Universität Bremen

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Hands-on Tutorial on Optimization

Exercise Sheet: Crude Oil Processing (09.10.2023)

Two processes are available to refine 10 barrels of crude oil

Process	cost per barrel	output per 10 barrels
1	3€	2 barrels heavy oil
		2 barrels medium heavy oil
		1 barrel light oil
2	5€	1 barrel heavy oil
		2 barrels medium heavy oil
		4 barrels light oil

Any amount of crude oil can be refined using any of the two processes above, including fractions of barrels. The minimum required amounts of the three categories of refined oil are as follows:

heavy oil:	3 barrels
medium heavy oil:	5 barrels
light oil:	4 barrels

Compute the minimal cost of producing the above amounts of refined oil. Determine the amount of crude oil that should be processed using the first and the second of the available processes, respectively.

Exercise 1 (Basic Structure)

Build a model of the above problem and solve it using Python and Pulp. Proceed as follows:

(a) Model the problem as LP.

(b) Implement the basic structure of your model using Pulp. This should include the declaration of the model variables.

(c) Define the objective function and compute a minimal solution at the end of your model.

(d) Now, add the constraints to your model.

(e) Complete your program by adding text output. Display the optimal objective function value as well as the values of your model variables.

Exercise 2 (Add Flexibility)

Increase the flexibility of the model by implementing it as a Python function that takes the following arguments and solves the model for all (feasible) inputs:

- a list `oil_type` of the different categories of refined oil represented by their names,

- a list `process` that contains the different refinement processes represented by their names,

- a list `demand` containing the demand for different categories of refined oil,

- a list `process_cost` containing for every process the cost of refining a unit of 10 barrel using that process,

- a list `max_time` indicating the maximum amount of time available for a process,

- a two-dimensional list `production` that holds the production of every type of refined oil for each process.

Use loops to define the constraints and use the scalar product functionality of Pulp (`lpDot`) to define the objective function.

Exercise 3 (Data Input)

Separate your problem from the data in the following way:

- Keep the list representation of the oil types and processes as in Exercise 2 but change the other arguments to dictionaries using the oil types and/or processes as keys.

- Change your function to use the summation functionality of Pulp (`lpSum`) and the new input data structures to implement and solve the model.

- Test your model on the alternative data provided on StudIP.