Advanced Optimization
Lecture/Exercise 2: The Travelling Salesperson Problem

November 29, 2016

Master AIC

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Course Overview

	Date		Topic
1	Tue, 22.11.2016	Dimo	Randomized Algorithms for Discrete Problems
2	Tue, 29.11.2016	Dimo	Exercise: The Travelling Salesperson Problem
3	Tue, 6.12.2016	Anne	Continuous Optimization I
	vacation		
4	Tue, 3.1.2017	Anne	Continuous Optimization II
5	Tue, 10.1.2017	Anne	Continuous Optimization III
6	Tue, 17.1.2017	Dimo	Evolutionary Multiobjective Optimization I
7	Tue, 31.1.2017	Dimo	Evolutionary Multiobjective Optimization II
	???		oral presentations (individual time slots)

all from 14:00 till 17:15 in PUIO - E213

Details on "No Exam..."

Idea of lecture is to prepare you for your Master's thesis:

- no written exam but instead each student is assigned a scientific paper (list online and on next slide)
  - to be read, understood, critically questioned, and presented
  - maximal 3 students per paper
  - decision made until *December 6, 2016 (next lecture)*
- summary of the paper in a short abstract in your own words
  - handed in via a web form until *January 9, 2017, 23h59* (https://docs.google.com/forms/d/e/1FAIpQLSdn3msR7Pf_4nAWeWHgmK_h2alY5KzutvWk0std_2K4wunL6A/viewform)
  - 4000 characters max.
- individual oral presentations at the end of the course
  - 15min presentation + 15min oral "exam"
  - dates to be decided with you (we will write a separate email with potential dates)
  - slides to be sent by email to us until last lecture (*Jan. 31, 2017*)

The List of Papers

All papers are relevant to current research in Randopt but the starred ones indicate possible *concrete research projects as follow-ups.

1*) Runtime Analysis of Simple Interactive Evolutionary Biobjective Optimization Algorithms.

2*) Two-dimensional subset selection for hypervolume and epsilon-indicator

3*) RM-MEDA: A regularity model-based multiobjective estimation of distribution algorithm.

4*) A universal catalyst for first-order optimization.

5*) Optimized Approximation Sets for Low-Dimensional Benchmark Pareto Fronts.

101) Efficient optimization of many objectives by approximation-guided evolution.

102) Covariance matrix adaptation for multi-objective optimization.

103) PISA - A Platform and Programming Language Independent Interface for Search Algorithms.

104) A Mean-Variance Optimization Algorithm.

105) Theoretical foundation for CMA-ES from information geometry perspective.

106) Population Size Adaptation for the CMA-ES Based on the Estimation Accuracy of the Natural Gradient.

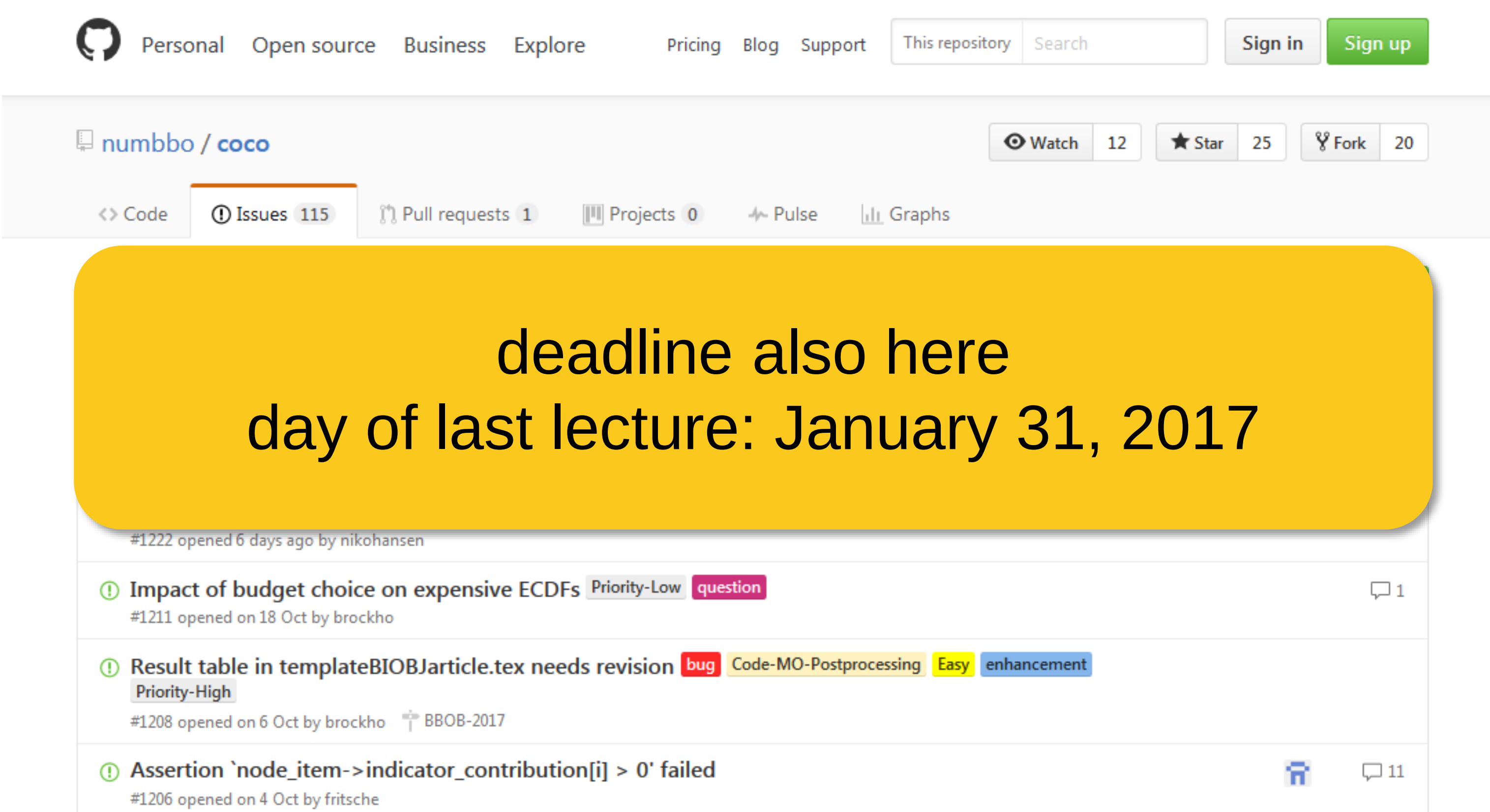
107) CMA-ES with Optimal Covariance Update and Storage Complexity.

108) Exponential natural evolution strategies.

Additional Offer: Solving COCO Issues

In addition, we plan to offer an upgrade of your grade (by 1 point max.) if you happen to solve an issue from the COCO issue tracker!

`https://github.com/numbbo/coco/issues/`



deadline also here
day of last lecture: January 31, 2017

Today's Lecture

❶ Exercise: The Travelling Salesperson Problem (TSP)

- reminder: problem definition + evolutionary algorithms
- rest of the day: exercise

Motivation:

- Motivation 1: show that it is easy to implement a working randomized search heuristic for the TSP
- Motivation 2: in research, you need to
  - prototype often (i.e. quickly)
  - try out many things
- hence: good idea to train this in python ☺

The Traveling Salesperson Problem (TSP)

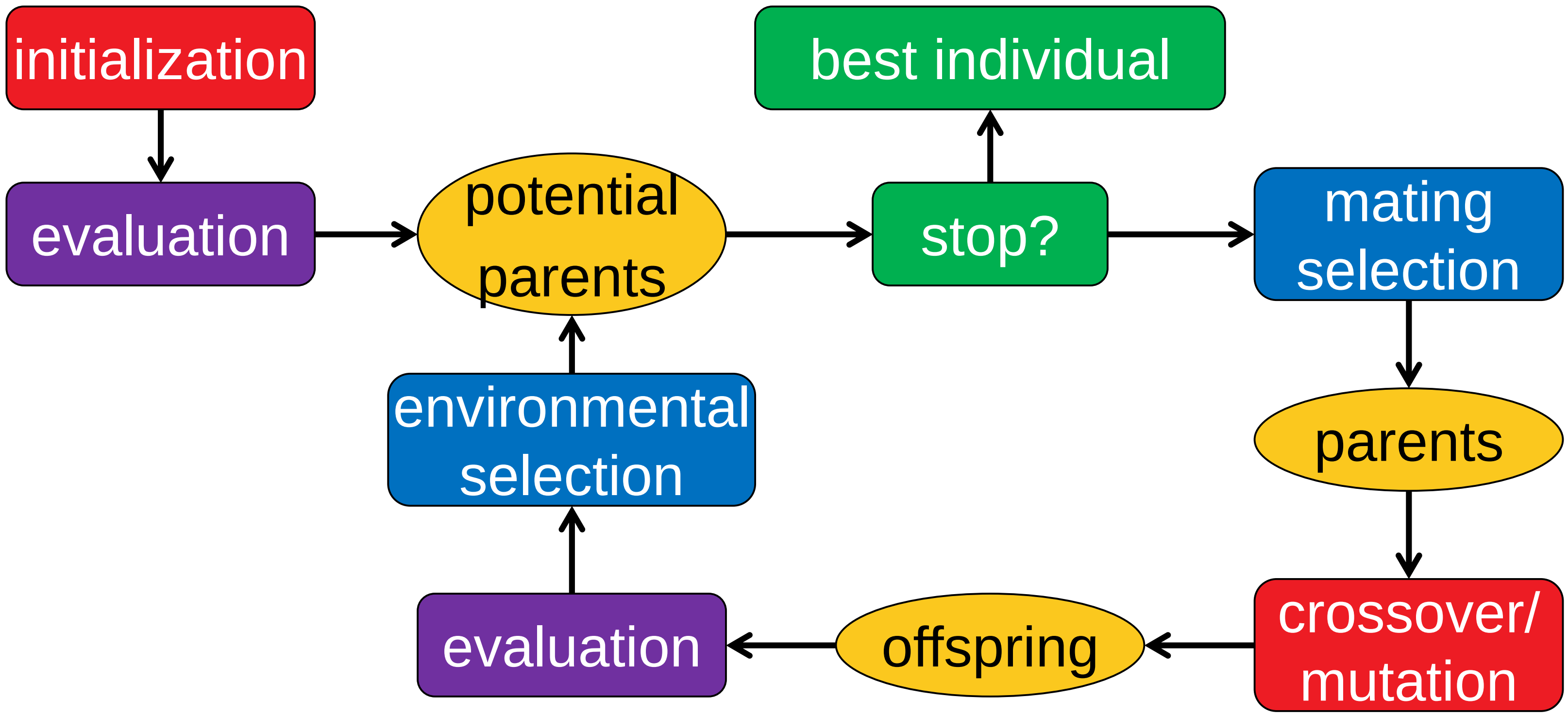
Reminder: TSP

Traveling Salesperson Problem (TSP)

- Given a set of cities and their distances
- Find the shortest path going through all cities
- Actually several variants:
  - Symmetric vs. asymmetric
  - Euclidean TSP

$$\Omega = S_n \text{ (set of all permutations)}$$

Reminder: Generic Framework of an EA



stochastic operators

"Darwinism"

stopping criteria

Important:
representation (search space)