Programming on the web

CSC309

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Why take a web programming course?

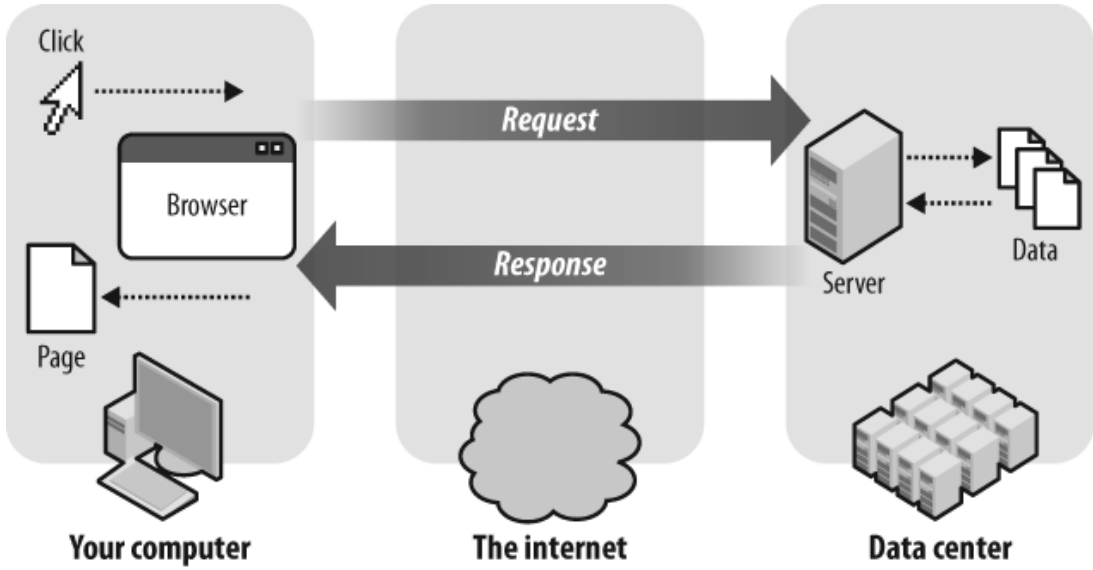
- It revolutionized the world
  - Every human being's life has changed prior to twenty years ago
- Life is unimaginable without internet
- Things are connected and seamless
- The technology behind is truly fascinating
  - We'll learn it in this course

What is it about?

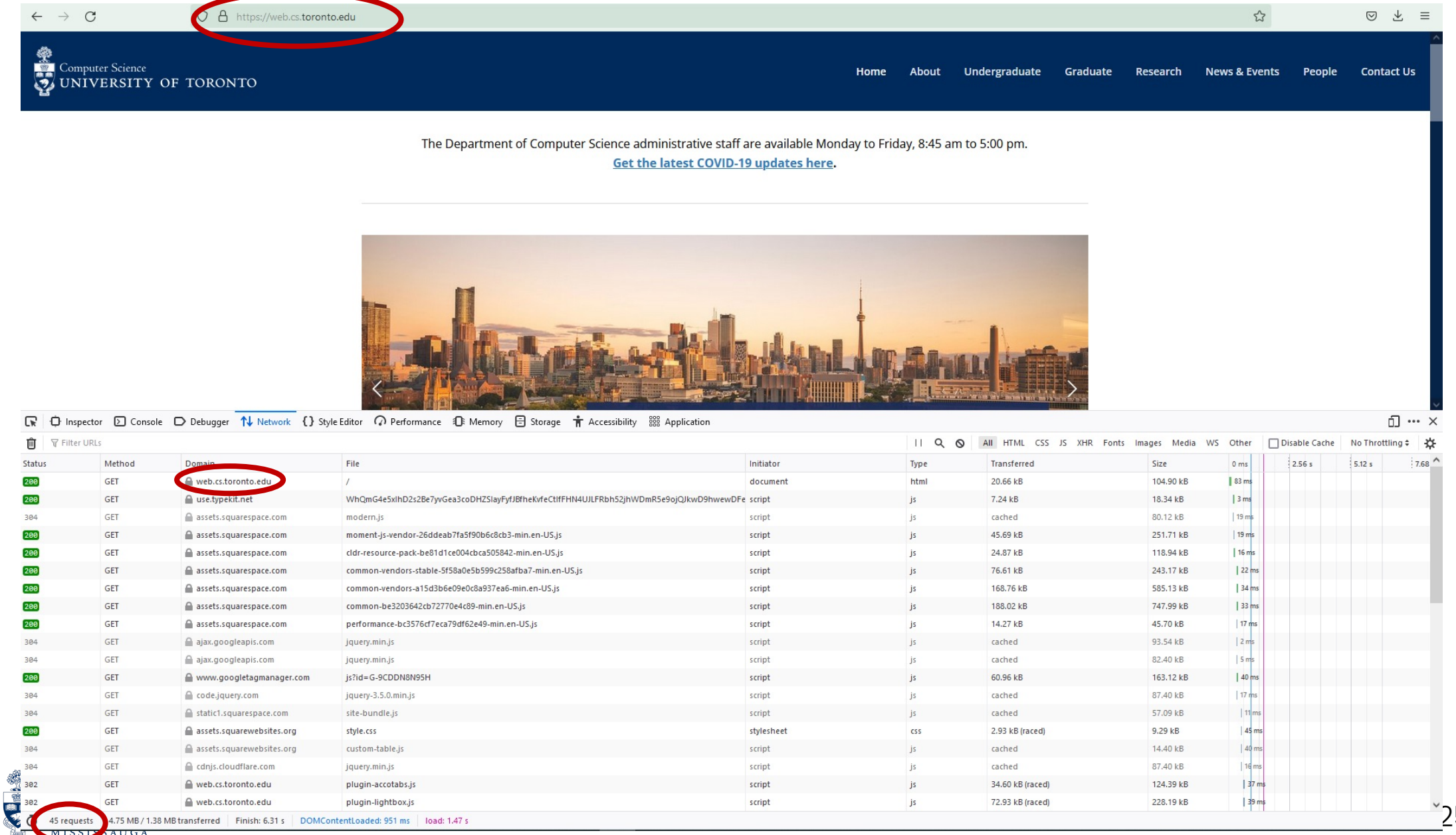
- How does web work?
  - Client/server, browsers, protocols
- Components of a website
  - Server, backend, frontend
- Software design
  - Design models, frameworks, data management
- Website deployment
  - Make your website accessible to the world!

How web works

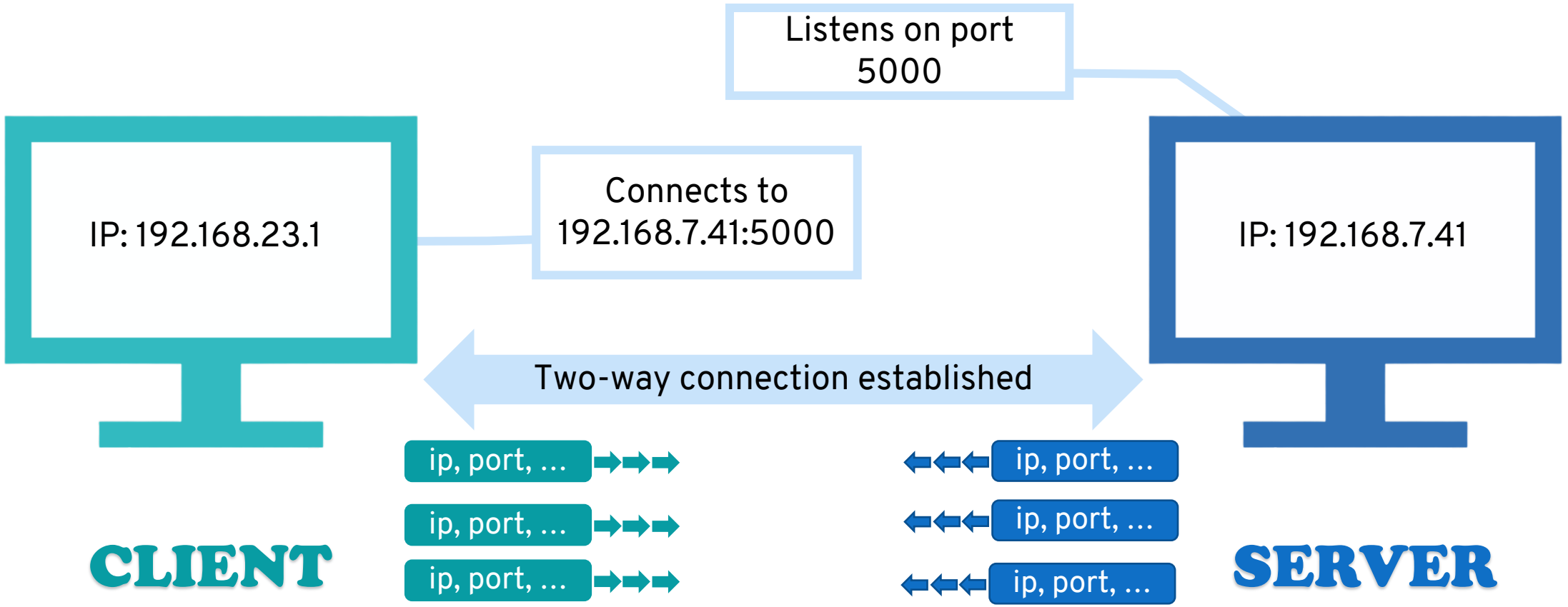
- A lot of things happen when a single webpage is loaded!
- Lots of HTML/CSS/JS is fetched
- All in the form of requests & responses
  - Browser (client) sends requests to one or more servers and receives responses



How web works



How computers talk to each other?



Domains

- Mapped to IP addresses
  - www.google.com -> 142.251.41.78
- Stored in Domain Name Servers (DNS)
- Clients first resolve the domain, then connect to the IP address
- Already knows which DNS server to talk to

Stateful vs Stateless

Two-way open connection is stateful

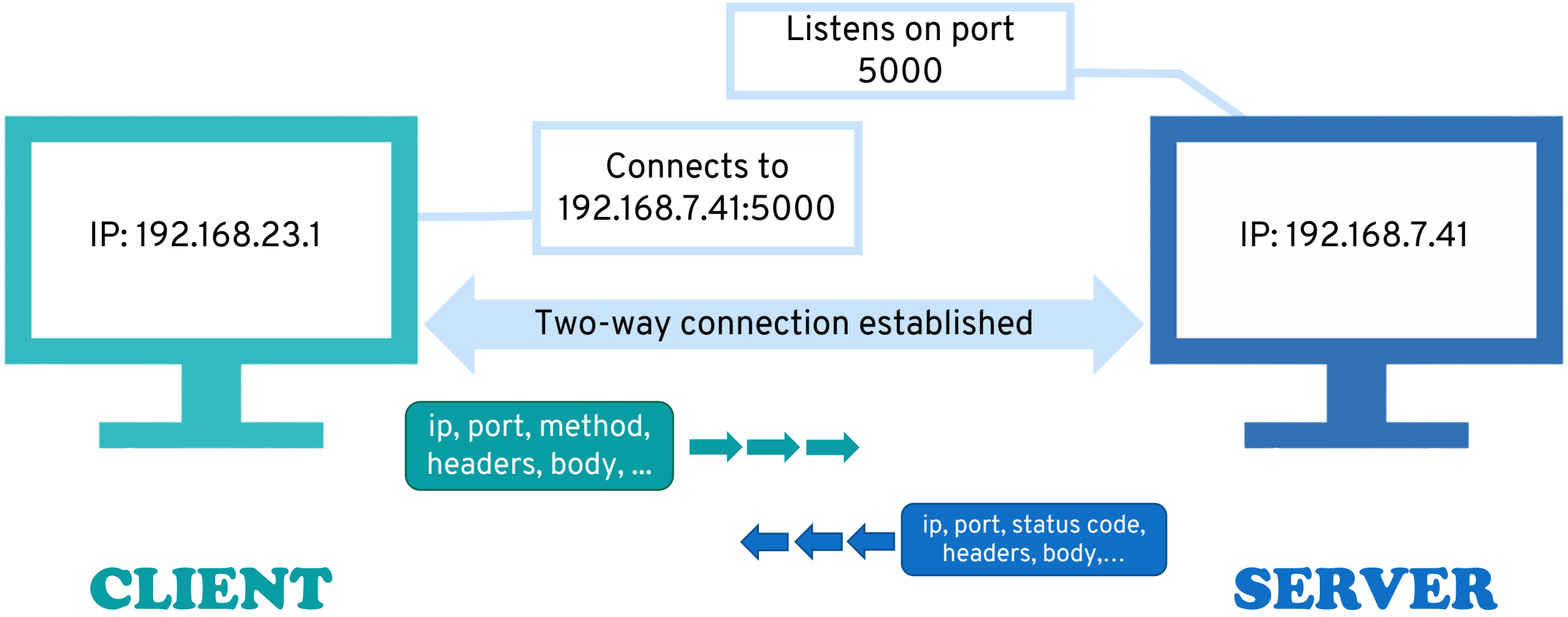
What the server responds depends on previous messages

Server should keep track of thousands of open connections

If connection breaks, all the state is lost

A stateless protocol is preferred

Stateless Protocol

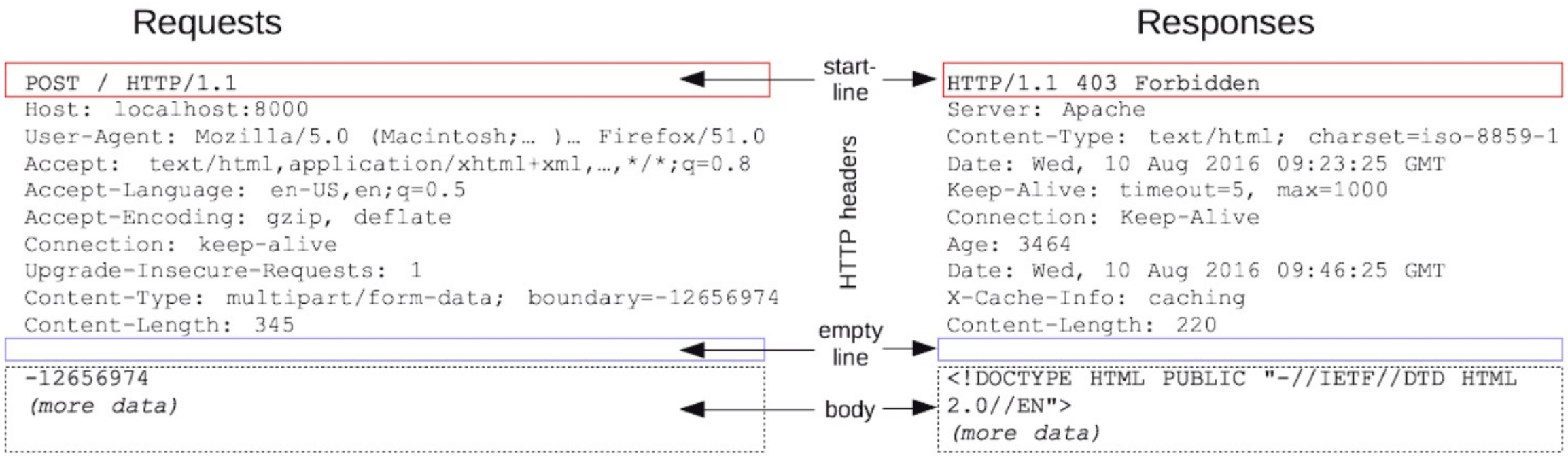


HyperText Transfer Protocol (HTTP)

HTTP Message

- A string with a special format
- Request a more specific target
  - Path: /, /signup, /account/index.html, …
  - Method: GET, POST, PUT, …
- Headers & Body
- Default port is 80

HTTP Message



Response codes

- Success: 200-299
  - 200 OK, 201 Created
- Redirection: 300-399
  - 301 moved Permanently
- Client errors: 400-499
  - 404 Not Found, 400 Bad Request, 403 Permission Denied
- Server errors: 500-599
  - 500 Internal Server Error, 502 Bad Gateway

HTML

A specific form of Extensible Markup Language (XML)

- Data is annotated with nested tags

- HTML has specific tags for a webpage to describe what the page contains

- More on HTML later today

Web browser

- Upon entering the Uniform Resource Locator (URL)
  - Connects, sends requests to server, and receives responses

- Renders the response
  - HTML
  - Image
  - PDF
  - Text

So far…

- Server listens on a specific port, client(s) connect to IP and port
- Stateless HTTP protocol: Request & Response
- HTTP response body can be in HTML format
- Browsers understand this format and renders accordingly

Questions?

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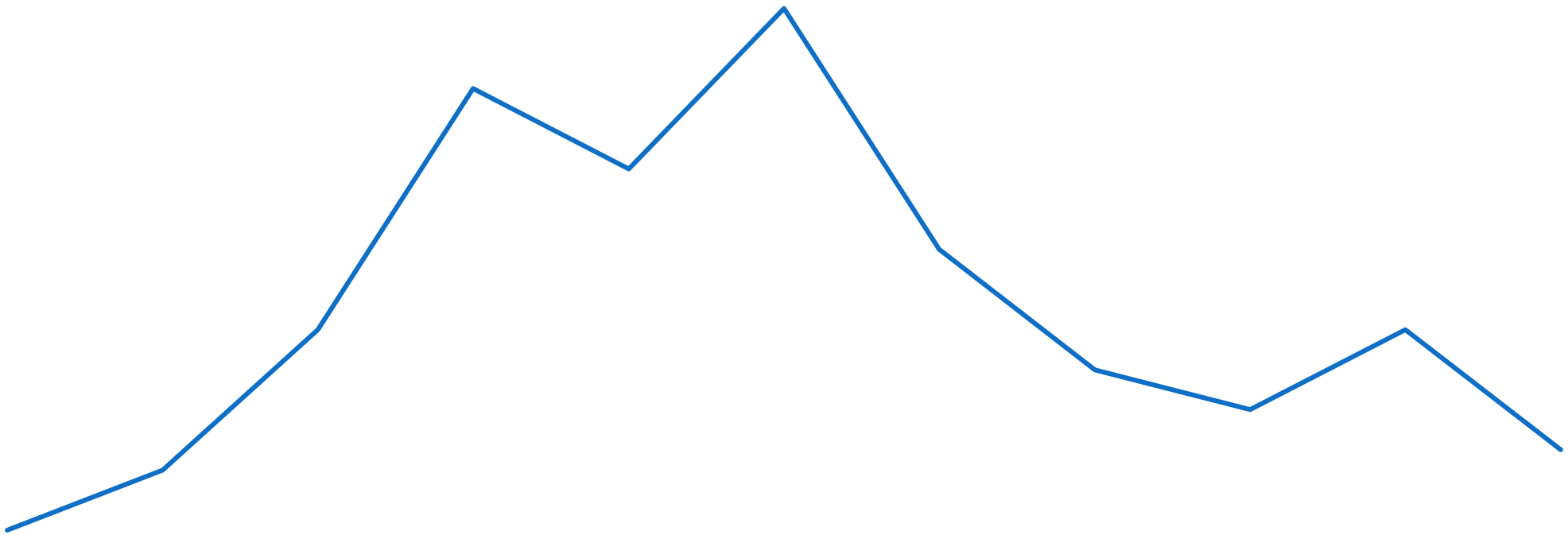
- No prior knowledge/experience in web development is assumed
  - We'll start from scratch!
- However, the course is quite up-to-date!
  - Web in 2024 is so different than in 2000!
  - We will cover latest technologies/frameworks
- It's fast-paced!

Topics

- Week 1
  - Course intro, web architecture
  - HTML, CSS
- Week 2
  - JavaScript
- Week 3-6
  - Backend development
  - Node.js, Next.js
  - Database models & ORM
  - Restful APIs
  - Authentication
- Week 7-9
  - Frontend development
  - Single-page applications
  - React
  - Advanced styling
  - Typing in JavaScript (TypeScript)
- Week 10
  - Docker
- Week 11
  - Deployment & DevOps

Difficulty levels throughout the term



Course delivery

- Mondays 5-7pm and 7-9pm

- Two sections are the same
  - Attend either lectures
  - Same TA's, assessments, etc.

- One lecture is recorded
  - It's a best-effort: quality is not guaranteed
  - Not meant to replace the lecture

Assessment

- Weekly exercises (10%)
  - Educational questions
  - Supplementing lecture material
  - Best 10 out of 11 will count
- Project (50%)
  - A full, real-world web app!
  - Two parts (PP1 20% - PP2 30%)
- Midterm (10%)
  - Feb 10th
  - During lecture time
- Final exam (30%)
  - 40% required for passing the course
- Occasional bonus questions at lectures

Weekly exercises

- Small, educational questions regarding the most recent lecture
  - Designed to provide initial experience with tools
- Auto-graded
  - Auto-grader will be given to you!
- Deadline: every Tuesday at 12pm.
  - No extensions, tokens, remark request

Project

- A full web app
  - A travel application
- In groups of up to 3 people
  - You may team up with people from the either sections
- Two parts
  - PP1: Next.js backend, PP2: Next.js frontend & Docker
- Mentor sessions with TA's

Project

- Each part is graded separately via TA interviews
  - Overall functionality of the app (shared within group)
  - Team member's contribution and participation (individual)

- Start looking for teammates now!

- Use best tools out there!
  - Open-source codes, ChatGPT, etc.
  - No code sharing between groups

Exams

- Closed-book, paper-based exams
  - One piece of hand-written cheat-sheet allowed!
- Challenges your understanding of concepts
  - Not your memory!
  - No need to memorize tags, classes, syntax, etc.
- Midterm (10%)
  - During lecture time in week 6
- Final exam (30%)

Contact points

- Course website
  www.cs.toronto.edu/~kianoosh/courses/csc309h5
- Piazza: Announcements + Q&A
  piazza.com/utoronto.ca/winter2025/csc309h5
- Announcements are NOT copied to Quercus
  to avoid duplication

- Email:
  kianoosh@cs.toronto.edu
- Discord server
  discord.com/invite/4mv76JsJaE
  Informal Q&A and chat
- Office hours
  - Mondays 3-5 (DH 3097B)

Academic integrity

- University's policy takes it very seriously
  - Violations may result in failing the course

- Rules
  - Exams are closed-book and paper-based
  - No interaction with other students during exams
  - No code sharing between groups in the project
  - Cite all open-source or AI-generated codes

Questions?

HTML

- A specific text format understood by browsers
- HTML file surrounded by the <html> tag
  - <body> and <head> tags
- Tags and elements
- Elements can have attributes

HTML tags

Visit https://www.w3schools.com/html/

- Headings: <h1> to <h6>
- Paragraphs: <p>
- Links: <a>
  - Stands for anchor
- Images: <img />
- Lists: <ol> and
- Tables: <table>
- Navigation Bar: <nav>
- New line:

HTML attributes

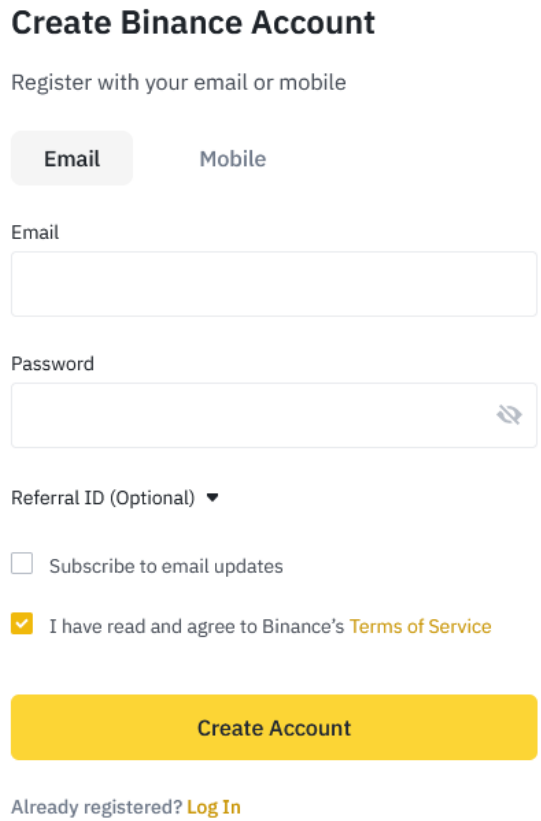
- style attribute
  - Discussed shortly later
- Identifiers: id vs class
- Other attributes: src for <img /> and href for <a>
- You can put any custom attribute you want
  - There's no compilation error!

Other HTML tags

- and
- Select part of document to apply specific attributes
- : inline organization
- : block-level organization

Forms

- Primary way to send user data to server
- On submit, a request is often sent
- Comprised of many inputs



Inputs

- Text field
  ```
  <input type="text" />
  ```
- Passwords, emails, etc.
  ```
  <input type="password" />
  ```
- Radio button
  ```
  <input type="radio" />
  ```
- Checkbox
  ```
  <input type="checkbox" />
  ```
- Textarea
  ```
  <textarea/>
  ```
- Submit button
  ```
  <button type="submit" />
  ```

Forms

- Action attribute defines the URL/path of the HTTP request
- Method attribute: HTTP method parameter
- Inputs: name and value attributes

GET vs POST

- GET is usually used for queries and retrievals
  - Google search
- The query params are appended to the end of the URL
  - Why?
- POST: sending private user data (name, password, etc.)
  - How much private actually?

CSS styles

- Style attribute
  - Describes how the element should look like

- Usage:

```
<h1 style="color: red"> Hello </h1>
<div style="width: 50px; height: 60px"> … </div>
```

Basic CSS properties

- color
- background-color
- font-size
- text-align
- width
- height
- z-index
- font-family
- list-style-type
- opacity

Stylesheets

- Style tag
  - Makes styles reusable by defining selectors

- Stylesheets
  - A separate CSS file with the content of style tags
  - Imported via `<link rel="stylesheet" href="style.css" />`

Selectors

- Same styles can be applied to an arbitrary set of elements
- All elements of a certain tag
  - All elements (the <html> element)
- A specific element: the id attribute
- A set of elements: the class attribute

Selectors

- CSS content (inside <style> or stylesheet)

```
/* Makes all paragraphs red */
p {
    color: red;
}

/* Specifies the size of the element with id `big-text` */
#big-text {
    font-family: Arial;
    font-size: 20px;
}

/* Aligns all elements from class `center` */
.center {
    text-align: center;
}
```

Precedence

Visit https://wattenberger.com/blog/css-cascade

- More specific selectors overrides less specific ones
  - #ID > .class > tag
  - Inline css > style tag > css file

- If everything is the same
  - Later rules override earlier ones

- To evade these:
  - Use the !important keyword

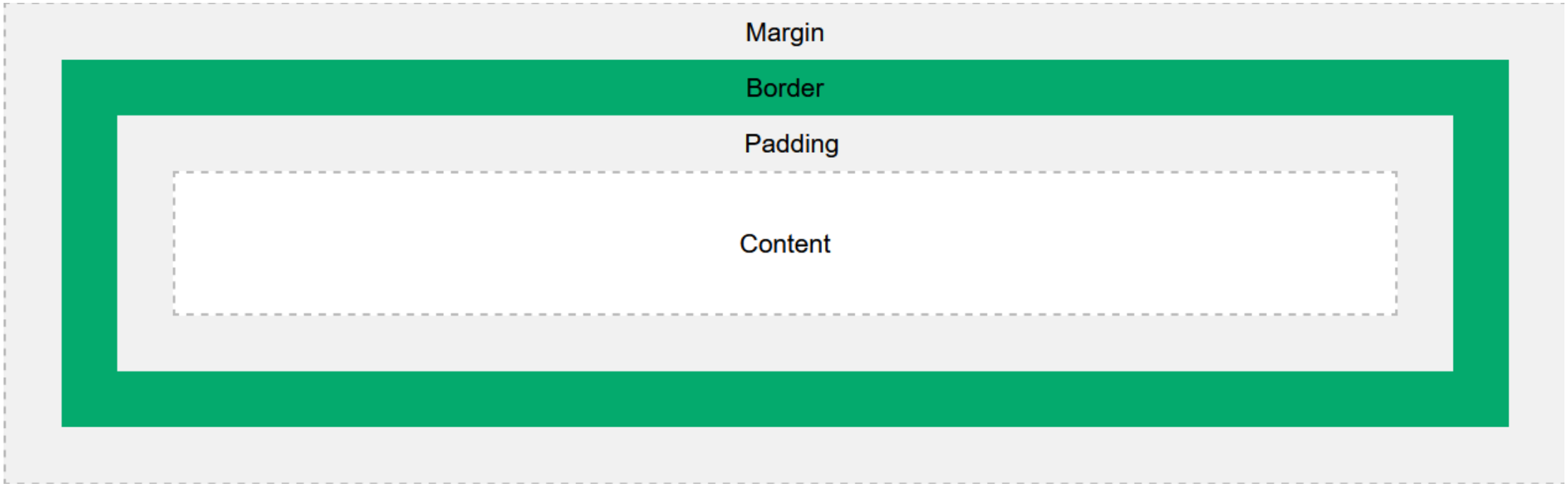
Units

- For width, margin, font-size, etc.

- Absolute lengths
  - cm, in, px

- Relative lengths
  - %,
  - vw: 1% of viewpoint width
  - em: element's font-size,
  - rem: root element's font-size (usually for font-size)
  - fr: fraction (of the available space)

Box Model



Spacing

- Border

```
border-style: solid/dotted/…
border-width: 10px/thin/0px
border-color: red/white/#fa23ca
border-radius: 5px
```

- The shortcut

```
border: 10px solid red;
```

- Style a specific edge

```
border-top-color, border-left-width
```

- Combine edges
  - Top-right-bottom-left

```
border-width: 1px 2px 3px 5px;
```

- Alternative
  - Top & bottom - left & right

```
border-width: 1px 2px;
```

Next session

- JavaScript history and syntax
- Scope, destructuring, and arrow functions
- Dynamic web pages