# Optimization

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Performance Motivated Enhancements

- Challenge: 10-day hourly timestep model
  - From ~90 minutes to ~2.5 minutes
- Many "dry holes"
- What worked?
  - Barrier method
  - Detect and skip easily satisfied goals
  - Replace Repeated Minimax with Summation with Reward Function
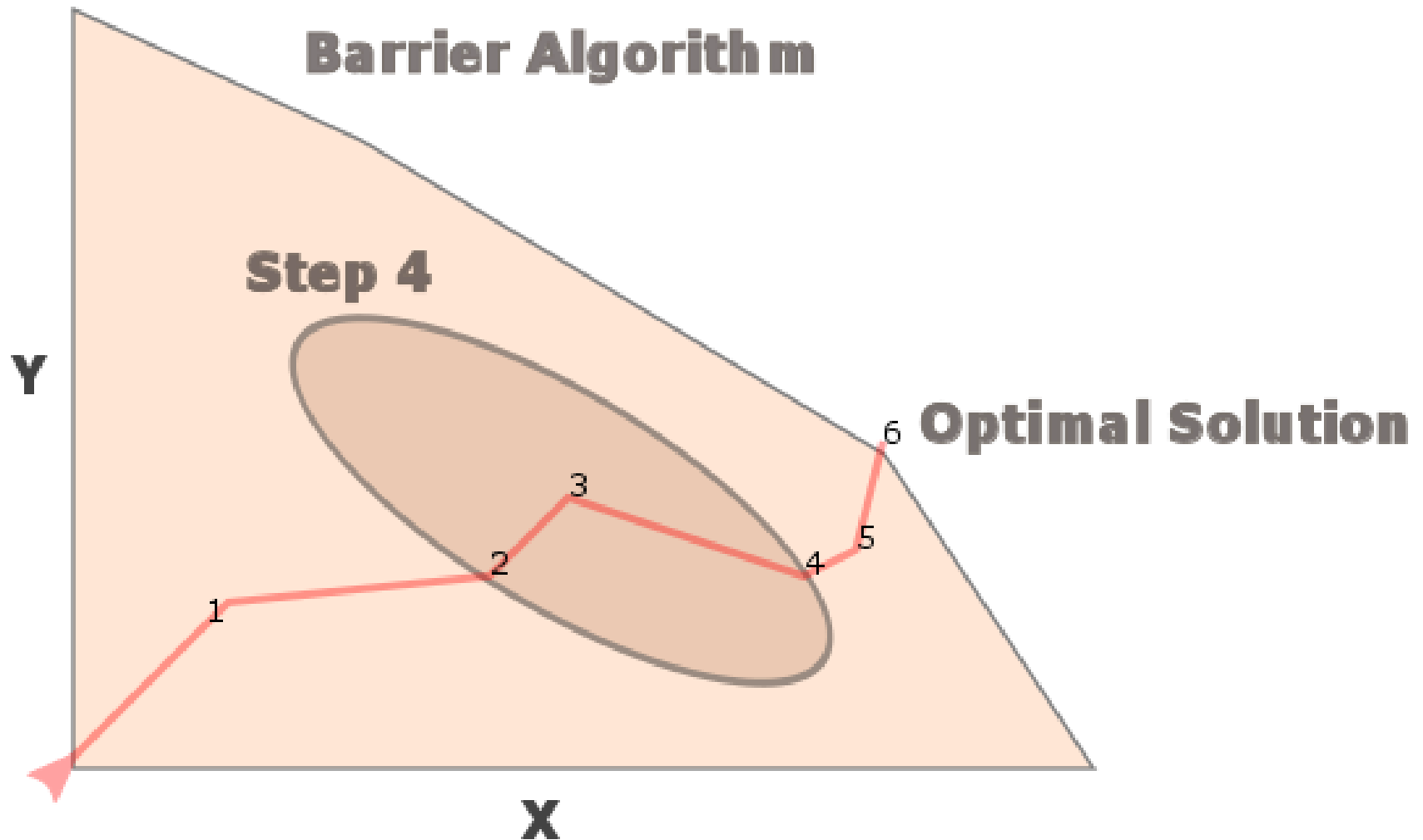
Simplex vs. Barrier

Barrier

Optimal Solution

Objective Function

Simplex

Crossover

Optimal Solution Zoomed View
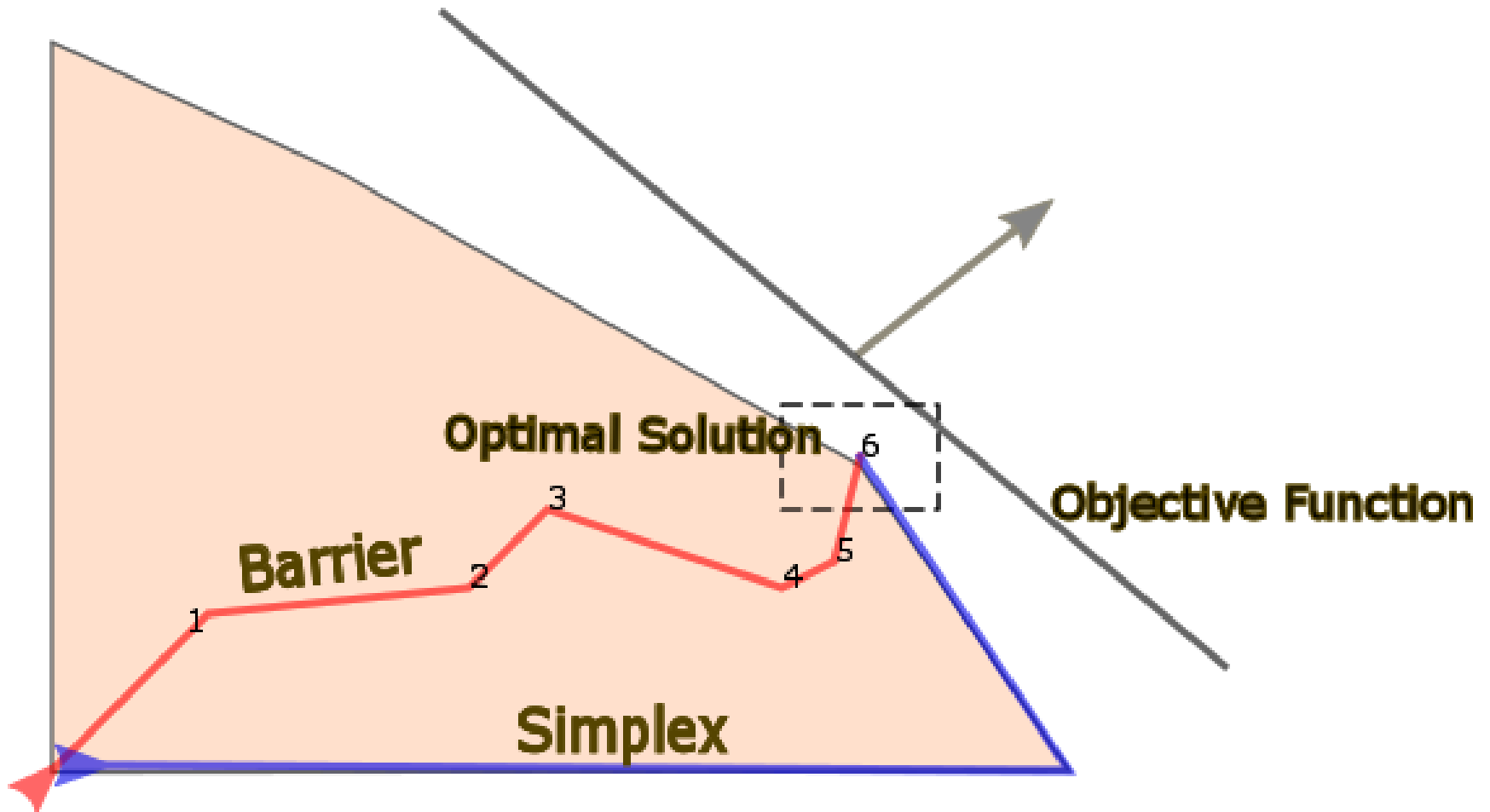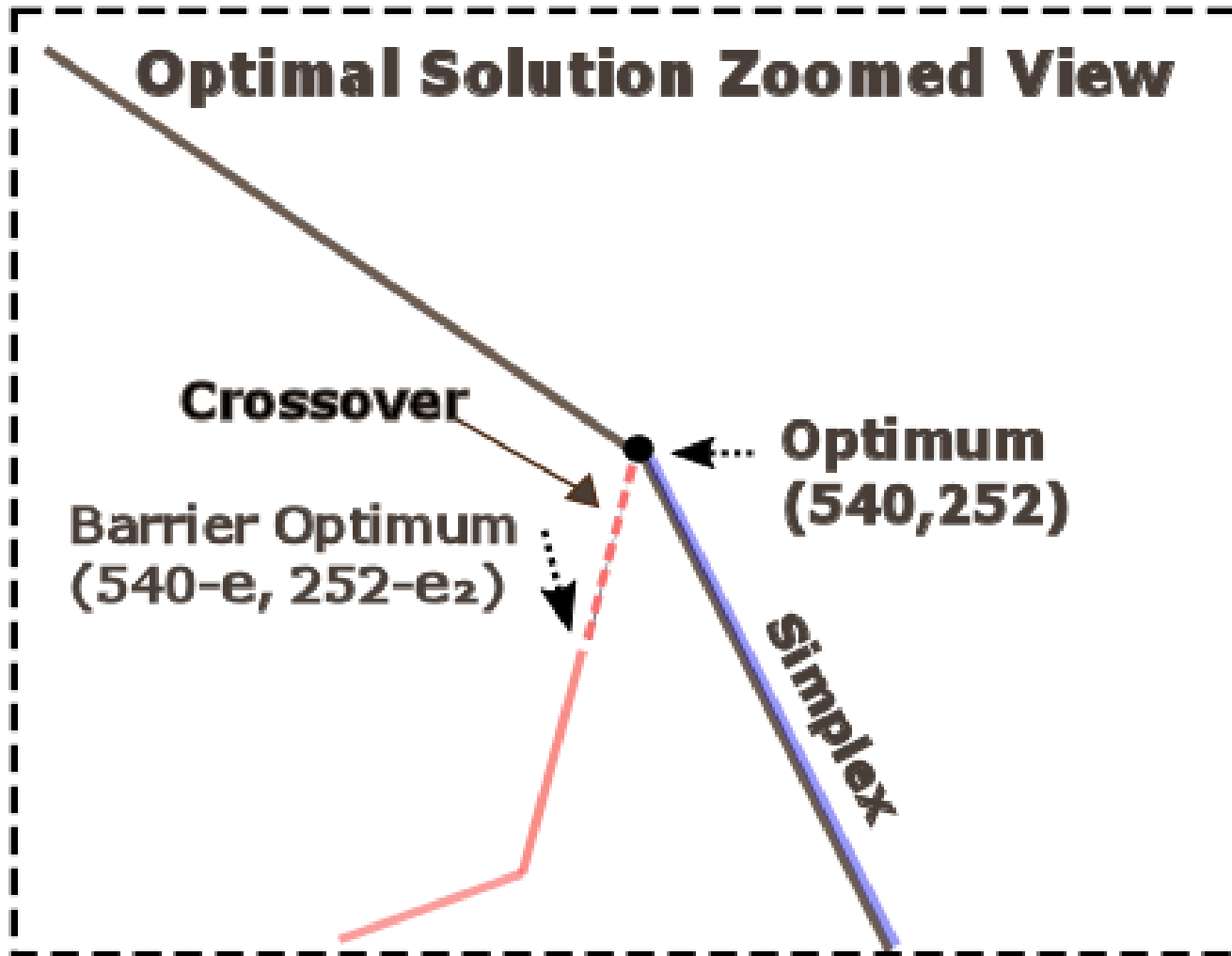
One Step of Barrier Method

Goal Programming

- After optimizing
  - Lower priorities constrained to the optimal face
  - Add soft constraints with an objective to satisfy them or an ordinary objective function
- Primal Simplex
  - Start with previous optimal point on a face
  - If necessary, move elsewhere on the face
  - Expect good start to lead to fast reoptimization

Barrier Method for Goal Programming

- Previous solution unused

- Rerun presolve
  - Freezing previous objective allows presolve to eliminate more variables and constraints

- Optimize new objective
  - Fast for sparse matrices, ~3 sec. normally
  - Crossover – usually a split second
  - Crossover allows same freezing as Simplex

Reformulation for Barrier Method

- Run time ~ # of objectives * 3 seconds
  - Reduce number of objectives
- Reduce Use Of Repeated Minimax Goals
  - Summation goals instead
    - Reward function
      - e.g. piecewise linear approx. of violation^2
      - Tends to have solutions at approximation points
        - Stable
- Don't optimize for feasible constraints
  - Use rules to determine if they are feasible
    - Ideal – if a constraint is feasible then rules produces a feasible solution. Imperfect.

New Methods

- Power Coefficient Estimate (Opt)
  - Needs a reasonable guess at the power coefficient for each time period
  - Faster and more accurate than Power Surface Approximation method for BPA
- Tailwater Coefficients (Sim & Opt)
  - TW = a + b Outflow + c TWBV
        + similar for t-1 + d TW(t-1)
  - Better fit for BPA reservoirs

Other Enhancements

- Reprioritize goals and parts of goals through batch mode and FEWS
- Solution Analysis in CSV file
- New RPL functions
  - OptValueByCol for agg series slots
  - OptValuePiecewise for piecewise approximations
    - Returns the approximated value
- Better modeling techniques

Future

- Improve optimization section of online help
- Daily timestep planning model
  - Leaning towards rules with special rules that are mini-optimization problems
- Value of System Storage
  - Leaning towards approximate Stochastic Dynamic Programming
  - Approximations to reduce dimensions
- Hydro Value Analysis
  - Expected future cost of constraints and outages
  - Value of "flexibility"
- Better joint optimization with rest of the power sys.
- Additional performance improvement?