### **Effective Programming Practices for Economists**

# **Numerical Optimization**

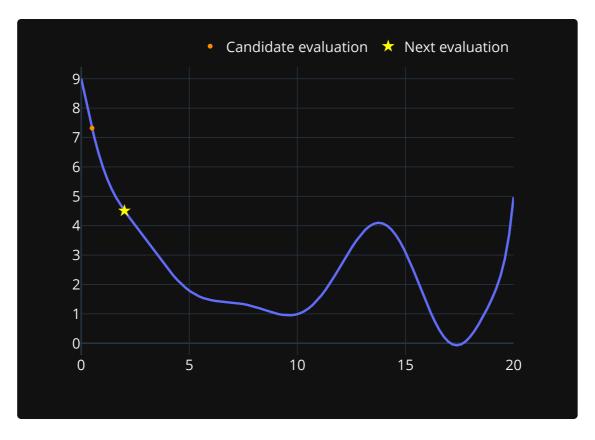
**Derivative-Free Direct Search Algorithms** 

Janoś Gabler, Hans-Martin von Gaudecker, and Tim Mensinger

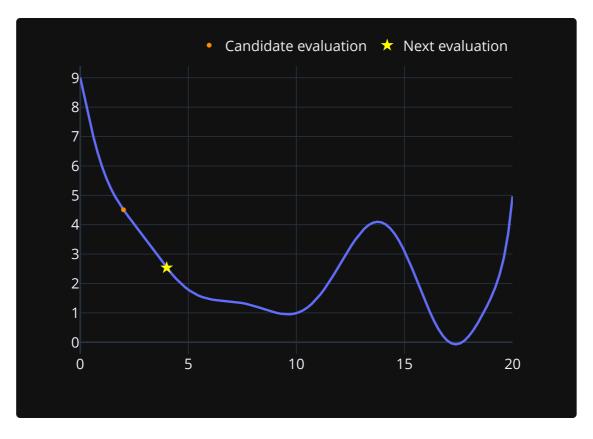
# **Basic Idea (optimagic docs)**

- Explore parameter space around current point systematically and accept the best value
- Also called pattern search because the points at which the function is evaluated form a pattern
- Easiest example for one dimensional problems:
  - Evaluate function at current point and one other point
  - Switch direction of other point if you got an increase in function value
  - Make steps larger after success
  - Make steps smaller after failure

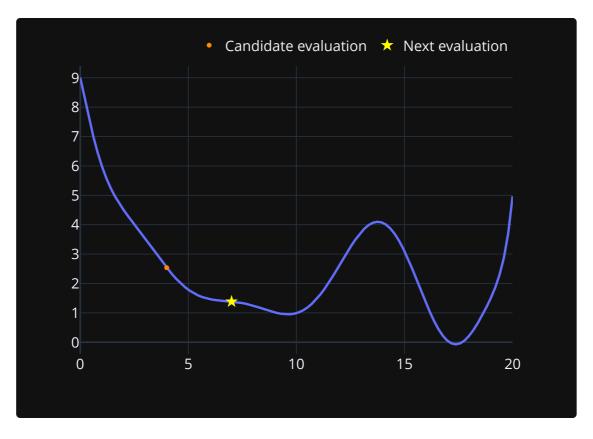
#### **Initial Evaluation**



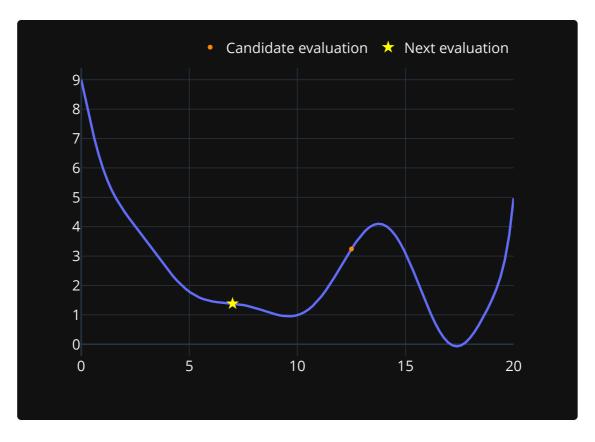
Candidate value > initial value  $\Rightarrow$  reject, reverse direction



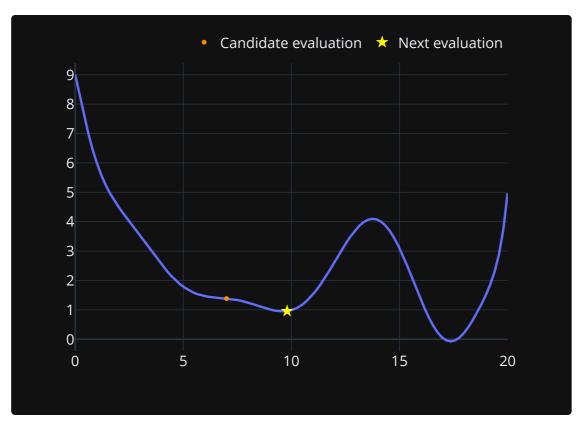
Candidate value < initial value  $\Rightarrow$  accept, increase step length.



Candidate value < initial value  $\Rightarrow$  accept, increase step length.



Candidate value > initial value  $\Rightarrow$  reject, decrease step length.



Converge eventually (gets worse in both directions).

### **Some Remarks**

- Adjusting the step size and switching to promising directions is complicated in real algorithms
- These algorithms only use the information which function value is smallest, not by how much
- Makes them slow but robust to small amounts of noise
- It does not help for large amounts of noise
- Most famous example is the Nelder-Mead algorithm
  - Very widely used
  - Very seldomly the best choice

## A real algorithm: Nelder Mead

