Here is a polynomial for which i need a mathematical proof that it is non-negative:

$$\mathbf{C_2} = \left(\alpha\,\psi + \beta\,\theta + \gamma\,(\theta + \psi)\right)^2 - 4\,(\alpha + \beta + \gamma)\,\gamma\,\psi\,\theta \qquad (\mathbf{??})$$

Through some tedious math I can show that $\mathbf{C_2}$ satisfies the identity

$$(\alpha + \gamma)^2\,\frac{\mathbf{C_2}}{\theta^{\mathbf{2}}} = 4\,\alpha\,\beta\,\gamma\,(\alpha + \beta + \gamma) + \left((\alpha + \gamma)^2\,\frac{\psi}{\theta} + \alpha\,\beta - (\alpha + \beta + \gamma)\,\gamma\right)^2 \quad (1)$$

The proof consists in writing $\mathbf{C_2}$ in the form

$$\frac{\mathbf{C_2}}{\theta^{\mathbf{2}}} = E_0 + E_1\,\tau + E_2\,\tau^{\mathbf{2}}$$

with

$$E_0 = (\beta + \gamma)^2 \quad (2)$$

$$E_1 = 2\,(\alpha\,\beta - \alpha\,\gamma - \beta\,\gamma - \gamma^{\mathbf{2}}) = 2\,\left(\alpha\,\beta - (\alpha + \beta + \gamma)\,\gamma\right) \quad (3)$$

$$E_2 = (\alpha + \gamma)^2 \quad (4)$$

and then re-write it in the form

$$\mathbf{C_2} = E + F\,(\tau - G)^2$$

where all three polynomials E, F, and G do not contain τ. Then I tried to use SymPy for this proof with the following code included in the same zip file: The output of the `sympy.pprint` command is

$$\mathbf{C_2} = -\gamma\,\tau\,\theta^{\mathbf{2}}\,(4\,\alpha + 4\,\beta + 4\,\gamma) + (\alpha\,\tau\,\theta + \beta\,\theta + \gamma\,(\tau\,\theta + \theta))^2$$

which can be re-written as

$$\mathbf{C_2} = -4\,\gamma\,\tau\,\theta^{\mathbf{2}}\,(\alpha + \beta + \gamma) + \theta^{\mathbf{2}}\,\left((\alpha + \gamma)\,\tau + \beta + \gamma\right)^2$$

This has the form

$$\mathbf{C_2} = E + F\,(\tau - G)^2$$

but whereas decomposition I used for my proof required that all threee polynomials E, F, and G do not contain τ, the above $E = -4\,\gamma\,\tau\,\theta^{\mathbf{2}}\,(\alpha + \beta + \gamma)$ does contain τ. I think this is a design error in the `sympy.collect` command.