# CSS values and units

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There are many types of CSS property values to consider, from numerical values to colors to functions that perform a certain action (like embedding a background image, or rotating an element.) Some of these rely on particular units for specifying the exact values they are representing — do you want your box to be 30 pixels wide, or 30 centimeters, or 30 em? In this guide, we look at more common values like length, color, and simple functions, as well as exploring less common units like degrees, and even unitless numerical values.

**Prerequisites:** Basic computer literacy, basic software installed, basic knowledge of working with files, HTML basics (study

| | |
|---|---|
| | Introduction to HTML), and an idea of How CSS works (study the previous articles in this module.) |
| **Objective:** | To learn about the most common types of CSS property values and associated units. |

There are many value types in CSS, some of them very common and some of them that you'll rarely come across. We won't cover all of them exhaustively in this article; just the ones that you are likely to find most useful as you continue on your path towards mastering CSS. In this article we will cover the following CSS values:

- Numeric values: Length values for specifying e.g. element width, border thickness, or font size, and unitless integers for specifying e.g. relative line width or number of times to run an animation.
- Percentages: Can also be used to specify size or length — relative to a parent container's width or height for example, or the default font-size. These are often to facilitate responsive design (e.g. creating "liquid layouts", which automatically adjust to fit on different screen sizes).
- Colors: For specifying background colors, text colors, etc.
- Functions: For specifying e.g. background images or background image gradients.

You'll also see examples of such units in use all the way through the rest of the CSS topic, and just about every other CSS resource you see! You'll get used to it all in no time.

**Note**: You can find an overview of CSS unit and value types as well as exhaustive coverage of CSS units in the CSS Reference; the units are the entries surrounded by angle brackets, for example <color>.

## Numeric values

You'll see numbers used in many places in CSS units. This section discusses the most common classes of number value.

### Length and size

You'll use length/size units (see <length> for reference) all the time in your CSS for layouts, typography and more. Let's look at a simple example — first the HTML:

```
<p>This is a paragraph.</p>
<p>This is a paragraph.</p>
<p>This is a paragraph.</p>
```

And now the CSS:

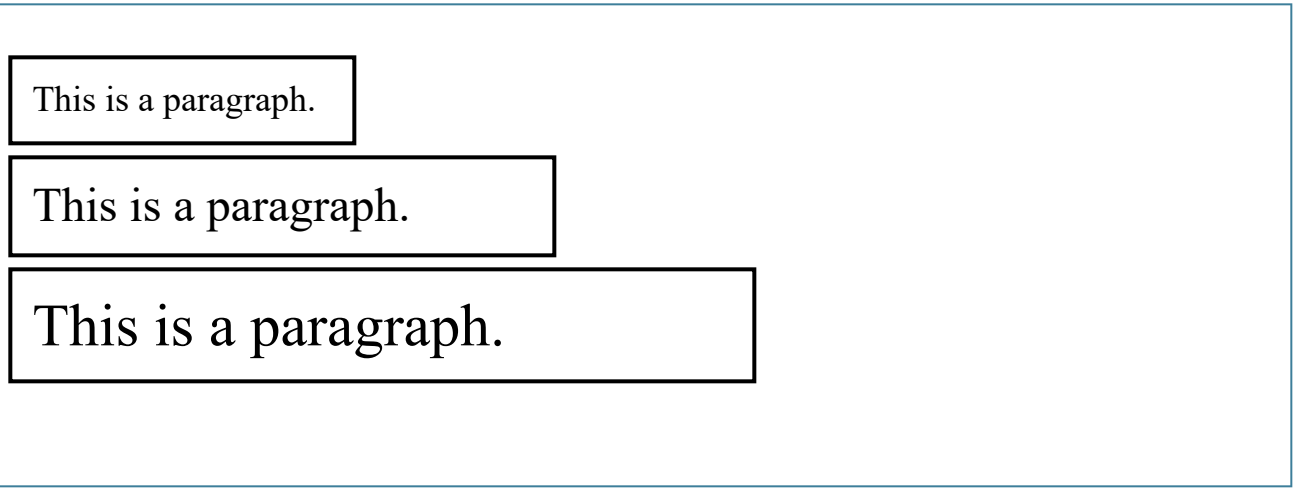
```
p {
  margin: 5px;
  padding: 10px;
  border: 2px solid black;
  background-color: cyan;
}

p:nth-child(1) {
  width: 150px;
  font-size: 18px;
}

```

```
13  p:nth-child(2) {
14    width: 250px;
15    font-size: 24px;
16  }
17
18  p:nth-child(3) {
19    width: 350px;
20    font-size: 30px;
21  }
```

The result is as follows:




So in this code we are doing the following:

- Setting the `margin`, `padding` and `border-width` of every paragraph to 5 pixels, 10 pixels and 2 pixels respectively. A single value for margin/padding means that all four sides are set to the same value. The border width is set as part of the value for the `border` shorthand.

- Setting the `width` of the three different paragraphs to larger and larger pixel values, meaning that the boxes get wider the further down you go.
- Setting the `font-size` of the three different paragraphs to larger and larger pixel values, meaning that the text gets bigger the further down you go. The `font-size` refers to the height of each glyph.

Pixels (px) are referred to as **absolute units** because they will always be the same size regardless of any other related settings. Other absolute units are as follows:

- `q`, `mm`, `cm`, `in`: Quarter millimeters, millimeters, centimeters, or inches.
- `pt`, `pc`: Points ($^{1}/_{72}$ of an inch) or picas (12 points.)

You probably won't use any of these very often except pixels.

There are also relative units, which are relative to the current element's `font-size` or viewport size:

- `em`: `1em` is the same as the font-size of the current element. The default base `font-size` given to web pages by web browsers before CSS styling is applied is 16 pixels, which means the computed value of 1 `em` is 16 pixels for an element by default. But beware — font sizes are inherited by elements from their parents, so if different font sizes have been set on parent elements, the pixel equivalent of an `em` can start to become complicated. Don't worry too much about this for now — we'll cover inheritance and font-sizing in more detail in later articles and modules. **`em` are the most common relative unit you'll use in web development**.
- `ex`, `ch`: Respectively these are the height of a lower case x, and the width of the number 0. These are not as commonly used or well-supported as em.

- `rem`: The `rem` (root `em`) works in exactly the same way as the `em`, except that it will always equal the size of the default base `font-size`; inherited font sizes will have no effect, so this sounds like a much better option than em, although rems don't work in older versions of Internet Explorer (see more about cross-browser support in Debugging CSS.)
- `vw`, `vh`: Respectively these are $^{1}/_{100}$th of the width of the viewport, and $^{1}/_{100}$th of the height of the viewport. Again, these are not as widely supported as `em`.

Using relative units is quite useful — you can size your HTML elements relative to your font or viewport size, meaning that the layout will stay looking correct if for example the text size is doubled across the whole website by a visually impaired user.

## Unitless values

You'll sometimes come across unitless numeric values in CSS — this is not always an error, in fact, it is perfectly allowed in some circumstances. For example, if you want to completely remove the `margin` or `padding` from an element, you can just use unitless 0 — 0 is 0, no matter what units were set before!

```
margin: 0;
```

### Unitless line height

Another example is `line-height`, which sets how high each line of text in an element is. You can use units to set a specific line height, but it is often easier to use a unitless value, which acts as a simple multiplying factor. For example, take the following HTML:

```
<p>Blue ocean silo royal baby space glocal evergreen relationship housekeeping
native advertising diversify ideation session. Soup-to-nuts herding cats resolutionary
```

```
virtuoso granularity catalyst wow factor loop back brainstorm. Core competency
baked in push back silo irrational exuberance circle back roll-up.</p>
```

And the following CSS:

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

This will result in the following output:

> Blue ocean silo royal baby space glocal evergreen relationship housekeeping native advertising diversify ideation session. Soup-to-nuts herding cats resolutionary virtuoso granularity catalyst wow factor loop back brainstorm. Core competency baked in push back silo irrational exuberance circle back roll-up.

Here the `font-size` is 16px; the line height will be 1.5 times this, or 24px.

## Number of animations

CSS Animations allow you to animate HTML elements on the page. Let's present a simple example that causes a paragraph to rotate when it is moused over. The HTML for this example is pretty simple:

```
<p>Hello</p>
```

The CSS is a little more complex:

```
@keyframes rotate {
  0% {
    transform: rotate(0deg);
  }

  100% {
    transform: rotate(360deg);
  }
}

p {
  color: red;
  width: 100px;
  font-size: 40px;
  transform-origin: center;
}

p:hover {
  animation-name: rotate;
  animation-duration: 0.6s;
  animation-timing-function: linear;
  animation-iteration-count: 5;
}
```

Here you can see a number of interesting units that we don't talk about explicitly in this article (<angle>s, <time>s, <timing-function>s, <string>s...), but the one we are interested in here is in the line `animation-iteration-count: 5;` — this controls how many times the animation occurs when it is set off (in this case, when the paragraph is moused over,) and is a simple unitless whole number (integer, in computer speak.)

The result we get from this code is as follows:

> Hello

---

## Percentages

You can also use percentage values to specify most things that can be specified by specific numeric values. This allows us to create, for example, boxes whose width will always shift to be a certain percentage of their parent container's width. This can be compared to boxes that have their width set to a certain unit value (like `px` or `em`), which will always stay the same length, even if their parent container's width changes.

Let's show an example to explain this.

First, two similar boxes, marked up in HTML:

```
<div>
  <div class="boxes">Fixed width layout with pixels</div>
  <div class="boxes">Liquid layout with percentages</div>
</div>
```

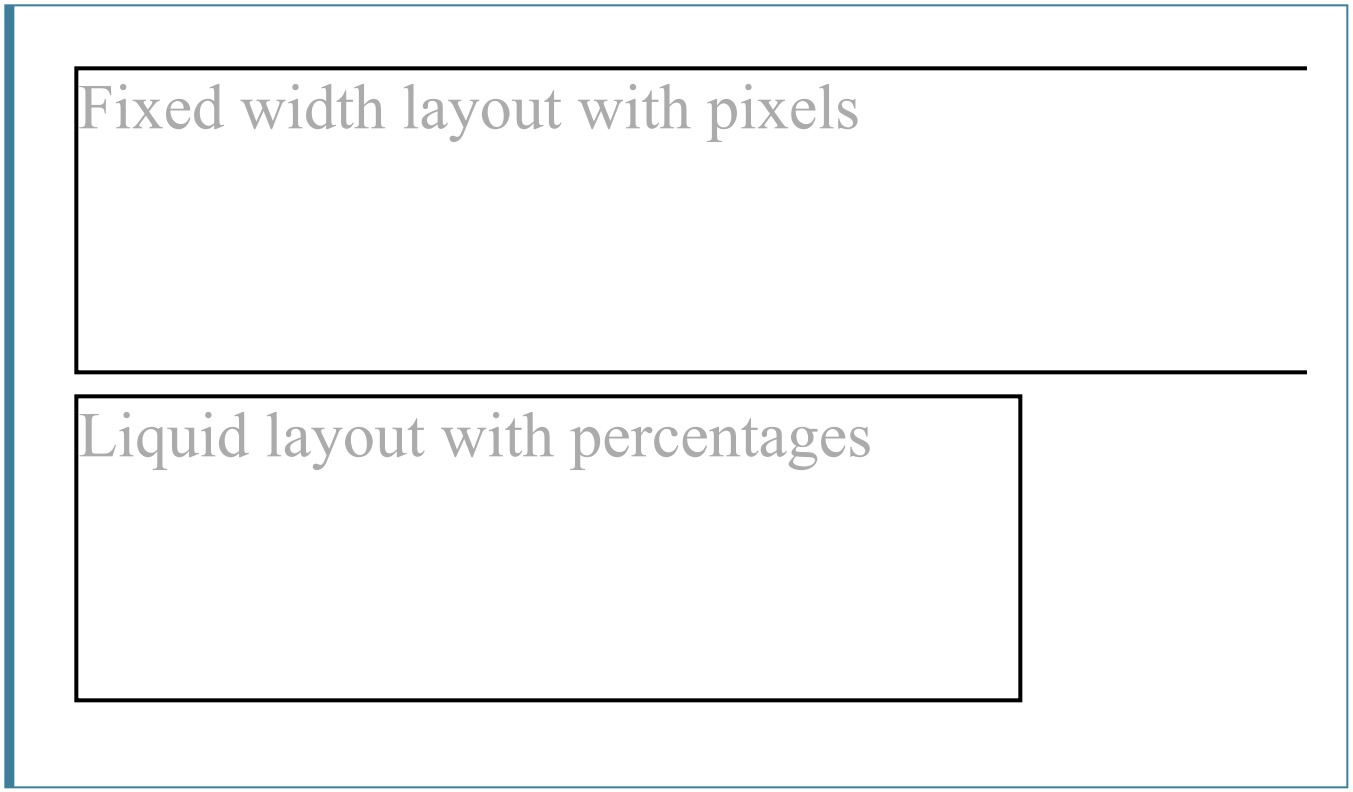
And now some CSS to style these boxes:

```
div .boxes {
  margin: 10px;
  font-size: 200%;
  color: white;
  height: 150px;
  border: 2px solid black;
}

.boxes:nth-child(1) {
  background-color: red;
  width: 650px;
}

.boxes:nth-child(2) {
  background-color: blue;
  width: 75%;
}
```

This gives us the following result:




Here we are giving both divs some `margin`, `height`, `font-size`, `border` and `color`. Then we are giving the first div and second div different `background-color`s so we can easily tell them apart. We are also setting the first div's `width` to 650px, and the second div's width to 75%. The effect of this is that the first div always has the same width, even if the viewport is resized (it will start to disappear off screen when the viewport becomes narrower than the screen), whereas the second div's width keeps changing when the viewport size changes so that it will always remain 75% as wide as its parent. In this case, the div's parent is the `<body>` element, which by default is 100% of the width of the viewport.

> **Note**: You can see this effect in action by resizing the browser window this article is in; also try doing the same thing on the raw examples found on Github.

We've also set the `font-size` to a percentage value: 200%. This works a bit differently to how you might expect, but it does make sense — again, this new sizing is relative to the parent's font-size, as it was with `em`. In this case, the parent font-size is 16px — the page default, so the computed value will be 200% of this, or 32px. This actually works in a very similar fashion to em — 200% is basically the equivalent of 2em.

These two different box layout types are often referred to as **liquid layout** (shifts as the browser viewport size changes), and **fixed width layout** (stays the same regardless.) Both have different uses, for example:

- A liquid layout could be used to ensure that a standard document will always fit on the screen and look ok across varying mobile device screen sizes.
- A fixed width layout can be used to keep an online map the same size; the browser viewport could then scroll around the map, only viewing a certain amount of it at any one time. The amount you can see at once depends on how big your viewport is.

You'll learn a lot more about web layouts later on in the course, in the CSS layout and Responsive design modules (TBD.)

## Active learning: Playing with lengths

For this active learning, there are no right answers. We'd simply like you to have a go at playing with the width/height of the `.inner` and `.outer` divs to see what effects the different values have. Try a percentage value for the `.inner` div, and see how it adjusts as the `.outer` div's width changes. Try some fixed values as well, such as pixels and `em`.

If you make a mistake, you can always reset it using the *Reset* button.

## HTML Input

```
<div class="outer">
  <div class="inner">
  </div>
</div>
```

## CSS Input

```
.outer {
  width: 100%;
  height: 10em;
  background-color: red;
}

.inner {
  width: 550px;
  height: 10em;
  background-color: blue;
```

## Output

Reset

## Colors

There are many ways to specify color in CSS, some of which are more recently implemented than others. The same color values can be used everywhere in CSS, whether you are specifying text color, background color, or whatever else.

The standard color system available in modern computers is 24 bit, which allows the display of about 16.7 million distinct colors via a combination of different red, green and blue channels with 256 different values per channel  (256 x 256 x 256 = 16,777,216.)

Let's run through the different available types of color value.

> **Note**: To convert between the different color systems discussed below, you'll need a color converter. There are lots of easy converters findable online, such as HSL to RGB / RGB to HSL / Hex Colour Converter.

### Keywords

The simplest, oldest color types in CSS are the color keywords. These are specific strings representing particular color values. For example, the following code:

```
<p>This paragraph has a red background</p>
```

```
p {
  background-color: red;
}
```

Gives this result:

> This paragraph has a red background

This is easy to understand, although it only really allows us to specify obvious color primitives. There are around 165 different keywords available for use in modern web browsers — see the full color keyword list.

You'll probably use pure colors like red, black and white regularly in your work, but beyond that you'll want to use another color system.

## Hexadecimal values

The next ubiquitous color system is hexadecimal colors, or hex codes. Each hex value consists of a hash/pound symbol (#) followed by six hexadecimal numbers, each of which can take a value between 0 and f (which represents 15) — so 0123456789abcdef. Each pair of values represents one of the channels — red, green and blue — and allows us to specify any of the 256 available values for each (16 x 16 = 256.)

So, for example, this code:

```html
<p>This paragraph has a red background</p>
<p>This paragraph has a blue background</p>
<p>This paragraph has a kind of pinky lilac background</p>
```

```css
/* equivalent to the red keyword */
p:nth-child(1) {
  background-color: #ff0000;
}

/* equivalent to the blue keyword */
p:nth-child(2) {
  background-color: #0000ff;
}

/* has no exact keyword equivalent */
p:nth-child(3) {
  background-color: #e0b0ff;
}
```

Gives the following result:

This paragraph has a red background

This paragraph has a blue background

This paragraph has a kind of pinky lilac background

These values are a bit more complex and less easy to understand, but they are a lot more versatile than keywords — you can use hex values to represent *any* color you want to use in your color scheme.

## RGB

The third scheme we'll talk about here is RGB. An RGB value is a function — `rgb()` — which is given three parameters that represent the **red**, **green** and **blue** channel values of the colors, in much the same way as hex values. The difference with RGB is that each channel is represented not by two hex digits, but by a decimal number between 0 and 255.

Let's rewrite our last example to use RGB colors:

```
<p>This paragraph has a red background</p>
<p>This paragraph has a blue background</p>
<p>This paragraph has a kind of pinky lilac background</p>
```

```css
/* equivalent to the red keyword */
p:nth-child(1) {
  background-color: rgb(255,0,0);
}

/* equivalent to the blue keyword */
p:nth-child(2) {
  background-color: rgb(0,0,255);
}

/* has no exact keyword equivalent */
p:nth-child(3) {
  background-color: rgb(224,176,255);
}
```

This gives the following result:

> This paragraph has a red background
>
> This paragraph has a blue background
>
> This paragraph has a kind of pinky lilac background

The RGB system is nearly as well supported as hex values — you probably won't come across any browsers that don't support them in your work. The RGB values are arguably a bit more intuitive and easy to understand than hex values too.

> **Note**: Why 0 to 255 and not 1 to 256? Computer systems tend to count from 0, not 1. So to allow 256 possible values, RGB colors take values in the range of 0-255.

## HSL

Slightly less well supported than RGB is the HSL model (not on old versions of IE), which was implemented after much interest from designers — instead of red, green and blue values, the `hsl()` function accepts **hue**, **saturation**, and **lightness** values, which are used to distinguish between the 16.7 million colors, but in a different way:

1. **hue**: the base shade of the color. This takes a value between 0 and 360, presenting the angles round a color wheel.
2. **saturation**: how saturated is the color? This takes a value from 0-100%, where 0 is no color (it will appear as a shade of grey), and 100% is full color saturation
3. **lightness**: how light or bright is the color? This takes a value from 0-100%, where 0 is no light (it will appear completely black) and 100% is full light (it will appear completely white)

> **Note**: An HSL cylinder is useful for visualising the way this color model works. See the HSL and HSV article on Wikipedia.

Now we'll rewrite our example to use HSL colors:

```
<p>This paragraph has a red background</p>
<p>This paragraph has a blue background</p>
<p>This paragraph has a kind of pinky lilac background</p>
```

```css
/* equivalent to the red keyword */
p:nth-child(1) {
  background-color: hsl(0,100%,50%);
}

/* equivalent to the blue keyword */
p:nth-child(2) {
  background-color: hsl(240,100%,50%);
}

/* has no exact keyword equivalent */
p:nth-child(3) {
  background-color: hsl(276,100%,85%);
}
```

Gives the following result:

This paragraph has a red background

This paragraph has a blue background

This paragraph has a kind of pinky lilac background

The HSL color model is intuitive to designers that are used to working with such color models. It is useful for, for example, finding a set of shades to go together in a monochrome color scheme:

```
/* three different shades of red*/
background-color: hsl(0,100%,50%);
background-color: hsl(0,100%,60%);
background-color: hsl(0,100%,70%);
```

## RGBA and HSLA

RGB and HSL both have corresponding modes — RGBA and HSLA — that allow you to set not only what color you want to display, but also what **transparency** you want that color to have. Their corresponding functions take the same parameters, plus a fourth value in the range 0–1 — which sets the transparency, or **alpha channel**. 0 is completely transparent, and 1 is completely opaque.

Let's show another quick example — first the HTML:

```
<p>This paragraph has a transparent red background</p>
<p>This paragraph has a transparent blue background</p>
```

Now the CSS — here we are moving the first paragraph downwards with some positioning, to show the effect of the paragraphs overlapping (you'll learn more about positioning later on):

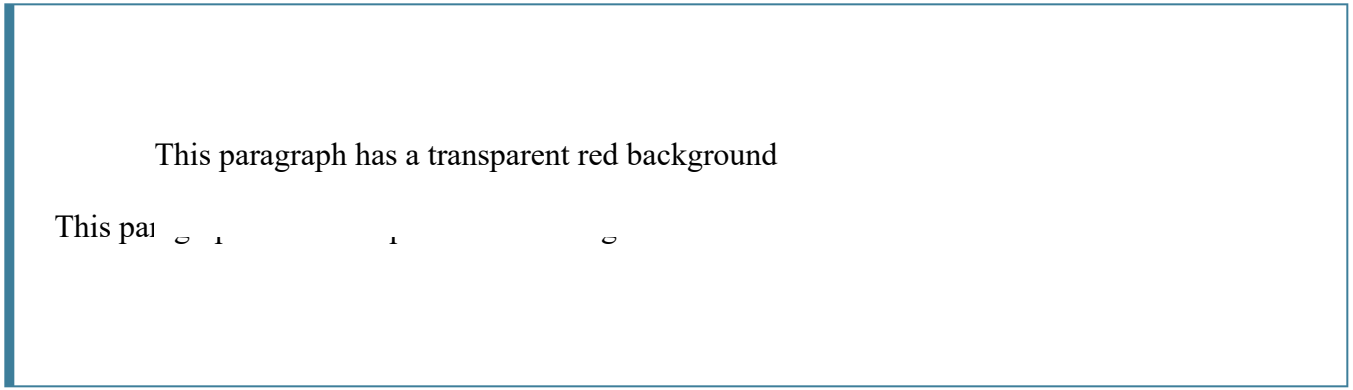
```
p {
  height: 50px;
  width: 350px;
}

/* Transparent red */
```

```
p:nth-child(1) {
  background-color: rgba(255,0,0,0.5);
  position: relative;
  top: 30px;
  left: 50px;
}

/* Transparent blue */
p:nth-child(2) {
  background-color: hsla(240,100%,50%,0.5);
}
```

This is the result:




Transparent colors are very useful for richer visual effects — blending of backgrounds, semi-transparent UI elements, etc.

> **Note**: Positioning in CSS is discussed later in the course.

## Opacity

There is another way to specify transparency via CSS — the `opacity` property. Instead of setting the transparency of a particular color, this sets the transparency of all selected elements and their children. Again, let's study an example so we can see the difference.

```
<p>This paragraph is using RGBA for transparency</p>
<p>This paragraph is using opacity for transparency</p>
```

Now the CSS:

```
/* Red with RGBA */
p:nth-child(1) {
  background-color: rgba(255,0,0,0.5);
}

/* Red with opacity */
p:nth-child(2) {
  background-color: rgb(255,0,0);
  opacity: 0.5;
}
```

This is the result:

This paragraph is using RGBA for transparency

This paragraph is using opacity for transparency

Note the difference — the first box that uses the RGBA color only has a semi-transparent background, whereas everything in the second box is transparent, including the text. You'll want to think carefully about when to use each — for example RGBA is useful when you want to create an overlaid image caption where the image shows through the caption box but the text is still readable. Opacity, on the other hand, is useful when you want to create an animation effect where a whole UI element goes from completely visible to hidden.

## Active learning: Playing with colors

This active learning session also has no right answers — we'd just like you to alter the background color values of the three boxes below that are slightly overlaid on top of one another. Try keywords, hex, RGB/HSL/RGBA/HSLA, and the opacity property. See how much fun you can have.

If you make a mistake, you can always reset it using the *Reset* button.

### HTML Input

```
<div class="first">
</div>
```

```
</div>
<div class="second">
</div>
<div class="third">
</div>
```

## CSS Input

```
.first {
  background-color: red;
  width: 400px;
  height: 200px;
  top: 0;
  left: 100px;
}

.second {
  background-color: blue;
```

## Output

## Functions

In programming, a function is a reusable section of code that can be run multiple times to complete a repetitive task with minimum effort on the part of both the developer and the computer. Functions are usually associated with languages like JavaScript, Python, or C++, but they do exist in CSS too, as property values. We've already seen functions in action in the Colors section, with `rgb()`, `hsl()`, etc.:

```
background-color: rgba(255,0,0,0.5);
background-color: hsla(240,100%,50%,0.5);
```

These functions calculate what color to use.

But you'll see functions in other places too — anytime you see a name with parenthesis after it, containing one or more values separated by commas, you are dealing with a function. For example:

```
/* calculate the new position of an element after it has been rotated by 45 degress */
transform: rotate(45deg);
/* calculate the new position of an element after it has been moved across 50px and down 60px */
transform: translate(50px, 60px);
/* calculate the computed value of 90% of the current width minus 15px */
width: calc(90% - 15px);
/* fetch an image from the network to be used as a background image */
background-image: url('myimage.png');

/* create a gradient and use it as a background image */
background-image: linear-gradient(to left, teal, aquamarine);
```

One of the more common CSS functions is the url() function notation, which returns a file; generally an image as seen above. There are several image functions, including ones to create linear, radial, and conic gradients.

There are many exciting bits of functionality to use within CSS, which you'll learn about in due course! You can continue below, or dig deeper into the various CSS unit and value types.

## Summary

We hope you enjoyed learning about CSS values and units — don't worry if this doesn't all make complete sense right now; you'll get more and more practice with this fundamental part of CSS syntax as you move forward!

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