

Homework 4

1. Consider the nonlinear program

$$\begin{aligned} \min f(x) &= x_1^2 + 2x_2^2 \\ \text{s.t. } x_1^2 + x_2^2 &\leq 5 \\ 2x_1 - 2x_2 &= 1 \end{aligned}$$

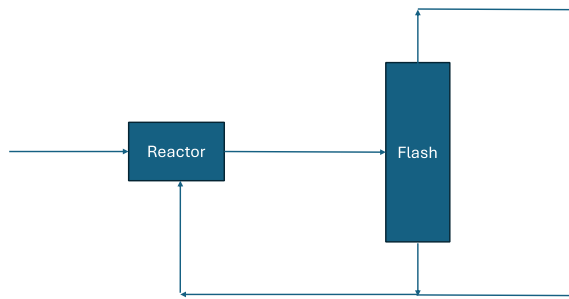
- a. Write the KKT conditions for the problem
- b. Using a and other conditions for optimality what can you conclude about the following solutions to the nonlinear program

$$x = (0,0)$$

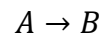
$$x = \left(1, \frac{1}{2}\right)$$

$$x = \left(\frac{1}{3}, -\frac{1}{6}\right)$$

2. Consider the following flowsheet:



Assume that the following reaction takes place with a 50% conversion. The feed to the reactor consists of pure A.



The flash separator can be modeled as a perfect separation unit, capable of producing any required purity.

We assume that the purge fraction should be between 1% to 99%.

The profit is given by the following equation:

$$0.5B^{Top} - 0.1F_R(500 - T) - 10^{-5}V$$

Where B^{Top} is the molar flow B exiting as top product from the flash separator. And F_R is the recycle molar flow rate.

- a. Formulate a model of this process.
- b. Set up the model in gams and try 3 different NLP solvers, compare the results.