Our Heuristics and MIP Oriented Research
Intro & Overview

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Major Application Domains

- Cutting and Packing
- Location and Assignment Problems
- Network Design
- Scheduling and Timetabling
- Transport Logistics, Vehicle Routing

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- Cutting and Packing
  - Frederico: 2D Cutting Stock Problems Problems
  - Johannes: 2D 3-Stage Strip Packing
- Location and Assignment Problems
  - Benjamin: Competitive Facility Location Problems
  - Christian: Planning of Bicycle Sharing Systems
- Network Design
  - Benedikt: Uniquely Hamiltonian Graphs
  - Martin R.: Telecom. Network Design Problem with Relays
- Scheduling and Timetabling
  - Johannes, Martin R.: Patient Scheduling at MedAustron
- Transport Logistics, Vehicle Routing
  - Benjamin: Stochastic Vehicle Routing Problem
  - Christian, Petrina: Balancing Bicycle Sharing Systems
  - Christopher: Hybrid Electric Vehicle Design and Logistics
  - Martin R.: Dial-a-Ride Problem

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Our Basic Methodologies

Exact Approaches

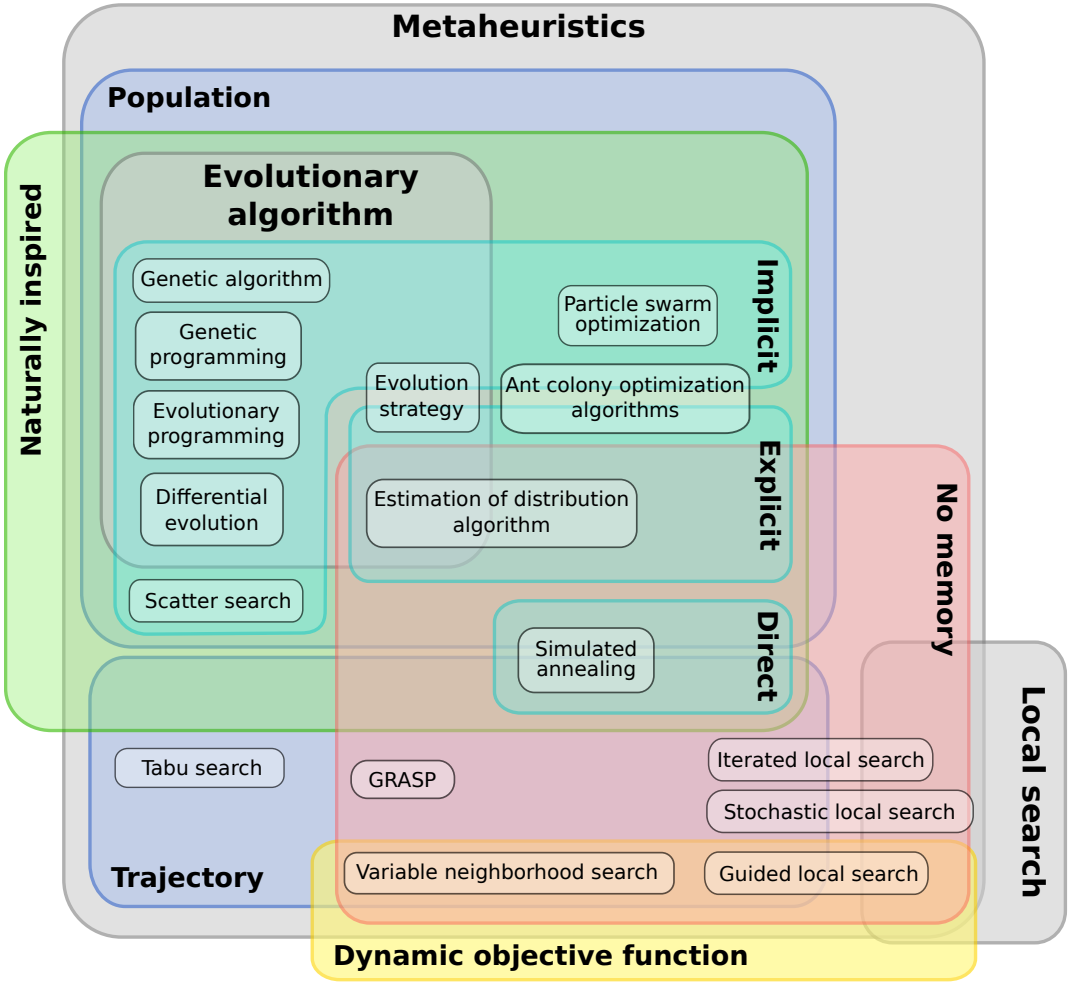
- tree search methods incl. branch-and-bound (B&B)
- dynamic programming
- **mixed integer linear programming (MIP)**
  - LP-based B&B
  - cutting plane algorithms, branch-and-cut
  - Lagrangean relaxation/decomposition
  - column generation, branch-and-price
- preprocessing/problem reduction techniques
- quadratic programming
- constraint programming

\+ in principle guaranteed to find optimal solutions

\− time often increases dramatically with problem size

Our Basic Methodologies

Heuristic Approaches

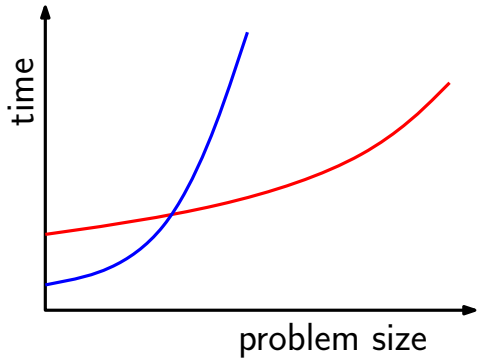


\+ often yield excellent solutions in practice

\− (usually) no performance guarantees

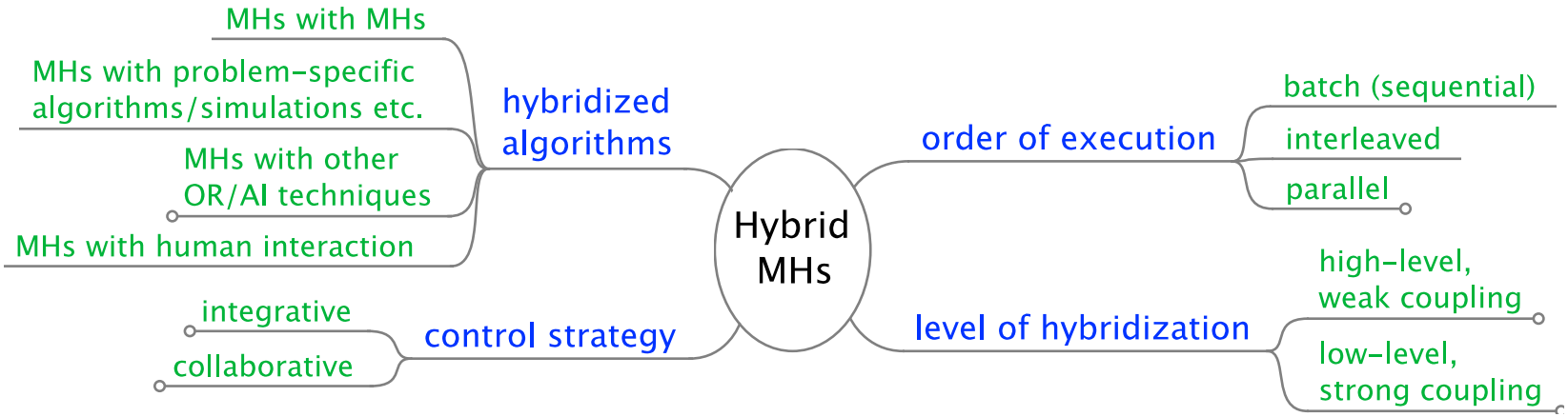
Combining Different Techniques: Hybrid Approaches

- Different approaches have different, sometimes complementary properties.



- Clever combinations can take advantages from the strengths of the basic strategies and benefit from **synergy**.

- Many very different ways for such combinations exist



Common Design Templates for Hybrids

- Finding initial or improved solutions by embedded methods
- Decoder-based approaches, indirect search
- Multi-stage approaches
- Large neighborhoods search methods, solution merging
- Strategic guidance of metaheuristics by other techniques
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- In conjunction with math. prog. decomposition techniques
  - Dantzig-Wolfe decomposition / column generation
  - Benders decomposition
  - Lagrangian decomposition

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