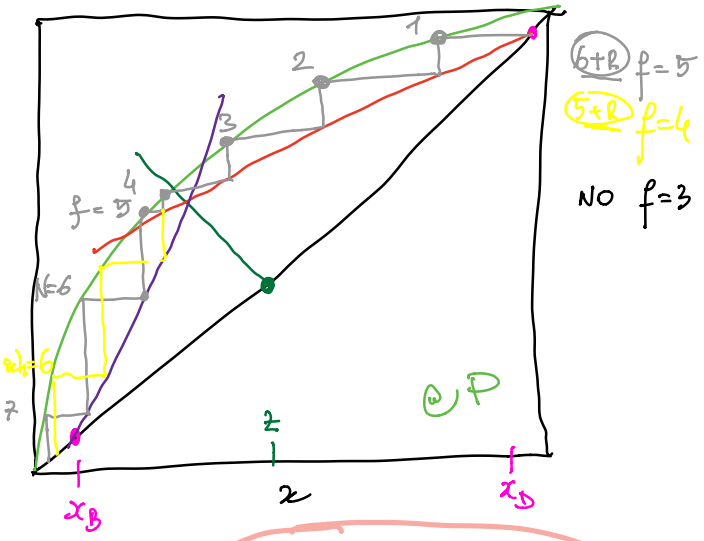
Summary Mc Cabe - Thiele

- data: feed, LVE
- specifications x_B, x_D
- $z, q \rightarrow$ q-line
- $R \rightarrow$ op. line rect. sec.
- op. line strip. sec. ← q-line and rect. op. line
- step-by-step construction (staircase) starting from top

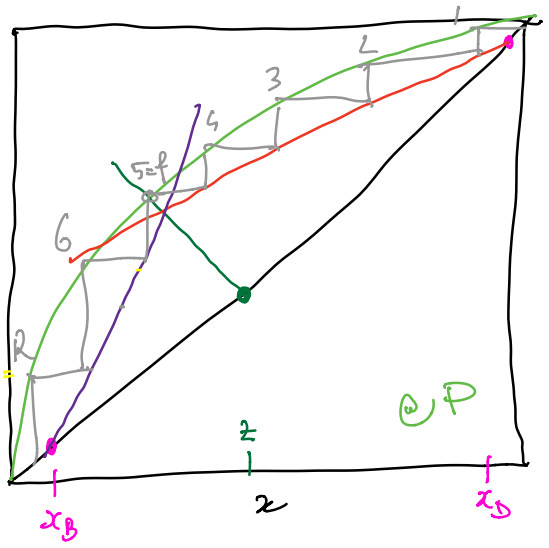


Optimal f: f = 4

→ to maximize Δy or Δx between steps

What is the optimal f and why?

↳ that which gives the smallest N!

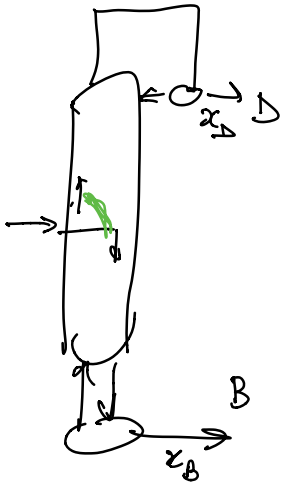


Start position

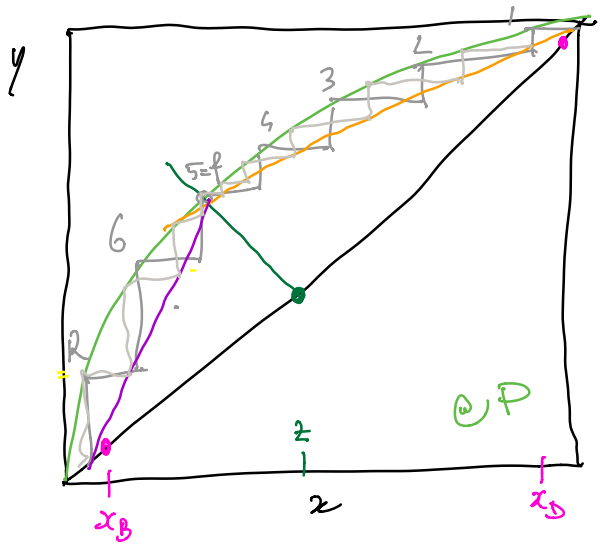
(i) distillate, x_D

(ii) bottoms, x_B

(iii) intersection between q-line and LVE line



↳ N, minimum for the specified R → ?

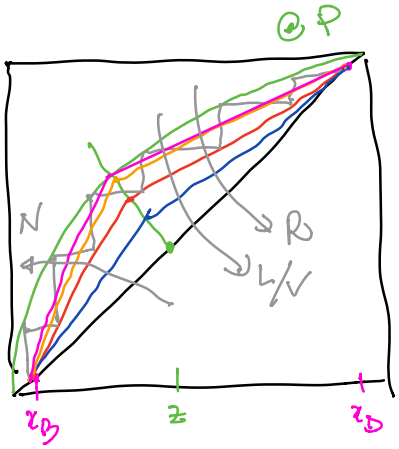


How to choose R $\Longleftrightarrow$ N

$$R = \frac{L}{D} = \frac{L}{V-L} = \frac{L/V}{1-L/V}$$

$$\frac{L}{V} = \frac{R}{1+R}$$

↳ slope of op. line



$R \downarrow$ $N \uparrow$

$$\frac{d(L/V)}{dR} = \frac{1}{(1+R)^2} > 0$$

$R > R_{min}$

$R < R_{\cdot}$ → 10 stages + reb.

$R_{\cdot}$ → 5 stages + reboiler

$R_{\cdot} > R_{\cdot}$ → 4 stages + reb.

$R \to +\infty \Rightarrow L/V \to 1$

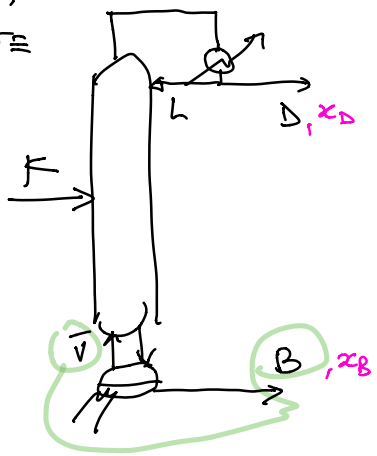
↳ 3 stages + reb

$R \to \infty \Longleftrightarrow N_{min}$

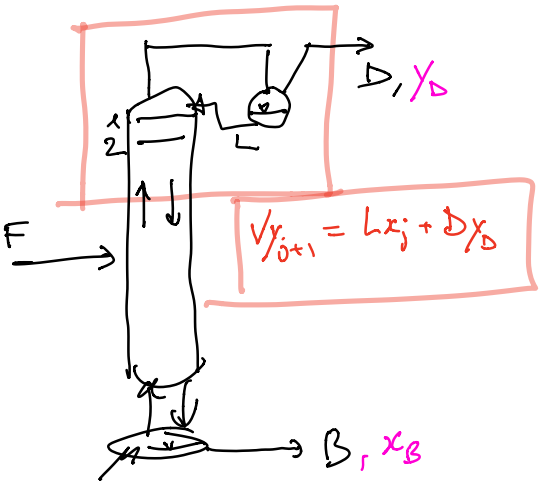
$R = R_{min} \Longleftrightarrow N \to \infty$

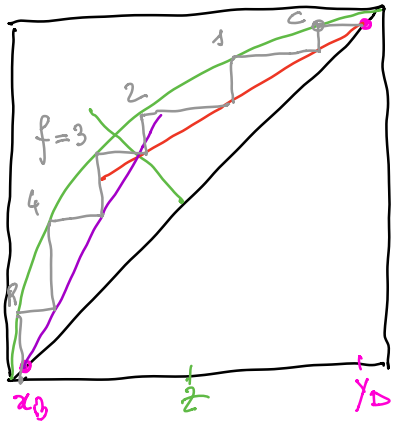
optimal R : compromise between operating costs and capital costs

So far we have considered
- total condenser ≠ eq. stage
- partial reboiler ≡ eq. stage

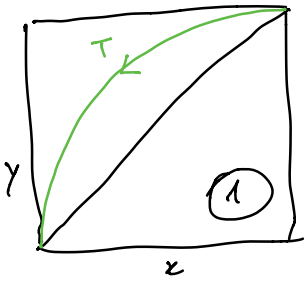


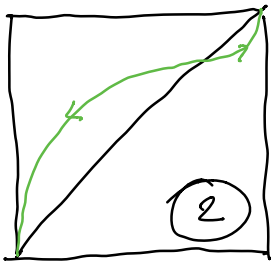
- partial condenser ≡ eq. stage
- partial reboiler ≡ eq. stage

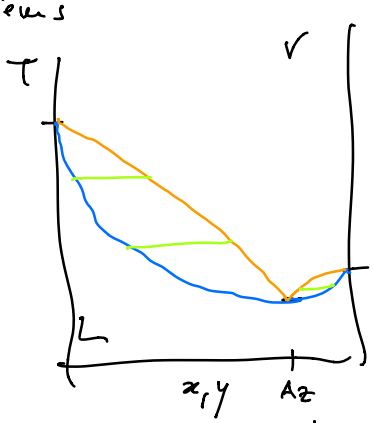




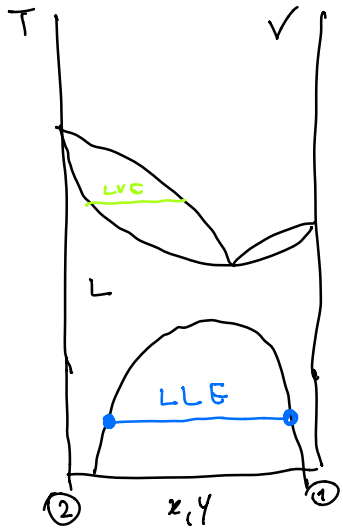
Characteristics of LVE for binary systems

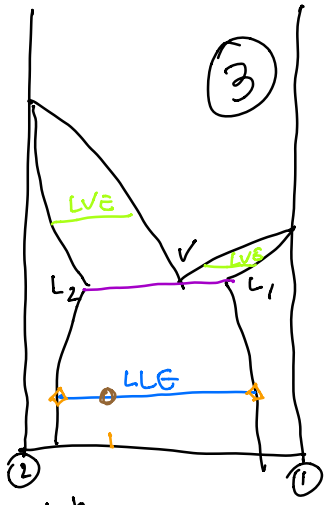




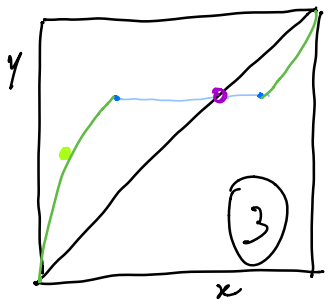


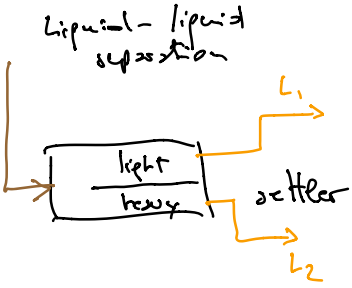
homogeneous azeotrop





heterogeneous azeotrop



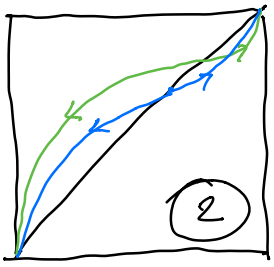


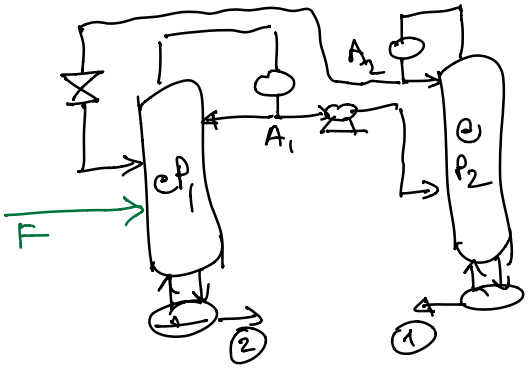
$x_D = 0.99$

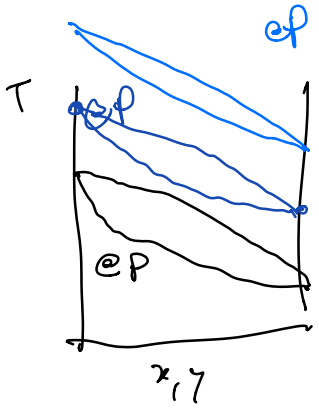
$x_B = 0.03$

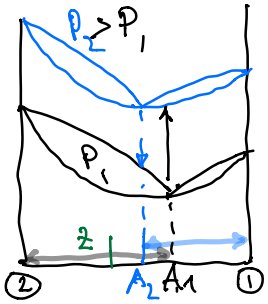
} ?

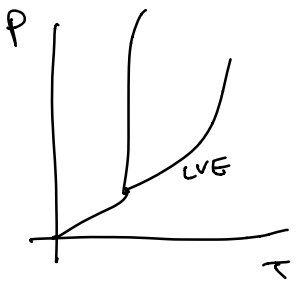
homogeneous Azeotrop











pressure swing distillation

heterogeneous azeotrop