High Performance Computing in Julia

from the ground up.

Optimisation & Type Stability

Live Examples

Hunting down allocations with profiling

https://github.com/JamieMair/MPAGS_Slides_Examples

Multiple Dispatch

- **Dispatch** refers to choosing which *method* to run
- Most languages with classes choose **single dispatch** which treats the first argument as "special" (think of "self" in Python)
- **Multiple Dispatch** means choosing the method based on the type of all arguments
- Advantages:
  - Massive code reuse and compatibility in the ecosystem with minimal "glue" code, and even extensions to packages after the fact
  - Allows for specialisation and optimisations based on all types
- Disadvantages:
  - Discovery of functions can be a bit more difficult
  - Intellisense is much worse than languages like C#, Java, C++ etc

The Unreasonable Effectiveness of Multiple Dispatch – Stefan Karpinski
https://www.youtube.com/watch?v=kc9HwsxE1OY

Multiple Dispatch

DifferentialEquations + Measurements

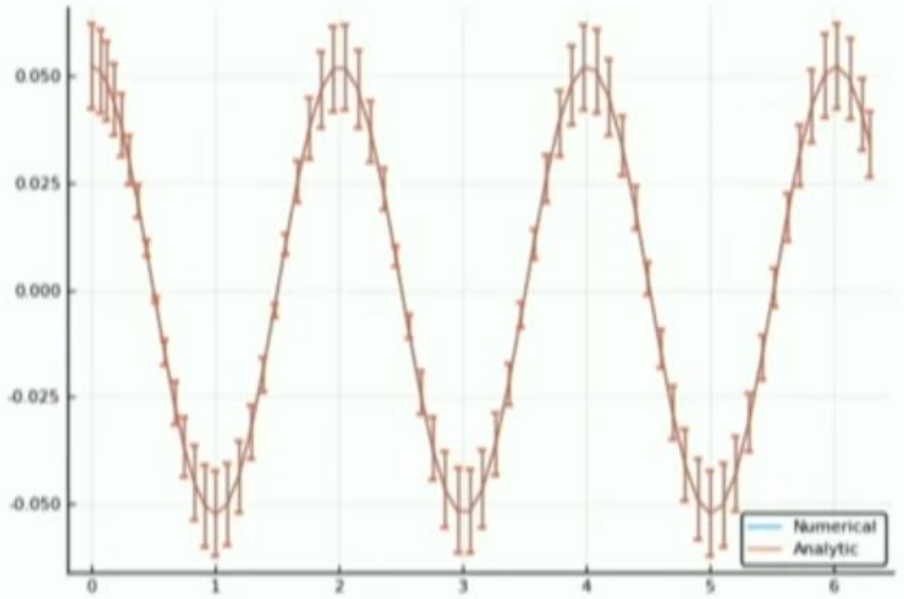
```
g = 9.79 ± 0.02 # Gravitational constants
L = 1.00 ± 0.01 # Length of the pendulum

# Initial speed & angle, time span
u₀ = [0 ± 0, π/60 ± 0.01]
tspan = (0.0, 6.3)

# Define the problem
function pendulum(du, u, p, t)
    θ  = u[1]
    dθ = u[2]
    du[1] = dθ
    du[2] = -(g/L)*θ
end

# Pass to solvers
prob = ODEProblem(pendulum, u₀, tspan)
sol = solve(prob, Tsit5(), reltol = 1e-6)

# Analytic solution
u = u₀[2] .* cos.(sqrt(g/L) .* sol.t)
```



Rackauckas et al. DifferentialEquations.jl – A Performant and Feature-Rich Ecosystem for Solving Differential Equations in Julia. 2017. (Journal of Open Research Software)

Giordano. Uncertainty propagation with functionally correlated quantities (arXiv: 1610.08716)

The Unreasonable Effectiveness of Multiple Dispatch – Stefan Karpinski

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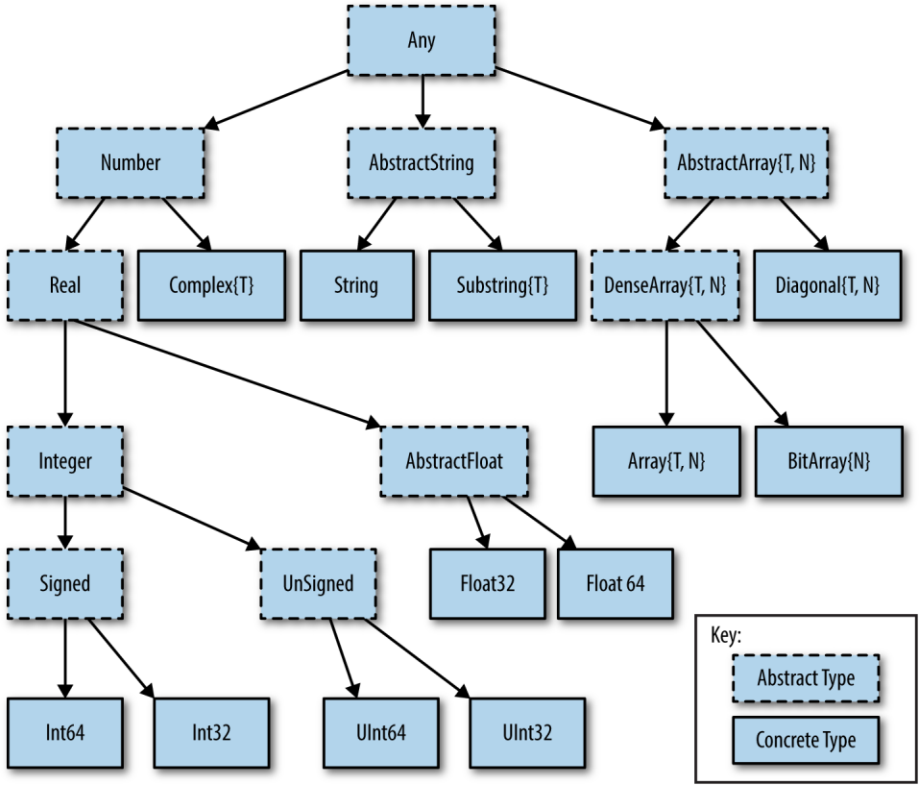
Julia's Type System



- Abstract types define **behaviour**
- All object instances have concrete types
- Concrete types are **final**, and are always leaf nodes
- Multiple dispatch will choose the implementation using the **most specific types**

Live Examples

Type Stability

Workshop – Thursday 26/01/2023

Assignment

https://classroom.github.com/a/HFbbhcO1

Tasks:

- Clone your repository
- Read through the README for assignment details
- Ask if you have any questions