ECH4905 ChemE Optimization HW 3

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1 Problem 1

Consider the nonlinear program

$$\begin{aligned} \text{minimize} \quad & x_1^2 + 2x_2^2 \\ \text{subject to} \quad & x_1^2 + x_2^2 \leq 5 \\ & 2x_1 - 2x_2 = 1 \end{aligned}$$

1.1 Part a

Write the KKT conditions for the problem
Solution:

1.2 Part b

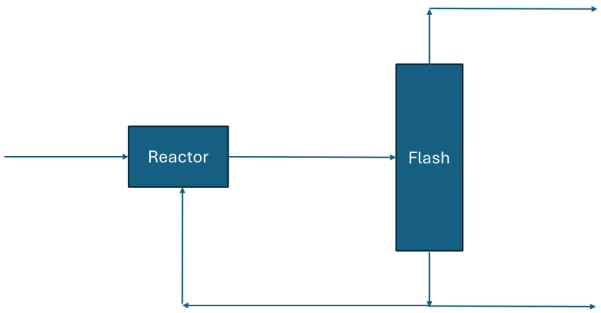
Using 1.1 and other conditions for optimality, what can you conclude about the following solutions to the nonlinear program

$$x = \begin{bmatrix} 0 \\ 0 \end{bmatrix}, \quad x = \begin{bmatrix} 1 \\ \frac{1}{2} \end{bmatrix}, \quad x = \begin{bmatrix} \frac{1}{3} \\ -\frac{1}{6} \end{bmatrix}$$

Solution:

2 Problem 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.

$$A \rightarrow B$$

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:

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

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.

2.1 Part a

Formulate a model of this process.
Solution:

2.2 Part b

Set up the model in GAMS and try 3 different NLP solvers, compare the results.
Solution: