Programming on the web

CSC309

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Why take a web programming course?

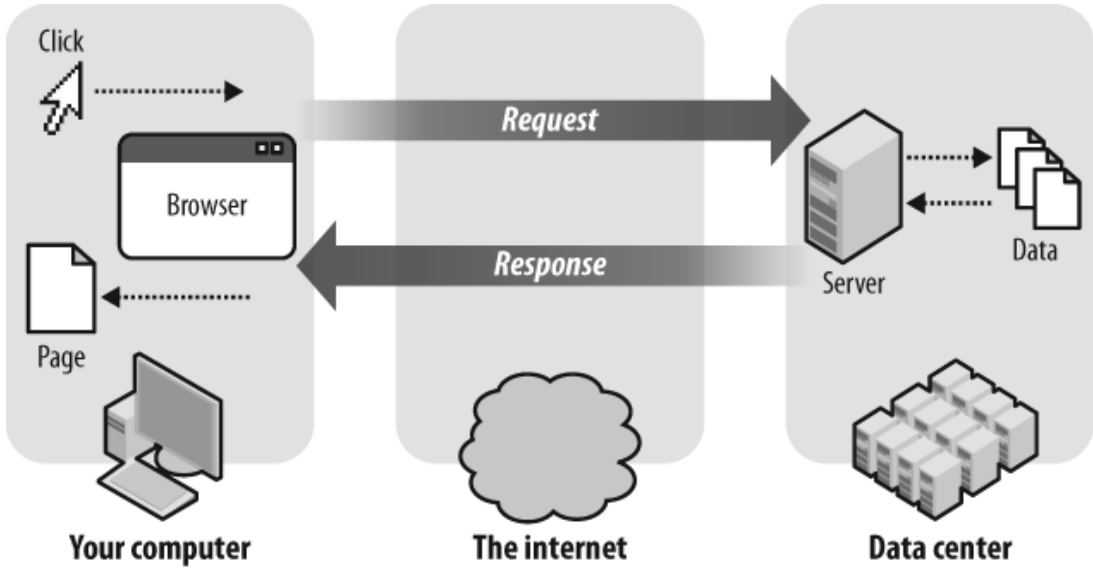
- It revolutionized the world
  - Every human being's life has changed prior to twenty years ago
- Life is unimaginable without internet
- Things are connected and seamless
- The technology behind is truly fascinating
  - We'll learn it in this course

What is it about?

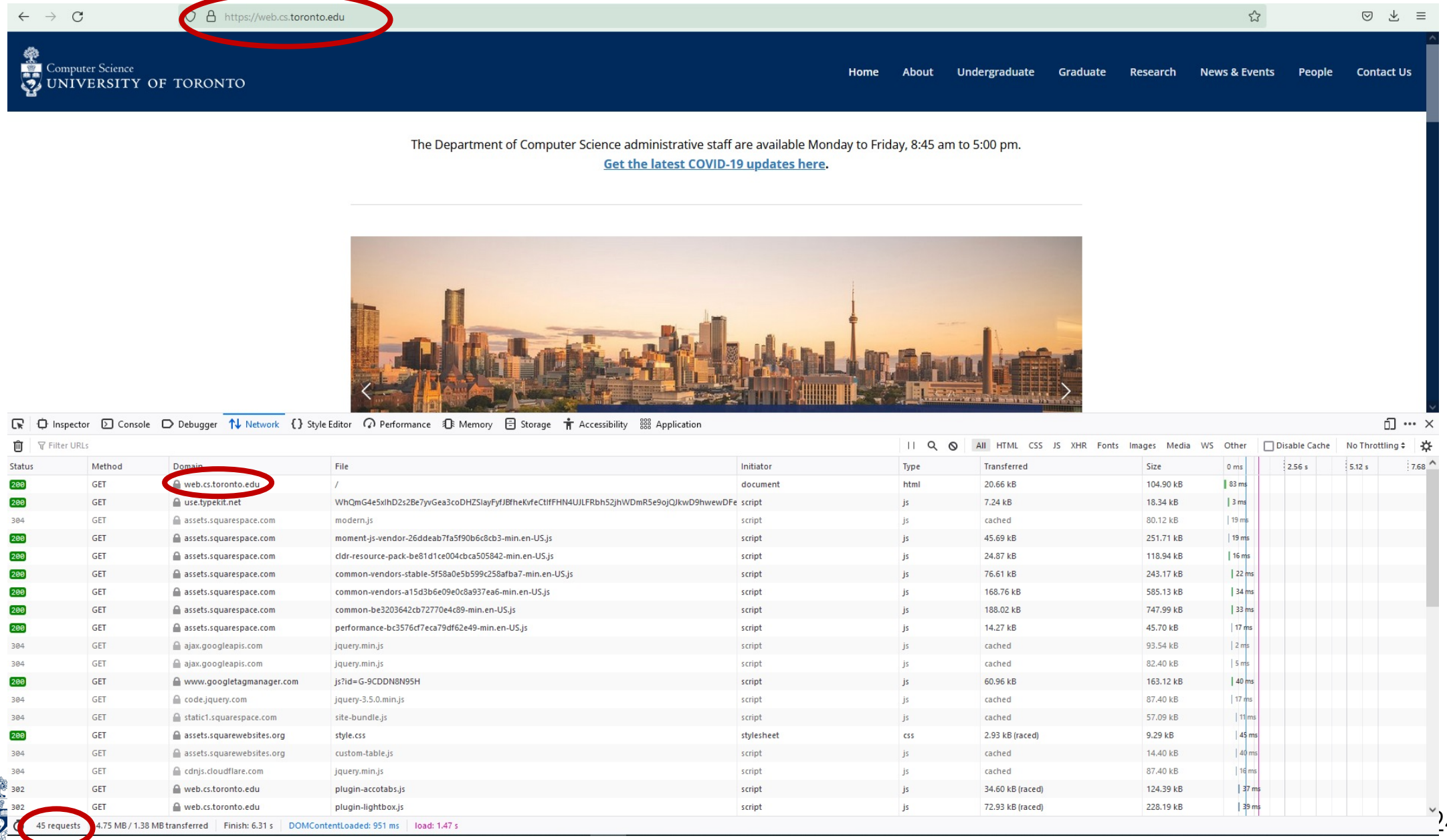
- How does web work?
  - Client/server, browsers, protocols
- Components of a website
  - Server, backend, frontend
- Software design
  - Design models, frameworks, data management
- Website deployment
  - Make your website accessible to the world!

How web works

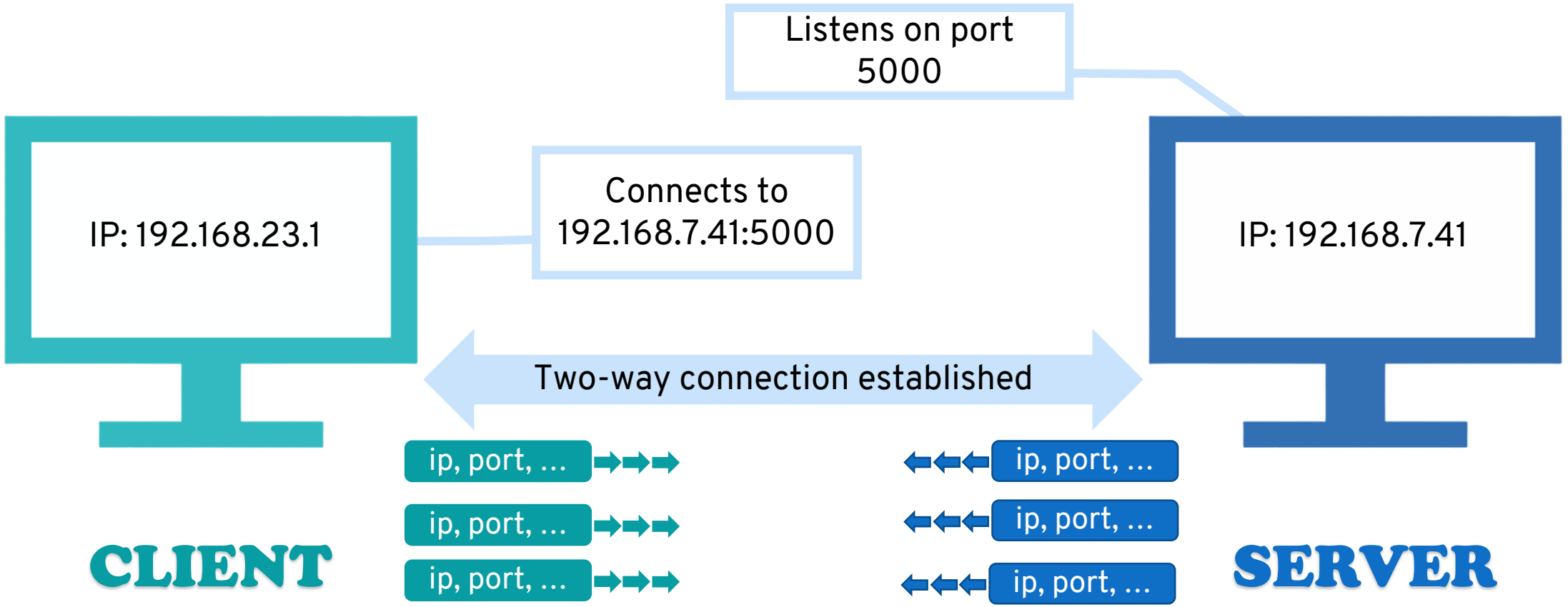
- A lot of things happen when a single webpage is loaded!
- Lots of HTML/CSS/JS is fetched
- All in the form of requests & responses
  - Browser (client) sends requests to one or more servers and receives responses



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

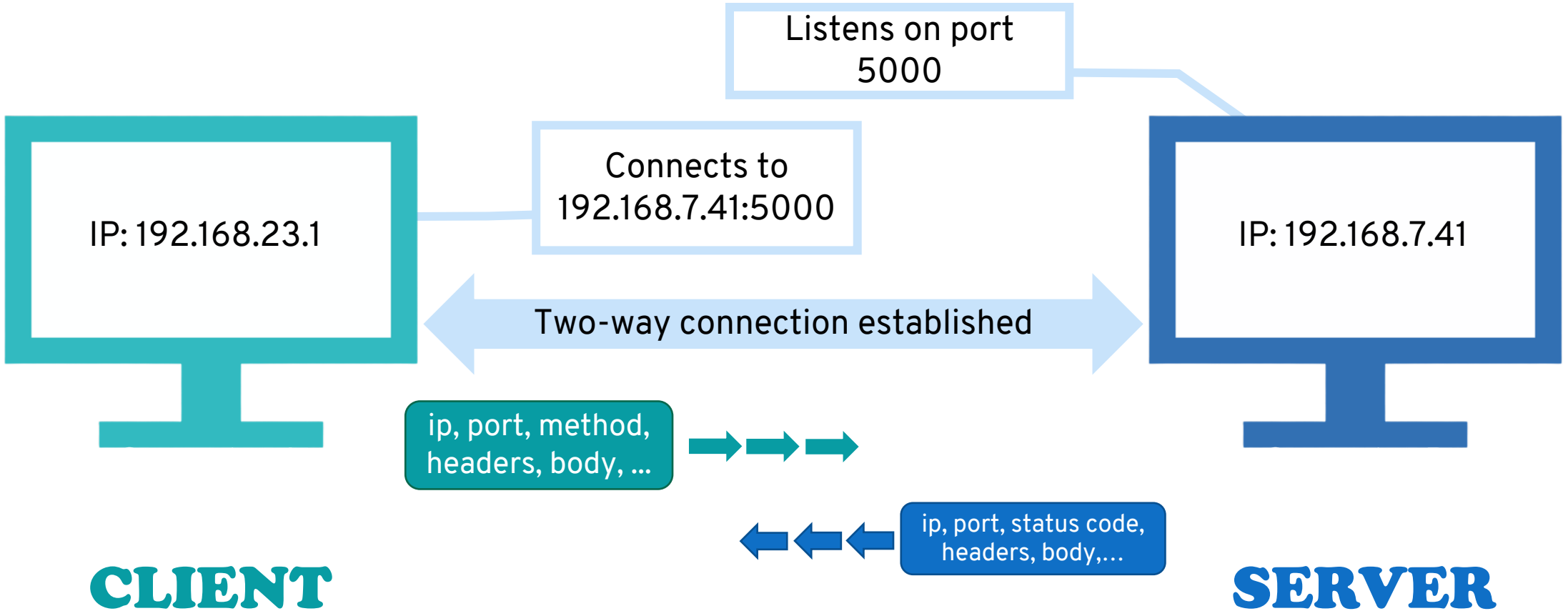
What the server responds depends on previous messages

Server should keep track of thousands of open connections

If connection breaks, all the state is lost

A stateless protocol is preferred

Stateless Protocol

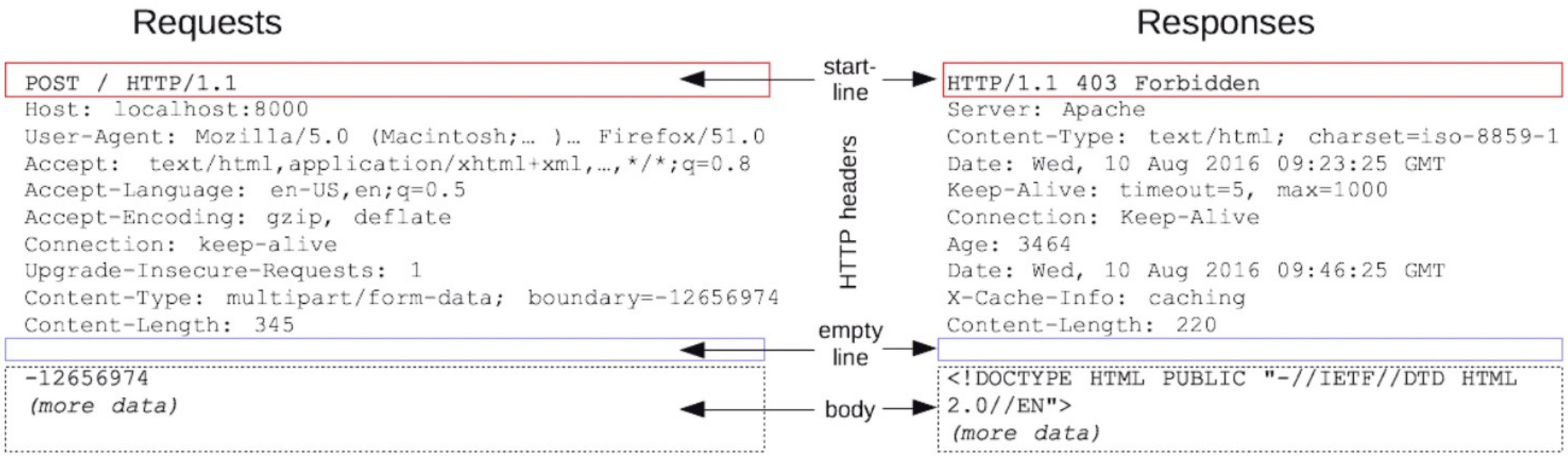


HyperText Transfer Protocol (HTTP)

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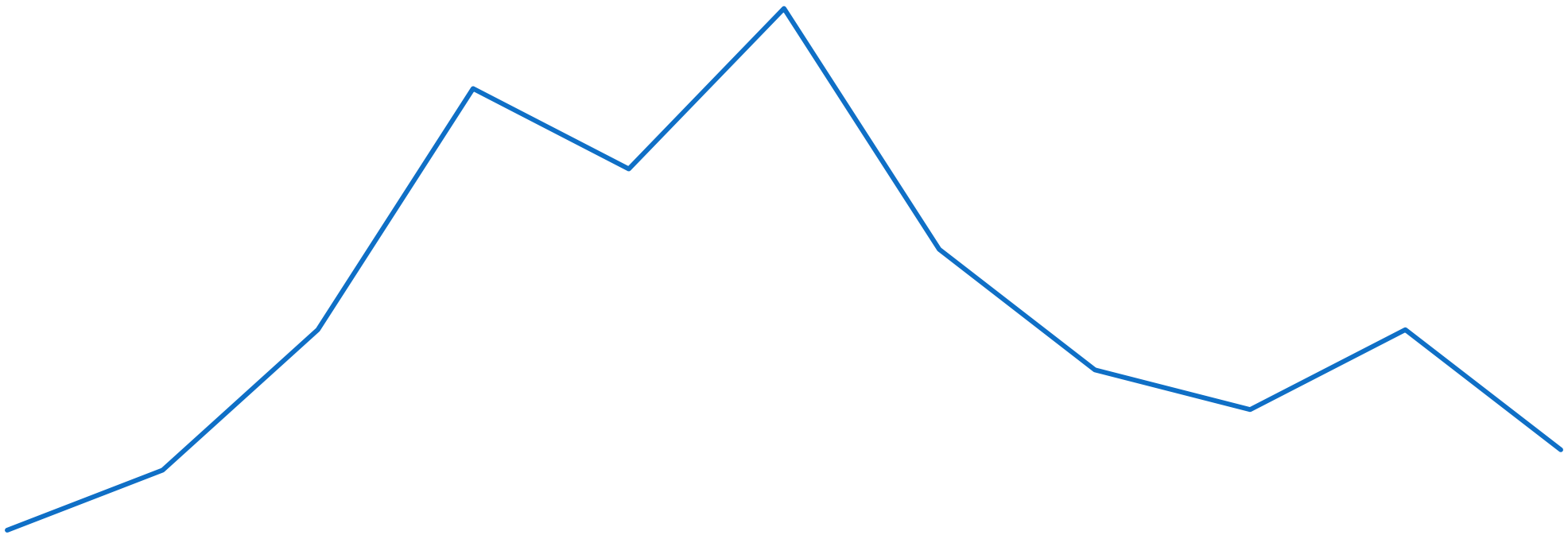
- No prior knowledge/experience in web development is assumed
  - We'll start from scratch!
- However, the course is quite up-to-date!
  - Web in 2024 is so different than in 2000!
  - We will cover latest technologies/frameworks
- It's fast-paced!

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

- Tuesdays and Thursdays 5-7
  - 7-8: Office hours, tutorials, lecture continuation, …

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

Assessment

- Weekly exercises (10%)
  - Educational questions
  - Supplementing lecture material
  - Best 9 out of 11 will count
- Project (50%)
  - A full, real-world web app!
  - Two parts (PP1 20% - PP2 30%)
- Midterm (10%)
  - Oct 1st and 3rd
  - During lecture time
- Final exam (30%)
  - 40% required for passing the course

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 Thursday at 3pm.
  - No extension, tokens, remark request

Project

- A full web app
- 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 5
- Final exam (30%)

Contact points

- Course website
  www.cs.toronto.edu/~kianoosh/courses/csc309/
- Piazza: Announcements + Q&A
  piazza.com/utoronto.ca/fall2024/csc309
- Announcements are NOT copied to Quercus
  to avoid duplication
- Email:
  csc309-2024-09@cs.toronto.edu
- Discord server
  https://discord.gg/XjY5SnFwhY
  Informal Q&A and chat
- Office hours
  - After lectures (7-8)

Course schedule

Lecture Number	Class Dates	Title	Important Events
L01	Sep 3rd, 5th	Intro, HTML, CSS	
L02	Sep 10th, 12th	JavaScript	
L03	Sep 17th, 19th	Node.js, API, Next.js	
L04	Sep 24th, 26th	Async, Models, ORM	
L05	Oct 1st, 3rd	CRUD	Midterm (10%)
L06	Oct 8th, 10th	Auth, migrations	
L07	Oct 15th, 17th	React, JSX	
L08	Oct 22nd, 24th	Monorepo, hooks	PP1 (20%)
Reading week			
L09	Nov 4th, 6th	Typing, advanced CSS	
L10	Nov 11th, 13th	Docker	
L11	Nov 18th, 20st	Deployment	PP2 (30%)
L12	Nov 25th, 27th	Optional topics	

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

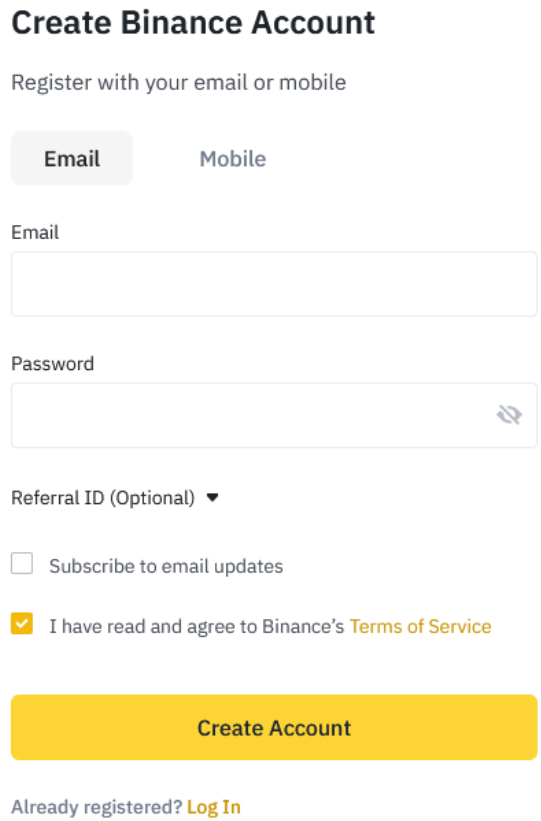
- style attribute
  - Discussed shortly later
- Identifiers: id vs class
- Other attributes: src for <img /> and href for <a>
- You can put any custom attribute you want
  - There's no compilation error!

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

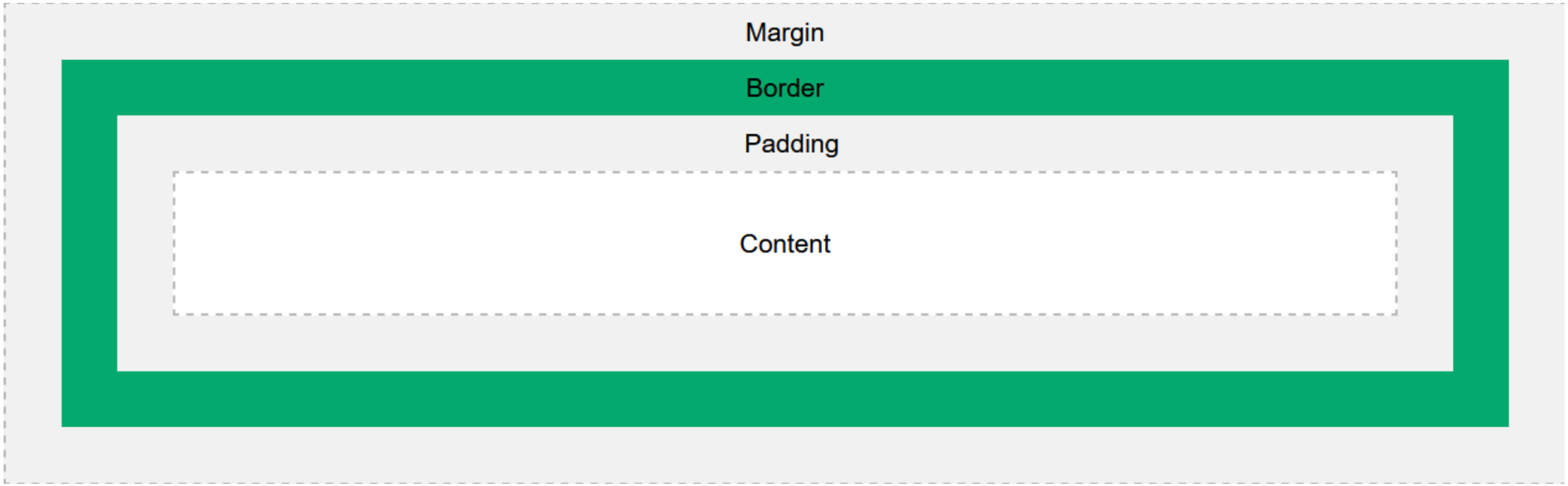
Units

- 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 and closure
- Dynamic web pages