Number Systems

A number system defines a way to represent numbers using a set of digits or symbols. The most common number systems are **Decimal**, **Binary**, **Hexadecimal**, and **Octal**.

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1. Decimal Number System (Base 10)

- **Digits used**: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9
- **Base**: 10
- **Description**: The decimal system is the most commonly used number system in everyday life. It is a positional number system, meaning that the value of a digit depends on its position in the number.

Example:

The decimal number `253` is calculated as:

```
253_{10} = 2 * 10^2 + 5 * 10^1 + 3 * 10^0 = 200 + 50 + 3 = 253
```

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2. Binary Number System (Base 2)

- **Digits used**: 0, 1
- **Base**: 2
- **Description**: The binary system is used in computers and digital systems. It only uses two digits: 0 and 1. Each binary digit is called a **bit**.

Example:

The binary number `1011` is calculated as:

```
1011_{2} = 1 * 2^3 + 0 * 2^2 + 1 * 2^1 + 1 * 2^0 = 8 + 0 + 2 + 1 = 11_{10}
```

---

3. Hexadecimal Number System (Base 16)

- **Digits used**: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F
  - **A** = 10, **B** = 11, **C** = 12, **D** = 13, **E** = 14, **F** = 15
- **Base**: 16

- **Description**: The hexadecimal system is often used in computing to represent large binary numbers in a more compact form. Each hexadecimal digit represents 4 bits.

Example:

The hexadecimal number `2A3` is calculated as:

```
2A3_{16} = 2 * 16^2 + A * 16^1 + 3 * 16^0 = 2 * 256 + 10 * 16 + 3 = 512 + 160 + 3 = 675_{10}
```

---

4. Octal Number System (Base 8)

- **Digits used**: 0, 1, 2, 3, 4, 5, 6, 7
- **Base**: 8
- **Description**: The octal system is another positional system that is often used in computing. Each octal digit represents 3 bits.

Example:

The octal number `745` is calculated as:

```
745_{8} = 7 * 8^2 + 4 * 8^1 + 5 * 8^0 = 7 * 64 + 4 * 8 + 5 = 448 + 32 + 5 = 485_{10}
```

Conversion Between Number Systems

Decimal to Binary

1. Divide the decimal number by 2.
2. Record the remainder (0 or 1).
3. Continue dividing the quotient by 2 until the quotient is 0.
4. The binary number is the remainders read from bottom to top.

Binary to Decimal

1. Multiply each binary digit by 2^{n} where **n** is the position (starting from 0 on the right).
2. Sum the results.

Decimal to Hexadecimal

1. Divide the decimal number by 16.

2. Record the remainder (0-9, A-F).
3. Continue dividing the quotient by 16 until the quotient is 0.
4. The hexadecimal number is the remainders read from bottom to top.

Hexadecimal to Decimal

1. Multiply each hexadecimal digit by 16^{n} where **n** is the position (starting from 0 on the right).
2. Sum the results.

Binary to Hexadecimal

1. Group the binary number into sets of 4 bits (starting from the right).
2. Convert each group of 4 bits into its hexadecimal equivalent.

Hexadecimal to Binary

1. Convert each hexadecimal digit into its 4-bit binary equivalent.

Octal to Binary

1. Convert each octal digit into its 3-bit binary equivalent.

Binary to Octal

1. Group the binary number into sets of 3 bits (starting from the right).
2. Convert each group of 3 bits into its octal equivalent.

Summary Table

Number System	Base	Digits Used
Decimal	10	0-9
Binary	2	0, 1
Hexadecimal	16	0-9, A-F
Octal	8	0-7

By understanding these systems and how to convert between them, you'll have a solid foundation for working with different numerical representations, especially in computing and digital electronics.

Reference video: https://www.youtube.com/live/Zyq1se36z0Q?feature=shared

Agenda: Discussion on Basic HTML and CSS Static Website and Week 2 summary

Overview of HTML and CSS

HTML (HyperText Markup Language) is the standard language used to create web pages. It structures the content on the page using elements like headings, paragraphs, links, and lists.

CSS (Cascading Style Sheets) is used to style the HTML elements. It defines how HTML elements should look in terms of layout, colors, fonts, and spacing.

Breakdown of the Code

1. Profile Page (index2.html)

```
<!DOCTYPE html>
<html lang="en">
<head>
    <link rel="stylesheet" href="style.css">
    <title>Profile Page</title>
    <style>
        /* CSS styles defined here */
        #main{width:500px;height:750px;margin:auto;padding: 15px;}
        .head{width:300px;padding:5px;}
        #propic{width:150px;}
        img{width:150px; height:150px;}
    </style>
</head>
<body>
  <div id="main">
    <div id="header" style="display: flex">
        <div id="propic" class="head">
            <img src="propic.png" alt="profile-image">
        </div>
        <div id="name" class="head">
            <h1>Robert Smith</h1>
            <h4>Senior Vice President</h4>
            <h4>Zoozle Co.</h4>
        </div>
    </div>

    <div id="content">
        <h1>Career Summary</h1>
        <p>My name is Robert Smith. I am a Senior Vice President at Zoozle Co. contributing
to Product Accessibility & Inclusive Design...</p>
        <h1>Other Links</h1>
        <ul>
            <li><h4><a href="award2.html">Achievements</a></h4></li>
            <li><h4><a href="edu2.html">Education</a></h4></li>
            <li><h4><a href="client2.html">Clients</a></h4></li>
        </ul>

        <h1>Contact</h1>
```

```
        <address>
            45555 West First Street<br>
            Middletown, Michigan 45555<br>
            <br>
            7850-999966 (Mon-Fri 9am-6pm)<br>
            rsmith@zoozle.co<br>
        </address>
    </div>
    <div id="footer">
        <h5> &copy; Robert Smith | Zoozle Co. </h5>
    </div>
  </div>
</body>
</html>
```

Explanation:

- **`<!DOCTYPE html>`: This declaration defines the document type and version of HTML. Here, it indicates that the document is an HTML5 document.**
- **`<html lang="en">`: This tag wraps the entire document and specifies that the language of the document is English.**
- **`<head>` Section: Contains meta-information about the HTML document, such as the title and linked stylesheets. The `<link>` tag references an external CSS file (`style.css`), and `<style>` contains internal CSS for specific styles.**
- **`<body>` Section: Contains the content that will be displayed on the web page.**
- **`<div id="main">`: This creates a container for the main content of the page. The `id` attribute allows CSS to target this specific `<div>`.**
- **Profile Information: The profile picture and name are displayed using nested `<div>` elements and headings (`<h1>`, `<h4>`). The `img` tag is used to display the profile picture.**
- **Career Summary: A section that provides an overview of Robert Smith's career.**
- **Other Links: A list (`<ul>`) of links to other pages (Achievements, Education, Clients) using `<a>` tags.**
- **Contact Information: Presented using the `<address>` tag for semantic meaning.**
- **Footer: Contains copyright information.**

2. Education Page (edu2.html)

```
<!DOCTYPE html>
<html>
  <body>
    <div>
    <div>
      <a href="index2.html">Home</a> | <a
href="award2.html">Achievements</a> | <a href="client2.html">Clients</a>
    </div>
    <div>
      <h1>Education</h1>
      <ul>
        <li>Master of Business Administration, University of London</li>
        <li>Master of Arts, University of Michigan</li>
        <li>Bachelor of Arts, University of Michigan</li>
      </ul>
    </div>
    <div>
      <h5> &copy; Robert Smith | Zoozle Co. </h5>
    </div>
    </div>
  </body>
</html>
```

Explanation:

- **This page lists Robert Smith's educational background.**
- **Similar structure to the main page with links to other pages for easy navigation.**

3. Clients Page (client2.html)

```
<!DOCTYPE html>
<html>
  <body>
    <div>
    <div>
      <a href="index2.html">Home</a> | <a
href="award2.html">Achievements</a> | <a href="edu2.html">Education</a>
    </div>
    <div>
      <h1>Clients</h1>
      <ol type="i">
        <li>Media Magic</li>
        <li>The organizers</li>
        <li>Zoo digital productions</li>
      </ol>
    </div>
    <div>
      <h5> &copy; Robert Smith | Zoozle Co. </h5>
    </div>
    </div>
  </body>
</html>
```

Explanation:

- **This page lists the clients Robert has worked with.**
- **Uses an ordered list (`<ol>`) to display clients.**

4. Achievements Page (awards2.html)

```
<!DOCTYPE html>
<html lang="en">
<head>
    <title>Achievements</title>
</head>
<body>
<div id="main">
    <div id="header">
        <a href="index2.html">Home</a> | <a href="edu2.html">Education</a>
| <a href="client2.html">Clients</a>
    </div>
    <div id="content">
        <h1>Awards</h1>
        <table border="1" cell-spacing="0px">
           <tr>
            <th>Award</th>
            <th>Year</th>
           </tr>
           <tr>
            <td>Top Office Broker award</td>
            <td>2022, 2023, 2024</td>
          </tr>
          <tr>
            <td>Silver Standard Award</td>
            <td>2024</td>
          </tr>
          <tr>
            <td>Top Michigan Broker Award</td>
            <td>2022</td>
          </tr>
        </table>
    </div>
    <div id="footer">
      <h5> &copy; Robert Smith | Zoozle Co. </h5>
    </div>
</div>
</body>
</html>
```

Explanation:

- **This page shows the awards Robert Smith has received.**
- **A table (`<table>`) is used to organize the awards and their respective years.**

5. CSS Styles (style.css)

```css
#main{padding:10px;}
#main{background-color: aliceblue;}
#header{background-color: rgb(226, 156, 43);}
/* #content>h1{color:blueviolet;} */
#footer{background-color: rgb(226, 174, 43);}
```

Explanation:

- **This CSS file styles the elements on the HTML pages.**
- **Selectors:**
  - **`#main`: Targets the main container, adding padding and a light blue background.**
  - **`#header`: Sets a background color for the header.**
  - **`#footer`: Sets a background color for the footer.**
- **Commented out line: The line with `#content>h1` is commented out (indicated by `/* ... */`), meaning it won't affect the styles. If active, it would change the color of `<h1>` headers inside the `#content` section.**

Conclusion

This code creates a simple, structured profile page and additional linked pages using HTML for content and CSS for styling. Code it yourself and complete your lab assignment.

Difference Between IPv4 and IPv6

Characteristic	IPv4	IPv6
Full Form	Internet Protocol Version 4	Internet Protocol Version 6
Address Length	32-bit (4 bytes)	128-bit (16 bytes)
Address Format	Decimal, separated by periods (e.g., `192.168.1.1`)	Hexadecimal, separated by colons (e.g., `2001:0db8:85a3::8a2e:0370:7334`)
Number of Addresses	2^{32} addresses (~4.3 billion)	2^{128} addresses (~340 undecillion)
Address Classes	Has address classes (A, B, C, D, E)	No address classes; simplified addressing
Addressing Method	Unicast, broadcast, multicast	Unicast, multicast, anycast
Header Size	20 bytes	40 bytes
Fragmentation	Done by both sender and routers	Only done by the sender
Security	Security depends on applications (optional)	IPsec (Internet Protocol Security) is mandatory
Checksum	Uses a checksum for error-checking	No checksum; relies on upper-layer protocols
Configuration	Manual (DHCP)	Auto-configuration and DHCP support
Support for QoS	Limited	Has improved support for Quality of Service (QoS) with flow labels
Broadcasting	Supports broadcasting	Does not support broadcasting, uses multicast
NAT (Network Address Translation)	Commonly used due to address exhaustion	Not required due to the vast address space

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Use Cases and Where They Are Used

IPv4 (Internet Protocol Version 4):

- Use Case: IPv4 is still the most widely used IP protocol for the internet, as it is deeply integrated into legacy systems and networks. It handles most home networks, small business networks, and corporate intranets.
- Where Used:
    - Legacy Systems: Many devices, websites, and applications still run on IPv4 due to its widespread adoption.
    - Local Area Networks (LANs): Most home and office networks continue to use IPv4.
    - Internet Services: The majority of internet services still run on IPv4, though there is a growing transition to IPv6.

IPv6 (Internet Protocol Version 6):

- Use Case: IPv6 is used where there is a need for a vast number of unique IP addresses, better security, and efficient routing. It is designed to replace IPv4 due to the exhaustion of IPv4 addresses.
- Where Used:
    - IoT (Internet of Things): IPv6 is essential for connecting a growing number of smart devices, sensors, and IoT applications that require unique IP addresses.
    - Mobile Networks: Many mobile service providers, especially in countries with high data usage and population density, are adopting IPv6 to manage the demand for IP addresses.
    - Next-Generation Internet Services: Newer websites and applications are being built with IPv6 in mind to support a growing number of users and devices.
    - Cloud Providers: Large cloud platforms like AWS, Google Cloud, and Azure support IPv6 to offer scalable, future-proof solutions for businesses.

Why IPv6?

- Address Exhaustion: IPv4 addresses are limited to around 4.3 billion, and with the explosion of internet-connected devices, this address space is exhausted.
- Scalability: IPv6 provides an almost limitless number of IP addresses, essential for future expansion, especially with the rise of IoT devices and mobile internet.

Example Scenarios:

1. IPv4: A small office LAN, where private IP addresses are assigned to each device, with Network Address Translation (NAT) used to connect them to the internet.
2. IPv6: A large-scale IoT deployment in a smart city, where each sensor and device has a unique IPv6 address, allowing direct internet connectivity and communication.