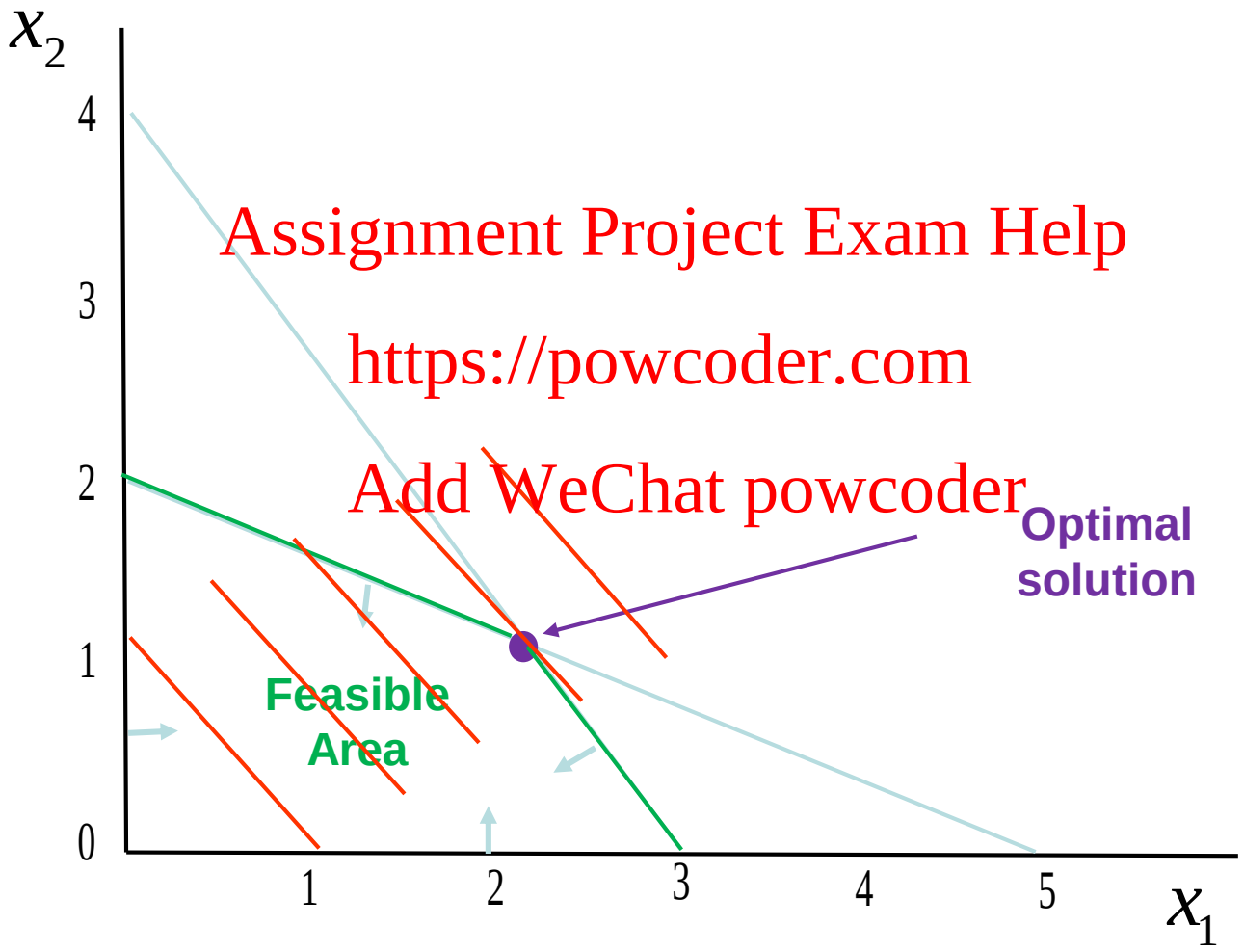
Non-linear programming

Non-smooth problems

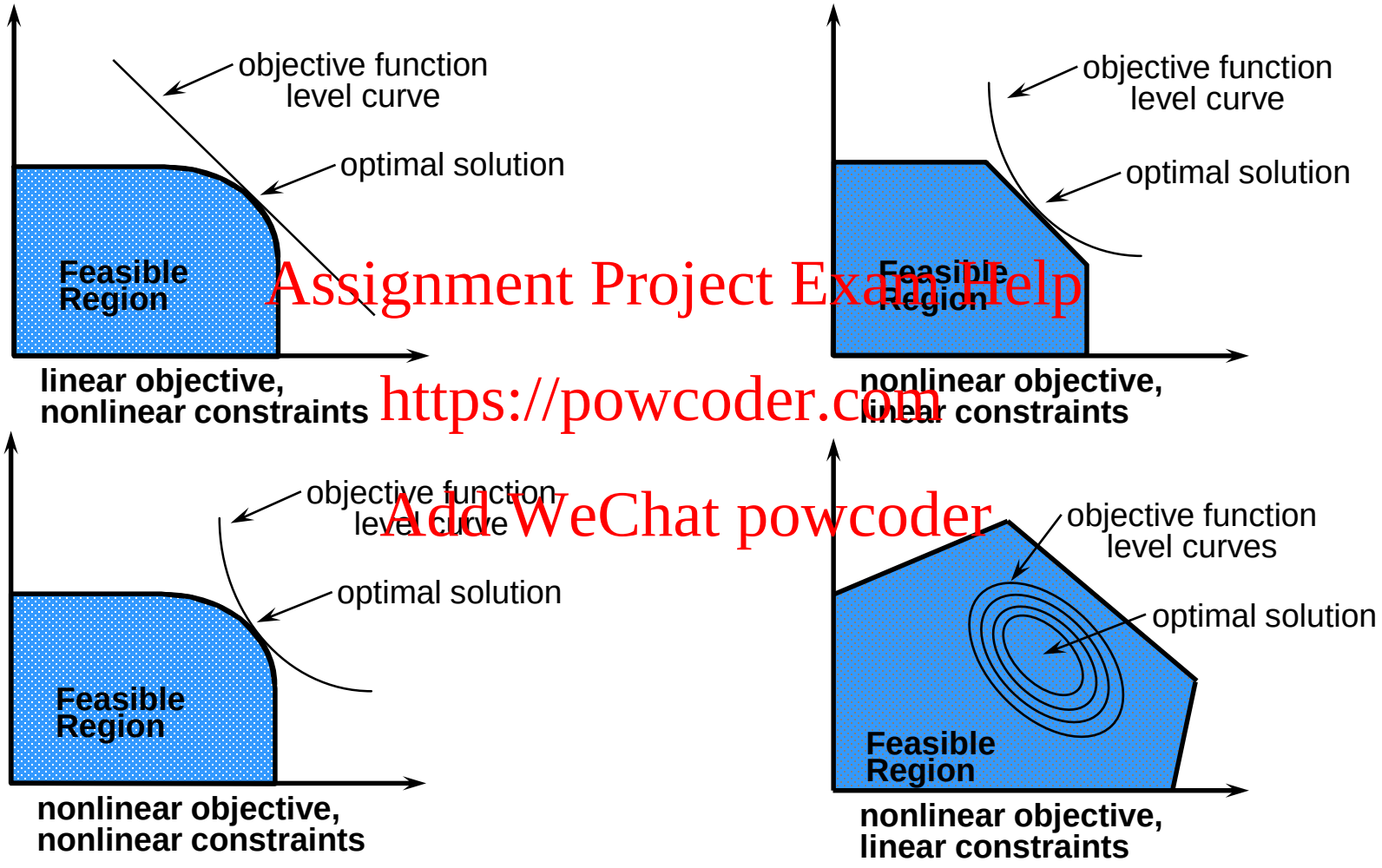
CIS 418

Reminder: Linear Programming

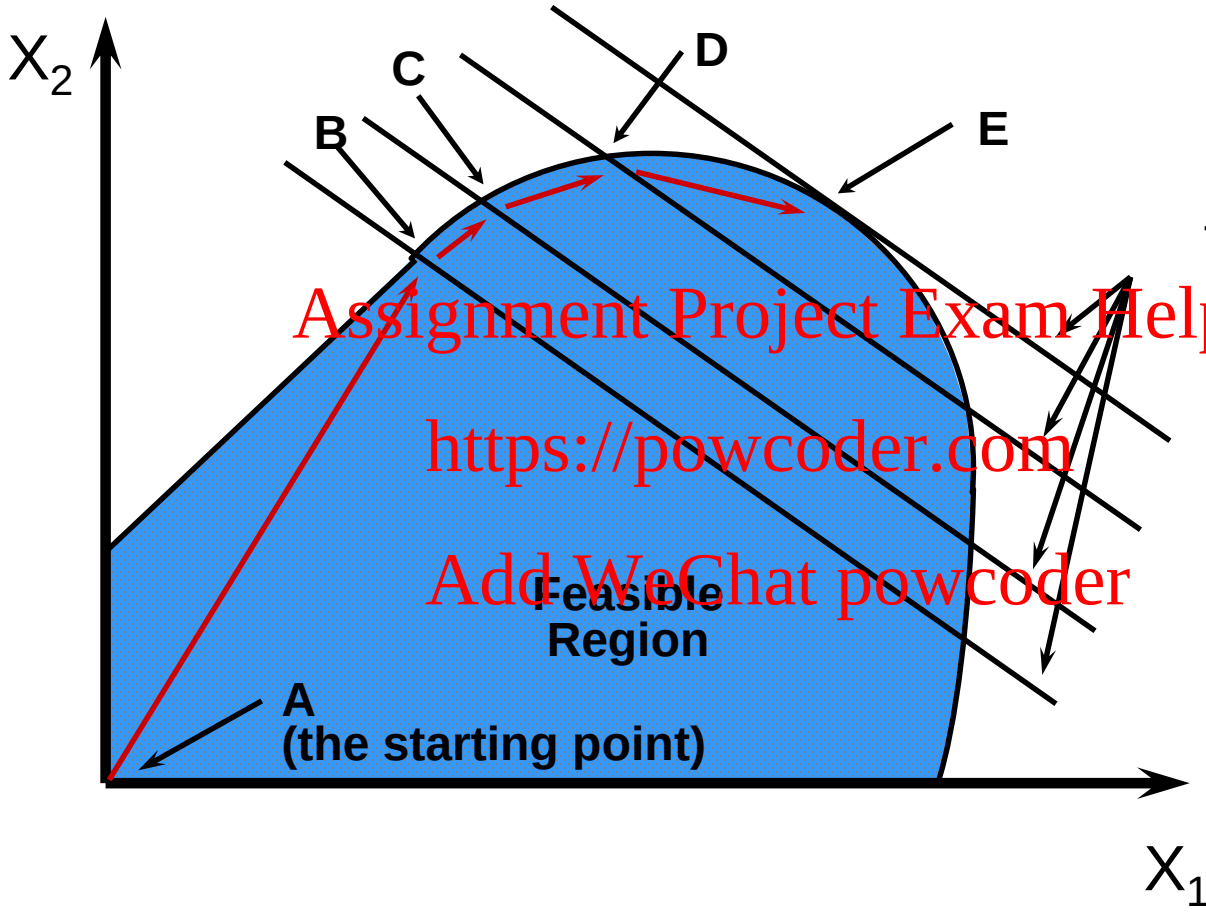
Both **objective** and **constraints** are **linear** functions of **decision variables.**



Non-linear optimization



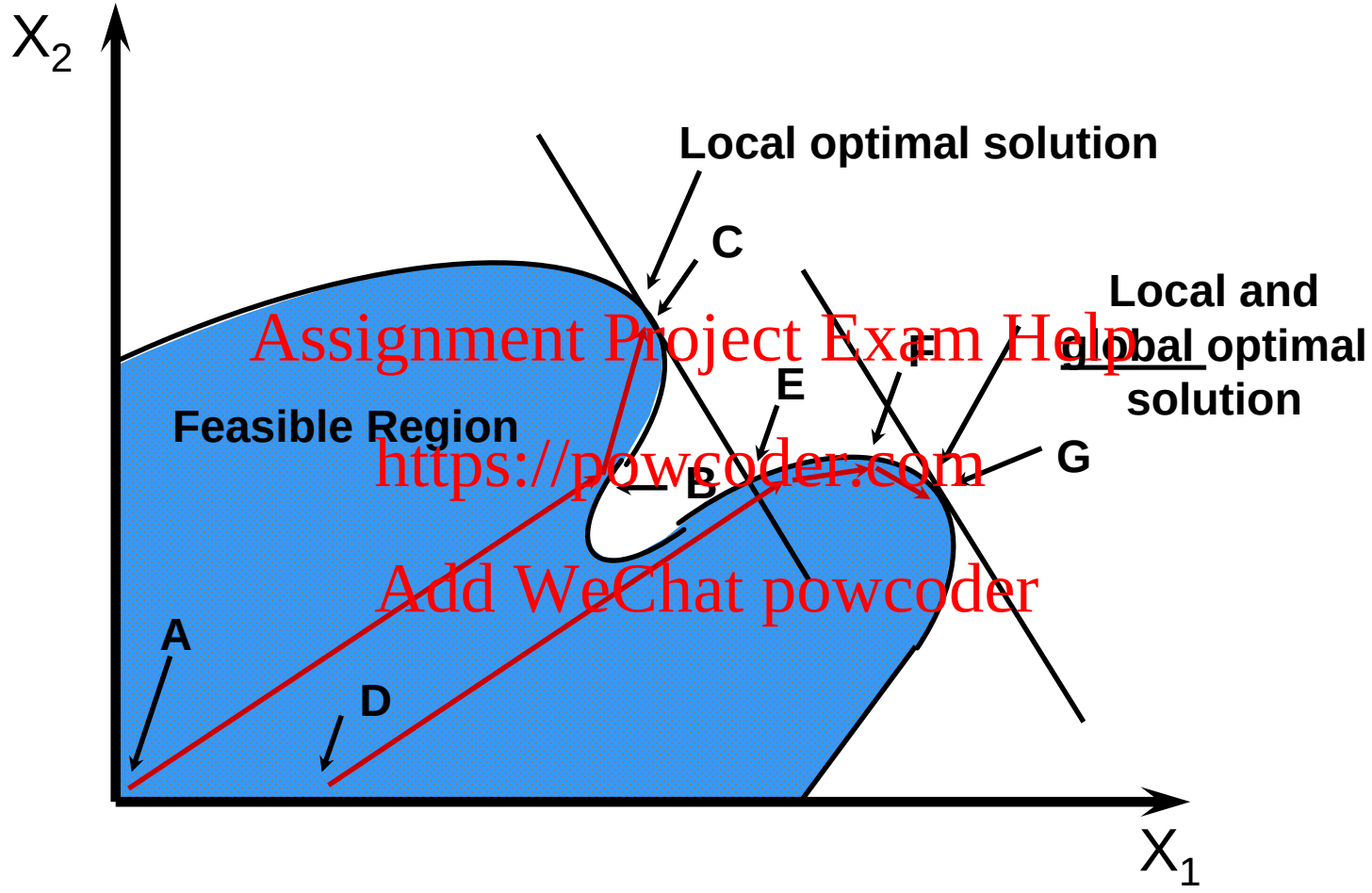
Solution Strategy: Improving Direction



objective function level curves

One of the solution strategies for handling non-linear problems is to move as far as possible in improving direction – and find a **global solution**

Non-Smooth Problems



- With a **non-smooth** problem, the algorithm may **not** be able to find the **global optimum.**
- The **starting point influences** the local optimal **solution** obtained.

Example for a non-smooth problem: Snoey Software

Product Cost Data

	High-Speed	Large-Scale	Educational
Product Completion Cost	$ 150,000	$ 100,000	$ -
Variable Cost	$ 36	$ 20	$ 10

Market Data

Market Segment	Segment Size	Marketing Costs	Willingness to pay for software version: High-Speed	Large-Scale	Educational
Large Companies	6,000	$ 100,000	$ 2,500	$ 1,000	$ 150
Small Companies	24,000	$ 100,000	$ 500	$ 250	$ 75
Consultants	12,000	$ 200,000	$ 750	$ 500	$ 100
Laboratories	1,200	$ 200,000	$ 1,000	$ 300	$ 125
Students	400,000	$ 300,000	$ 75	$ 40	$ 25

Formulate the problem

- Objective:
  - Maximize profit
- Decisions:
  - How to price each version
- Constraints:
- Calculations:
  - Revenue
  - Marketing costs
  - Production costs
  - Variable costs

Go to the excel file and calculate the optimal solution using solver

The computer algorithm can run into a Local Optimum

	Data Table Analysis Varying Two Prices (assumes High Speed Version price $2500)					
		Educational Version Price				
	$5,748,000	$ 25	$ 75	$ 100	$ 125	$ 150
Large-Scale Version Price	$ 40	7,864,000	7,864,000	7,864,000	7,864,000	7,864,000
	$ 250	9,518,000	9,236,000	9,236,000	9,236,000	9,236,000
	$ 300	10,418,000	5,978,000	4,548,000	4,776,000	4,776,000
	$ 500	8,438,000	4,598,000	8,148,000	8,178,000	8,240,000
	$ 1,000	5,748,000	2,208,000	1,228,000	528,000	14,534,000
	Maximum	14,534,000				

Moving anywhere in the immediate vicinity of this point does not improve profit

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This is the global maximum