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Einstein's theory of general relativity has radically altered the way in which we perceive the universe. Einstein's breakthrough was to realize that the fabric of space is deformable in the presence of mass, and that space and time are linked into a continuum. Much evidence has been gathered in support of general relativity over the decades. Some of the indirect evidence for GR includes the phenomenon of gravitational lensing, the anomalous perihelion of mercury, and the gravitational redshift. One of the most striking predictions of GR, that has not yet been confirmed, is the existence of gravitational waves. The primary source of gravitational waves in the universe is thought to be produced during the merger of binary black hole systems, or by binary neutron stars. The starting point for computer simulations of black hole mergers requires highly accurate initial data for the space-time metric and for the curvature. The equations describing the initial space-time around the black hole(s) are non-linear, elliptic partial differential equations (PDE). In this talk, we will discuss how to use a pseudo-spectral (collocation) method to calculate initial puncture data corresponding to both single and binary black hole systems. (Received September 12, 2008)