[Course Overview](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live)

[Course Overview](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live)

[Hi everyone. My name is Steve Michelotti.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=5.48) [Welcome to my course, C# Design Patterns:](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=8.02) [Composite. I'm a software engineer and](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=10.71) [technologist, and I work for Microsoft. If](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=13.04) [you're a C# developer who wants to learn](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=15.85) [more about design patterns, then you're in](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=17.8) [the right place. The composite pattern](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=19.68) [provides a way to work with tree](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=21.83) [structures, and to do this in a uniform](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=23.36) [fashion, regardless of whether you're](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=25.55) [working with a parent or a child item in](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=28.16) [that tree. In this course, I'm going to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=30.39) [cover everything you'll need to be](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=33.01) [extremely productive implementing or](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=34.83) [leveraging composite patterns in C# on day](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=36.88) [one. Some of the major topics that we will](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=39.98) [cover include understanding what the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=42.79) [composite pattern is and why we care about](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=45.08) [it, implementing your own composite](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=47.47) [patterns, how to elegantly compose](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=49.7) [composites with builders, understanding](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=52.44) [how to consume composites effectively and](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=55.02) [efficiently, and even identifying and](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=57.16) [working with existing composites that can](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=59.61) [be found in .NET itself. By the end of](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=61.65) [this course, you'll be familiar not only](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=64.53) [with all the basics of the composite](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=66.52) [pattern, but also even ways to traverse](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=68.15) [composites with optimal performance.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=70.97) [Before beginning this course, you should](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=73.88) [feel comfortable with C# and have some](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=75.7) [basic experience with introductory data](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=78.13) [structures. I hope you'll join me on this](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=80.62) [journey to learn how to use the composite](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=83.28) [pattern with my C# Design Patterns: Composite course, on Pluralsight.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=f5c8eafa-c8ca-4573-ae92-638105eafe68&clip=0&mode=live&start=85.09)

[Composite Pattern](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live)

[The Composite Pattern](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live)

[Hi, this is Steve Michelotti. Welcome to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=1.44) [my course on the composite design pattern](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=3.83) [using C#. Deepening your knowledge to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=6.31) [include the canonical design patterns and](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=8.89) [object‑oriented programming will be an](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=11.13) [invaluable tool in your toolbox as you](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=13.28) [progress through your journey as a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=15.72) [developer. I'll start out with a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=17.43) [conceptual overview of the composite](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=20.69) [pattern itself, what it is, and why we'd](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=22.66) [want to use it. We'll then jump quickly](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=25.6) [into code and I'll show you a simple](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=28.02) [structural example first, followed by an](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=29.76) [implementation of a more real‑world](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=32.33) [example. Understanding the composite](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=34.14) [pattern is important not only so you can](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=36.67) [implement it yourself, but also so you can](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=38.97) [identify composites when you see them and](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=41.44) [leverage them effectively. We'll look at a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=43.53) [real‑world example from .NET itself. Okay,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=45.83) [first things first. What is the composite](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=49.97) [pattern? Why do we care? What is this](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=52.66) [useful for? When you think of the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=55.51) [composite pattern, think tree structures.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=57.74) [In other words, data structures with](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=61.09) [parent/child relationships. Composite](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=63.19) [being that we compose objects into tree](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=67.16) [structures. The composite pattern enables](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=70.34) [clients to interact with individual](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=73.34) [objects or compositions of objects in a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=75.21) [uniform fashion. In this context, by](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=78.08) [individual objects, we are referring to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=81.78) [leaf objects or leaf nodes. That is,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=84.51) [objects with no children, whereas the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=87.04) [compositions of objects that have](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=90.05) [children, and these children might be leaf](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=92.35) [nodes or other nested compositions. Let's](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=95.18) [look at a more concrete example. One of](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=98.15) [the most common things we think of as a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=101.48) [tree structure is a file system. We have a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=103.43) [root directory, which can contain](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=105.72) [children. In this example, we see there](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=107.44) [are three directories, Directory 1, 2, and](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=109.55) [3. Directories can contain files or other](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=113.11) [directories. We can think of the files](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=115.46) [here as the leaf nodes because they](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=118.49) [contain no children. And we can think of](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=120.78) [the directories here as the composites](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=122.77) [because they contain children. And those](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=125.42) [children can be leaf nodes or other](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=128.02) [composites. As you can see here, Directory](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=130.18) [2 contains Directory 4, and of course](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=133.76) [Directory 4 could contain other](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=135.79) [directories, and we could go down as deep](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=137.56) [as we wanted. Now the composite pattern is](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=139.97) [not only about modeling tree structures,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=142.65) [but in particular, enabling clients to act](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=144.87) [on those tree structures uniformly. For](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=147.77) [example, if I want to get the size of an](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=151.22) [individual file, then I could have a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=153.65) [method on this individual File #7 here to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=155.53) [give me its size, and it returns me the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=158.87) [number of bytes in the file. But what if I](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=161.5) [wanted the size of a directory, say](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=164.08) [Directory 4? I want to just call a method](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=166.31) [on Directory 4 here, and as a consumer, I](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=170.25) [don't want to have to worry about the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=172.77) [details of the work of going through all](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=174.18) [the directory's files to add up all their](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=176.32) [sizes so I can get the total size of the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=178.52) [directory. Or, what if I wanted the size](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=180.82) [of Directory 2? I just want a simple](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=184.18) [method to call on Directory 2 without](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=186.36) [worrying about the details. So](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=188.32) [conceptually, this is what the composite](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=190.14) [pattern is enabling, whether I want to act](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=192.38) [upon the granular level of an individual](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=194.77) [leaf node, a file in this case, or if I](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=197.33) [want to act upon the entire structure or I](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=200.68) [want to act upon just a subsection like](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=203.77) [one of the directories. The composite](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=206.57) [pattern will enable us to deal with all](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=208.53) [this uniformly. A composite pattern](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=211.3) [commonly consists of these four items, a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=214.57) [component, the composite, a leaf, and the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=217.49) [client. Let's have a quick look at each](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=220.35) [one. The component defines the common](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=222.87) [interface, including the primary](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=225.92) [operation. In the example I used earlier,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=228.08) [the primary operation would be getting the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=230.24) [size of a file system object. The leaf and](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=232.22) [the composite inherit from the component,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=235.47) [and again, the leaf does not have](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=237.47) [children, but the composites do.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=239.98) [Specifically, the composite has a child](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=243.04) [collection of component objects, and](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=245.58) [remember, each component might be either a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=247.55) [leaf or another composite. Finally, the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=250.12) [client is what manipulates a component,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=253.57) [invoking the primary operation. And](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=255.49) [remember, one of the main benefits of the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=258.48) [composite pattern is that the client can](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=260.64) [manipulate a single component at any level](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=262.8) [in the tree hierarchy, regardless of](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=265.33) [whether that component is a leaf or a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=267.57) [composite. Now that you have solid](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=269.64) [background context for the composite pattern, let's start diving into code.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=0&mode=live&start=272.02)

[Implementing the Composite Pattern](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live)

[It's time to build our first composite,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=1.24) [and we're going to start out with a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=3.56) [somewhat contrived structural example](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=4.69) [before diving into some real‑world](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=6.78) [examples. Here I have a simple .NET Core](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=8.59) [console application with nothing added](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=11.59) [except the default Program.cs file. What](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=14.09) [I'm going to do first is I am going to add](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=17.91) [a new folder called Structural, which will](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=20.27) [hold our first example. And I'm going to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=23.25) [add a class to that file called](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=26.32) [Component.cs. I'm using the Add New File](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=27.72) [Visual Studio extension to add files](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=32.03) [quickly in case anyone is wondering what](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=33.81) [that pop‑up was. Now we're going to make](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=35.64) [this class abstract because this is the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=37.51) [base class for the leaf and composite](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=39.64) [nodes. Let's add a constructor. And to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=42.11) [this constructor, we are going to add an](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=45.58) [input property for the name, and let's](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=47.9) [assign a property for that name. Let's](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=50.510000000000005) [generate a read‑only property. As a side](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=54) [note, notice we have a read‑only property,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=56.95) [but we're actually assigning a value to it](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=59.23) [in the constructor. This is legal because,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=61.48) [as of C# 6, we have the read‑only auto](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=63.93) [properties language feature, which allows](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=67.04) [for read‑only properties, but also for the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=69.25) [values to be set only in the body of the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=70.88) [constructor. Now let's add our primary](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=72.81) [operation. This is going to be the main](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=75.55) [operation of the pattern that can be](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=77.72) [executed by both composites and leaf](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=79.79) [nodes. Because this is a structural](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=82.04) [example, the name, PrimaryOperation, is a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=84.32) [little funny, but in actual practice, this](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=86.72) [method will have a more descriptive name,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=89.01) [as we'll see shortly. The Add and Remove](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=90.75) [methods will enable us to add and remove](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=93.81) [components to and from composite nodes.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=95.72) [With this abstract base class in place,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=98.54) [let's go implement the rest of our](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=100.73) [pattern. I'm going to add a class](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=102) [literally called Leaf.cs. It's going to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=104.23) [inherit from our component and we're going](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=107.59) [to implement the abstract class. This is a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=112.17500000000001) [nice little shortcut for Visual Studio to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=114.72) [put those methods in there. Another Visual](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=116.57) [Studio shortcut, I'm going to generate](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=119.17) [that constructor so that we can pass the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=121.21) [name to the base class. Since this is just](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=123.62) [a structural example, we're just going to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=127.9) [output a message as our primary operation.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=129.9) [Also, since this is the leaf node, we're](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=132.54) [actually going to leave the Add and Remove](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=135.01) [methods as not implemented. Now let's add](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=137.39) [our Composite.cs. Similarly, this is also](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=140.83) [going to inherit from Component, Ctrl+dot](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=145.64) [to implement the abstract class, Ctrl+dot](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=149.16) [again to generate the constructor. Because](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=152.365) [this is a composite, I want this to have](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=155.84) [its own list of child objects, and with](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=158.45) [that list in place, we can implement the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=165.4) [Add and Remove operations. These methods](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=167.31) [are pretty straightforward. They're just](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=171.63) [adding and removing from that list of](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=172.96) [child objects. Now let's put code in our](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=174.95) [PrimaryOperation. Now initially, this is](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=177.5) [the exact same code we put in the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=179.6) [PrimaryOperation method of the Leaf class,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=181.05) [but because this isn't a composite, let's](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=183.66) [make the implementation a little](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=185.45) [different, iterating over the children.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=187.11) [And we can see here for our](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=188.7) [PrimaryOperation, not only do we show the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=191.1) [name of this composite, but we'll also](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=192.44) [loop over and show each of its children by](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=194.77) [invoking the PrimaryOperation. Now let's](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=197.18) [flip back to the Program.cs, specifically](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=199.62) [our main method. This represents our](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=203.06) [Client object, and we'll put our initial](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=205.66) [code right here. Now I just put a lot of](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=208.98) [code in here, so let's go step by step and](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=211.37) [let me explain what's going on. First, we](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=213.93) [have some red squiggles, so let's resolve](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=216.29) [our namespace here. Now what you can see](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=218.32) [on lines 12 to 14, we are instantiating](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=221.21) [our root composite, called literally root,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=223.88) [and we're adding two children to it, and](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=227.69) [these are leafs, Leaf A and Leaf B.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=229.87) [Sixteen to 18, we create another](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=231.79) [composite, and it has its own leaves. And](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=234.38) [on lines 19 and 20, we create another](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=237.445) [composite, and on 21 you can see that we](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=239.45) [are making Composite 2 a child of](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=241.63) [Composite 1 , and Composite 1 becomes a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=244.17) [child of the root on line 23. Lines 27](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=247.43) [through 29 are just mechanically showing](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=251.15) [that we can add and remove a leaf from any](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=252.84) [level. But really, the key here is that on](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=255.43) [line 32, we're invoking the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=257.81) [PrimaryOperation on the root, which will](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=259.25) [in turn invoke the PrimaryOperation at all](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=262.06) [other levels because we're doing it on the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=264.79) [root. Let's run the app and take a look,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=266.35) [and sure enough, we can see here the root](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=270.72) [and the exact tree structure. The root has](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=272.445) [a couple of direct leafs, A and B, it has](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=274.66) [a Composite C1, which has its own leaves,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=277.66) [and then another Composite, C2, which it](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=279.95) [has its leaves. So we can build out the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=281.73) [complete tree structure, and at each level](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=283.59) [we call the PrimaryOperation, which in](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=285.65) [this case is something as trivial as](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=287.17) [displaying the output. Now remember, a key](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=288.92) [consideration of a composite is that we](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=291.6) [can act on it at any level. In this case,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=293.76) [we just did root, but let's say we wanted](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=296.58) [to change this root to the second](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=299.35) [composite, or comp2. Now let's run it](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=301.74) [again, and we can see that it's only](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=304.64) [outputting at that level for the composite](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=307.415) [of C2. We could even change this to a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=309.47) [leaf, and there is the Leaf D that we](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=311.88) [created. And this leaf is actually](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=314.95) [technically an orphan leaf because we](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=317.08) [removed and no longer part of the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=318.72) [composition, but you get the point. But](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=320.12) [for now, let's switch back to root. At](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=322.11) [this point, we fully implemented our](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=324.39) [composite. As a next step, I'm going to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=326.12) [show you a couple of alternative](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=327.96) [implementations, and then we're going to dive into more real‑world examples](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=1&mode=live&start=329.28)

[Alternative Considerations](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live)

[An important thing to keep in mind is that](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=1.34) [these are patterns, not prescriptive code](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=3.11) [examples that only have one true correct](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=6.12) [implementation. You'll sometimes see](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=9.44) [slight variations in the patterns, and](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=11.7) [it's important to be able to identify them](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=13.68) [as different variations can have their own](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=15.6) [pros and cons. One thing you may have](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=17.54) [noticed was that the base Component class](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=21.22) [had Add and Remove methods. These methods](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=23.71) [were abstract, and it forced all](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=26.37) [subclasses to have these methods as well,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=28.27) [including leaf nodes, which, by](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=30.46) [definition, cannot add and remove](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=32.21) [children. This conflicts with the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=34.13) [principle that a class should only define](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=36.11) [operations that are meaningful to it.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=38.12) [Let's look at the problem. If I come here](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=40.17) [to a leaf node, we'll just go right under](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=42.5) [Leaf D, there's nothing stopping me from](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=44.05) [adding something to a leaf. The compiler](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=46.76) [seems perfectly happy with this. Let's see](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=51.38) [what happens when we run it. Okay, well, I](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=53.22) [guess at runtime it prevented us from](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=56.49) [doing the wrong thing, but that was not an](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=58.24) [ideal experience because I didn't find out](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=60.19) [at compile time. I didn't figure it out](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=62.17) [until runtime, so let's see how we can](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=64.03) [improve this. One option is that we can](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=65.86) [come to the Leaf class and just comment](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=68.93) [out that exception. Now when we run it](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=71.88) [again it works, but this could lead to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=75.21) [significant confusion by consuming](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=77.77) [developers because we're calling a method](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=79.77) [and the method isn't doing anything, so we](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=81.99) [need to make this a little better. Option](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=84.1) [number one, we could go to the base class,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=86.45) [which is the Component class, and instead](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=89.05) [of making the Add and Remove abstract, we](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=91.08) [could make them virtual, meaning](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=93.44) [subclasses can choose to override them or](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=95.91) [not. For the baseline implementation we'll](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=97.82) [put the NotImplementException here. Let's](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=100.53) [do the same thing for the Remove method.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=103.65) [Now what we can do is go to our leaf and](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=108.62) [we can actually remove these methods from](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=110.61) [the leaf. So now maybe our code has gotten](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=112.39) [a little bit better where the class isn't](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=115.89) [defining methods that aren't meaningful to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=118.03) [it. Let's run it though. When we run it,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=119.89) [we still have the same problem. So whereas](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=122.98) [the code maybe looked a little bit better,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=125.32) [this could still be confusing to consuming](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=126.76) [developers. So let's look at another](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=128.75) [alternative. At this point, we've](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=132.06) [addressed the principle where a class](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=134.09) [doesn't define methods that are not](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=135.44) [meaningful to it, but we still have the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=136.96) [issue where a class hierarchy shouldn't](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=138.66) [define methods that are not meaningful to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=141.27) [it. So if we go to Component.cs, we can](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=143.78) [just completely remove these methods](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=147.74) [altogether. And then what happens is if we](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=150.56) [go over to the Composite, we can see that](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=154.28) [we no longer need to override the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=156.56) [Add/Remove methods, but we still need them](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=158.21) [there, so simply remove the override](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=161.005) [keyword. Let's try again. Oh, and at this](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=162.73) [point now things are getting better](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=167.32) [because we're actually getting a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=169.42) [compilation time check. Let's look very](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=171.49) [closely. We can see here that on line 28](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=174.27) [it's saying, no, no, no, you cannot add](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=177.41) [something to a leaf node. This is much](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=179.87) [more in line with what we want here. Now](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=182.55) [we have better safety because the compiler](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=184.73) [is showing us the problem at design time.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=187.14) [In fact, it prevents the problem](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=189.15) [altogether, so we can just remove that](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=190.71) [line. Now when we run it again, the code](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=192.63) [is successfully executing and our code is](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=195.91) [much cleaner this time around. So this](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=198.13) [really comes down to priorities. If your](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=199.81) [priority is absolute safety and developer](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=201.23) [clarity, this last option is usually your](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=203.61) [best option. But if your priority is to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=205.72) [treat all components uniformly, then the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=207.57) [first implementation is still okay. In](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=209.6) [practical reality, you're going to observe](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=211.87) [different variations of this pattern](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=213.65) [across different code bases. Remember,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=215.14) [these are patterns, not exact prescriptive](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=217.19) [code implementations, so it's good for you](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=219.99) [to be familiar with various alternative implementations.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=2&mode=live&start=221.75)

[Real World Example](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live)

[Now that we've looked at a mechanical](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=1.44) [structural example, let's use a paradigm](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=2.95) [that's a little more real world. To do](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=5.69) [this, we're going to revisit the diagram I](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=8.89) [showed a little earlier. We're going to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=11.04) [implement a composite pattern to represent](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=12.66) [a virtual file system. The directory](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=14.79) [objects are the composite components, and](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=17.17) [the file objects are the leaf components.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=19.02) [Here I am back in Visual Studio. I'm going](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=21.94) [to take all the code that we used earlier,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=23.735) [and we're done with this code for now, but](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=26.56) [instead of just deleting it, I'm going to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=29.05) [move it off into its own separate method,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=30.36) [we'll just call it StructuralExample. I'm](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=32.5) [just moving it out of the Main method](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=36.39) [because for those of you that like to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=38.22) [download the course code samples, you'll](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=40.08) [be able to recreate the entire course](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=42.17) [here. Okay, now our main method is clear](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=43.63) [and we can start our next example. The](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=46.87) [first thing I'm going to do is create our](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=48.43) [base Component class, and this is going to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=50.28) [be a FileSystemItem. And because it's our](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=52.38) [base item, we're going to make this an](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=56.32) [abstract class. The initial implementation](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=58.22) [might look a little similar. We're going](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=62.01) [to send a name into the constructor, and](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=63.34) [we're going to assign this to a name](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=66.82) [property. Similarly, we'll generate a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=68.19) [read‑only property. Now at this point, we](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=71.42) [want to implement our primary operation.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=75.85) [In this case, the primary operation is](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=79.44) [going to be GetSizeInKB, so a more](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=81.09) [meaningful name than just primary](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=84.09) [operation. This GetSizeInKB method will be](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=85.65) [executed by both leaf nodes and composite](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=88.76) [nodes, which are our directories.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=91.66) [Implementation will be different, but we](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=93.36) [can execute them in a uniform way across](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=95.17) [the tree structure. We'll start a new](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=97.99) [class to represent our leaf node. Once](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=99.98) [again, we'll inherit from FileSystemItem,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=103.5) [which is our base component. We'll](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=105.87) [implement the abstract class, we'll](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=109.08) [generate our constructor. Also with this](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=111.61) [constructor, we're going to add some](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=113.54) [additional initialization code to send in](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=115.15) [the value for the file bytes into the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=118.38) [constructor. Let's assign those file](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=120.25) [bytes, and once again let's generate a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=122.81) [property. Now at this point, it's time to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=127.28) [implement our primary operation,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=131.21) [GetSizeInKB. This is going to be a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=132.825) [relatively straightforward operation,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=136.15) [we're just going to divide the bytes by](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=137.79000000000002) [1000 to get kilobytes. Now let's add our](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=140.09) [composite. This is going to be a directory](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=142.29) [item. At this point, you probably know](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=143.9) [what's coming. This is going to inherit](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=146.88) [from the FileSystemItem. We'll implement](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=148.19) [the abstract class and we'll generate the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=151.42) [constructor. Now, because this is a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=154.63) [composite class, we need a collection of](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=156.44) [child objects. Another side note, line](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=158.13) [number 15 that I just inserted here, this](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=161.65) [is using two features that were introduced](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=164.21) [in C# 6. Number one, read‑only auto](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=166.08) [implemented properties, and number two,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=169.13) [auto property initializers. Now let's add](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=171.74) [our Add and Remove methods. These are](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=175.25) [typical Add/Remove methods on our](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=177.41) [composite objects, and these are very](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=179.3) [straightforward. Let's finish this off by](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=180.85) [providing implementation for the primary](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=183.27) [operation in our DirectoryItem class,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=185.24) [which is our GetSizeInKB method. Notice](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=187.6) [here we're summing up all of the items in](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=191.96) [the collection. Now before we implement](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=194.92) [our client code, remember, this is a file](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=197.84) [system object, so let's look at a sample](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=199.62) [file system. Here I have a root folder](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=201.98) [called Development, and that root folder](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=204.6) [has two directories in it, project1 and](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=207.08) [project2. We can see that project1 has its](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=209.54) [own subdirectory, sub‑dir1, which has its](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=212.76) [own files, and project1 also has a couple](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=214.99) [of files that are added directly to it,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=217.55) [p1f1 and p1f2. And then finally, project2](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=221.3) [has two files directly in it. So here's a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=224.12) [hierarchical composite structure. Let's](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=226.58) [create this exact structure in C#. Now](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=229.29) [that we're back in Visual Studio, let's](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=233.42) [add that code. Now I just added a bunch of](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=234.66) [code, so let's take this step by step.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=236.67) [Line 11 I added the root object, that](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=239.4) [directory called Development. Lines 12 and](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=242.19) [13 I created two folders, or directories,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=244.94) [project1 and project2, and on line 14 and](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=248.46000000000004) [15 I added those two directories to the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=251.26) [root directory. On line 17 and 18, you can](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=253.98) [see that we're adding files, or leaf](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=257.18) [nodes, to the first project1, and then](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=259.64) [lines 19 through 22 we're creating a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=263.05) [nested directory item, subDir1, adding a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=266.5) [couple files to it, and adding it to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=269.72) [project1 on line. 22. Finally, on lines 24](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=272.58) [and 25 we're adding a couple files](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=276.24) [directly to project2. With that in place,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=278.15) [let's see how we can act on the tree](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=280.46) [structure. Now this line of code I just](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=282.12) [inserted on line 27, I'm getting the size](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=284.55) [in kilobytes of project2. Now we can see](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=287.75) [project2 has two files, 6100 and 7100, so](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=291.1) [this should be 13.2. Let's run it and see.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=294.86) [Yep, sure enough, 13.2. Next one, let's](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=298.74) [look at project1. Now project1 contains a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=302.4) [total of four files if we take into](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=305.45) [account all the nested directories, 2100,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=307.19) [3100, 4100, and 5100, that all adds up to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=310.1) [14.4, and there it is, our 14.4. And as](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=313.55) [the last step, let's say we want to get](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=318.54) [the entire root. That's both project1 and](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=320.46) [project2, 13.2 plus 14.4, that's going to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=322.715) [be 27.6. And sure enough, there's 27.6.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=325.23) [Once again, this shows how powerful the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=330.2) [composite can be because we can manipulate](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=332.12) [any component anywhere in the composite](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=334.85) [hierarchy in a uniform fashion and](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=336.85) [regardless of whether it's a leaf or a composite with children.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=3&mode=live&start=339.45)

[Encapsulate Composite with Builder](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live)

[After composite structures are built,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=1.38) [they're really easy to work with. However,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=3.24) [actually building these composite objects](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=5.61) [can sometimes be a little confusing. And](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=7.93) [in this case, we can use a dedicated](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=10.19) [builder to do the job. Let's talk](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=12.37) [concretely about some of the challenges](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=15.78) [here. Number one, we have to instantiate](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=17.34) [each individual object. Anytime you see](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=19.97) [the new keyword being used, we're having](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=22.16) [to instantiate the object ourselves.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=24.41) [Additionally, having to initialize values](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=26.75) [for each object, you can see we have to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=29.15) [set the file name and set the actual](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=30.84) [number to each object. Third, we have to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=32.3) [correctly assign the right node to the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=35.87) [right parent, meaning anytime you see that](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=38.12) [we're having to call the Add method, we](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=40.3) [have to make sure we're doing that](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=41.7) [correctly. For example, do we call](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=43.03) [root.Add here on line 14 or 15? Or, I](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=45.18) [guess we could have done that on line 26.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=48.52) [Either would have worked. Where should we](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=50.99) [do it? What's going to be the most](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=52.26) [readable? On line 22 we have proj1 and we](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=53.95) [add the subDir1. Should we do this on line](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=57.38) [23? Maybe we should have done it right](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=59.8) [after line 19. I guess either would have](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=61.99) [worked. Let's build the exact same](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=63.7) [composite structure we just did, but with](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=66.01) [a specialized builder pattern. Now this is](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=67.72) [not a course on the builder pattern, but](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=70.42) [it is a good example of instances you'll](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=72.44) [often see, which are different design](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=74.34) [patterns working together. So for this](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=76.45) [example, let's add a new class called](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=78.57) [FileSystemBuilder. And we're going to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=80.33) [create a constructor, and in this](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=84.83) [constructor we're going to give it the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=87.66) [name of the root directory. And in here](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=88.82) [we'll assign it to a property called Root.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=92.44) [Notice we've already encapsulated the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=97.24) [instantiation of the object. Let's also](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=99.18) [create a private field to create a pointer](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=101.47) [to our current directory, and we'll](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=104.18) [initially set it to Root. We'll generate a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=108.09) [read‑only property for Root, and we'll](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=111.265) [generate a private field for the current](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=114.24) [directory, and we'll move the private](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=116.09) [fields up to the top. Now back in the Main](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=118.49) [method, I once again want to clear out my](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=122.14) [Main method, so let's just take this and](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=124.16) [move it to a different method so we can](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=126.09) [still refer back to it without deleting it](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=127.47) [completely. Now let's put some initial](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=129.68) [code in there for what the code might look](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=134.92) [like once we start using our dedicated](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=137.07) [builder. Now ignore the red squiggles for](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=139.42) [a second, but what you see is we fully](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=143.25) [built out project1, including all its](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=145.45) [files and subdirectories with sub‑dir, and](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=147.31) [it looks much more readable. We can see we](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=150.29) [add a directory, add a couple files to it,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=152.77) [add another directory, which will](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=155.29) [automatically put sub‑dir in project1, and](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=156.77499999999998) [then add files 3 and 4 to that](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=159.57) [subdirectory. So the code on line 11](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=161.18) [through 17 is, I think, much more readable](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=163.73) [than what we have to do from lines 23 down](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=166.77) [to 34. Okay, now we haven't implemented](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=170.62) [any of these methods yet, so let's do that](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=173.84) [now, starting with AddDirectory. You can](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=175.76) [see that the builder here is encapsulating](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=180.23) [the various aspects. Number one, the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=182.67) [instantiation of the new DirectoryItem.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=185.025) [Number two, the initialization. And number](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=186.525) [three, adding to the correct parent. Let's](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=189.27) [do the AddFile method next. Same thing](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=192.52) [here. Now we have encapsulation of the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=195.73) [instantiation, the initialization, and](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=198.03) [adding to the correct parent. Now we fully](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=200.67) [built out project1, but now we need to add](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=206.43) [project2, which is a sibling of project1.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=209.36) [However, we can't just call AddDirectory](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=212.03) [from our current location or it will put](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=214.02) [project2 as a subdirectory inside of](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=216.15) [sub‑dir. We need to set our context back](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=218.25) [to the Development folder and create](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=221.31) [project2 as a subdirectory of that](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=223.26) [location. So you can see that we have the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=224.87) [SetCurrentDirectory call that sets it back](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=227.92) [to the Development folder, and then we can](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=230.57) [run it just the same as the other ones.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=232.6) [This now fully builds out project2, which](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=234.765) [only consisted of those two files. But we](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=237.49) [haven't made this work quite yet because](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=239.78) [we need to implement the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=241.47) [SetCurrentDirectory method. In order to do](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=242.35) [this, we have to know how to traverse a composite. We'll cover that next.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=4&mode=live&start=244.92)

[Completing the Builder - Traversing the Composite](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live)

[When we left off, we were almost done](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=1.34) [creating our composite builder. The last](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=3.18) [thing we need to be able to do is to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=5.92) [implement the SetCurrentDirectory method](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=7.16) [where we needed to know how to iterate a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=9.31) [complete composite tree structure. Let's](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=11.8) [go do that now. Now one way to do this is](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=14) [with a recursive function, that is a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=17.73) [function that calls itself. Although there](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=19.58) [are instances where a recursive function](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=21.76) [might be an elegant solution, they can](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=23.71) [sometimes be harder to understand. Also,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=25.53) [they're often not as efficient as an](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=27.84) [alternative iterative solution and can](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=29.68) [lead to StackOverflow exceptions depending](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=32.58) [on how large your call stack is. So](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=34.43) [instead of recursion, let's implement our](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=36.34) [search through our composite with an](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=38.28) [iterative stack‑based solution. We're](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=40.54) [going to instantiate a generic Stack](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=43.6) [object where the generic type is](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=45.33) [DirectoryItem, and we're just going to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=47.31) [push the root onto the stack by default.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=48.69) [With our stack in place, we can just](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=51.24) [iterate over it with a simple loop. Notice](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=52.84) [that we pop an item off the top of the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=55.29) [stack each time. The first thing to do is](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=57.03) [to check if this is the directory name](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=60.05) [we're looking for. If we found it, then](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=62.59) [we're done and you can see we can just](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=65.12) [return it on line 46. However, remember,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=66.56) [this is a composite, so if we haven't](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=69.35) [found it yet, then we should search](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=71.11) [through the child items, and the child](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=72.73) [items could be either file items or](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=74.54) [directory items. We only want to consider](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=76.72) [directory items in our search, though,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=78.83) [because our whole point is that we're](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=80.74) [trying to find a specific directory. On](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=82.04) [line 48, I used the OfType method so we](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=86.58500000000001) [only get directory items, not file items.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=88.99) [For any child directory item, push it on](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=91.685) [the stack so we can check for its name on](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=94.49) [the next iteration of our loop. As a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=96.49) [general statement, this is a pretty handy](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=98.71) [algorithm to have in your toolbox anytime](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=100.66) [you need to traverse or iterate a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=102.77) [hierarchical tree structure and you want](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=104.955) [to do it without recursion. Final thing we](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=106.53) [need to remember to do after our loop,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=109) [just in case the directory sent in is not](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=112.14) [found anywhere, we need to throw an](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=114.4) [InvalidOperationException. Now back in our](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=116.34) [Main method, it's time to manipulate the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=119.89) [composite. I'm going to do two things](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=121.92) [here, help with the size and show the JSON](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=125.54) [representation. Remember, our total size](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=128.3175) [should be 27.6, starting from the root as](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=130.09) [we saw in the previous example. I'm also](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=132.94) [just outputting the composite with the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=135.3) [JSON representation as an easy way to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=137.08) [visualize the hierarchy of the composite](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=139.07) [that we've just created with our builder.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=141.82) [Before we do that, let's resolve the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=144.04) [namespace. A handy little feature of](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=145.36) [Visual Studio is we can install a package](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=149.42000000000002) [and resolve the namespace at the same](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=151.38) [time. Now let's run the app. There's our](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=152.75) [total size of 27.6 on top, and here is our](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=158.17) [full hierarchical structure of the JSON](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=161.78) [that we just built. And as you can see,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=164.24) [using a builder to encapsulate the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=169.47) [creation of the composite can lead to a little bit easier code to write.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=5&mode=live&start=171.09)

[Example Composites in .NET](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live)

[It's valuable to know how to build your](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=1.34) [own composites, but it's also valuable to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=2.97) [know how to use the composites you find in](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=5.06) [the frameworks you use. We already talked](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=7.26) [about tree structures, like a file system,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=9.42) [but there are many examples of composites,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=11.63) [JSON documents, XML documents, HTML](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=14.06) [documents. In the .NET Framework, it's](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=17.12) [common for our control object, which can](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=19.48) [represent a user interface control, to be](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=21.81) [implemented as a composite with its own](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=24.61) [child collection of other controls. Now](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=27.06) [let's look at a specific concrete example.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=29.63) [Here I am back in Visual Studio. Once](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=33.94) [again, let's take the code that we're no](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=35.82) [longer using and just extract it away, and](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=37.16) [what we're going to explore now is an](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=41.71) [XElement. This is built into .NET. We can](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=43.915) [go to the definition on it and see it's in](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=48.51) [the System.Xml.Linq namespace, it inherits](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=50.44) [from XContainer, and we'll go to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=53.93) [definition on that. And we can see right](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=55.66) [here, it has an Elements member, which is](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=60.01) [an IEnumerable of XElement. So it is](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=62.33) [itself an XElement that has a member](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=65.03) [called Elements, which is a collection of](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=67.49) [other XElements. Let's see how we can use](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=69.96) [this composite in action. I'm actually](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=73.39) [going to add an XML file to this project.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=75.51) [Notice this XML file is a direct replica](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=80.05) [of the structure that I've been using](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=82.9) [throughout this entire course. Let's](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=84.22) [right‑click on the properties here, and](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=85.68) [say Copy if newer. So we can actually get](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=88.77) [at the contents when we load it in. Now](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=91.68) [let's use it. Let's say we want to simply](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=93.72) [traverse this composite data structure and](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=99.01) [point out all names and file sizes for](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=101.54) [each leaf node. Let's create a single](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=104.13) [extension method that's aware of our](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=106.41) [composite structure that iterates over our](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=109.1) [composite. To do this, I'm just going to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=111.45) [create a new file called Extensions.cs.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=113.66) [This is going to hold extension methods,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=116.005) [so we need to make this class static. And](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=119.16) [let's just enter the method here. This](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=121.88) [method is almost identical to the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=125.02) [implementation of the SetCurrentDirectory](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=127.39) [method we implemented it in the file](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=130.44) [system builder, which we can see right](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=131.74) [here. The main difference is that in the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=135) [SetCurrentDirectory method, we were](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=137.27) [looking only for the matching directory](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=139.63) [name, which we can see that check right](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=142.06) [here on line 43, whereas in this extension](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=144.2) [method, we can pass in literally any](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=148.66) [predicate we want, so it'll be completely](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=151.49) [multi‑purpose and reusable. And we check](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=153.83) [the value of that predicate in the if](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=156.52) [statement on line 24. Let's see how we can](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=157.95) [use this. Back in our Program.cs, we want](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=160.44) [to iterate over just the leaf nodes, so](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=164.22500000000002) [let's start out by doing a foreach, and](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=166.75) [because I know it's going to be leaves,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=169.55) [let's say foreach leaf, and we're going to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=170.67) [use this FindElements extension method](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=174.02) [that I just created. At this point, we](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=177.06) [need to put in a predicate. This predicate](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=179.99) [will actually be really easy to implement.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=182.27499999999998) [We know something is a composite node if](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=184.32) [it has children, and we know it's a leaf](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=186.49) [node if it doesn't have children. In here,](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=188.33) [we're just looking for all the leaf nodes.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=191.01) [So all we have to do is if it does not](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=192.82) [have elements, it must be a leaf, it must](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=196.01) [not be a composite. Now I'll just put a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=198.12) [Console.WritetLine statement. We're just](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=199.94) [outputting the leaf's name and its file](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=202.15) [size in bytes. Let's run it, and we can](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=204.48) [see all of the leaf nodes outputted with](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=208.21) [their file sizes. Here we have leverage](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=210.57) [our knowledge of working with composites](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=212.83) [to efficiently use a composite that is built into .NET.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=6&mode=live&start=214.76)

[Final Words](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live)

[We covered many aspects of the composite](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=1.24) [pattern in this course. We started out](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=3.29) [with a conceptual overview of the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=6.25) [composite pattern, what it is, and why](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=7.74) [we'd want to use it. I discussed that the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=10.49) [composite pattern enables interacting with](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=12.62) [tree structures in a uniform way. We then](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=14.62) [dove into code and I showed a basic](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=17.71) [structural example of the pattern so you](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=19.68) [could solidify the concepts. And then, we](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=21.44) [implemented a virtual file system for a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=23.94) [more real‑world example. It's important to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=26.63) [know the composite pattern, not just you](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=29.22) [can write your own implementations, but](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=30.82) [also so that you can identify the pattern](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=32.91) [in various code libraries you might](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=34.94) [consume and be able to leverage it](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=36.44) [effectively. If you remember nothing else](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=38.32) [from this course, remember this. When you](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=41.06) [think of the composite pattern, you should](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=43.41) [immediately think of tree structures and](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=45.14) [specifically enabling the ability to](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=47.63) [manipulate a component at any level of](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=50.13) [that tree structure and working with it in](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=52.75) [a uniform way, regardless of whether that](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=55.13) [component is a leaf component or a](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=57.75) [composite component. This concludes the](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=59.98) [course on the composite pattern in C#.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=62.42) [Thanks for watching, and I hope you](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=64.51) [enjoyed the course. Deepening your](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=66.06) [understanding of all design patterns can](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=68.04) [have tremendous benefits as you create](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=69.74) [your own code and consume code from](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=71.54) [others. I hope this course helps you along your journey. Happy coding.](https://app.pluralsight.com/player?course=c-sharp-design-patterns-composite&author=steve-michelotti&name=dbad5e34-79f8-4819-95d1-2141f077ab76&clip=7&mode=live&start=73.17)