Modern Wave Propagation - Discontinuous Galerkin & Julia

Setting Up Julia & First Steps

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1 Installing Julia

Download and install Julia 1.8 from `https://julialang.org/downloads/`.
Follow `https://docs.julialang.org/en/v1/manual/getting-started/` to see some first steps. If you have some experience with another language, it also worth reading the differences that are described in this section

2 Hello Julia

- Write a small program in Julia that prints "Hello Julia" and execute it.
- For collaborative sessions, we use Visual Studio code (`https://code.visualstudio.com/`). Download it and install the Julia Language support extension. We also recommend that you use the Live Share plugin for collaborative editing. We will use this tool in the first session.

3 Hello Linear Algebra

- Generate the matrices
$$\boldsymbol{A} = \begin{pmatrix} 0 & 1 \\ 2 & 3 \\ 4 & 5 \end{pmatrix}, \quad \boldsymbol{B} = \begin{pmatrix} 1 & 1 & 1 \\ 2 & 2 & 2 \end{pmatrix},$$
- Can you use some built in functions (`reshape`, `range`, ...) for the task?
- Compute the matrix product $\boldsymbol{C} = \boldsymbol{A}\boldsymbol{B}$.
- Use the function `reshape` to convert the vector
$$\boldsymbol{u} = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 \end{pmatrix}$$
to a matrix of shape $(3,3)$. What does this tell you about the order in which multi-dimensional arrays are stored?

4 Hello Functions

- Write a function that takes a vector v as an argument and fills it with $v_i = \exp(-i^2)$.
- Use the vectorized operators for this `https://docs.julialang.org/en/v1/manual/mathematical-operations/#man-dot-operators`.

5 Hello Packages

- Familiarize yourself with the Julia package manager by trying to install the package `FastGaussQuadrature`. You can use the documentation of the package from this `https://github.com/JuliaApproximation/FastGaussQuadrature.jl`. The documentation is linked directly behind the headline of the readme.
- Use the package to compute some quadrature nodes and weights.
- Compute the integral with some quadrature scheme: $\int_0^1 \sin(x)dx \approx 0.45970$.