$Fluids := \text{stack}(\text{"ETHANE"}, \text{"METHANE"}, \text{"PROPANE"})$ $\quad n := \text{length}(Fluids)$

$x := \text{stack}(0.5, 0.3, 0.2)$ $\quad \sum x = 1$ $\quad Mix := \text{""}$

```
for i ∈ [1..n]
  Mix := concat(Mix, "&", Fluids_i, "[", var2str(x_i), "]")
```

$Mix := \text{substr}(Mix, 2) = \text{"ETHANE[0.5]\&METHANE[0.3]\&PROPANE[0.2]"}$

$To := 600\ K$ $\quad Po := 150\ kPa$ $\quad$ **Objective:** find Vo @ To, Po using Redlich-Kwong

$$Tc := \overrightarrow{\text{CoolProp\_Props1}(\text{"TCRIT"}, Fluids)} = \begin{bmatrix} 305.322 \\ 190.564 \\ 369.89 \end{bmatrix} K$$

Critical properties

$$Pc := \overrightarrow{\text{CoolProp\_Props1}(\text{"PCRIT"}, Fluids)} = \begin{bmatrix} 4.8722 \\ 4.5992 \\ 4.2512 \end{bmatrix} MPa$$

$$b := \overrightarrow{\frac{\sqrt[3]{2}-1}{3} \frac{mol\ K}{J} R_m{}^2 \cdot \frac{Tc}{Pc}} = \begin{bmatrix} 0.3753 \\ 0.2482 \\ 0.5211 \end{bmatrix} \frac{L}{mol}$$

volume constant correction for each compound

$$b' := \sum_{i=1}^{n} x_i \cdot b_i = 0.3663 \frac{L}{mol}$$

volume constant correction for the mixture. Notice that it is lineal in x

$$a := \overrightarrow{\frac{1}{9 \cdot \left(\sqrt[3]{2}-1\right)} R_m{}^2 \cdot \frac{Tc^{2.5}}{Pc}} = \begin{bmatrix} 9.88 \\ 3.2211 \\ 18.2918 \end{bmatrix} \frac{J^2 \cdot \sqrt{K}}{mol^2\ Pa}$$

attractive potential of molecules coefficient for each compound

```
for i ∈ [1..n]
  for j ∈ [1..n]
    α_ij := sqrt(a_i · a_j)
```

$$\alpha = \begin{bmatrix} 9.88 & 5.6413 & 13.4433 \\ 5.6413 & 3.2211 & 7.6759 \\ 13.4433 & 7.6759 & 18.2918 \end{bmatrix} \frac{J^2 \cdot \sqrt{K}}{mol^2\ Pa}$$

The "a" coefficient for the mixture is not lineal in x, assuming that α(i,j) is the geometric mean of a(i) & a(j)

$$a' := \sum_{i=1}^{n} \sum_{j=1}^{n} x_i \cdot x_j \cdot \alpha_{i\,j} = 8.7937 \frac{J^2 \cdot \sqrt{K}}{mol^2\ Pa}$$

attractive potential of molecules coefficient for the mixture

Now we can solve the Redlich-Kwong for the mixture like it was a compound

$$Vo := \text{FindRoot}\left(Po = \frac{R_m \cdot To}{Vo - b'} - \frac{a'}{\sqrt{To} \cdot Vo \cdot (Vo + b')}, Vo = 1 \frac{L}{mol}\right)$$

$$Vo = 33.5544 \frac{L}{mol}$$

Coolprop result:

$$\frac{\text{CoolProp\_Props1}(\text{"M"}, Mix)}{\text{CoolProp\_Props}(\text{"D"}, \text{"T"}, To, \text{"P"}, Po, Mix)} = 33.2394 \frac{L}{mol}$$

Alvaro $\quad \text{appVersion}(4) = \text{"1.0.8348.30405"}$