

## 18.335 Problem Set 2

Due Fri. Mar 12, 2021, at 3pm via Stellar.

### Problem 1: Stability

- (a) Trefethen, exercise 15.1. You will need to review the definition of “stability,” of which backwards stability is a (common) special case, in that chapter. [In parts (e) and (f), assume that  $\frac{1}{k!}$  can be computed to  $O(\epsilon_{\text{machine}})$  and concentrate on the accumulation of errors in the summations.]
- (b) Trefethen, exercise 16.1.

### Problem 2: Norms

- (a) Derive Trefethen eq. (3.10) (for which Trefethen only writes “by much the same argument”). Find the code that computes the induced  $\|A\|_{\infty}$  norm in Julia, the `opnorm(A, Inf)` function, on [github.com/JuliaLang/julia](https://github.com/JuliaLang/julia) in `stdlib/LinearAlgebra/src/generic.jl` and satisfy yourself that it is equivalent to (3.10).
- (b) Trefethen, problem 3.4. Check your result for a random  $10 \times 7$  matrix  $A$  in Julia, constructed by `A=randn(10,7)` with the induced  $p = 2$  norm as computed by `opnorm(A)` in Julia.

### Problem 3: SVD and low-rank approximations

- (a) Trefethen, problem 4.5.
- (b) Trefethen, problem 5.2.
- (c) Trefethen, problem 5.4.

### Problem 4: Least squares

Trefethen, problem 11.2. Note that the  $\Gamma(x)$  function is provided as `gamma(x)` by the `SpecialFunctions` package in Julia (execute `] add SpecialFunctions` to install this package).