Consider the system of differential equations:
\[
\begin{align*}
x'_1 &= -0.5x_1 + x_2, & x_1(0) &= 0 \\
x'_2 &= -x_1 - 0.5x_2, & x_2(0) &= 1
\end{align*}
\]

1. Write this in matrix form, \( \mathbf{x}' = \mathbf{A}\mathbf{x} + \mathbf{b} \).

2. Given that the eigenvalues of \( \mathbf{A} \) are \( \lambda_1 = -\frac{1}{2} + i \) and \( \lambda_2 = -\frac{1}{2} - i \), with associated eigenvectors \( \mathbf{v}_1 = (1, i) \) and \( \mathbf{v}_2 = (1, -i) \), write the general solution to \( \mathbf{x}' = \mathbf{A}\mathbf{x} \).

3. Use Euler’s formula \( e^{it} = \cos t + i\sin t \) to write a solution (e.g., \( x_1(t) \)) as a sum of its real and imaginary parts: \( x(t) = u(t) + i\ w(t) \).

4. Write the general solution as a linear combination of real-valued functions: \( x(t) = C_1 u(t) + C_2 w(t) \).
5. Find the particular solution satisfying the initial condition.

6. Sketch the phase portrait of the system. Also sketch the particular solution satisfying the initial condition.