If value of learning rate i.e. alpha = inverse of double derivative of the function then this algorithm is known as newton's algorithm (Double derivative for a multivariate function is hessian matrix).Rest everything remains exactly the same as gradient descent just that here we no need to do hyperparameter tuning.All different types of stopping criteria seen in gradient descent can also be used here.

This algorithms also fails everywhere where gradient descent fails

Newton's algorithm for two decision variables looks something like this

New_point = current_point - (1/f”(current_point))*f’(current_point)