Crank-Nicholson with Black-Scholes

is defined on

Boundary conditions & initial condition:

Consider

therefore

Boundary conditions & initial condition:

Then the derivatives can be discretized as

Crank-Nicholson has 2nd order accuracy in time and space.

Plug into the original PDE

Define following variables

In the stencil form

In the matrix form w/ boundary conditions

Move everything known to LHS and then solve for backwardly

looks like following

