Finding Triangles or Independent Sets

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We revisit the algorithmic problem of finding a triangle in a graph <Triangle Detection>, and examine its relation to other problems such as <Independent Set> and <Graph Coloring>. Consider for example an algorithm that:

Given a graph $G = (V, E)$, performs one of the following tasks in $O(m + n)$ (i.e., linear) time: (i) compute a $\Omega(1/\sqrt{n})$-approximation of <Maximum Independent Set> in G or (ii) find a triangle in G. The run-time is faster than that for any known method for each of these tasks.

The above result suggests the following broader research direction: if it is difficult to find (A) or (B) separately, can one find one of the two efficiently? This motivates the *dual pair* concept we introduce. We discuss and provide several instances of dual-pair approximation.