### Algorithm 5.6: Eigenvalue Decomposition in One Pass

*Given an Hermitian matrix* $\boldsymbol{A}$, *a random test matrix* $\boldsymbol{\Omega}$, *a sample matrix* $\boldsymbol{Y} = \boldsymbol{A\Omega}$, *and an orthonormal matrix* $\boldsymbol{Q}$ *that verifies* (5.1) *and* $\boldsymbol{Y} = \boldsymbol{QQ}^*\boldsymbol{Y}$, *this algorithm computes an approximate eigenvalue decomposition* $\boldsymbol{A} \approx \boldsymbol{U\Lambda U}^*$.

1. Use a standard least-squares solver to find an Hermitian matrix $\boldsymbol{B}_{\text{approx}}$ that approximately satisfies the equation $\boldsymbol{B}_{\text{approx}}(\boldsymbol{Q}^*\boldsymbol{\Omega}) \approx \boldsymbol{Q}^*\boldsymbol{Y}$.
2. Compute the eigenvalue decomposition $\boldsymbol{B}_{\text{approx}} = \boldsymbol{V\Lambda V}^*$.
3. Form the product $\boldsymbol{U} = \boldsymbol{QV}$.