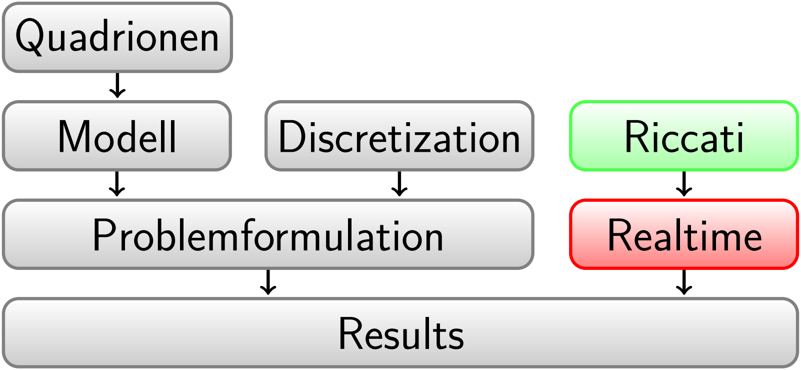
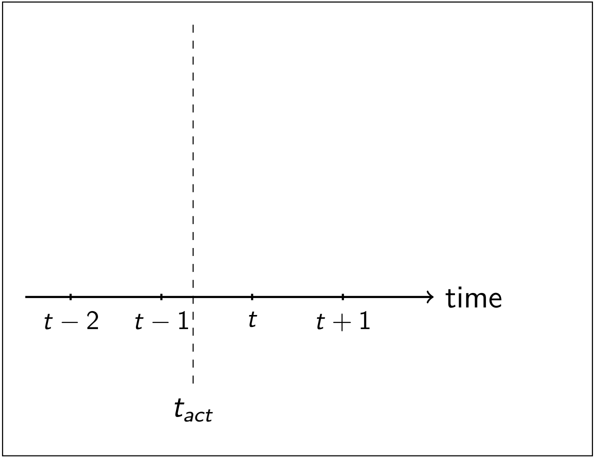

Quadrionen
Modell
Discretization
Riccati
Problemformulation
Realtime
Results

# Setting



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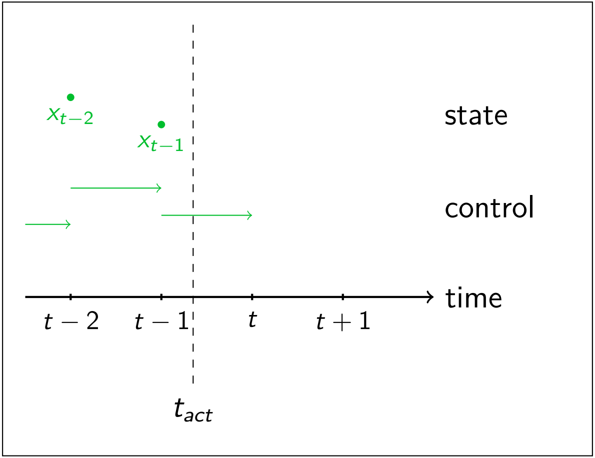

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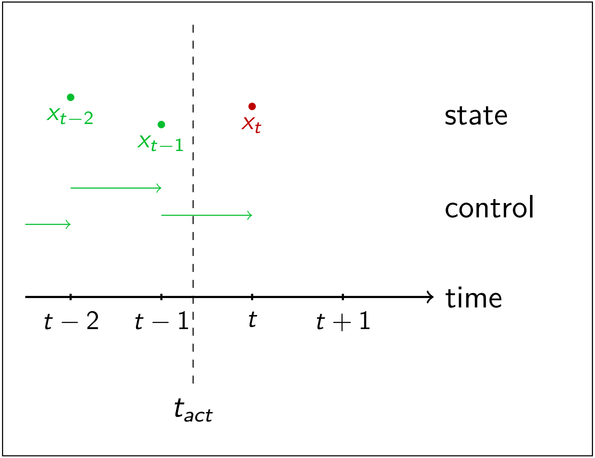

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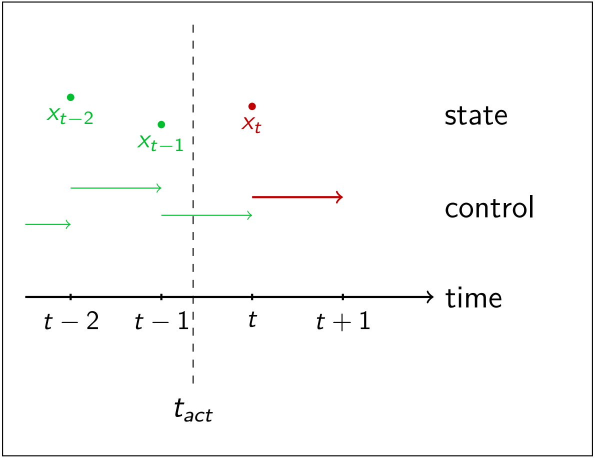


# Discrete Problem

$$\min_{x,u} \sum_{i=t}^{N} J_i(x_i, u_i) \quad \text{s.t.} \quad h_i(x_i, u_i) = 0 \quad i = t, \ldots, N$$

$J_i(x_i, u_i)$ discretized goal function

$h_i(x_i, u_i)$ equality condition at time $i$

# The Lagrangian

$$L^t(y) = \sum_{i=t}^{N} J_i(x_i, u_i) + \sum_{i=t}^{N} \lambda_i^T h_i(x_i, u_i)$$

$$y := (\lambda, x, u)$$

$$y^* \text{ optimal} \Leftrightarrow \nabla_y L^t(y^*) = 0$$

# The SQP Method

Find $y^*$:

$$y_{k+1} = y_k + s_k$$

$$\min_{s_k} \frac{1}{2} s_k^T \nabla^2 L(y_k) s_k + \nabla L(y_k)^T s_k$$

# Quasi Newton-Method

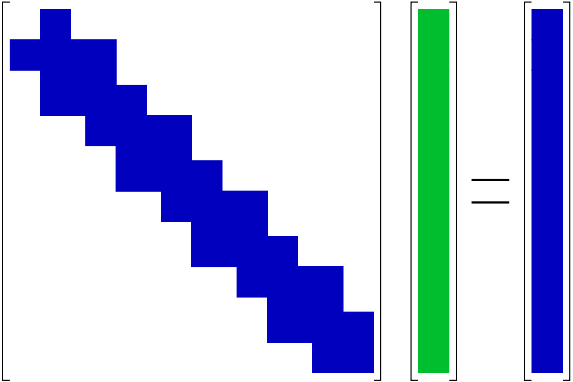
Find $s_k$ with:

$$\nabla L(y_k) + \nabla^2 L(y_k) s_k = 0$$

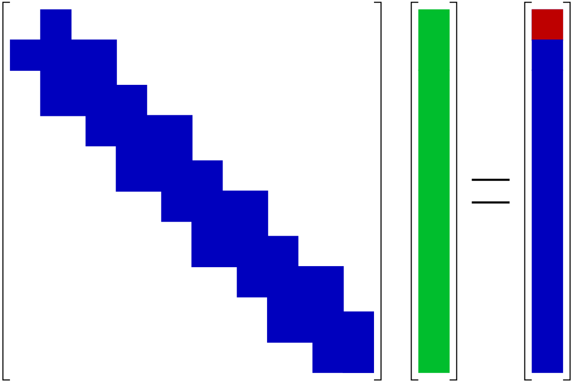
Approximate $\nabla^2 L(y_k)$ and solve:

$$H(y_k) s_k = -\nabla L(y_k)$$

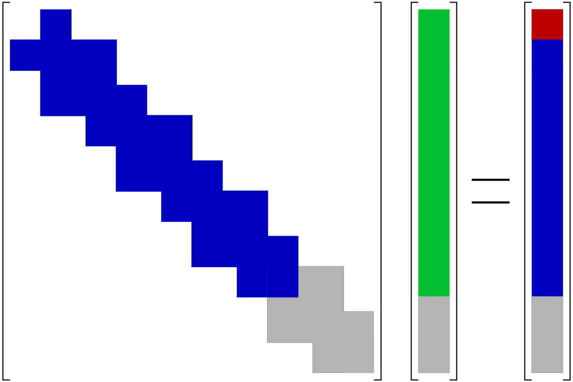
# Riccati Recursion



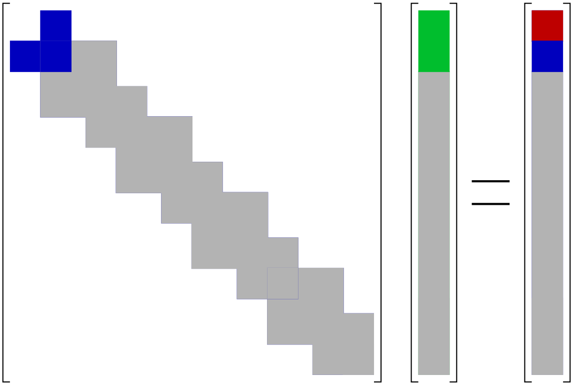
# Riccati Recursion



# Riccati Recursion



# Riccati Recursion



# Summary

What happens in interval $[t-1, t]$ ?

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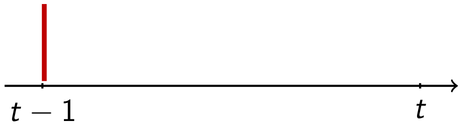
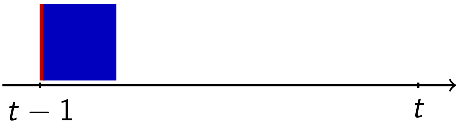



1. calculate control $u_{t-1}$ (Riccati Part II)

# Summary

What happens in interval $[t-1, t]$ ?



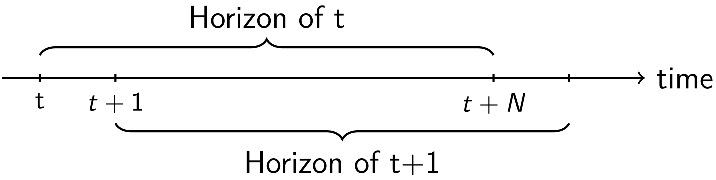

1. calculate control $u_{t-1}$ (Riccati Part II)
2. calculate $y$ (Riccati Part II)

# Summary

What happens in interval $[t-1, t]$ ?


1. calculate control $u_{t-1}$ (Riccati Part II)
2. calculate $y$ (Riccati Part II)
3. prepare $u_t$ (Newton & Riccati Part I)

# Finite Horizon




| | runtime | error |
|---|---|---|
| $N = 20$ | | |
| $N = 50$ | | |
| $N = 100$ | | |

# Results

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