$ORIGIN := 1$

$T := 373.15$ $\quad P := 30$

$n := 2$

$i := 1 .. n$ $\quad j := 1 .. n$

$T_c := \begin{pmatrix} 190.6 \\ 305.3 \end{pmatrix}$ $\quad P_c := \begin{pmatrix} 46.1 \\ 49 \end{pmatrix}$ $\quad \omega := \begin{pmatrix} 0.011 \\ 0.099 \end{pmatrix}$ $\quad y := \begin{pmatrix} 0.35 \\ 0.65 \end{pmatrix}$

$R := 83.14$ $\quad k := \begin{pmatrix} 0 & -0.003 \\ -0.003 & 0 \end{pmatrix}$

$T_{r_i} := \frac{T}{T_{c_i}}$ $\quad P_{r_i} := \frac{P}{P_{c_i}}$

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

$A_{i,\,i} := 0.45724 \cdot \left[\frac{P_{r_i}}{\left(T_{r_i}\right)^2}\right] \cdot \alpha_i$ $\quad B_i := 0.07780 \cdot \left(\frac{P_{r_i}}{T_{r_i}}\right)$

$A_{i,\,j} := \left(1 - k_{i,\,j}\right) \cdot \sqrt{A_{i,\,i} \cdot A_{j,\,j}}$

$A_{mix} := \sum_i \sum_j \left(y_i \cdot y_j \cdot A_{i,\,j}\right) = 0.121$ $\quad B_{mix} := \sum_i \left(y_i \cdot B_i\right) = 0.034$

$p := -1 + B_{mix}$ $\quad q := A_{mix} - 3 \cdot B_{mix}^2 - 2 \cdot B_{mix}$ $\quad r := -A_{mix} \cdot B_{mix} + B_{mix}^2 + B_{mix}^3$

$M := X^3 + p \cdot X^2 + q \cdot X + r \;\Big|\; \begin{matrix} \text{solve} \\ \text{assume}, X = \text{real} \end{matrix} \rightarrow 0.91564815744609433811$

$Z := \max(M) = 0.916$

$C := \frac{Z + \left(1 + \sqrt{2}\right) \cdot B_{mix}}{Z + \left(1 - \sqrt{2}\right) \cdot B_{mix}}$

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

$$\phi = \begin{pmatrix} 0.986 \\ 0.883 \end{pmatrix}$$

$$f_i := y_i\cdot P\cdot\phi_i$$

$$f = \begin{pmatrix} 10.357 \\ 17.217 \end{pmatrix}$$

Alternative Solution

$$T_c := \begin{pmatrix} 190.6 \\ 305.3 \end{pmatrix} \qquad P_c := \begin{pmatrix} 46.1 \\ 49 \end{pmatrix} \qquad \omega := \begin{pmatrix} 0.011 \\ 0.099 \end{pmatrix} \qquad y := \begin{pmatrix} 0.35 \\ 0.65 \end{pmatrix}$$

$$k := \begin{pmatrix} 0 & -0.003 \\ -0.003 & 0 \end{pmatrix}$$

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

$$\phi(T, P) :=$$

$n \leftarrow 2$

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 $j \in 1 .. n$

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

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

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

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

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

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

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

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

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

$$\phi(T, P) = \begin{pmatrix} 0.986 \\ 0.883 \end{pmatrix}$$