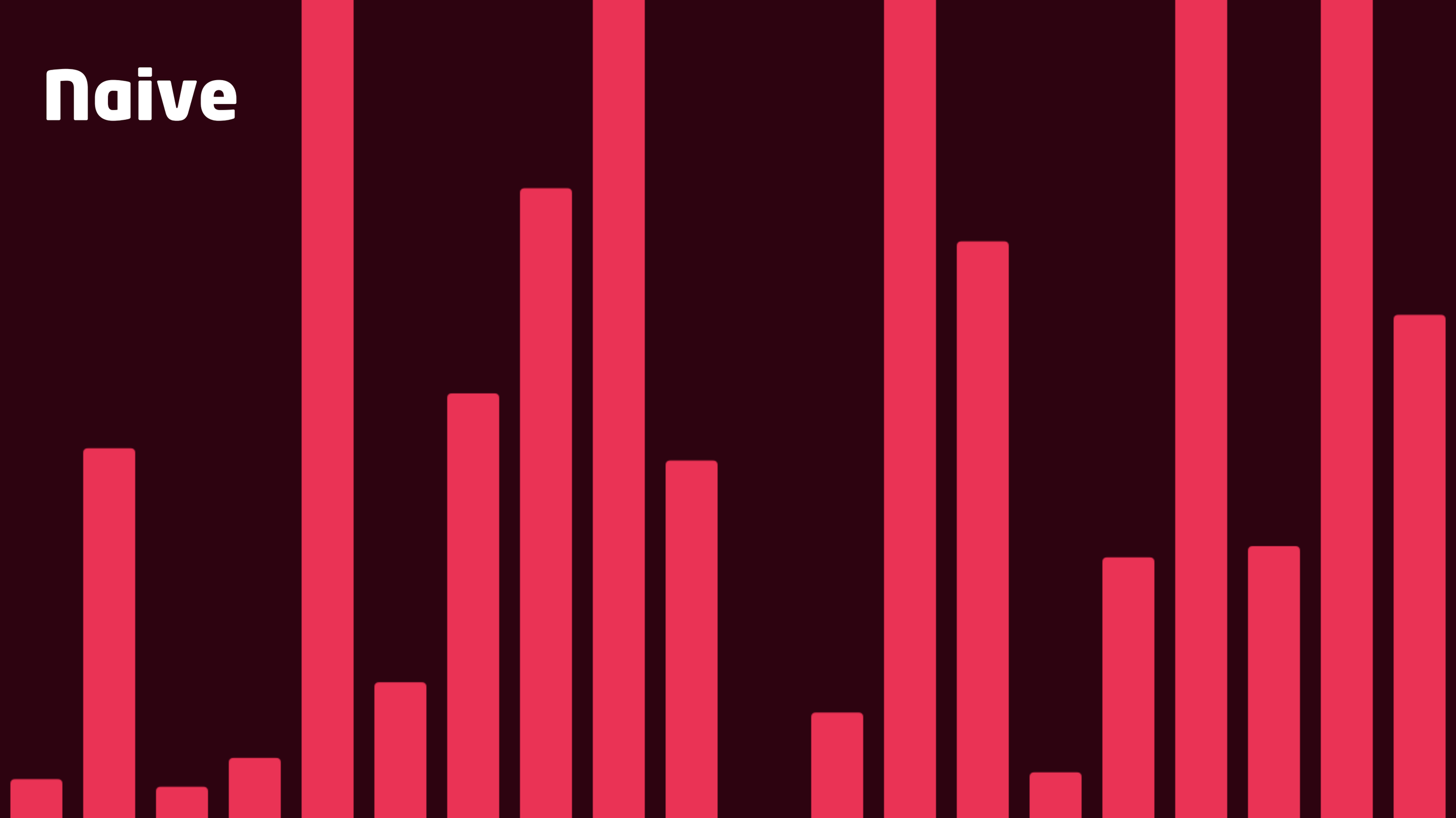
Natural

Randomness

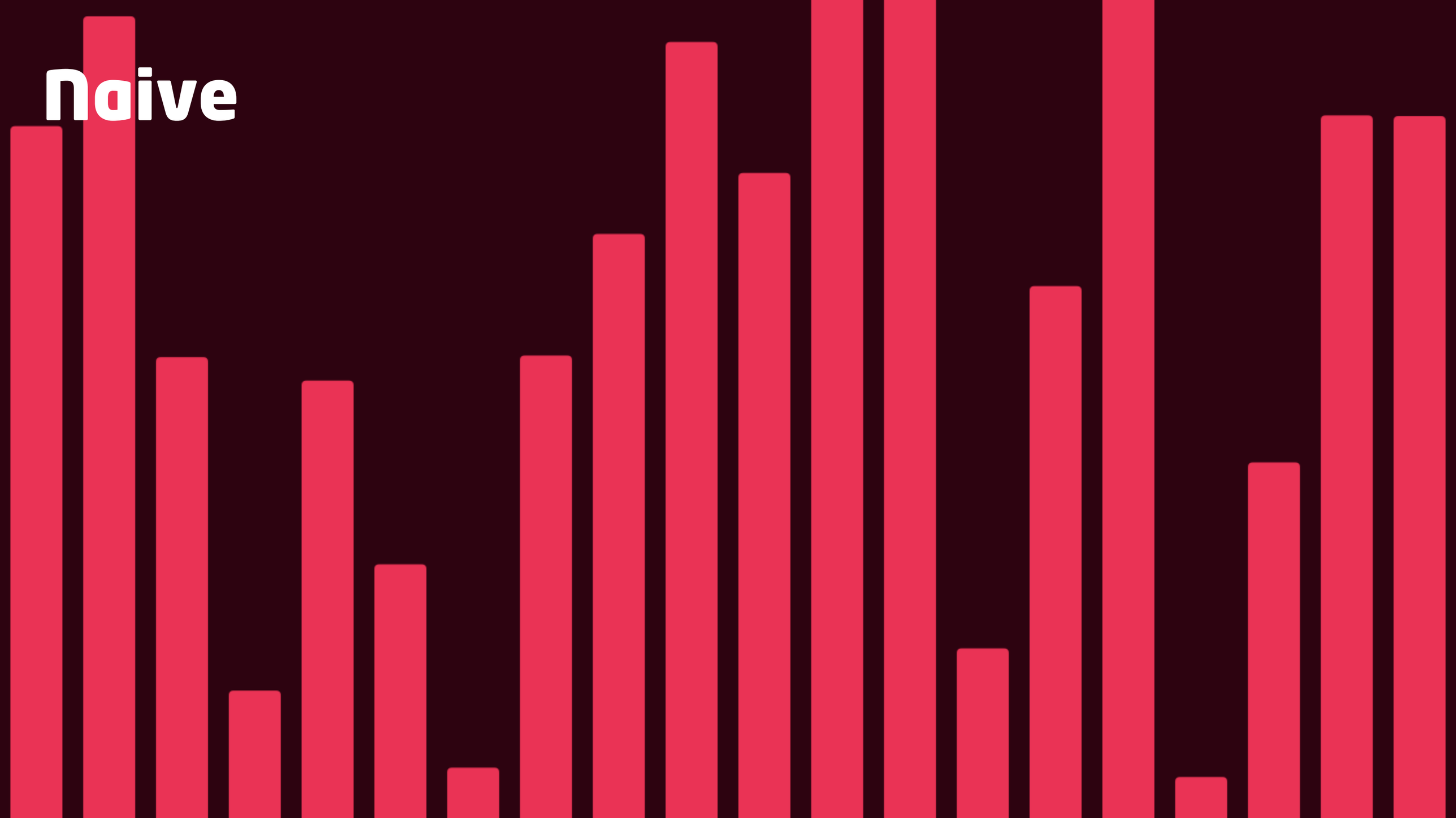
Naive

```
CGFloat(arc4random()) / CGFloat(UINT32_MAX)
```

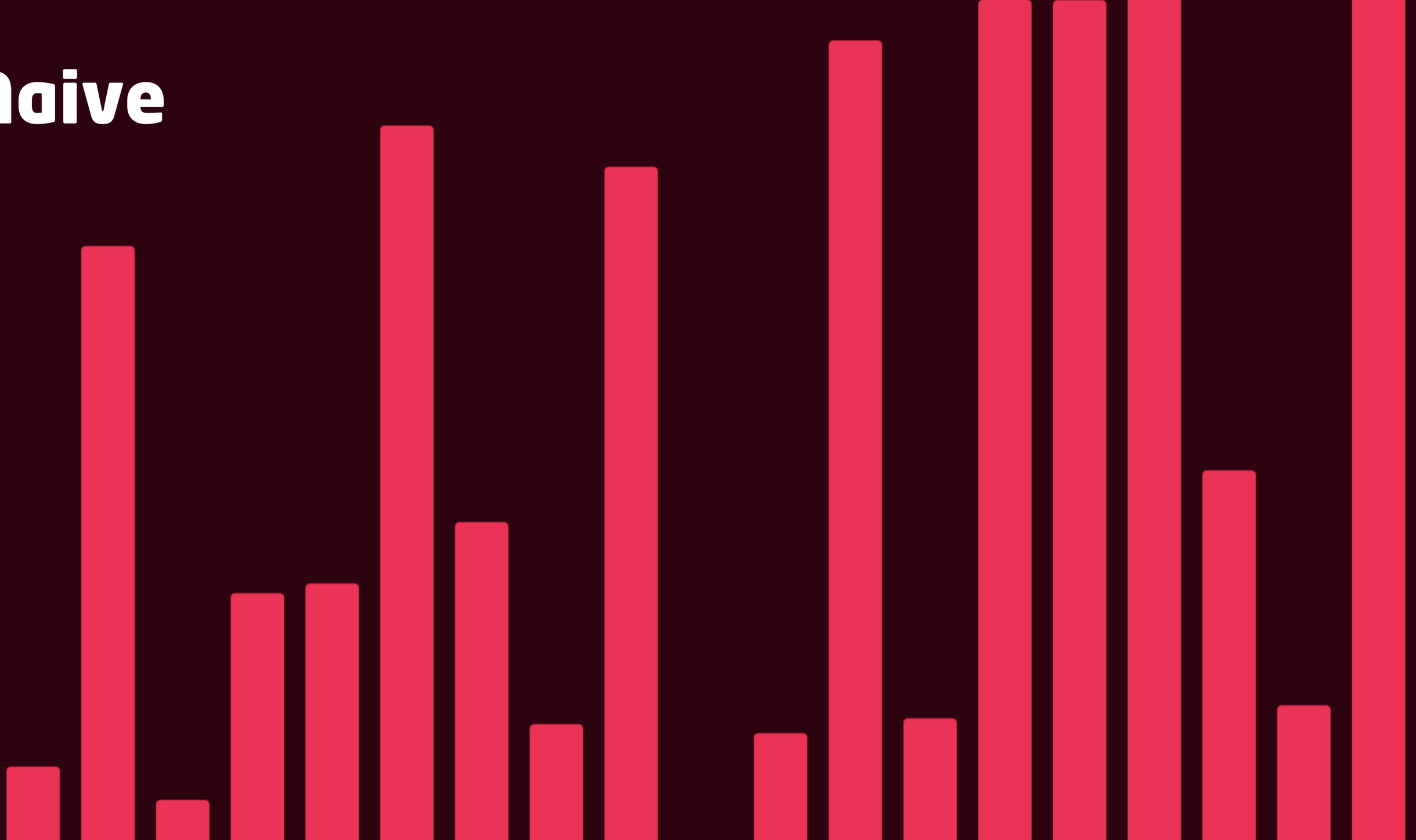
Naive



Naive



Naive



Gem

```
import GameplayKit
```

Gem

```
import GameplayKit

let source = GKPerlinNoiseSource(
    frequency: 2,
    octaveCount: 3,
    persistence: 0.5,
    lacunarity: 2
)
```

Gem

```
import GameplayKit

let source = GKPerlinNoiseSource(
    frequency: 2,
    octaveCount: 3,
    persistence: 0.5,
    lacunarity: 2
)
```

Gem

```
let noise = GKNoise(source)
```

Gem

```
let map = GKNoiseMap(
    noise,
    size: vector2(1, 1),
    origin: vector2(0, 0),
    sampleCount: vector2(3, 5),
    seamless: true
)
```

Gem

```
map.value(at: vector2(0, 0))
```

Gem

```
map.value(at: vector2(0, 0))

map.value(at: vector2(1, 0))
map.value(at: vector2(2, 0))
```

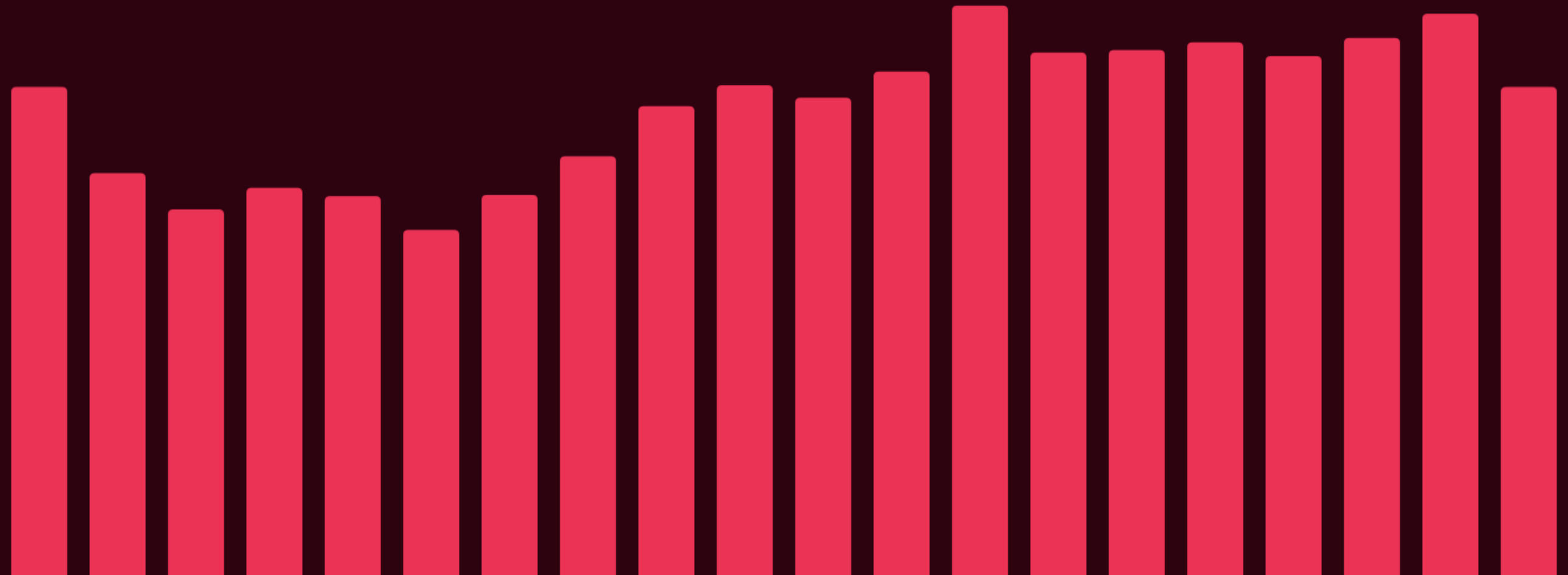
Gem

```
map.value(at: vector2(0, 0))

map.value(at: vector2(1, 0))
map.value(at: vector2(2, 0))

map.value(at: vector2(0, 1))
map.value(at: vector2(0, 2))
map.value(at: vector2(0, 3))
map.value(at: vector2(0, 4))
```

Gem



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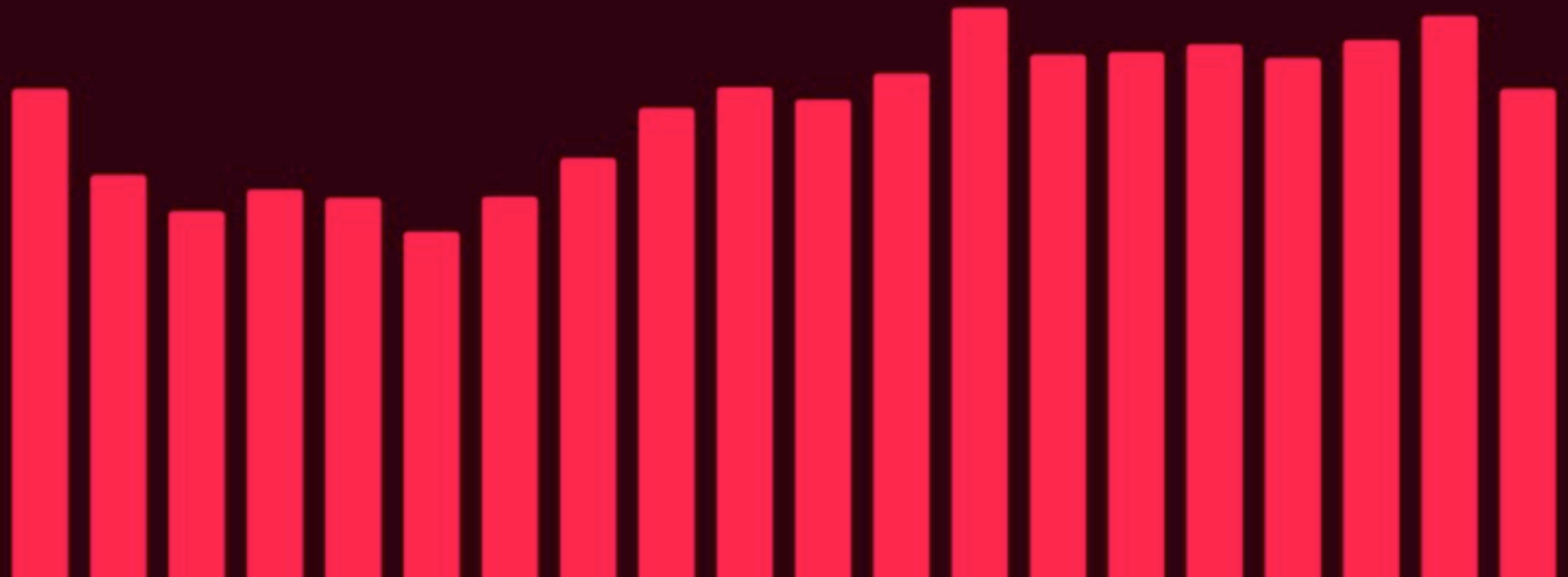

Path finding


Rådhuset
Industriens Hus
Vesterbrogade
Vesterbrogade
Fredagsrock
Bernstorffsgade
H.C. Andersens Boulevard
Bag Rådhuset
Tivoli Gardens
Tivoli
Banegårdspladsen
Reventlowsgade
Bernstorffsgade
Tietgensgade
New Carlsberg Museum
Retshjælpen
Reverdilsgade
Puggaardsgade

Tivoli Gardens, Copenhagen

Obstacles

Open Street Map data

Obstacles

```
let obstacle =

GKPolygonObstacle(
    points: [
        float2(0, 0),
        float2(0, 2),
        float2(1, 2),
        float2(1, 0)
    ]
)
```

⚠️ Counterclockwise[1]

```
let obstacle =

GKPolygonObstacle(
    points: [
        float2(0, 0),
        float2(1, 0),
        float2(1, 2),
        float2(0, 2)
    ]
)
```

Obstacle Graph

```
let graph =

GKObstacleGraph(
    obstacles: [obstacle],
    bufferRadius: 0
)
```

Obstacles


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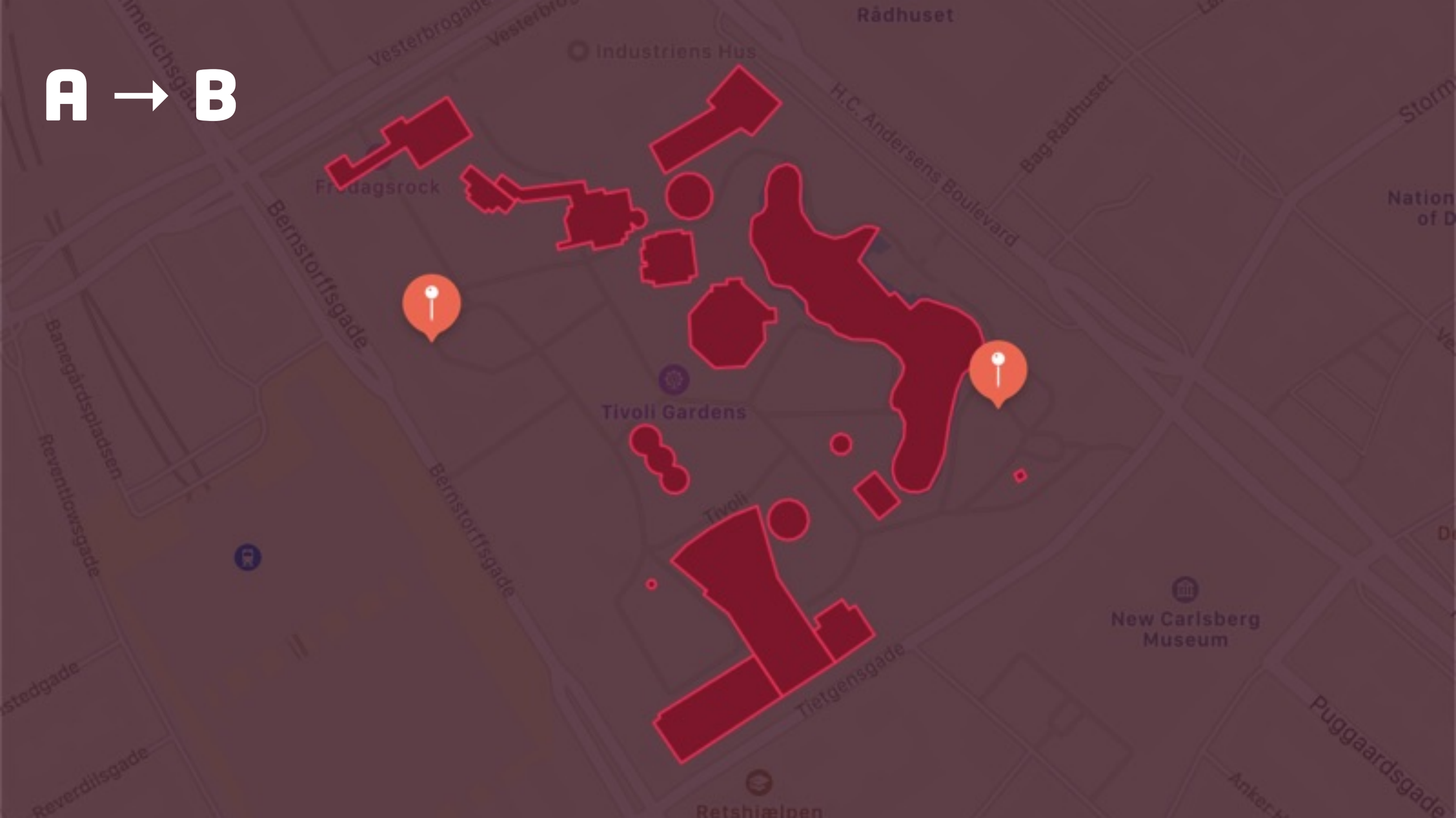
Reverdilsgade
Puggaardsgade


A → B
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Puggaardsgade

Path

```
let a = GKGraphNode2D(point: float2(x: -1, y: 1))
let b = GKGraphNode2D(point: float2(x:  2, y: 1))
```

Path

```
let a = GKGraphNode2D(point: float2(x: -1, y: 1))
let b = GKGraphNode2D(point: float2(x:  2, y: 1))

graph.connectUsingObstacles(node: a)
graph.connectUsingObstacles(node: b)
```

Path

```
let a = GKGraphNode2D(point: float2(x: -1, y: 1))
let a = GKGraphNode2D(point: float2(x:  2, y: 1))

graph.connectUsingObstacles(node: a)
graph.connectUsingObstacles(node: b)

let path = graph.findPath(from: a, to: b)
```

Path

```
let from = GKGraphNode2D(point: float2(x: -1, y: 1))
let to   = GKGraphNode2D(point: float2(x:  2, y: 1))

graph.connectUsingObstacles(node: from)
graph.connectUsingObstacles(node: to)

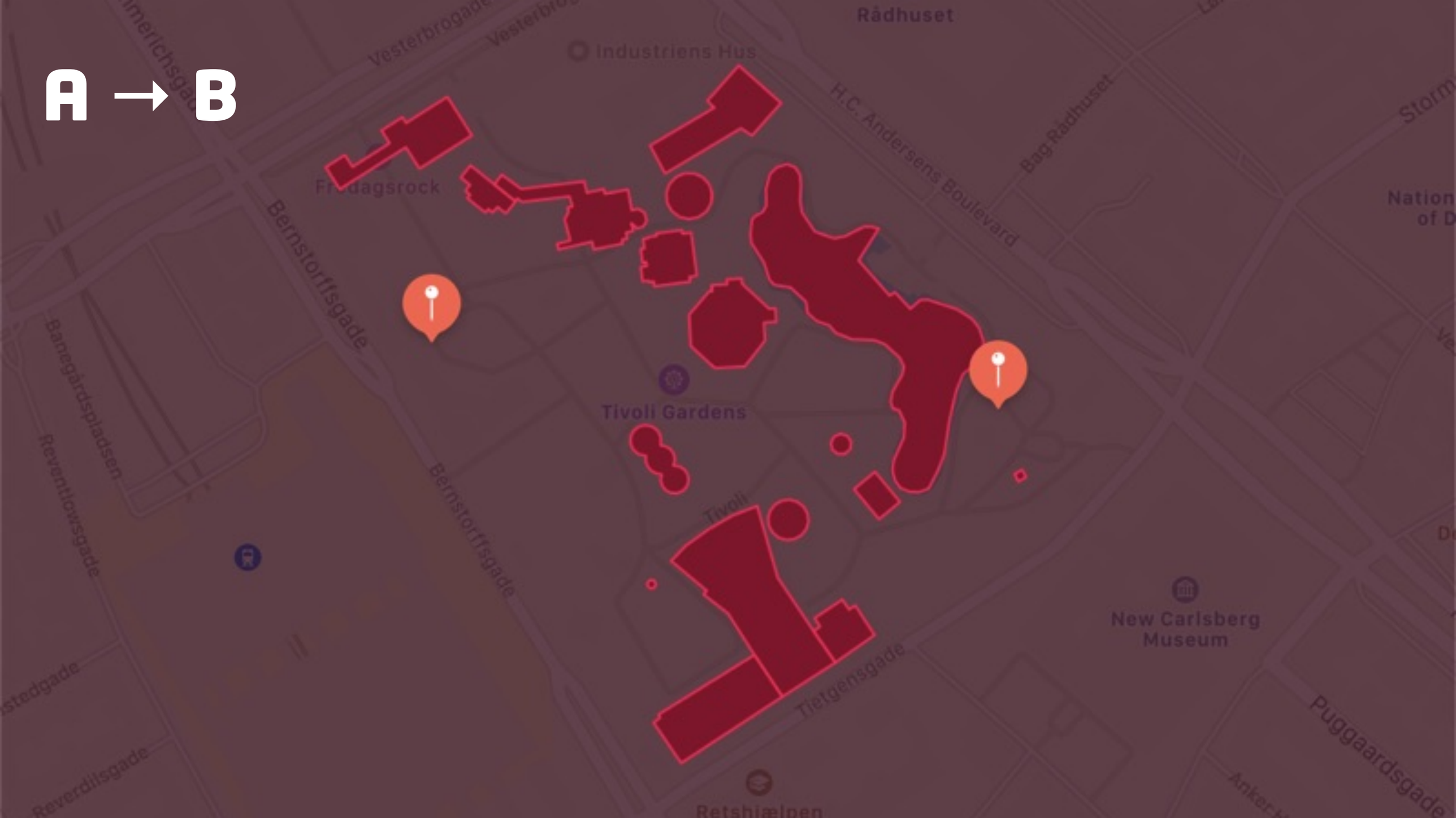
let path = graph.findPath(from: from, to: to)
```

```
[
    GKGraphNode2D: {-1, 1},
    GKGraphNode2D: { 0, 0},
    GKGraphNode2D: { 1, 0},
    GKGraphNode2D: { 2, 1}
]
```

Buffer Radius

```
let graph = GKObstacleGraph(
    obstacles: [obstacle],
    bufferRadius: 0.5
)

[
    GKGraphNode2D: {-1.0, 1.0},
    GKGraphNode2D: {-0.5, 0.0},
    GKGraphNode2D: { 1.5,-0.5},
    GKGraphNode2D: { 2.0, 1.0}
]
```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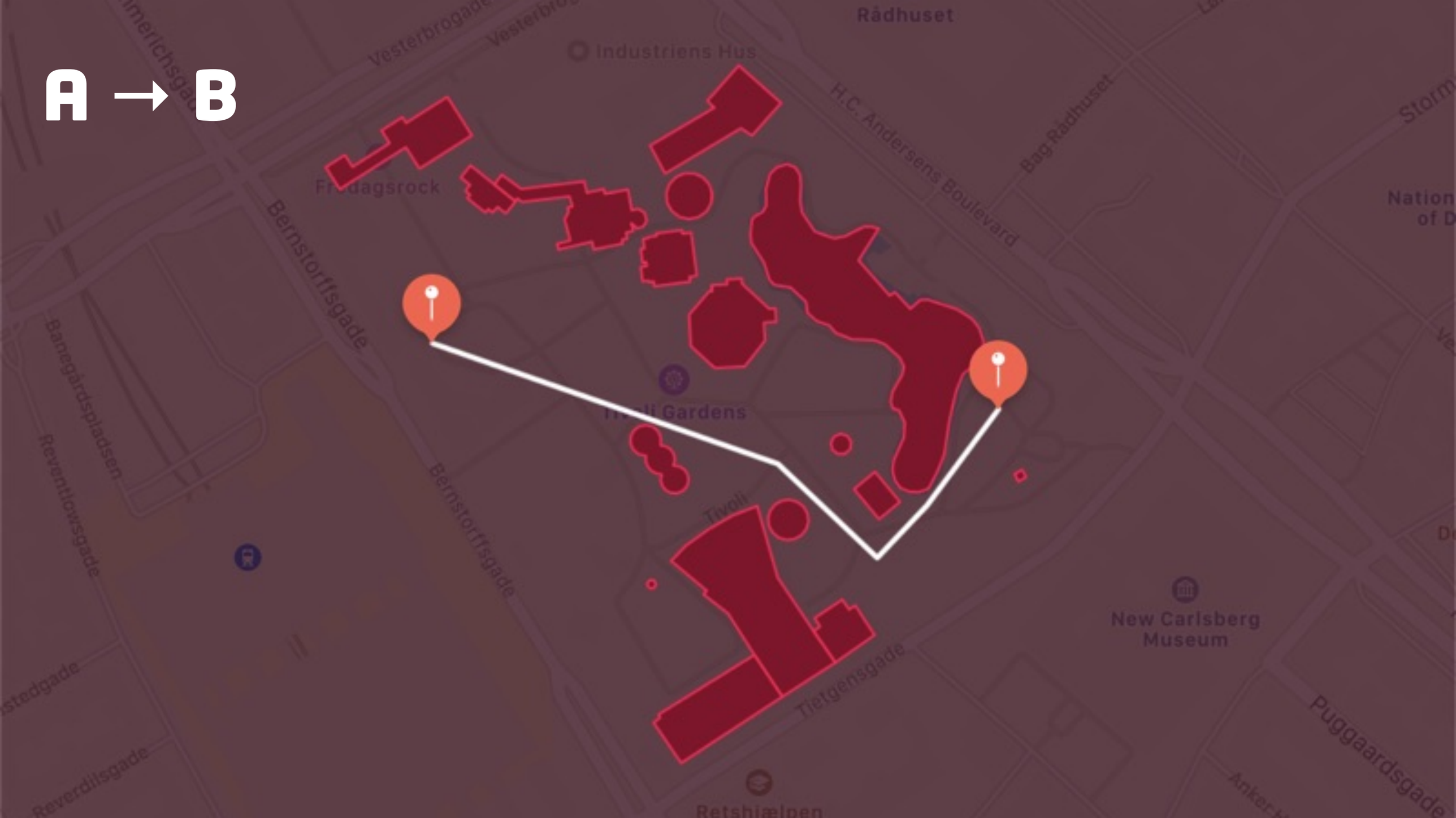
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Bernstorffsgade
Reventlowsgade
Reventlowsgade
Reverdilsgade
Puggaardsgade

Links

- About GameplayKit *by Apple*
- Random Talk: The Consistent World of Noise *by Natalia Berdys*
- GameplayKit: Beyond Games *by Sash Zats*
- The Right Way To Write Dijkstra's Algorithm In Swift *by Federico Zanetello*
- Playground Examples

Gems of Gameplay Kit

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