Starting from classical Electromagnetism and Maxwell's equations we will give an
introduction to local gauge theories, arriving at the non-abelian QCD Lagrangian. We will
then discuss a variety of perturbative QCD topics in \( e^+e^- \) annihilation and Deep Inelastic
scattering. The idea will be to explore some of the underlying theoretical issues and
uncertainties in a manner closely linked to analyses of experimental data.

Outline syllabus:

- QED from classical EM
- Local gauge invariance- QED
- Non-abelian gauge theories
- The Lagrangian of QCD
- QCD Feynman Rules
- Renormalization-beta-function of QCD and QED
- Vacuum polarization
- The \( R(e^+e^-) \) ratio
- Fits to "smeared" low-energy \( e^+e^- \) data
- Scheme dependence problem in QCD, and solutions:
  - Effective Charges, CORGI
  - \( e^+e^- \) event shape observables
  - \( \alpha_s(M_Z) \) from event shape means
  - DIS: parton model
  - DGLAP equations