$ORIGIN := 1$

$T := 278.15$

$$T_C := \begin{pmatrix} 33.2 \\ 304.2 \end{pmatrix} \qquad P_C := \begin{pmatrix} 13.0 \\ 73.8 \end{pmatrix} \qquad \omega := \begin{pmatrix} -0.216 \\ 0.239 \end{pmatrix} \qquad k := \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}$$

$$root(p, q, r) := \left| \begin{array}{l} v \leftarrow \begin{pmatrix} r \\ q \\ p \\ 1 \end{pmatrix} \\ x \leftarrow polyroots(v) \\ \text{for } i \in 1 .. 3 \\ \quad x_i \leftarrow 0 \text{ if } Im(x_i) \neq 0 \\ x1 \leftarrow max(x) \\ y \leftarrow min(x) \\ x2 \leftarrow \left| \begin{array}{ll} max(x) & \text{if } y = 0 \\ y & \text{otherwise} \end{array} \right. \\ \begin{pmatrix} x1 \\ x2 \end{pmatrix} \end{array} \right.$$

$$\phi_V(y, P) :=$$

$n \leftarrow 2$

for $i \in 1 .. n$

$T_{r_i} \leftarrow \frac{T}{T_{c_i}}$

$P_{r_i} \leftarrow \frac{P}{P_{c_i}}$

$\alpha_i \leftarrow \left[1 + \left[0.37464 + 1.54226 \cdot \omega_i - 0.26992 \cdot (\omega_i)^2\right] \cdot \left(1 - \sqrt{T_{r_i}}\right)\right]^2$

$A_{i,i} \leftarrow 0.45724 \cdot \left[\frac{P_{r_i}}{(T_{r_i})^2}\right] \cdot \alpha_i$

$B_i \leftarrow 0.07780 \cdot \left(\frac{P_{r_i}}{T_{r_i}}\right)$

for $i \in 1 .. n$

for $j \in 1 .. n$

$A_{i,j} \leftarrow (1 - k_{i,j}) \cdot \sqrt{A_{i,i} \cdot A_{j,j}}$

$A_{mix} \leftarrow \sum_{i=1}^{n} \sum_{j=1}^{n} (y_i \cdot y_j \cdot A_{i,j})$

$B_{mix} \leftarrow \sum_{i=1}^{n} (y_i \cdot B_i)$

$p \leftarrow -1 + B_{mix}$

$q \leftarrow A_{mix} - 2 \cdot B_{mix} - 3 \cdot B_{mix}^2$

$r \leftarrow -A_{mix} \cdot B_{mix} + B_{mix}^2 + B_{mix}^3$

$Z \leftarrow \text{root}(p, q, r)_1$

$C \leftarrow \ln\left[\frac{Z + (1 + \sqrt{2}) \cdot B_{mix}}{Z + (1 - \sqrt{2}) \cdot B_{mix}}\right]$

for $i \in 1 .. n$

$\phi_i \leftarrow \exp\left[\frac{B_i \cdot (Z - 1)}{B_{mix}} - \ln(Z - B_{mix}) - \frac{A_{mix} \cdot C}{2\sqrt{2} \cdot B_{mix}} \cdot \left[\frac{2 \cdot \sum_{j=1}^{n} (y_j \cdot A_{i,j})}{A_{mix}} - \frac{B_i}{B_{mix}}\right]\right]$

ϕ

$$\phi_L(x, P) :=$$

$n \leftarrow 2$

for $i \in 1 .. n$

$$T_{r_i} \leftarrow \frac{T}{T_{c_i}}$$

$$P_{r_i} \leftarrow \frac{P}{P_{c_i}}$$

$$\alpha_i \leftarrow \left[1 + \left[0.37464 + 1.54226 \cdot \omega_i - 0.26992 \cdot (\omega_i)^2\right] \cdot \left(1 - \sqrt{T_{r_i}}\right)\right]^2$$

$$A_{i,i} \leftarrow 0.45724 \cdot \left[\frac{P_{r_i}}{(T_{r_i})^2}\right] \cdot \alpha_i$$

$$B_i \leftarrow 0.07780 \cdot \left(\frac{P_{r_i}}{T_{r_i}}\right)$$

for $i \in 1 .. n$

for $j \in 1 .. n$

$$A_{i,j} \leftarrow (1 - k_{i,j}) \cdot \sqrt{A_{i,i} \cdot A_{j,j}}$$

$$A_{mix} \leftarrow \sum_{i=1}^{n} \sum_{j=1}^{n} (x_i \cdot x_j \cdot A_{i,j})$$

$$B_{mix} \leftarrow \sum_{i=1}^{n} (x_i \cdot B_i)$$

$$p \leftarrow -1 + B_{mix}$$

$$q \leftarrow A_{mix} - 2 \cdot B_{mix} - 3 \cdot B_{mix}^2$$

$$r \leftarrow -A_{mix} \cdot B_{mix} + B_{mix}^2 + B_{mix}^3$$

$$Z \leftarrow \text{root}(p, q, r)_2$$

$$C \leftarrow \ln\left[\frac{Z + (1 + \sqrt{2}) \cdot B_{mix}}{Z + (1 - \sqrt{2}) \cdot B_{mix}}\right]$$

for $i \in 1 .. 2$

$$\phi_i \leftarrow \exp\left[\frac{B_i \cdot (Z - 1)}{\square} - \ln(Z - B_{mix}) - \frac{A_{mix} \cdot C}{\square} \cdot \left[\frac{2 \cdot \sum_{j=1}^{n} (x_j \cdot A_{i,j})}{\square} - \frac{B_i}{\square}\right]\right]$$

$$\left| \phi \right. \quad \left\lfloor B_{mix} \quad \backslash \quad \text{''''/} \quad 2\sqrt{2 \cdot B_{mix}} \left\lfloor A_{mix} \quad B_{mix} \right\rfloor \right\rfloor$$

First Data Set

$$x := \begin{pmatrix} 0.0290 \\ 1 - 0.0290 \end{pmatrix} \qquad y := \begin{pmatrix} 0.2789 \\ 1 - 0.2789 \end{pmatrix} \qquad P := 77.22$$

$$\phi_V(y, P) = \begin{pmatrix} 1.401 \\ 0.57 \end{pmatrix} \qquad \phi_L(x, P) = \begin{pmatrix} 10.984 \\ 0.412 \end{pmatrix}$$

$$\phi_V(y, P)_1 \cdot y_1 = 0.391 \qquad \phi_L(x, P)_1 \cdot x_1 = 0.319$$

$$\phi_V(y, P)_2 \cdot y_2 = 0.411 \qquad \phi_L(x, P)_2 \cdot x_2 = 0.4$$

Second Data Set

$$x := \begin{pmatrix} 0.1026 \\ 1 - 0.1026 \end{pmatrix} \qquad y := \begin{pmatrix} 0.4796 \\ 1 - 0.4796 \end{pmatrix} \qquad P := 153.67$$

$$\phi_V(y, P) = \begin{pmatrix} 1.364 \\ 0.419 \end{pmatrix} \qquad \phi_L(x, P) = \begin{pmatrix} 5.703 \\ 0.246 \end{pmatrix}$$

$$\phi_V(y, P)_1 \cdot y_1 = 0.654 \qquad \phi_L(x, P)_1 \cdot x_1 = 0.585$$

$$\phi_V(y, P)_2 \cdot y_2 = 0.218 \qquad \phi_L(x, P)_2 \cdot x_2 = 0.22$$

Third Data Set

$$x := \begin{pmatrix} 0.1307 \\ 1 - 0.1307 \end{pmatrix} \qquad y := \begin{pmatrix} 0.5055 \\ 1 - 0.5055 \end{pmatrix} \qquad P := 192.53$$

$$\phi_V(y, P) = \begin{pmatrix} 1.406 \\ 0.367 \end{pmatrix} \qquad \phi_L(x, P) = \begin{pmatrix} 4.801 \\ 0.213 \end{pmatrix}$$

$\phi_V(y, P)_1 \cdot y_1 = 0.711$ $\phi_L(x, P)_1 \cdot x_1 = 0.628$

$\phi_V(y, P)_2 \cdot y_2 = 0.181$ $\phi_L(x, P)_2 \cdot x_2 = 0.185$