Tabu Search

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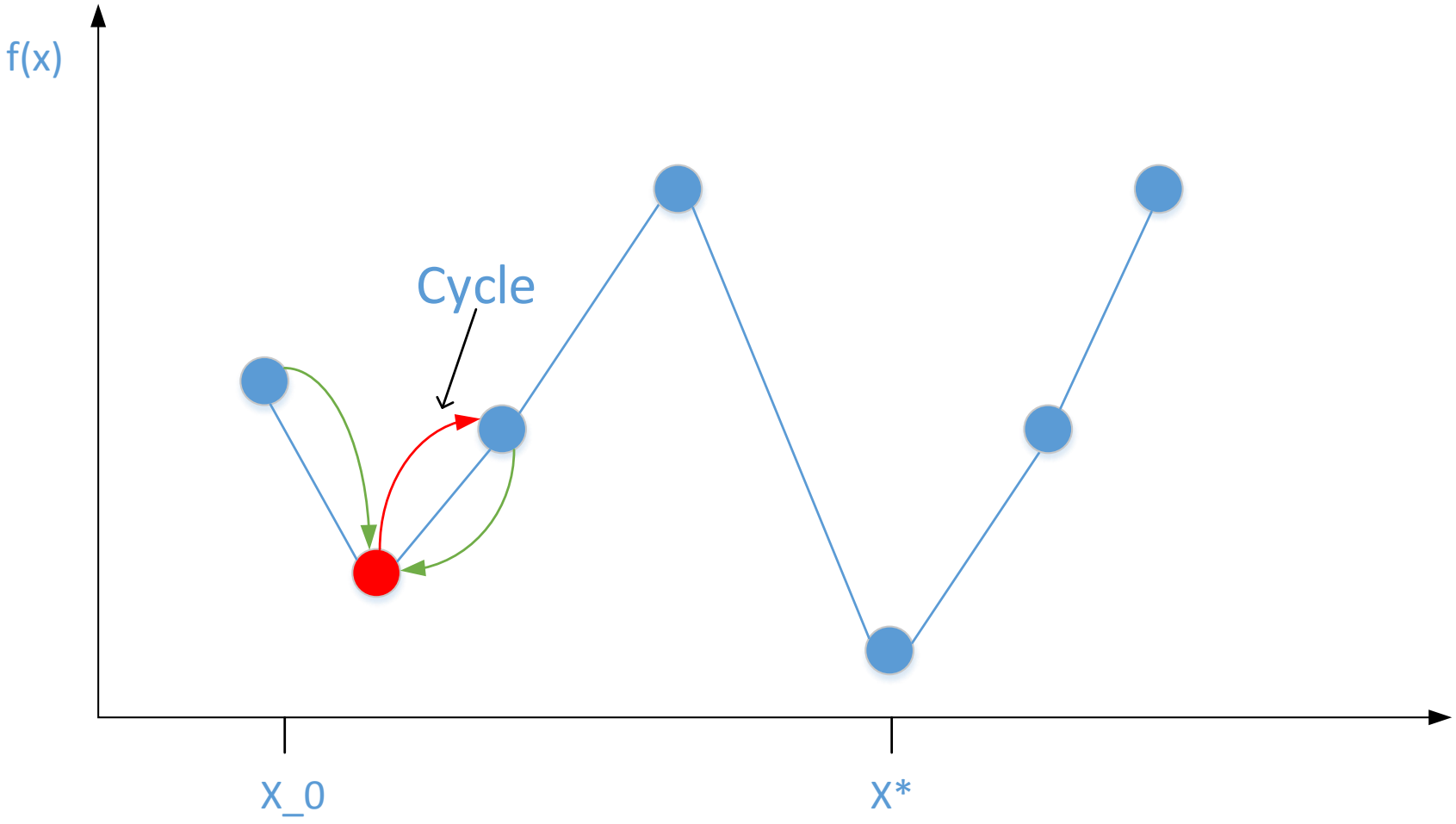
Outline of Topics

Question

- We have learned Simulated Annealing which can escape from local optima by accepting worse solutions with some probability.
- **Question**: is there any other strategies to find better local optima?

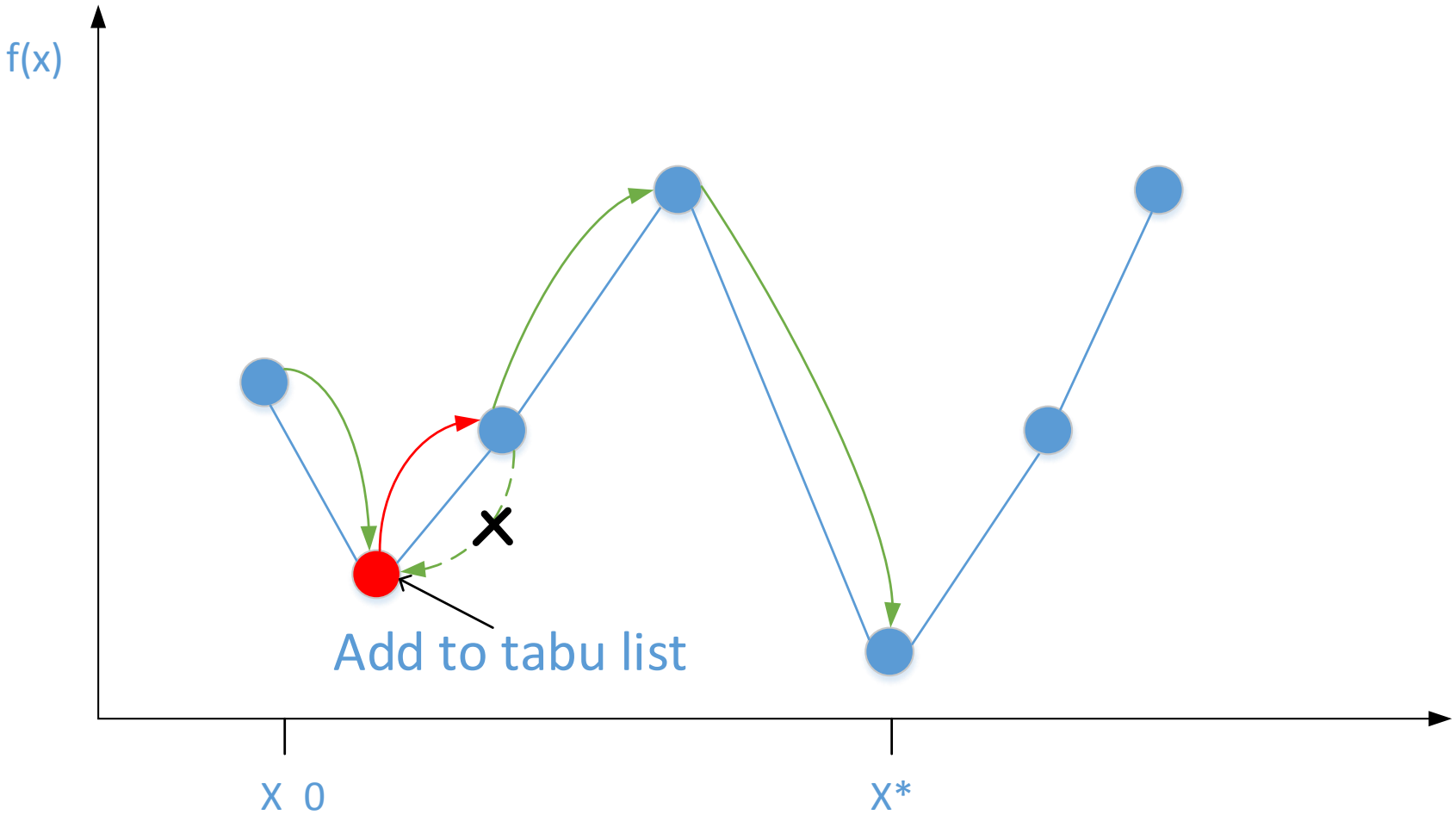
Search trajectory: cycles



Tabu search

- Invented by Professor Fred W. Glover in 1986 and formalized in 1989
- Many applications since publications
- 'Tabu' means "things that cannot be touched because they are sacred"
- Main idea: use memory to guide local search process away from local optima
  - Maintains a memory structure called tabu list that memorises previously visited solutions
  - Forbids the local search algorithm immediately return to previously visited solutions

Search trajectory: Tabu search



More about Tabu list

- Tabu list consists of:
  - banned solutions; or
  - a set of rules to ban solutions
- Use tabu list to exclude some neighborhood solutions for local search
- Essentially construct a neighborhood $N^*(x)$ solutions to be explored
- The simplest Tabu list:
  - Recently visited solutions
  - The duration of memory (in search steps) called Tabu tenure
  - Rule out any search attempts that would lead back to those previously visited solutions
- Extension: maintain a tabu list to avoid unfavourable neighbourhood solutions

Problem: How to construct a Tabu list for TSP

- We aim to solve TSP using tabu search
- The key component: Tabu list
- Assuming the we use the 2-OPT algorithm for local search
- Question: How to design a tabu list?

Tabu search algorithm pseudocode

Tabu search algorithm

while (terminationflag != true)

Determine set $N^*(x)$ of non-tabu neighbours of x

$x_{new} = LocalSearch(N^*(x))$

Update tabu list based on x_{new}

$x = x_{new}$

Output x^i

Take home message

- Main idea: escape or **avoid** local optima
- Tabu search tutorial: here

Exercises

- Download my source code from Canvas
- Explanation