*Understanding **HTTP/2** prioritization*

Moto Ishizawa
@summerwind

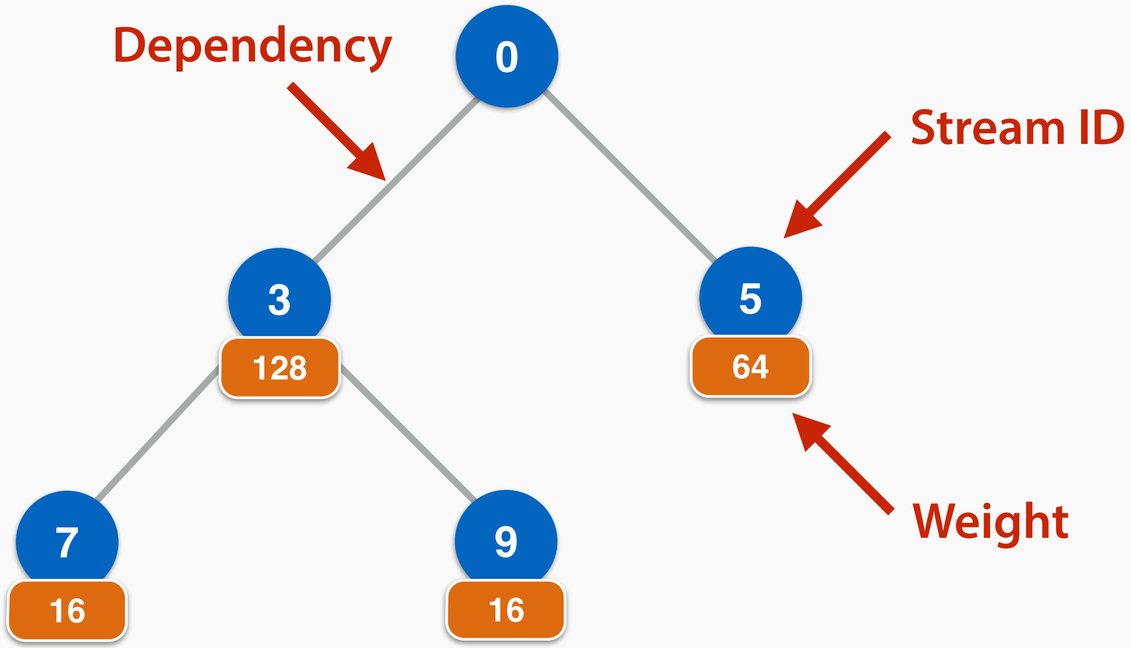
Who? :-)

- **Platform Engineer @ Yahoo! JAPAN**
  - *Beacon platforms, Data pipelines*
- **Reviewer of HPBN Japanese Edition**
  - *Sections: HTTP/1.1, HTTP/2, WebRTC*
- **HTTP/2 Japan Community**
  - *RFC7540 Japanese Translation, h2spec*

HTTP/2 Prioritization

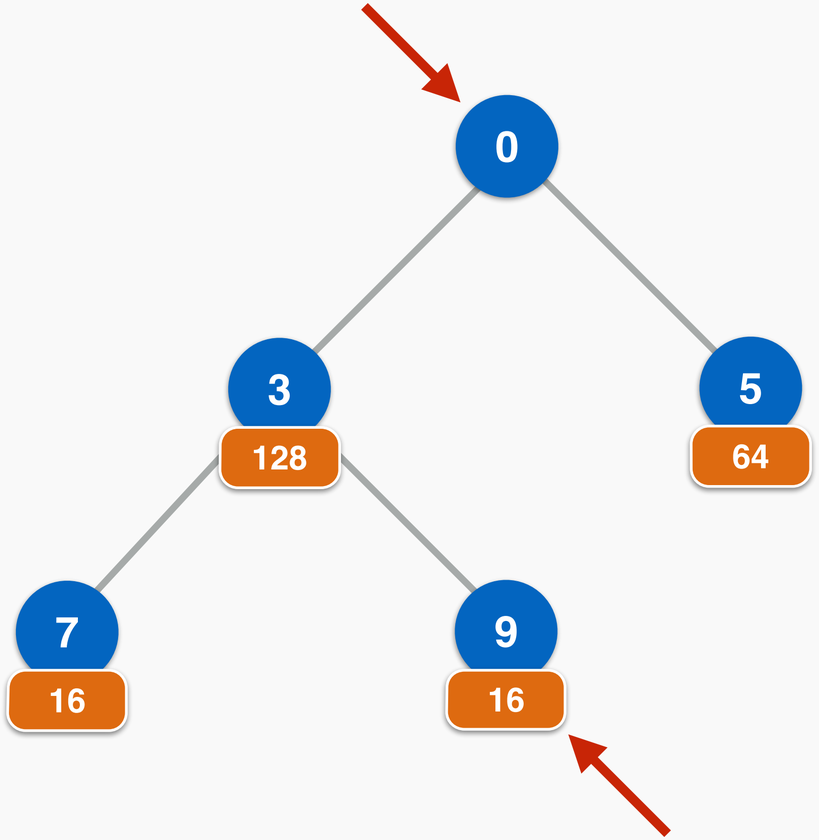
- **HTTP/2 client controls the transmission order of resources by priority**
  - *Priority is expressed by **dependency** and **weight***
  - *Priority is **a hint**, server may ignore it*
- **In the browser, there is a possibility that the priority affects the rendering**
  - *Prioritization might adversely affect the critical rendering path*

Priority Tree



Priority Tree

All streams depend on the Stream ID 0 by default.

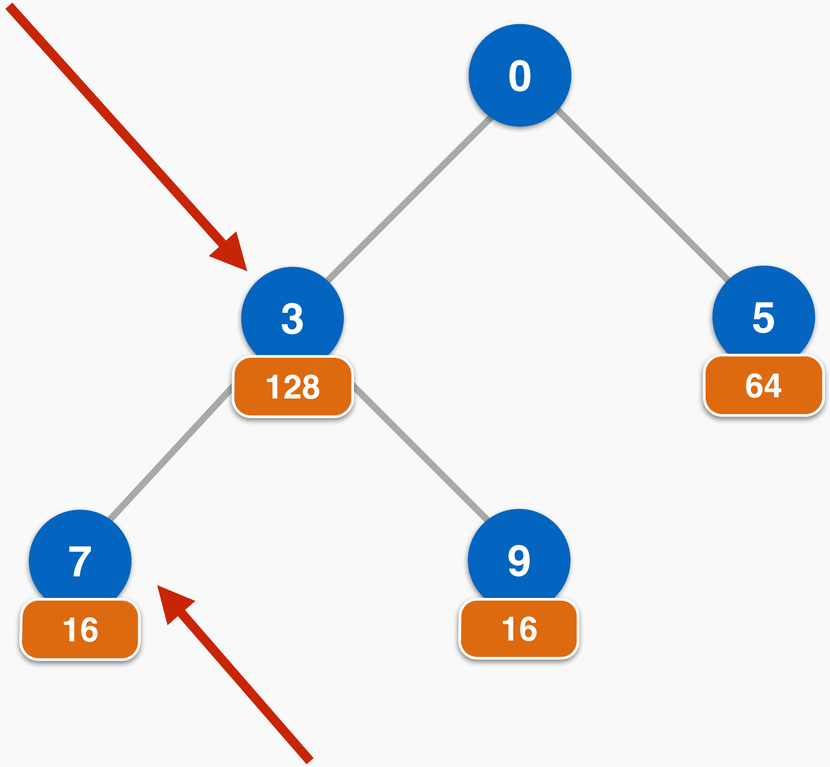


All streams are set weight 16 by default.

Priority Tree

The priority of the stream is determined by the relative proportions of the weights.

Stream ID 3 should receive two-thirds of available resources.



The priority of the stream that depends on another stream is determined by the weight of dependent stream.

Stream ID 7 should receive half of the resources of Stream ID 3.

Implementation status

Server

Name	Version	Support
nghttp2	1.0.2	YES
H2O	1.2.0	YES
Apache Traffic Server	5.3.0	NO

Browser

Name	Version	Support
Firefox	38.0.5	YES
Chrome	43.0.2357.65	YES (Weight only)
Edge	0.11.10074.0 (Preview)	NO
Safari	9,0 (Preview)	NO

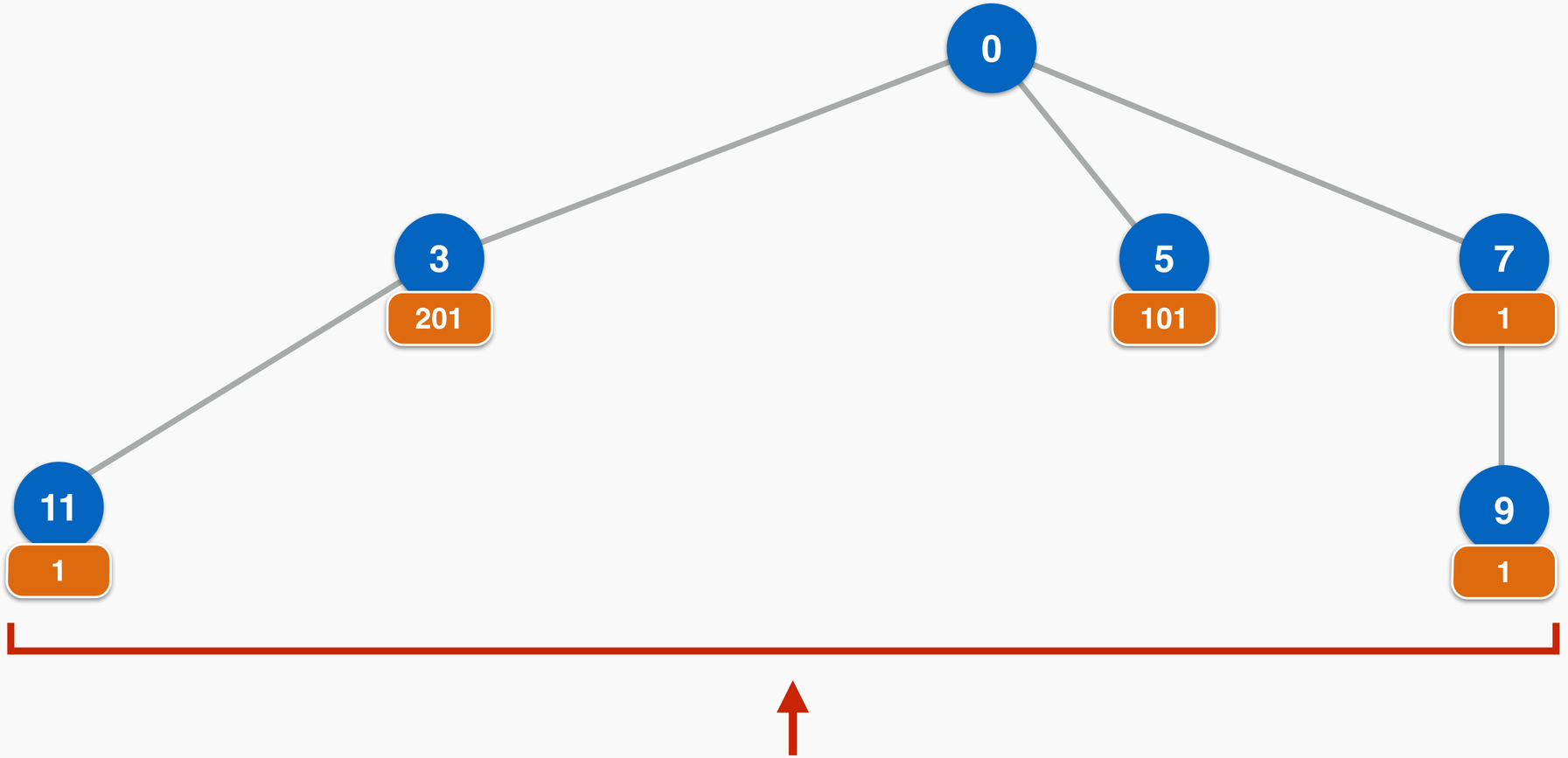
Testing the prioritization of browsers

- **Test page**
  - *CSS in the <head> × 3*
  - *Javascript in the <head> × 3*
  - *JavaScript in the <body> × 3*
  - *Image in the <body> × 3*
  - *Size of all resources: 100KB*
- **Server**
  - *nghttpx v1.0.1*

```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="utf-8">
  <title>Test</title>

  <link href="tests/1.css" rel="stylesheet">
  <link href="tests/2.css" rel="stylesheet">
  <link href="tests/3.css" rel="stylesheet">

  <script src="tests/1.js"></script>
  <script src="tests/2.js"></script>
  <script src="tests/3.js"></script>
</head>

<body>
  <h1>Test</h1>

  <img src=“tests/1.jpg” alt="1">
  <img src=“tests/2.jpg“ alt="2">
  <img src=“tests/3.jpg” alt="3">

  <script src="tests/4.js"></script>
  <script src="tests/5.js"></script>
  <script src="tests/6.js"></script>
</body>
</html>
```

Firefox's Priority Tree

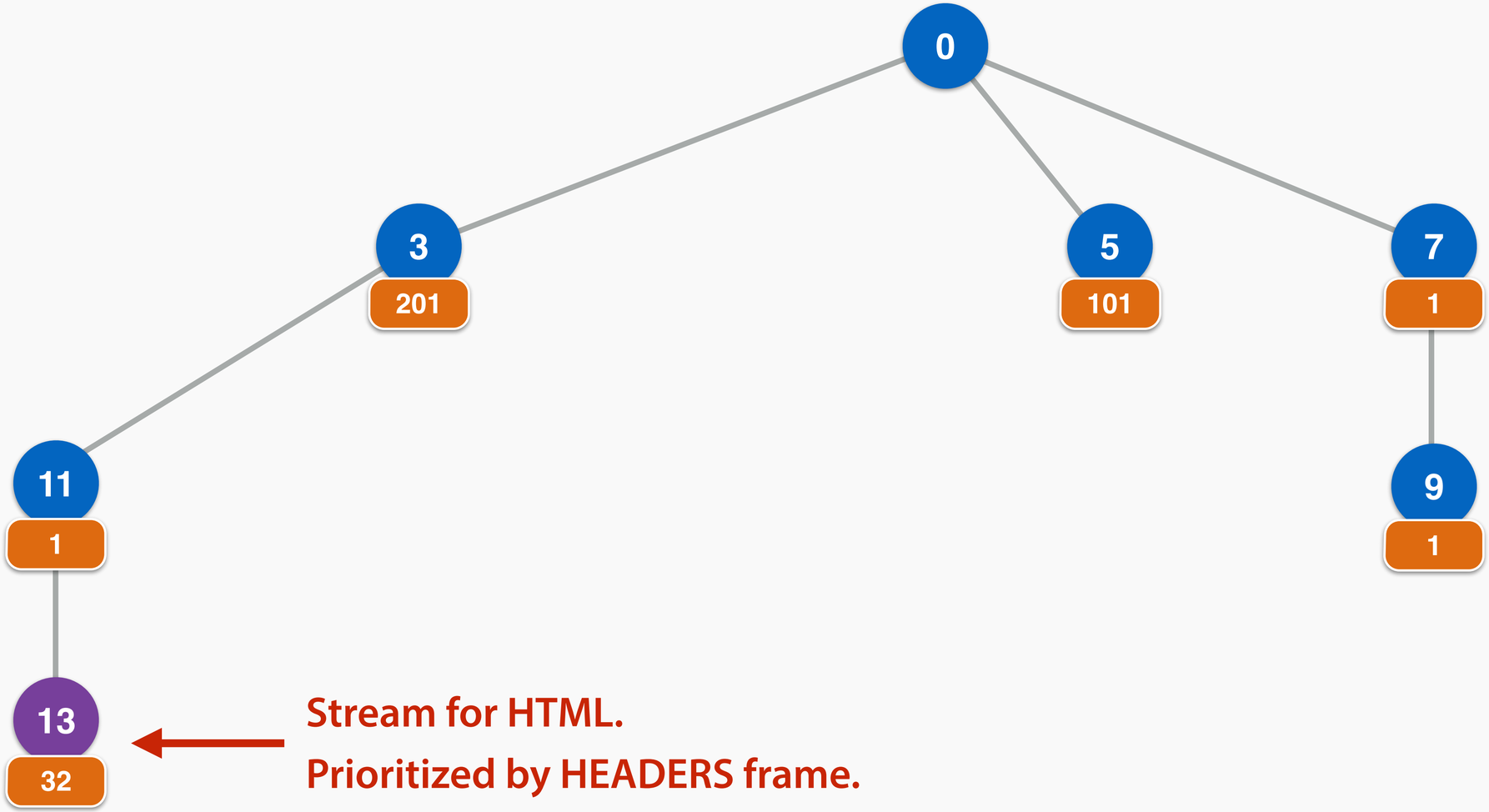
1. Initialization



Initializing the priority tree by PRIORITY frames.

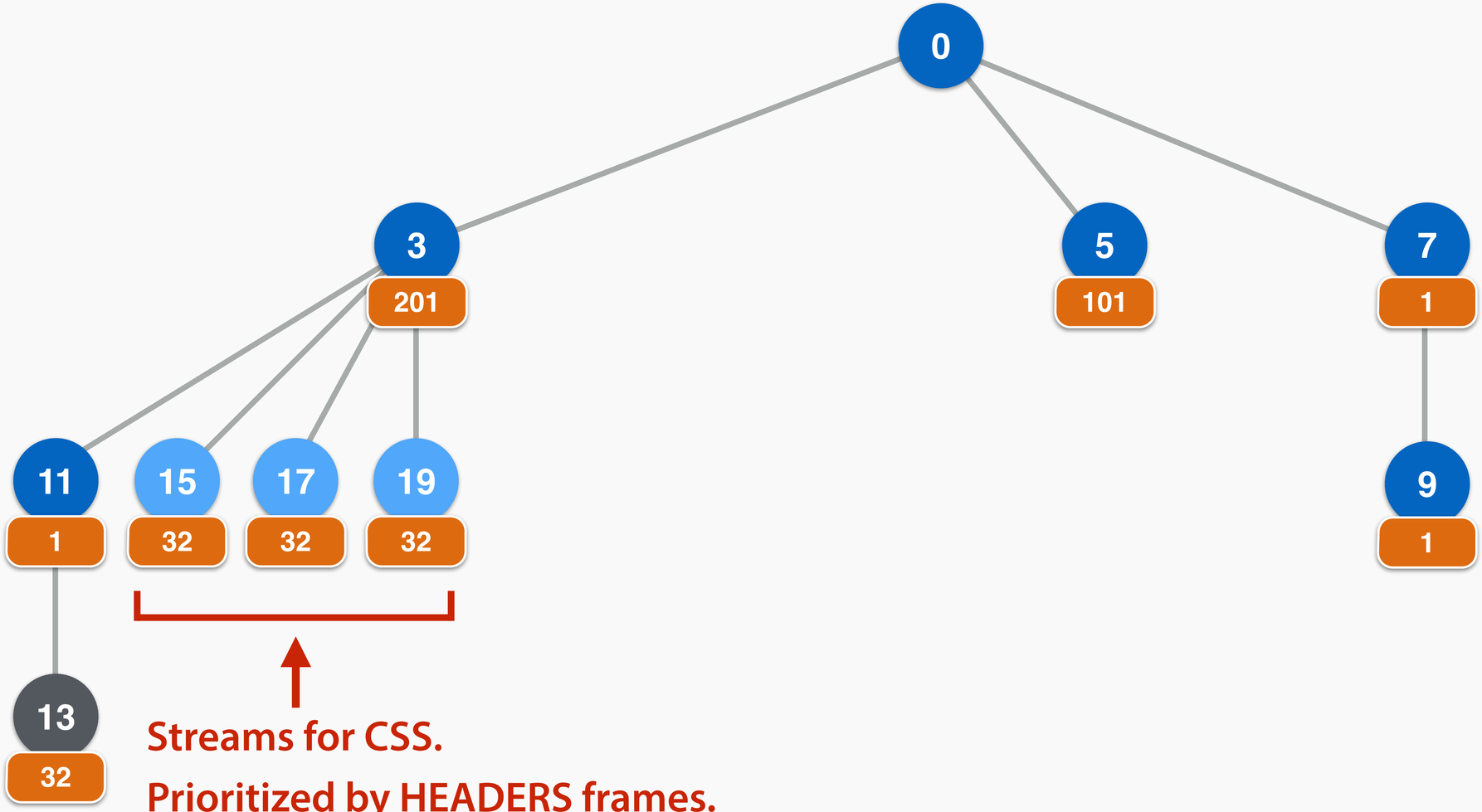
Firefox's Priority Tree

2. HTML



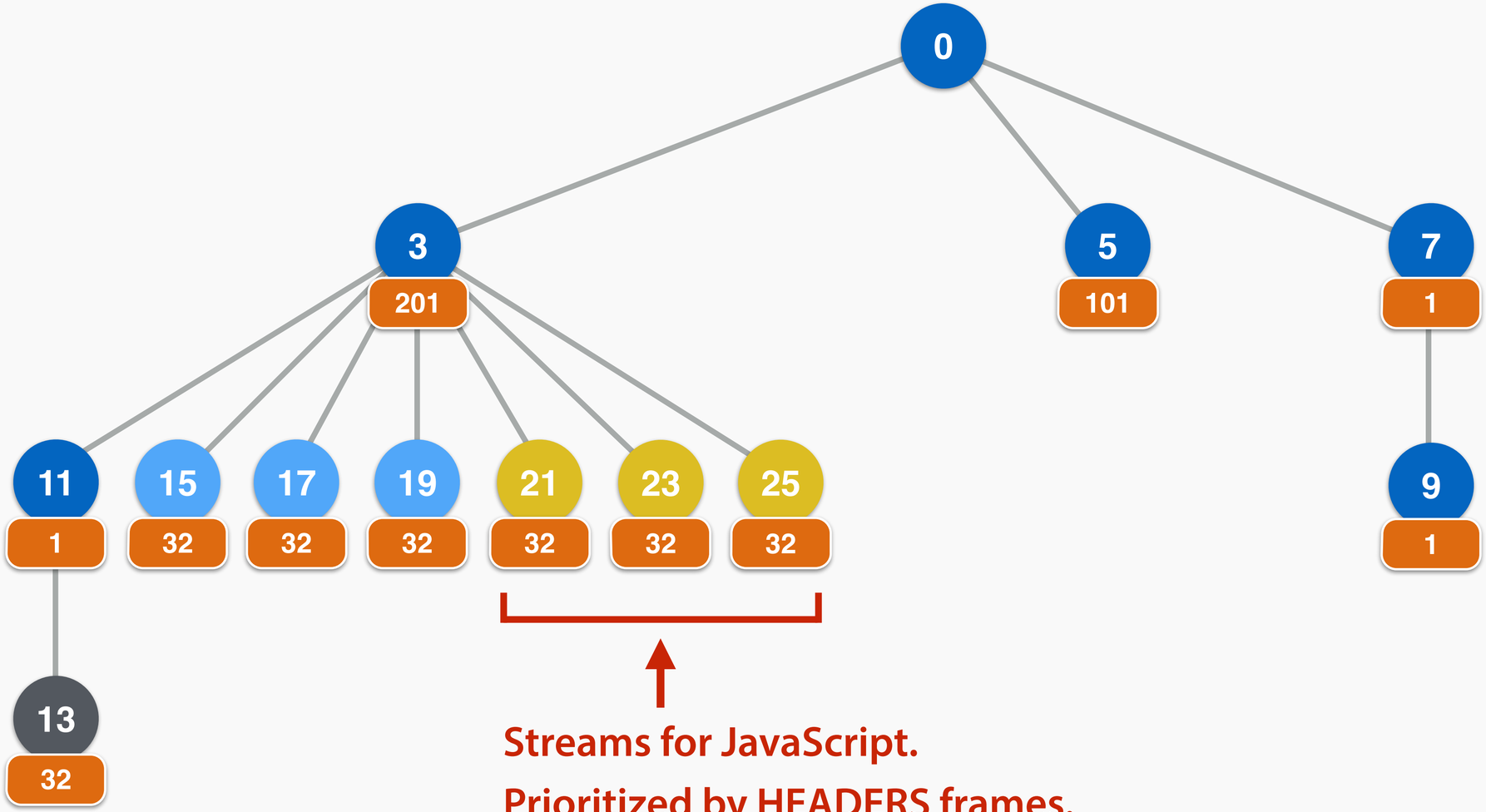
Firefox's Priority Tree

3. CSS



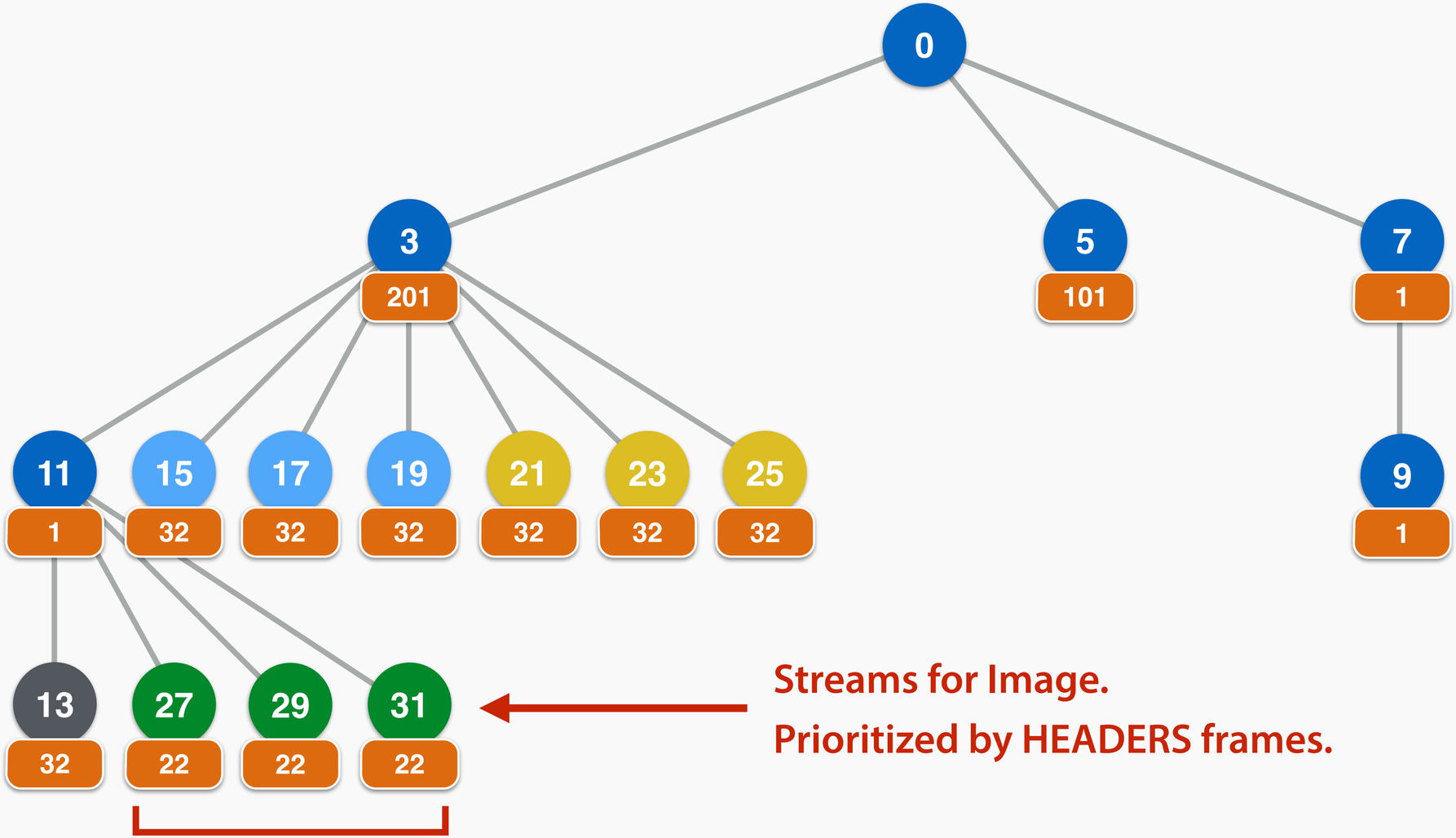
Firefox's Priority Tree

4. JavaScript in the <head>



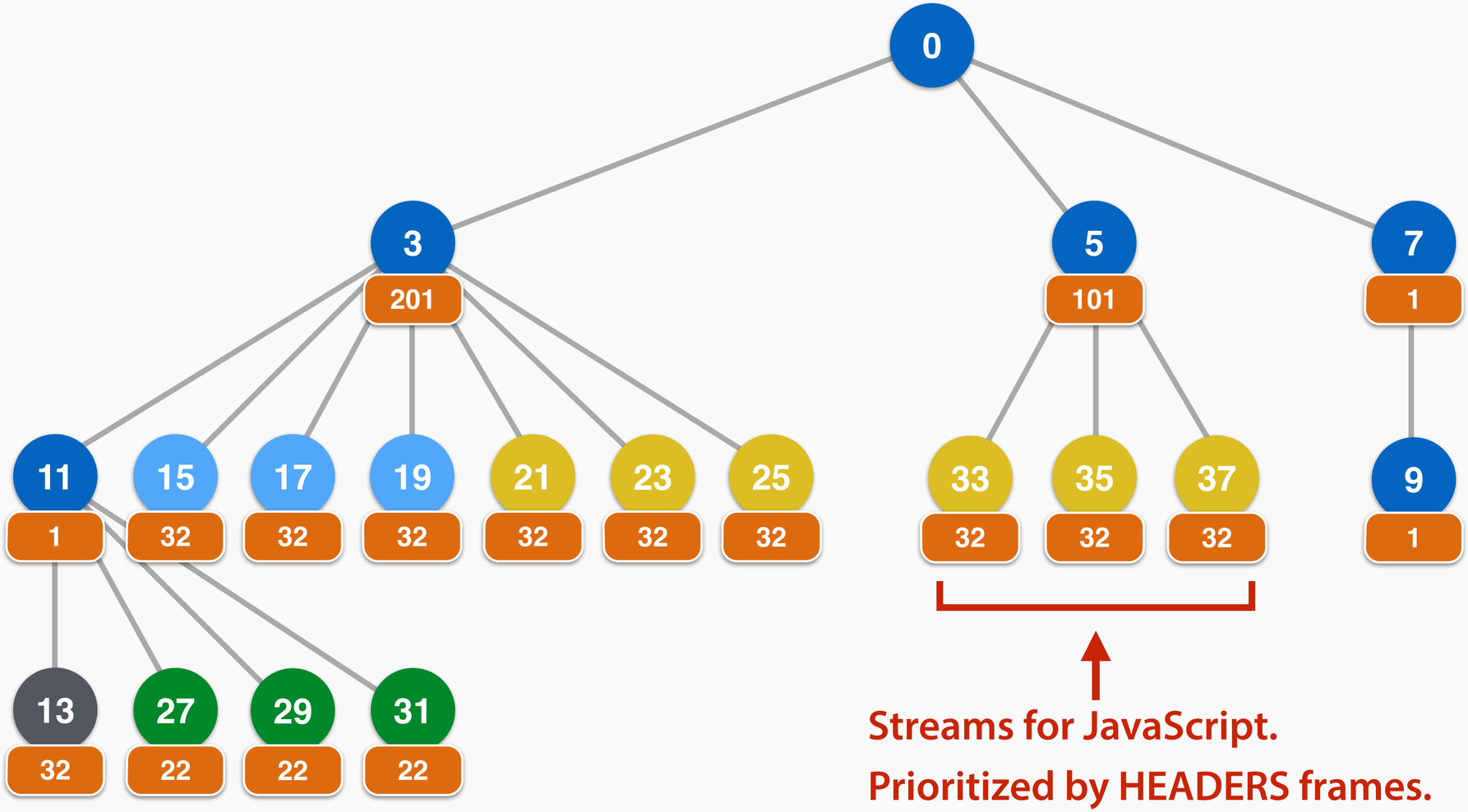
Firefox's Priority Tree

5. Image



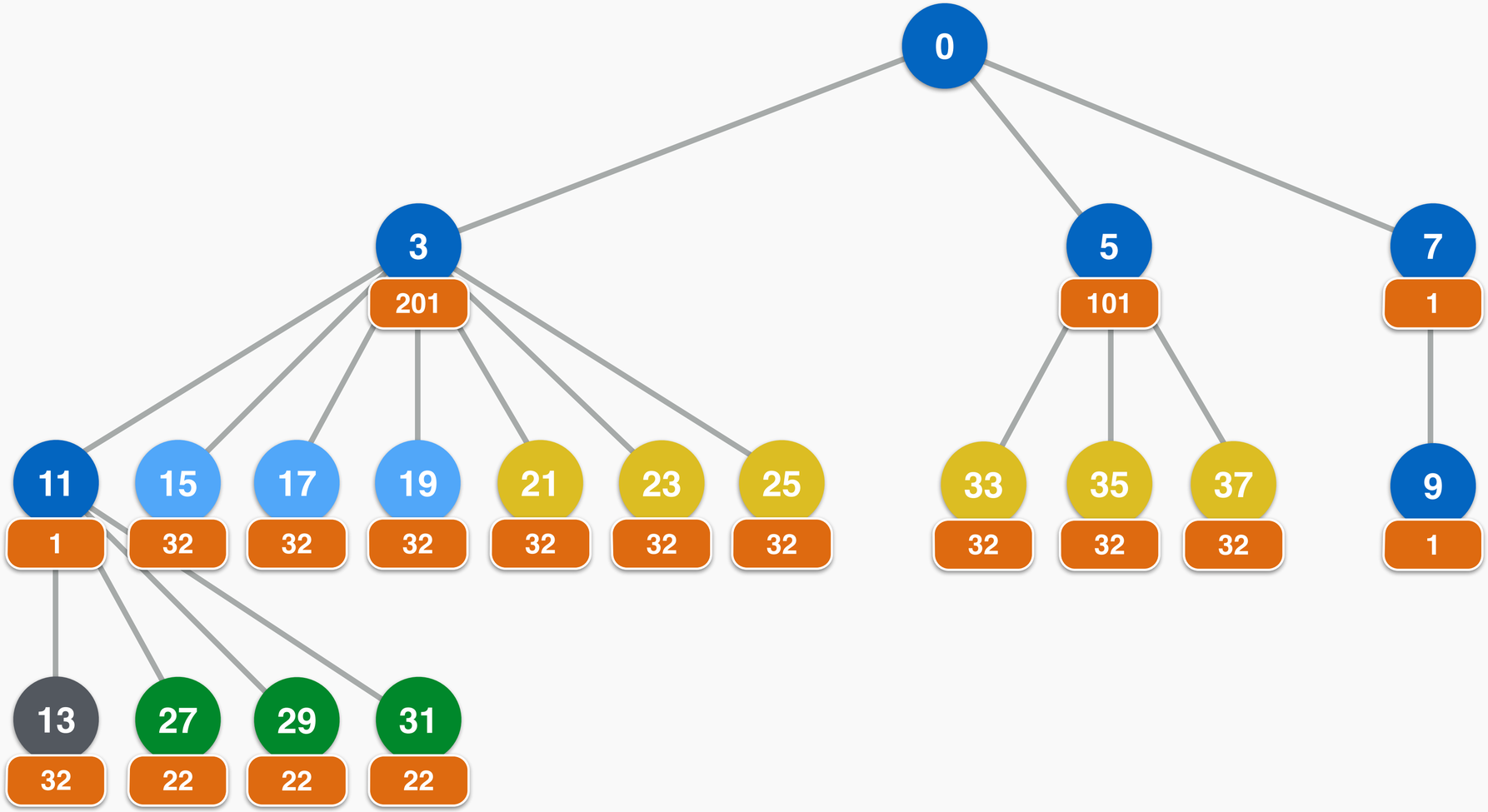
Firefox's Priority Tree

6. JavaScript in the <body>



Firefox's Priority Tree

7. Download



Firefox's Priority Tree

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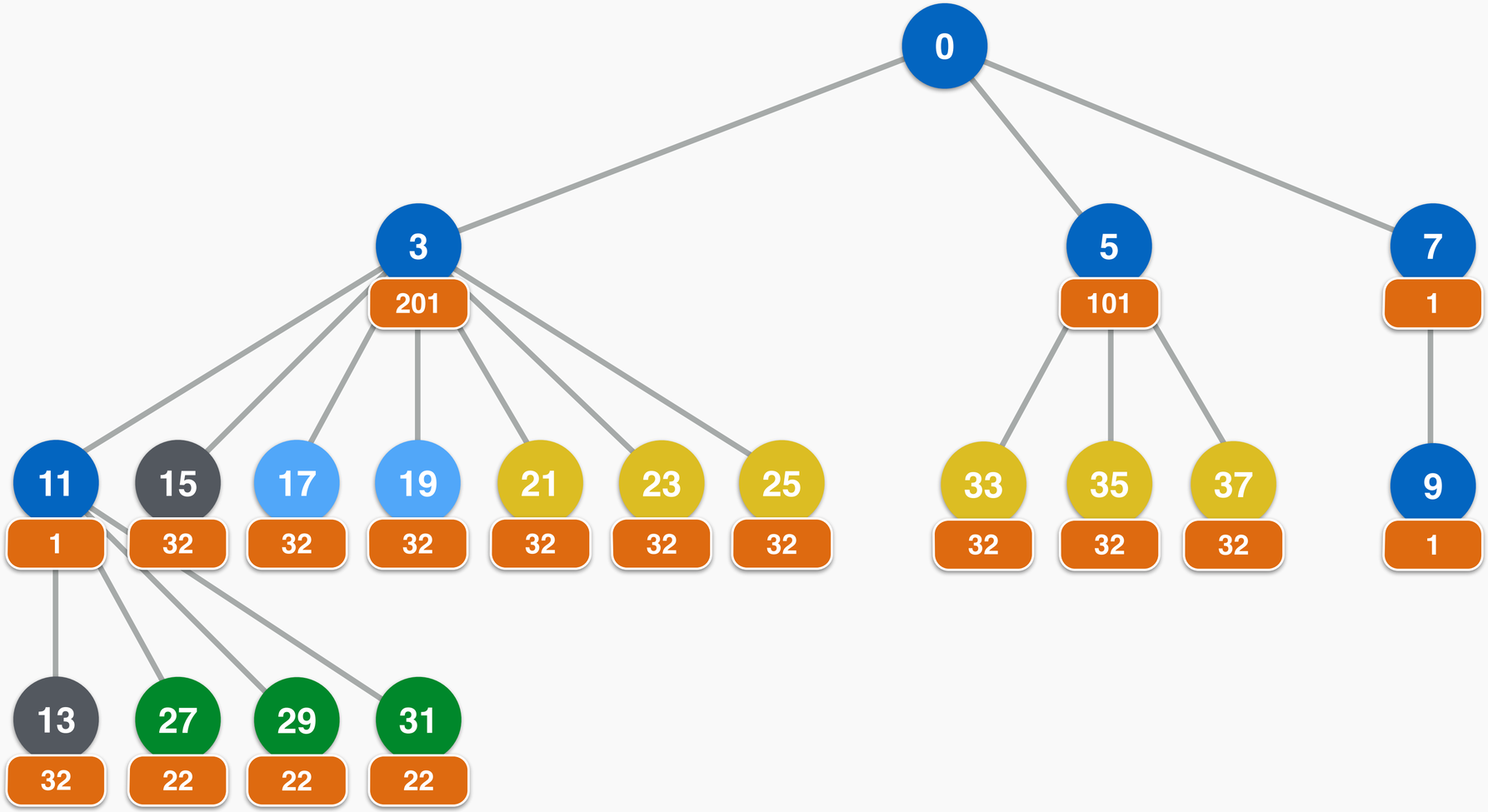

Firefox's Priority Tree

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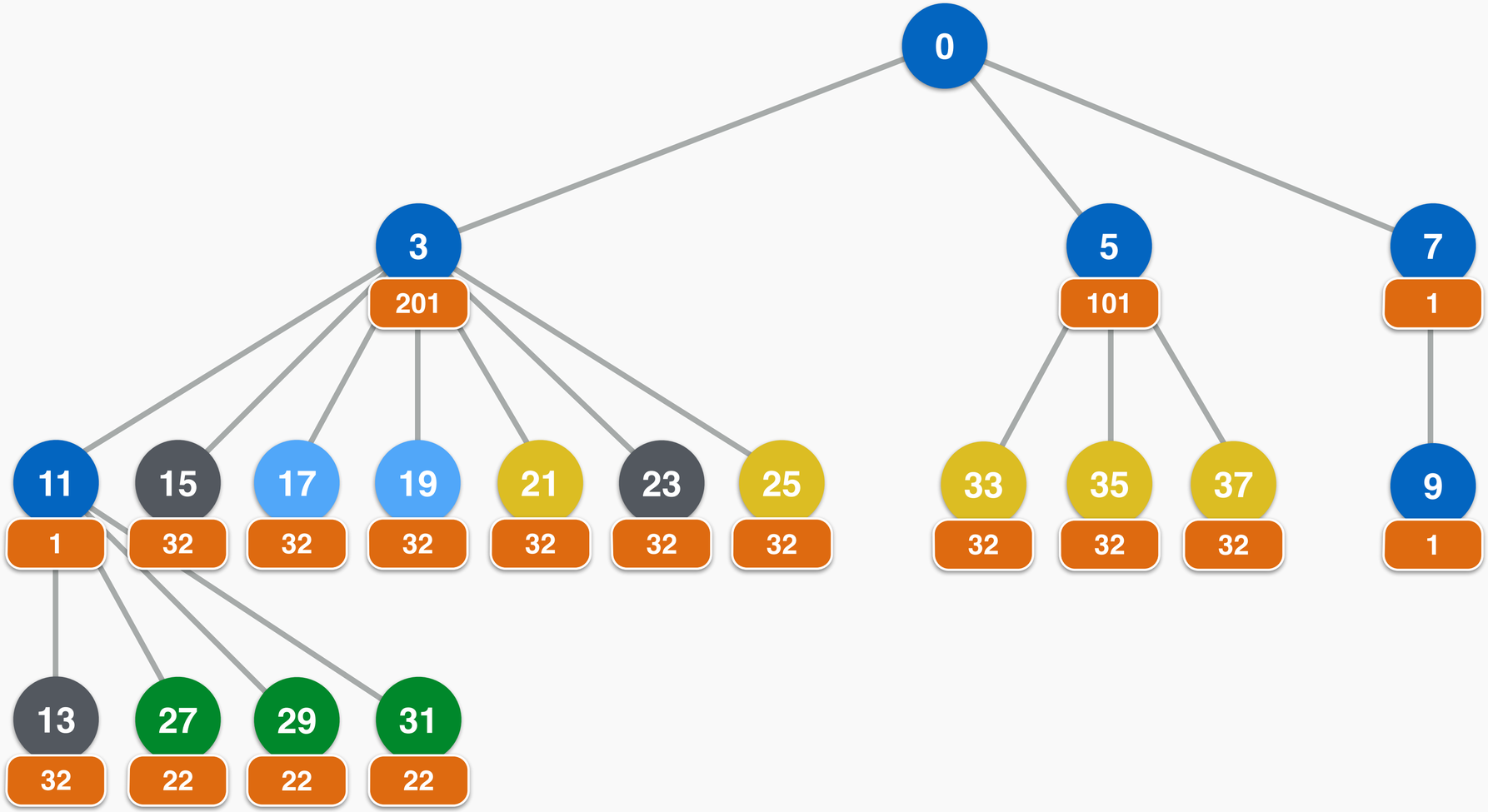

Firefox's Priority Tree

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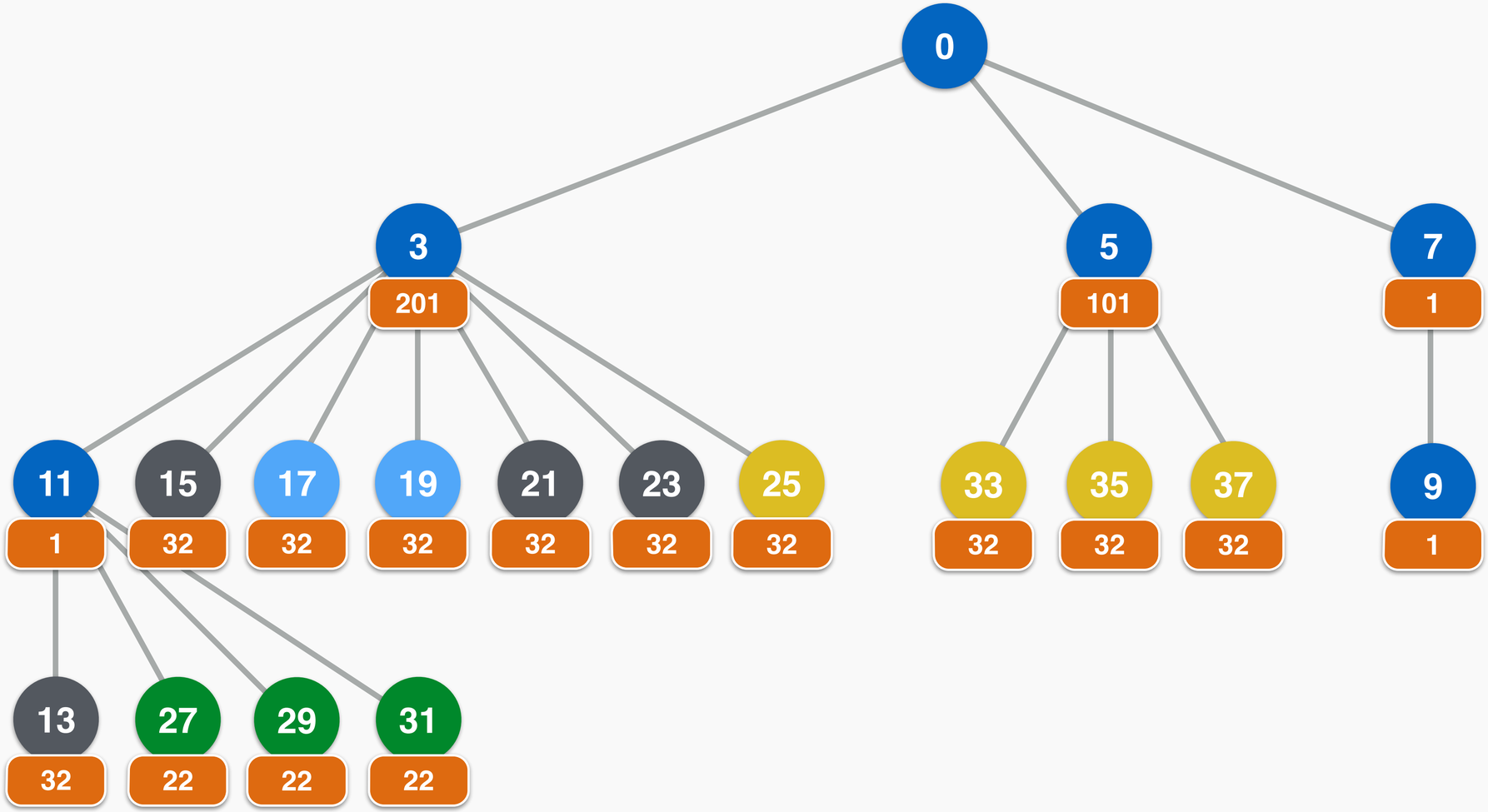

Firefox's Priority Tree

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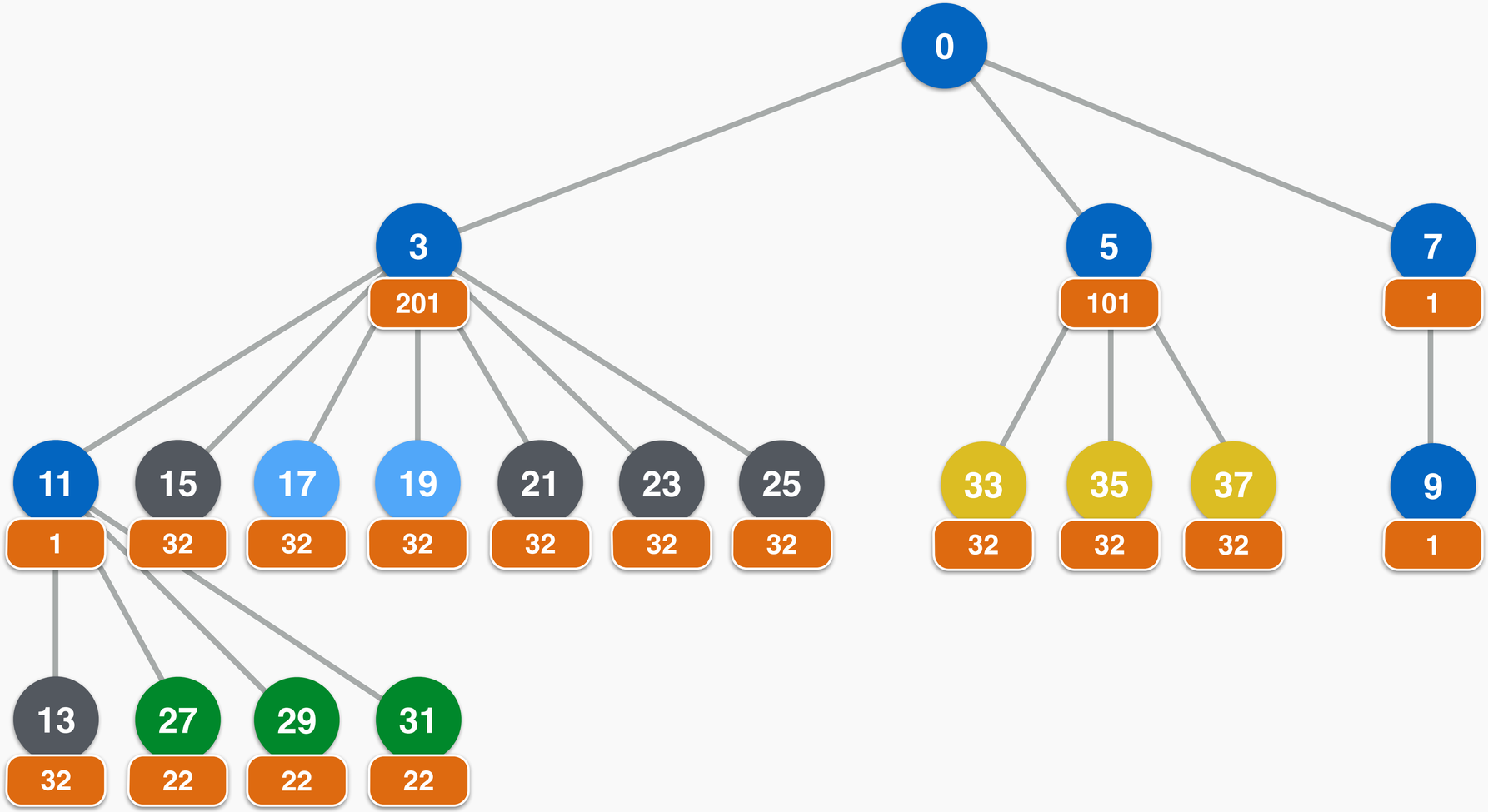

Firefox's Priority Tree

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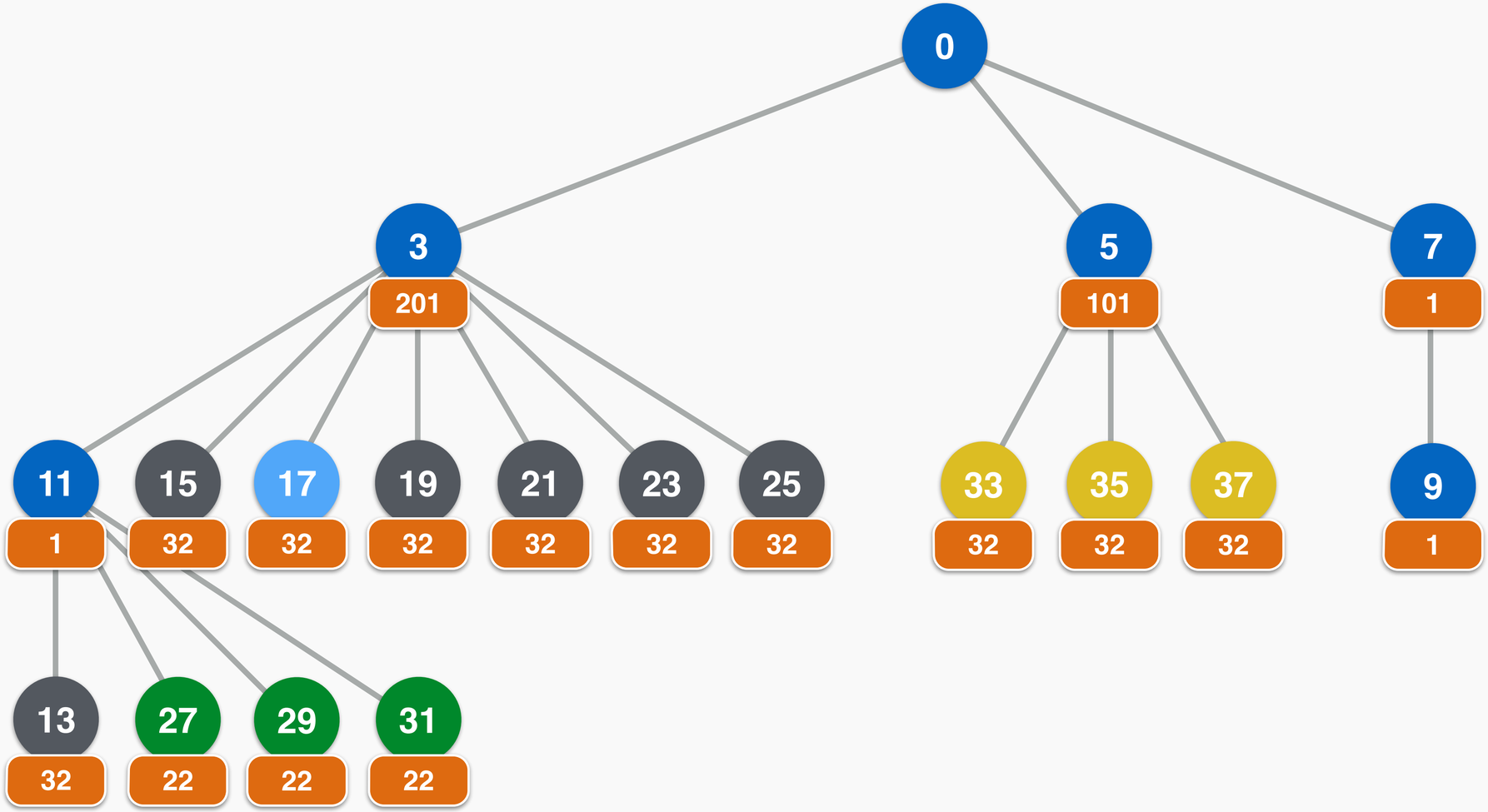

Firefox's Priority Tree

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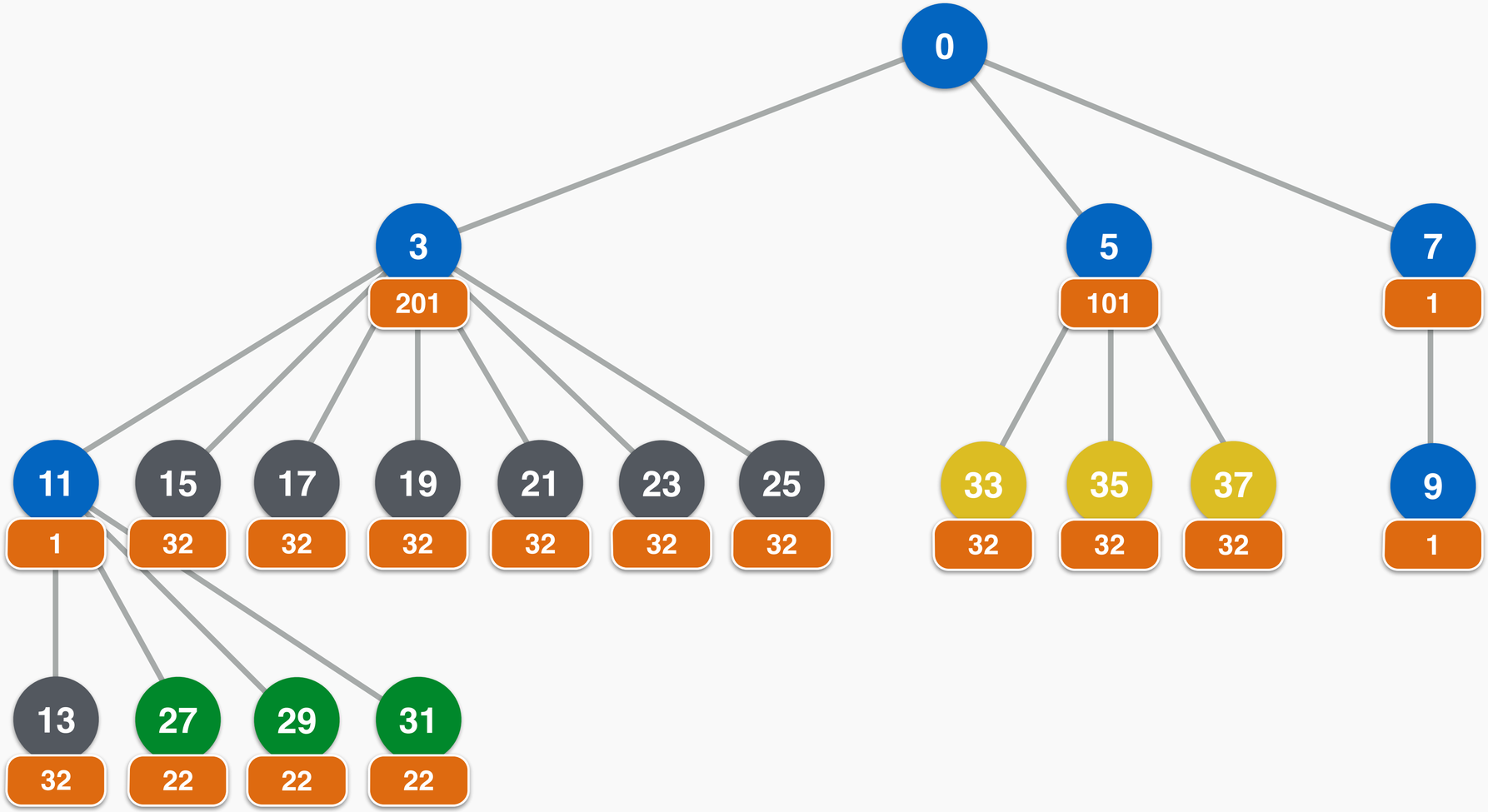

Firefox's Priority Tree

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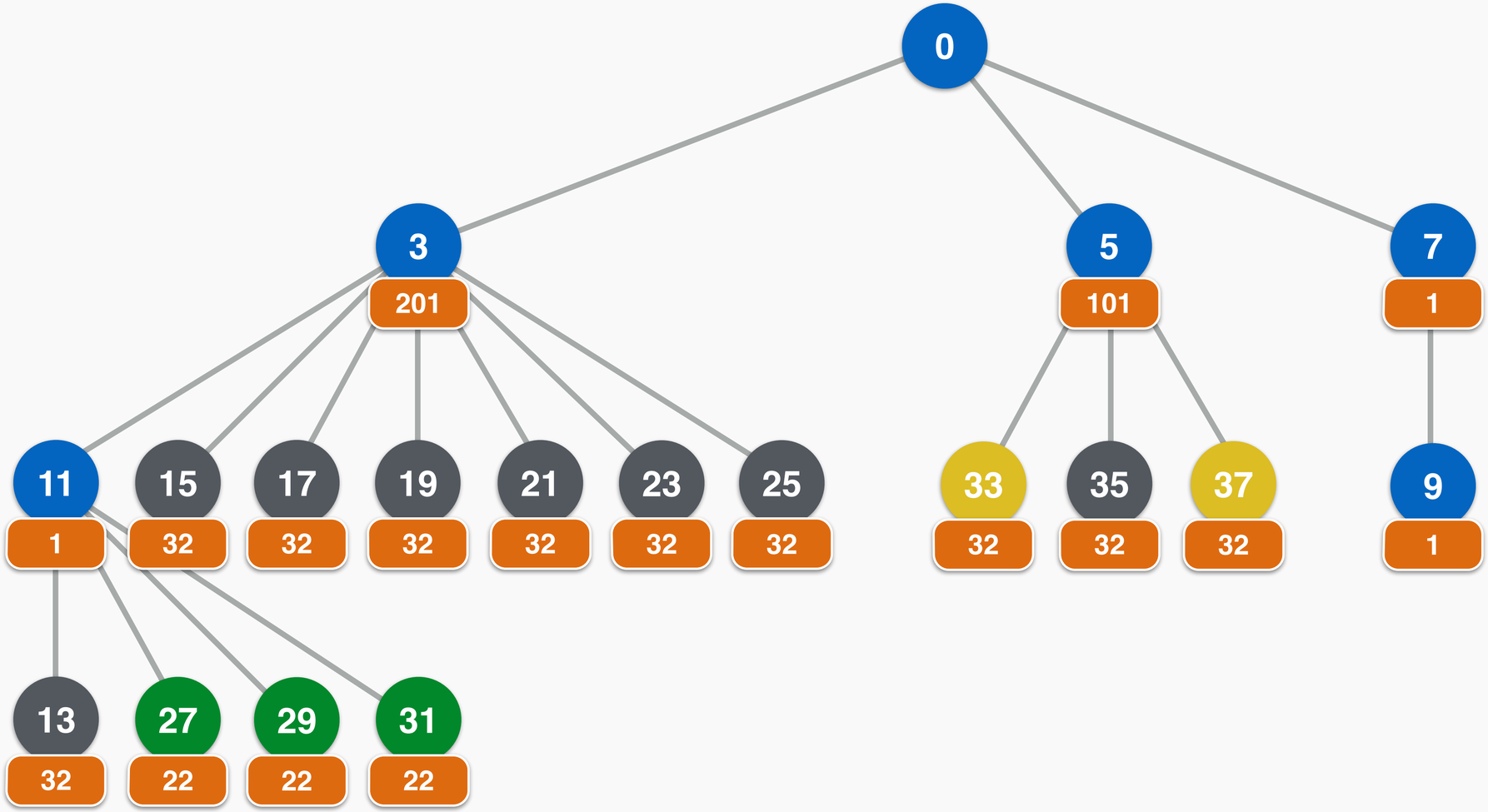

Firefox's Priority Tree

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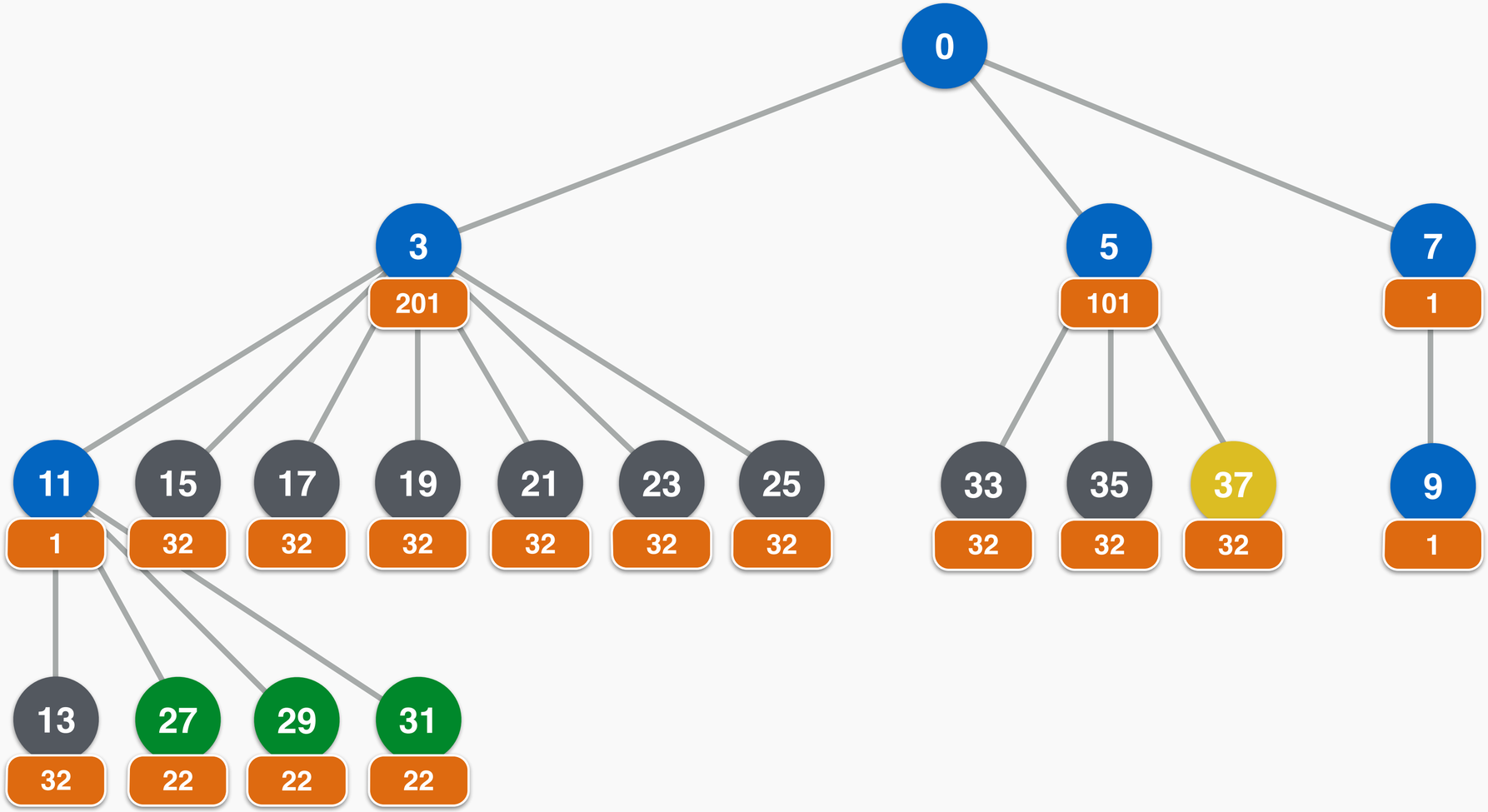

Firefox's Priority Tree

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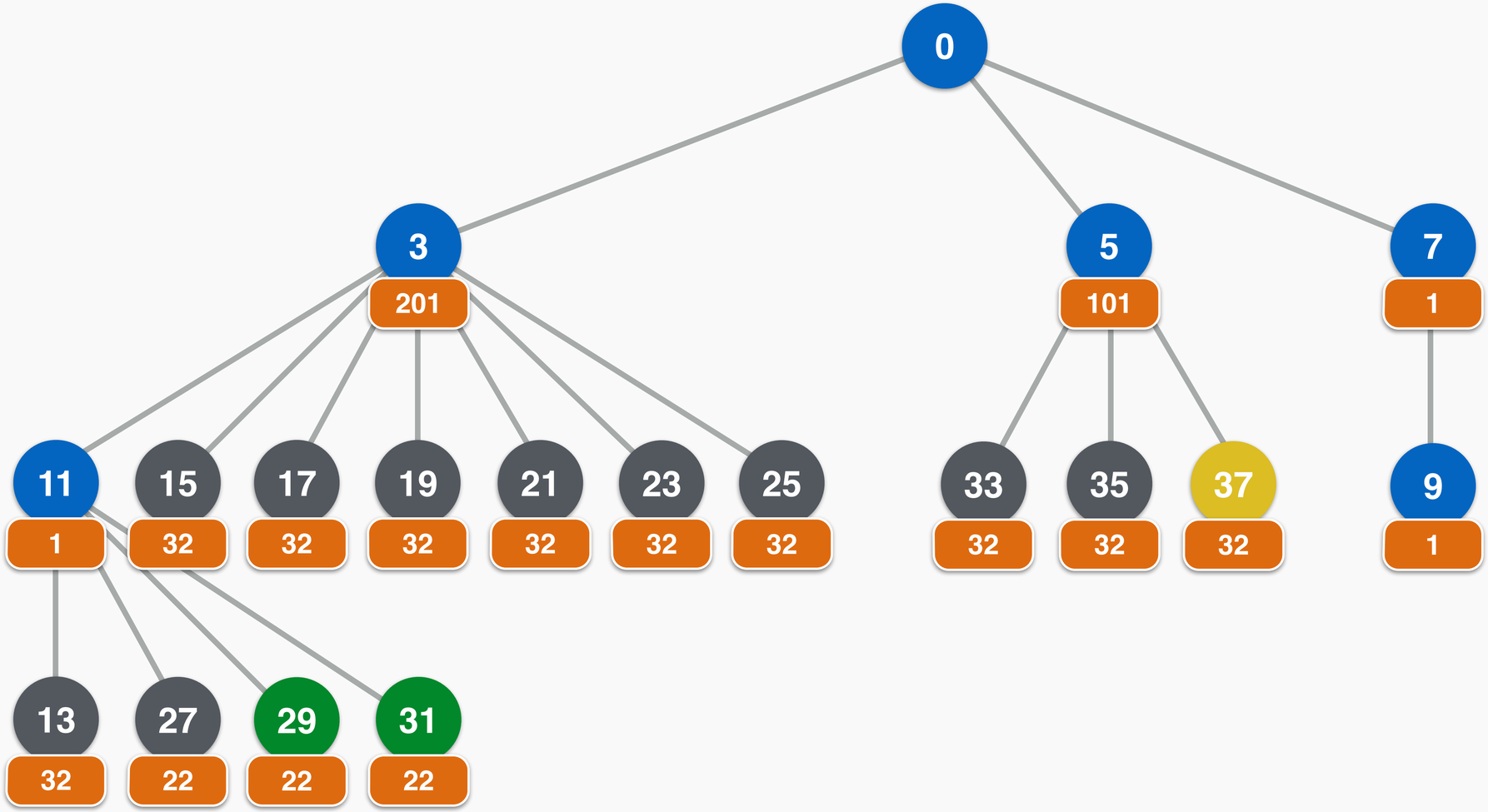

Firefox's Priority Tree

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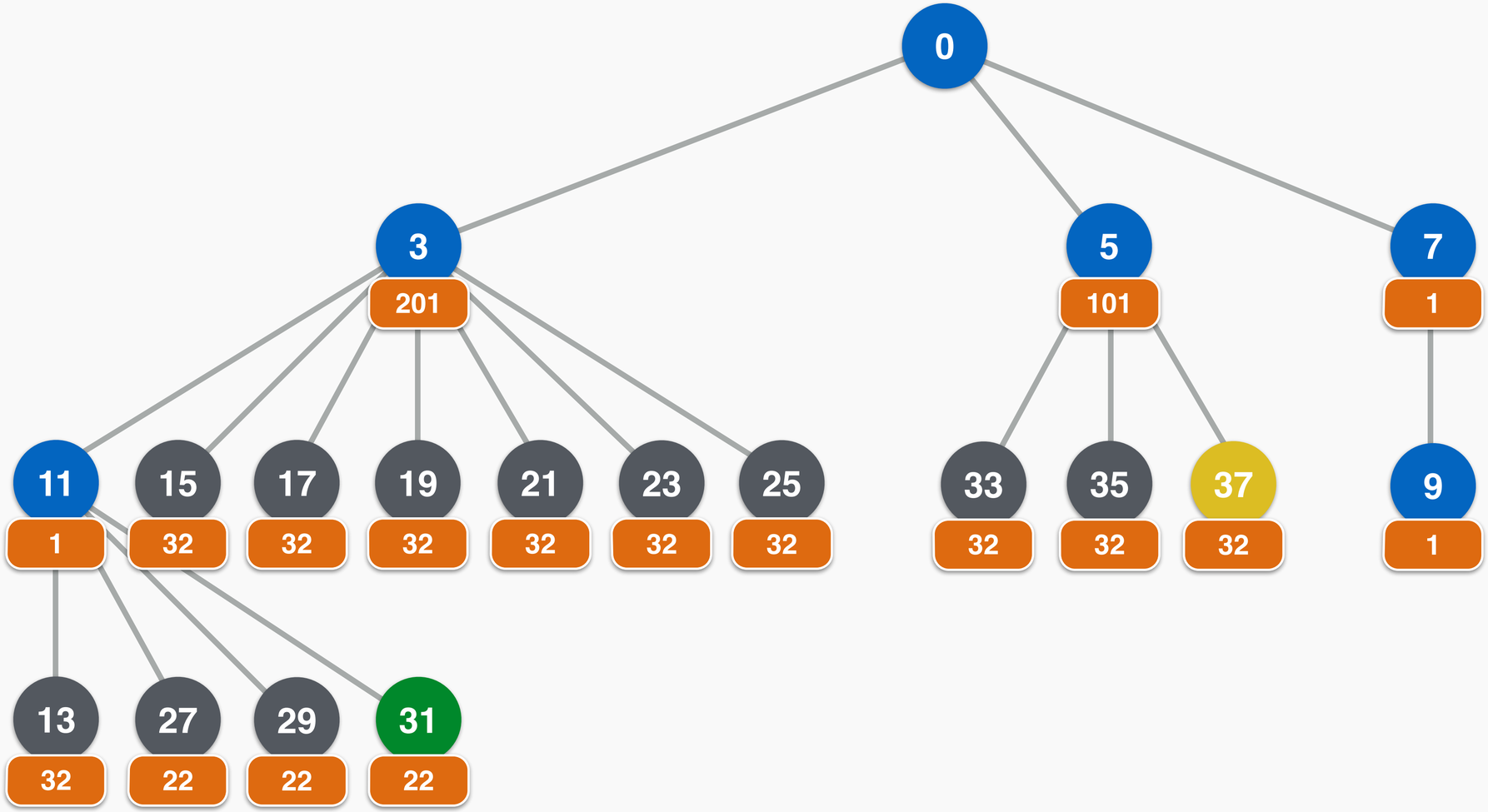

Firefox's Priority Tree

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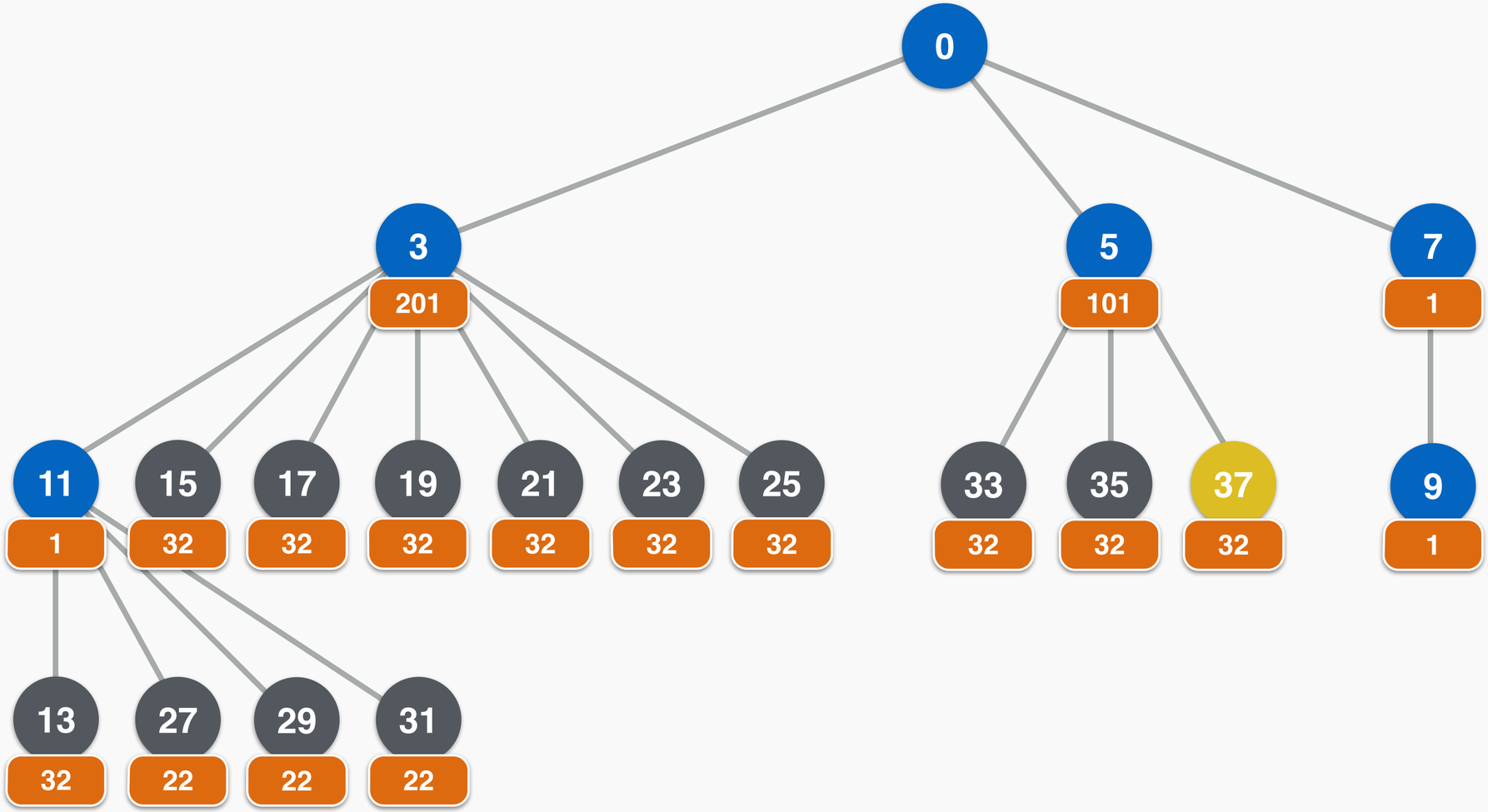

Firefox's Priority Tree

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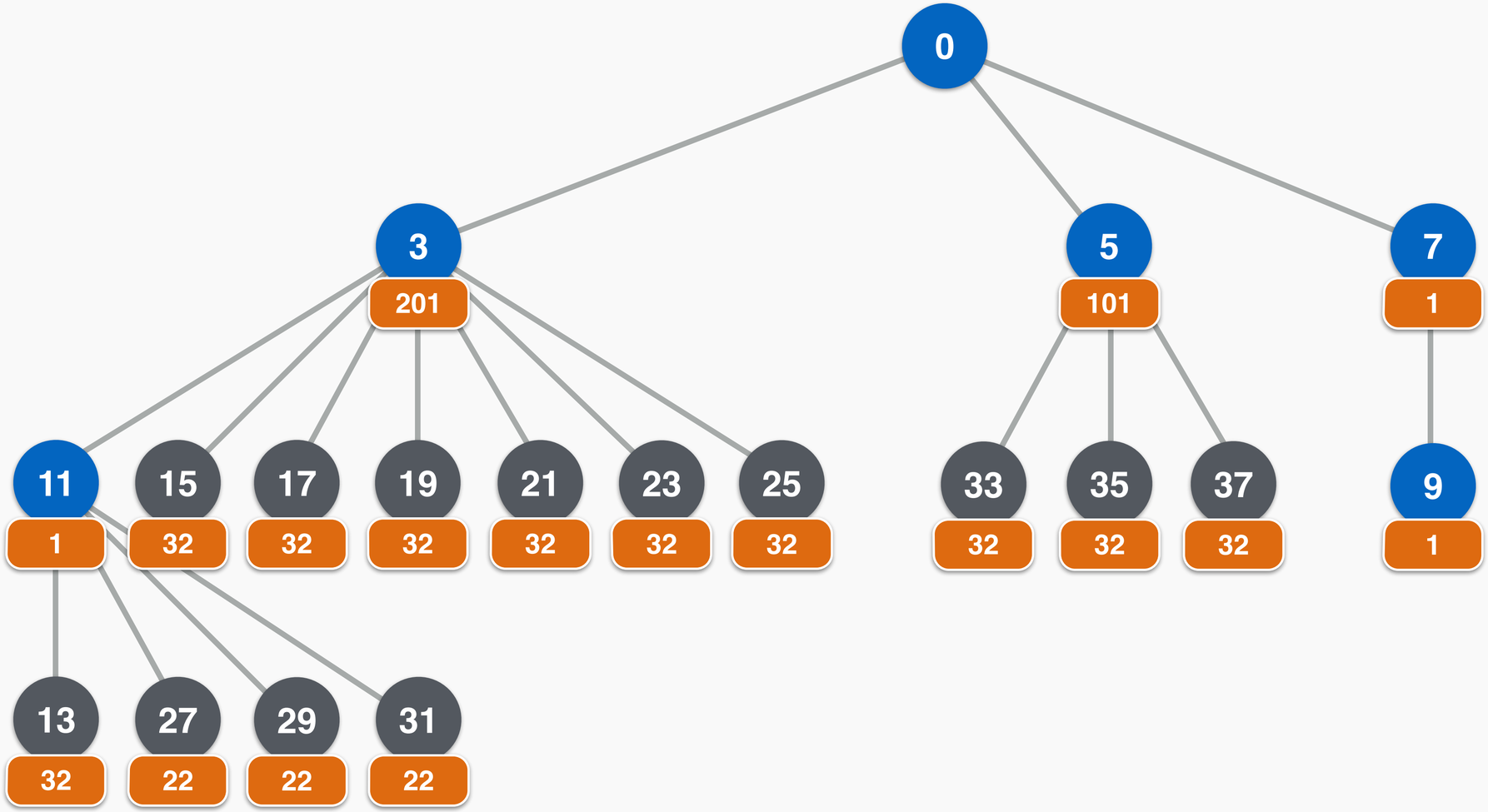
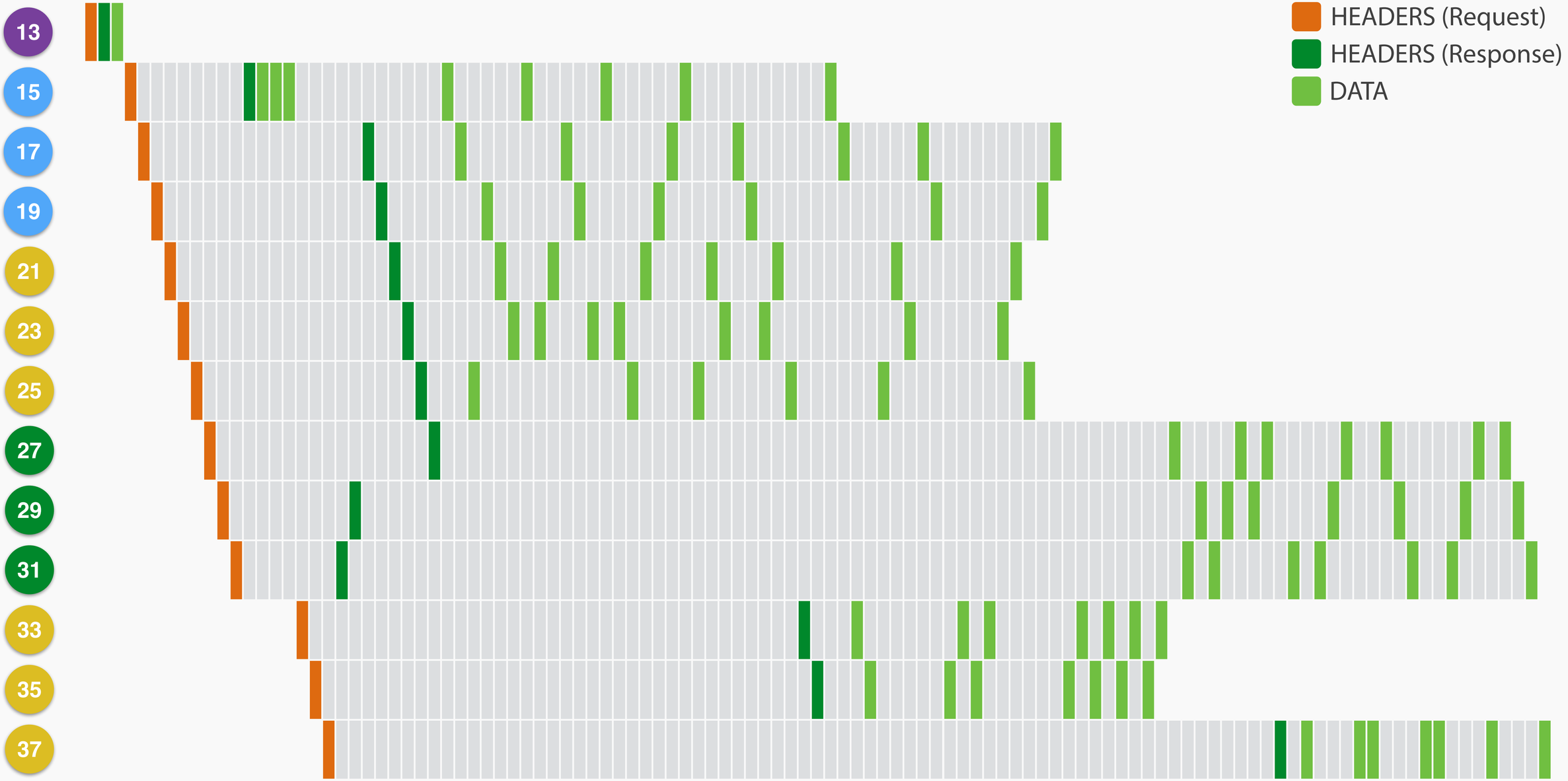
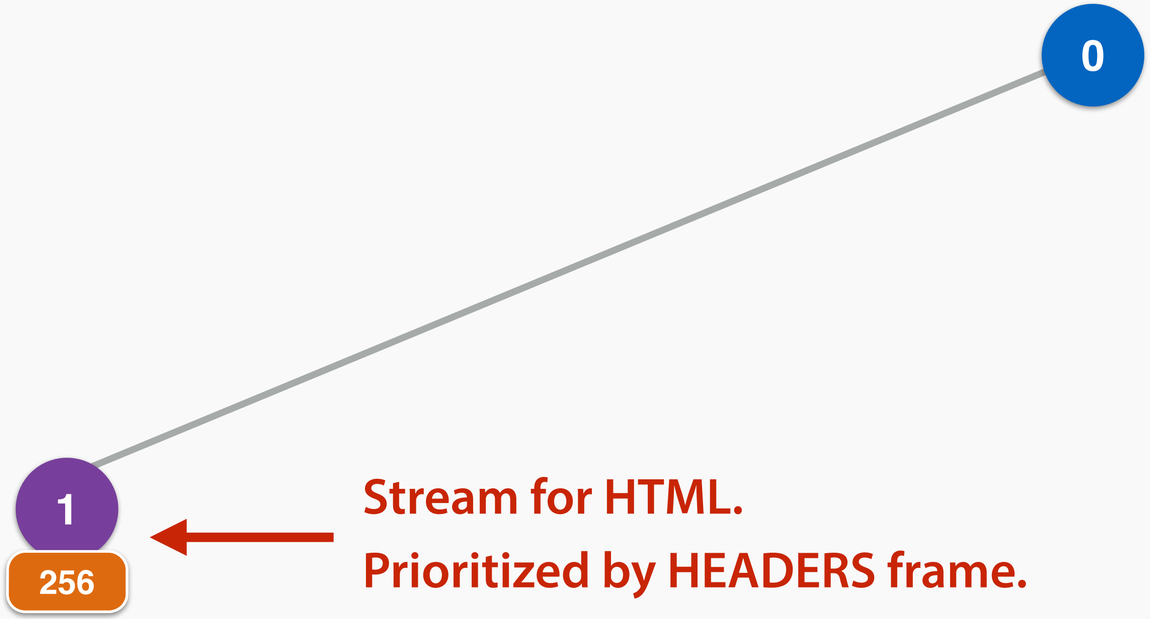


Firefox's Timeline



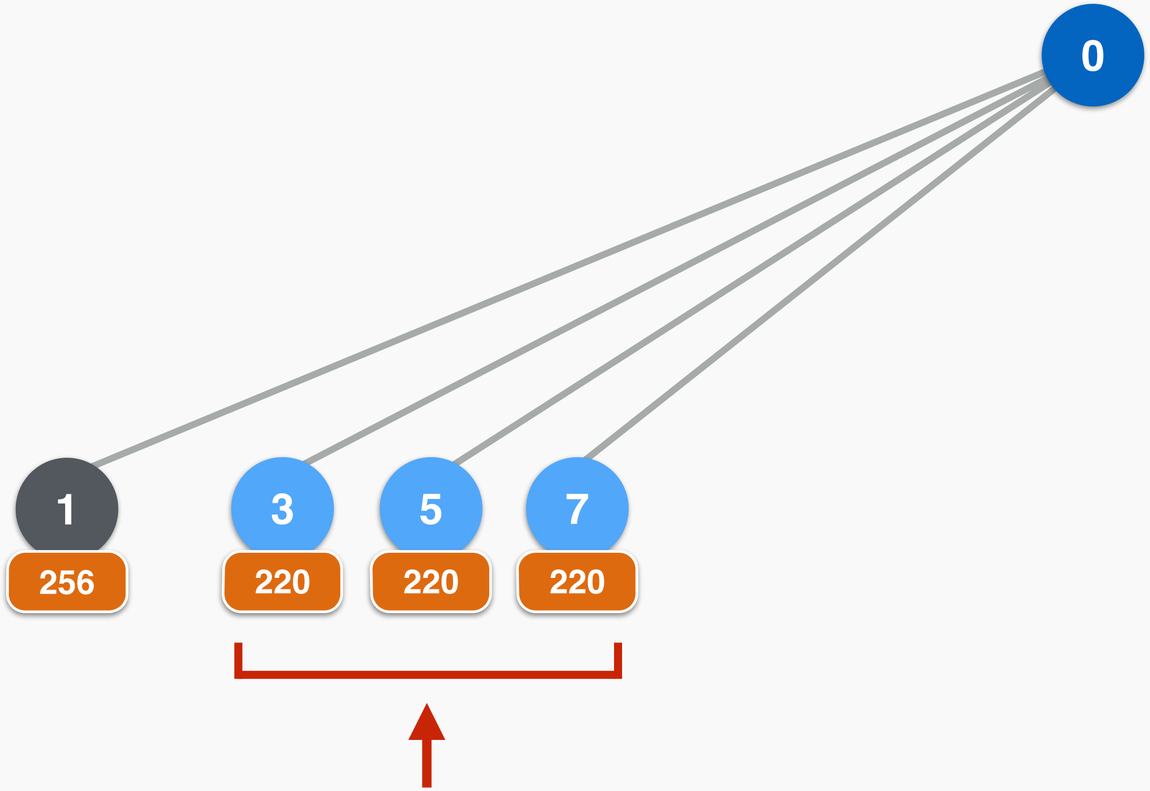
Chrome's Priority Tree

1. HTML



Chrome's Priority Tree

2. CSS

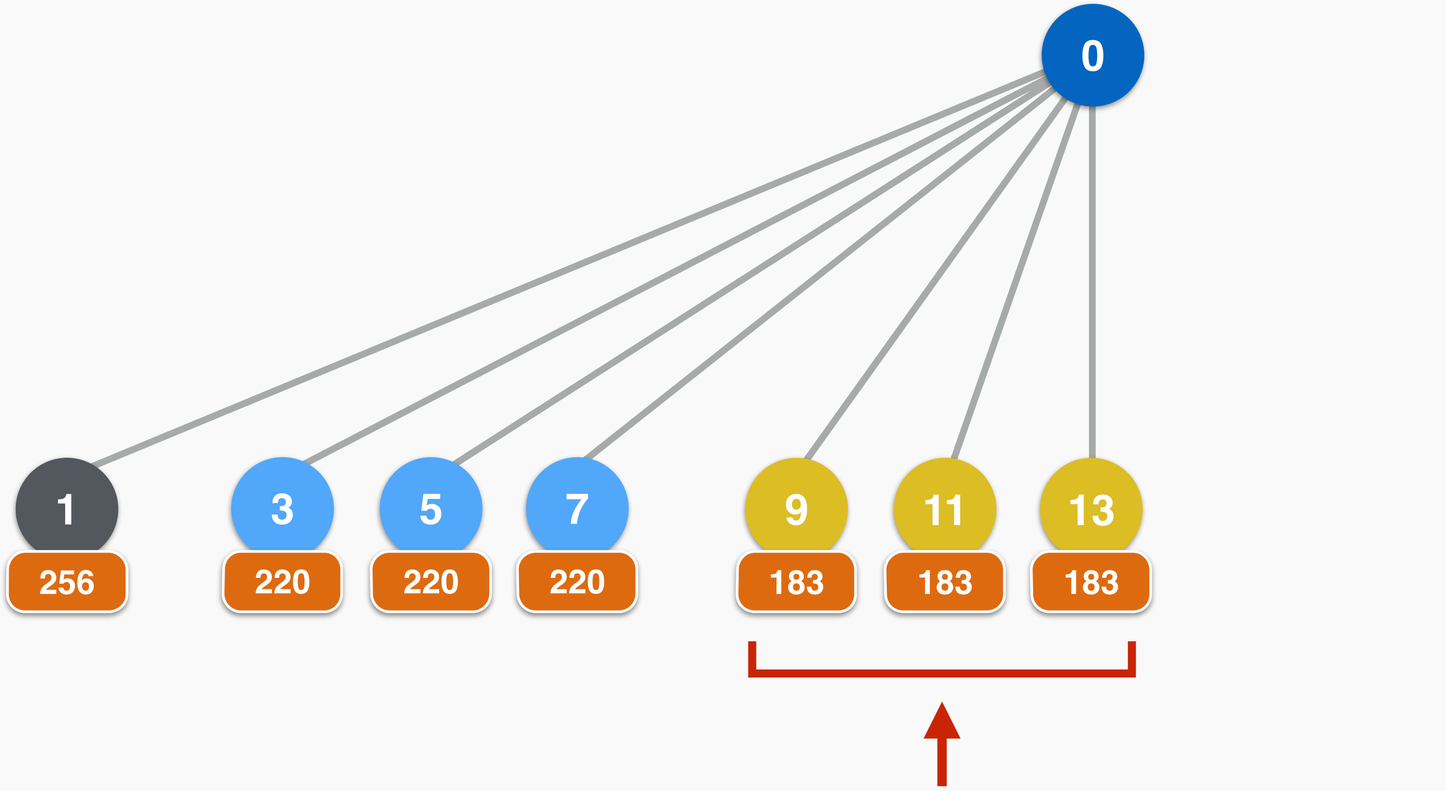


Streams for CSS.

Prioritized by HEADERS frames.

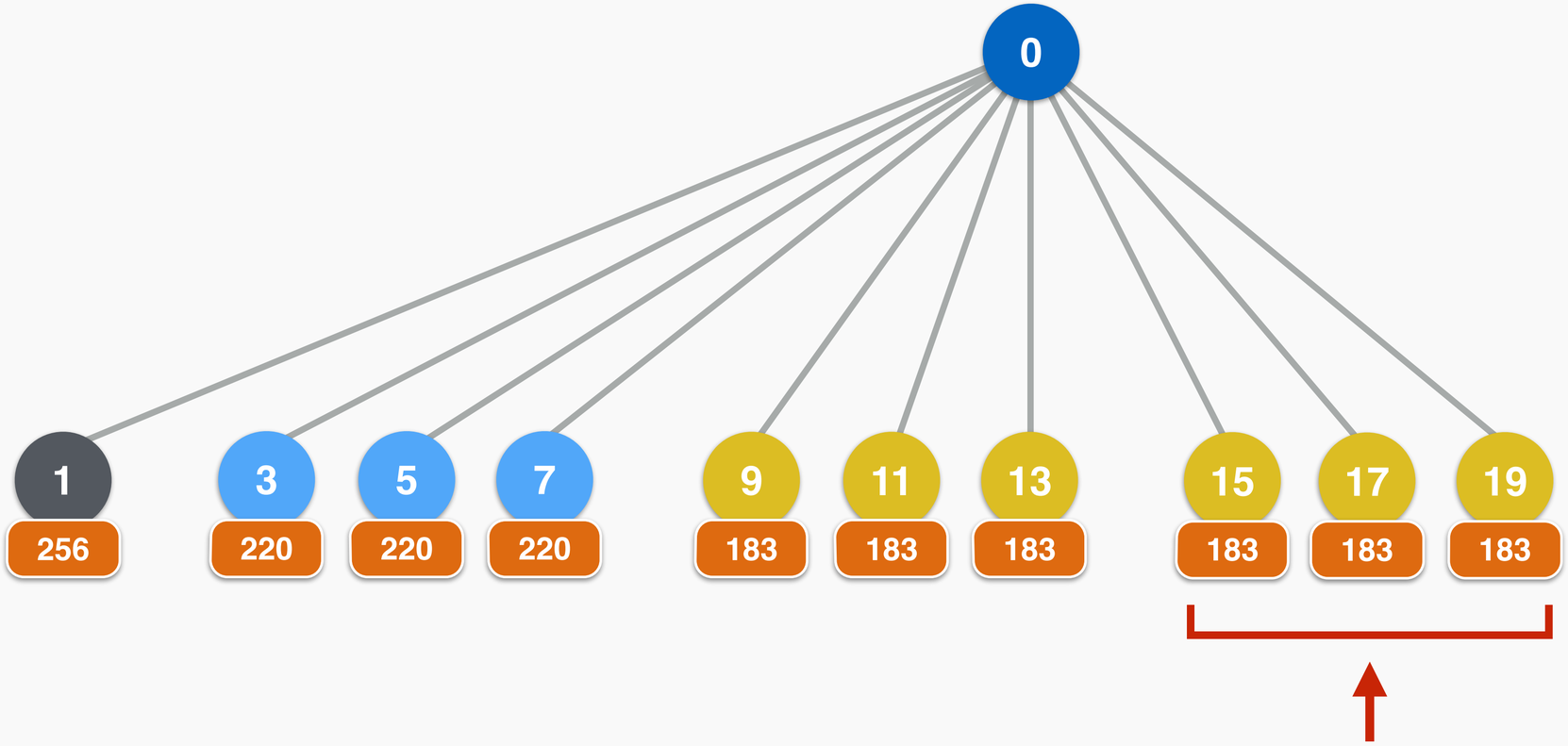
Chrome's Priority Tree

3. JavaScript in the <head>



Chrome's Priority Tree

4. JavaScript in the <body>

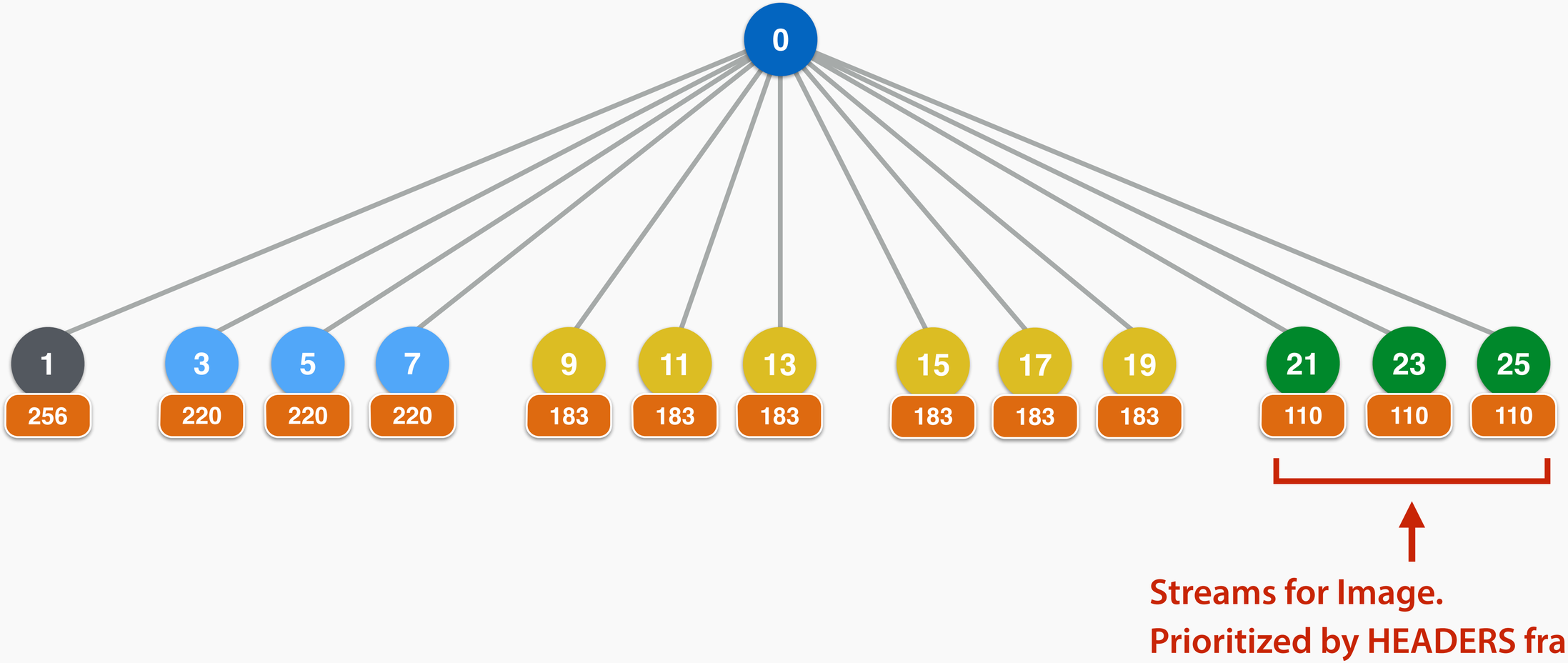


Streams for JavaScript.

Prioritized by HEADERS frames.

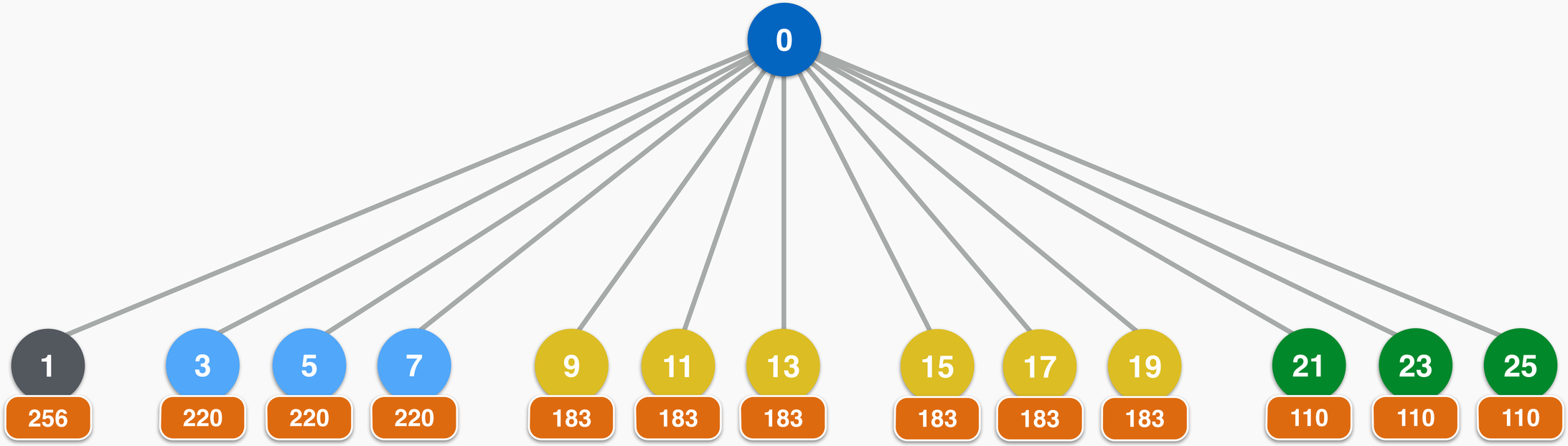
Chrome's Priority Tree

5. Image



Chrome's Priority Tree

6. Download



Chrome's Priority Tree

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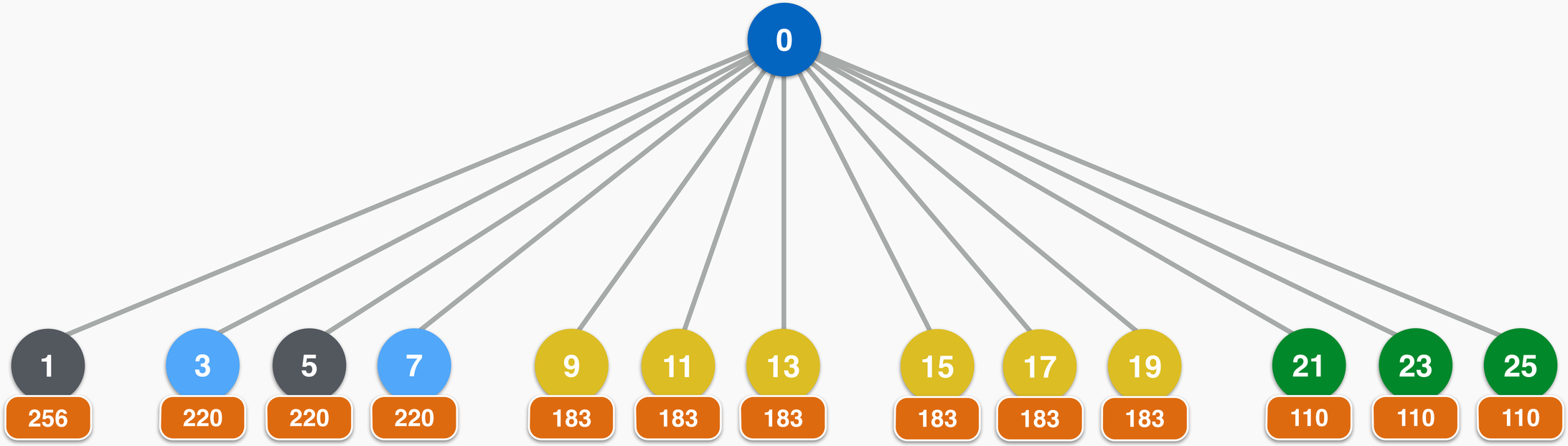

Chrome's Priority Tree

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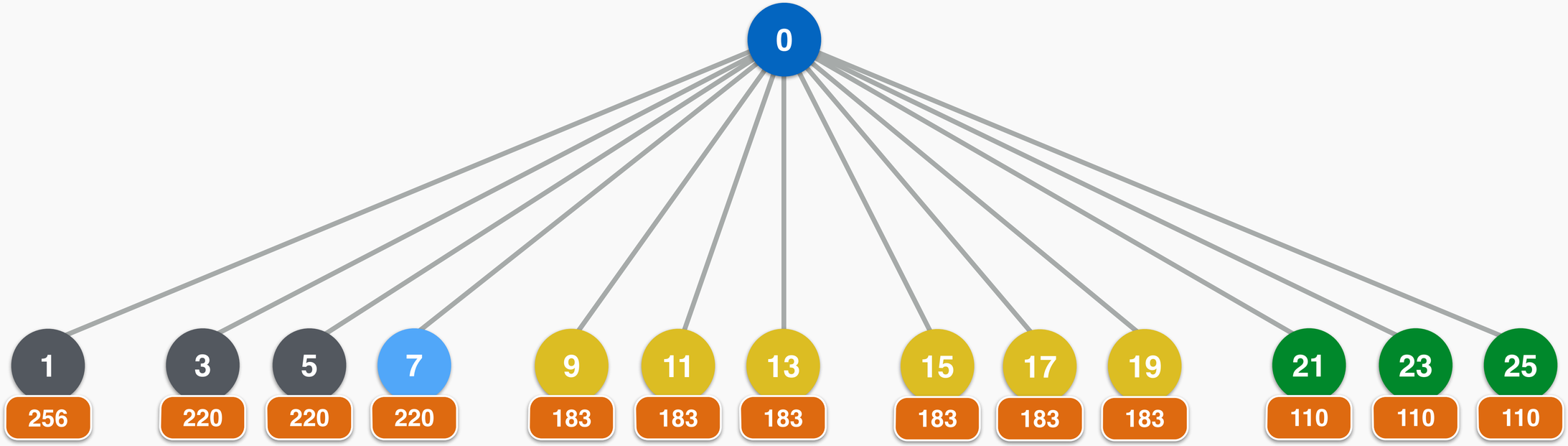

Chrome's Priority Tree

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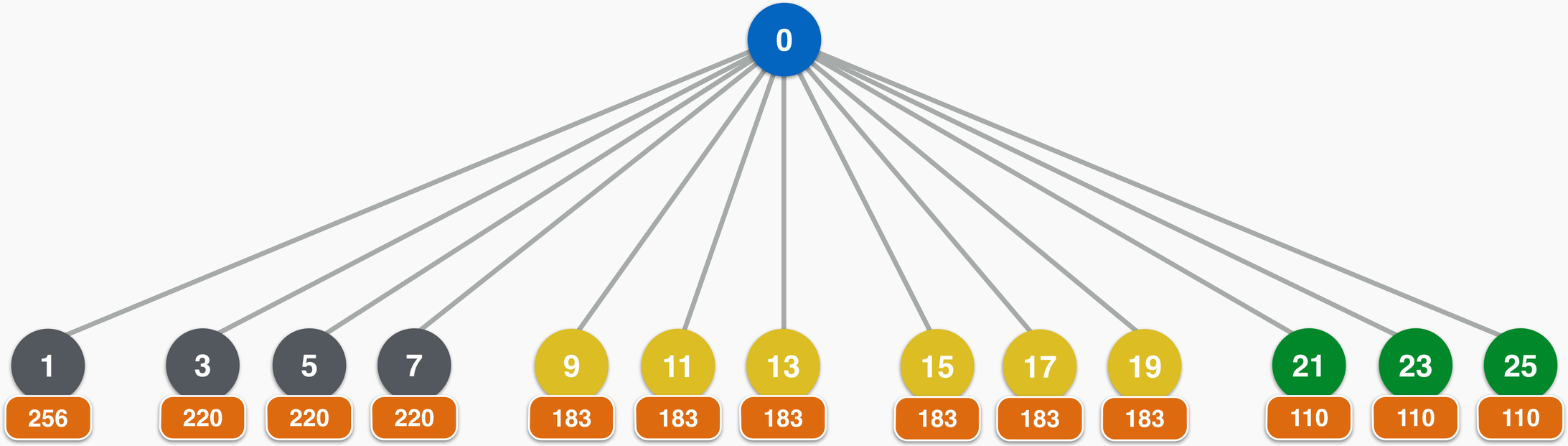

Chrome's Priority Tree

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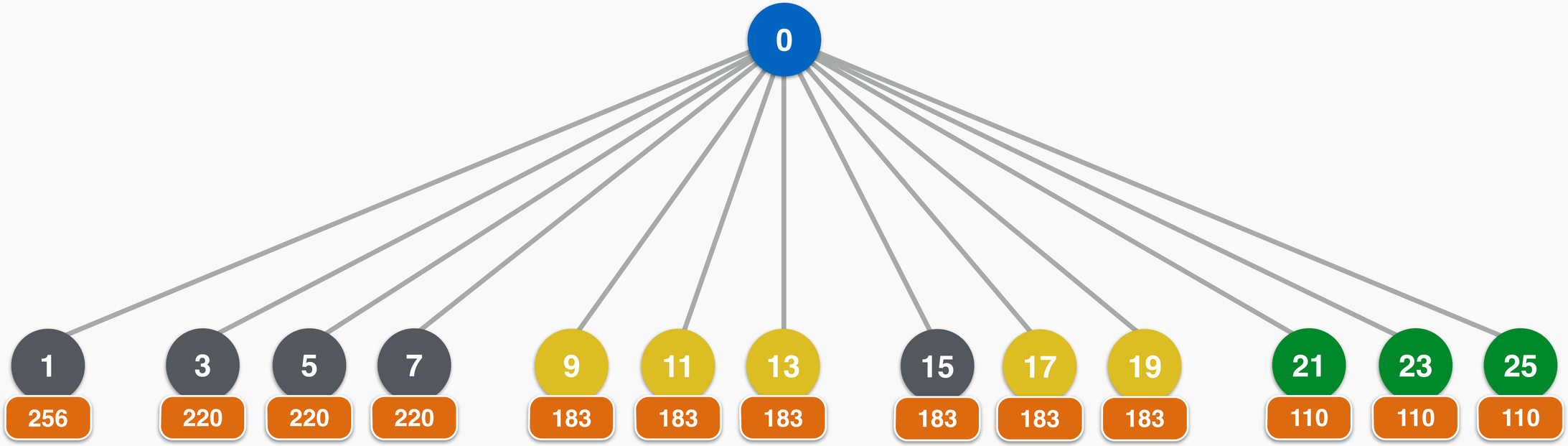

Chrome's Priority Tree

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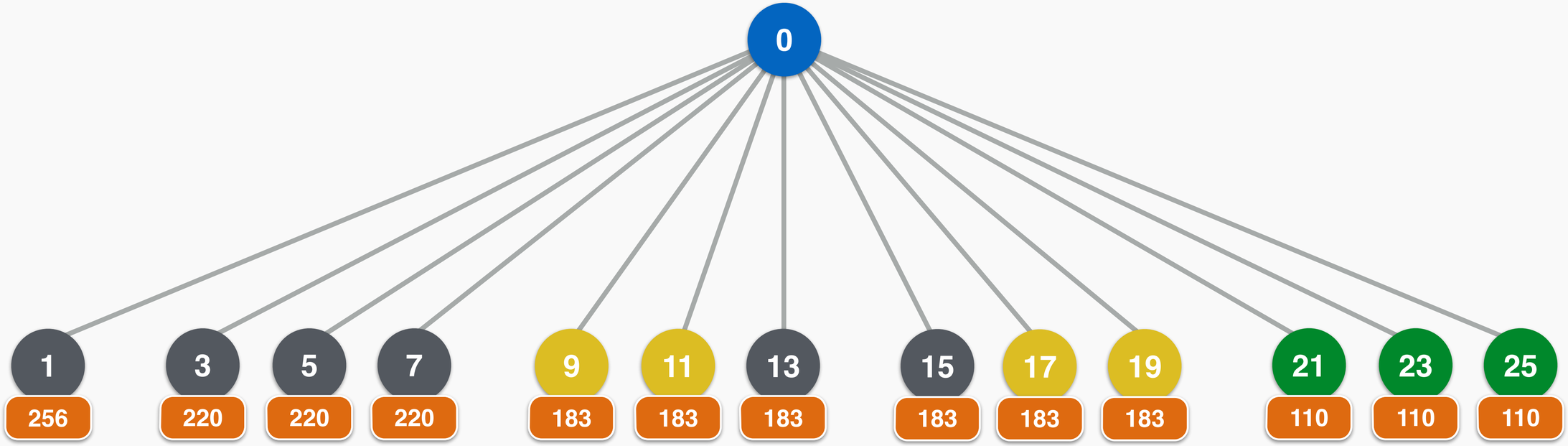

Chrome's Priority Tree

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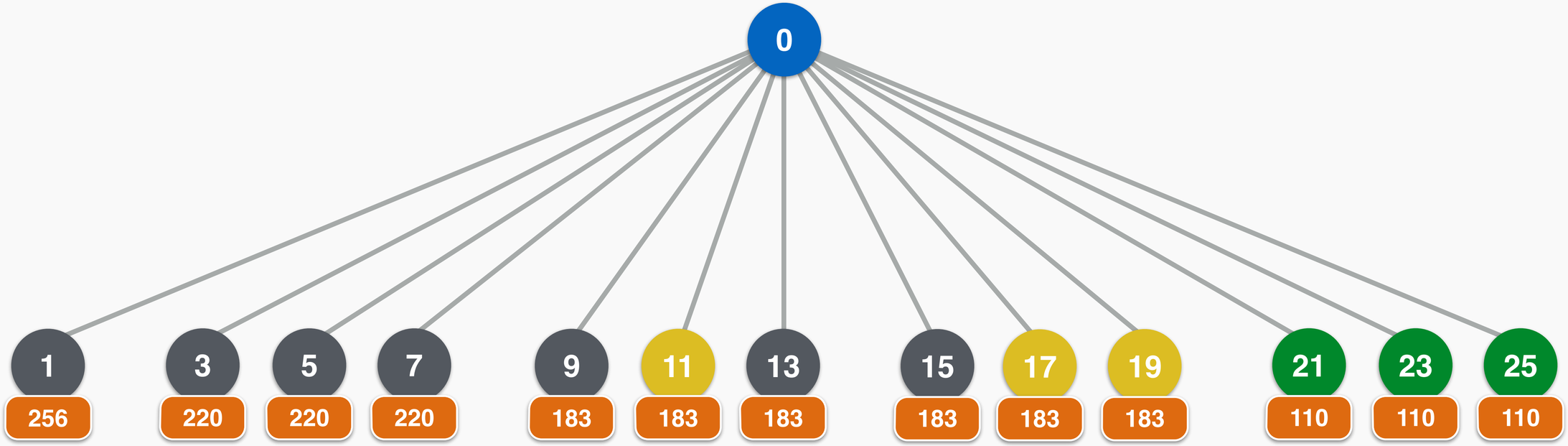
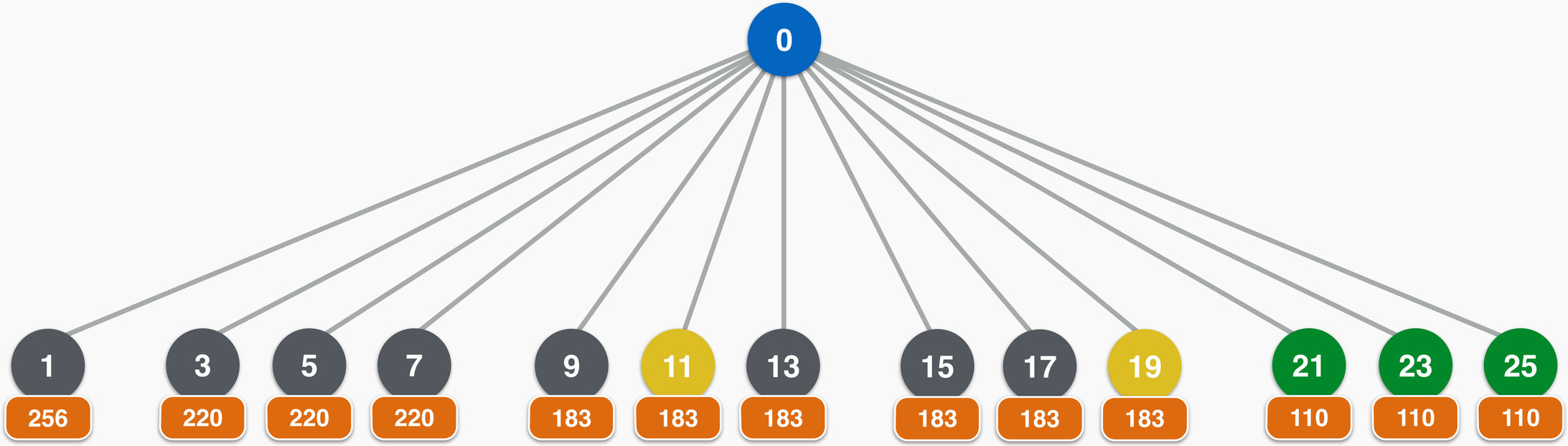


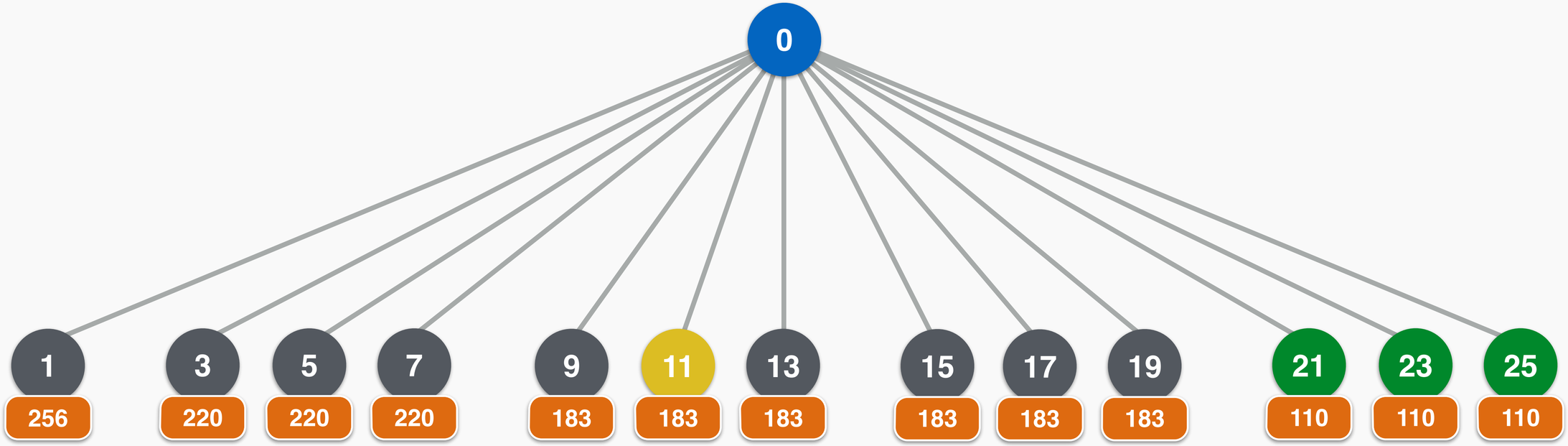
Chrome's Priority Tree

6. Download



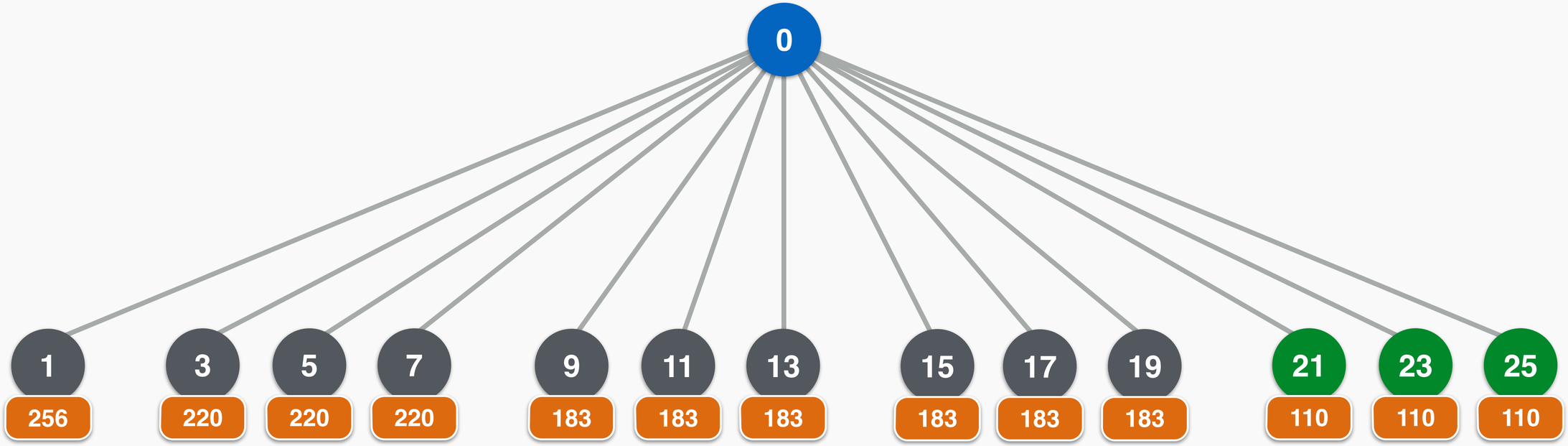
Chrome's Priority Tree

6. Download



Chrome's Priority Tree

6. Download



Chrome's Priority Tree

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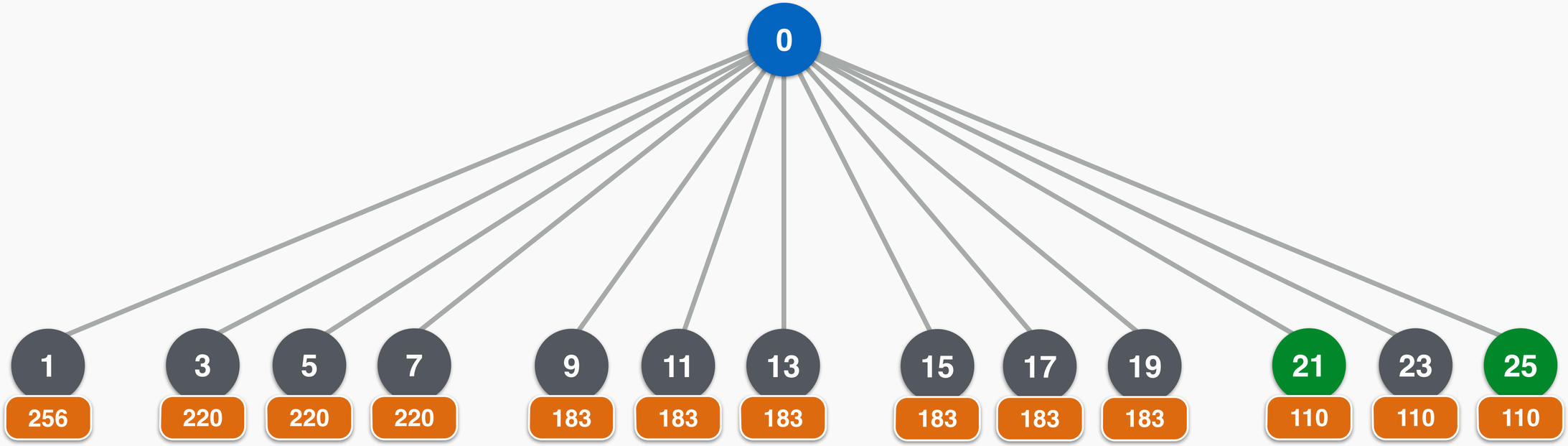

Chrome's Priority Tree

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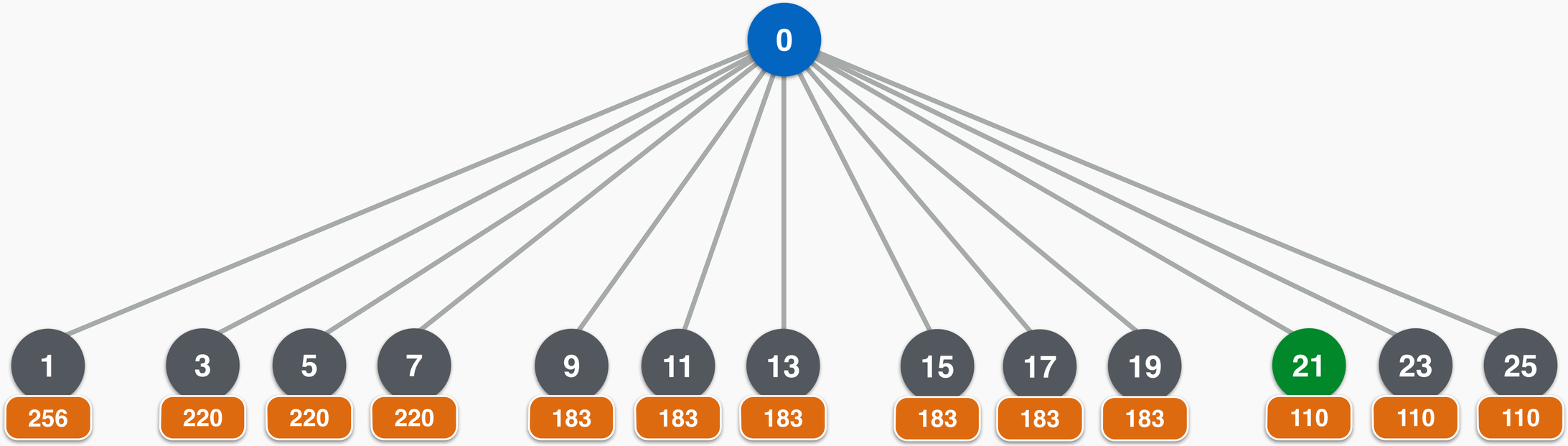
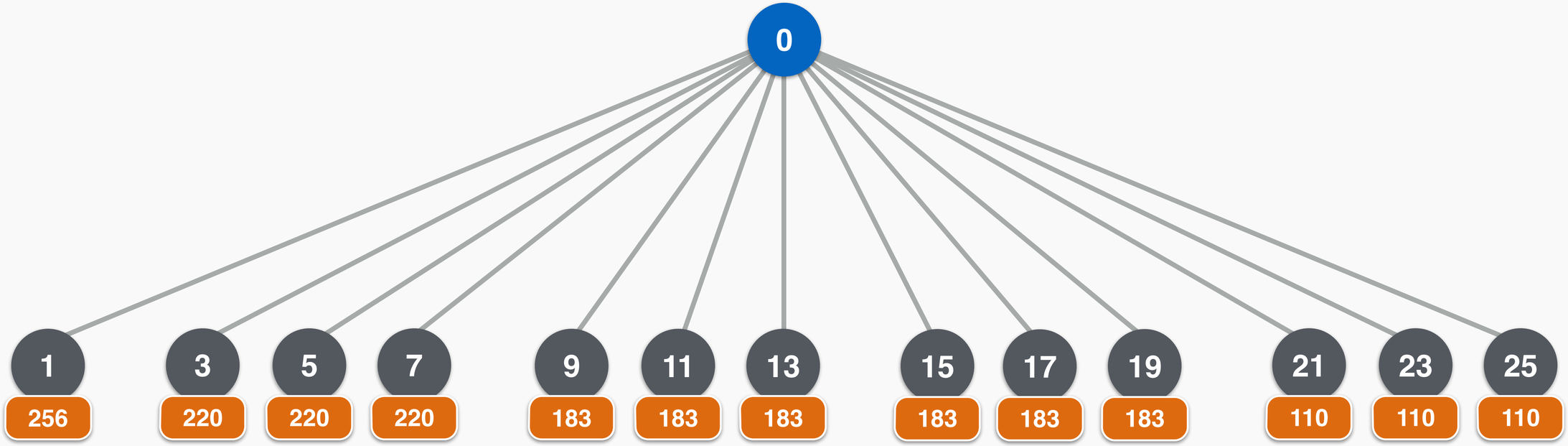
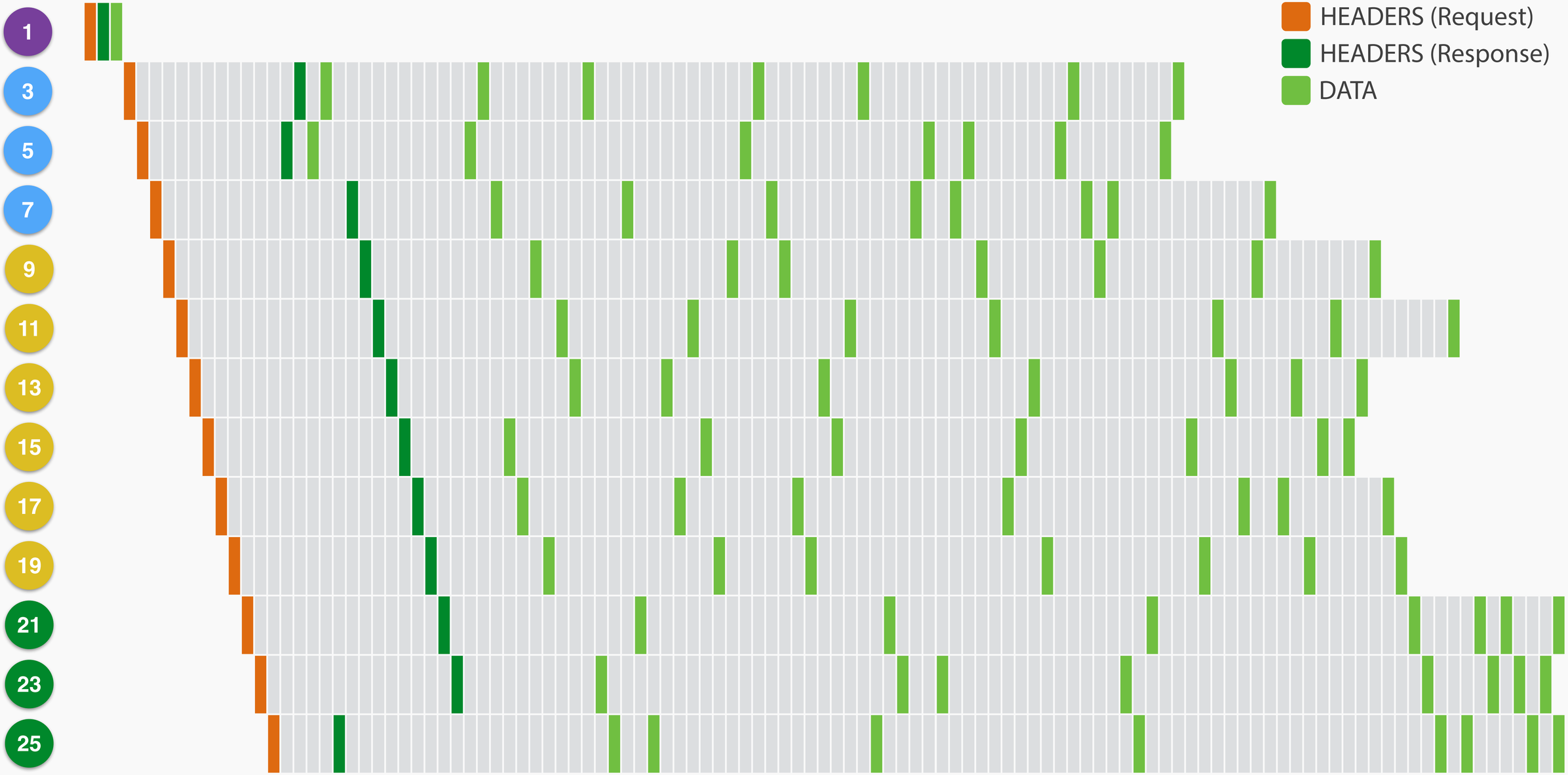


Chrome's Priority Tree

6. Download



Chrome's Timeline

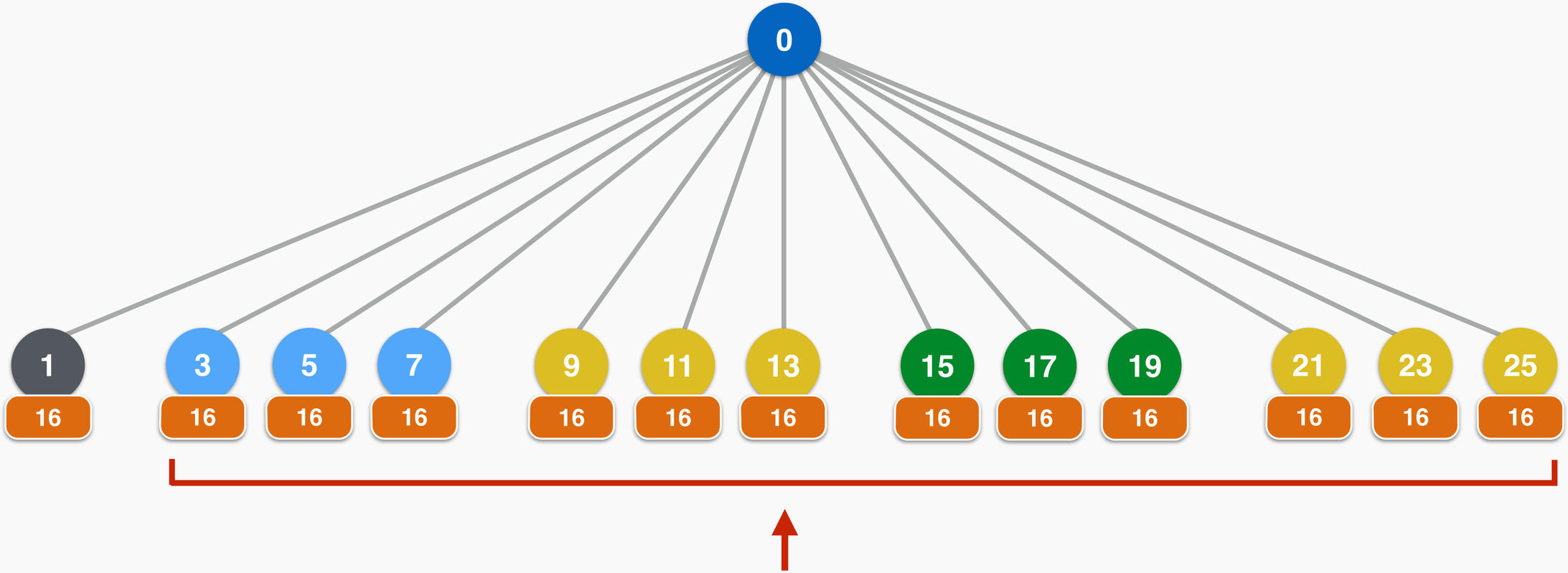


Edge's Priority Tree

1. HTML

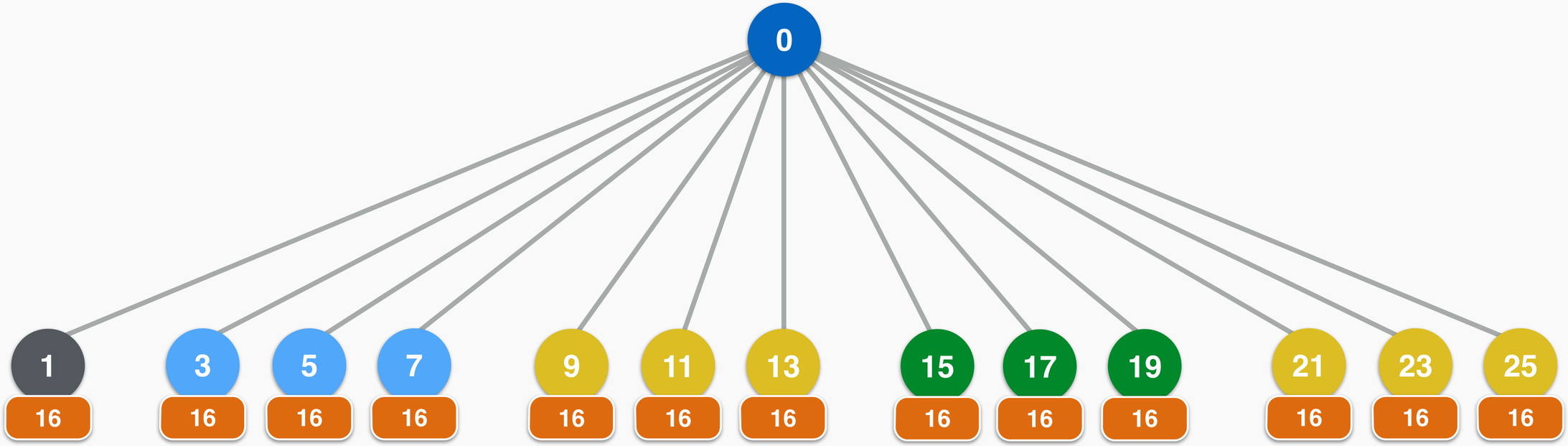
Edge's Priority Tree

2. CSS, JavaScript, Image



Edge's Priority Tree

3. Download



Edge's Priority Tree

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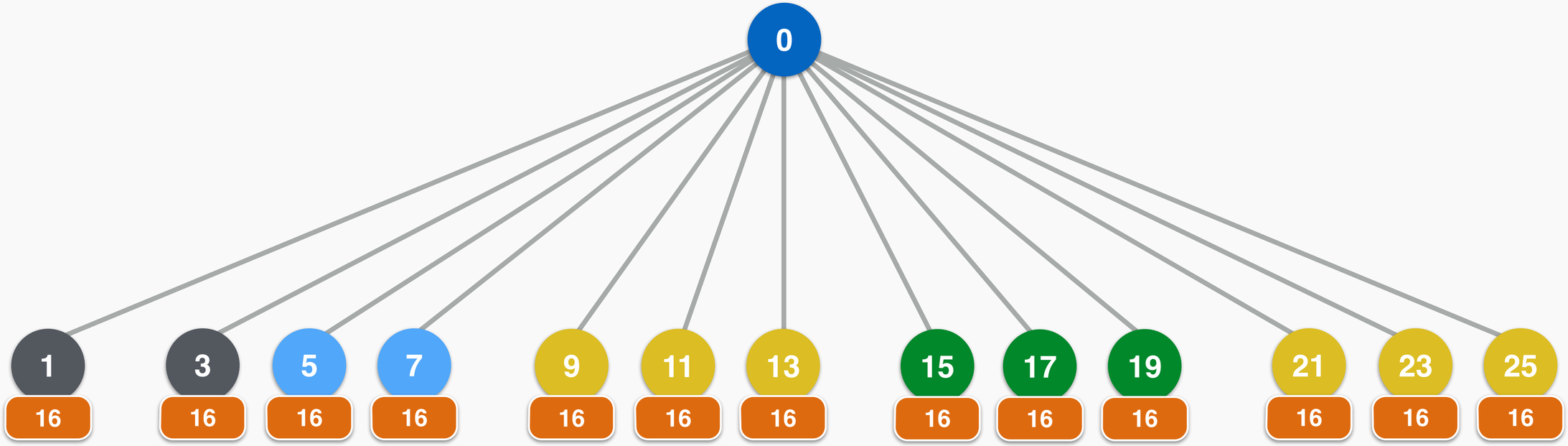
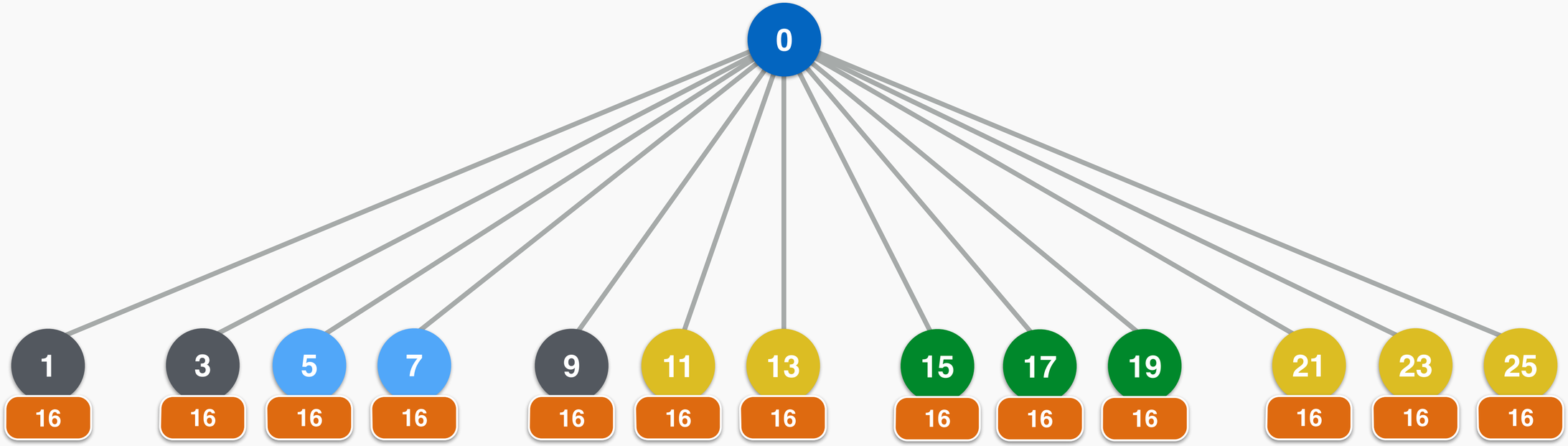


Edge's Priority Tree

3. Download



Edge's Priority Tree

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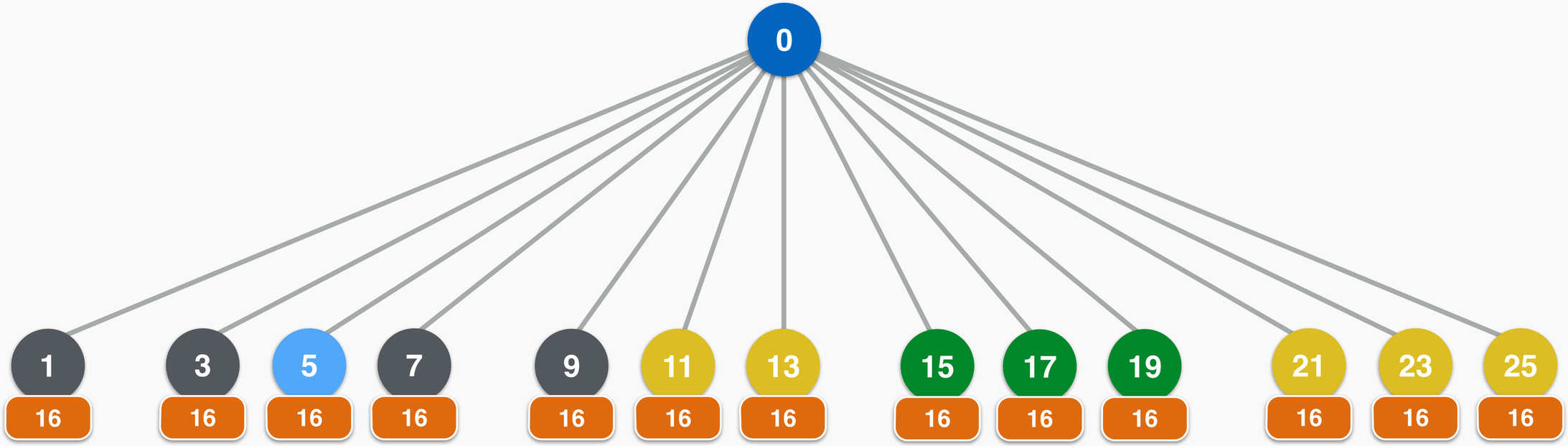

Edge's Priority Tree

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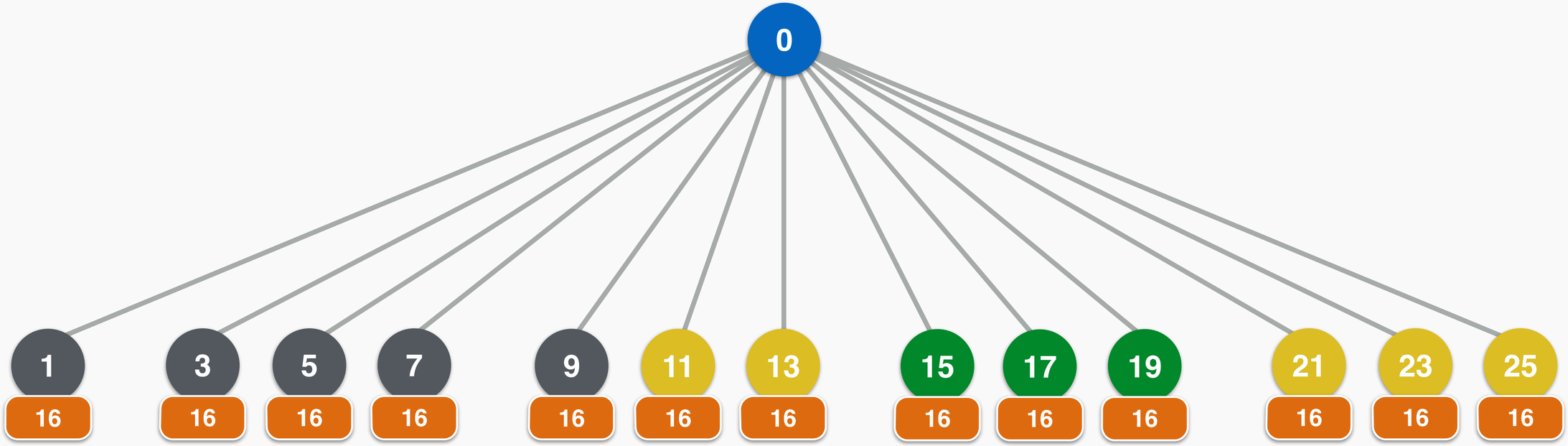

Edge's Priority Tree

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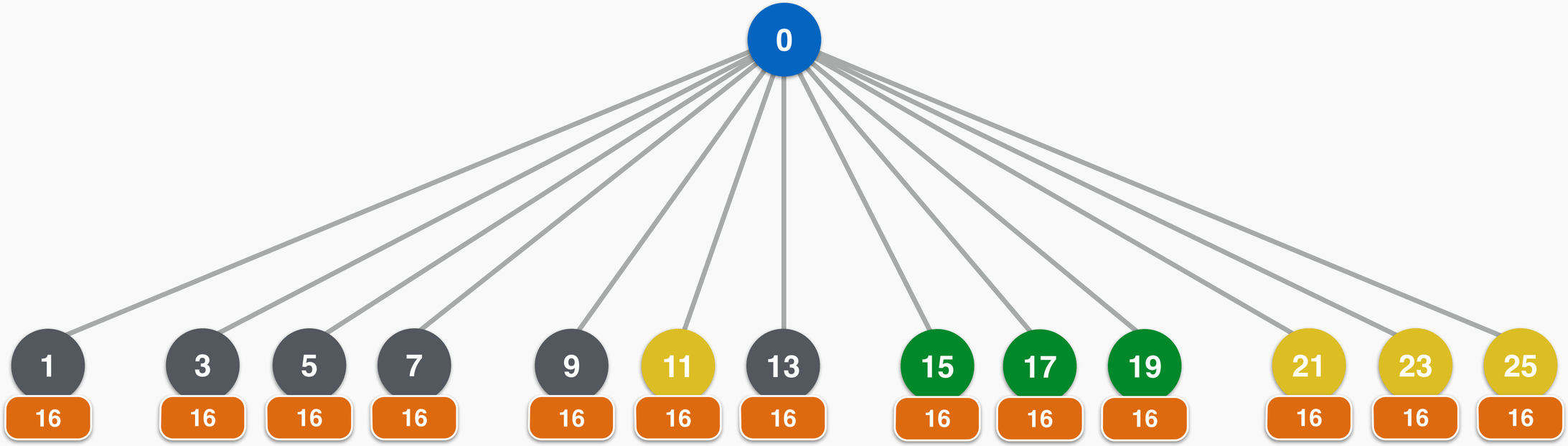

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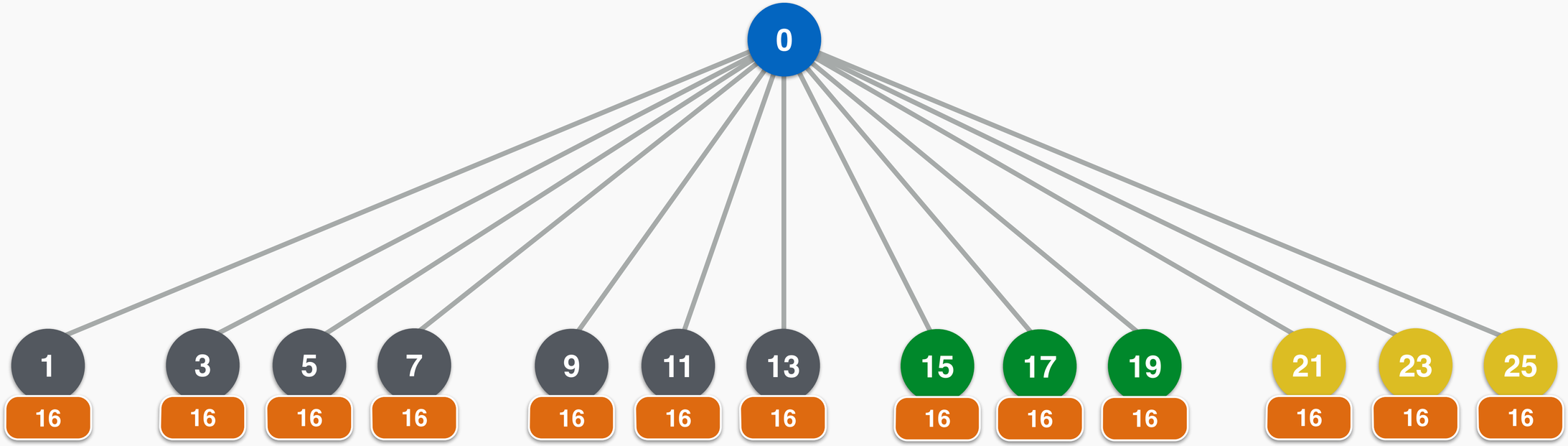

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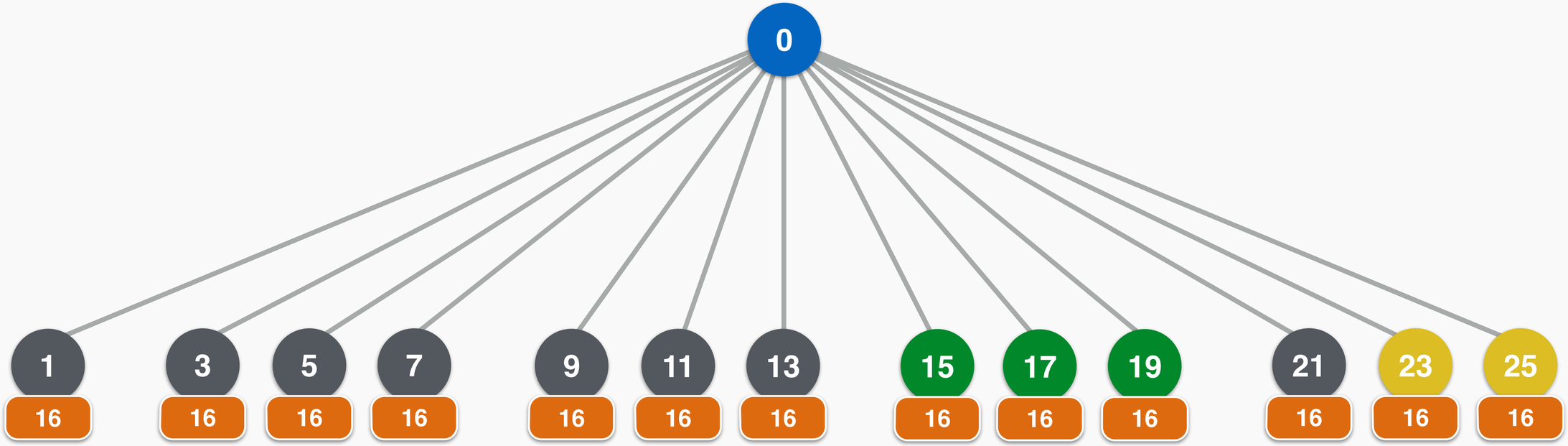
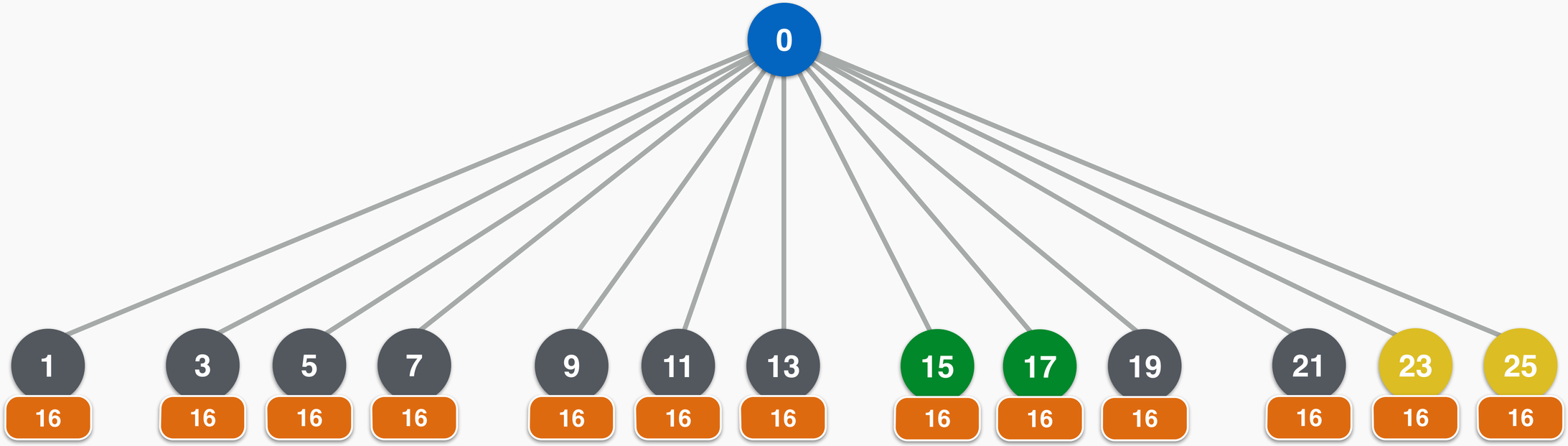


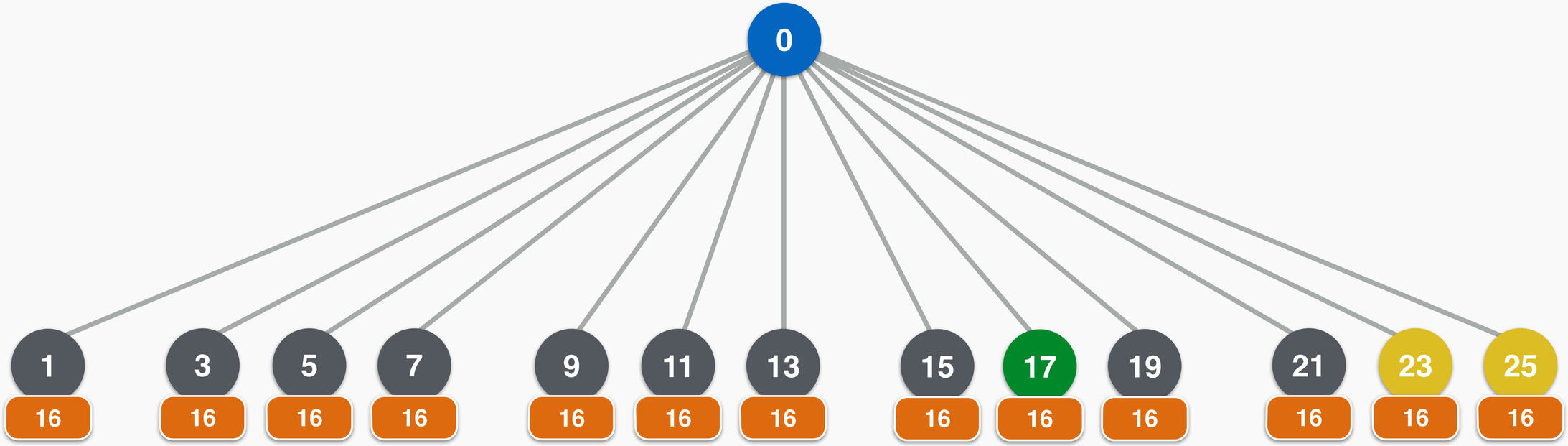
Edge's Priority Tree

3. Download



Edge's Priority Tree

3. Download



Edge's Priority Tree

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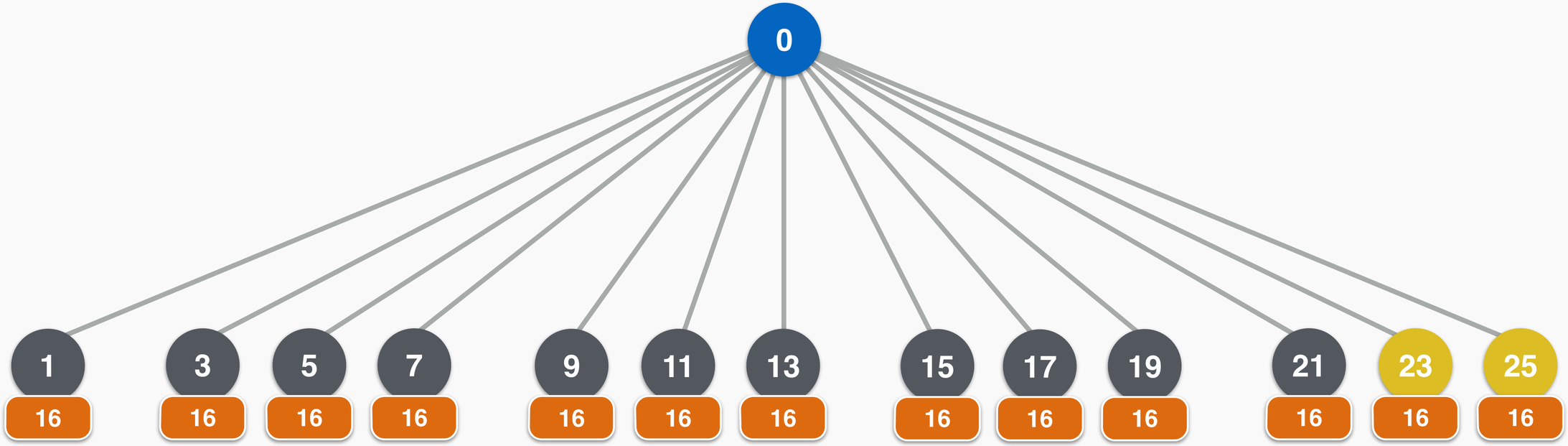

Edge's Priority Tree

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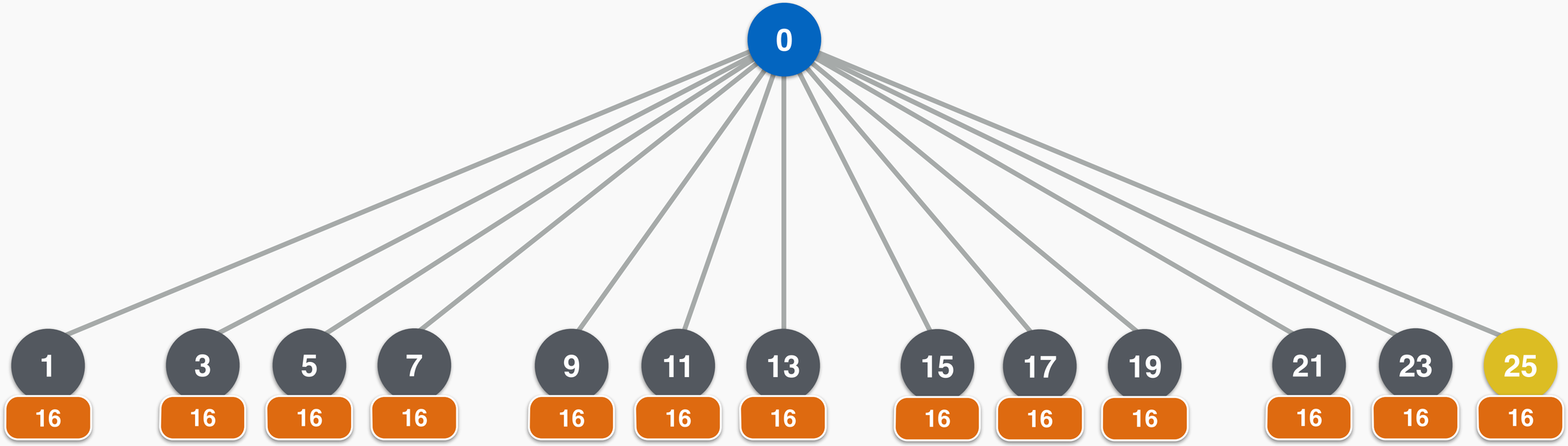
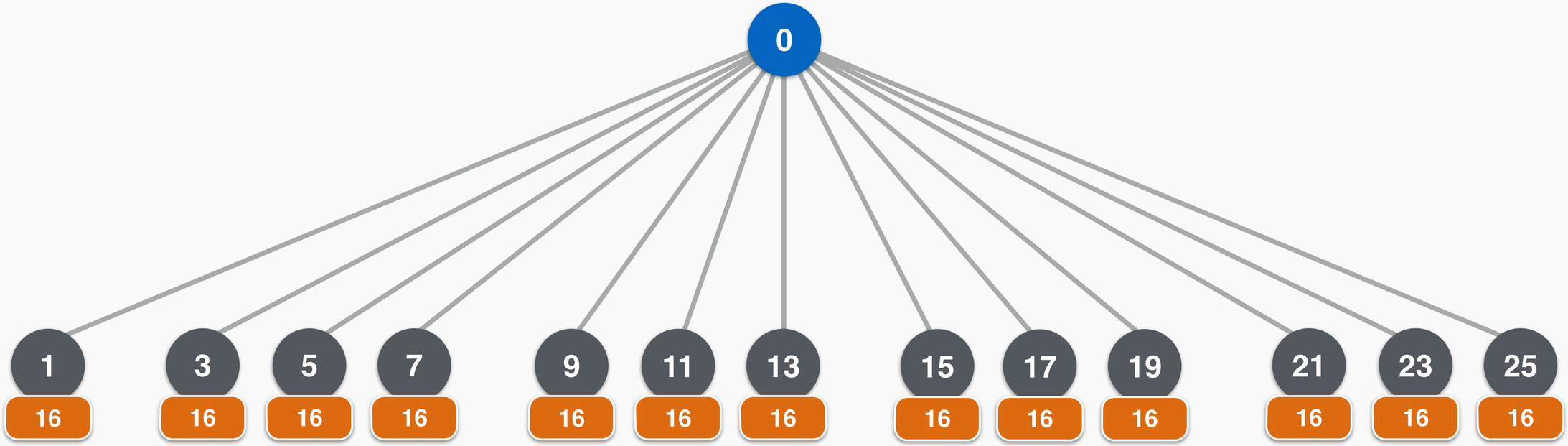
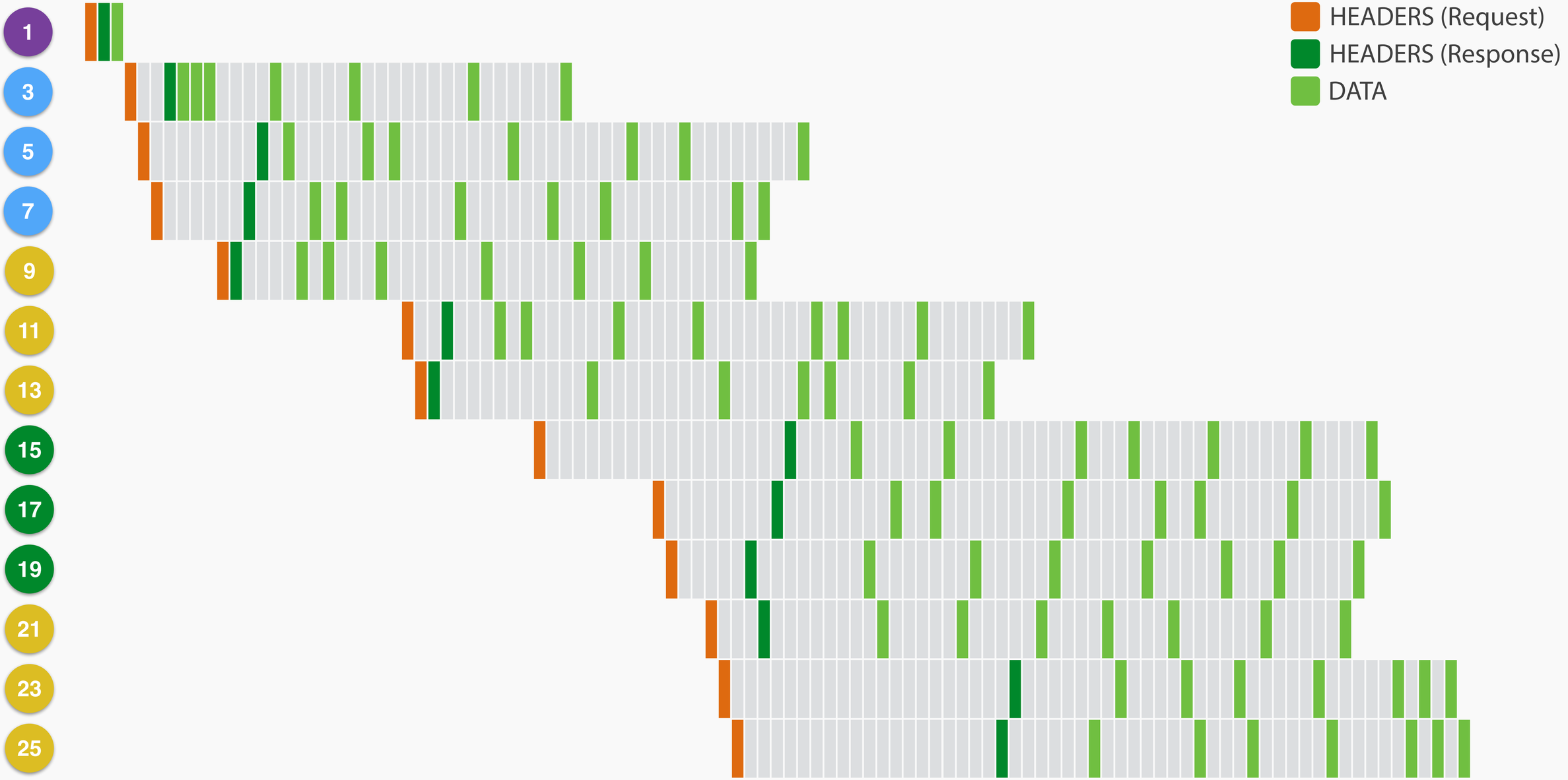


Edge's Priority Tree

3. Download



Edge's Timeline



The prioritization strategy of browsers

- **Firefox builds the priority tree that is optimized for Web pages**
  - *Priority order: CSS, JavaScript, Images*
- **Chrome reuses the prioritization strategy of SPDY era that is used only weight**
  - *The difference in weight is small… there is room for optimization!*
- **Edge does not support the prioritization**
  - *It seems to control the download of the resource by the timing of request...*

Conclusion

- **HTTP/2 prioritization consists of dependency and weight**
  - *Client notifies the priority, server builds the priority tree*
- **Each browser have different prioritization strategy**
  - *The use of priority dependencies may produce better results*
- **Need to measurement the effect of HTTP/2 prioritization!**
  - *But there is no tool that can measure the prioritization of HTTP/2...*

Thanks!