ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

TIK
Computer Engineering
and Networks Laboratory

Bio-inspired Optimization and Design

Project 2: Knapsack Problem – Part II – Task 2

Discussion

Task 2 a)

We want to re-use the algorithm from Task 1.

Describe which parts of the algorithm have to be modified and how.

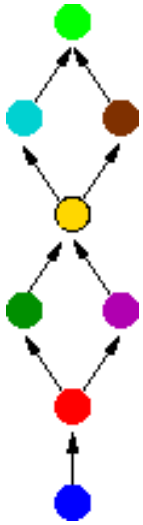
a) Single-objective vs. Multi-objective

One objective

- Total order
- Fitness often equals the objective value

2 or more objectives

- Partial order
  - Incomparable solutions!



a) Changes

One objective

- Total order
- Fitness often equals the objective value

2 or more objectives

- Partial order
  - Incomparable solutions!
- Total order necessary
  - Mapping: $(f_1(x), f_2(x)) \longrightarrow \mathbb{R}$
  - Weighted sum
  - Ranks (e.g. dominance rank)
  - (Hypervolume) indicator
  - Switching Objectives
  - Multistart Constraint

Changes necessary in

- Fitness calculation
- Mating and environmental selection

Aggregation (Weighted Sum)

- Objective 1: $f_1(x)$
- Objective 2: $f_2(x)$
- Fitness = $\alpha \cdot f_1(x) + (1-\alpha) f_2(x), \quad \alpha \in [0,1]$

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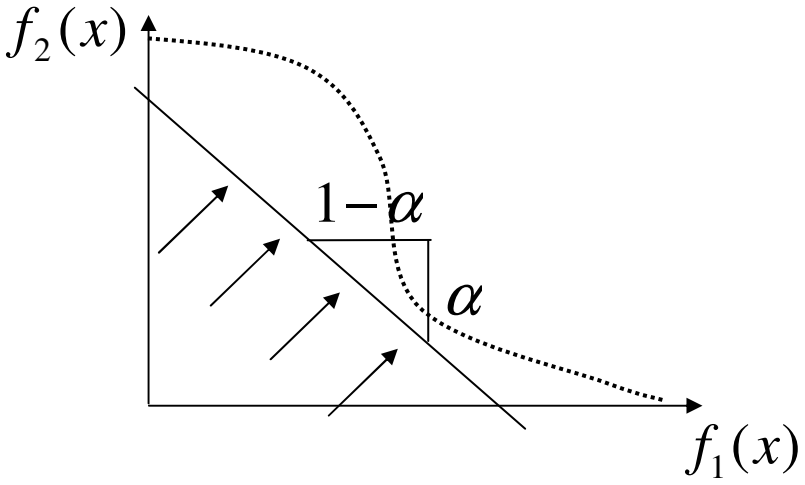
Problem: Fixed alpha: Single-objective problem -> strong bias



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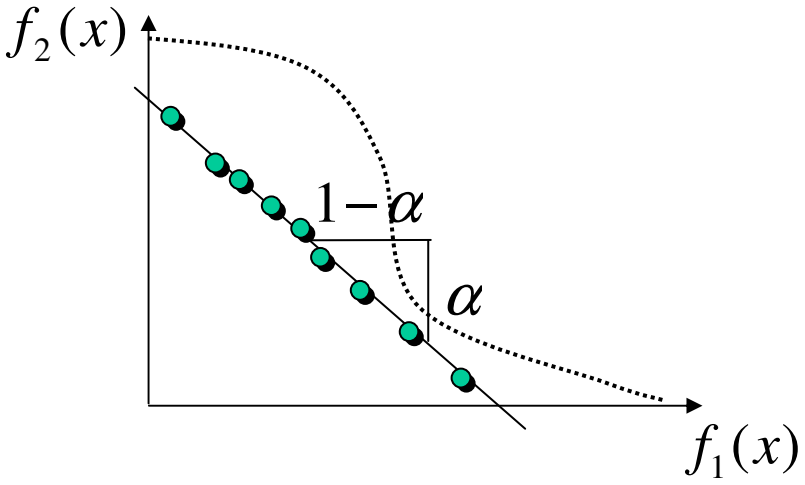

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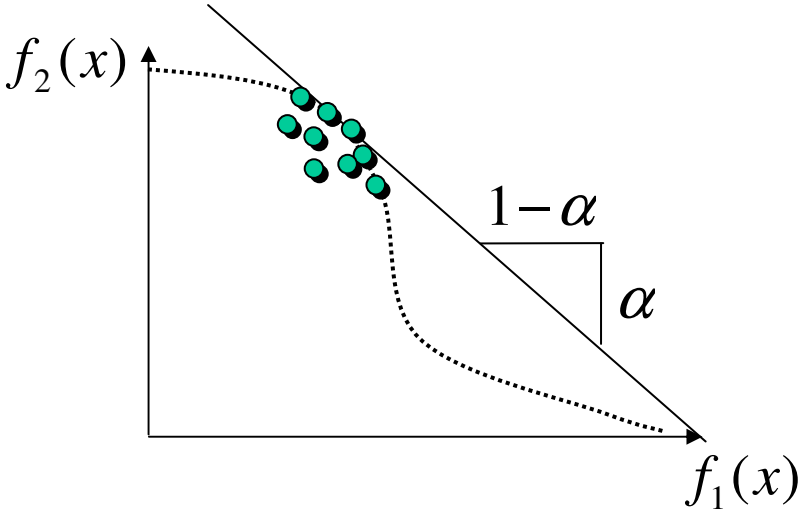
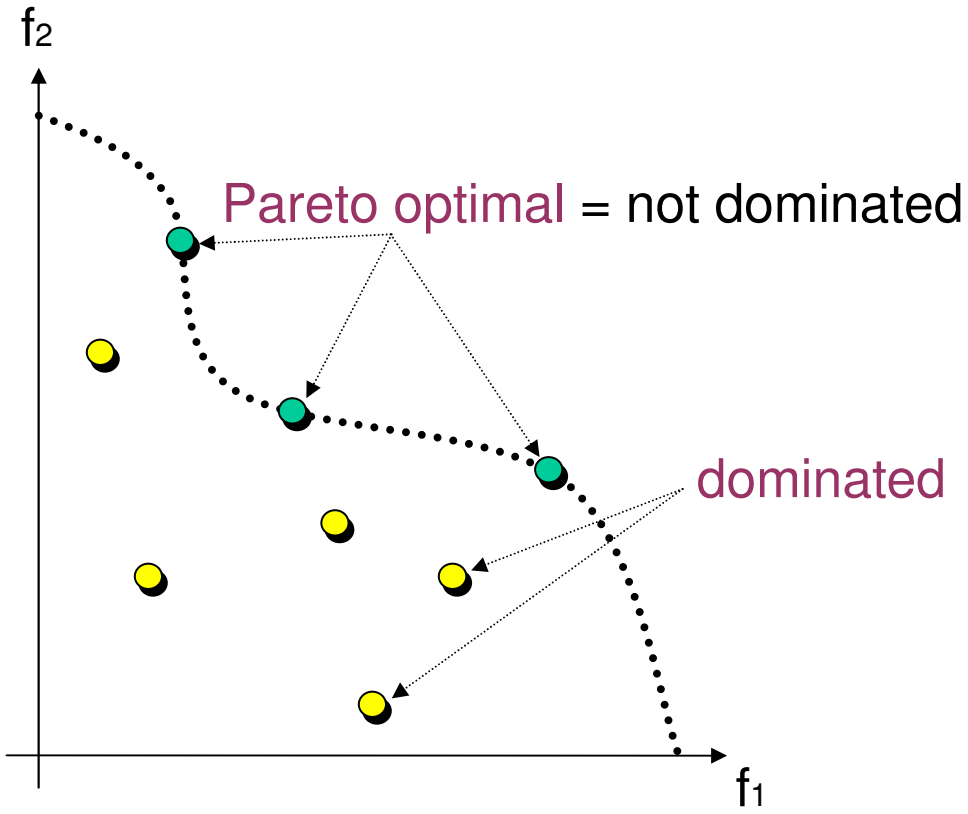


Solution: Start algorithm multiple times (with different alpha's)

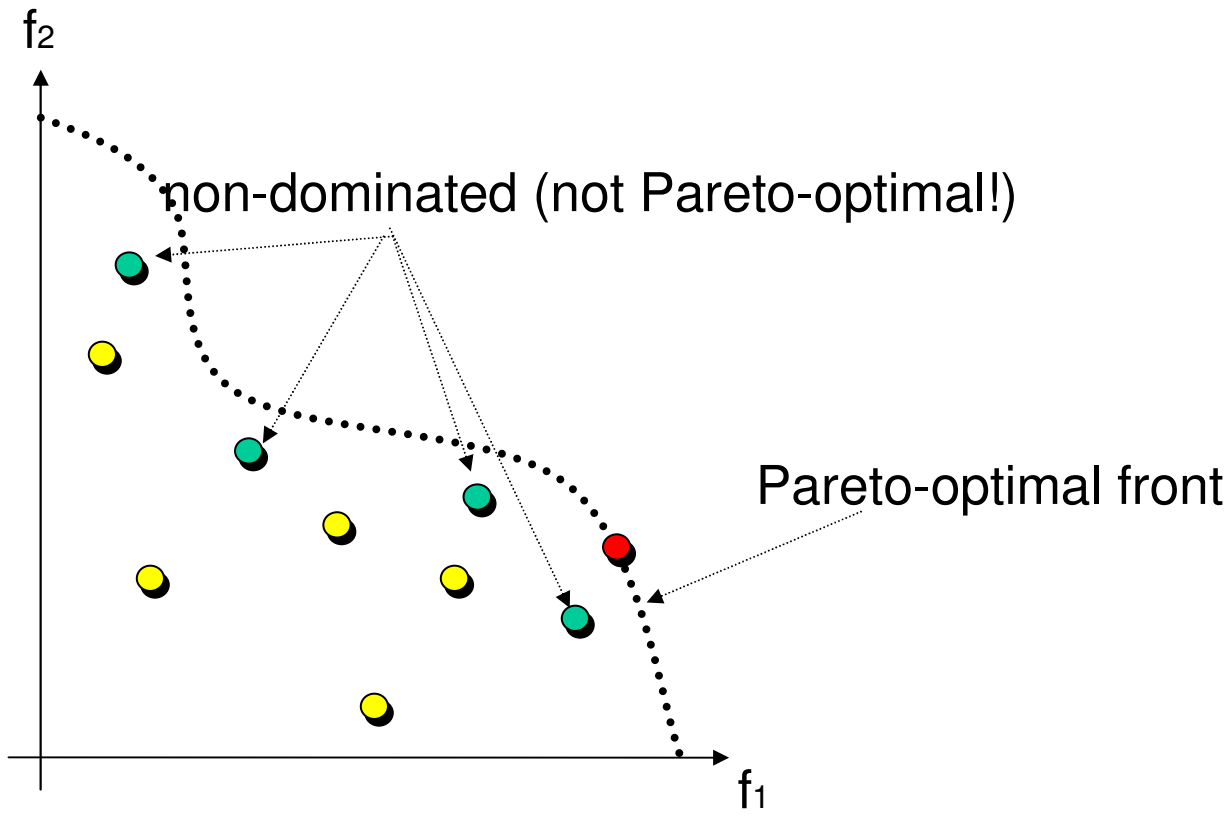
Pareto-optimal vs. Non-dominated

- Pareto-optimal is defined wrt the entire set of solutions



Pareto-optimal vs. Non-dominated

- Pareto-optimal is defined wrt the entire set of solutions
- For a subset of solutions, the "best" solutions are called non-dominated

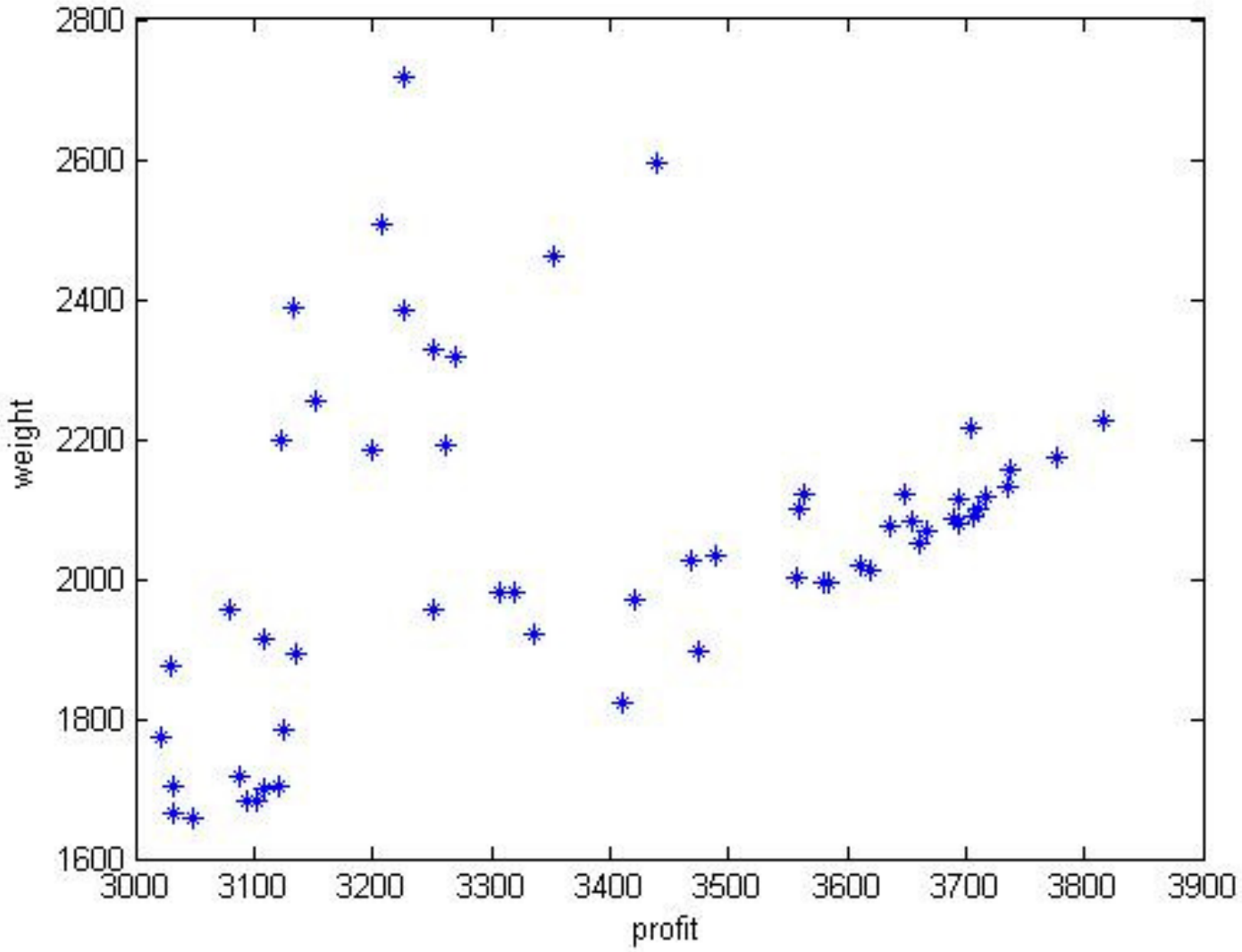


Task 2 b)

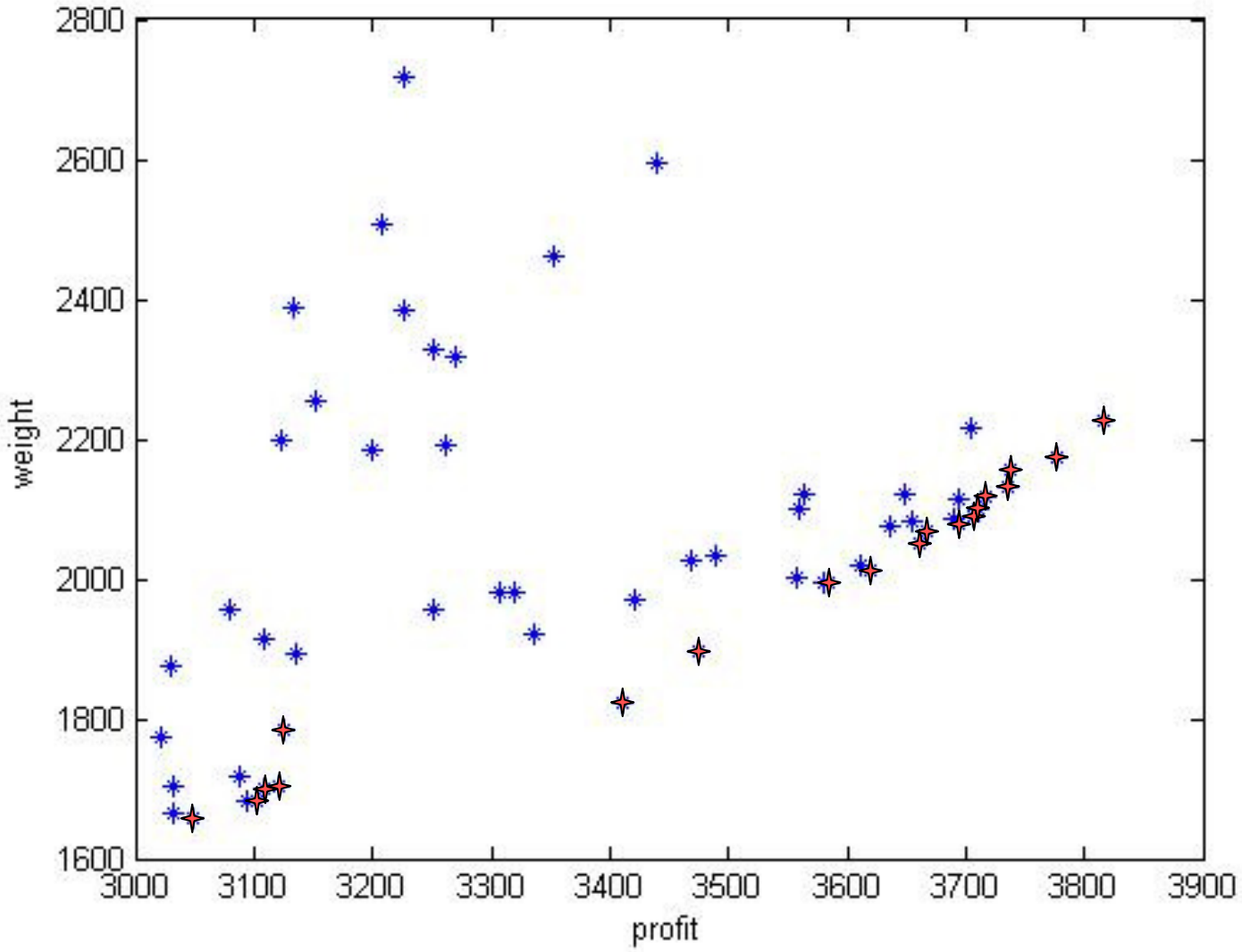
Run the algorithm on the problem instance given on the website.

Report the Pareto front approximation found after 500 and after 1000 generations as a two dimensional plot, where the x-axis denotes the profit and the y-axis the weight.

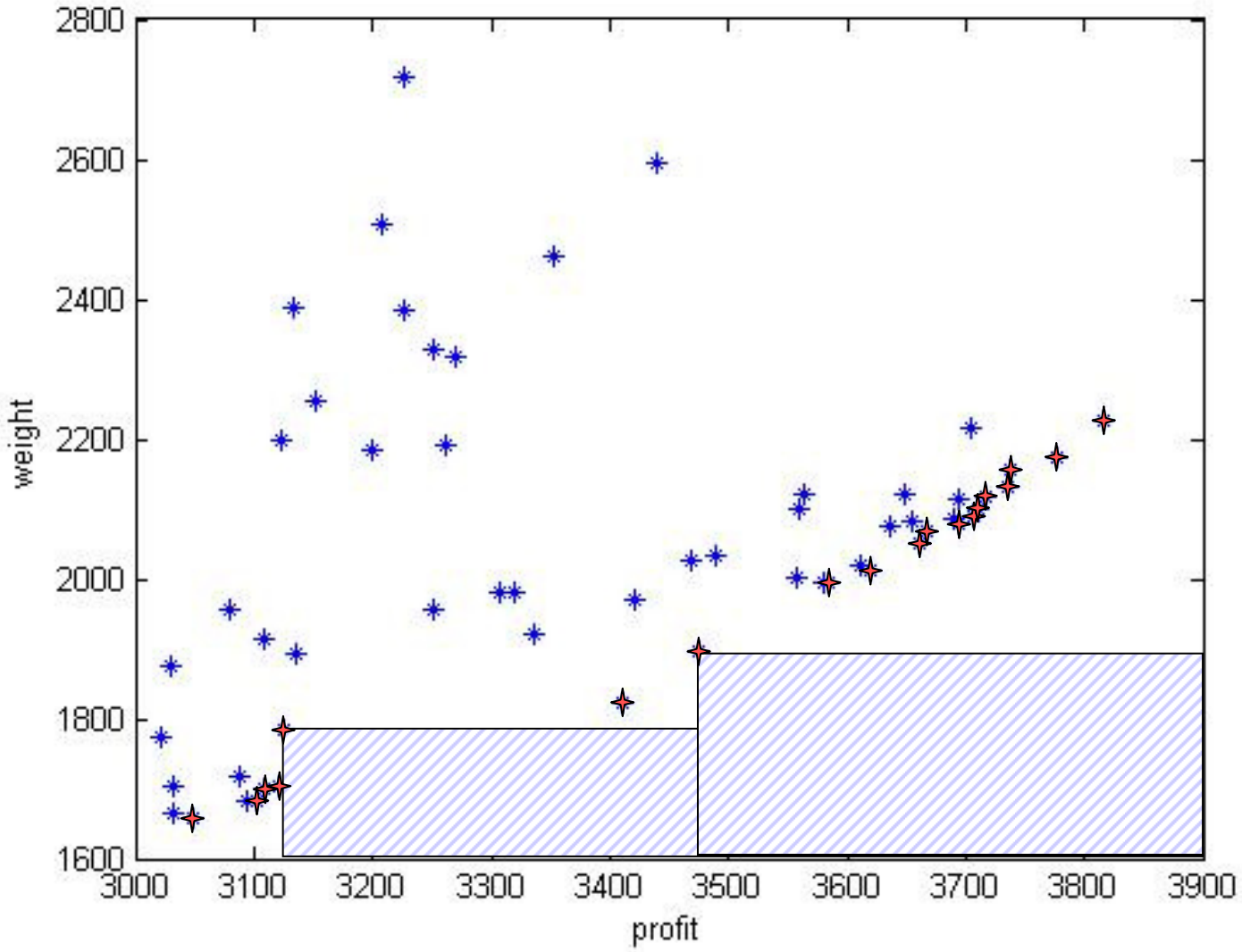
Not only non-dominated Solutions



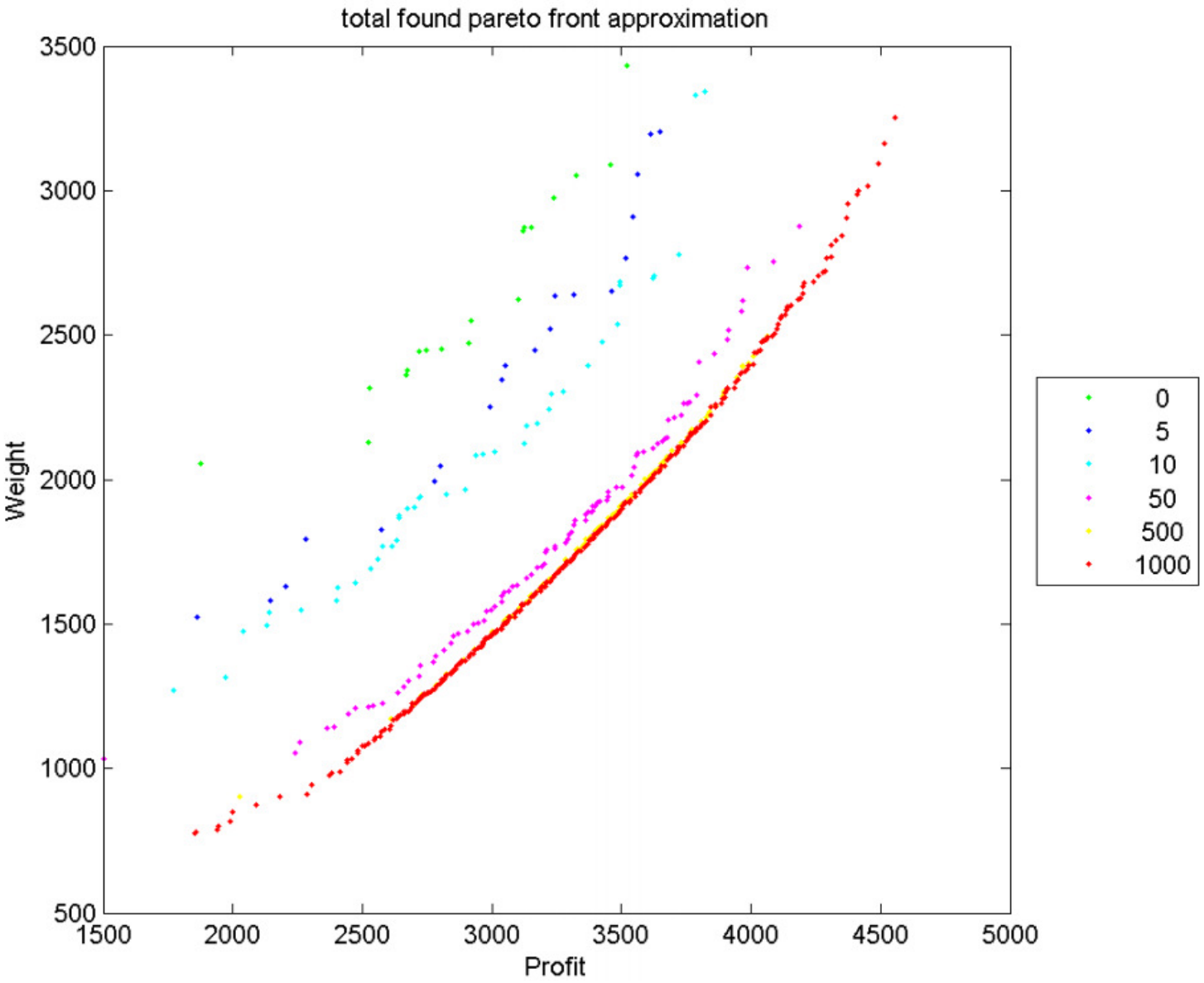
Not only non-dominated Solutions



Not only non-dominated Solutions



Better…


total found pareto front approximation
Weight
Profit
3500
3000
2500
2000
1500
1000
500
1500
2000
2500
3000
3500
4000
4500
5000
0
5
10
50
500
1000