

# Lecture II - First Steps in Julia

## Applied Optimization with Julia

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### Quick Recap on the Technical Setup

#### Download and Install Julia



To prepare for the upcoming lectures, we start by installing the Julia Programming Language and an Integrated Development Environment (IDE) to work with Julia.

# Installing Julia

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## The Julia Programming Language

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### Julia in a Nutshell

#### Fast

Julia was designed for [high performance](#). Julia programs automatically compile to efficient native code via LLVM, and support [multiple platforms](#).

#### Dynamic

Julia is [dynamically typed](#), feels like a scripting language, and has good support for [interactive](#) use, but can also optionally be separately compiled.

#### Reproducible

[Reproducible environments](#) make it possible to recreate the same Julia environment every time, across platforms, with [pre-built binaries](#).

#### Composable

Julia uses [multiple dispatch](#) as a paradigm, making it easy to express many object-oriented and [functional](#) programming patterns. The talk on the [Unreasonable Effectiveness of Multiple Dispatch](#) explains why it works so well.

#### General


Julia provides [asynchronous I/O](#), [metaprogramming](#), [debugging](#), [logging](#), [profiling](#), a [package manager](#), and more. One can build entire [Applications and Microservices](#) in Julia.

#### Open source

Julia is an open source project with over 1,000 contributors. It is made available under the [MIT license](#). The [source code](#) is available on GitHub.

- Head to [julialang.org](https://julialang.org) and follow the instructions.

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 **Tip**

If you are ever asked to add something to your “PATH”, do so!

## VS Code



- Next, we are going to install VS Code
- Alternatively, you can install VS Codium
- It is essentially VS Code but without any tracking by MS

### Installing VS Code

- Head to the website [code.visualstudio.com](https://code.visualstudio.com)
- OR to the website [vscodium.com](https://vscodium.com)
- Download and install the latest release

### Verify the Installation

- Start the IDE and take a look around
- Search for the field “Extensions” on the left sidebar
- Click it and search for “Julia”
- Download and install “Julia (Julia Language Support)”

## Create a new file

- Create a new file with a “.jl” ending
- Save it somewhere on your computer
- e.g., in a folder that you will use in the course

```
print("Hello World!")
```

```
Hello World!
```

- Run the file by clicking “run” in the upper right corner
- OR by pressing “Control+Enter” or “STRG+Enter”

## Everything working?

- If the terminal opens with a `Hello World!` → perfect!
- If not, it is likely that the IDE cannot find the path to Julia
- Try to determine the path and save it to VS Code
- After saving it, try to run the file again



Tip

Don't worry if it is not running right away. We will fix this together!

## Learning Julia

### Julia as a Programming Language

- Following three lectures are dedicated to learning the basics
- Start with the very basics and gradually move on
- Focus in the first two lectures on the programming language
- Third lecture dedicated to Mathematical Optimization

## Working with VS Code and Julia

### Notebooks in VS Code

- The easiest way is by using VS Code
- For the detailed instructions, just open the first tutorial.
- It explains step-by-step how to use `.jl` or `.ipynb` files as notebook

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Note

If you use `.jl` files, you can also put them under version control with Git, as you will see later in this lecture.

## Downloading the Notebooks

- You will find the tutorial notebooks next to the tutorial pages
- On each page, you will find a button [Julia](#) on the right
- Click it to download the `.jl` file and save it
- If `.jl` files do not work for you, you can also click on [Jupyter](#)
- This will download a `.ipynb` file which you can use directly as notebook
- I'd really recommend storing the files in a separate directory for this course

## Learning by doing

- The best way to learn a programming language is by doing
- We will therefore solve problems the coming weeks
- The goal is to get you familiar with the language
- You can discuss the problems with your fellow students
- You can hand in your solutions to receive bonus points!

## Working with Git

### What is Git?

- Git is a version control system that tracks changes in your code
- Can be used for collaboration and keeping track of your work
- Allows you to save “snapshots” of your project at different stages
- You can always go back to previous versions if something goes wrong
- No need to create files like `tutorial_v1.jl` and `tutorial_v2.jl`

### Installing Git

- Head to [git-scm.com](https://git-scm.com) and download Git
- Follow the installation instructions on the website for your OS

#### Tip

If you have any questions, feel free to ask!

### Git Extension in VS Code

- VS Code has built-in Git support!
- Look for the “Source Control” icon in the left sidebar (looks like a branch)
- For enhanced features, install the [GitGraph extension](#)

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#### Tip

You don't need to use Git, but once you get used to it it becomes invaluable, especially if you are working with a lot of code!

## Initialize a Repository

- Open your project folder (of our lecture) in VS Code
- Click on “Source Control” in the left sidebar
- Click “Initialize Repository” button
- Your folder is now a Git repository!

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### Tip

You can also synchronize your repository with GitHub or other hosting services. Then, your code is saved in a remote location, making it accessible from anywhere and allowing collaboration with others.

## Making Your First Commit

- Make changes to your files (e.g., work on a tutorial `.jl` file)
- Go to Source Control panel
- You’ll see your changes listed under “Changes”
- Click the “+” next to files to stage them
- Add a commit message describing your changes
- Click the checkmark ✓ to commit

## Viewing History

- Use the “Git Graph” extension for a visual representation
- Click the “Git Graph” button in the Source Control panel
- See your commit history as a branching diagram

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### Tip

Start using Git from day one! Even for small projects, it’s a good habit to develop.

## Submission of Assignments

### Submission of Assignments

- You can work in groups of up to three people
- Submit the assignment via OpenOlat
- You will submit your assignment by uploading a notebook
- The assignment is due the day before the next tutorial

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#### Tip

Don't forget to save your notebook before uploading it to OpenOlat!

### Grading of Assignments

- Each assignment is worth 0.5 points
- You can get a maximum of 6.0 points from the assignments
- The points will be added to your exam points
- You need to pass the exam first, to receive any bonus points!

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#### Note

The assignments are not mandatory, but highly recommended!

## Five Tutorials for this Week

### Topics of the Tutorials

- Variables: Learn how to assign values to variables
- Vectors: Learn how to create and manipulate vectors
- Comparisons: Learn how to compare values
- Loops: Learn how to use loops to repeat code
- Scope: Learn about the scope of variables

### Get started with the tutorials

- Download the first notebook and open it
- Start with the first problem and solve it step by step
- You can find the tutorials here on the website
- You can ask questions anytime!

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#### And that's it for this lecture!

The remaining time we will already start working on the first problems.

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## Literature

### Literature

- Lauwens, B., & Downey, A. B. (2019). Think Julia: How to think like a computer scientist (First edition). O'Reilly®. [Link to the free book website.](#)
- [Julia Documentation](#)

For more interesting literature to learn more about Julia, take a look at the [literature list](#) of this course.

## Bibliography