BC Why does machine learning benefit from automatic differentiation?

Machine learning benefits from automatic differentiation for a few key reasons:

1. **Gradient Computation**: Many machine learning algorithms, such as neural networks, rely on optimizing parameters by computing gradients of a loss or cost function with respect to those parameters. Automatic differentiation allows the gradients to be computed efficiently and accurately, often orders of magnitude faster than manual differentiation or finite-difference approximations.
2. **Flexibility**: Automatic differentiation can handle complex, nested functions that would be difficult to differentiate manually. This allows machine learning models to use sophisticated architectures and loss functions without the need to derive the gradients by hand.
3. **Numerical Stability**: Automatic differentiation can avoid numerical issues like overflow, underflow, and cancellation errors that can arise when computing gradients manually or using finite differences. This improves the reliability and stability of the optimization process.