Task 6

1. The distortion in the signal is a carrier phase difference, i.e., it is defined in the form:
$$x[n] = \tilde{x}[n]\, e^{j\tilde{\varphi}[n]},$$
where $\tilde{x}[n]$ is the original generated symbol, $\tilde{\varphi}[n]$ is a time-varying phase. Your task is to develop a dynamic system that compensates this distortion. Use $x[n]$ as an input of the dynamic system. Denote an output of this system by $y[n]$ and the current value of the recovered phase by $\varphi[n]$.

   - Define a correction application in the from $y[n] = f(x[n], \varphi[n-1])$.
   - Define a cost function $J[n]$. Assume you precisely know the value of the original symbol (you can use $\hat{y}[n] \equiv \tilde{x}[n]$ in this expression). Hint: minimize square of the difference.
   - Use the stochastic gradient approach to express the increment of the $\varphi[n]$ on the next clock cycle.
   - Draw block diagram of this dynamic system.