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

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

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

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

Since the rhs is obviously non-negative this is the proof I need. The proof introduces the new parameter $\tau = \psi/\theta$ and shows that $\mathbf{C_2}/\boldsymbol{\theta^2}$ can be written in the form

$$\frac{\mathbf{C_2}}{\boldsymbol{\theta^2}} = A_0 + A_1\,\tau + A_2\,\boldsymbol{\tau^2}$$

with

$$A_0 = (\beta + \gamma)^2 \tag{3}$$
$$A_1 = 2\,\left(\alpha\,\beta - (\alpha + \beta + \gamma)\,\gamma\right) \tag{4}$$
$$A_2 = (\alpha + \gamma)^2 \tag{5}$$

and re-writes it in the form

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

where all three polynomials E, F, and G do not contain τ. This gives (2).

I tried to use `SymPy` for this proof with the `python3` code `20200910_sympy.py` submitted at the same time.

```
import sympy
sympy.init_printing(use_unicode=True)

alpha,beta,gamma,psi,theta,tau,CCC_2 = \
    sympy.symbols('alpha_beta_gamma_psi_theta_tau_CCC_2')

psi=theta*tau

CCC_2 = (alpha*psi+beta*theta+gamma*(psi+theta))**2 \
        -4*(alpha+beta+gamma)*gamma*psi*theta

sympy.pprint(sympy.collect(CCC_2, tau))
```

The output of the `sympy.pprint` command is

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

which can be re-written as

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

This is similar to (2) but has one important difference: It can be re-written in the form

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

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