

Convergence experiments for the advection equation. Use exact solution $u(x,t)=u_0(x-t)$, $u_0(x)=e^{(-\sin(\pi x))^2}$ for all parts.

1. Compute the maximum error at time $T=0.7$ for $\text{num_elements} = 32$, polynomial degree $N = 1, \dots, 10$. Plot the resulting errors against N (use a logarithmic y-axis) (you may also need to set `abstol, reltol = 1e-11` in `solve` if the error stalls).
2. Plot the maximum error as a function of time using both upwind and central fluxes, up to final time $T = 100$. Compute the errors for both $N = 1$, $\text{num_elements} = 80$ and $N=7$, $\text{num_elements}=20$ (these setups have the same number of degrees of freedom). What do you observe?