$$K_{nm} = \gamma_\mu D_{\mu,nm} + m\delta_{n,m}$$

$$D_{\mu,nm} = \frac{1}{2a}\{U^\mu_n \delta_{n+\hat{\mu},m} - U^{\mu\dagger}_{n-\hat{\mu}}\delta_{n-\hat{\mu},m}\}$$

fermion doubling: 'Wilson fermions'

'staggered fermions'

partion function:

$$\mathcal{Z}_{QCD} = \int \prod_{n,\mu} dU^\mu_n \prod_n d\bar{\psi}_n \prod_n d\psi_n e^{-S^E_{QCD}(U^\mu_n, \bar{\psi}_n, \psi_n)}$$

fermions can be integrated out:

$$\int \prod_n d\bar{\psi}_n \prod_n d\psi_n e^{-S_F(U^\mu_n, \bar{\psi}_n, \psi_n)} = \det K[U]$$

then

$$\mathcal{Z}_{QCD} = \int \prod_{n,\mu} dU^\mu_n \det K[U] e^{-S_G(U^\mu_n)}$$

$$K_{nm} = m(\frac{1}{m}\gamma_\mu D_{\mu,nm} + \delta_{n,m})$$

$m \to \infty$ 'quenched approximation'