EECS 468
Programming Language Paradigms

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Fall 2023

Reminders

- Assignment 1 due: 11:59 PM, Friday, September 1
- Assignment 2 due: 11:59 PM, Monday, September 11

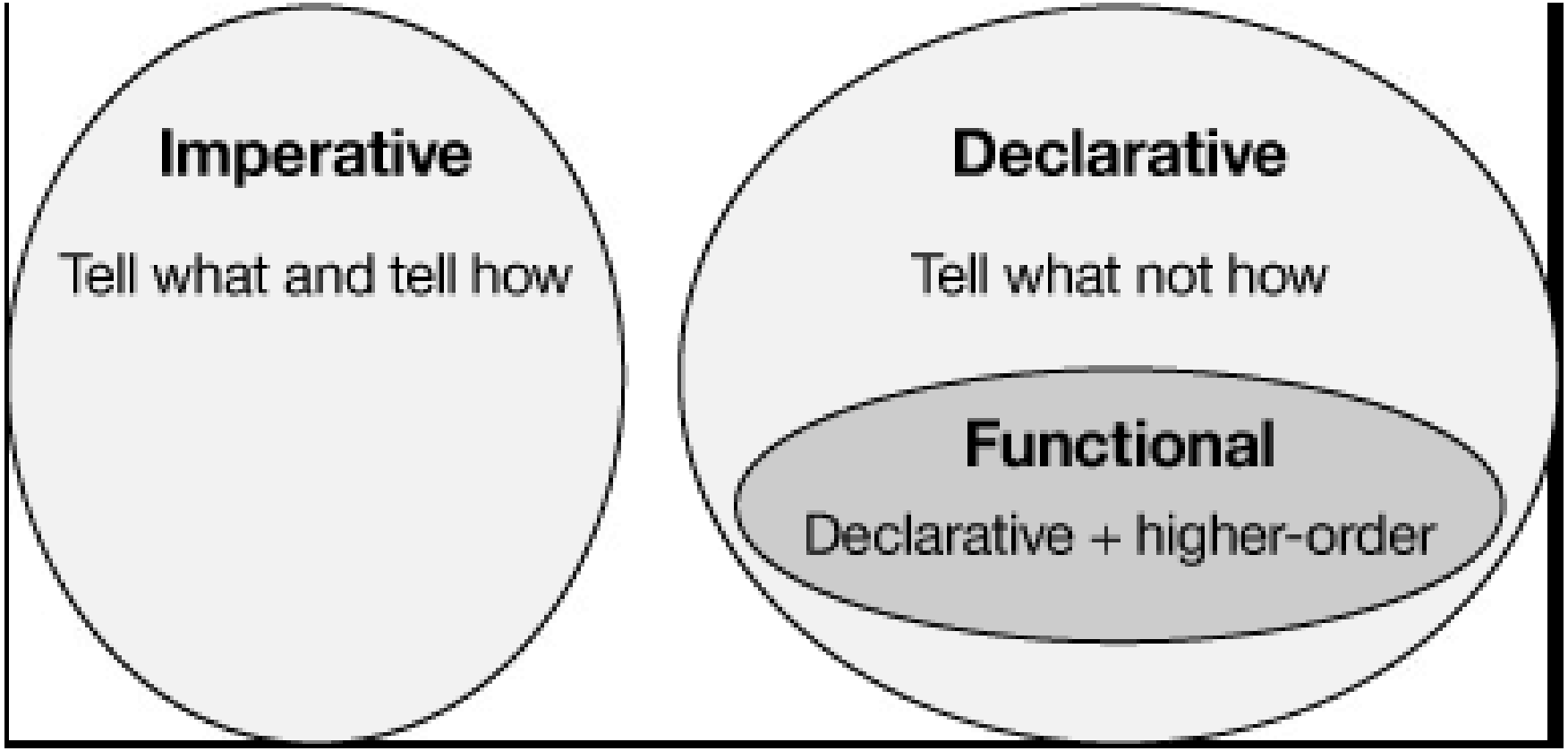
Any Questions?

In-Class Problem Solution

- 1-(8-23) In-Class Problem Solution.pptx

Any Questions?

Imperative vs. Declarative Programming Languages



EECS 468

- We are going to look at two languages in detail
  - JavaScript (Imperative)
  - Haskell (Declarative – Functional)
- We will also look at Cloud Computing from a language point of view.
- We will study several DSLs:
  - JavaScript Support Vector Graphics (SVG)
  - JavaScript Canvas
  - Haskell QuickCheck

What is JavaScript?

- JavaScript was introduced in 1995 as a way to add programs to web pages in the Netscape Navigator browser.
- The language has since been adopted by all other major graphical web browsers.
- It has made modern web applications possible—applications with which you can interact directly without doing a page reload for every action.

What is JavaScript?

- It is important to note that JavaScript has almost nothing to do with the programming language named Java.
- The similar name was inspired by marketing considerations rather than good judgment.
- When JavaScript was being introduced, the Java language was being heavily marketed and was gaining popularity.
- Someone thought it was a good idea to try to ride along on this success.
- Now we are stuck with the name!

What is JavaScript?

- After its adoption outside of Netscape, a standard document was written to describe the way the JavaScript language should work so that the various pieces of software that claimed to support JavaScript were actually talking about the same language.
- This is called the ECMAScript standard, after the Ecma International organization that did the standardization.
- In practice, the terms ECMAScript and JavaScript can be used interchangeably—they are two names for the same language.

What is JavaScript?

- Web browsers are not the only platforms on which JavaScript is used.
- Some databases, such as MongoDB and CouchDB, use JavaScript as their scripting and query language.
- Several platforms for desktop and server programming, most notably Node.js, provide an environment for programming JavaScript outside of the browser.

What is JavaScript?

- JavaScript is very much alive as a language and books (including this one) get out-of-date quickly.
- www3 is a good resource for questions about JavaScript.
- Also just googling your question will result in a plethora of answers.

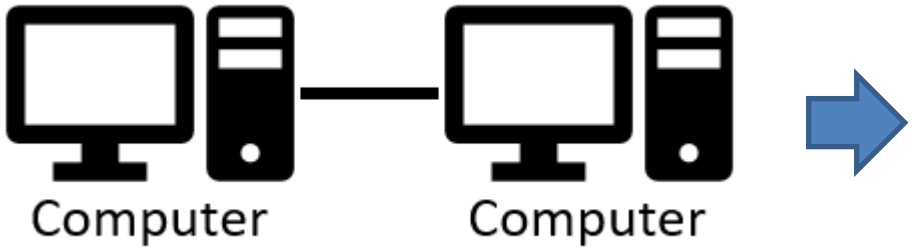
Any Questions?

JavaScript and the Browser

- In EECS 168 and 268, you learned how to write programs that run on one computer.
- For the rest of our time studying JavaScript, we are going to learn how JavaScript is used in modern web applications!

Computer Networks

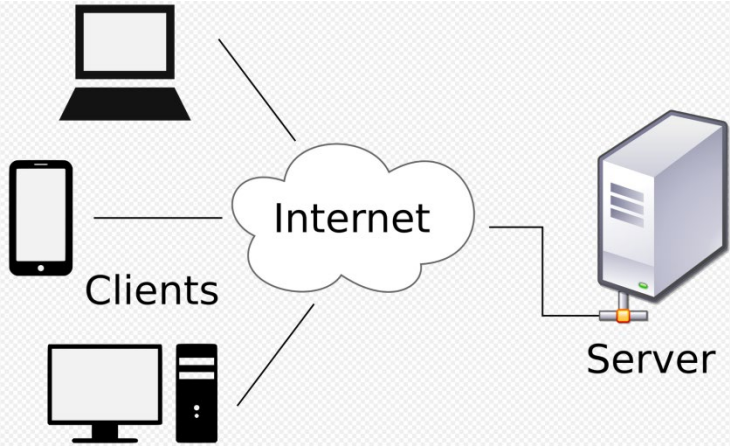
- Computer networks have been around since the 1950s.
- If you put cables between two computers and allow them to send data back and forth through these cables, you can do all kinds of wonderful things.
- And if connecting two machines in the same building allows us to do wonderful things, connecting machines all over the planet should be even better.
- The technology to start implementing this vision was developed in the 1960s, and the resulting network is called the Internet.
- It has lived up to its promise.



Client-Server Architecture

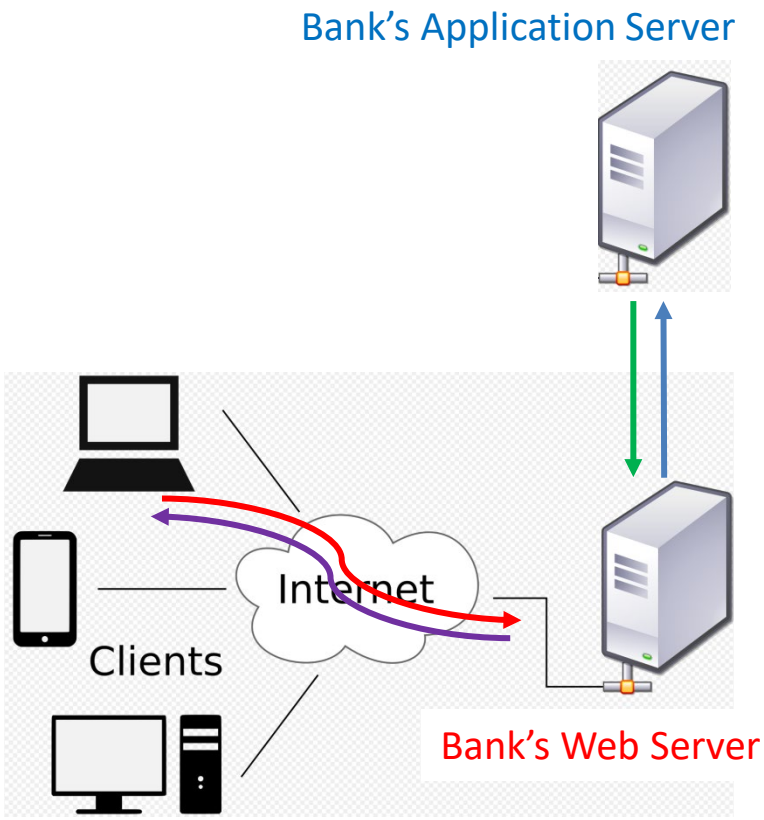
Modern web applications are based on the Client-Server Architecture

- Servers:
  - Provide resources or services
  - Await incoming requests from clients
  - For example: Canvas service where all your grades and my lectures are stored
- Clients:
  - Request a resource or service
  - Initiate communication sessions with servers
  - Canvas app on your phone that retrieves your grades and my lectures
- Communicate over:
  - Computer network (e.g., Internet)
- Examples:
  - Email
  - Network printing
  - Web or phone apps



Client-Server Example

- Bank customer accesses online banking services with a web browser (the client)
- Client initiates a login request to the bank's Web Server.
- Customer's login credentials may be stored in a database on an Application Server
- Web Server accesses the Application Server as a client.
- Application Server verifies the customer's login credentials and provides the output to the Web Server.
- Finally, the Web Server returns the result to the client web browser for display.
- In each step of this sequence of client-server message exchanges, a computer processes a request and returns data.
- This is the request-response messaging pattern.



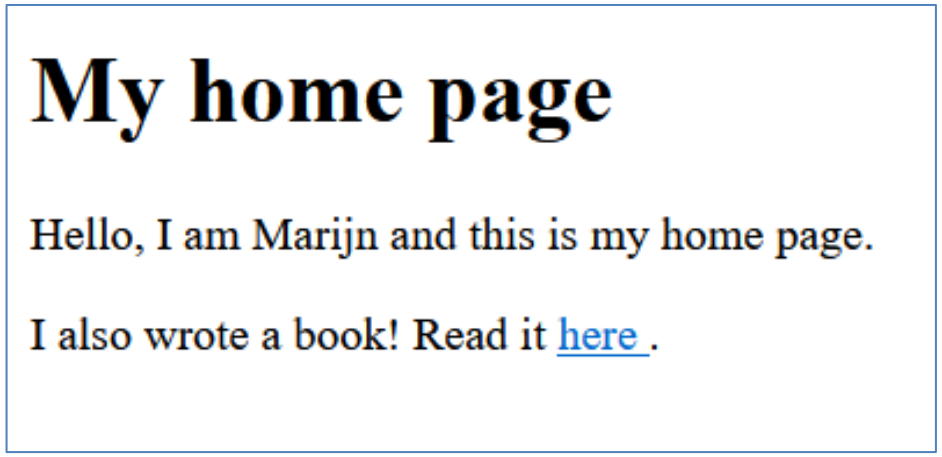
Any Questions?

Hypertext Markup Language (HTML)

- HTML is the document format used for web pages.
- HTML is not a network protocol.
- It is the language in which webpages are written.
- An HTML document contains text, as well as tags that give structure to the text, describing things such as links, paragraphs, and headings.
- The tags, wrapped in angle brackets (< and >), provide information about the structure of the document.
- The other text is just plain text.

```
<!doctype html>
<html>
 <head>
  <meta charset="utf-8">
  <title>My home page</title>
 </head>
 <body>
  <h1>My home page</h1>
  <p>
  Hello, I am Marijn and this is my home page.
  </p>
  <p>
  I also wrote a book! Read it
   <a href="http://eloquentjavascript.net">
   here
   </a>.
  </p>
 </body>
</html>
```

Hypertext Markup Language (HTML)

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Hypertext Markup Language (HTML)

- The document starts with <!doctype html>, which tells the browser to interpret the page as modern HTML, as opposed to various dialects that were in use in the past.
- HTML documents have a head and a body.
- The head contains information about the document.
- The body contains the document itself.

```
<!doctype html>
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```

Hypertext Markup Language (HTML)

- In this case, the head declares:
  - It uses the UTF-8 encoding, which is a way to encode Unicode text as binary data.
  - The title of this document is “My home page”
  - The title is what will be displayed on the browser tab.
- The document’s body contains:
  - A heading (<h1>, meaning “heading 1”)
    - <h2> through <h6> produce subheadings
  - Two paragraphs (<p>).

```
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  Hello, I am Marijn and this is my home page.
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   here
   </a>.
  </p>
 </body>
</html>
```

Hypertext Markup Language (HTML)

Tags come in several forms:

- An element, such as the body, a paragraph, or a link, is started by an opening tag like and ended by a closing tag like .
- Some kinds of tags do not enclose anything and thus do not need to be closed. The metadata tag <meta charset="utf-8"> is an example of this.
- Some opening tags, such as the one for the link (<a>), contain extra information in the form of name="value" pairs.
- These are called attributes.
- In this case, the destination of the link is indicated with href="http://eloquentjavascript.net", where href stands for “hypertext reference”.

```
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<html>
 <head>
  <meta charset="utf-8">
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```

Any Questions?

HTML and JavaScript

- In the context of this course, the most important HTML tag is <script>.
- This tag allows us to include a piece of JavaScript in a document.

```
<h1>Testing alert</h1>
<script>alert("hello!");</script>
```

- Such a script will run as soon as its <script> tag is encountered while the browser reads the HTML.
- This page will pop up a dialog when opened—the alert function resembles prompt, in that it pops up a little window, but only shows a message without asking for input.
- A script tag must always be closed with </script>, even if it refers to a script file and doesn't contain any code.
- If you forget this, the rest of the page will be interpreted as part of the script.

HTML and JavaScript

- Including large programs directly in HTML documents is often impractical.
- The <script> tag can be given an src attribute to fetch a script file (a text file containing a JavaScript program) from a URL.

```
<h1>Testing alert</h1>
<script src="code/hello.js"></script>
```

- The code/hello.js file included here contains the same program—alert("hello!").
- When an HTML page references other URLs as part of itself …
  - for example, an image file or a script
- … web browsers will retrieve them immediately and include them in the page.

HTML and JavaScript

- Some attributes can also contain a JavaScript program.
- The <button> tag shown next (which shows up as a button) has an onclick attribute.
- The attribute's value will be run whenever the button is clicked.

```
<button onclick="alert('Boom!');">DO NOT PRESS</button>
```

- Use single quotes for the string in the onclick attribute…
- …because double quotes are already used to quote the whole attribute.

HTML and JavaScript

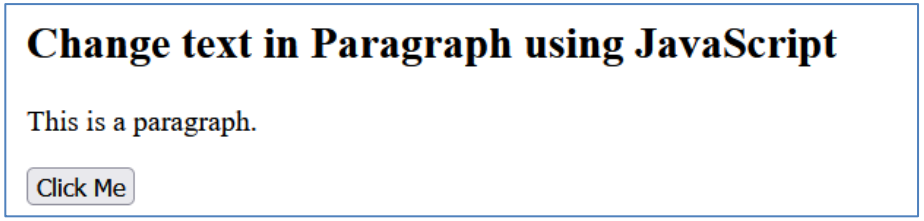
We can make this more extensible by calling a JavaScript function.

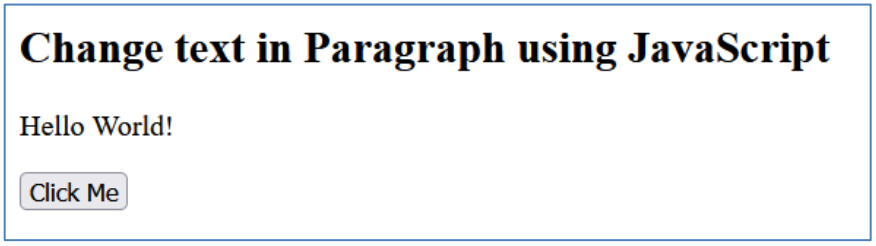
```
<button onclick="myFunc()">DO NOT PRESS</button>
<script>
   function myFunc()
   {
      alert("Boom!");
   }
</script>
```

HTML and JavaScript

This is a more sophisticated example of changing the text in a paragraph.

```
<h2>Change text in Paragraph using JavaScript</h2>
  <p id="myPara">This is a paragraph.</p>
  <button type="button" onclick="changeText()">Click Me</button>
  <script>
  function changeText(){
     var element = document.getElementById("myPara");
     element.innerHTML = "Hello World!";
  }
  </script>
```





Any Questions?

JavaScript/HTML Programs

- The easiest way to create a JavaScript/HTML program is with a simple text editor, like NotePad for Windows.
- Save the file with an .html extension and double click on it to execute it.
- Double clicking on the .html file is how your Programming Assignments 1-6 will be graded.

Note:

- Past students have had problems running HTML/JavaScript code in Visual Studio.
- You can use Visual Studio to write the code but test it by double clicking on the .html file.
- Chrome does not support all of the JavaScript features we will be using, so use another browser to test your code.

Any Questions?

In-Class Problem

- A "Hello, World!" program generally is a computer program that outputs or displays the message "Hello, World!".
- Such a program is very simple in most programming languages.
- It is often used to illustrate the basic syntax of a programming language.
- It is often the first program written by people learning to code a new language.
- It can also be used as a sanity test to make sure that computer software intended to compile or run source code is correctly installed, and that the operator understands how to use it.

- Write a “Hello World!” program in HTML.

- For full credit, include:
  - Tag that tells the browser to interpret the page as modern HTML.
  - Header and body.
  - Tag that tells the browser that the character set is “utf-8”.
  - Tag that will display “Hello World!” on the browser tab.
  - Tags that will display “Hello World!” in the browser window.