Exploiting Webpage Characteristics for Energy-Efficient Mobile Web Browsing

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Department of Electrical and Computer Engineering
The University of Texas at Austin

Best of CAL — Feb. 11th, 2015

Isn’t This a Network Issue?

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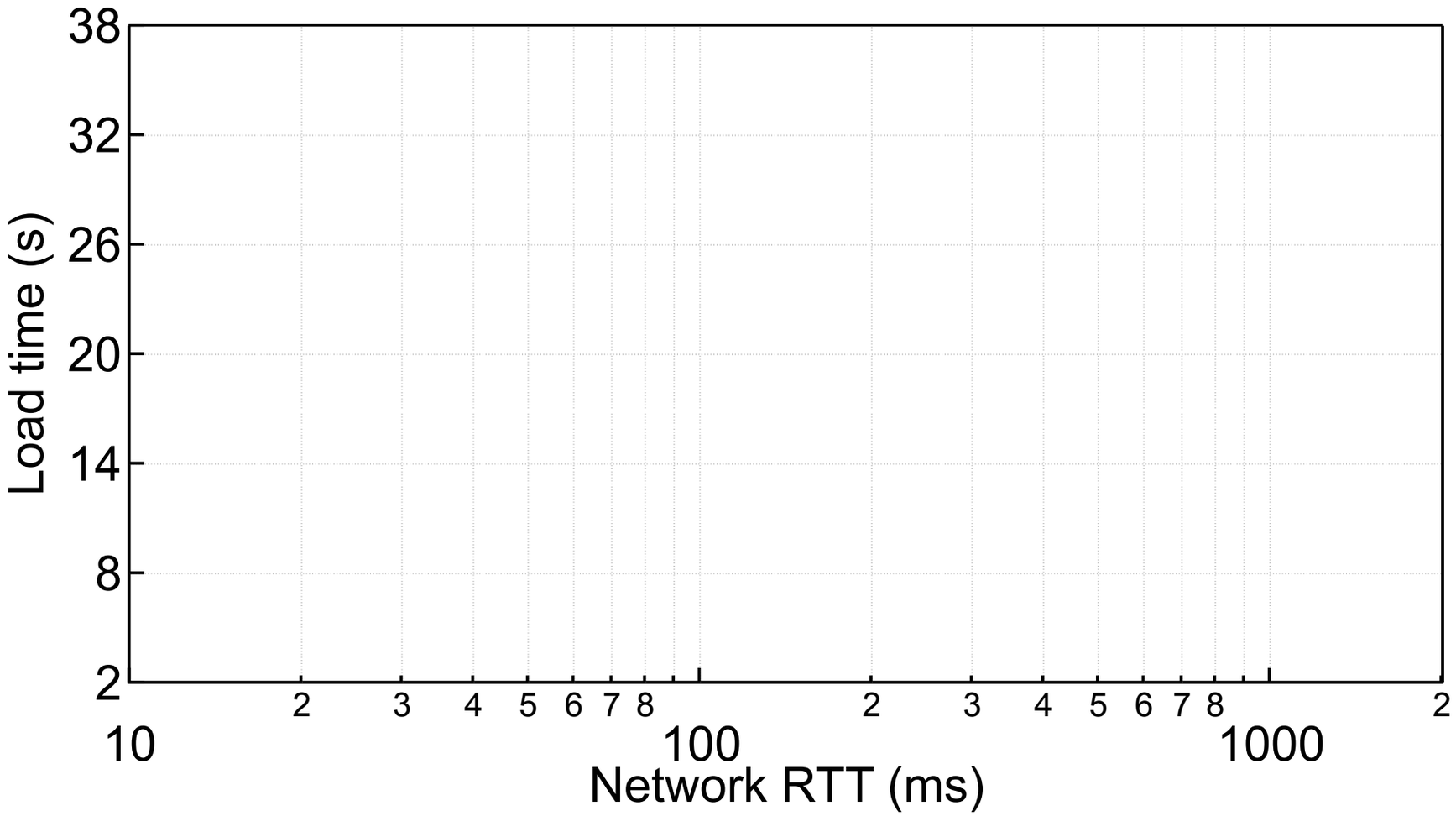

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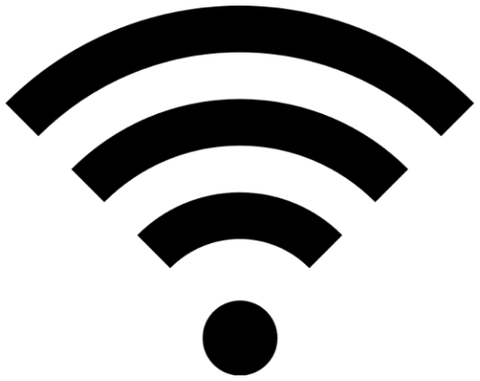

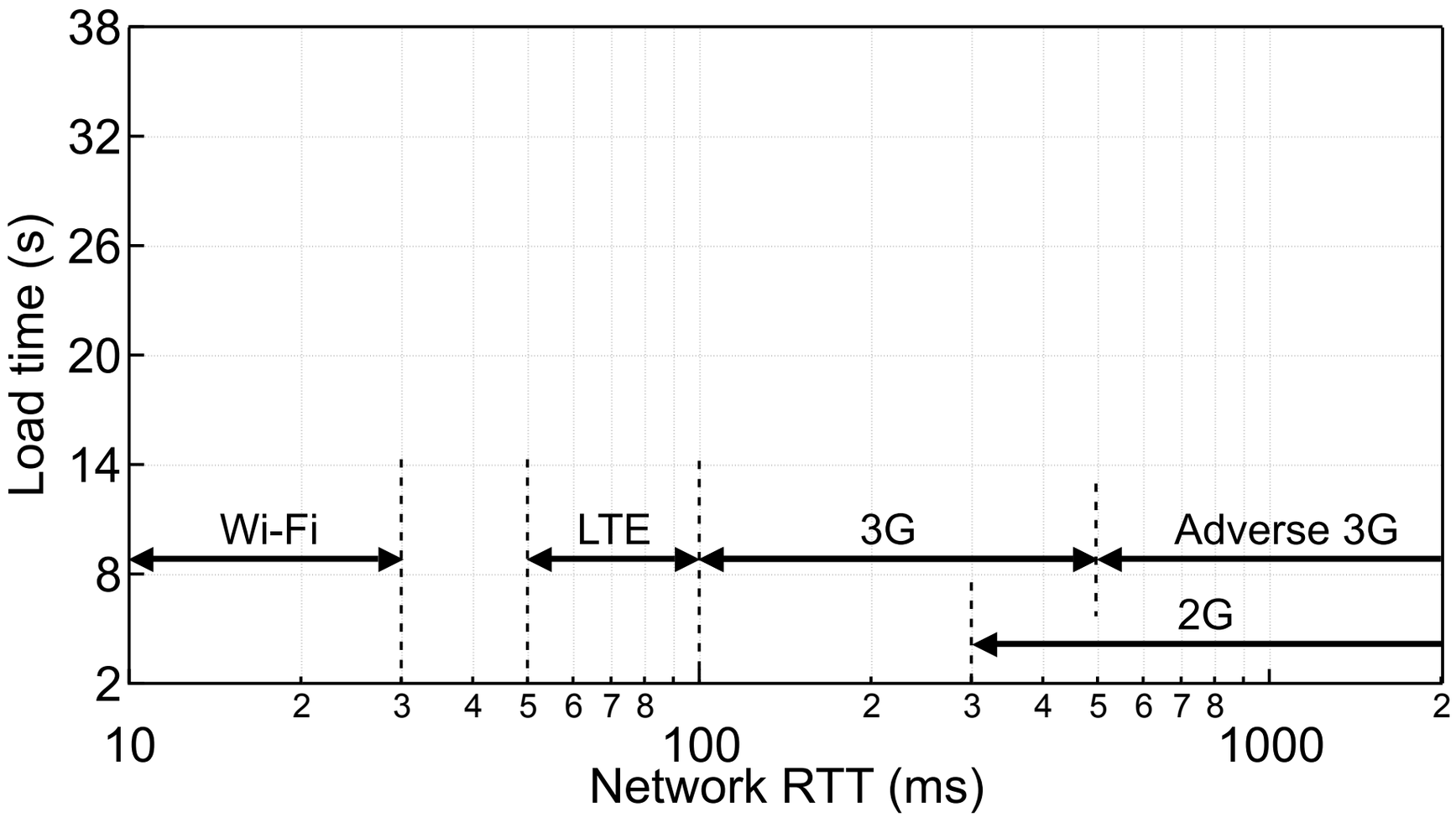

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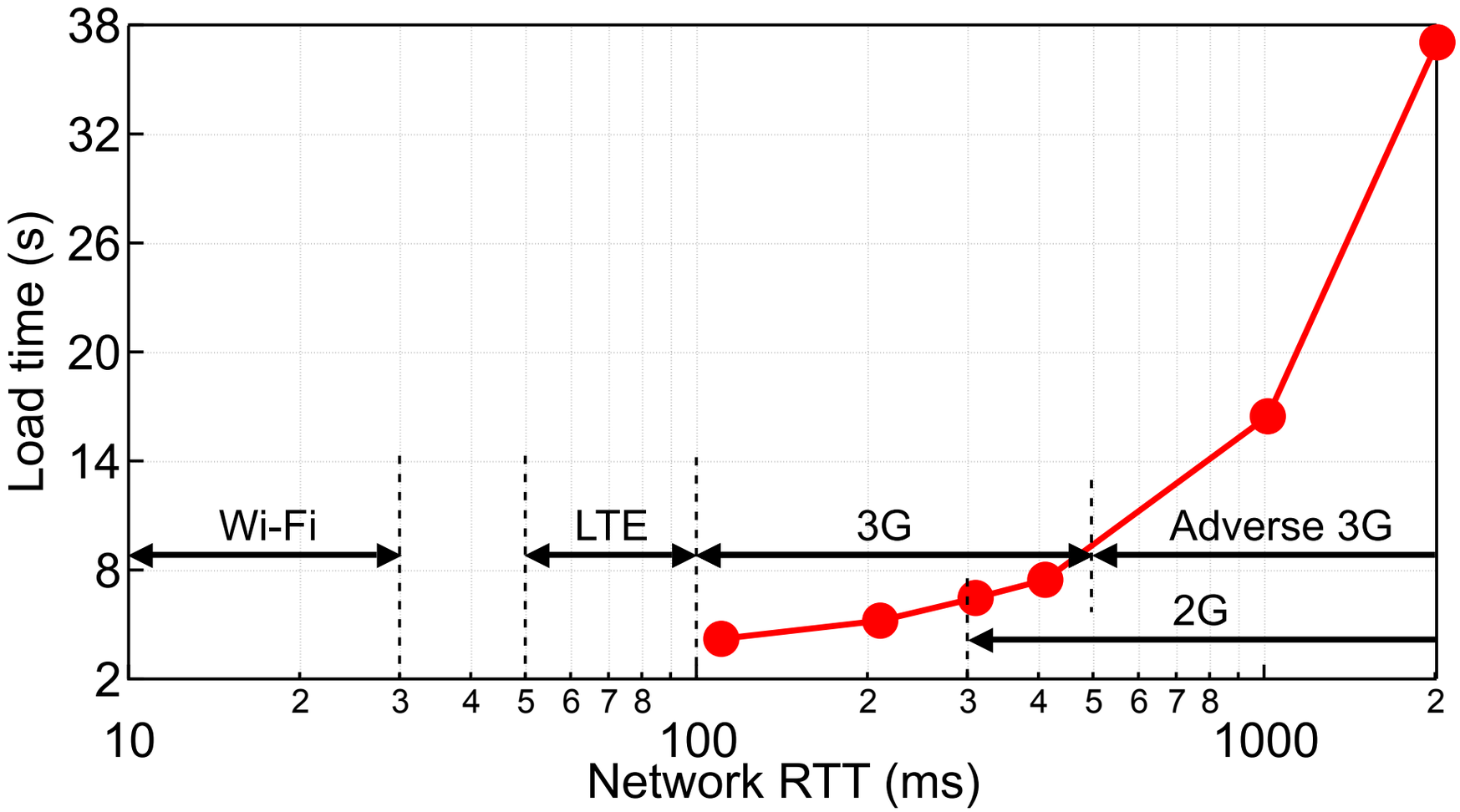

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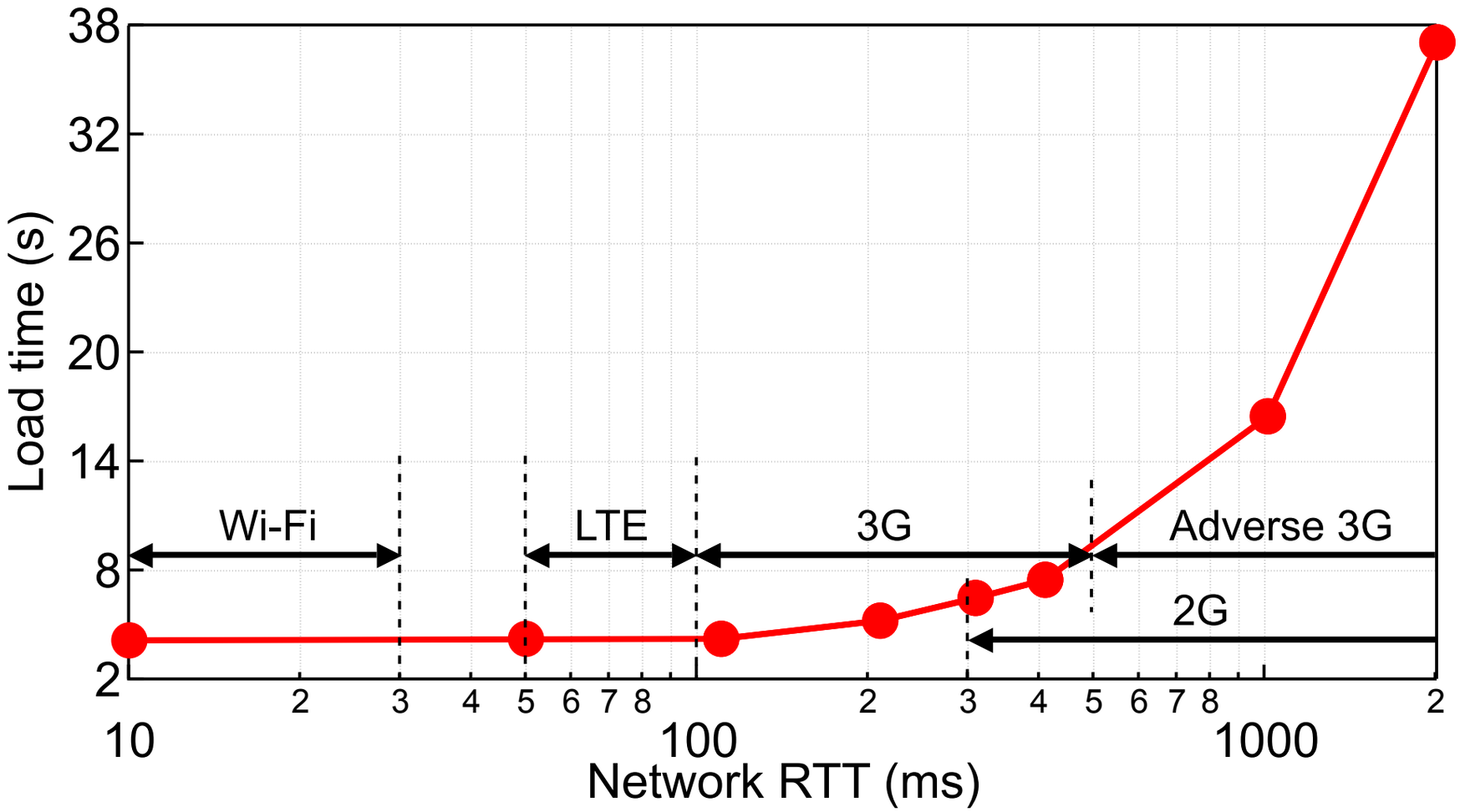

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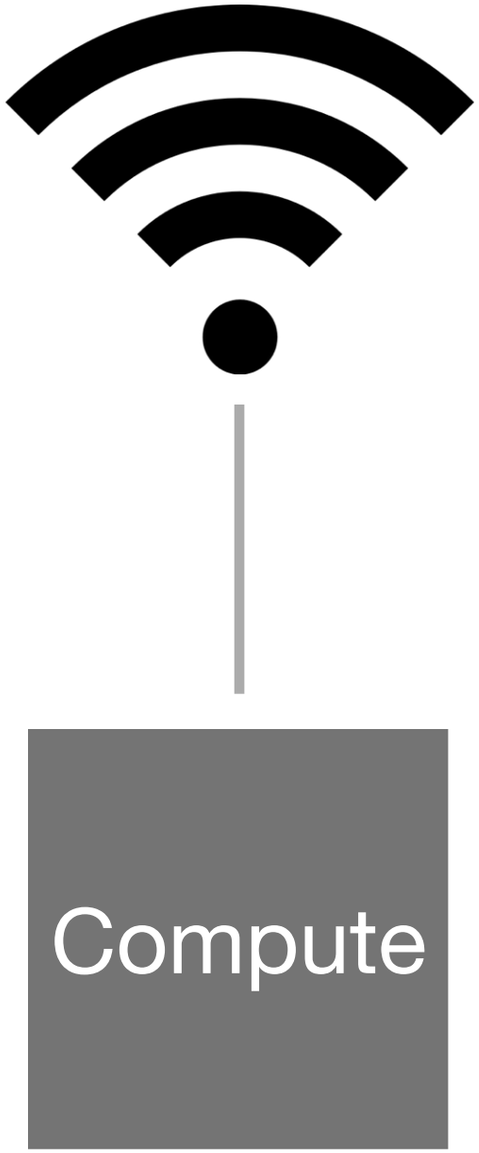
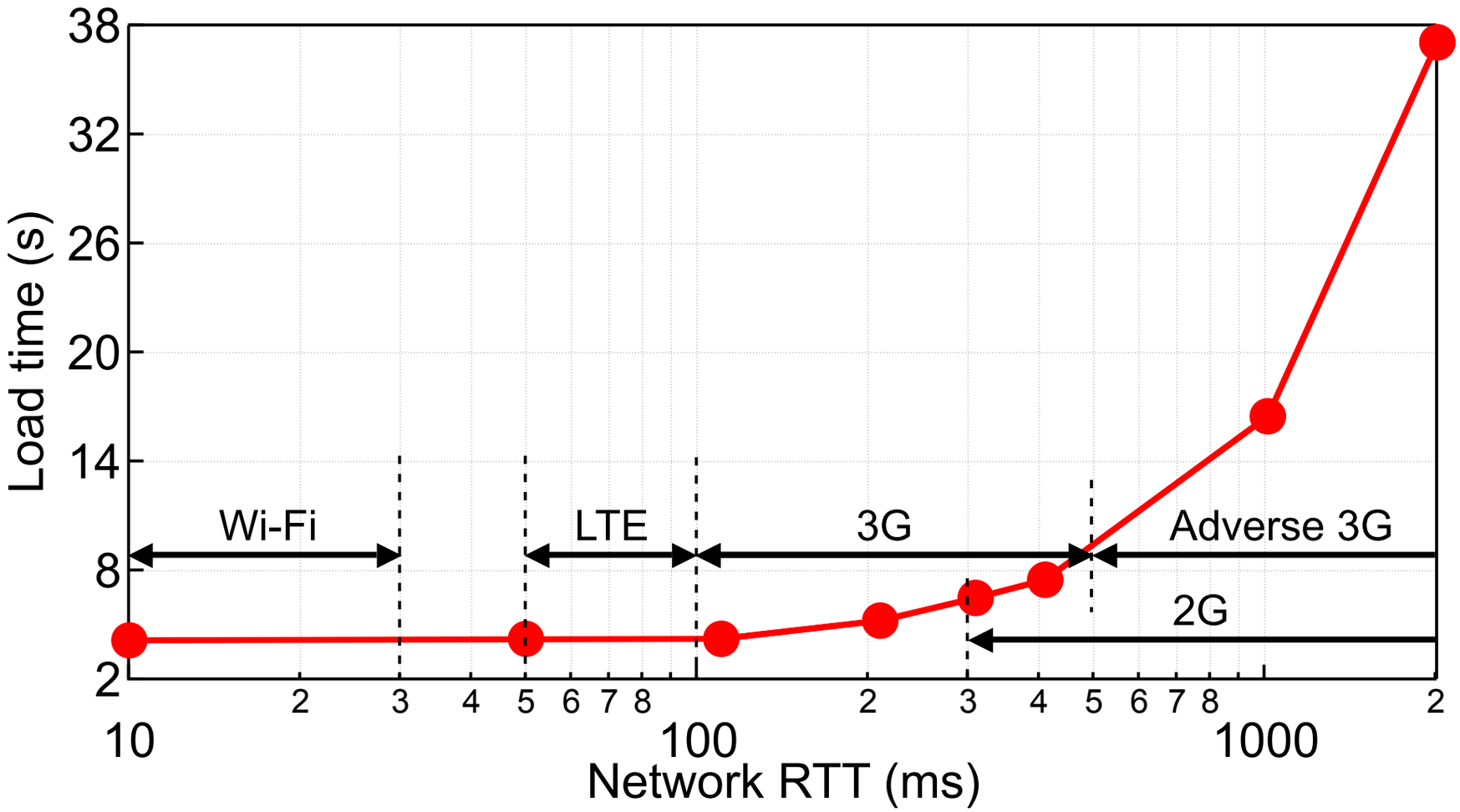


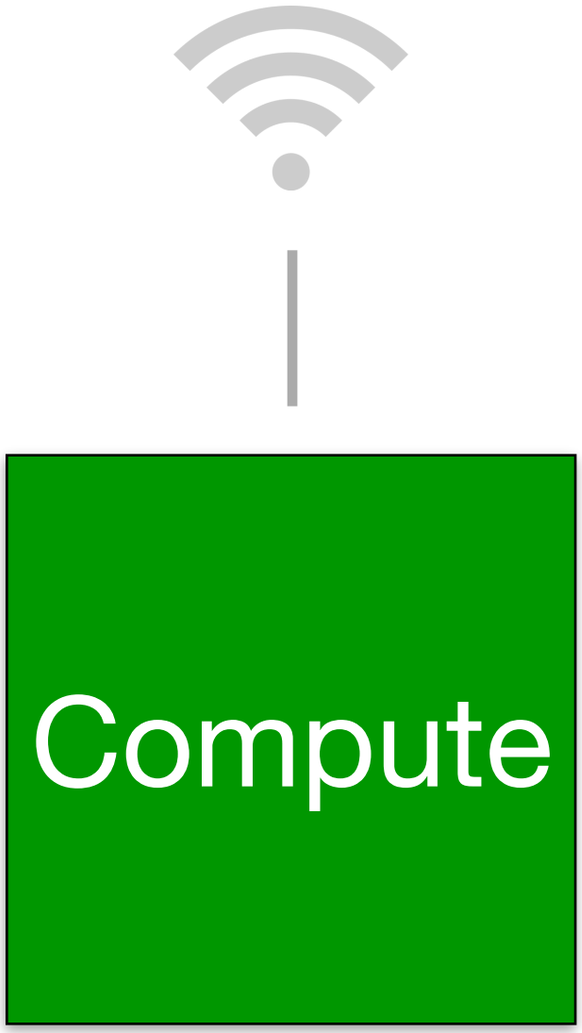
Compute

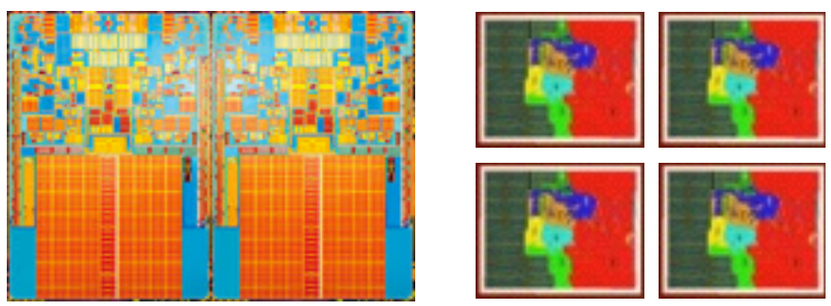


Web Browsing from a Compute Perspective

Compute

Web Browsing from a Compute Perspective





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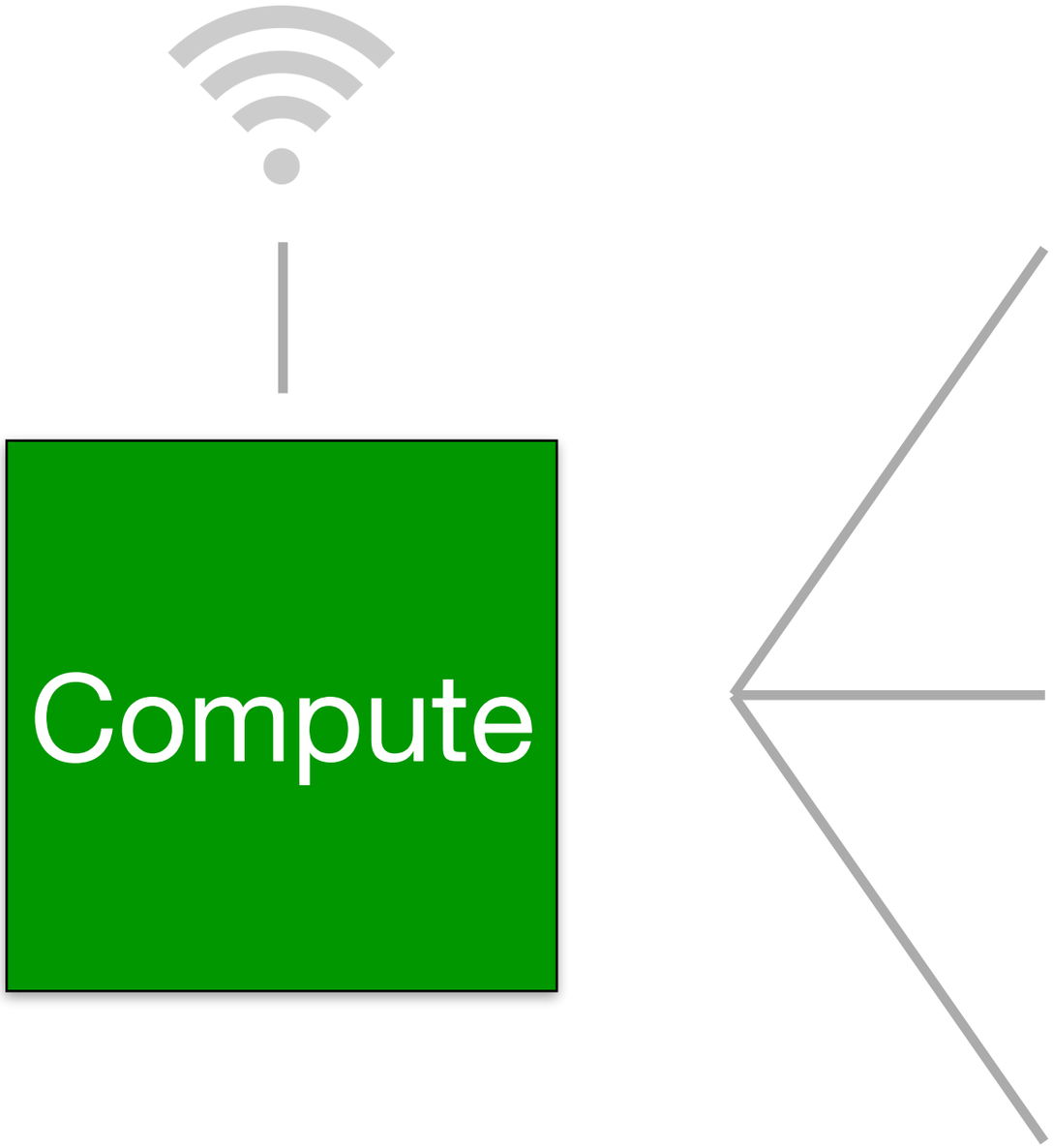

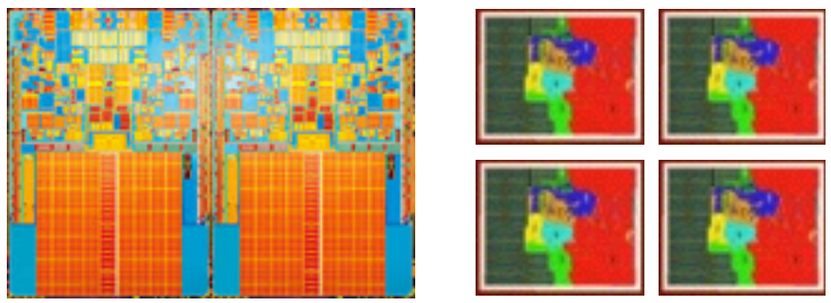

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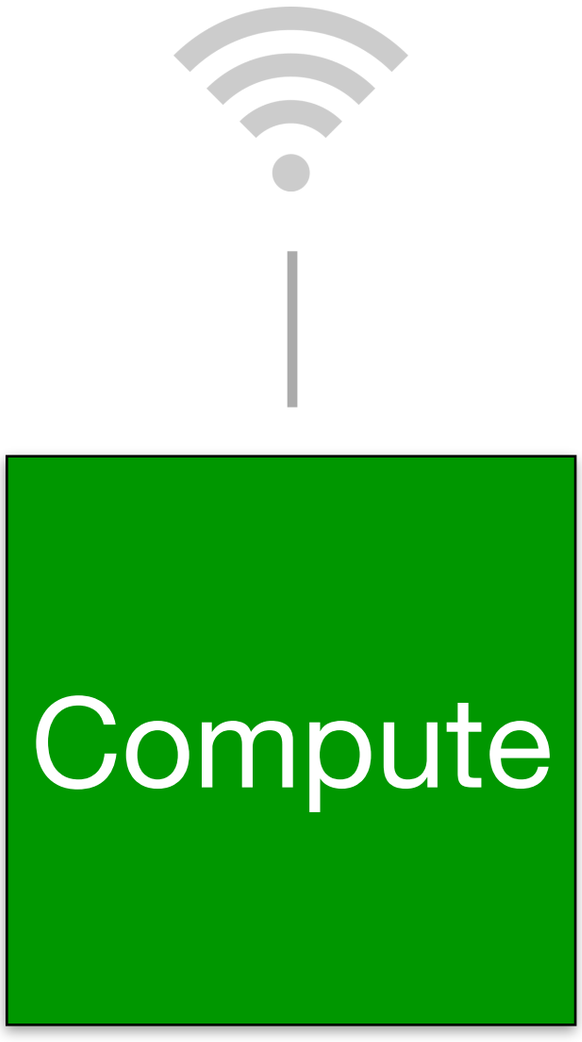

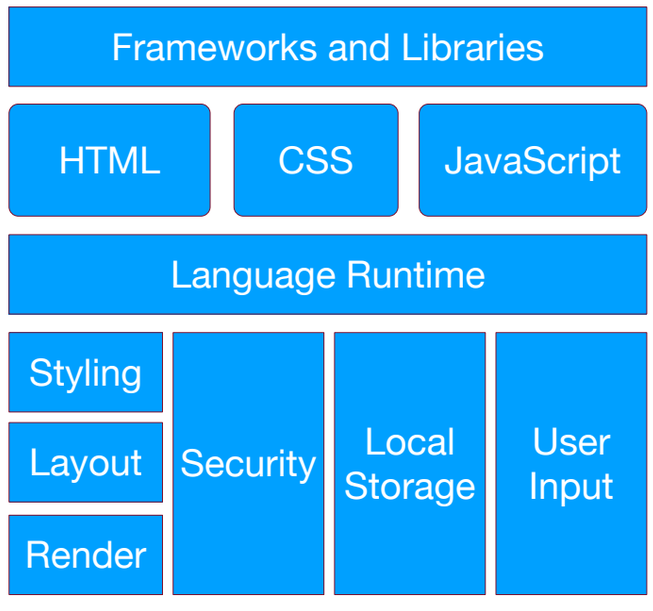

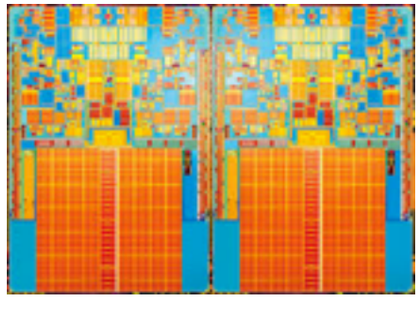

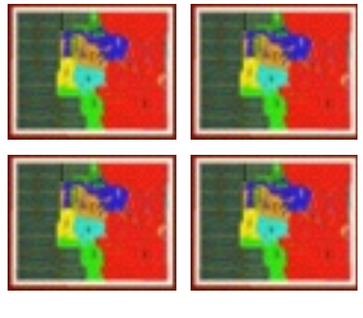

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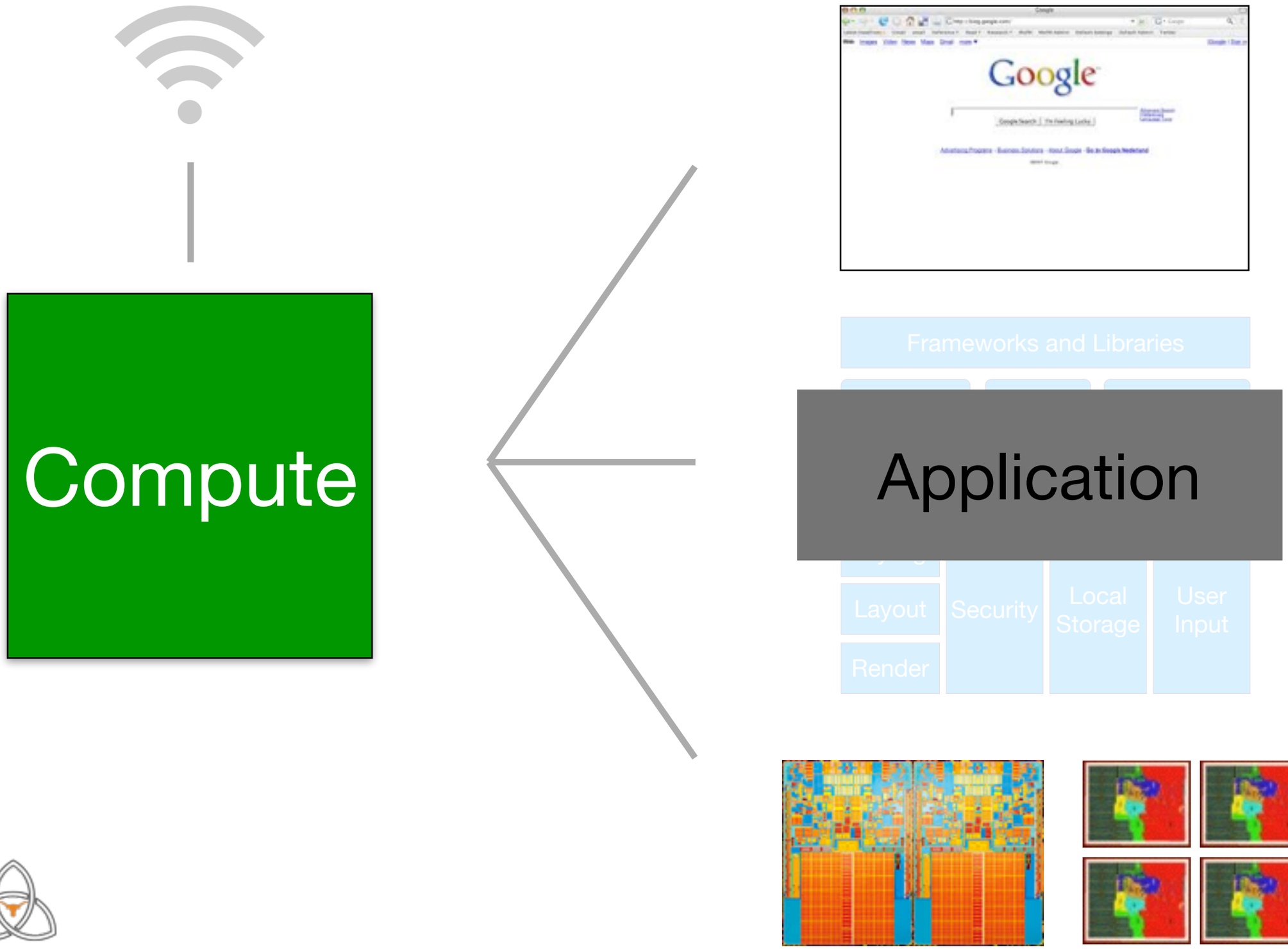

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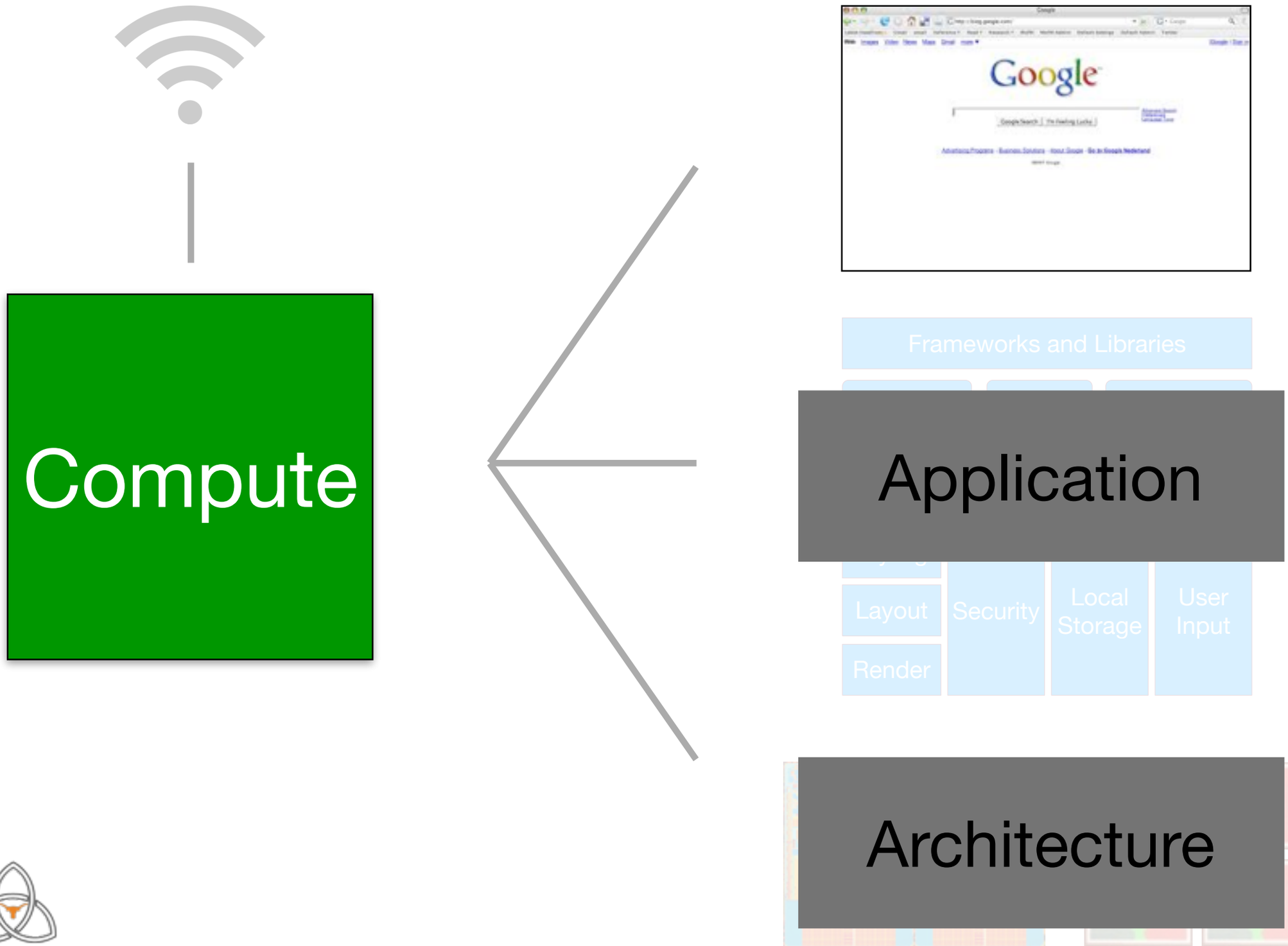

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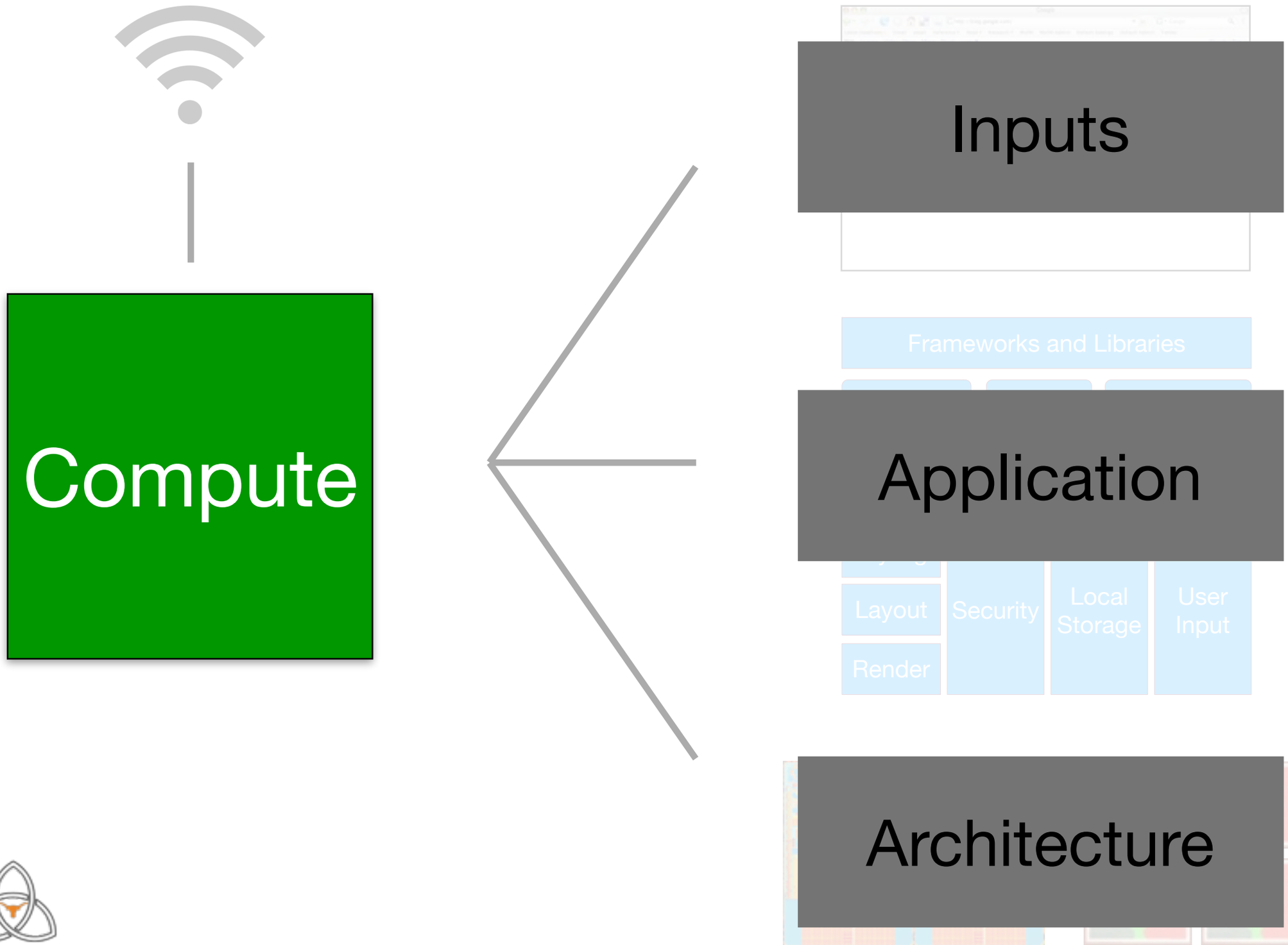

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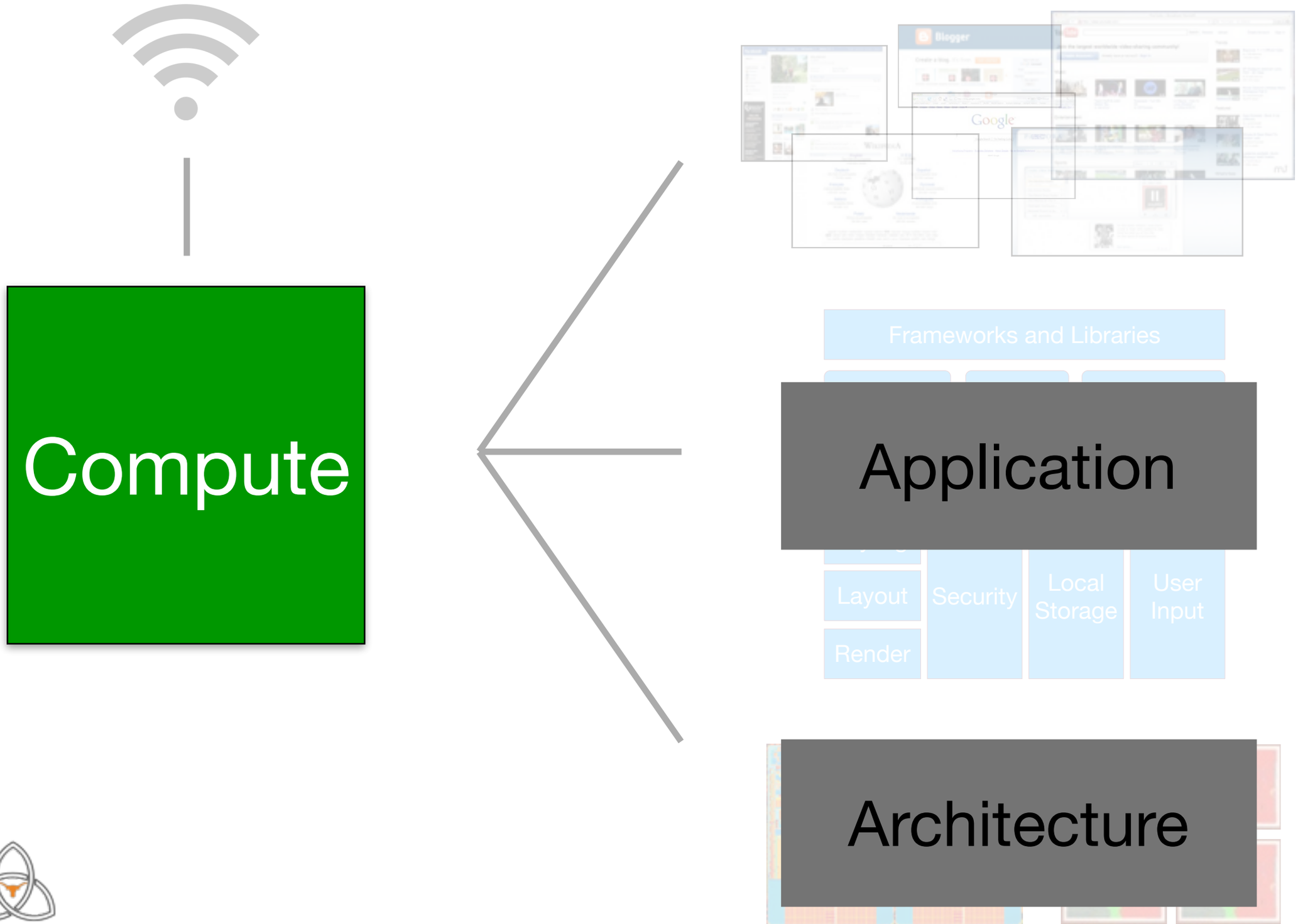

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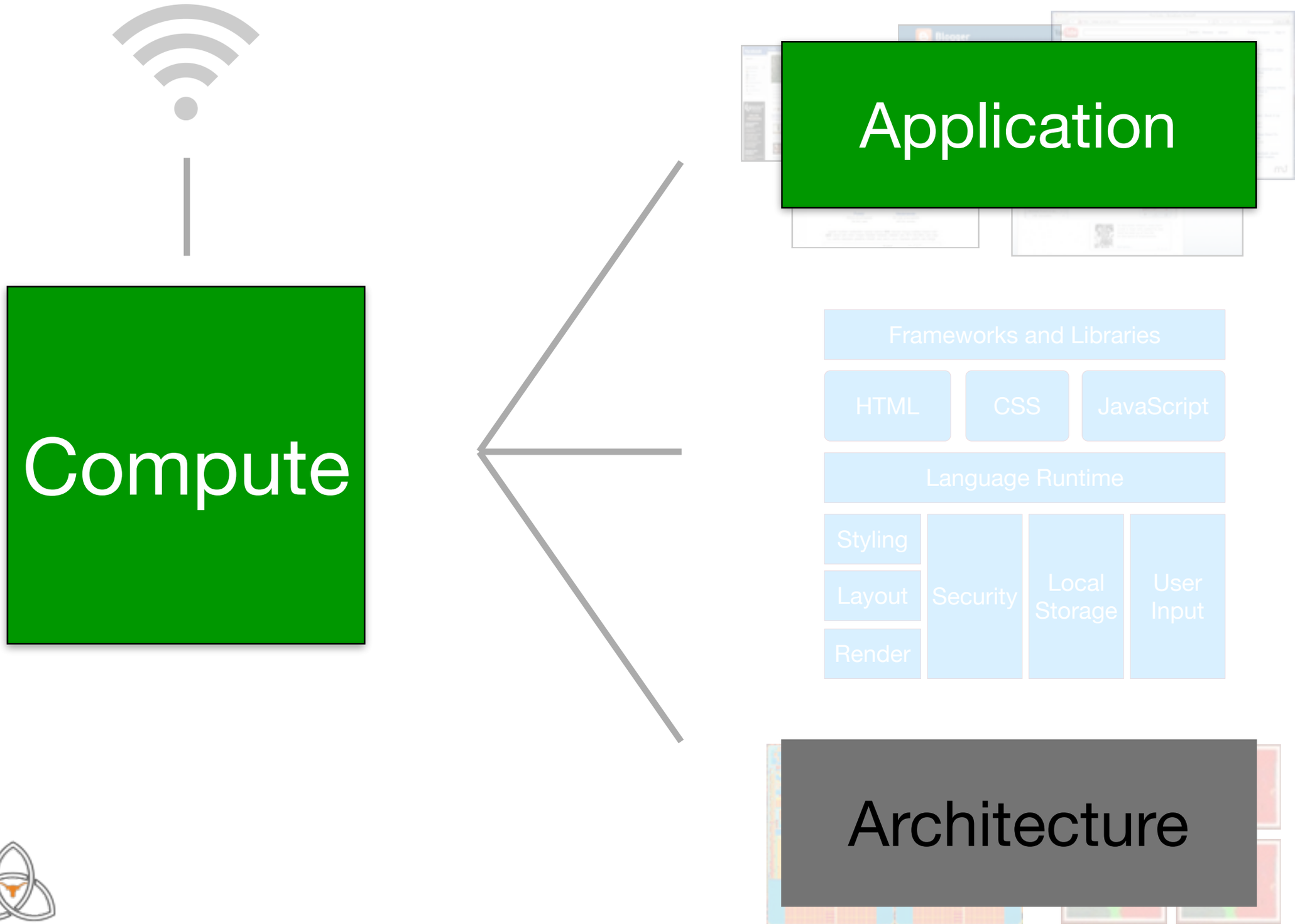

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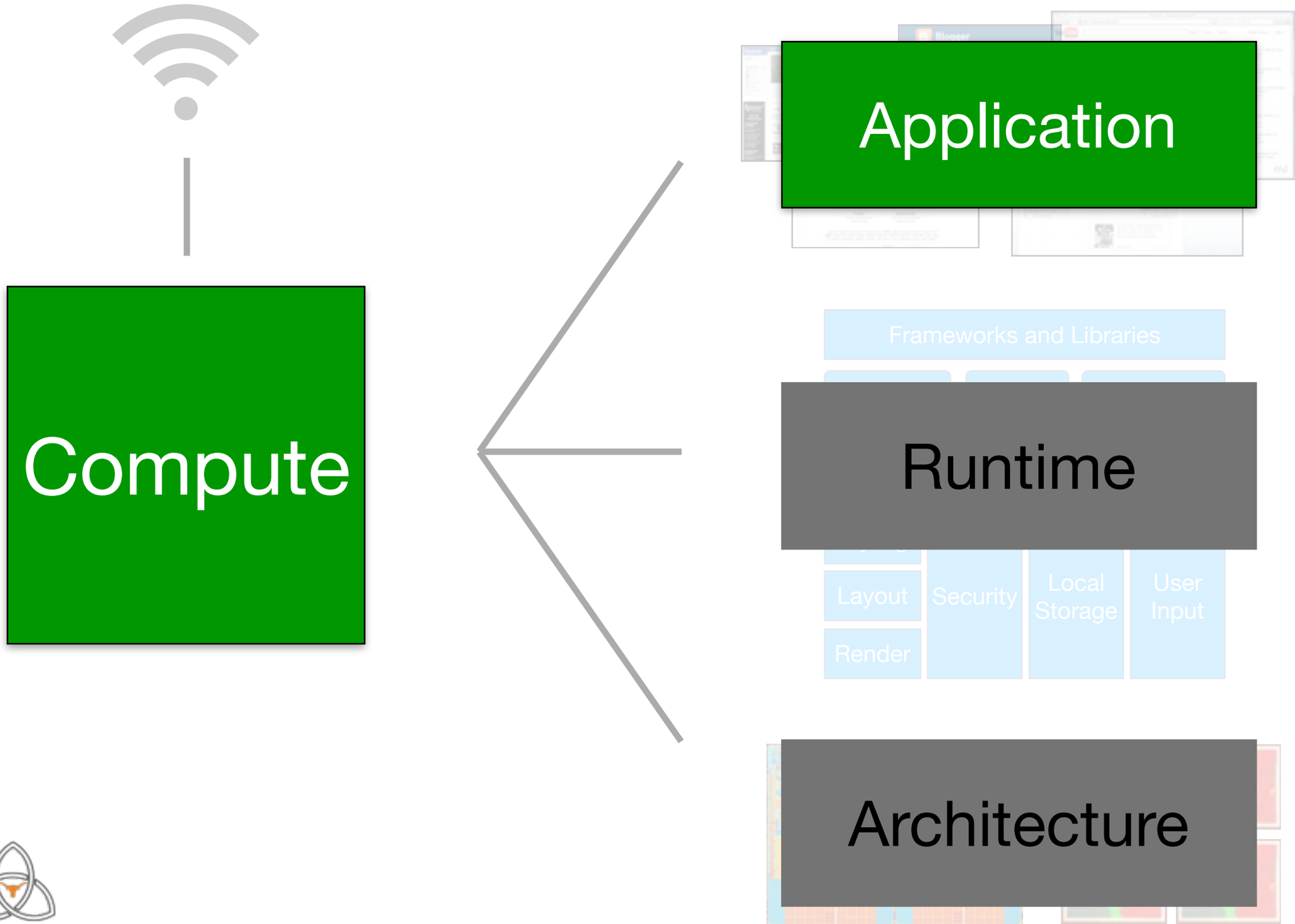
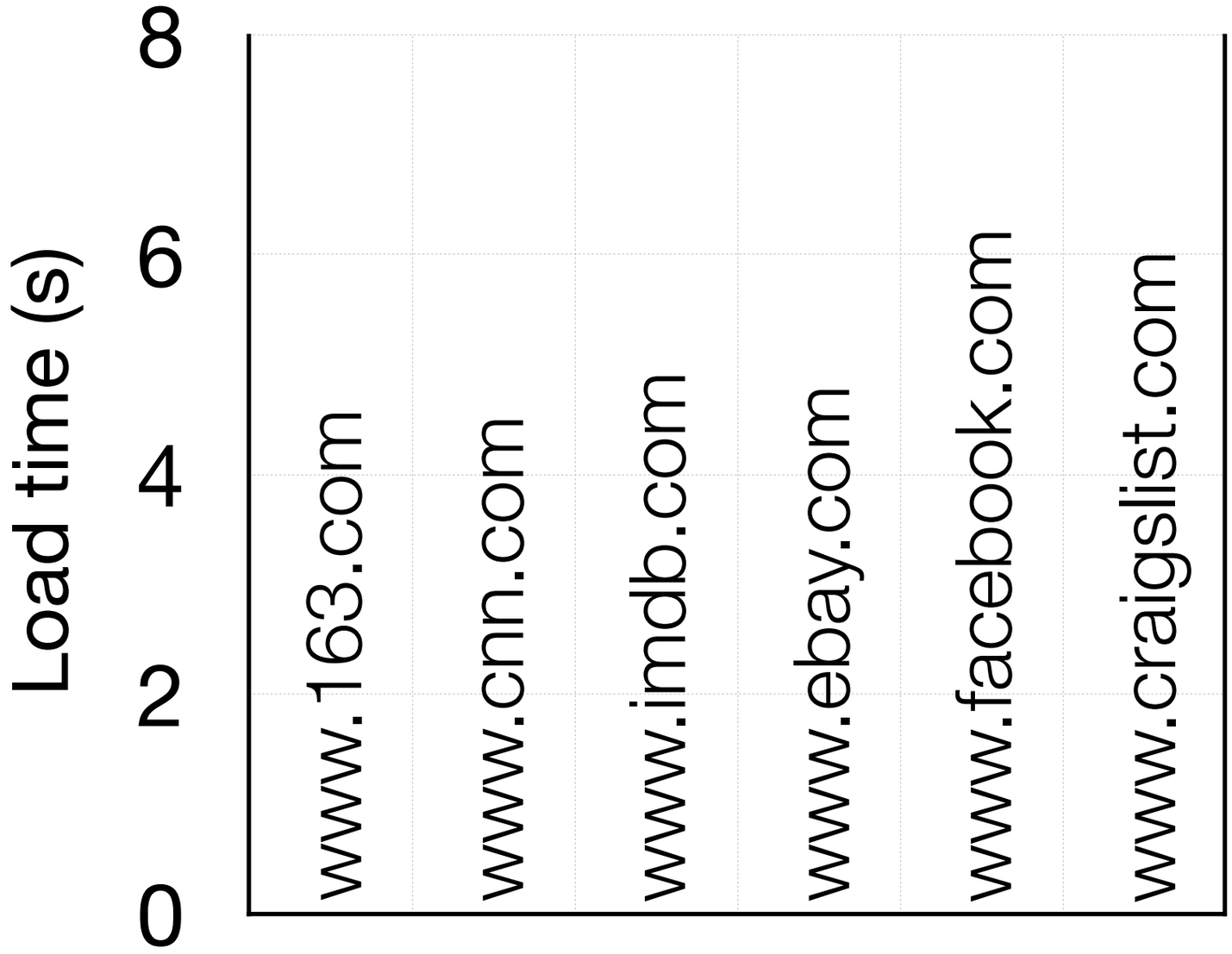


Webpage-Level Characterization



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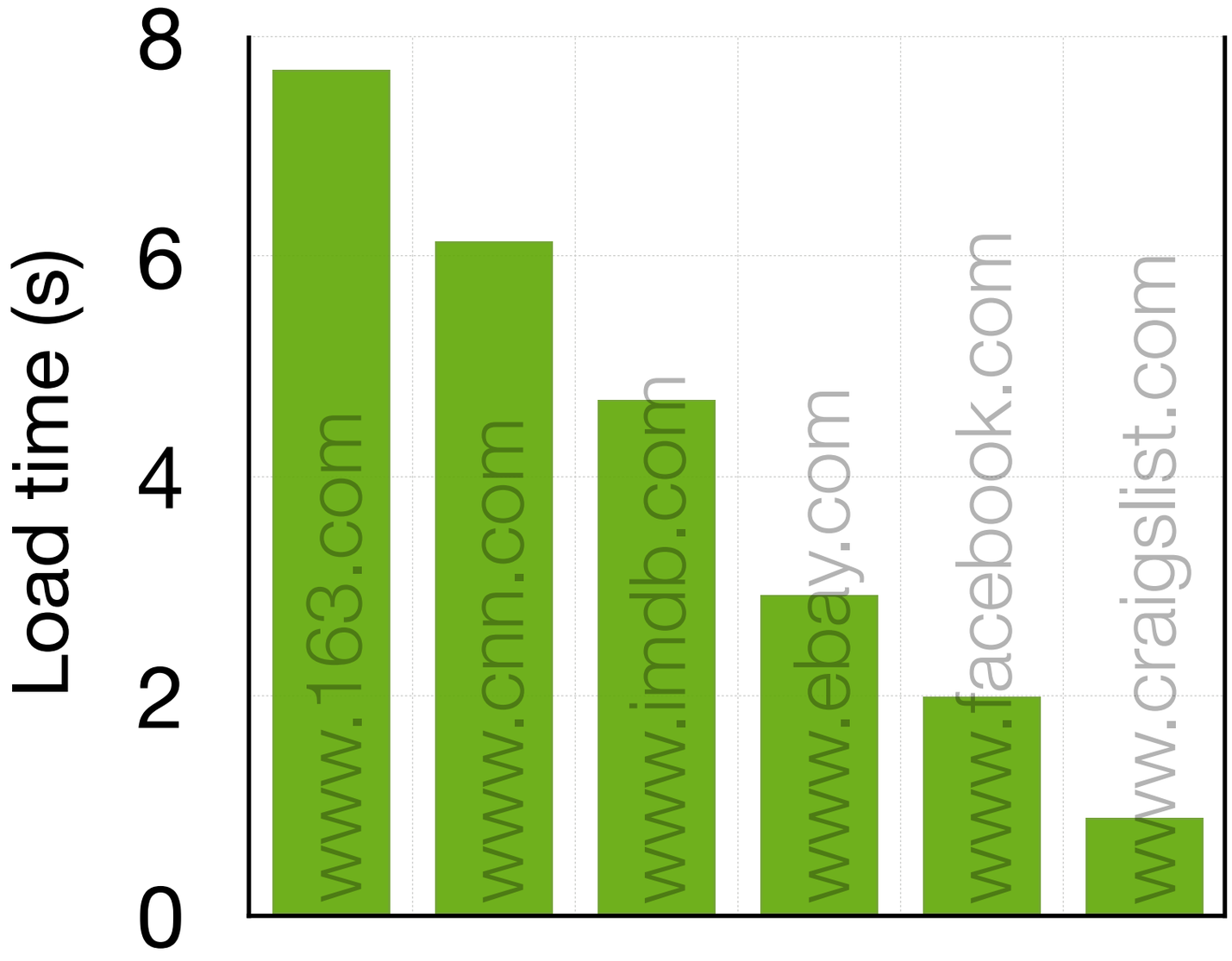

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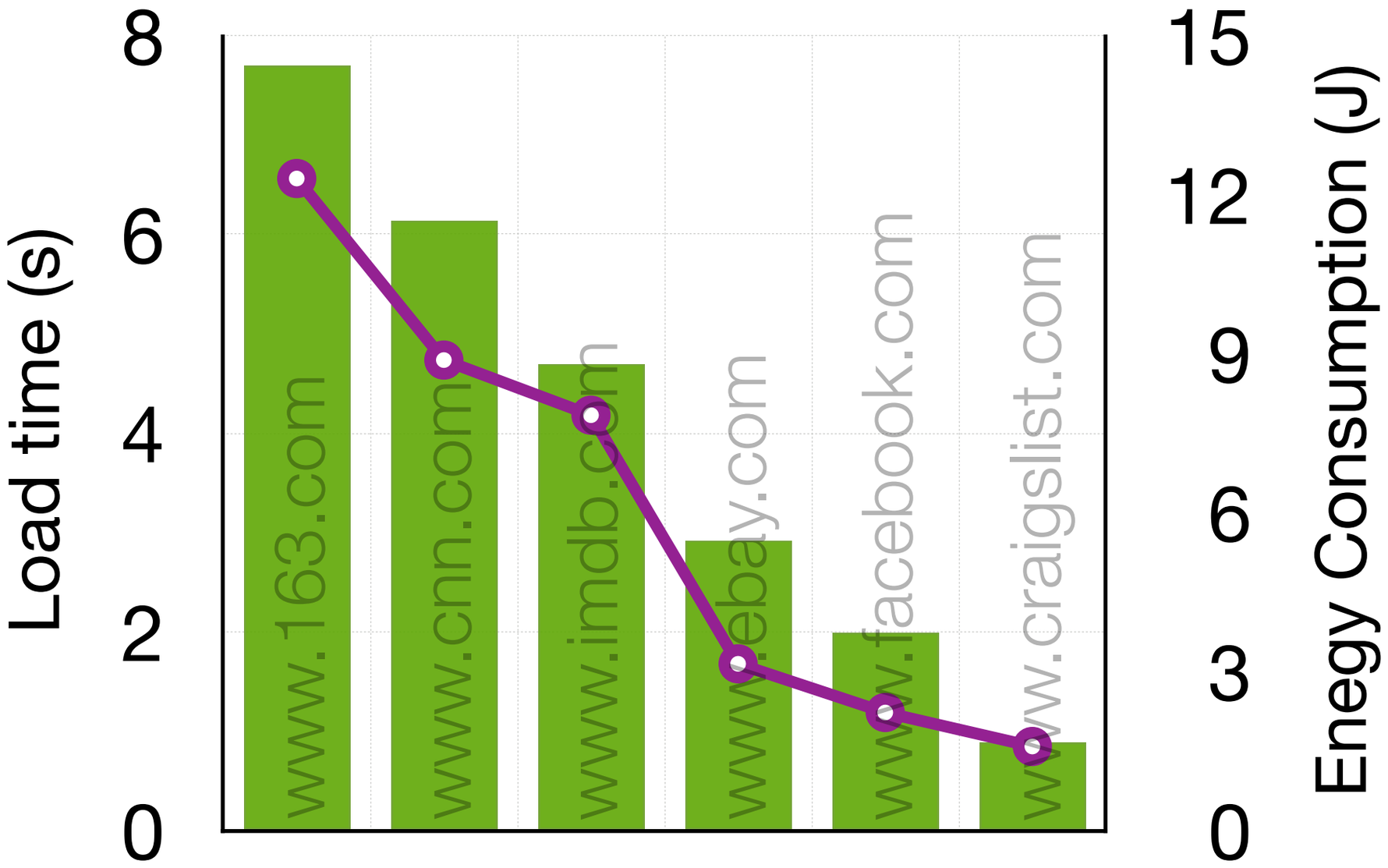

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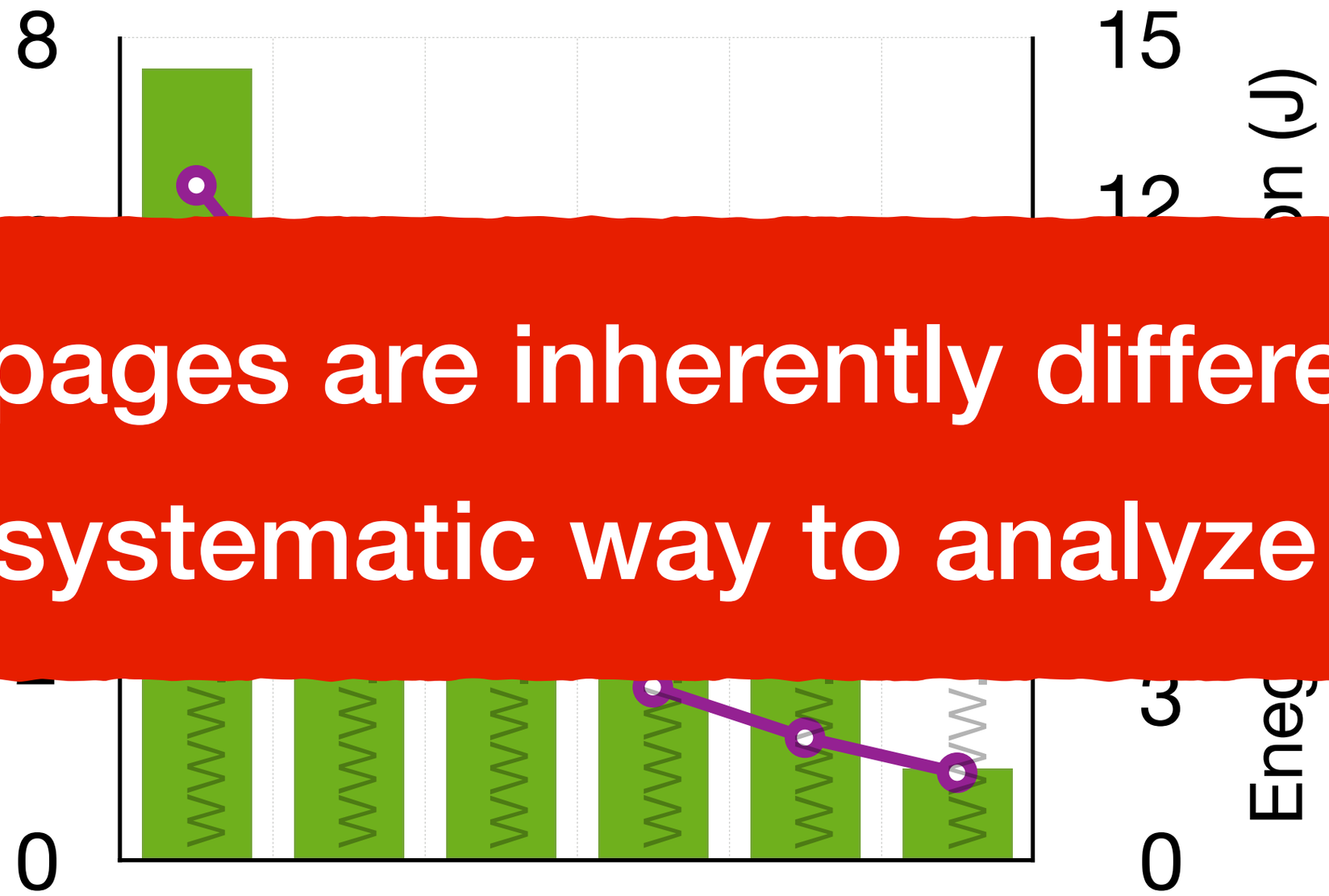


Webpages are inherently different.

Need a systematic way to analyze them.

Breaking Down the Computations

Breaking Down the Computations

HTML (Structure)

CSS (Style)

Breaking Down the Computations

HTML (Structure)

- Tag
- Attribute

CSS (Style)

Breaking Down the Computations

HTML (Structure)

Tag

Attribute

```
<input value="hpca2015">
```

CSS (Style)

Breaking Down the Computations

HTML (Structure)

Tag

Attribute

```
<input value="hpca2015">
```

CSS (Style)

Selector

Property

Breaking Down the Computations

HTML (Structure)

Tag

Attribute

```
<input value="hpca2015">
```

CSS (Style)

Selector

Property

```
input {font-style: italic}
```

Breaking Down the Computations

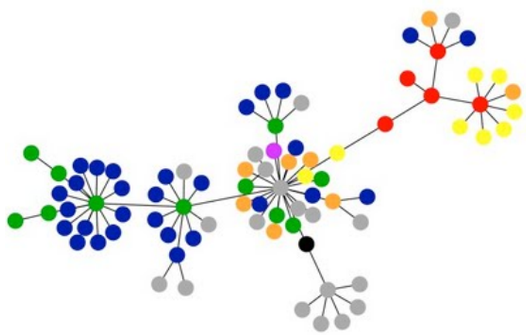
HTML (Structure)

Tag

Attribute

<input value="hpca2015">

DOM Tree



CSS (Style)

Selector

Property

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Breaking Down the Computations

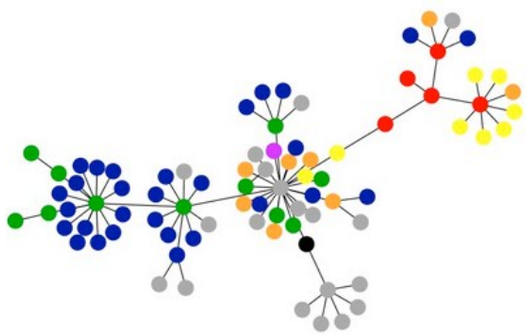
HTML (Structure)

Tag

Attribute

<input value="hpca2015">

DOM Tree



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Selector

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HTML Tag Analysis

www.163.com

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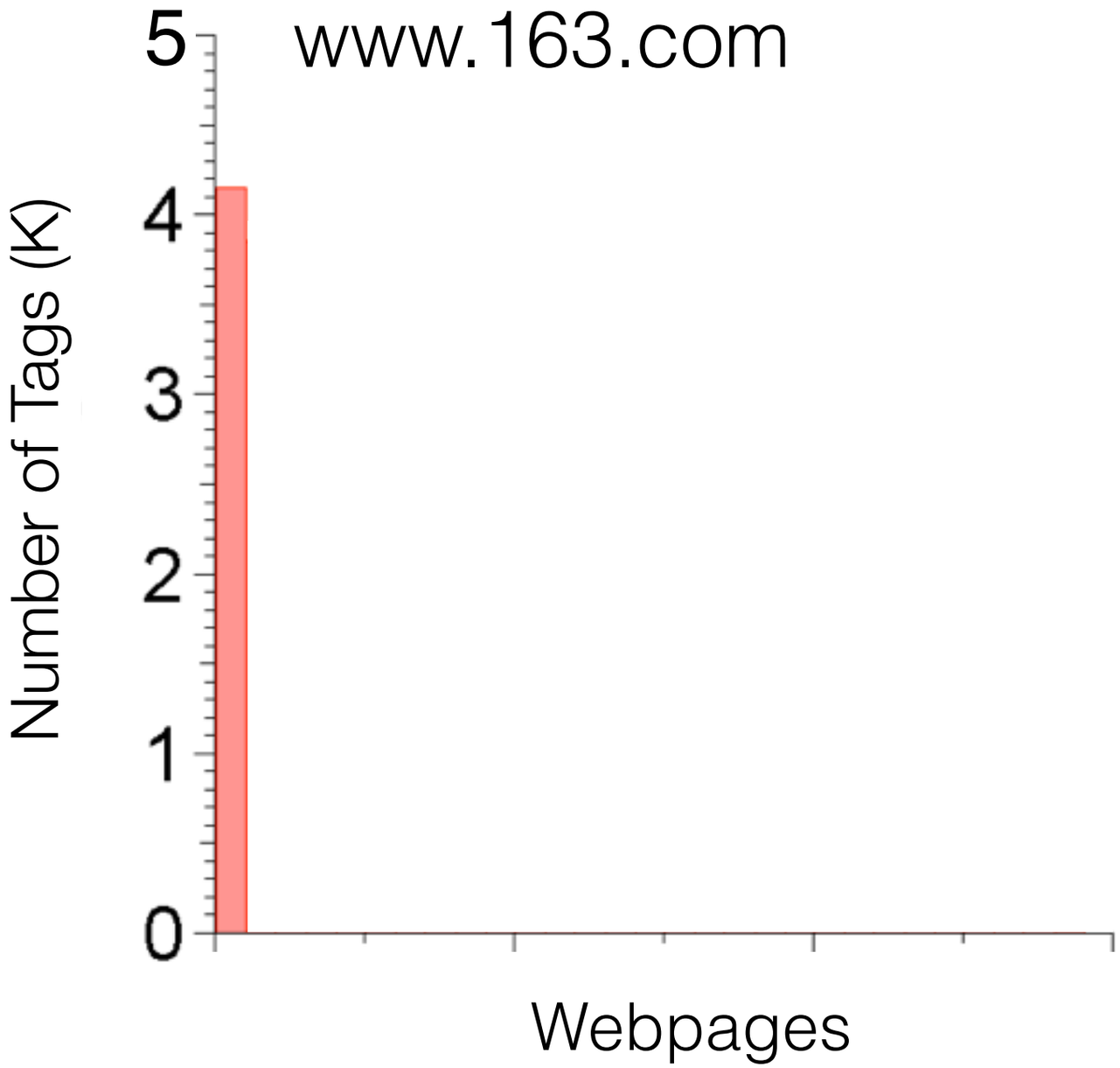

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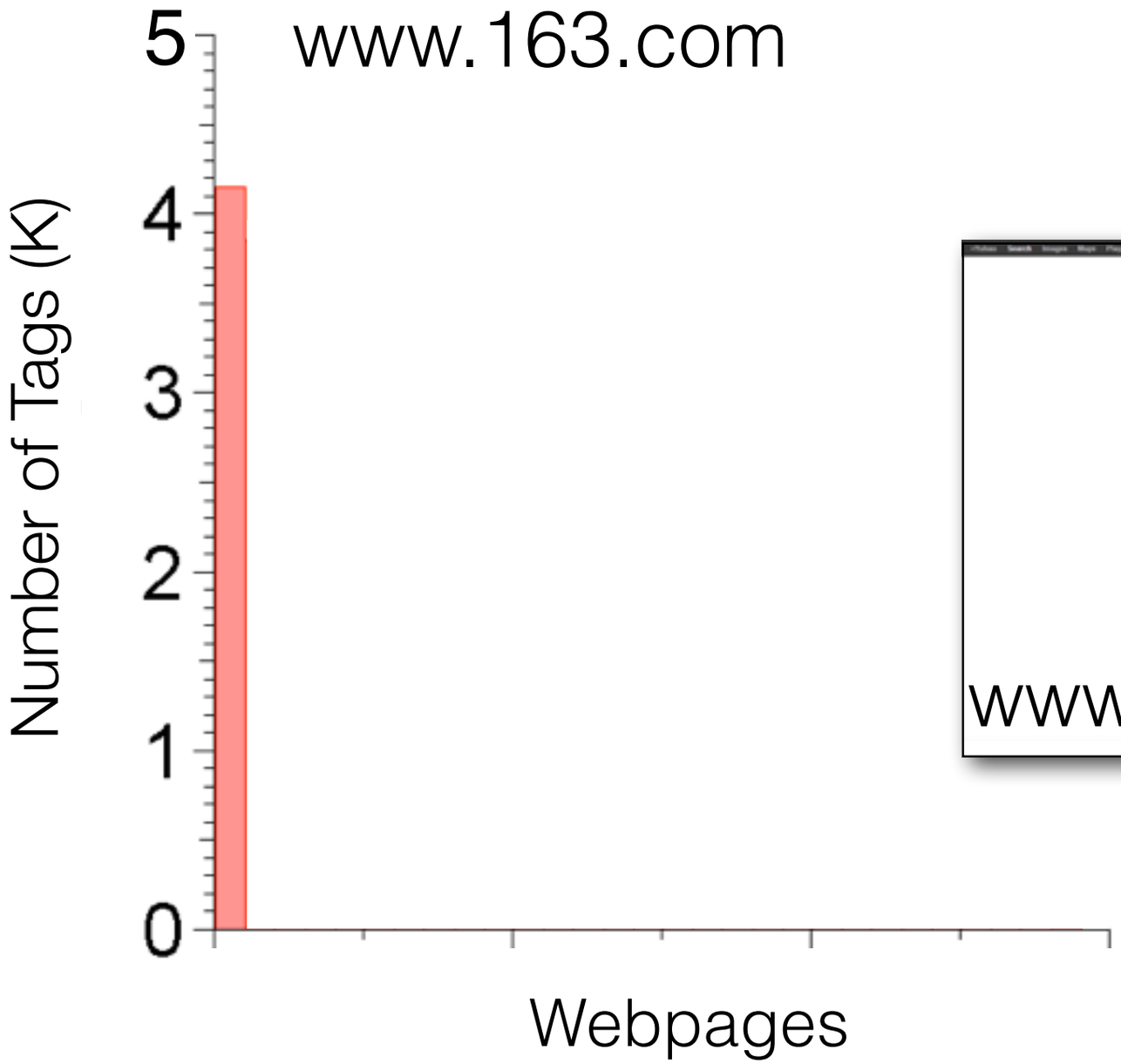
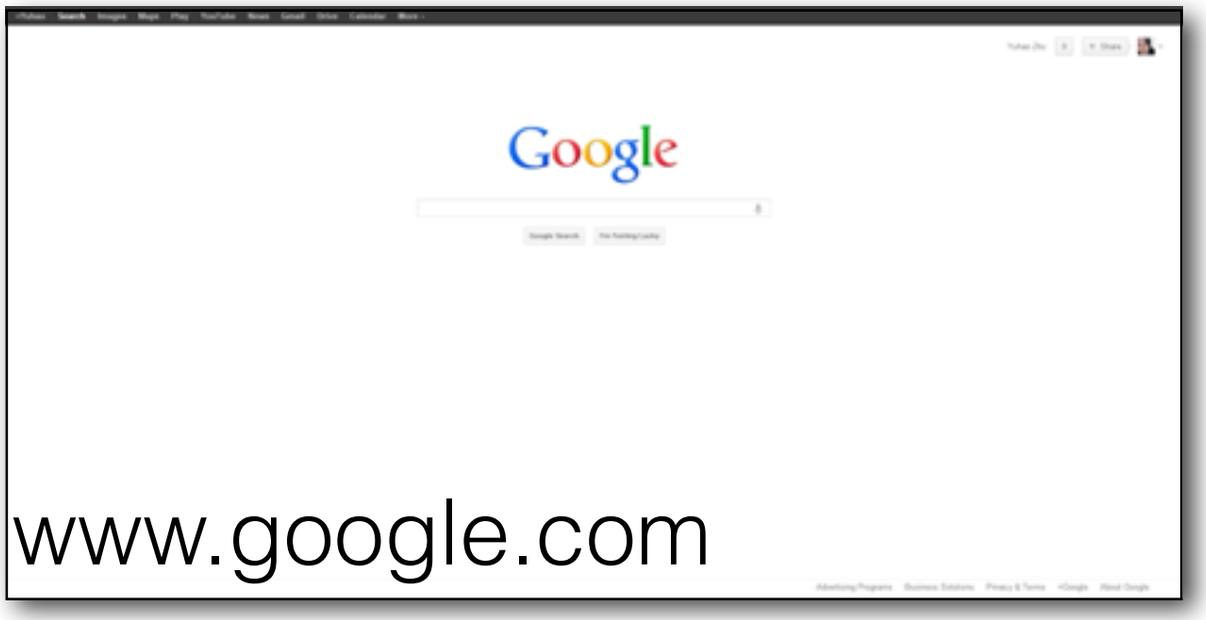
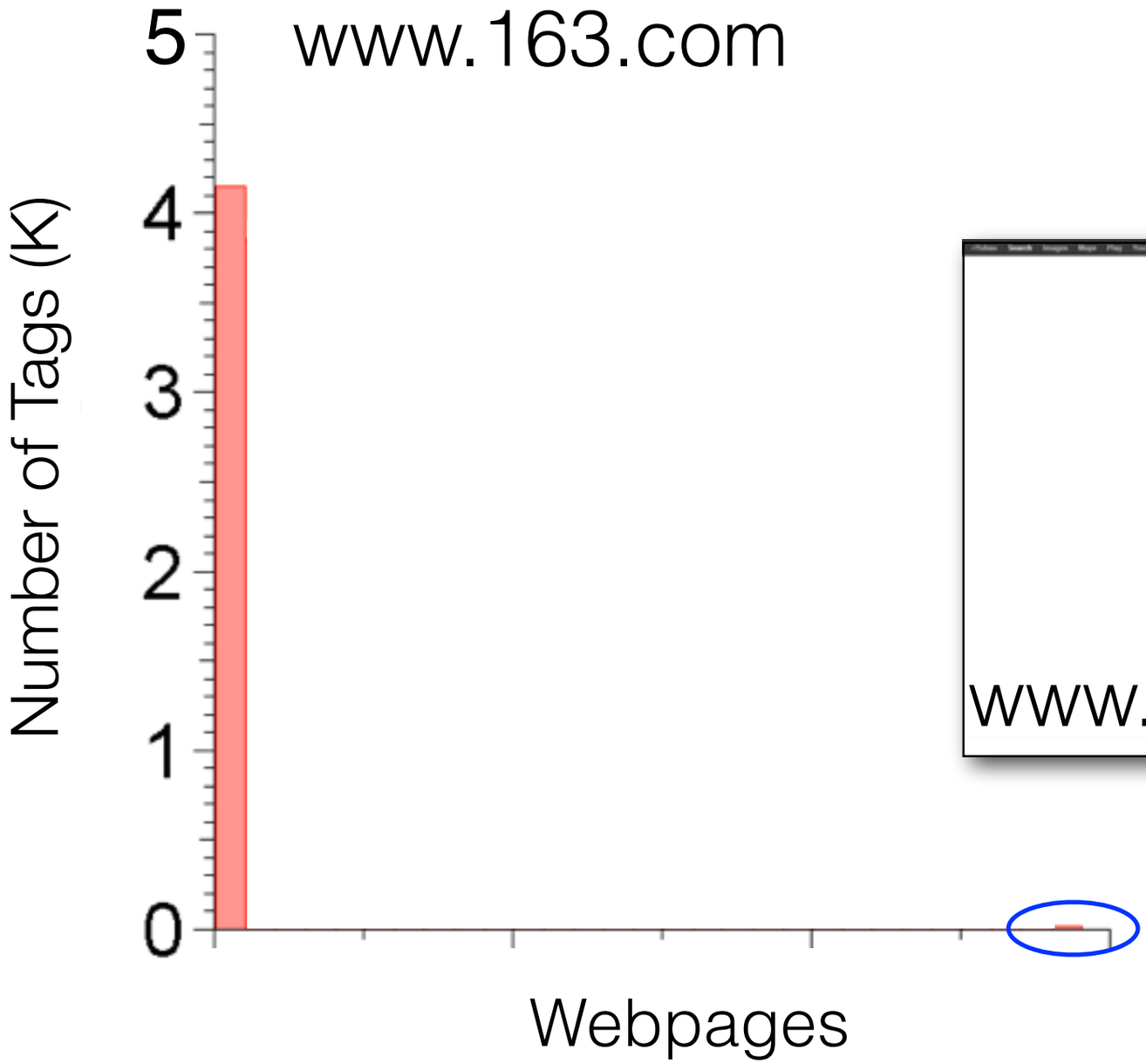




www.google.com

HTML Tag Analysis



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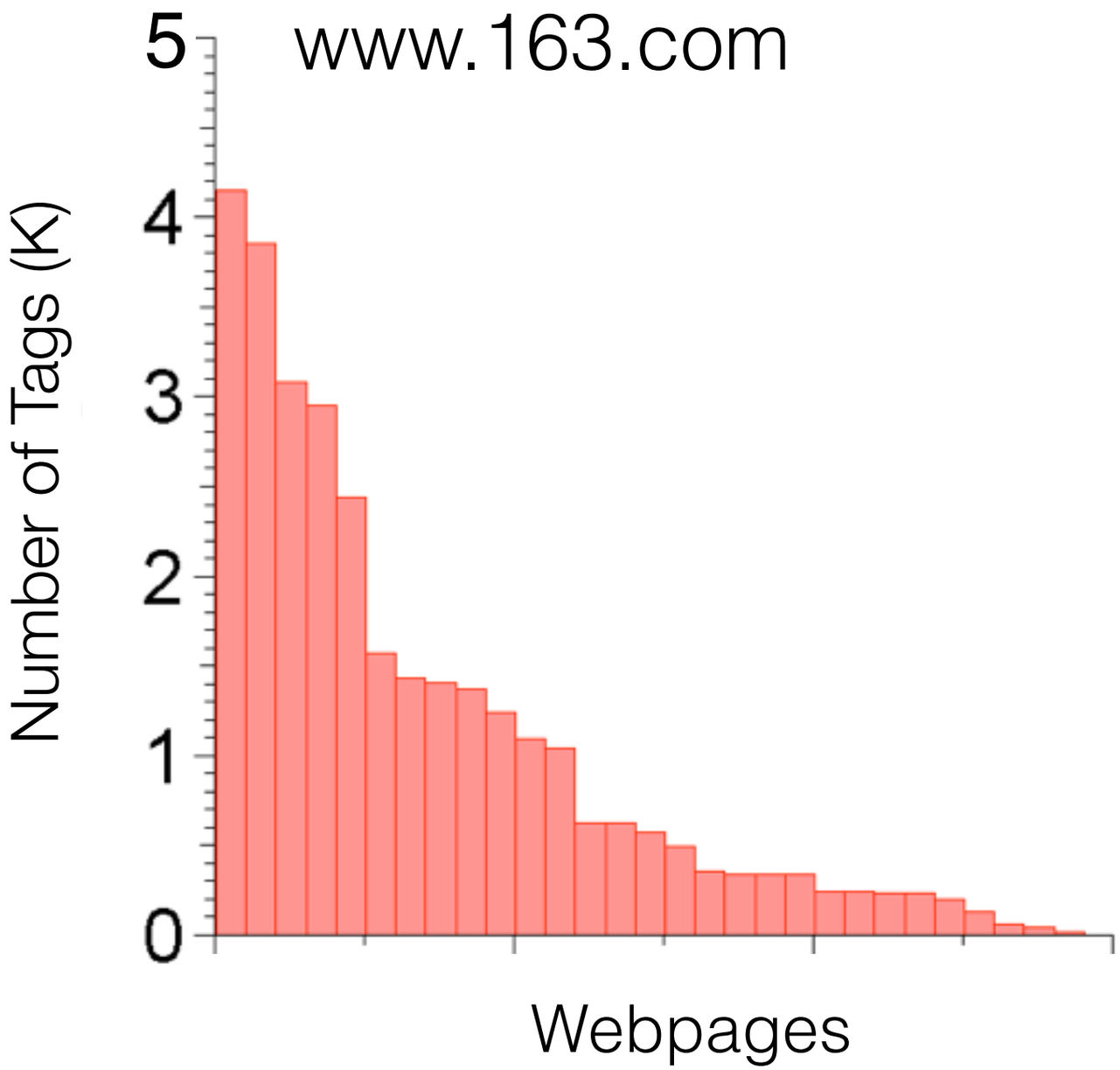

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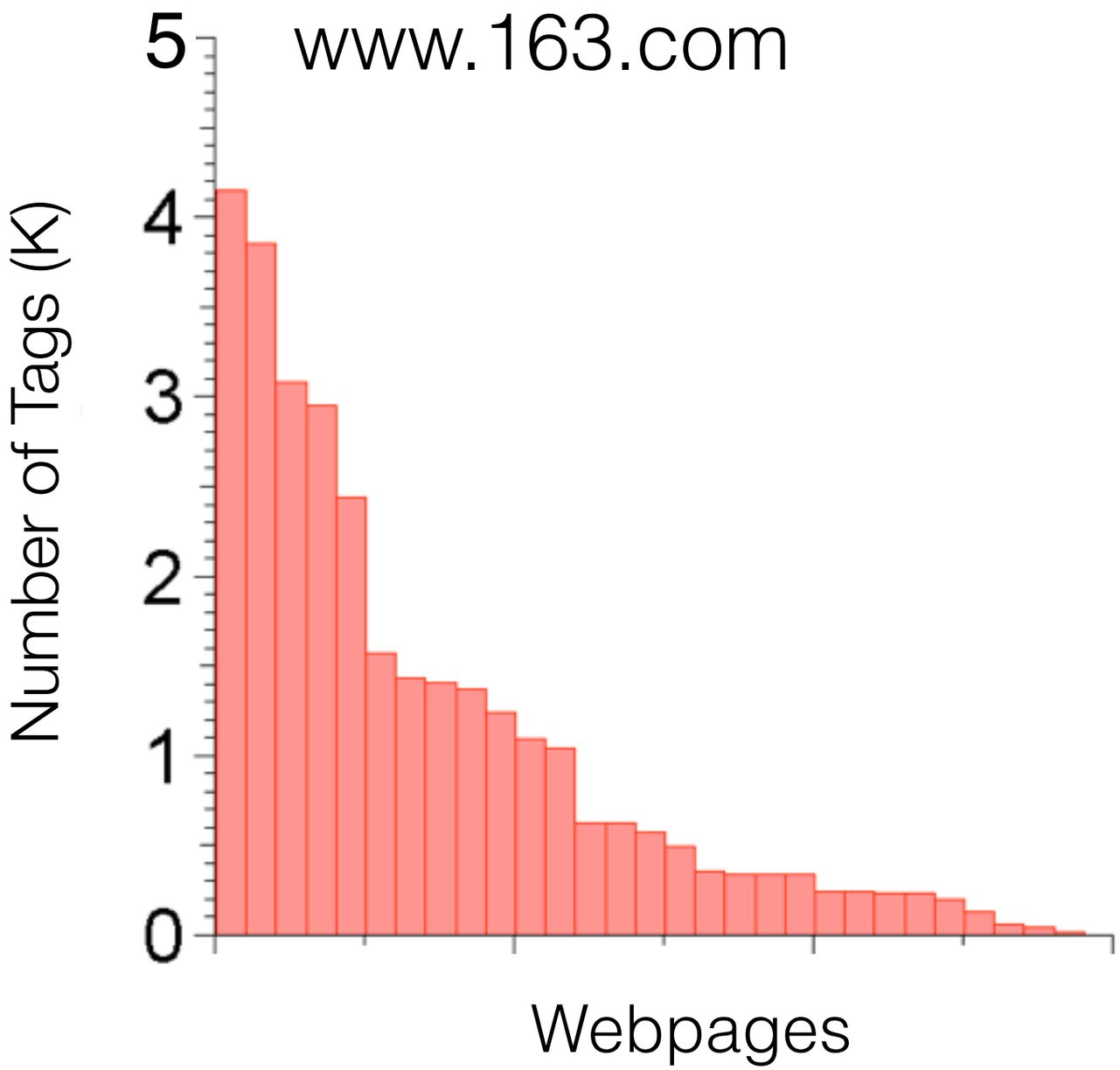
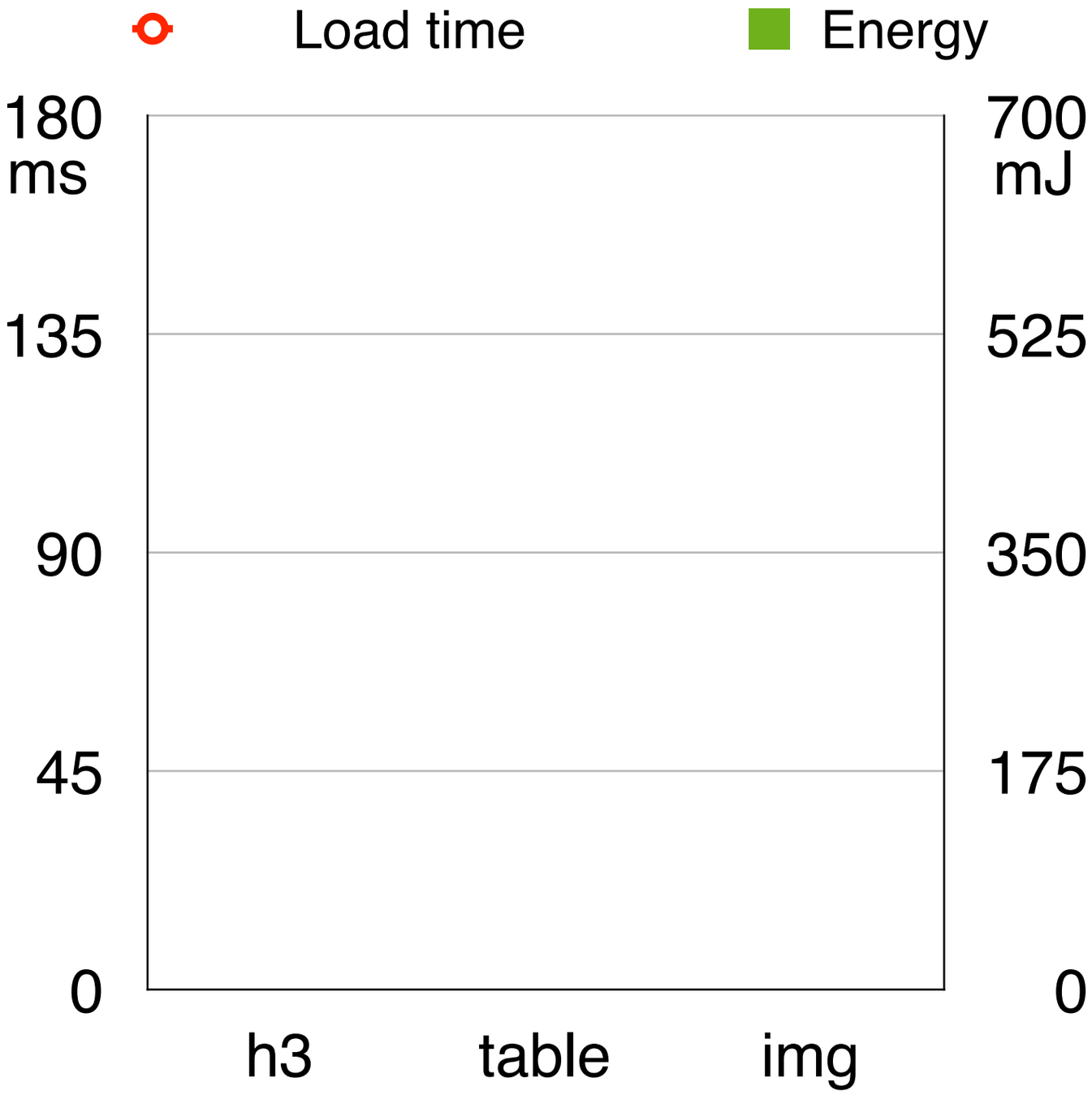


Webpages have different tag counts

Tag Processing Overhead



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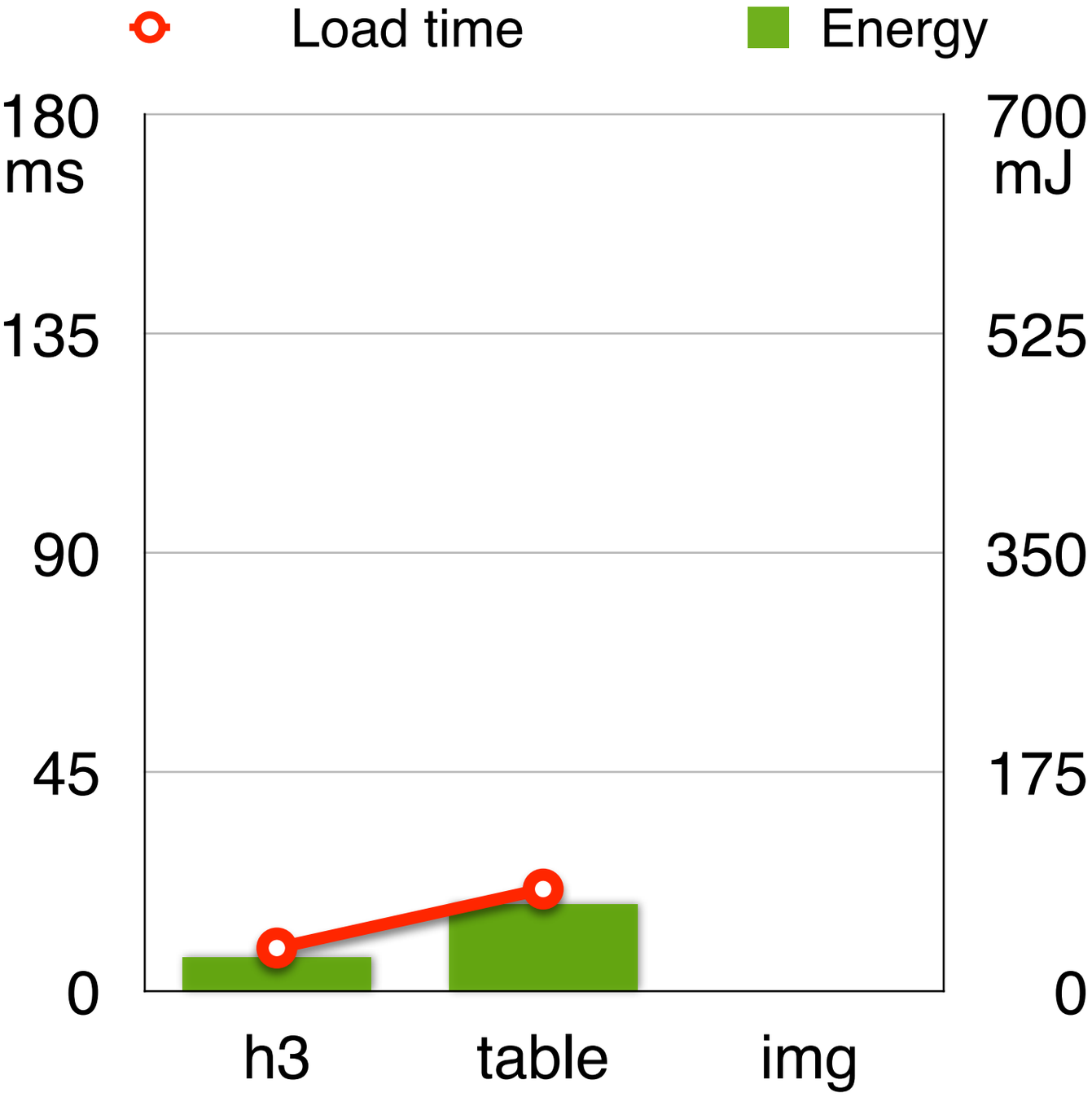

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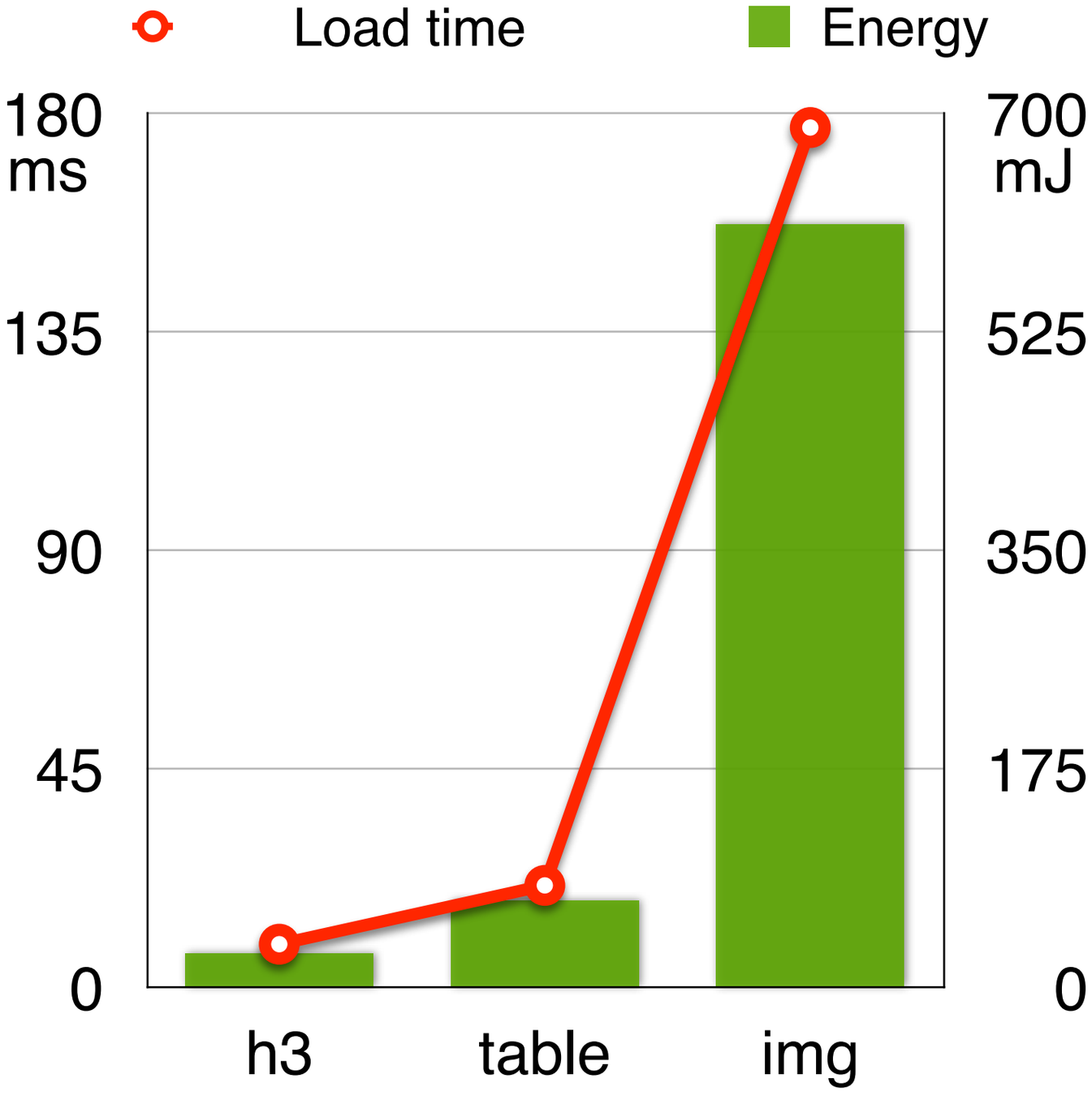

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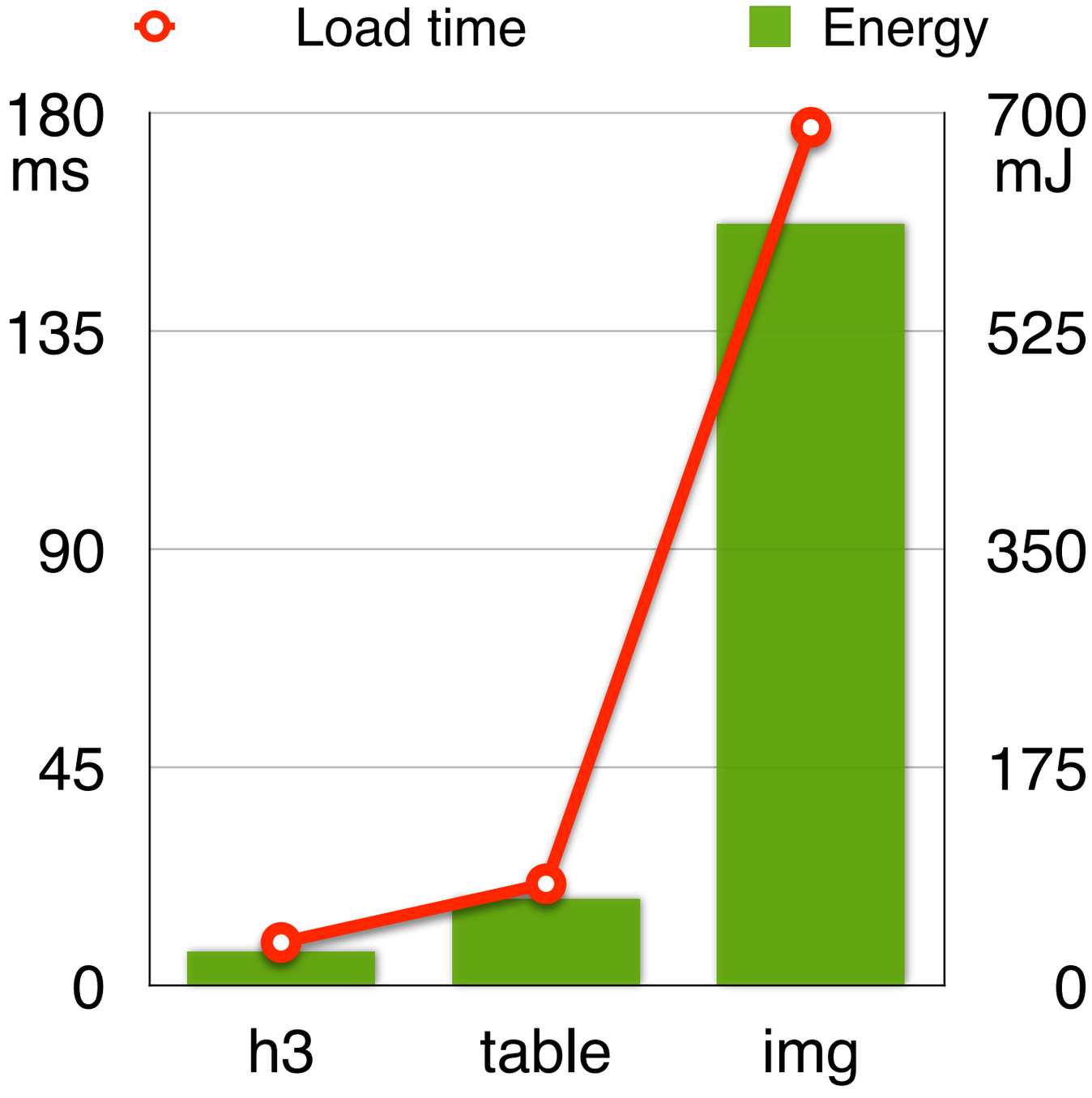


Webpages have different tag counts

Tags have different processing overheads

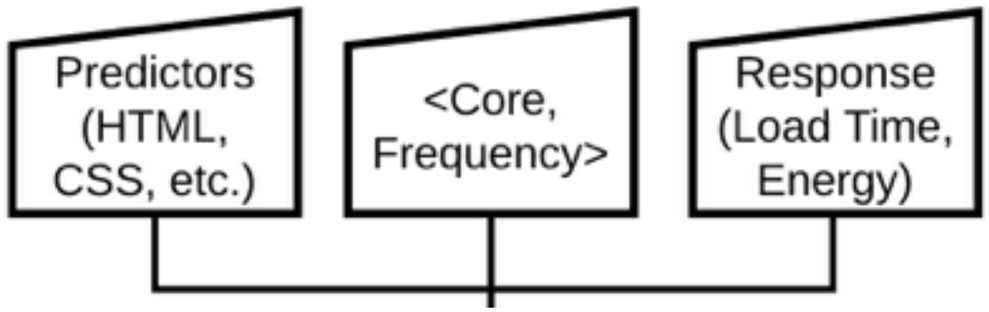
Capturing Webpage-Level Diversity

Idea: **predict** webpage load time and energy consumption (responses) based on webpage characteristics (predictors)

Capturing Webpage-Level Diversity

Identify Predictors

Training using hottest 2,500 webpages



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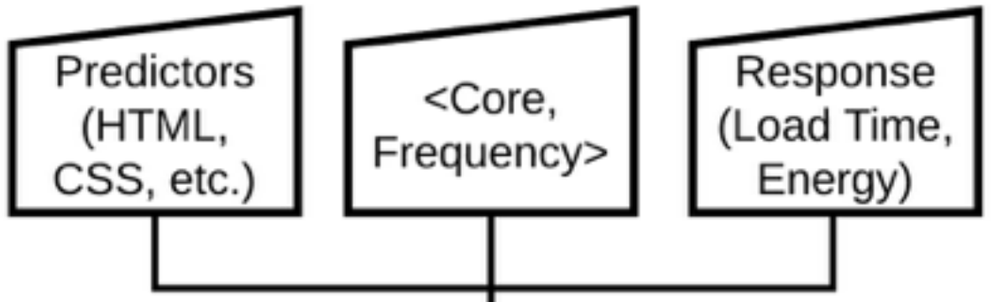

Group	Model Predictors
HTML	Number of each tag
	Number of each attribute
	Number of DOM tree nodes
CSS	Number of rules
	Number of each selector pattern
	Number of each property
Content-dependent	Total image size
	Total webpage size

Capturing Webpage-Level Diversity

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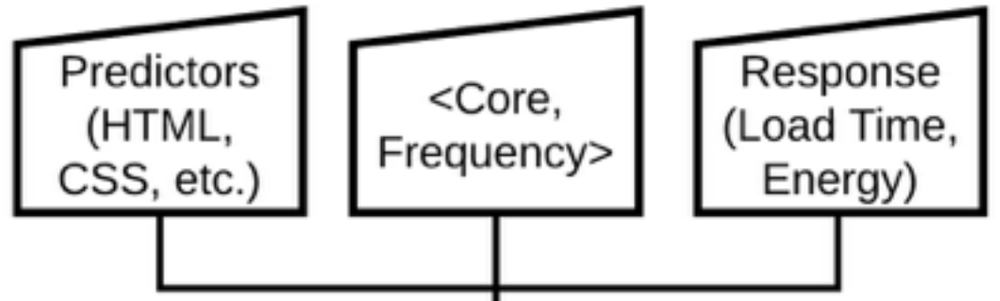

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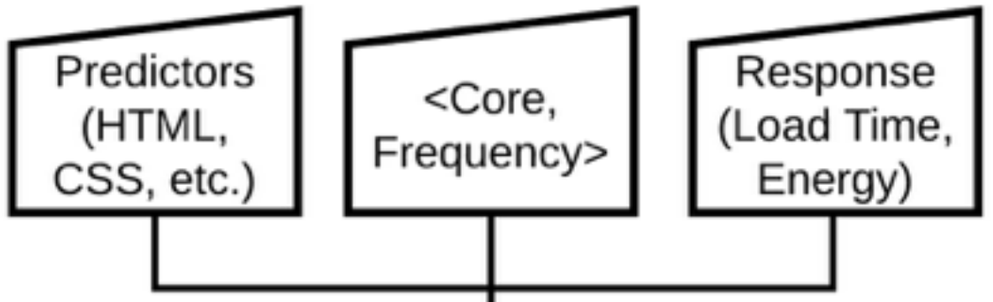

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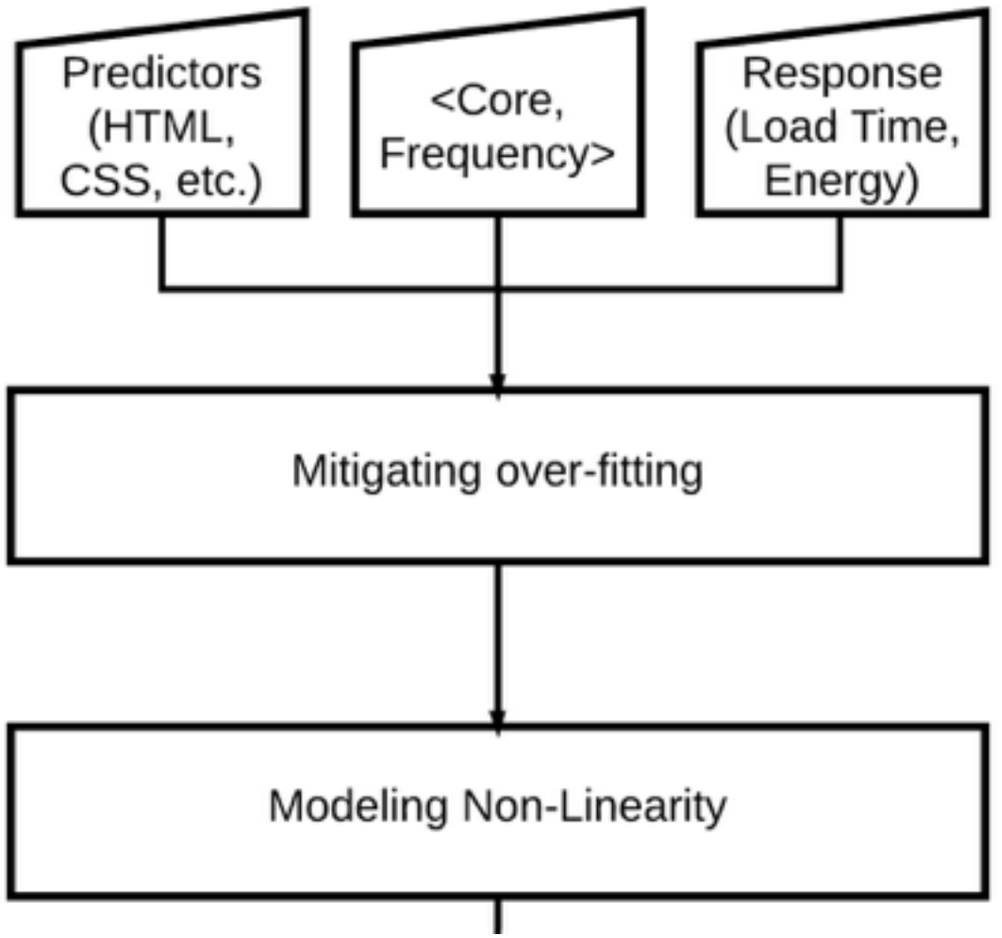
Capturing Webpage-Level Diversity

Identify Predictors
Training using hottest 2,500 webpages

Model Construction and Refinement
Start from the linear model and progressively refine it



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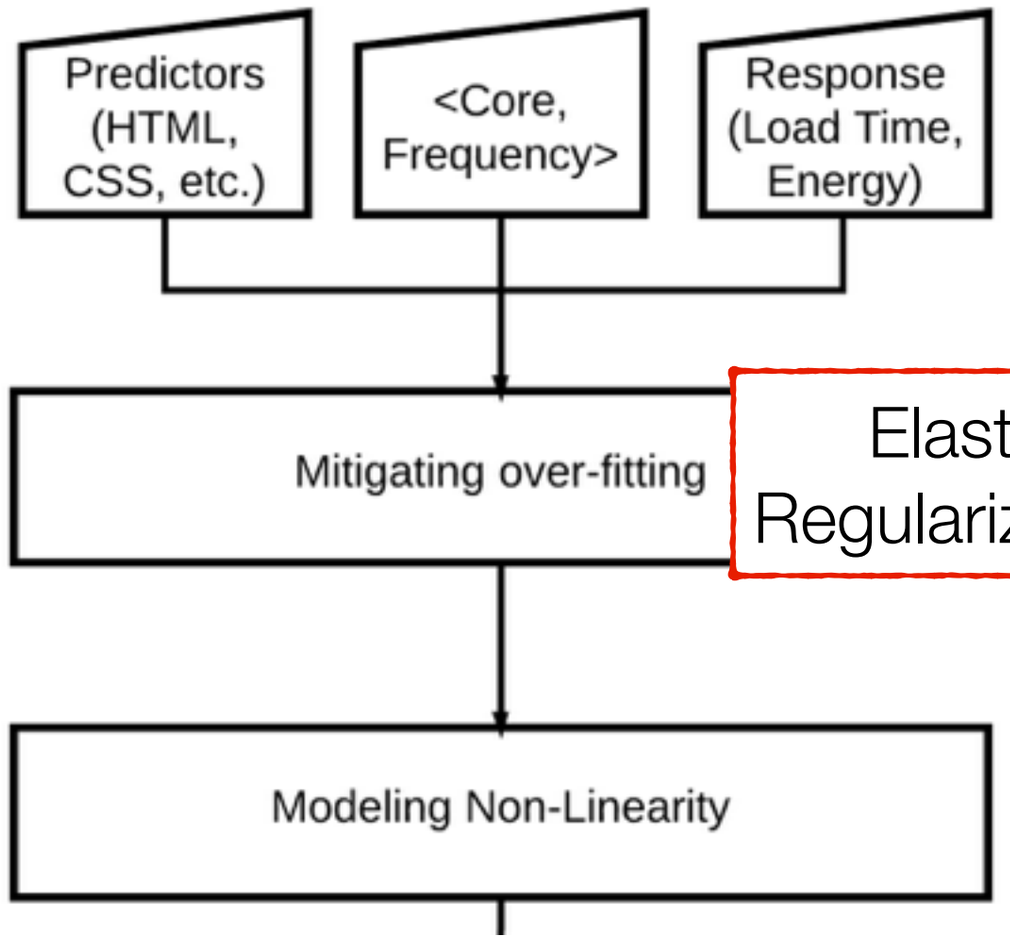

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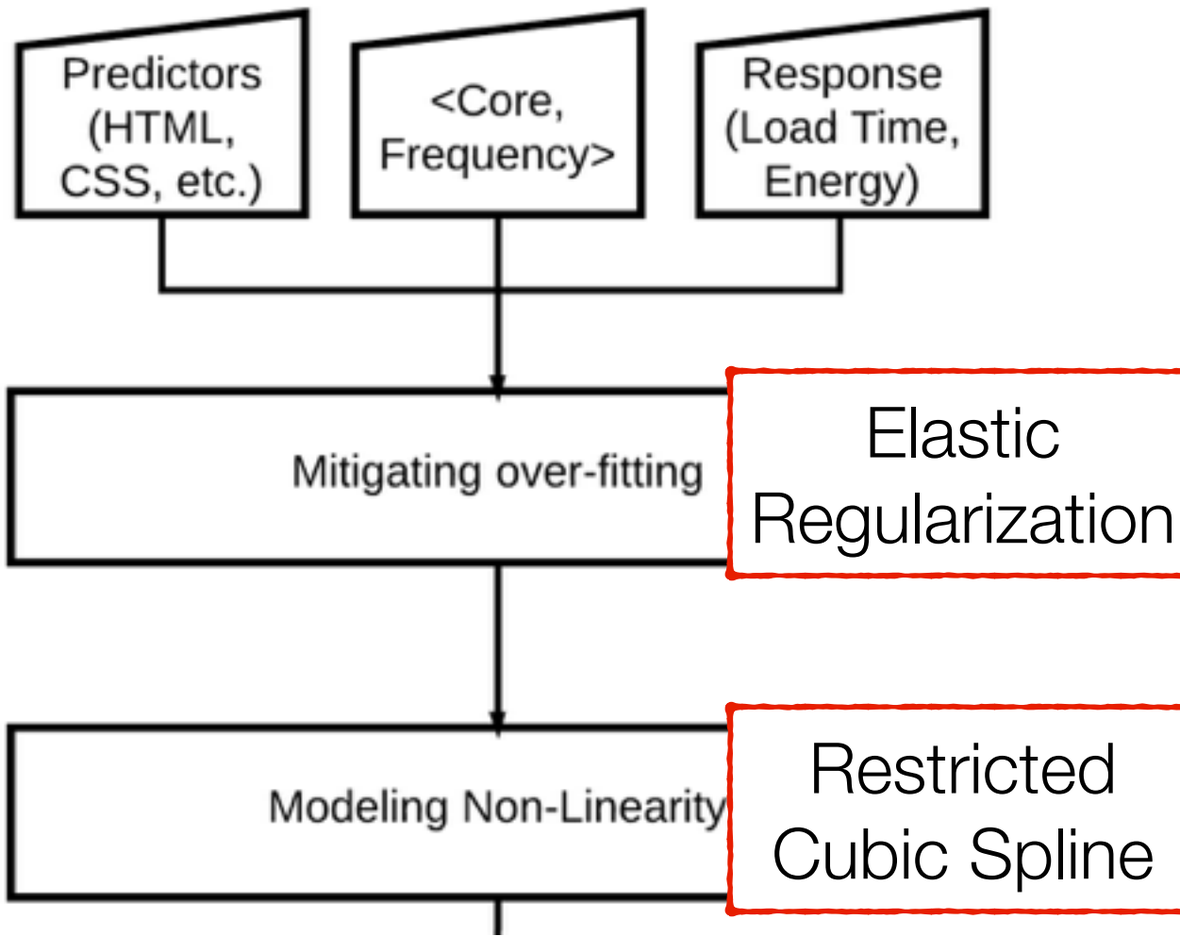
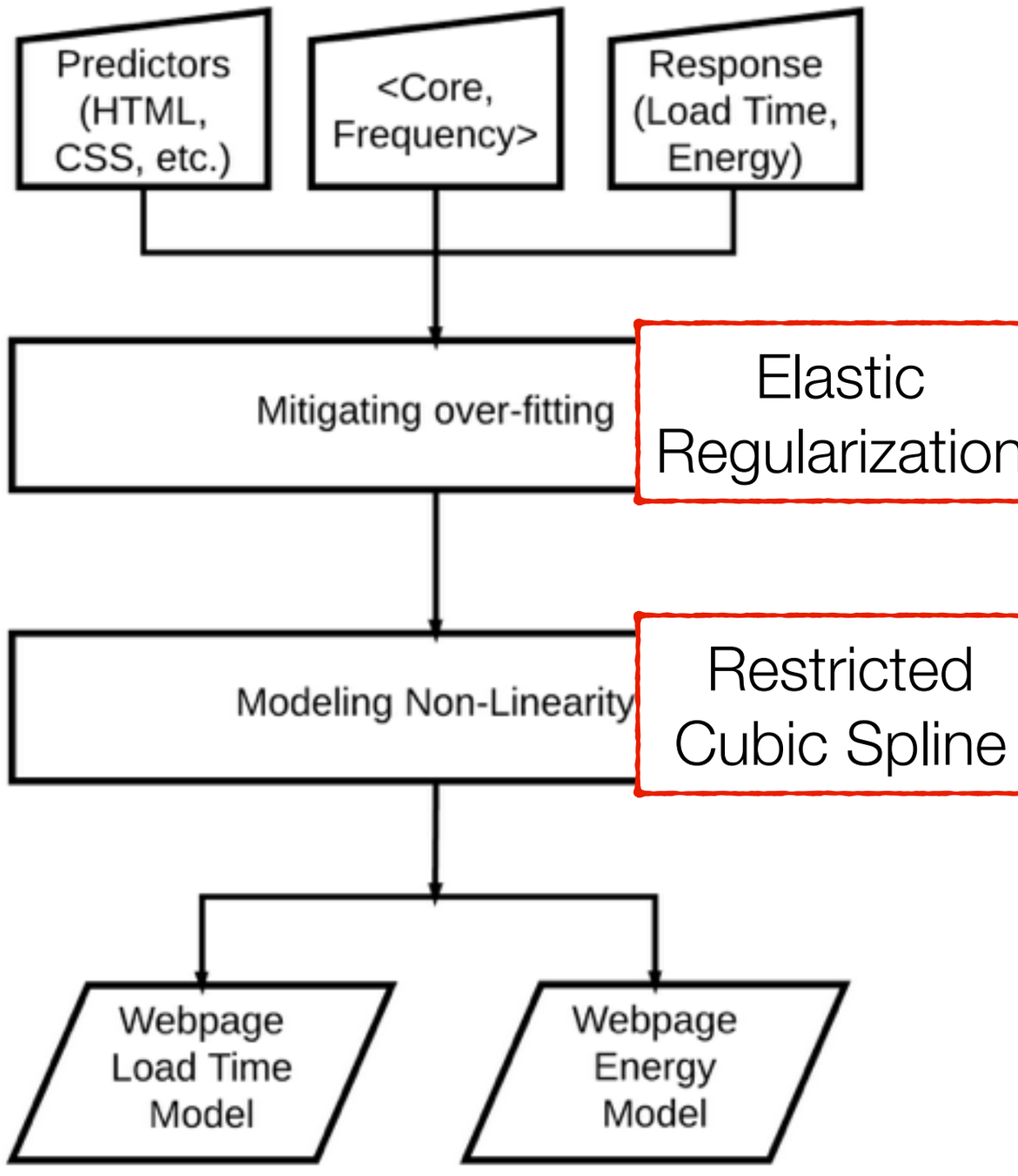


Capturing Webpage-Level Diversity

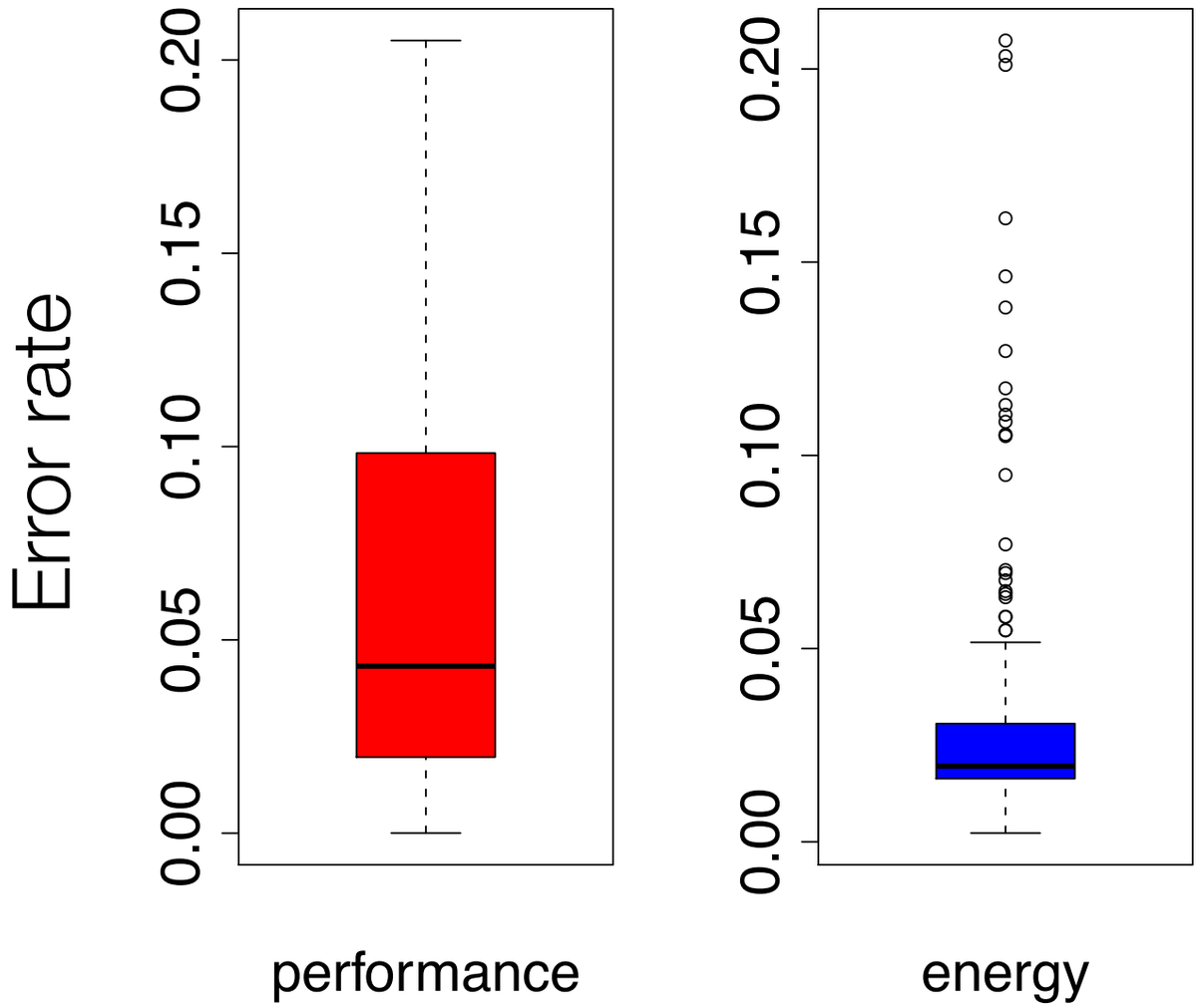
Identify Predictors
Training using hottest 2,500 webpages

Model Construction and Refinement
Start from the linear model and progressively refine it

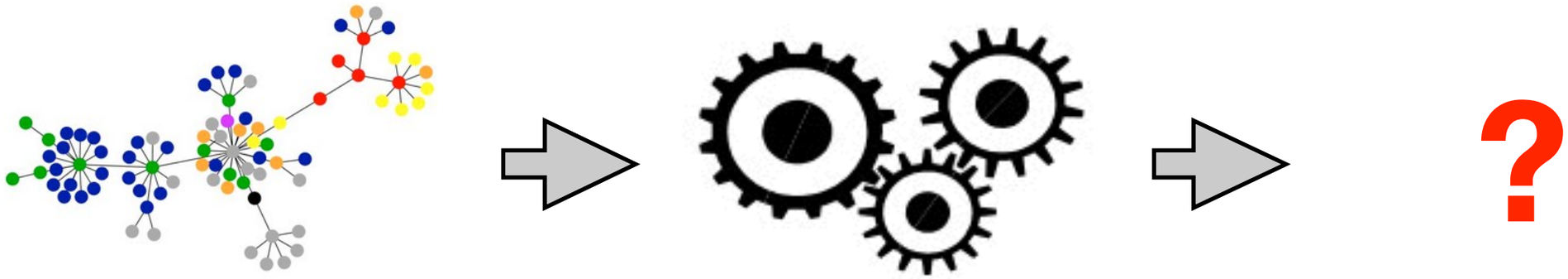
Model Validation
Validating on another 2,500 webpages



Model Accuracy



Median prediction error is less than 5%
for the performance and energy model

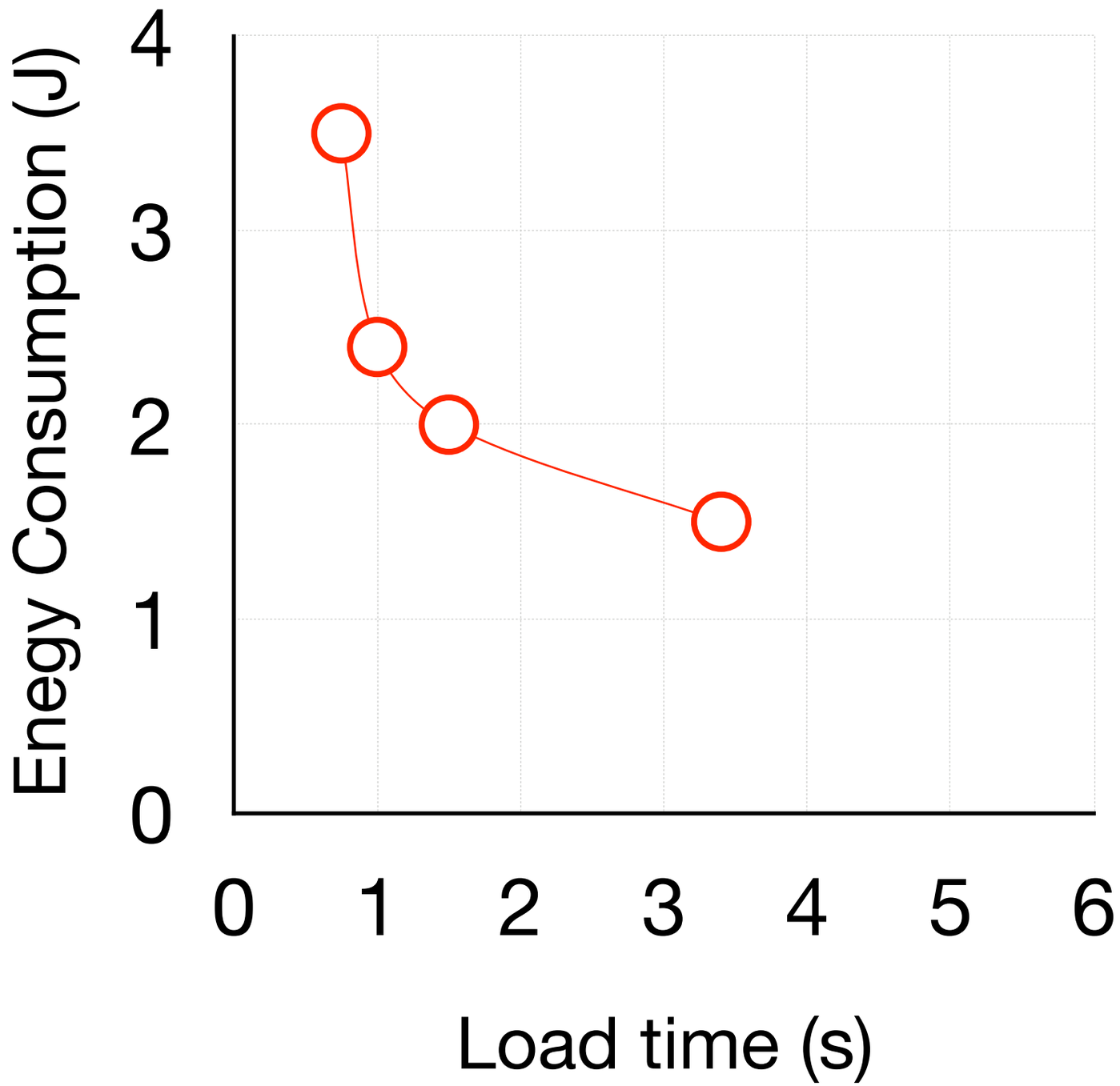


Webpage Characterization

Performance/Energy Prediction

Processor Architecture

Energy-Efficiency Optimizations



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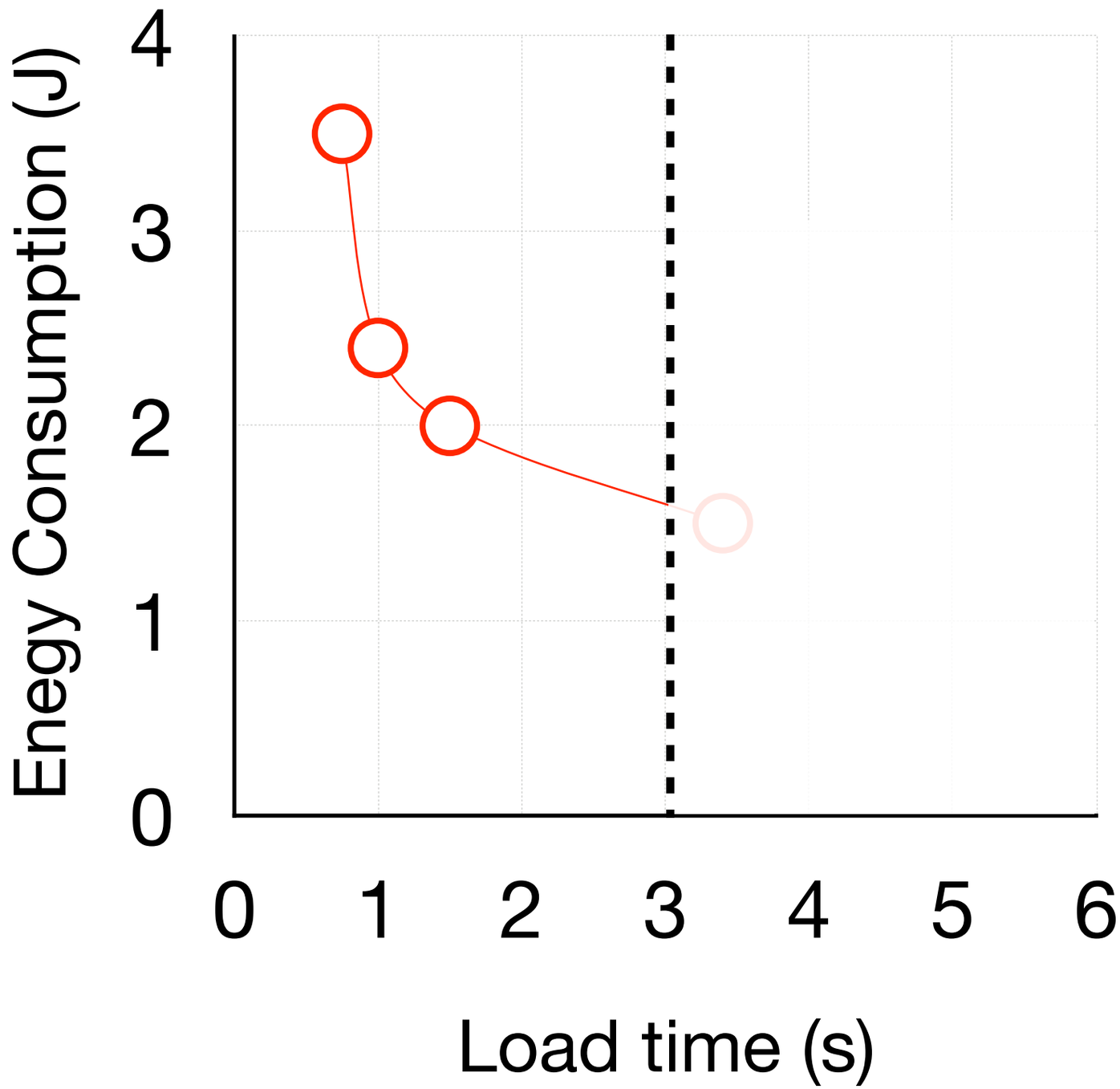

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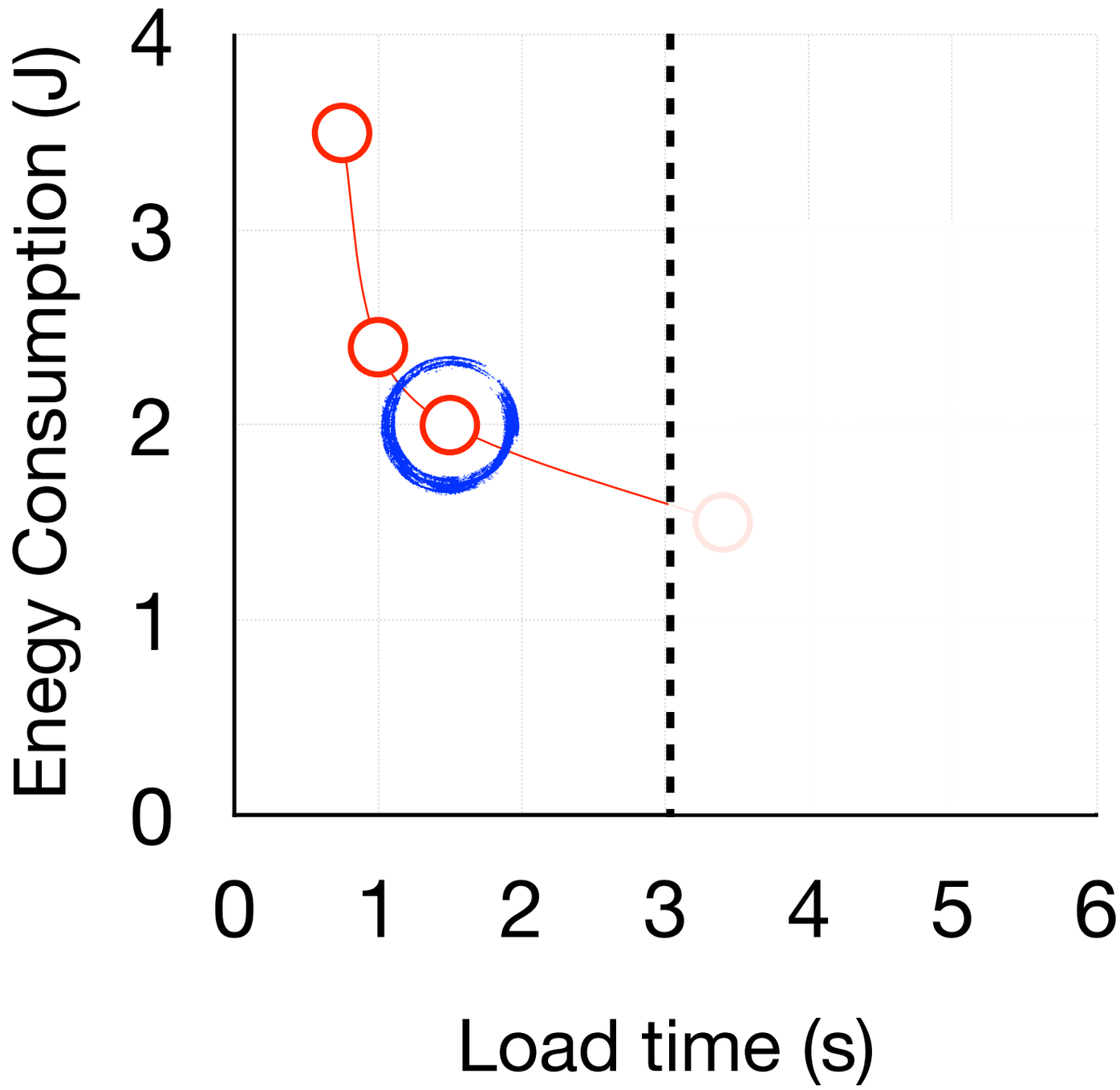

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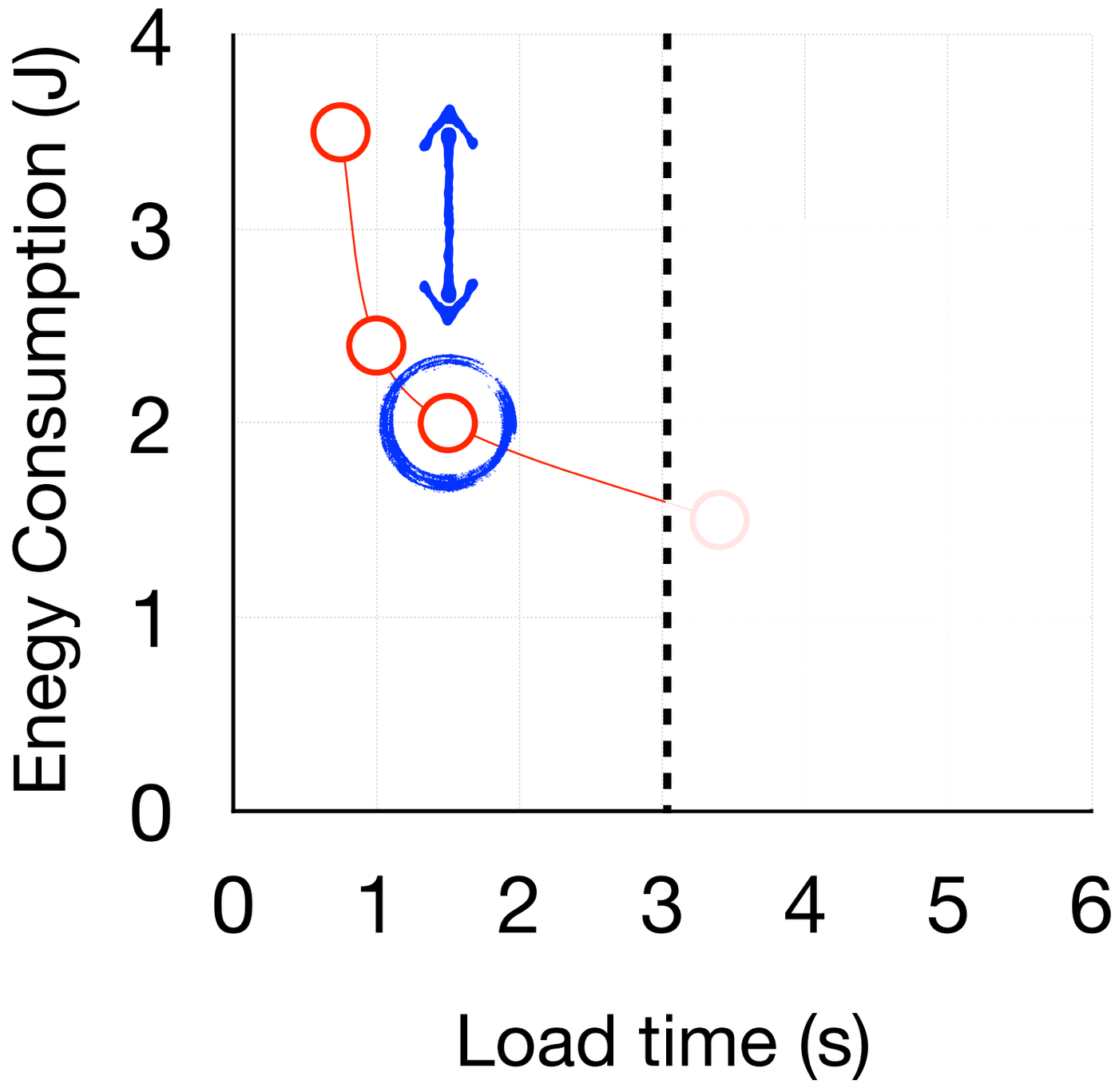
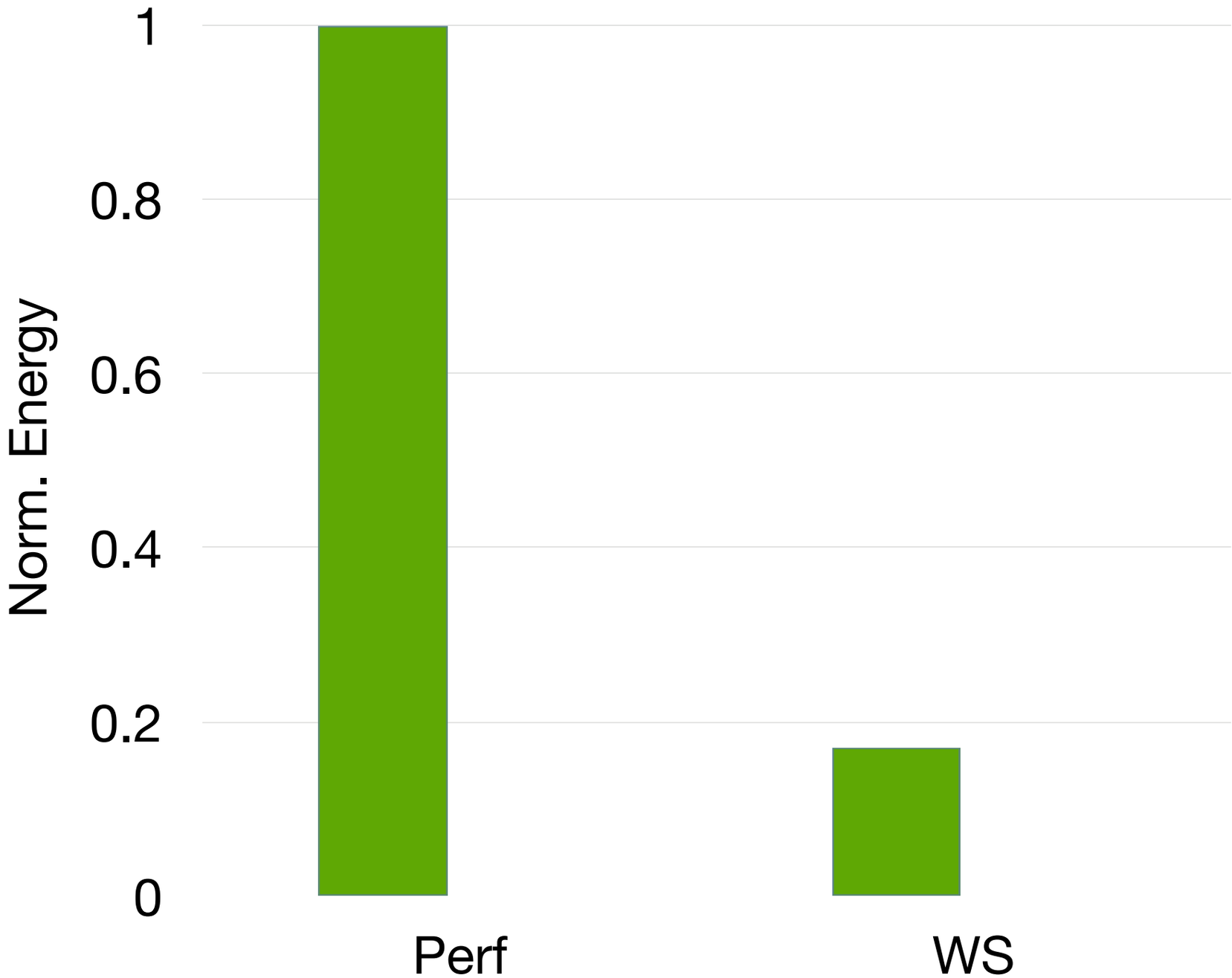


Scheduling Results



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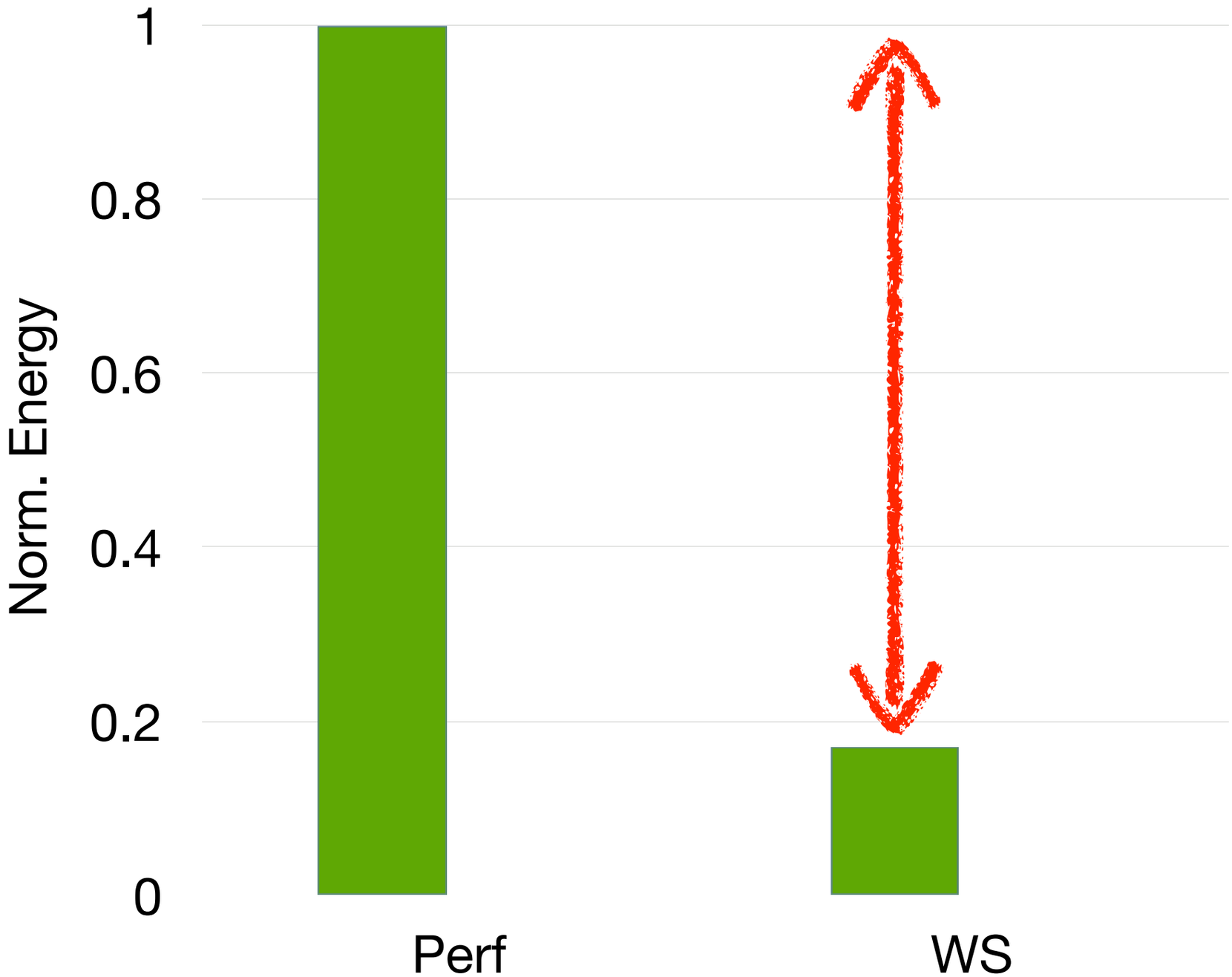
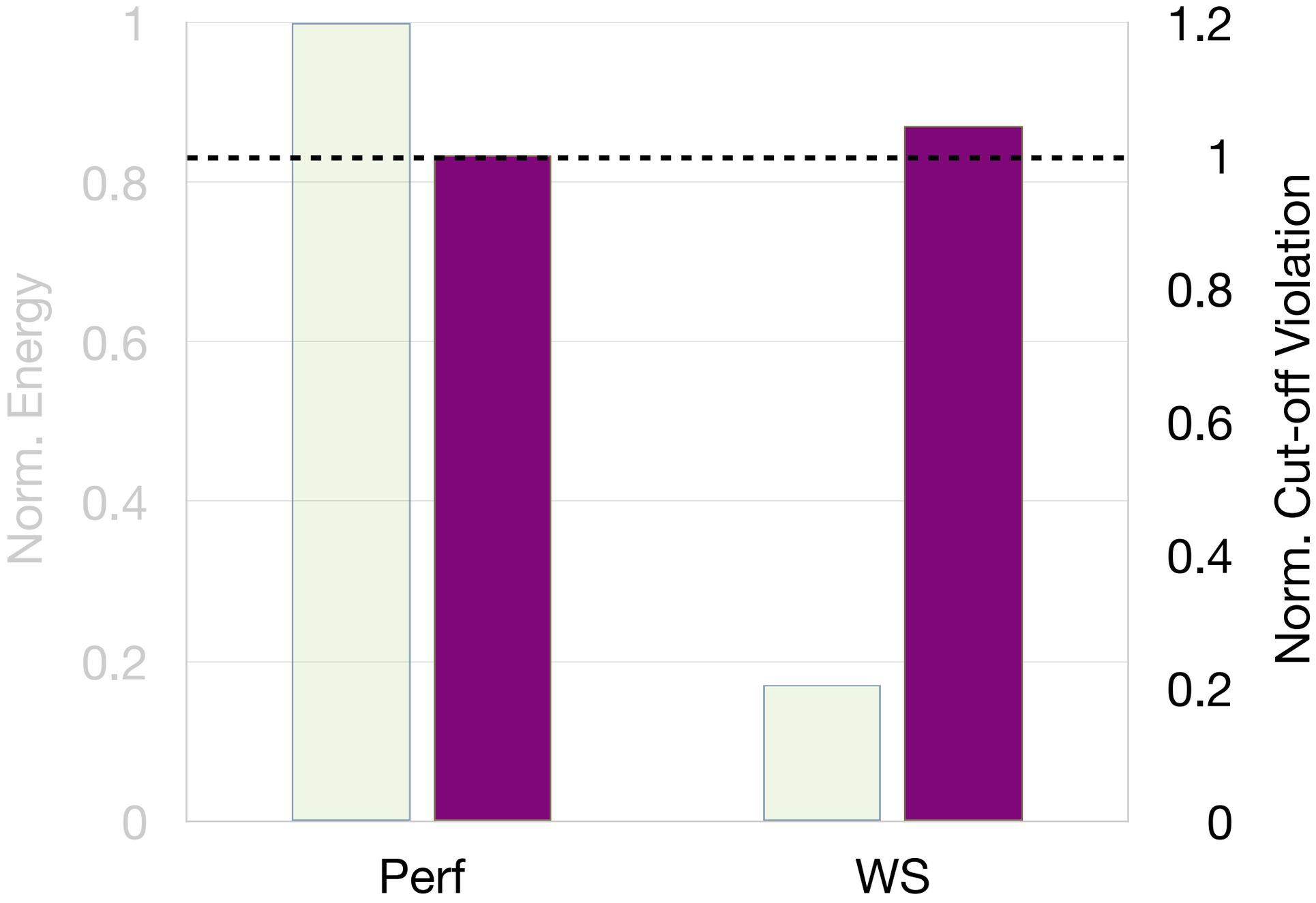
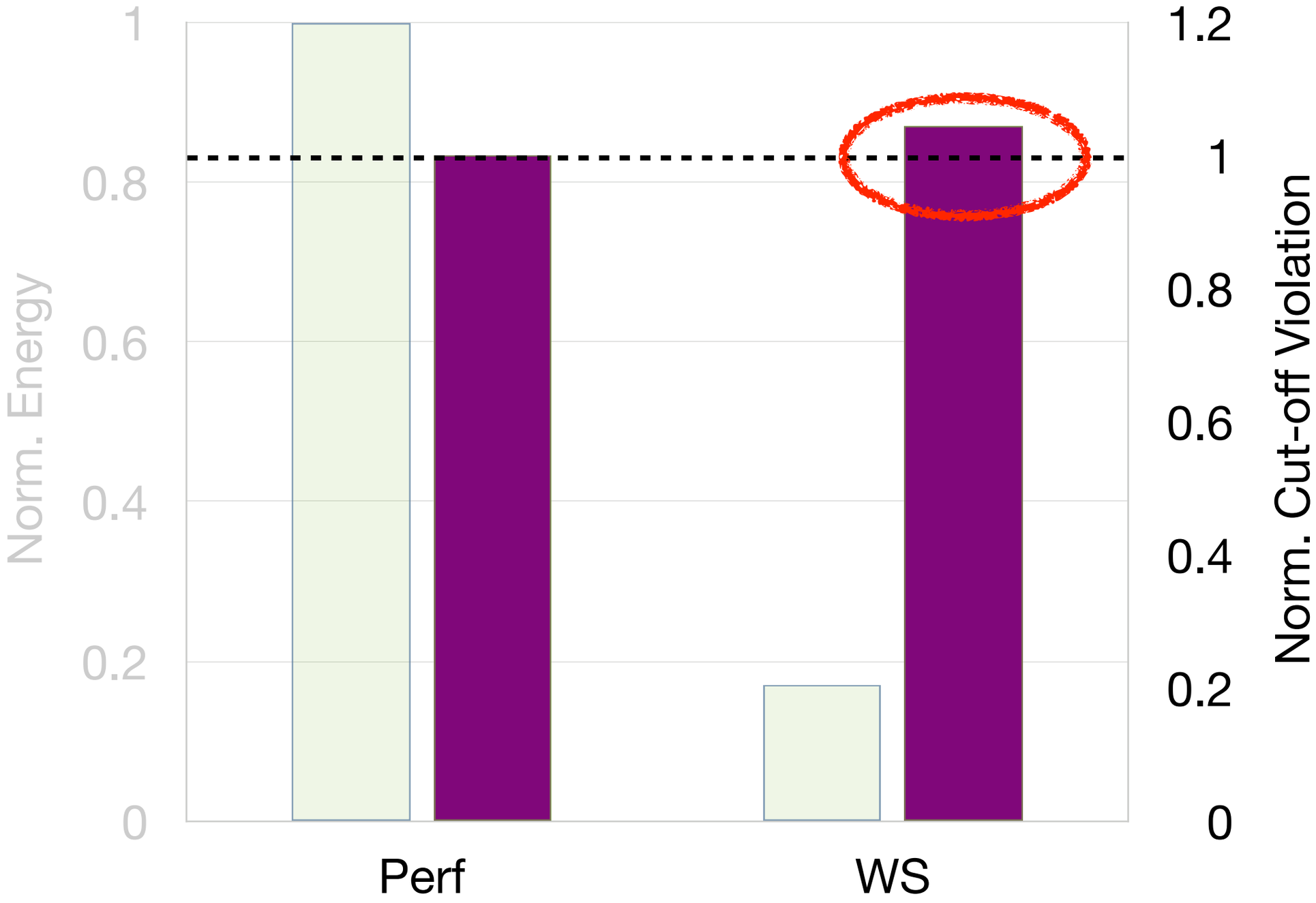
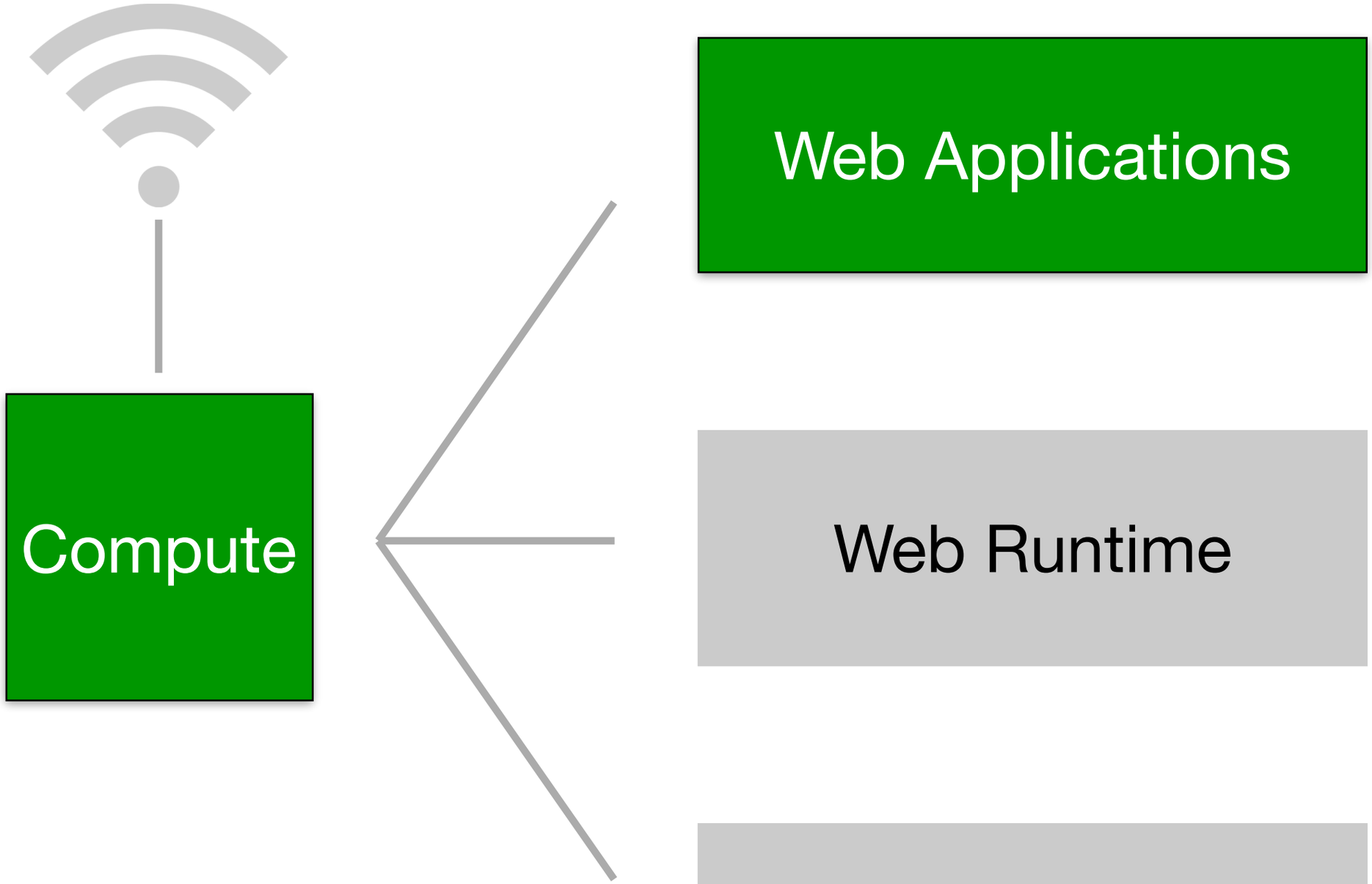


Scheduling Results



Scheduling Results

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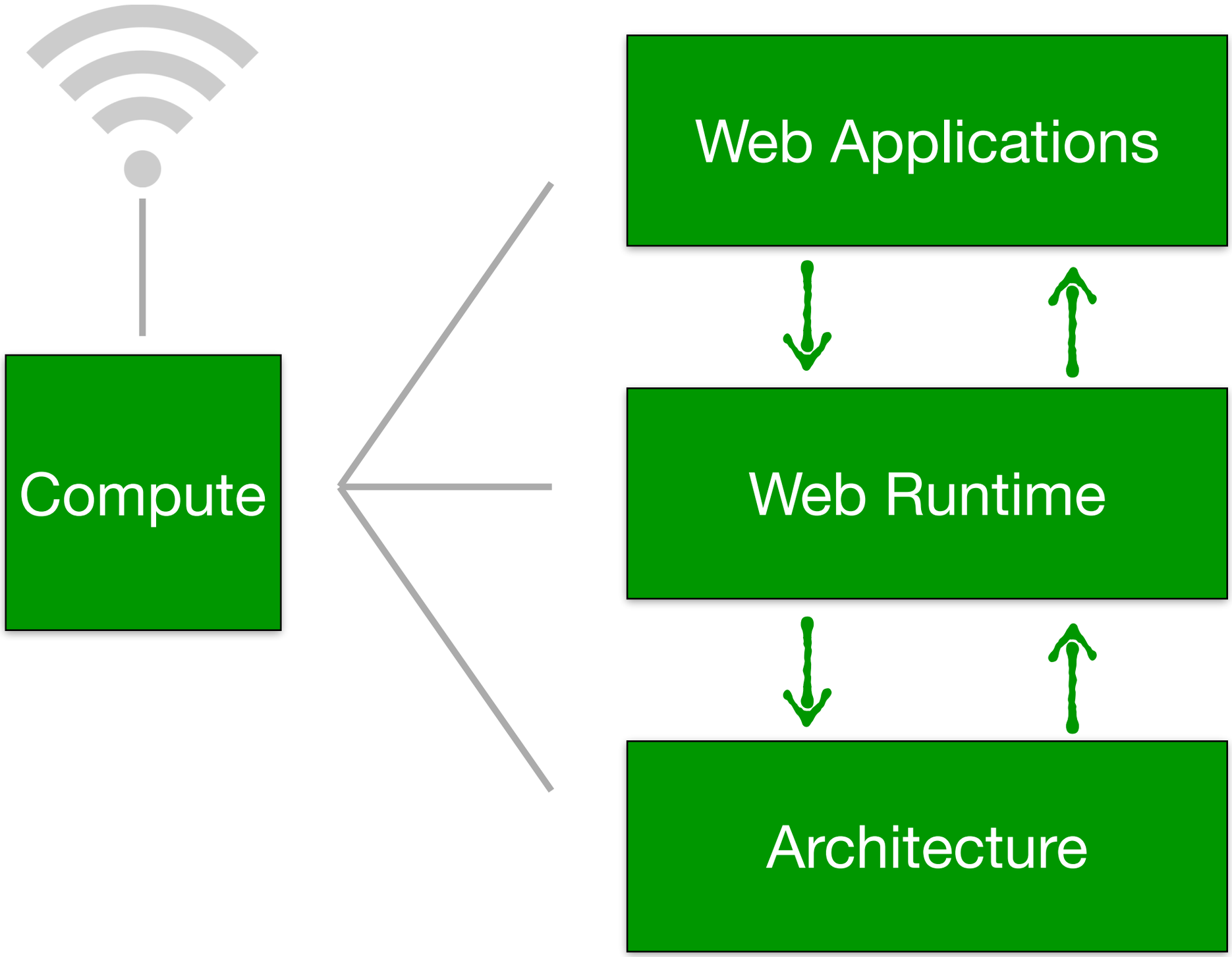
Web Applications
Web Runtime
Architecture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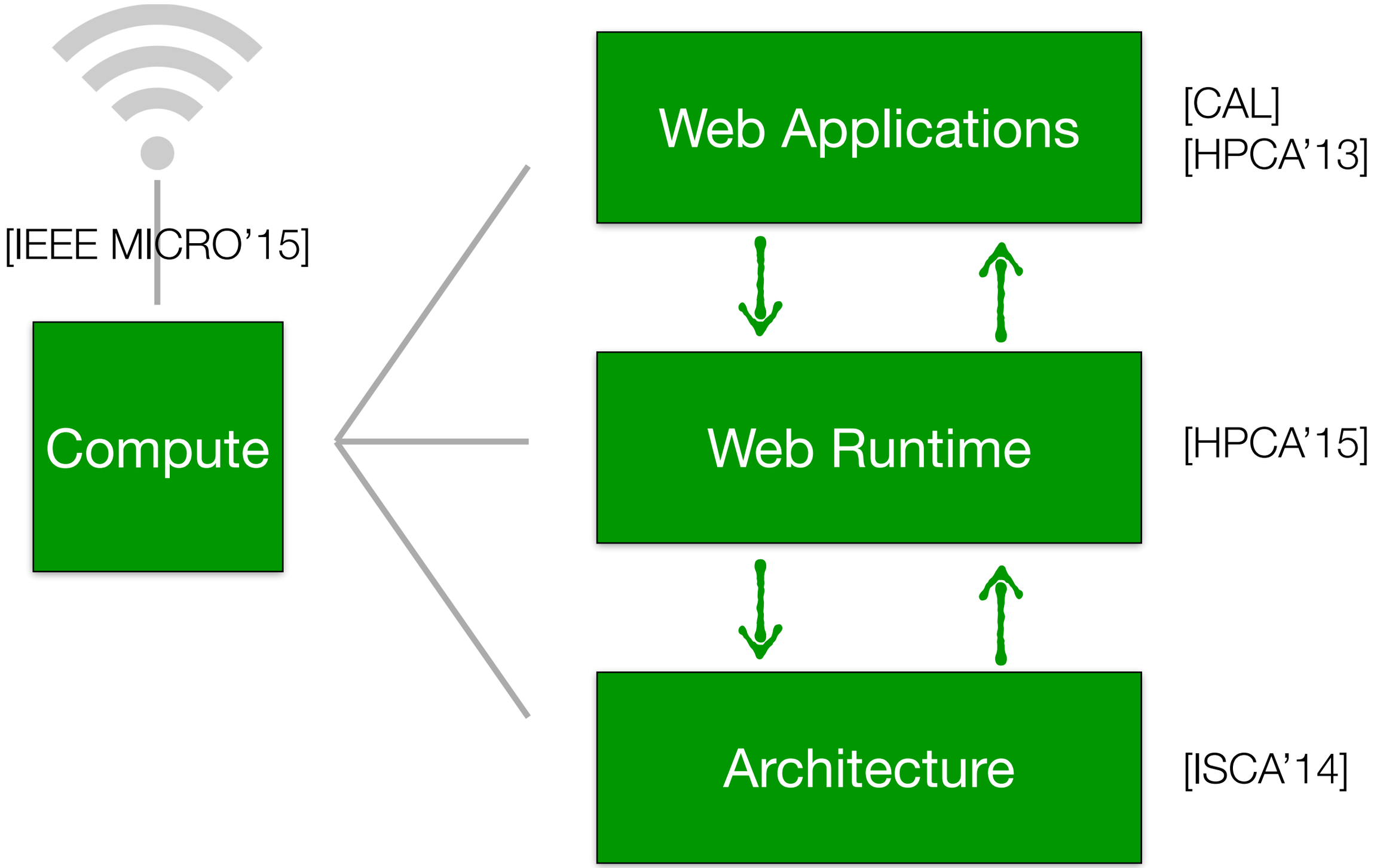
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Web-Based Technology is Everywhere

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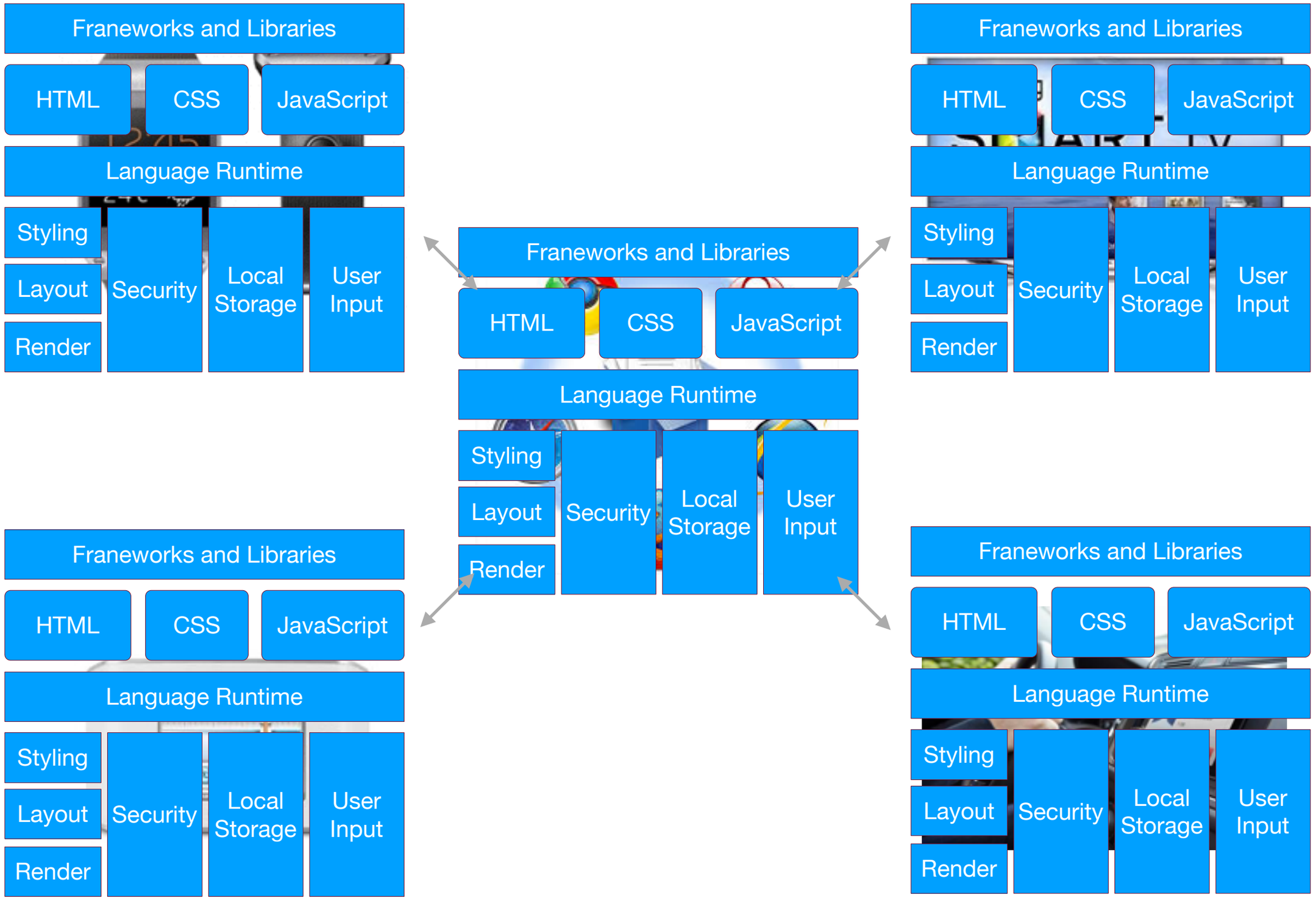

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