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Gamma-ray binaries are comprised of a massive, main-sequence star orbiting a neutron star or a black hole that generates bright gamma-ray emission. Only six of these systems have been discovered. Here we report on a candidate stellar-binary system associated with the unidentified gamma-ray source HESS J1844-030, whose detection was revealed in the H.E.S.S. galactic plane survey. Analysis of 60 ks of archival *Chandra* data and over 100 ks of *XMM-Newton* data reveal a spatially associated X-ray counterpart to this TeV-emitting source (E>10^12 eV), CXO J1845-031. The X-ray spectra derived from these exposures yields column density absorption in the range n_H = (0.4 - 0.7) x 10^22 cm^-2, which is below the total galactic value for that part of the sky, indicating that the source is galactic. The flux from CXO J1845-031 increases with a factor of up to 2.5 in a 60-day timescale, providing solid evidence for flux variability at a confidence level exceeding 7 standard deviations. The point-like nature of the source, the flux variability of the nearby X-ray counterpart, and the low column density absorption are all indicative of a binary system. Once confirmed, HESS J1844-030 would represent only the seventh known gamma-ray binary, providing valuable data to advance our understanding of the physics of pulsars and stellar winds and testing high-energy astrophysical processes at timescales not present in other classes of objects.