This list contains what are relatively less time demanding final project themes.

P-KERR Programming project:
Upgrade the linear pulse propagation simulator developed in HW4 for use with nonlinear media.

In the spirit of Split-Step Method, add to the code from HW4 a sub-step in which the nonlinear response from the Kerr medium will affect the pulsed beam propagation. Demonstrate the self-focusing collapse, for example in a way similar to that we discussed in the class.

Point of departure: Your HW4, or the corresponding Instructor's solution of the same. This linear propagator can be upgraded by adding simple code representing transmission through a nonlinear-phase screen.

P-DISP Programming project:
Upgrade the linear pulse propagation simulator developed in HW4 for use with dispersive media.

Task: A) Modify the code to include a susceptibility function (for example in the form of a parameterized function) for a medium of your choice (see e.g. refractiveindexinfo.com). B) Optionally, modify the code to use only positive angular frequencies. This can be achieved by setting the propagator array to zero for negative ω.

Point of departure: Your HW4, or the corresponding Instructor's solution of the same. This linear propagator can be upgraded by changing the code that initializes the propagator array, and adjusting the inverse FFT normalization by a factor of two.

P-PP Simulation project:
Pump-probe experiment modeling (using UPPEcore)

Goal: Design a simulated test to measure medium nonlinear response. Set up a simulation in which the probe pulse passes through as thin slice of a medium where it experiences nonlinear phase shift (you may utilize simple Kerr model for the nonlinearity). In a second simulation, simulate a reference pulse which is initially identical to the probe and switch off the nonlinearity (leaving chromatic dispersion on). Extract the electric field phase from both simulations and subtract the results — this is a measure of the nonlinear phase shift. Show that the magnitude of the nonlinear phase shift thus obtained does correspond to the nonlinear index used in the simulation.

Point of departure: Work-package with the simulation template *wrk_090_Pump_Probe_Simulations* can serve as illustration. However, this project mimics such an experiment in a significantly simplified setup. Optionally you may choose to set this numerical experiment with three pulses: a strong pump, and weak reference an an identical weak probe co-propagating with the pump. This would be a model of the experimental method discussed in P-RES.