

Astrodynamics.jl

**AN OPEN-SOURCE FRAMEWORK FOR
INTERACTIVE HIGH-PERFORMANCE
MISSION ANALYSIS**

HELGE EICHHORN – OSCW 23/11/2017

What implicit assumptions
are holding us back?

Reusable



Affordable



Orbital

Reusable



Vega



Affordable

Orbital

Reusable



Space Shuttle



Affordable

Orbital

Reusable



New Shepard



Affordable

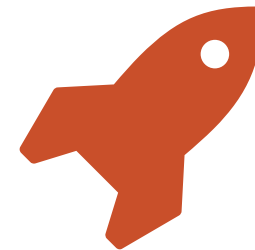


Orbital

Reusable



Affordable



Orbital

LOL, NOPE.

Interactive

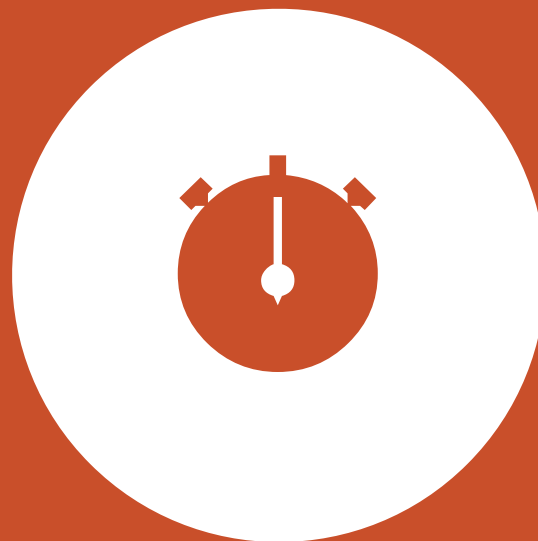


Fast



**Easily
Extensible**

Interactive



Fast



Easily Extensible

C++
Fortran
Java

Interactive



MATLAB
Python

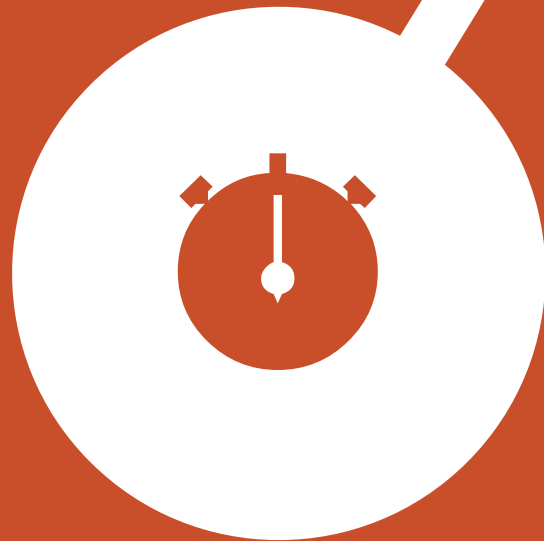


Fast

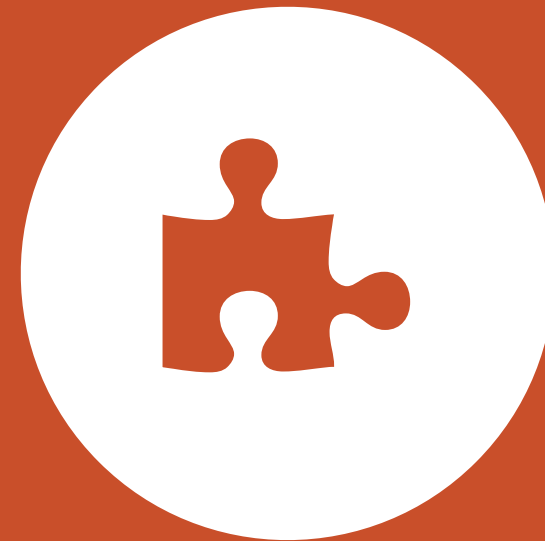
Easily
Extensible

Interactive

**MEX
GMAT
STK**



Fast

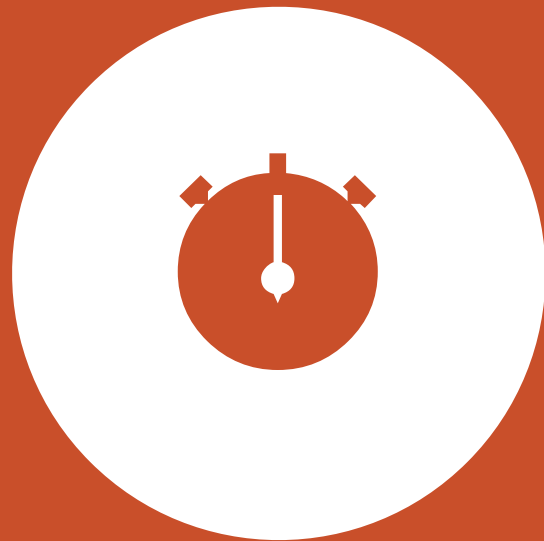


**Easily
Extensible**

Interactive



?



Fast



**Easily
Extensible**

ICATT 2016 STUDY

Eichhorn, H., Cano, J.L., McLean, F. et al. CEAS Space J (2017). <https://doi.org/10.1007/s12567-017-0170-8>.

ICATT 2016 STUDY

1. Calculating the Keplerian orbital elements

ICATT 2016 STUDY

1. Calculating the Keplerian orbital elements
2. Solving Kepler's equation

ICATT 2016 STUDY

1. Calculating the Keplerian orbital elements
2. Solving Kepler's equation
3. Solving Lambert's problem

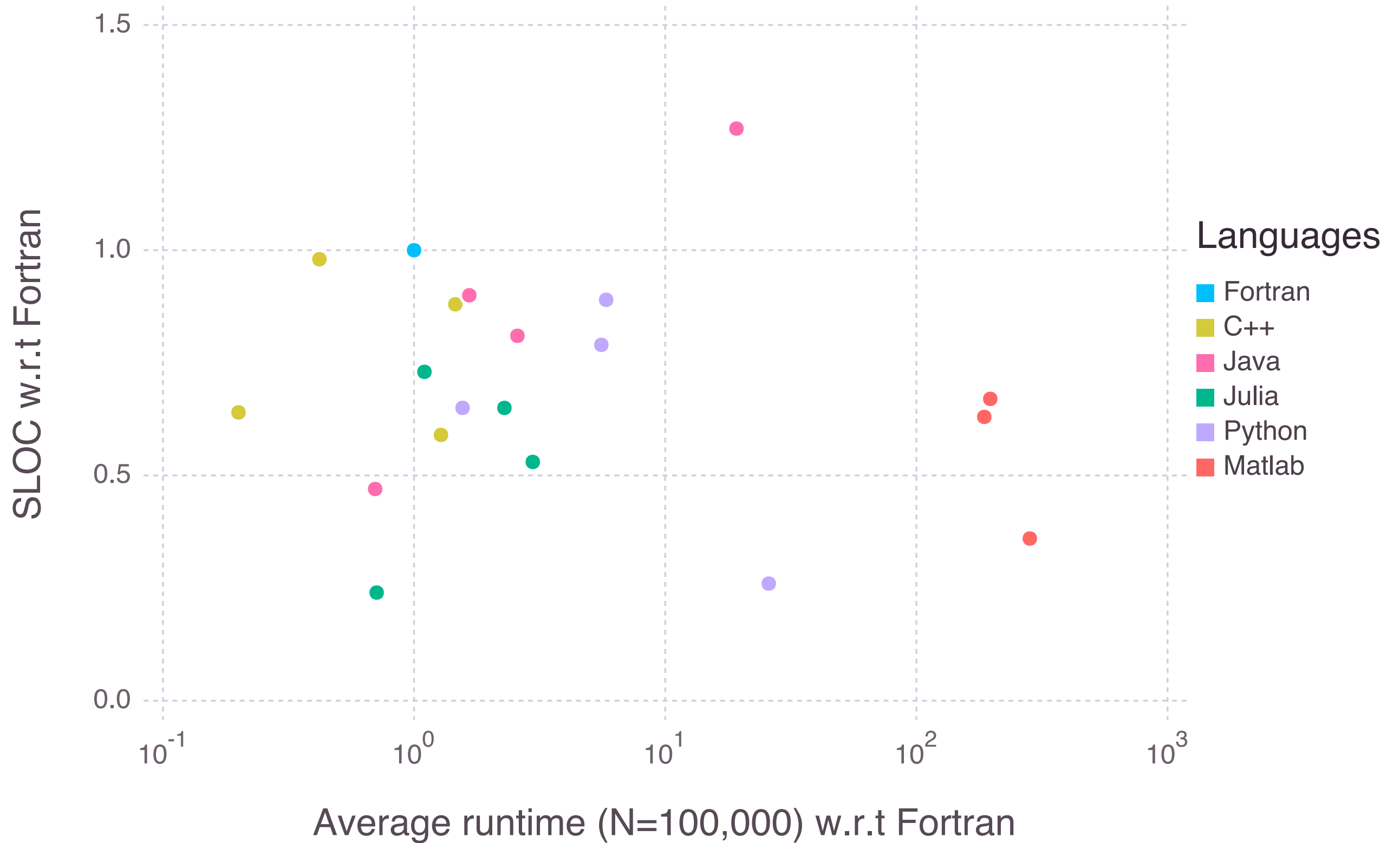
ICATT 2016 STUDY

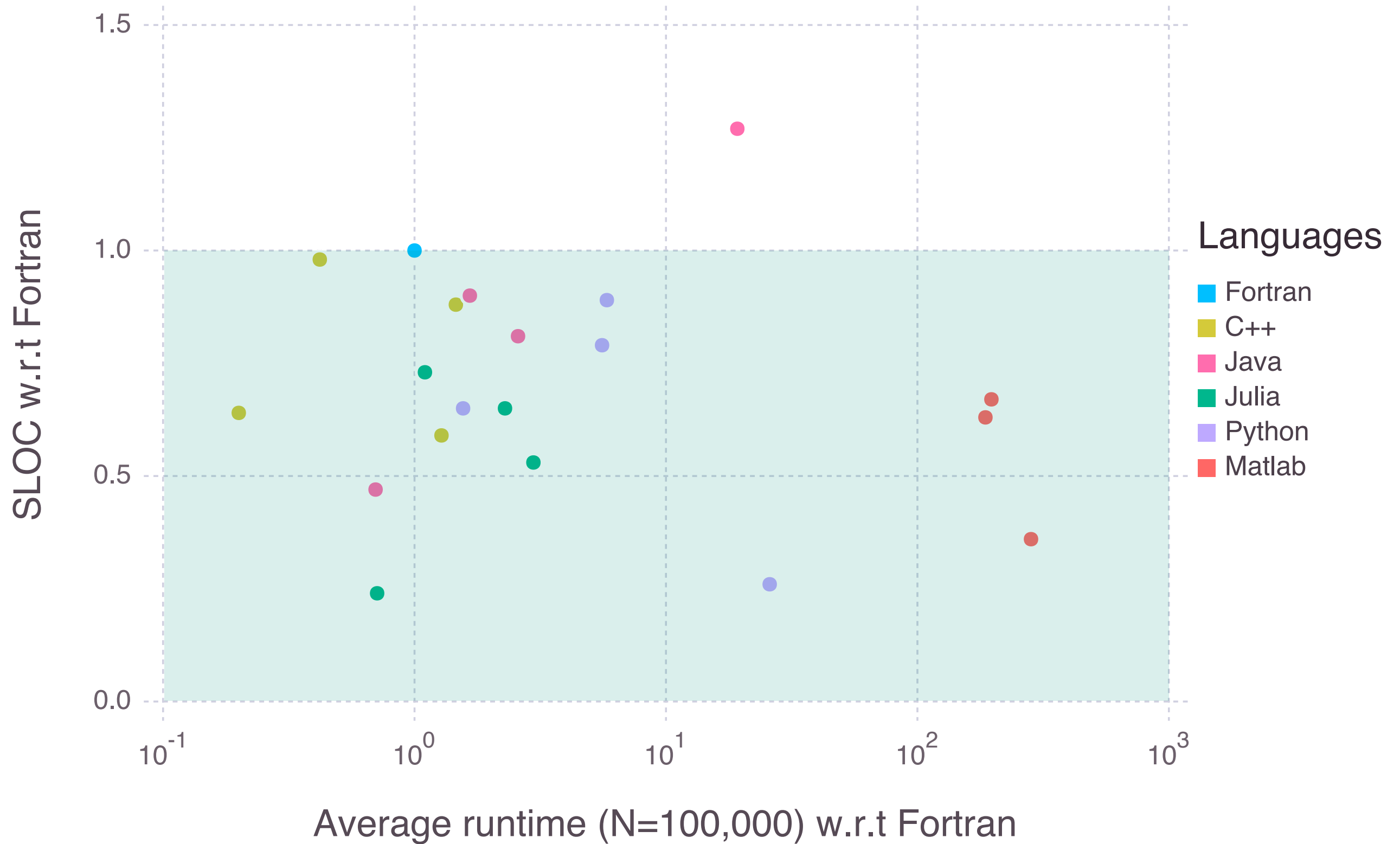
1. Calculating the Keplerian orbital elements
2. Solving Kepler's equation
3. Solving Lambert's problem
4. Calling the DOP853 Fortran 77 code

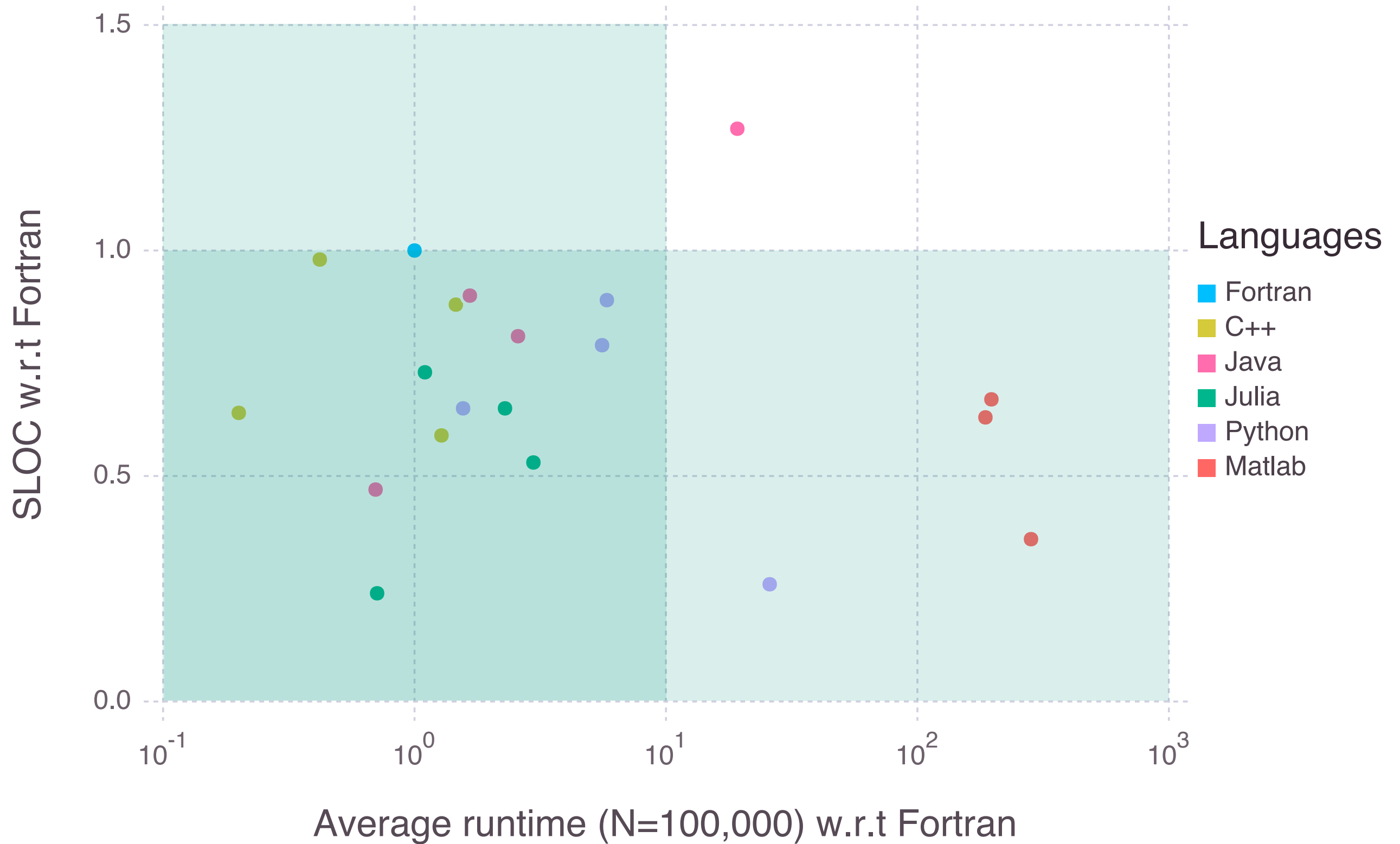
ICATT 2016 STUDY

1. Calculating the Keplerian orbital elements
2. Solving Kepler's equation
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4. Calling the DOP853 Fortran 77 code

Fortran, C++, Java, MATLAB, Python, Julia







How I Learned to Stop Worrying and Love the JIT

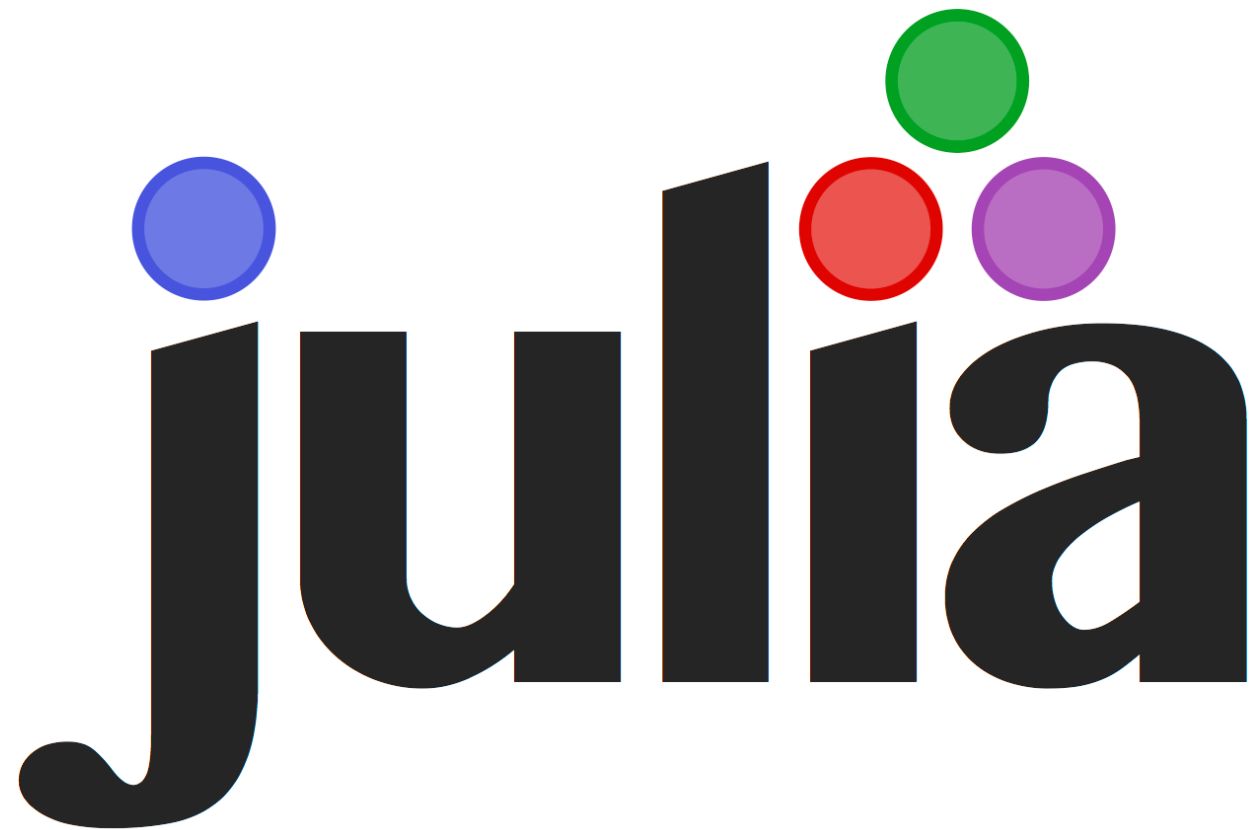


High-level, high-performance dynamic programming language

Initially developed at MIT now at Julia Computing, Inc.

Comprehensive standard library and rapidly growing ecosystem

600+ individual contributors



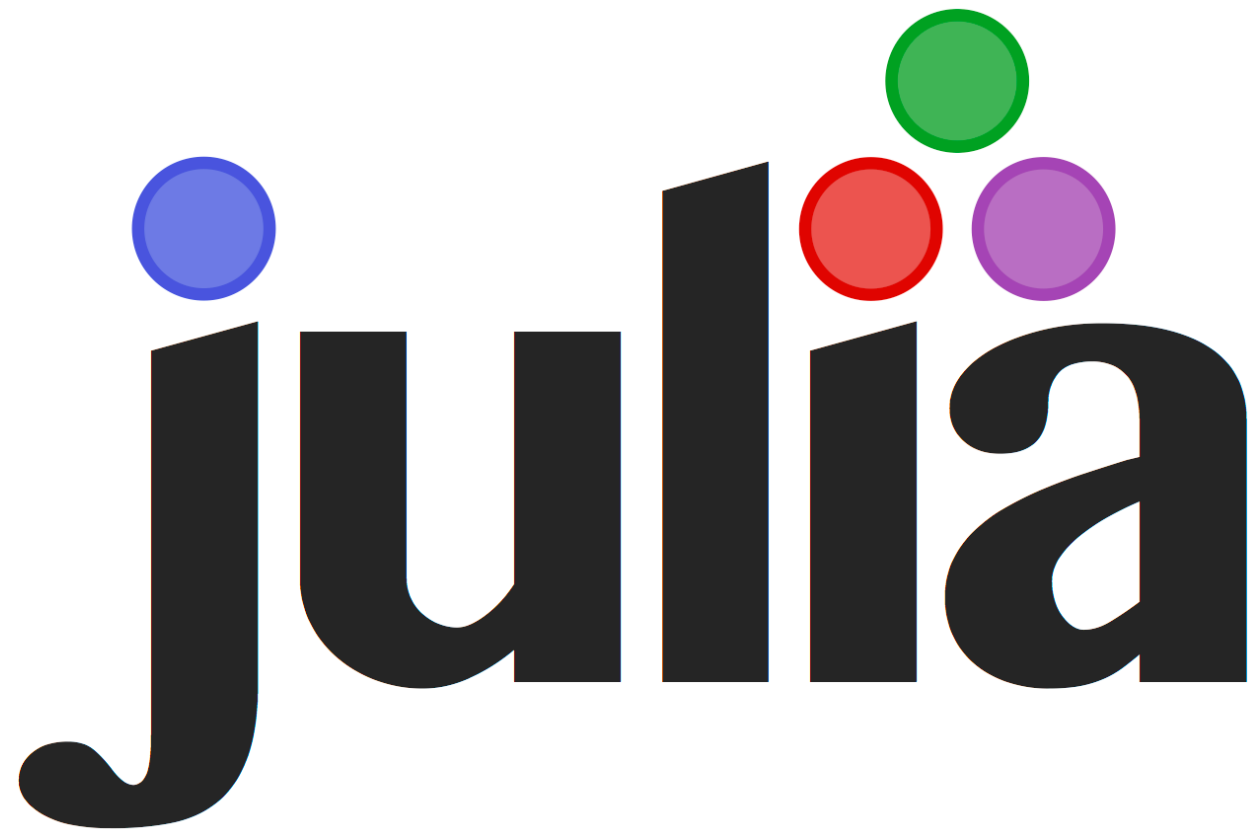
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High-level, high-performance dynamic programming language

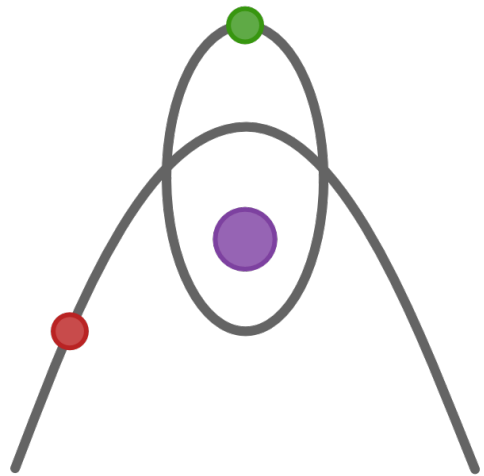
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Looks like MATLAB with a heavy dose of Python but runs like Fortran

Current version: 0.6 → next will be 1.0 (Early 2018)



Astrodynamics.jl

<https://github.com/JuliaAstrodynamics/Astrodynamics.jl>

MPLv2-licensed framework for
astrodynamics applications

Proof-of-concept for my PhD thesis

Current Status: MVP

Completed Features:

Time scale and reference frame
conversions

High-performance ephemerides

Semi-analytical and numerical
propagation with event detection

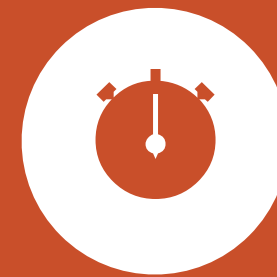
Work in progress:

I/O (CCSDS, SPICE)

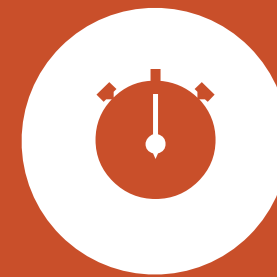
Optimization

Validated with Orekit, GMAT, and SPICE

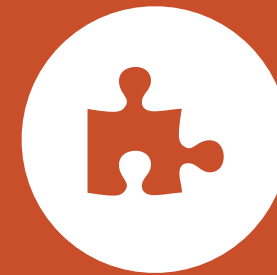
High performance



High performance



Extensible at runtime



High performance



Extensible at runtime



API for humans



High performance



Extensible at runtime



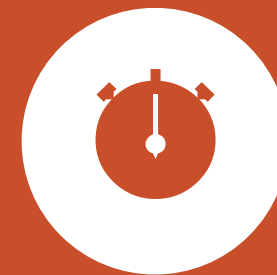
API for humans



Well documented



High performance



Extensible at runtime



API for humans



Well documented



Make STK obsolete



High performance



Extensible at runtime



API for humans



Well documented



Make STK obsolete



High performance



Extensible at runtime



API for humans



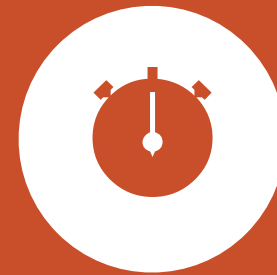
Well documented



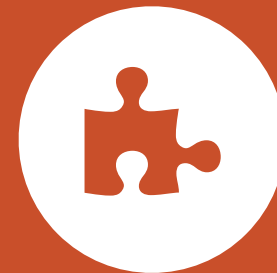
Make STK obsolete



High performance



Extensible at runtime



API for humans



Well documented



Make STK obsolete



High performance



Extensible at runtime



API for humans



Well documented



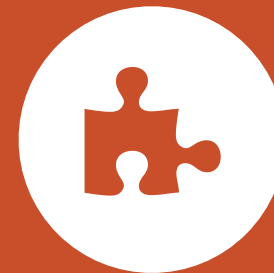
Make STK obsolete



High performance



Extensible at runtime



API for humans



Well documented



Make STK obsolete



A high-resolution image of the Martian horizon, showing a reddish-brown, cratered surface curving from the bottom left towards the bottom right. The sky is a deep, solid black, creating a stark contrast with the illuminated edge of the planet.

How I can I help you get
your mission of the
ground?

A curved horizon of Mars, showing its reddish-brown surface with numerous craters and a thin white atmospheric glow, set against a black background.

How I can I help you get
your mission of the
ground?

THANK YOU VERY MUCH!



<https://github.com/helgee/oscw-2017>