Comprehensive Guide to CSS

Welcome to the comprehensive guide on **CSS (Cascading Style Sheets)**! CSS is a cornerstone technology of the web, enabling you to create visually appealing and responsive websites. This guide is designed to take you from the basics of CSS to more advanced topics, complete with code examples, detailed explanations, exercises, and multiple-choice questions to test your understanding.

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1. Introduction to CSS

What is CSS?

CSS (Cascading Style Sheets) is a stylesheet language used to describe the presentation of a document written in HTML or XML. CSS defines how elements should be displayed on screen, on paper, in speech, or on other media.

Why Use CSS?

- **Separation of Concerns:** Separates content (HTML) from presentation (CSS).
- **Reusability:** Apply the same styles to multiple elements.
- **Maintainability:** Easier to update and manage styles across large websites.
- **Enhanced Design:** Create visually appealing and responsive layouts.

Basic Example

```
<!DOCTYPE html>
<html>
<head>
    <title>CSS Example</title>
    <style>
        body {
            background-color: #f0f0f0;
```

```
        }
        h1 {
            color: blue;
            text-align: center;
        }
    </style>
</head>
<body>
    <h1>Welcome to CSS!</h1>
</body>
</html>
```

Explanation:

- The `<style>` tag contains CSS rules.
- `body` selector sets the background color.
- h1 selector styles the heading text.

2. CSS Syntax and Selectors

Understanding CSS syntax and selectors is fundamental to effectively styling web pages.

Basic Syntax

A CSS rule consists of a selector and a declaration block.

```
selector {
    property: value;
    property: value;
}
```

Example:

```
p {
    color: green;
    font-size: 16px;
```

```
}
```

Explanation:

- p is the selector targeting all <p> elements.
- `color` and `font-size` are properties.
- `green` and `16px` are values assigned to the properties.

Basic Selectors

Element Selector

Targets all instances of a specific HTML element.

```
/* Targets all <h2> elements */
h2 {
    color: purple;
}
```

Class Selector

Targets elements with a specific class attribute. Prefixed with a dot (`.`).

```
/* Targets elements with class="highlight" */
.highlight {
    background-color: yellow;
}
```

ID Selector

Targets a unique element with a specific ID attribute. Prefixed with a hash (#).

```
/* Targets the element with id="main-header" */
#main-header {
    font-weight: bold;
}
```

Note: IDs should be unique within an HTML document, whereas classes can be reused.

Grouping Selectors

Apply the same styles to multiple selectors by separating them with commas.

```
/* Targets both <h1> and <h2> elements */
h1, h2 {
    font-family: Arial, sans-serif;
}
```

Combinators

Define relationships between selectors.

Descendant Selector

Targets elements that are descendants of a specified ancestor.

```
/* Targets all <span> inside <div> */
div span {
    color: red;
}
```

Child Selector

Targets direct children of a specified parent.

```
/* Targets only direct <li> children of <ul> */
ul > li {
    list-style-type: square;
}
```

Adjacent Sibling Selector

Targets elements that are immediately preceded by a specified element.

```
/* Targets <p> that directly follows <h3> */
h3 + p {
    margin-top: 0;
}
```

General Sibling Selector

Targets all siblings after a specified element.

```
/* Targets all <p> siblings after <h3> */
h3 ~ p {
    color: gray;
}
```

Pseudo-classes and Pseudo-elements

Pseudo-classes

Target elements in a specific state.

```
/* Targets links when hovered */
a:hover {
    text-decoration: underline;
}
/* Targets the first child of a parent */
li:first-child {
    font-weight: bold;
}
```

Pseudo-elements

Target specific parts of an element.

```
/* Targets the first letter of a paragraph */
p::first-letter {
    font-size: 200%;
    color: blue;
}
/* Inserts content before an element */
h2::before {
    content: "★ ";
    color: gold;
}
```

Attribute Selectors

Select elements based on their attributes.

```
/* Targets <input> elements with type="text" */
input[type="text"] {
    border: 1px solid #ccc;
}
/* Targets <a> elements with href containing "example" */
a[href*="example"] {
    color: green;
}
```

3. CSS Box Model

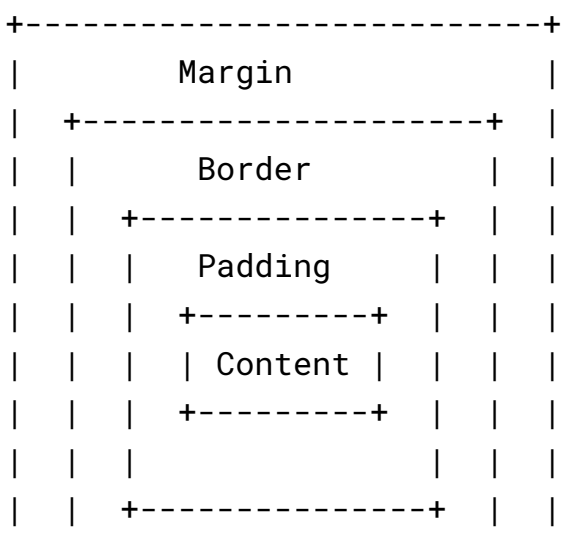
The **CSS Box Model** is a fundamental concept that defines how elements are structured and displayed on a web page. Understanding the box model is crucial for precise layout and design.

Understanding the Box Model

Every element on a web page is considered a rectangular box, consisting of four areas:

1. **Content:** The actual content of the box, such as text or images.
2. **Padding:** Clears an area around the content. It's transparent.
3. **Border:** A border surrounding the padding and content.
4. **Margin:** Clears an area outside the border. It's also transparent.

Visual Representation:



```
|  |                      |  |
|  +----------------------+  |
|                            |
+----------------------------+
```

Box Sizing

The `box-sizing` property alters the default CSS box model used to calculate widths and heights of elements.

Content-box (Default)

The `width` and `height` properties include only the content. Padding and border are added outside.

```
div {
    width: 200px;
    padding: 20px;
    border: 5px solid black;
    box-sizing: content-box;
}
```

Total Width: `200px (content) + 40px (padding) + 10px (border) = 250px`

Border-box

The `width` and `height` include content, padding, and border.

```
div {
    width: 200px;
    padding: 20px;
    border: 5px solid black;
    box-sizing: border-box;
}
```

Total Width: `200px (includes content, padding, and border)`

Advantages:

- Easier to manage element sizes.
- Prevents elements from unexpectedly increasing in size due to padding or borders.

Example: Box Model in Action

```
<!DOCTYPE html>
<html>
<head>
    <title>Box Model Example</title>
    <style>
        .box {
            width: 200px;
            padding: 20px;
            border: 5px solid black;
            margin: 10px;
            background-color: #e0e0e0;
            box-sizing: border-box; /* Change to content-box to
see the difference */
        }
    </style>
</head>
<body>
    <div class="box">
        This is a box.
    </div>
</body>
</html>
```

Explanation:

- The `.box` element has a set width, padding, border, and margin.
- `box-sizing: border-box;` ensures the total width remains `200px`.
- Changing to `content-box` would make the total width `200px + 40px + 10px = 250px`.

4. CSS Colors and Backgrounds

Colors and backgrounds are essential for creating visually appealing websites. CSS provides various ways to specify colors and manage backgrounds.

Color Values

CSS allows you to specify colors using different formats:

Named Colors: Predefined color names.

```
p {
    color: navy;
}
```

Hexadecimal Notation: #RRGGBB or shorthand #RGB.

```
h1 {
    color: #ff5733;
}
```

RGB: `rgb(red, green, blue)` with values from 0 to 255.

```
div {
    background-color: rgb(255, 0, 0); /* Red */
}
```

RGBA: `rgba(red, green, blue, alpha)` where alpha is opacity (0 to 1).

```
div {
    background-color: rgba(0, 0, 255, 0.5); /* Semi-transparent
blue */
}
```

HSL: `hsl(hue, saturation%, lightness%)`.

```
span {
    color: hsl(120, 100%, 50%); /* Green */
}
```

HSLA: `hsla(hue, saturation%, lightness%, alpha)`.

```
span {
    color: hsla(240, 100%, 50%, 0.3); /* Semi-transparent blue
*/
}
```

Background Properties

CSS provides a range of properties to control backgrounds.

Background Color

Sets the background color of an element.

```
body {
    background-color: #f0f8ff; /* AliceBlue */
}
```

Background Image

Sets a background image for an element.

```
div {
    background-image: url('images/background.jpg');
}
```

Background Repeat

Controls how the background image repeats.

```
div {
    background-repeat: no-repeat; /* Options: repeat, repeat-x,
repeat-y, no-repeat */
}
```

Background Position

Sets the initial position of the background image.

```
div {
```

```
    background-position: center center; /* Options: top, bottom, left, right, center, or specific coordinates */
}
```

Background Size

Specifies the size of the background image.

```
div {
    background-size: cover; /* Options: auto, cover, contain, or specific dimensions */
}
```

Shorthand Background Property

Combines multiple background properties into one.

```
div {
    background: url('images/bg.png') no-repeat center center / cover #ffffff;
}
```

Explanation:

- `url('images/bg.png')` sets the background image.
- `no-repeat` prevents repetition.
- `center center` positions the image at the center.
- `/ cover` sets the background size to cover the element.
- `#ffffff` sets the background color to white.

Example: Styling a Header with Background

```
<!DOCTYPE html>
<html>
<head>
    <title>Background Example</title>
    <style>
        .header {
            height: 200px;
```

```
            background-image: url('header-bg.jpg');
            background-size: cover;
            background-position: center;
            background-repeat: no-repeat;
            color: white;
            display: flex;
            align-items: center;
            justify-content: center;
            font-size: 2em;
        }
    </style>
</head>
<body>
    <div class="header">
        Welcome to My Website
    </div>
</body>
</html>
```

Explanation:

- The `.header` div has a background image that covers the entire area.
- Flexbox centers the text both vertically and horizontally.
- Text color is set to white for contrast.

5. CSS Typography

Typography plays a crucial role in web design, affecting readability and user experience. CSS provides extensive control over text styling.

Font Properties

font-family

Specifies the typeface to be used for text.

```
body {
```

```
    font-family: "Helvetica Neue", Arial, sans-serif;
}
```

Explanation:

- Lists fonts in order of preference.
- If the first font isn't available, the browser tries the next one.

font-size

Sets the size of the font.

```
h1 {
    font-size: 2em; /* Relative to the parent element's font
size */
}
p {
    font-size: 16px; /* Absolute size */
}
```

font-weight

Sets the weight (boldness) of the font.

```
strong {
    font-weight: bold;
}
.light-text {
    font-weight: 300;
}
```

font-style

Sets the style of the font (e.g., italic).

```
em {
    font-style: italic;
}
```

line-height

Sets the height between lines of text.

```
p {
    line-height: 1.5;
}
```

Text Properties

color

Sets the color of the text.

```
h2 {
    color: darkgreen;
}
```

text-align

Sets the horizontal alignment of text.

```
p {
    text-align: justify;
}
```

text-decoration

Adds decorations to text, such as underline.

```
a {
    text-decoration: none;
}
```

text-transform

Controls the capitalization of text.

```
.uppercase {
    text-transform: uppercase;
}
```

letter-spacing and word-spacing

Adjusts spacing between letters and words.

```
h3 {
    letter-spacing: 2px;
}
p {
    word-spacing: 4px;
}
```

Example: Styling Text

```
<!DOCTYPE html>
<html>
<head>
    <title>Typography Example</title>
    <style>
        body {
            font-family: "Georgia", serif;
            line-height: 1.6;
            color: #333;
        }
        h1 {
            font-size: 3em;
            text-align: center;
            text-transform: uppercase;
            color: #2c3e50;
        }
        p {
            font-size: 1.2em;
            text-align: justify;
        }
        a {
            color: #2980b9;
            text-decoration: none;
        }
        a:hover {
```

```
            text-decoration: underline;
        }
    </style>
</head>
<body>
    <h1>Welcome to My Blog</h1>
    <p>
        Lorem ipsum dolor sit amet, consectetur adipiscing elit.
        <a href="#">Read more</a> about our latest updates and
features.
    </p>
</body>
</html>
```

Explanation:

- The body uses a serif font with a comfortable line height.
- The <h1> is large, centered, and uppercase.
- Paragraphs are slightly larger and justified.
- Links are styled with a distinct color and underline on hover.

6. CSS Layout

CSS provides powerful tools to create complex and responsive layouts. This section covers various layout techniques.

Display Property

The `display` property defines how an element is rendered on the page.

Block

Elements occupy the full width available and start on a new line.

```
div {
    display: block;
}
```

Inline

Elements occupy only the width necessary and do not start on a new line.

```
span {
    display: inline;
}
```

Inline-block

Elements behave like inline elements but can have set widths and heights.

```
img {
    display: inline-block;
    width: 100px;
    height: 100px;
}
```

None

Elements are not displayed on the page.

```
.hidden {
    display: none;
}
```

Positioning

The `position` property controls how an element is positioned in the document.

Static

Default positioning. Elements follow the normal flow of the page.

```
p {
    position: static;
}
```

Relative

Positions the element relative to its normal position.

```
.box {
    position: relative;
    top: 10px; /* Moves the element 10px down */
    left: 20px; /* Moves the element 20px to the right */
}
```

Absolute

Positions the element relative to its first positioned ancestor.

```
.container {
    position: relative;
}
.box {
    position: absolute;
    top: 50px;
    right: 30px;
}
```

Explanation:

- `.box` is positioned 50px from the top and 30px from the right of `.container`.
- If `.container` has `position: relative;`, `.box` is positioned within `.container`.

Fixed

Positions the element relative to the viewport, remaining in the same place even when scrolling.

```
.navbar {
    position: fixed;
    top: 0;
    width: 100%;
}
```

Sticky

Positions the element based on the user's scroll position. It toggles between relative and fixed.

```
.header {
    position: sticky;
    top: 0;
    background-color: white;
}
```

Explanation:

- `.header` sticks to the top of the viewport when scrolled to its position.

Flexbox

Flexbox is a one-dimensional layout method for arranging items in rows or columns.

Basic Flexbox Example

```
<!DOCTYPE html>
<html>
<head>
    <title>Flexbox Example</title>
    <style>
        .container {
            display: flex;
            justify-content: space-between; /* Align items
horizontally */
            align-items: center; /* Align items vertically */
            height: 100vh;
            padding: 20px;
            background-color: #f8f8f8;
        }
        .box {
            width: 100px;
            height: 100px;
            background-color: #3498db;
            color: white;
```

```
            display: flex;
            align-items: center;
            justify-content: center;
            border-radius: 5px;
        }
    </style>
</head>
<body>
    <div class="container">
        <div class="box">1</div>
        <div class="box">2</div>
        <div class="box">3</div>
    </div>
</body>
</html>
```

Explanation:

- `.container` uses `display: flex;` to create a flex container.
- `justify-content: space-between;` distributes space between items.
- `align-items: center;` centers items vertically.
- `.box` elements are flex items, centered both horizontally and vertically.

Common Flexbox Properties

- `flex-direction`: Defines the direction of the flex items (`row`, `column`, `row-reverse`, `column-reverse`).
- `justify-content`: Aligns items along the main axis (`flex-start`, `flex-end`, `center`, `space-between`, `space-around`).
- `align-items`: Aligns items along the cross axis (`flex-start`, `flex-end`, `center`, `stretch`).
- `flex-wrap`: Controls whether flex items should wrap onto multiple lines (`nowrap`, `wrap`, `wrap-reverse`).

CSS Grid

CSS Grid is a two-dimensional layout system for creating complex and responsive grid-based layouts.

Basic Grid Example

```
<!DOCTYPE html>
<html>
<head>
    <title>Grid Example</title>
    <style>
        .grid-container {
            display: grid;
            grid-template-columns: repeat(3, 1fr);
            grid-gap: 10px;
            padding: 10px;
        }
        .grid-item {
            background-color: #2ecc71;
            color: white;
            padding: 20px;
            text-align: center;
            border-radius: 5px;
        }
    </style>
</head>
<body>
    <div class="grid-container">
        <div class="grid-item">1</div>
        <div class="grid-item">2</div>
        <div class="grid-item">3</div>
        <div class="grid-item">4</div>
        <div class="grid-item">5</div>
        <div class="grid-item">6</div>
    </div>
</body>
</html>
```

Explanation:

- `.grid-container` uses `display: grid;` to establish a grid layout.
- `grid-template-columns: repeat(3, 1fr);` creates three equal-width columns.
- `grid-gap: 10px;` sets the spacing between grid items.
- `.grid-item` styles individual grid cells.

Advanced Grid Features
Grid Areas:

```
.grid-container {
    display: grid;
    grid-template-areas:
        "header header"
        "sidebar content"
        "footer footer";
}
.header {
    grid-area: header;
}
.sidebar {
    grid-area: sidebar;
}
.content {
    grid-area: content;
}
.footer {
    grid-area: footer;
}
```

Responsive Grid:

```
@media (max-width: 600px) {
    .grid-container {
        grid-template-columns: 1fr;
        grid-template-areas:
```

```
            "header"
            "content"
            "sidebar"
            "footer";
    }
}
```

Explanation:

- `grid-template-areas` defines named grid areas for easier placement of elements.
- Media queries adjust the grid layout for different screen sizes, ensuring responsiveness.

Example: Creating a Responsive Layout with Flexbox and Grid

```
<!DOCTYPE html>
<html>
<head>
    <title>Responsive Layout</title>
    <style>
        body {
            margin: 0;
            font-family: Arial, sans-serif;
        }
        .navbar {
            background-color: #34495e;
            color: white;
            padding: 15px;
            text-align: center;
        }
        .container {
            display: grid;
            grid-template-columns: 1fr 3fr;
            grid-gap: 20px;
            padding: 20px;
```

```
        }
        .sidebar {
            background-color: #ecf0f1;
            padding: 15px;
        }
        .content {
            background-color: #bdc3c7;
            padding: 15px;
        }
        .footer {
            background-color: #34495e;
            color: white;
            text-align: center;
            padding: 10px;
            grid-column: 1 / -1;
        }
        @media (max-width: 800px) {
            .container {
                grid-template-columns: 1fr;
            }
        }
    </style>
</head>
<body>
    <div class="navbar">
        My Website
    </div>
    <div class="container">
        <div class="sidebar">
            <h3>Sidebar</h3>
            <p>Links and information here.</p>
        </div>
        <div class="content">
            <h2>Main Content</h2>
```

```
            <p>Welcome to the main content area.</p>
        </div>
    </div>
    <div class="footer">
        © 2024 My Website
    </div>
</body>
</html>
```

Explanation:

- **Navbar and Footer:** Use full-width grid areas.
- **Container:** Uses CSS Grid to layout the sidebar and content.
- **Responsive Design:** At screen widths below 800px, the layout stacks vertically.

7. Responsive Design

Responsive design ensures that web pages look and function well on all devices, from desktops to smartphones. CSS offers several tools to achieve responsiveness.

Media Queries

Media queries apply CSS rules based on device characteristics like screen width, height, orientation, and resolution.

Syntax:

```
@media (condition) {
    /* CSS rules */
}
```

Example:

```
/* Styles for screens wider than 600px */
@media (min-width: 600px) {
    .container {
        display: flex;
    }
```

```
}
/* Styles for screens 600px or narrower */
@media (max-width: 600px) {
    .container {
        display: block;
    }
}
```

Common Breakpoints:

- **Mobile:** `max-width: 600px`
- **Tablet:** `min-width: 601px` and `max-width: 1024px`
- **Desktop:** `min-width: 1025px`

Fluid Layouts and Units

Using relative units makes layouts more adaptable to different screen sizes.

Relative Units

% (Percentage): Relative to the parent element.

```
.box {
    width: 50%; /* 50% of the parent's width */
}
```

em: Relative to the font-size of the element.

```
p {
    font-size: 1.2em; /* 1.2 times the parent's font-size */
}
```

rem: Relative to the root (html) font-size.

```
h1 {
    font-size: 2rem; /* 2 times the root font-size */
}
```

vw and vh: Relative to the viewport's width and height.

```
.banner {
```

```
    width: 100vw; /* 100% of the viewport width */
    height: 50vh; /* 50% of the viewport height */
}
```

Flexible Grid Systems

Using percentages and relative units to create flexible grid layouts that adjust to screen sizes.

Example:

```
.container {
    display: flex;
    flex-wrap: wrap;
}
.column {
    flex: 1 1 300px; /* Grow, shrink, basis */
    margin: 10px;
}
```

Explanation:

- `.column` elements will flexibly adjust their width, wrapping to new lines as needed based on available space.

Mobile-First Approach

Designing for mobile devices first and then enhancing for larger screens.

Example:

```
/* Mobile styles */
.container {
    display: block;
}
/* Enhancements for larger screens */
@media (min-width: 600px) {
    .container {
        display: flex;
```

```
    }
}
```

Advantages:

- Prioritizes essential content and performance for mobile users.
- Easier to add enhancements for larger screens.

Example: Responsive Image Gallery

```
<!DOCTYPE html>
<html>
<head>
    <title>Responsive Gallery</title>
    <style>
        .gallery {
            display: grid;
            grid-template-columns: repeat(auto-fill,
minmax(150px, 1fr));
            grid-gap: 10px;
            padding: 10px;
        }
        .gallery img {
            width: 100%;
            height: auto;
            border-radius: 5px;
        }
    </style>
</head>
<body>
    <div class="gallery">
        <img src="images/photo1.jpg" alt="Photo 1">
        <img src="images/photo2.jpg" alt="Photo 2">
        <img src="images/photo3.jpg" alt="Photo 3">
        <!-- Add more images as needed -->
    </div>
```

```
</body>
</html>
```

Explanation:

- **Grid Layout:** Uses `auto-fill` and `minmax` to create a responsive grid that adjusts the number of columns based on available space.
- **Images:** Set to `width: 100%` to fill their grid cells and maintain aspect ratio with `height: auto`.

8. CSS Transitions and Animations

Enhance user experience by adding dynamic visual effects using CSS transitions and animations.

Transitions

Transitions allow you to change property values smoothly over a specified duration.

Syntax:

```
selector {
    transition: property duration timing-function delay;
}
```

Example:

```
.button {
    background-color: #3498db;
    transition: background-color 0.3s ease;
}
.button:hover {
    background-color: #2980b9;
}
```

Explanation:

- The `.button` changes its background color smoothly over 0.3 seconds when hovered.

- `ease` defines the transition timing function.

Transition Shorthand

```
transition: background-color 0.3s ease 0s;
```

Animations

Animations allow more complex and multi-step transitions.

Syntax:

```
selector {
    animation: name duration timing-function delay
iteration-count direction fill-mode;
}
```

@keyframes Rule:

Defines the animation sequence.

Example:

```
/* Define the animation */
@keyframes fadeIn {
    from { opacity: 0; }
    to { opacity: 1; }
}
.box {
    width: 100px;
    height: 100px;
    background-color: #e74c3c;
    animation: fadeIn 2s ease-in-out;
}
```

Explanation:

- `@keyframes fadeIn` defines an animation that changes opacity from `0` to 1.
- `.box` applies the `fadeIn` animation over 2 seconds with an `ease-in-out` timing function.

Advanced Animation Example

```
@keyframes moveRight {
    0% { transform: translateX(0); }
    50% { transform: translateX(100px); }
    100% { transform: translateX(0); }
}
.moving-box {
    width: 50px;
    height: 50px;
    background-color: #2ecc71;
    animation: moveRight 3s infinite;
}
```

Explanation:

- The `.moving-box` moves 100px to the right and back to the original position repeatedly every 3 seconds.

Example: Hover Animation

```
<!DOCTYPE html>
<html>
<head>
    <title>Hover Animation</title>
    <style>
        .card {
            width: 200px;
            height: 150px;
            background-color: #ecf0f1;
            border-radius: 10px;
            box-shadow: 0 2px 5px rgba(0,0,0,0.1);
            transition: transform 0.3s ease, box-shadow 0.3s
ease;
            display: flex;
            align-items: center;
            justify-content: center;
```

```
            cursor: pointer;
        }
        .card:hover {
            transform: translateY(-10px);
            box-shadow: 0 5px 15px rgba(0,0,0,0.3);
        }
    </style>
</head>
<body>
    <div class="card">
        Hover Me!
    </div>
</body>
</html>
```

Explanation:

- The `.card` moves up by 10px and its shadow becomes more prominent when hovered, creating a lifting effect.

9. CSS Variables (Custom Properties)

CSS Variables, also known as **Custom Properties**, allow you to store reusable values directly in your CSS. They enhance maintainability and make it easier to implement themes.

Defining and Using CSS Variables

Syntax:

```
:root {
    --primary-color: #3498db;
    --secondary-color: #2ecc71;
    --font-stack: 'Helvetica Neue', Arial, sans-serif;
}
.button {
    background-color: var(--primary-color);
```

```
    color: white;
    font-family: var(--font-stack);
}
.button-secondary {
    background-color: var(--secondary-color);
    color: white;
    font-family: var(--font-stack);
}
```

Explanation:

- `:root` is a pseudo-class that matches the document's root element (`<html>`). Variables defined here are globally accessible.
- `--primary-color`, `--secondary-color`, and `--font-stack` are custom properties.
- `var(--property-name)` is used to retrieve the value of a custom property.

Fallback Values

Provide fallback values in case the variable is not defined.

```
p {
    color: var(--text-color, #333);
}
```

Explanation:

- If `--text-color` is not defined, the color defaults to #333.

Dynamic Themes with CSS Variables

Changing variables at runtime allows for dynamic theming.

Example:

```
<!DOCTYPE html>
<html>
<head>
    <title>CSS Variables Theme</title>
```

```
    <style>
        :root {
            --bg-color: white;
            --text-color: black;
            --link-color: #3498db;
        }
        body {
            background-color: var(--bg-color);
            color: var(--text-color);
            font-family: Arial, sans-serif;
        }
        a {
            color: var(--link-color);
        }
        .dark-theme {
            --bg-color: #2c3e50;
            --text-color: #ecf0f1;
            --link-color: #e74c3c;
        }
    </style>
</head>
<body>
    <h1>Welcome!</h1>
    <p>This is an example of CSS variables.</p>
    <a href="#">Learn more</a>
    <br><br>
    <button onclick="toggleTheme()">Toggle Dark Theme</button>
    <script>
        function toggleTheme() {
            document.body.classList.toggle('dark-theme');
        }
    </script>
</body>
</html>
```

Explanation:

- CSS variables define default theme colors.
- The `.dark-theme` class overrides these variables.
- Clicking the button toggles the `.dark-theme` class, switching between light and dark themes.

10. Advanced Selectors and Specificity

Mastering selectors and understanding specificity is key to writing effective and conflict-free CSS.

Specificity

Specificity determines which CSS rule is applied when multiple rules target the same element.

Specificity Hierarchy:

1. **Inline styles:** Highest specificity (e.g., `style="color: red;"`).
2. **IDs:** High specificity (e.g., `#header`).
3. **Classes, attributes, pseudo-classes:** Medium specificity (e.g., `.button`, `[type="text"]`, `:hover`).
4. **Elements and pseudo-elements:** Low specificity (e.g., `div`, `p`, `::before`).

Calculating Specificity:

- **Inline styles:** 1000
- **IDs:** 100 per ID
- **Classes, attributes, pseudo-classes:** 10 per item
- **Elements and pseudo-elements:** 1 per item

Example:

```
/* Specificity score: 10 */
.button {
    color: blue;
}
/* Specificity score: 100 */
```

```
#submit-button {
    color: green;
}
/* Specificity score: 11 */
button[type="submit"] {
    color: red;
}
/* Specificity score: 1 */
button {
    color: black;
}
```

Explanation:

- An element with `id="submit-button"` will have its color set to green, overriding other rules.
- If an element has both a class and an element selector, the class selector takes precedence.

Advanced Selectors

Universal Selector

Targets all elements.

```
* {
    box-sizing: border-box;
}
```

Explanation:

- Applies `box-sizing: border-box;` to all elements, simplifying layout calculations.

Child Combinator

Targets direct children of an element.

```
ul > li {
```

```
    list-style-type: disc;
}
```

Adjacent Sibling Selector

Targets an element that is immediately preceded by another.

```
h2 + p {
    margin-top: 0;
}
```

General Sibling Selector

Targets all siblings after a specified element.

```
h2 ~ p {
    color: gray;
}
```

Attribute Selectors

Select elements based on attribute values.

```
input[type="email"] {
    border: 2px solid blue;
}
```

Pseudo-classes and Pseudo-elements

Pseudo-classes: Target elements in a specific state.

```
a:hover {
    color: red;
}
```

Pseudo-elements: Target specific parts of an element.

```
p::first-line {
    font-weight: bold;
}
```

Descendant Selector

Targets elements nested within other elements.

```
div p {
    margin-bottom: 10px;
}
```

Explanation:

- Applies to all `<p>` elements inside `<div>` elements, regardless of depth.

Combining Selectors

Combine multiple selectors to target specific elements.

```
/* Targets <a> elements inside <nav> with class "active" */
nav a.active {
    color: green;
}
```

Explanation:

- Applies styles to `<a>` elements that have the class `active` and are inside a `<nav>` element.

11. CSS Best Practices

Adhering to best practices ensures your CSS is efficient, maintainable, and scalable.

1. Keep CSS Organized

- **Modular Approach:** Split CSS into multiple files or sections based on functionality (e.g., layout, typography, components).

Consistent Naming Conventions: Use naming conventions like BEM (Block, Element, Modifier) for clarity.

```
/* BEM Naming Convention */
.button {
```

```
    /* Block */
}
.button__icon {
    /* Element */
}
.button--primary {
    /* Modifier */
}
```

2. Avoid Over-Specificity

- Use selectors with appropriate specificity to prevent conflicts and make overrides easier.
- Prefer classes over IDs for styling.

3. Use Comments

Add comments to explain complex sections or to separate different parts of your CSS.

```
/* Header Styles */
.header {
    background-color: #34495e;
}
```

4. Leverage CSS Variables

Use custom properties to manage colors, fonts, and other reusable values.

```
:root {
    --main-color: #3498db;
}
.button {
    background-color: var(--main-color);
}
```

5. Minimize Use of `!important`

- Avoid using `!important` as it makes debugging and maintenance harder.

- Instead, increase selector specificity or restructure your CSS.

6. Optimize for Performance

- Minimize the use of complex selectors.
- Combine and minify CSS files for faster loading.
- Use shorthand properties where possible.

7. Responsive Design

- Design with multiple devices in mind.
- Use media queries and relative units to ensure adaptability.

8. Accessibility

- Ensure sufficient color contrast.
- Use relative units for text to support user preferences.
- Avoid relying solely on color to convey information.

Example: Organized and Maintainable CSS

```
/* Variables */
:root {
    --primary-color: #3498db;
    --secondary-color: #2ecc71;
    --font-family: 'Arial, sans-serif';
}
/* Reset Styles */
* {
    margin: 0;
    padding: 0;
    box-sizing: border-box;
}
/* Typography */
body {
    font-family: var(--font-family);
    color: #333;
}
```

```
h1, h2, h3 {
    color: var(--primary-color);
}
p {
    line-height: 1.6;
}
/* Layout */
.container {
    width: 90%;
    max-width: 1200px;
    margin: auto;
    padding: 20px;
}
/* Components */
.button {
    background-color: var(--primary-color);
    color: white;
    padding: 10px 20px;
    border: none;
    border-radius: 5px;
    cursor: pointer;
    transition: background-color 0.3s ease;
}
.button:hover {
    background-color: var(--secondary-color);
}
```

Explanation:

- **Variables:** Centralized color and font definitions.
- **Reset Styles:** Removes default browser margins and paddings.
- **Typography:** Consistent styling for text elements.
- **Layout:** Defines a responsive container.
- **Components:** Reusable `.button` class with hover effects.

12. Projects and Exercises

Applying what you've learned through projects and exercises is essential for mastering CSS. Below are several hands-on activities to reinforce your understanding.

Project 1: Personal Portfolio Website

Objective: Create a personal portfolio website to showcase your projects, skills, and contact information.

Features:

- **Home Section:** Introduction and profile picture.
- **About Section:** Information about yourself.
- **Projects Section:** Gallery of projects with descriptions.
- **Skills Section:** List of skills with proficiency indicators.
- **Contact Section:** Contact form and social media links.
- **Responsive Design:** Ensure the site looks good on all devices.

Solution Outline:

1. **HTML Structure:**
    - Create separate sections using semantic HTML elements (`<header>`, `<section>`, `<footer>`).
2. **CSS Styling:**
    - Use Flexbox or Grid for layout.
    - Apply consistent typography and color scheme.
    - Add hover effects to project cards.
3. **Responsive Design:**
    - Implement media queries for different screen sizes.
4. **Enhancements:**
    - Add smooth scrolling between sections.
    - Use CSS animations for visual appeal.

Sample Code Snippet: Header and Navigation

```
<!DOCTYPE html>
<html>
<head>
    <title>My Portfolio</title>
```

```
    <link rel="stylesheet" href="styles.css">
</head>
<body>
    <header class="navbar">
        <div class="container">
            <h1>My Portfolio</h1>
            <nav>
                <ul>
                    <li><a href="#home">Home</a></li>
                    <li><a href="#about">About</a></li>
                    <li><a href="#projects">Projects</a></li>
                    <li><a href="#skills">Skills</a></li>
                    <li><a href="#contact">Contact</a></li>
                </ul>
            </nav>
        </div>
    </header>
    <!-- Additional sections go here -->
</body>
</html>
/* styles.css */
:root {
    --primary-color: #3498db;
    --secondary-color: #2ecc71;
    --font-family: 'Segoe UI', Tahoma, Geneva, Verdana,
sans-serif;
}
body {
    font-family: var(--font-family);
    margin: 0;
    padding: 0;
    color: #333;
}
.navbar {
```

```
    background-color: var(--primary-color);
    padding: 20px 0;
}
.navbar .container {
    display: flex;
    justify-content: space-between;
    align-items: center;
}
.navbar h1 {
    color: white;
    margin: 0;
}
.navbar nav ul {
    list-style: none;
    display: flex;
}
.navbar nav ul li {
    margin-left: 20px;
}
.navbar nav ul li a {
    color: white;
    text-decoration: none;
    font-size: 1em;
    transition: color 0.3s ease;
}
.navbar nav ul li a:hover {
    color: var(--secondary-color);
}
```

Exercise 1: Creating and Styling a Navigation Bar

Task: Create a horizontal navigation bar with links to "Home", "About", "Services", and "Contact". Style it with a background color, and change the link color on hover.

Solution:

```
<!DOCTYPE html>
<html>
<head>
    <title>Navigation Bar</title>
    <style>
        body {
            margin: 0;
        }
        .navbar {
            background-color: #34495e;
            padding: 15px;
        }
        .navbar ul {
            list-style: none;
            display: flex;
            justify-content: center;
            margin: 0;
            padding: 0;
        }
        .navbar li {
            margin: 0 15px;
        }
        .navbar a {
            color: white;
            text-decoration: none;
            font-size: 1.1em;
            transition: color 0.3s ease;
        }
        .navbar a:hover {
            color: #e74c3c;
        }
    </style>
</head>
<body>
```

```
    <nav class="navbar">
        <ul>
            <li><a href="#home">Home</a></li>
            <li><a href="#about">About</a></li>
            <li><a href="#services">Services</a></li>
            <li><a href="#contact">Contact</a></li>
        </ul>
    </nav>
</body>
</html>
```

Explanation:

- `.navbar` is styled with a dark background and padding.
- `.navbar ul` uses Flexbox to center the navigation links.
- Links change color smoothly on hover.

Exercise 2: Building a Responsive Grid Layout

Task: Create a responsive grid layout that displays three columns on desktop screens and one column on mobile screens. Each grid item should have a background color and padding.

Solution:

```
<!DOCTYPE html>
<html>
<head>
    <title>Responsive Grid</title>
    <style>
        .grid-container {
            display: grid;
            grid-template-columns: repeat(3, 1fr);
            grid-gap: 20px;
            padding: 20px;
        }
        .grid-item {
```

```
            background-color: #ecf0f1;
            padding: 30px;
            text-align: center;
            border-radius: 5px;
        }
        @media (max-width: 600px) {
            .grid-container {
                grid-template-columns: 1fr;
            }
        }
    </style>
</head>
<body>
    <div class="grid-container">
        <div class="grid-item">Item 1</div>
        <div class="grid-item">Item 2</div>
        <div class="grid-item">Item 3</div>
    </div>
</body>
</html>
```

Explanation:

- `.grid-container` uses CSS Grid to create three equal columns with gaps.
- `.grid-item` elements are styled with background color and padding.
- Media query changes the layout to a single column on screens narrower than 600px.

Exercise 3: Implementing a Hover Effect with Transition

Task: Create a square div that changes its background color and scales up slightly when hovered, using CSS transitions.

Solution:

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

```
<head>
    <title>Hover Effect</title>
    <style>
        .square {
            width: 150px;
            height: 150px;
            background-color: #2ecc71;
            margin: 50px auto;
            transition: background-color 0.3s ease, transform
0.3s ease;
            border-radius: 10px;
        }
        .square:hover {
            background-color: #27ae60;
            transform: scale(1.1);
        }
    </style>
</head>
<body>
    <div class="square"></div>
</body>
</html>
```

Explanation:

- `.square` is a green square with smooth transitions.
- On hover, the background color darkens, and the square scales up by 10%.

13. Multiple Choice Questions

Test your understanding of CSS with the following multiple-choice questions. Answers and explanations are provided after each question.

Question 1

Which of the following is the correct way to apply a class named "active" to a `<div>` element in CSS?

A) `div.active { /* styles */ }`

B) `div .active { /* styles */ }`

C) `div #active { /* styles */ }`

D) `.div.active { /* styles */ }`

Answer: A) `div.active { /* styles */ }`

Explanation:

- `div.active` targets `<div>` elements with the class `active`.
- Option B (`div .active`) targets elements with class `active` inside a `<div>`.
- Option C uses ID selector instead of class.
- Option D incorrectly uses a dot before `div`.

Question 2

What does the `flex-direction: column;` property do in Flexbox?

A) Aligns items horizontally.

B) Aligns items vertically.

C) Reverses the order of items.

D) Wraps items onto multiple lines.

Answer: B) Aligns items vertically.

Explanation:

- `flex-direction: column;` stacks flex items vertically from top to bottom.

Question 3

Which property is used to change the text color of an element?

A) `background-color`

B) `font-color`

C) `color`

D) `text-color`

Answer: C) `color`

Explanation:

- The `color` property sets the color of the text.

Question 4

How can you make a text bold in CSS?

A) `font-style: bold;`

B) `text-weight: bold;`

C) `font-weight: bold;`

D) `text-style: bold;`

Answer: C) `font-weight: bold;`

Explanation:

- The `font-weight` property controls the boldness of the text.

Question 5

Which CSS property controls the space between lines of text?

A) `letter-spacing`

B) `line-height`

C) `text-spacing`

D) `word-spacing`

Answer: B) `line-height`

Explanation:

- The `line-height` property sets the height between lines of text.

Question 6

What does the `box-sizing: border-box;` property do?

A) Includes padding and border in the element's total width and height.

B) Excludes padding and border from the element's total width and height.

C) Sets the box to have a fixed size.

D) Makes the box responsive to content size.

Answer: A) Includes padding and border in the element's total width and height.

Explanation:

- `box-sizing: border-box;` ensures that `width` and `height` include content, padding, and border.

Question 7

Which of the following is NOT a valid CSS color format?

A) `rgb(255, 0, 0)`

B) `#FF0000`

C) `hsl(0, 100%, 50%)`

D) `rgba(255, 0, 0, 256)`

Answer: D) `rgba(255, 0, 0, 256)`

Explanation:

- The alpha value in `rgba` should be between `0` and `1`. `256` is invalid.

Question 8

Which CSS property is used to create space between the border and the content of an element?

A) `margin`

B) `padding`

C) `border-spacing`

D) `gap`

Answer: B) `padding`

Explanation:

- `padding` creates space inside the element between the border and content.

Question 9

How do you select all <p> elements that are direct children of a `<div>`?

A) `div p { /* styles */ }`

B) `div > p { /* styles */ }`

C) `div + p { /* styles */ }`

D) `div ~ p { /* styles */ }`

Answer: B) `div > p { /* styles */ }`

Explanation:

- The > combinator targets direct children only.

Question 10

Which property is used to make an element stay fixed in place even when the page is scrolled?

A) `position: relative;`

B) `position: absolute;`

C) `position: fixed;`

D) `position: sticky;`

Answer: C) `position: fixed;`

Explanation:

- `position: fixed;` fixes the element relative to the viewport, maintaining its position during scroll.

Question 11

Which CSS property allows you to control the opacity of an element?

A) `visibility`

B) `opacity`

C) `display`

D) `z-index`

Answer: B) `opacity`

Explanation:

- The `opacity` property sets the transparency level of an element.

Question 12

What is the default value of the `display` property for `<span>` elements?

A) `block`

B) `inline`

C) `inline-block`

D) `flex`

Answer: B) `inline`

Explanation:

- `<span>` elements are inline by default.

Question 13

Which CSS property is used to change the font of an element?

A) `font-style`

B) `font-weight`

C) `font-family`

D) `font-size`

Answer: C) `font-family`

Explanation:

- `font-family` specifies the typeface for text.

Question 14

How can you center a block-level element horizontally within its container?

A) `text-align: center;`

B) `margin: auto;`

C) `display: flex; justify-content: center;`

D) All of the above

Answer: D) All of the above

Explanation:

- **Option A:** `text-align: center;` centers inline and inline-block elements.
- **Option B:** `margin: auto;` centers block-level elements with a defined width.
- **Option C:** Using Flexbox to center elements.

Question 15

Which pseudo-class would you use to style an element when it is being hovered over by the mouse?

A) `:active`

B) `:focus`

C) `:hover`

D) `:visited`

Answer: C) `:hover`

Explanation:

- `:hover` applies styles when the user hovers over an element.

14. Conclusion

Congratulations! You've completed the comprehensive guide to **CSS**. This guide has covered everything from the basics of CSS syntax and selectors to advanced topics like Flexbox, Grid, responsive design, transitions, animations, and best practices. By working through the code examples, exercises, and multiple-choice questions, you've built a solid foundation in CSS that will empower you to create stunning and responsive web designs.