1. Is it Conservative?

Check if the following vector fields are conservative over all of the plane. If it is, find the potential function. If it is not, find a closed curve (i.e. a loop) where integrating over the curve gives a non-zero line integral.

- $\langle x + y, y \rangle$
- $\langle y, x \rangle$
- $\langle -y, x \rangle$
- $\langle y + 2yx, x + x^2 \rangle$

2. Evaluate Line Integrals

Let $\vec{F} = \langle x, y \rangle$.

- Verify that $\vec{F}$ is conservative.
- Let C_{ab} be the curve (at, bt) where t goes from 0 to 1. Compute the function defined by

$$f(a, b) := \int_{C_{ab}} \vec{F} dr$$

- Verify that $\nabla f = \vec{F}$.