Example for using the Python/SymPy tool chain with the signalflowgrapher

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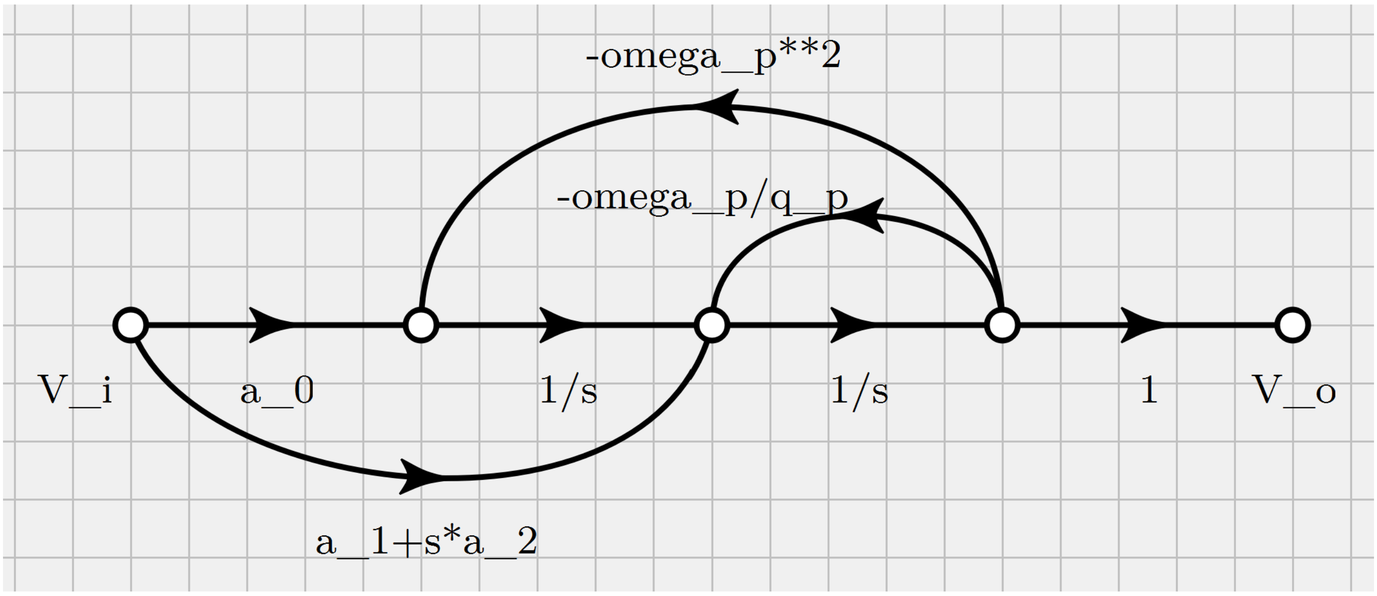
Draw a signal-flow graph

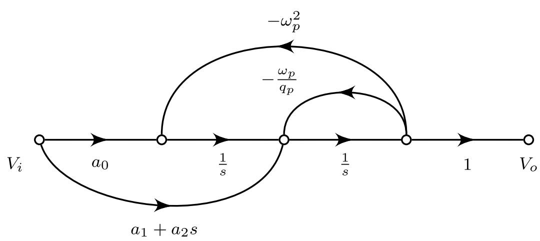
signalflowgrapher file `sfg.json`

Screen shot:



Nice vector graphics for documentation / Jupyter notebooks

If you want it to look nicer, save as TikZ, translate with pdflatex to a pdf, and if you need it, make an svg from it with pdf2svg:



Evaluate Mason in signalflowgrapher and paste code to Jupyter notebook

In [1]:
```
import sympy as sp
Delta = sp.symbols('Delta')
L1,L2 = sp.symbols('L1,L2')
T_num = sp.symbols('T_num')
T_den = sp.symbols('T_den')
T_io = sp.symbols('T_io')
q_p,a_0,omega_p,a_1,a_2,s = sp.symbols('q_p,a_0,omega_p,a_1,a_2,s')

loops = [(L1, -omega_p**2/s**2), (L2, -omega_p/(q_p*s))]
determinant = [(Delta, -L1 - L2 + 1)]
denominator = [(T_den, Delta)]

P1,D1,P2,D2 = sp.symbols('P1,D1,P2,D2')
paths = [(P1, (a_1 + a_2*s)/s), (D1, 1), (P2, a_0/s**2), (D2, 1)]
numerator = [(T_num, D1*P1 + D2*P2)]

transfer_function = [(T_io, T_num/T_den)]
T=T_io.subs(transfer_function).subs(numerator).subs(denominator).subs(determinant).subs(paths).sub
s(loops).simplify()
display(T)
```

$$\frac{q_p\left(a_0 + s\left(a_1 + a_2 s\right)\right)}{\omega_p^2 q_p + \omega_p s + q_p s^2}$$

Nicer expression with hanspitools

pip install hanspitools

In [2]:
```
import hanspitools as ht
```

In [3]:
```
ht.mani.numden(lambda p: ht.mani.nicepoly(p,s),T)
```

Out[3]:

$$\frac{a_0 q_p + a_1 q_p s + a_2 q_p s^2}{\omega_p^2 q_p + \omega_p s + q_p s^2}$$

Insert numbers and plot bode diagram

In [4]:
```
import numpy as np
```

In [5]:
```
target = [(a_0,1),(a_1,0),(a_2,0),(omega_p,1),(q_p,5)]
wn = 10.0**np.arange(-2,2,0.01)
```

In [6]:
```
T_a = ht.freq.amplitude(T,s,wn,target)
T_p = ht.freq.phase(T,s,wn,target)
```

In [7]:
```
%matplotlib notebook
import matplotlib.pyplot as plt
```

In [8]:
```
fig, ax1 = plt.subplots()

color = 'tab:blue'
ax1.set_xlabel('$\omega$ in rad/sec')
ax1.set_ylabel('$|T|$', color=color)
ax1.loglog(wn, T_a, color=color)
ax1.tick_params(axis='y', labelcolor=color)

ax2 = ax1.twinx()  # instantiate a second axes that shares the same x-axis

color = 'tab:red'
ax2.set_ylabel('$\phi$ in degrees', color=color)  # we already handled the x-label with ax1
ax2.plot(wn, T_p, color=color)
ax2.tick_params(axis='y', labelcolor=color)

fig.tight_layout()  # otherwise the right y-label is slightly clipped
plt.show()
```