1 Interaction effects in solids and electronic correlations

This section will deal with a

$$H = \sum_{i\sigma} \epsilon_0 c^\dagger_{i\sigma} c_{i\sigma} - t \sum_{\langle i,j\rangle\sigma} c^\dagger_{i\sigma} c_{j\sigma} + U \sum_i n_{i\uparrow} n_{i\downarrow} \tag{1.1}$$

with parameters $\epsilon_0, t, U \in \mathbb{R}$. Explanation of the individual terms:

- onsite energy $\sum_{i\sigma} \epsilon_0 c^\dagger_{i\sigma} c_{i\sigma}$: the term $c^\dagger_{i\sigma} c_{i\sigma}$ counts the number of particles lattice site i with spin σ, attaches an energy ϵ_0 to each lattice site if the site (with spin σ) is occupied
- hopping term $t \sum_{\langle i,j\rangle\sigma} c^\dagger_{i\sigma} c_{j\sigma}$: pairs different lattice sites
- double occupancy $U \sum_i n_{i\uparrow} n_{i\downarrow}$: energy prize U when lattice site i has two electrons (one with spin up and one with spin down)