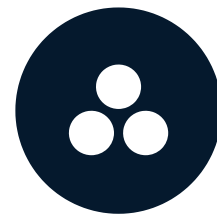


Getting started with Julia

INTRODUCTION TO JULIA



James Fulton

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What is Julia?

- An open-source language designed for data science
- Newer than other common languages
- General purpose
- Designed for scientific computing and data tasks



| Language | Release year |
|--------------|--------------|
| MATLAB | 1978 |
| Python | 1991 |
| R | 1993 |
| Julia | 2012 |

Why create Julia?

Designed by Jeff Bezanson, Stefan Karpinski, Viral B. Shah, and Alan Edelman

Julia was designed to be:

- Simple to learn
- Able to keep the most serious hackers happy
- As usable for general programming as Python
- As easy for statistics as R
- As powerful and natural for linear algebra as MATLAB
- Speed of C

¹ <https://julialang.org/blog/2012/02/why-we-created-julia>

This course

- For beginner programmers
- Basics of Julia
- Working with data in Julia

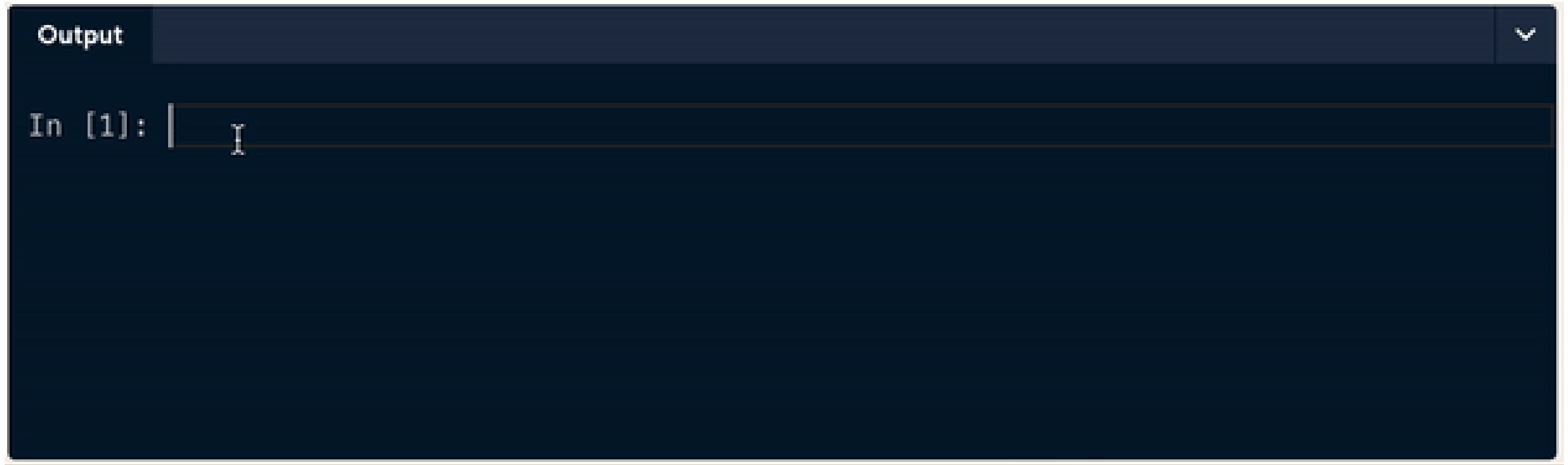


Installing Julia

- You can download Julia from:
 - <https://julialang.org/downloads>
- Run Julia online:
 - <https://julialang.org/learning/tryjulia>

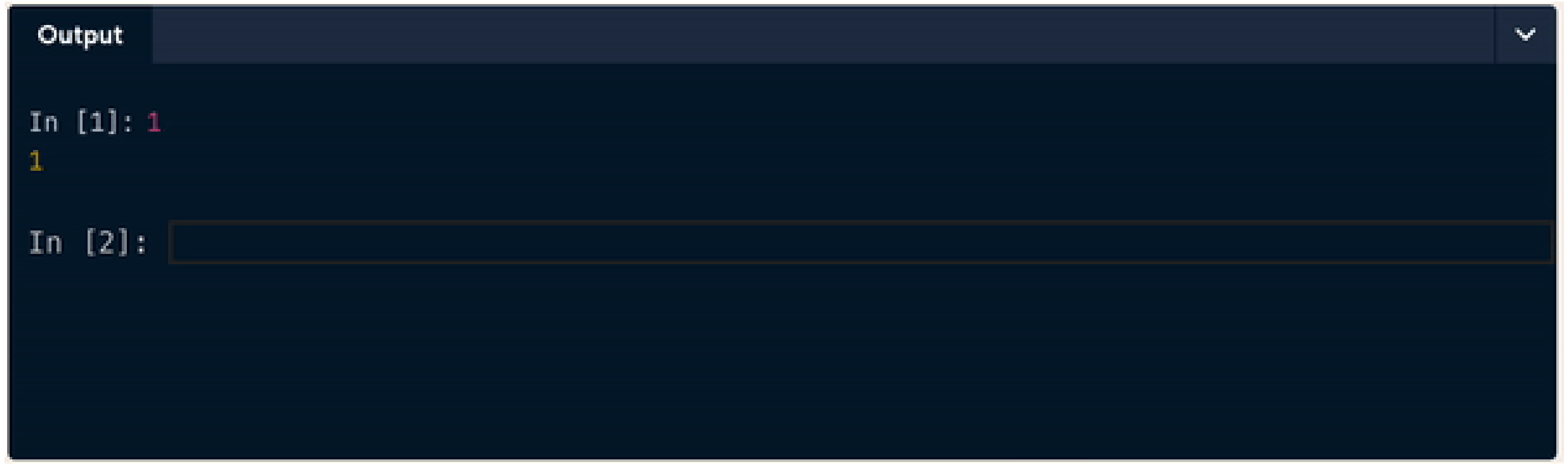
Scripts vs. the console

The console



Scripts vs. the console

The console

A screenshot of a Jupyter Notebook's console output area. The background is dark blue. At the top left, the word "Output" is written in white. To its right is a dark blue bar with a white downward-pointing chevron icon. Below this, the text "In [1]: 1" is displayed, with the "1" in red. Underneath, a yellow "1" is shown. Further down, the text "In [2]:" is followed by a horizontal rectangular input box with a thin brown border, which is currently empty.

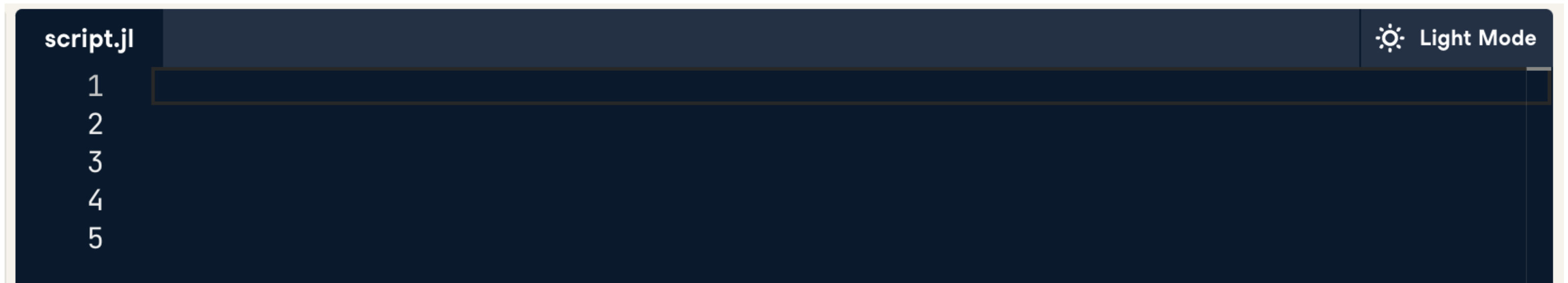
```
Output
```

```
In [1]: 1
```

```
1
```

```
In [2]:
```

Scripts vs. the console



Simple calculations and printing

Inside `script.jl`:

```
# Print the number 2
println(2)

# Print the sum of 1+2
println(1+2)
```

2

3

Comments

Inside `script.jl`:

```
# Print the number 2      <--- these are comments
println(2)

# Print the sum of 1+2    <--- these are comments
println(1+2)
```

2

3

Comments

Inside `script.jl`:

```
Print the number 2  
println(2)
```

```
Print the sum of 1+2  
println(1+2)
```

```
ERROR: LoadError: syntax: extra token "the" after end of expression
```

```
Stacktrace:
```

```
[1] top-level scope  
@ ~/script.jl:1
```

Multi-line comments

Inside `script.jl`:

```
#=
```

```
=#
```

```
println(2)
```

```
2
```

Multi-line comments

Inside `script.jl`:

```
#=  
Print the  
number 2  
=#  
println(2)
```

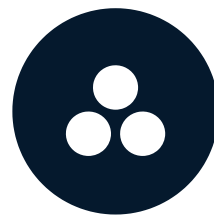
```
2
```

Let's practice!

INTRODUCTION TO JULIA

Variables

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Assigning variables

```
# Store the number 3 in the variable x  
x = 3  
  
# Print the variable  
println(x)
```

3

```
double_x = 2*x  
println(double_x)
```

6

Calculating with variables

```
# Distance run in meters
distance = 5000

# Time taken in minutes
time = 32.3

# Convert distance to miles and time to hours
distance_miles = distance/1609
time_hours = time/60

# Print speed in miles per hour
println(distance_miles/time_hours)
```

```
5.772483341575157
```

Calculating with variables

```
# Distance in meters
distance = 5000

# Time taken in minutes
time = 30.1

# Convert distance to miles and time to hours
distance_miles = distance/1609
time_hours = time/60

# Print speed in miles per hour
println(distance_miles/time_hours)
```

```
6.194392423019188
```

Naming variables

Variable names in previous example:

`distance` , `time` , `distance_miles` ,
`time_hours`

- Must begin with letter `[a-z]` or `[A-Z]`
- Or other unicode characters e.g. ϕ , β , σ
- Names of variables are in lower case

- Words separated using by underscores `_`
- Underscores can be omitted if still readable
 - e.g. `time_hours` → `timehours`
- Can use numbers after first letter
 - `x_times_2` is valid
 - `2_times_x` is not valid

More operations using variables

| Operator | Operation | Example | Result |
|----------|-----------|---------|--------|
| + | Add | 1+2 | 3 |
| - | Subtract | 4-2 | 2 |
| * | Multiply | 5*3 | 15 |
| / | Divide | 20/4 | 5 |
| ^ | Power | 2^3 | 8 |

- 2^3 is the same as $2*2*2$

```
speed = (distance/1609)/(time/60)
println(speed)
```

```
5.772483341575157
```

```
speed = distance/1609/time/60
println(speed)
```

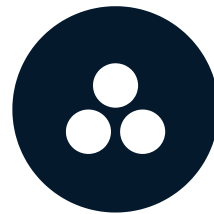
```
0.0016034675948819882
```

Let's practice!

INTRODUCTION TO JULIA

Basic data types

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Types of data

Integers are whole numbers

```
# This is stored as an integer
x_int = 1

# Print the type of x_int
println(typeof(x_int))
```

Int64

Floats are numbers with a decimal point

```
# This is stored as a float
x_float = 1.0

# Print the type of x_float
println(typeof(x_float))
```

Float64

Other basic data types

Booleans

```
x_bool = true # or false

# Print the type of x_bool
println(typeof(x_bool))
```

Bool

Strings

```
x_string = "Hello there"

# Print the type of x_string
println(typeof(x_string))
```

String

- Must use `"..."`
- Cannot use `'...'`

Other basic data types

Characters

```
x_char = 'A'  
  
# Print the type of x_char  
println(typeof(x_char))
```

Char

- Cannot have character 'AB'
- Only 'A' or 'B', etc.

Consequences of data types

```
# Bank balance as integer
```

```
balance = 100
```

```
# Interest rate as float
```

```
interest_rate = 1.05
```

```
new_balance = balance * interest_rate
```

```
println(new_balance)
```

```
println(typeof(new_balance))
```

```
105.0
```

```
Float64
```

```
# Bank balance as string
```

```
balance = "$100"
```

```
# Interest rate as string
```

```
interest_rate = "5%"
```

```
new_balance = balance * interest_rate
```

```
println(new_balance)
```

```
println(typeof(new_balance))
```

```
$1005%
```

```
String
```

Consequences of data types

```
# Bank balance as integer  
balance = 100
```

```
# Interest rate as string  
interest_rate = "5%"
```

```
new_balance = balance * interest_rate
```

```
ERROR: MethodError:  
no method matching *(::Int64, ::String)
```

Converting between types

```
# Convert the integer x to float y
x = 1
y = Float64(x)

println(typeof(y))
```

Float64

```
# Convert the float x to integer y
x = 1.0
y = Int64(x)

println(typeof(y))
```

Int64

Converting between types

```
# Convert the float x to integer y
x = 1.01
y = Int64(x)
```

```
ERROR: InexactError: Int64(1.01)
```

```
# Convert the float x to integer y
x = 1.0
y = Int64(x)

println(typeof(y))
```

```
Int64
```

Converting between types

```
# Convert the integer x to string y
x = 1
y = string(x) # y = "1"

println(typeof(y))
```

String

```
# Convert the string x to integer y
x = "1"
y = parse{Int64}(x)

println(typeof(y))
```

Int64

Converting between types

```
# Convert the integer x to string y
x = 1
y = string(x) # y = "1"

println(typeof(y))
```

String

```
# Convert the string x to float y
x = "1.0"
y = parse(Float64, x)

println(typeof(y))
```

Float64

Summary of conversions

- Use `typeof(x)` to find the type of `x`
- Convert between data types using:

| From | To | Function |
|------------------|---------|--------------------------------|
| Integer | Float | <code>Float64(x)</code> |
| Float | Integer | <code>Int64(x)</code> |
| Integer or float | String | <code>string(x)</code> |
| String | Float | <code>parse(Float64, x)</code> |
| String | Integer | <code>parse(Int64, x)</code> |

Let's practice!

INTRODUCTION TO JULIA