Getting Started with Grafana

Real-Time Dashboards for IT and Business Operations

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Ronald McCollam
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To my partner, my friends, and family (both birth and chosen), who put up with my absence for far too many evenings and weekends. Thank you!
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About the Author

Ronald McCollam is a “geek of all trades” with experience ranging from full stack development to IT operations management. He has a strong background in open source software dating back to when a stack of 3.5” Slackware floppies was the easy way to install Linux. When not on the road for work or in his lab building robots that can operate a Ouija board, Ronald resides on his back porch in Somerville, MA, with a frosty beverage in hand.
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Alfons Muñoz is a Program Manager at C2C Global, the Google Cloud Customer Community, where he specializes in developing a vibrant cloud community. He is 3x Google Cloud certified, including Associate Cloud Engineer, Cloud Architect, and Collaboration Engineer, and is also a Google Cloud Partner. As a big fan of data-driven companies, Alfons is always involved in the data management projects in the company and enjoys moderating events in the community where he interviews cloud and data specialists.
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dog again, I promise.
Introduction

The first time I saw Grafana I fell in love.

When I started monitoring IT operations at a legal document analysis company 20 years ago, there weren’t a lot of good options for simply visualizing what was really going on. There were plenty of tools to capture data from the bulky, noisy racks of hardware in the datacenter, but they were all limited to showing simple statistics in tables or (in the case of the really fancy ones) line graphs that could plot a single set of metrics over time. “Monitoring” meant staring at these tables and charts at least a few times per week to look for indications of trends that might become problems down the line. Automated alerts were simple thresholds for CPU or memory utilization that pointlessly woke me up at 3:00 in the morning, but still had to be checked and reset before I could go back to bed. I spent as much time trying to build ways to see and manage my data as I did in actually using it productively.

We’ve come a long way in the last couple of decades. Most services now run in cloud environments where individual servers no longer matter. At the same time, the move to microservice architectures means that the number of services that an operator or Site Reliability Engineer (SRE) cares about has exploded. The simple tools from my datacenter days are still there, but their singular focus can’t give the broader context that we now need to understand how these complex components interrelate.

That’s where Grafana comes in. Grafana is the gold standard for live, real-time data visualization. It works with your existing tools and talks to your data where it lives. Rather than ingesting static point-in-time CSV dumps, Grafana runs queries against databases or services. Forget exporting and importing, no need to copy or move data; Grafana sits on top of your existing infrastructure and just lets you see.

You might be a manager who needs to meet specific service-level objectives (SLOs) for your business, wondering how best to track the service-level indicators (SLIs) that tell you if you’re meeting your goals. Perhaps, you’ve just read the Google SRE Handbook and want a good way to track the Four Golden Signals for your application. Or maybe you just care about data and want a beautiful, easy way to visualize it! This is the book to get you started.
INTRODUCTION

You’ll first learn how to get up and running with Grafana in the cloud and how to create simple dashboards. From there, you’ll deploy Grafana in your own environment, connect it to your own data, and manage user access and permissions to that data.

Next, you’ll see how to design beautiful and effective dashboards that show your data in the most meaningful way. You’ll learn how to build powerful workflows that guide people to the most relevant information, even when that information is scattered across many tools and storage systems. Templates and variables will let you create comprehensive views of data with minimal effort, and alerts will warn you about problems that occur when you’re busy elsewhere.

Finally, you’ll explore the full power and extensibility of Grafana. You’ll see how to scale Grafana and treat its configuration and dashboards as code. You’ll use the Grafana API to automate processes and provision new environments. You’ll even get a peek at some of the enhancements available in the Enterprise version of Grafana.

As “monitoring” has grown to “observability,” we’ve moved from looking at simple metrics from a single program or server to thinking about systems. A high CPU utilization doesn’t matter as long as transactions are being processed within the business’s SLOs. A server going offline entirely is fine if the service heals itself and keeps running. I might care to know that it happened, but I certainly don’t want it to wake me up in the middle of the night!

Grafana is everything that I wanted when I was (literally) keeping the lights on in a datacenter decades ago. It elegantly combines data from nearly any source into a simple and beautiful interface that can give both real-time views and historical context about anything you care to track. After discovering it, I threw away all of my home-built scripts and clunky tables and charts and have never looked back.

In this book, I hope to give you an introduction to the power that Grafana contains. The concepts and techniques covered here will enable you to build meaningful representations of your data that can be used to inform decisions about scaling, point out potential issues, and even show how seemingly separate systems interrelate.

Grafana is an amazing tool that can be used almost anywhere. I hope you will enjoy it as much as I do!
PART I

Getting Started

The fastest way to learn to use Grafana is to just start using it. In Chapter 1, we’ll look at some ways to use Grafana, starting with the free tier of Grafana Cloud. This will give you a full Grafana environment without any need to install anything or mess around with setting up a system, virtual machine, or container. Instead, you can just create an account and immediately start building dashboards!

In Chapter 1, you’ll learn how to create a Grafana Cloud account, how to log in to Grafana and navigate around the interface, and how to create and save a simple dashboard with some mock data.

Chapter 2 will show you how to work with panels to build and customize more complex dashboards. We’ll also take a look at ways to experiment with and explore data quickly for those times when building a full dashboard isn’t really needed.

This initial exposure to Grafana from the perspective of a user will lay the foundation for more advanced topics in Part II (Chapters 3–5), where we’ll look at deploying and managing Grafana in various environments.
CHAPTER 1

Grafana Cloud

As a widely used open source tool, Grafana can be deployed in a nearly limitless number of ways and at scales ranging from a single instance on a pocket-sized Raspberry Pi up to highly available multiregion deployments with hundreds of nodes. Figuring out the best way to deploy it for your own environment can seem a bit daunting.

Fortunately, Grafana is also available as Software as a Service (SaaS), meaning that someone else has already done all the work to set it up correctly and make it available to you to sign up and use automatically. Since Grafana is open source, anyone can host a SaaS Grafana service. And because Grafana continues to grow in popularity, there are a growing number to choose from.

Note Deploying Grafana yourself isn’t as hard as it might look! We’ll walk through some common deployments in the next section. For now, starting with Grafana Cloud lets us get up and running quickly.

In Part I, we’ll focus on Grafana Cloud, provided at www.grafana.com. Grafana Cloud has a few advantages for our purposes. For one, it’s managed by Grafana Labs, the corporate backer of the Grafana project. So Grafana Cloud will always have the latest release of Grafana available, and since it’s run by the people who make Grafana, you can count on it to be configured and patched correctly.

Another reason to use Grafana Cloud is that it provides a free tier that should provide plenty of resources to get you started with Grafana. (It even includes some other services such as metrics and logs storage so you can experiment with your own real data if you choose.) You can sign up without using a credit card or other forms of payment. And while you’ll start on a “pro” tier that is time limited, the standard open source Grafana functionality will remain free after this initial trial expires.
Creating a Grafana Cloud Account

To use the hosted version of Grafana, you’ll first need to create a Grafana Cloud account. Start by opening your web browser and visiting the Grafana home page at www.grafana.com.

The web page may change from time to time, but look for a button that says something like “Create a free account.” If you don’t see anything like that, click the “Login” link in the upper right. You can then register for an account from the login page directly (Figure 1-1).

![Figure 1-1. The Grafana home page with the “Create a free account” button center left](image)

Next, you’ll need to choose how you want to authenticate to Grafana Cloud. There are a number of options, including single sign-on (SSO) options. If you have an account on a supported service such as Google (or Gmail), GitHub, Microsoft, or Amazon, you can use that account to log in without having to remember any new credentials. Of course, the old standby of using your email address and creating a password is available too, as shown in Figure 1-2. Don’t worry too much about which method you use – you can always add other accounts and authorization systems later.
Creating a Grafana Cloud account with an email address

If you do choose to use an email address, there’s one extra step: you’ll need to validate your address before you can finish creating your account. Look for an email in your inbox (and remember to check your spam folder if you don’t see it). There’s a code you can copy and paste into your browser window, or you can just click the link in the email to complete the validation process directly.

Once you’ve used an SSO system or validated your email address, there’s one final important step: choosing a URL for your Grafana instance. Each instance of Grafana that is hosted in Grafana Cloud gets its own unique URL. This is what you’ll put in your browser to go directly to your Grafana environment.

Grafana Cloud will suggest something for you based on your name. (If you have a common name, it might have to add a number or some extra text to make the URL unique.) But you can change this if you like, and the URL doesn’t have to be based on your name at all. If you choose a URL that’s already in use, Grafana Cloud will let you know that you need to try something else before you can continue. And note that there are a few restrictions on what you can use in the name. You can only use letters and numbers, no spaces, dashes, underscores, or periods. Figure 1-3 shows a valid URL being selected.
Caution Your URL can’t be changed later, so be sure you’re happy with it before you move on! Double-check your spelling to verify that it’s 100% correct.

Once you click this last button, Grafana Cloud will create an instance of Grafana just for you. You’ll be set up as the administrator for this instance, so you’ll be able to configure data sources, set permissions on dashboards, and invite other users to the account. This may take a few seconds, but once it’s finished, you’ll be automatically logged in to your brand-new Grafana instance. When you see a getting started screen with a navigation bar on the left, you’ll know your instance is running. When your instance starts, you’ll see a screen like Figure 1-4.
Congratulations! Your Grafana Cloud account and new Grafana instance are ready to use!

**A Quick Overview of the Grafana Interface**

We’ll review the functionality of Grafana in more detail in the following sections. But it’s worth taking a quick tour of the interface (Figure 1-5) to understand how the Grafana UI works and where to look for the tools you need.
Navigating Grafana

On the left is a menu bar with a set of icons running top to bottom. This is the Grafana navigation bar, which provides quick links to the main functionality provided by Grafana. The stylized orange “G” at the top of the navigation bar is the Grafana logo, and clicking this will always take you to your Grafana home page. By default this page is an overview of the dashboards and alerts you’ve configured plus helpful links to install plugins and manage your Grafana Cloud account. But this can be customized or can be set to any dashboard you like.

The other buttons down the navigation bar will help you find or create dashboards, explore data, create and manage reports and alerts, manage data sources and other settings, and expose extra functionality provided by plugins.

At the very bottom of the navigation bar are two icons. The top is a user icon where you can manage your personal account settings. The bottom is a help menu that provides keyboard shortcuts and a way to request support from Grafana Labs.

Figure 1-5. An example Grafana dashboard
Dashboards and Panels

Dashboards are the most important part of Grafana and as such take up most of the space in the interface. Everything outside of the dashboard controls at the top of the screen and the navigation bar is the dashboard space.

A dashboard is a collection of panels. Panels are the actual charts, graphs, numbers, tables, and other objects that show data. By design, Grafana can use any panel with any data source, so regardless of where your data is, you have the same options for visualizing it. This means that you can easily combine data from multiple different sources and still have a uniform representation of everything in one place.

Note Panels can only show data that makes sense for the type of visualization they provide. If you have a panel that represents geographic location data, it probably won’t show much if you give it quarterly sales figures represented in dollars.

There are many types of panels built into Grafana that will probably cover most of how you want to represent data. But you can also extend Grafana by adding panel plugins that provide different ways of visualizing your data. We’ll look at more of this functionality in the next chapter.

Dashboard Options

Across the top of the screen whenever a dashboard is open (which is most of the time), you’ll see a set of dashboard controls.

The top left shows the current dashboard folder and name. Grafana uses folders to organize dashboards for easy search and to let you group dashboards logically. Clicking the folder name will show you other dashboards in the same folder as the current dashboard. Clicking the dashboard name will show the full list of folders and a search field for quick dashboard access.

At the top right are two icons. The leftmost icon in the shape of a gear opens the dashboard settings menu. This includes metadata like the dashboard name and folder, variables that can be used to change functionality, how frequently the data on a dashboard should refresh, and other settings. We’ll cover these in a future section.
The rightmost icon in the shape of a display changes Grafana's view mode. By default, the full Grafana UI is shown. But clicking this button lets you cycle through various display modes to hide the navigation bar or even put the dashboard into a full screen “kiosk” mode.

Creating Your First Dashboard

Now that you have a Grafana instance up and running, it’s time to see what it can do! There are a few links on the default page that’s created with your Grafana instance that will help you import data from various sources, but we’ll start with some random sample data for now while you get a feel for using Grafana.

Adding Panels

Let’s build a dashboard. Start by clicking the large + button on the navigation bar. This is the “new dashboard” button and will start creating a dashboard from scratch. You’ll see that Grafana creates a new dashboard and starts by asking how you’d like to add your first panel, shown in Figure 1-6.

Figure 1-6. Creating a new dashboard
For now, click “Add an empty panel.” This will create a new panel and bring up the panel editing interface (Figure 1-7).

![Figure 1-7. A new panel with sample data](image)

There’s a lot going on here! The panel editor provides a huge list of ways to query and manipulate data. We’ll cover all of this in detail in the next chapter, so don’t worry about all the options here yet. For now, just click the “Apply” button in the upper-right corner of the screen.

Once you apply the panel settings, you’ll see that the panel has been placed on the dashboard. It’s now showing the sample data in a simple line graph.

Let’s add one more panel so we have a more interesting dashboard. Click the “Add panel” button in the upper right of the screen. (It looks like a bar graph with a large + next to it, as shown in Figure 1-8.) Once again, add an empty panel to the dashboard.

![Figure 1-8. The “Add panel” button](image)
This time, let’s change the visualization from a time series to a gauge. Click the dropdown in the upper-right corner of the panel editor – it should currently say “Time series.” Select “Gauge” and you’ll immediately see the visual representation of the sample data change, as in Figure 1-9.

![Figure 1-9. Changing the visualization to a gauge](image)

Now hit “Apply” again, and you’ll see the gauge added to your new dashboard.

**Working with Panels**

You can change the size and layout of panels on a dashboard just by clicking and dragging. To move a panel on the dashboard, click and hold on the *panel title* (the bar at the top of the panel) and drag the panel to where you want it to go. You’ll see that other panels will move out of the way and rearrange themselves as you do this. This is because dashboards in Grafana are arranged in a grid. Panels will automatically snap to the closest grid location, ensuring that nothing gets lost or hidden behind another panel.
Resizing panels works similarly. Hover over the lower-right corner of a panel, and you’ll see a small arrow appear. You can click and drag there to resize the panel. The panel visualization will resize to fit the new panel size. Some panels may also rearrange the data (or even show and hide components) as a panel grows or shrinks to make the best use of the available space.

Finally, if you want to change any of the options in your panel, just click the panel title. Select “Edit” from the menu that appears to go back into the panel options view (Figure 1-10).

![Panel menu showing the “Edit” option highlighted](image)

**Figure 1-10. The panel menu showing the “Edit” option highlighted**

Try creating a few panels and arranging them in different ways to see how your dashboard can be laid out. When you’re happy with what you’ve built, click the “Save” icon at the top of the screen (Figure 1-11) to save your dashboard.

![Save button](image)

**Figure 1-11. The “Save” button**
Give your dashboard a descriptive name. You can sort the dashboard into a folder to keep it grouped with other related dashboards, but for now just keep the default “General” folder as shown in Figure 1-12. Click “Save” and your dashboard will stick around for next time!

![Figure 1-12. Saving a dashboard]

Logging Out of and In to Grafana

Creating an account on Grafana Cloud automatically logged you in to your new Grafana instance. In case you’re on a shared computer or want to log out to switch accounts (or for any other reason), you can do that right from the Grafana window itself.

Signing Out

To log out, hover over your user icon in the lower left on the navigation bar. A menu will appear with your username and several options (Figure 1-13). Click “Sign out” and you’ll be taken back to the Grafana login page for your instance.
Tip  Logging out of your Grafana instance doesn’t automatically log you out of Grafana.com. You can have access to more than one Grafana instance with a single Grafana.com account. The two accounts are connected but not the same. If it’s a bit confusing, don’t worry – you’ll only need to think about any of this if you set up multiple Grafana instances from a single Grafana.com account. Otherwise, you can ignore the distinction and just think of your Grafana.com account as unlocking your Grafana instance whenever you log in.

Signing In

There are a couple of ways of signing back in to Grafana. The easiest is to simply visit your URL in a browser and click the button marked “Sign in with Grafana.com”. If you’re still logged in to your Grafana.com account, this will log you straight in to your Grafana instance as well. Otherwise, you’ll see a login screen similar to the account creation screen from earlier like the one in Figure 1-14.