# The World Wide Web (WWW)

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# Background

- Enormously popular application that provides a tremendous wealth of information
- Origins: 1989 Tim Berners-Lee (CERN) proposed mechanism to distribute high-energy physics data (reports, photos, blueprints etc)
  - Proposal eventually lead to World Wide Web (WWW)
- 1993, first graphical browser Mosaic was released
- 1994, W3C (world wide web consortium) was formed to develop web and standards

# Jargon

- **Web page** consists of base **HTML** file which includes several referenced **objects**
  - Object can be other HTML files, JPEG images, Java applets, audio files,……
  - Text/Image that links to another page is called a **hyperlink** (often highlighted by some means)
- Each object is addressable by a **URL** (Uniform Resource Locator)
  - E.g. http://www.iitb.ac.in/images/header/iitb_logo.gif

Protocol

Host Name

Path

# Jargon

- Web pages are viewed by a program called a **browser**
  - E.g. Internet Explorer, Google Chrome, Mozilla Firefox
- Web pages are written in Hyper Text Markup Language (**HTML**)
  - Describes the structure of a web page using tags
  - Tags: insert paragraphs ( para ), insert images (<img src="url">), include code (<script>code</script>)
- HTML, CSS and Javascript form a technology triad to enable web

# Sample HTML

Run »

```html
<!DOCTYPE html>
<html>
<head>
<title>Page Title</title>
</head>

<body>

<h1>This is a Heading</h1>
<p>This is a paragraph.</p>

</body>
</html>
```

## This is a Heading

This is a paragraph.

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

# Cascading Style Sheets (CSS)

- Used for describing the presentation of a document (layout, colors, fonts etc)
- Separates document content from presentation.

```
body {
   background-color: lightblue;
}
h1 {
   color: navy;
   margin-left: 20px;
}
```

See Demo:
https://www.w3schools.com/css/css_intro.asp

# Javascript

- Javascript (nothing to do with java) is a scripting language
- Permits developers to present interactive and dynamic web content
  - Example: On mouse over, pop up window.

```
< script type="text/javascript" >
function hello() { alert("Hello world!" ); }
< /script>
< img src="picture.jpg"
onMouseOver="javascript:hello()" >
```

Run »

```
<!DOCTYPE html>
<html>
<body>

<h2>My First JavaScript</h2>

<button type="button"
onclick="document.getElementById('demo').innerHTML = Date()">
Click me to display Date and Time.</button>

<p id="demo"></p>

</body>
</html>
```

## My First JavaScript

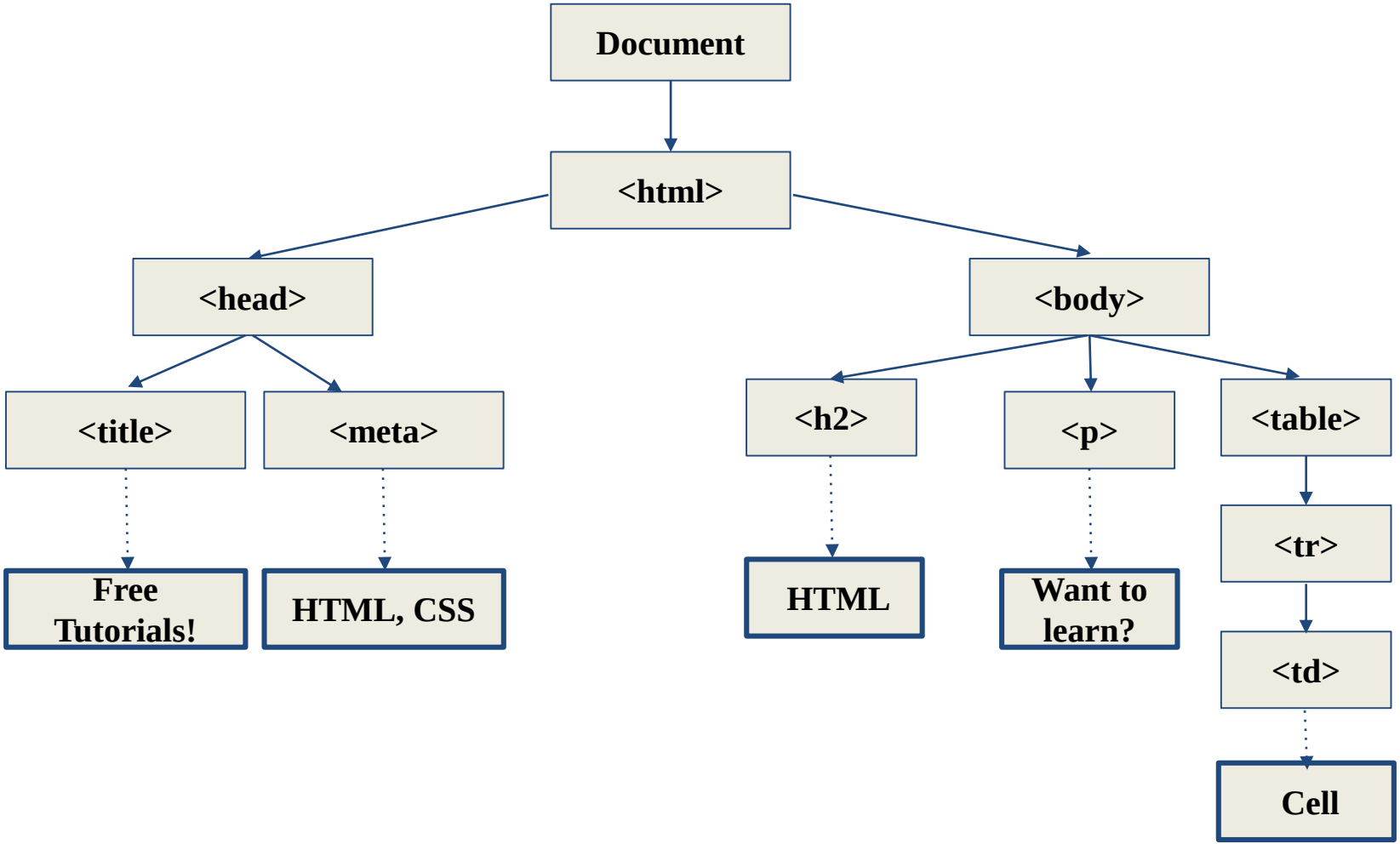
Click me to display Date and Time.

Fri Oct 18 2019 07:53:39 GMT+0530 (India Standard Time)

https://www.w3schools.com/js/tryit.asp?filename=tryjs_myfirst

# Document Object Model (DOM)

- An application programming interface (api) that extracts a tree structure out of HTML
  - Each node is an object representing a part of the document
  - Objects can be manipulated programmatically vis JavaScript


Document
<html>
<head>
<body>
<title>
<meta>
<h2>
<p>
<table>
<tr>
<td>
Free Tutorials!
HTML, CSS
HTML
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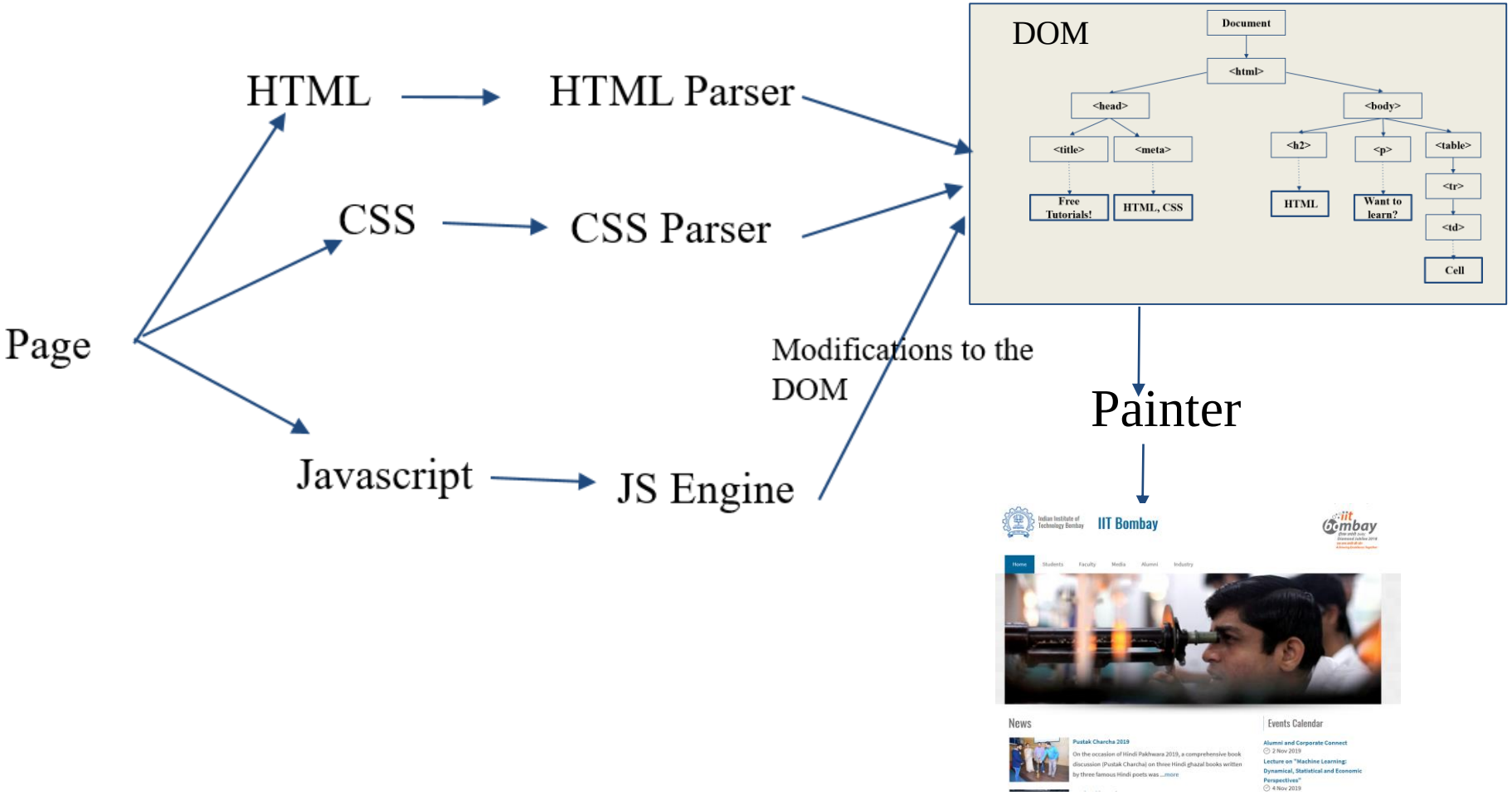
Page
HTML
HTML Parser
CSS
CSS Parser
Javascript
JS Engine
Modifications to the DOM
DOM
Document
<html>
<head>
<body>
<title>
<meta>
<h2>
<p>
<table>
<tr>
<td>
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HTML
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IIT Bombay
Home
Students
Faculty
Media
Alumni
Industry
News
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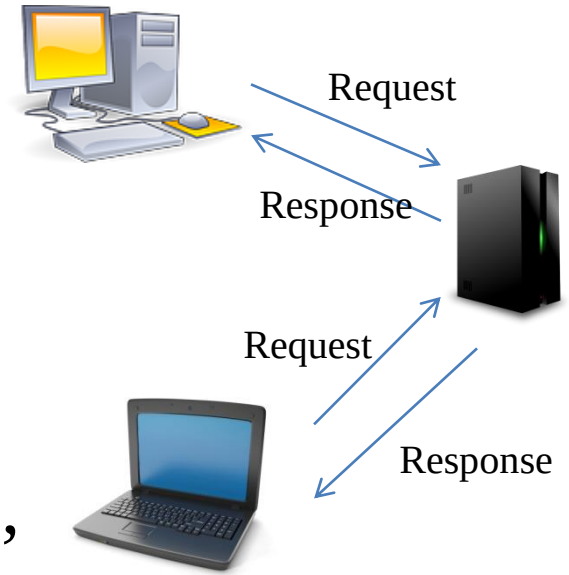
Pustak Charcha 2019
Alumni and Corporate Connect
Lecture on "Machine Learning: Dynamical, Statistical and Economic Perspectives"

# Plugins/Helpers

- Plugins: Code-module which run within the browser
  - Plugin is removed from browser's memory after job done
  - E.g. Flash player, java plugin
- Helper Applications: A complete program that runs as a separate process
  - E.g. Acrobat reader for pdf; Microsoft word for .doc

# Hyper Text Transfer Protocol (HTTP)

- The protocol employed by Web application
- Based on client-server model
  - Client (browser) requests web objects
  - Server responds with status code and requested object (if present)
- Operates over TCP, server port 80 (http), 443 (https)
- Stateless protocol i.e. no user information stored across requests



# HTTP Message Format

- Two types of messages: Request and Response
- Request Message:

GET /~chebrolu/ HTTP/1.1
Host: www.cse.iitb.ac.in
User-agent: Mozilla/5.0
Connection: close
Accept-language: fr
(blank line)

Header Lines

Request Line

| | | | | | | |
|---|---|---|---|---|---|---|
| Method | sp | URL | sp | Version | cr | lf |
| Header field name: | sp | Value | cr | lf | | |
| Header field name: | sp | Value | cr | lf | | |
| Header field name: | sp | Value | cf | lf | | |
| cr | lf | | | | | |
| Entity Body | | | | | | |

# Methods

| Method | Description |
|---|---|
| GET | Request for a web object |
| HEAD | Request for header fields (no body); Useful for debugging, get time of last modification |
| PUT | Upload an object to a specified path on a web server; body of request contains the object; used with web publishing tools |
| POST | Similar to PUT, except that object contained in body is “appended”; often used when user fills forms; |
| DELETE | Remove the object |
| TRACE | Asks server to echo incoming request; Useful for debugging |
| CONNECT | Used to facilitate secure connection when using Proxy servers |
| OPTIONS | Query server about its properties or that of an object |
| PATCH | Similar to PUT except permits partial modification to an object instead of a full replacement |

# Web Forms

- Allows users to upload content in the form of name-value pairs to a web server
- Can be achieved both via GET and POST
  - GET (preferable for querying database) http://www.example.com/form.php?name=pappu&age=53
  - POST: name, value is included in the request body (preferable when there is a resulting action, e.g. sending email or writing to database)
    - Accidental navigation that triggers GETs does not mess things up

# Response Message Format

Response Line

HTTP/1.1 200 OK
Date: Sat, 02 Nov 2013 12:31:22 GMT
Server: Apache
Last-Modified: Fri, 02 Jan 2009 15:55:54 GMT
ETag: "424c001-fd-f9d8d680"
Accept-Ranges: bytes
Content-Length: 253
Content-Type: text/html; charset=UTF-8

Header Lines

data data data data data ...

| | | | | | | |
|---|---|---|---|---|---|---|
| Version | sp | Status Code | sp | Phrase | cr | lf |
| Header field name: | sp | Value | cr | lf | | |
| Header field name: | sp | Value | cr | lf | | |
| Header field name: | sp | Value | cr | lf | | |
| cr | lf | | | | | |
| Entity Body | | | | | | |

# Sample Status Code and Phrases

| Status Code | Phrase | Description |
|---|---|---|
| 200 | OK | Request successful, information enclosed |
| 301 | Moved Permanently | Object moved; new url under Location: |
| 400 | Bad Request | Request could not be understood |
| 404 | Not Found | Requested object not found on server |
| 503 | Service Unavailable | Server is currently unavailable (overloaded) |
| 505 | HTTP Version not supported | Server does not support the HTTP version |

# Web Sessions and Cookies

- Session captures interaction between client and server
- Client information often should persist across loading of various web pages
  - E.g. User is authenticated or items in cart
- But HTTP is a stateless protocol. What to do?

# Use of GET/POST

- Server generates some invisible code capturing user's session information
- Inserts it into page delivered to client using hidden fields
- Each time user navigates to a new page, code (executed by browser) passes the user's session information to server
- The cycle repeats
- This method is particularly susceptible to man-in-the-middle attacks unless HTTPs is used

# Cookies

- Server sends ‘small amount of data (cookie)’ to store at client
- Every time client contacts the server (same domain), browser sends cookie (of the domain) to server

# Cookie Structure

Browsers need to support at least 4KB cookie size

- Name of cookie
- Value of cookie
- Expiry of cookie
- Path the cookie is good for
- Domain of the cookie
- Type of connection needed

If no expiration date, cookie deleted when user exits browser → **Nonpersistent Cookie**

# Example

- Browser to Server

  Post /users/info HTTP/1.1

  [form contents which includes user identification]

- Server to Browser

  HTTP/1.1 200 OK

  Set-Cookie: Customer=“Pappu”

  (Server also maintains an entry in backend database)

# Example

- Browser to Server

  GET /info.html HTTP/1.1

  Cookie: Customer=“Pappu”

[Server accesses backend to retrieve information logged and acts accordingly]

# Things to Note

- Only hosts within a domain can set a cookie for that domain
- A subdomain can set a cookie for a higher-level domain, but not vice versa
  - mail.example.com could access cookies set for example.com or mail.example.com
  - example.com cannot access cookies set for mail.example.com
- Normally cannot set cookies for top-level domains such as .edu or .com (enforced at the browser level)

- Path field: cookie can be accessed within a specific subdirectory of the web site
  - Defaults to the root directory of a given domain
- Secureflag: Cookie be transmitted using HTTPS
- HTTP-Onlyflag: scripting languages cannot access/manipulate cookies stored on the client

# Session ID/Token

- Associates a given session with a particular client via a unique identifier (Id or token)
- Server sets this via a non-persistent cookie (server may also use persistent cookies on top)
- A session ID should be hard to guess (hence random; sometimes protected by MAC)

# Summary

- Web provides a tremendous wealth of information
- HTML, CSS and Javascript triad help enable web
- HTTP protocol helps in client-server communication
  - Methods, Forms, Cookies and Tokens