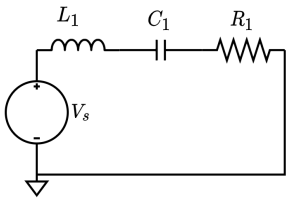
Resistor-Inductor-Capacitor circuits

1. Series RLC

```
circuit = Circuit('circuits/rlc_series.txt');
circuit.list
```

```
ans =
    'Vin 1 0 DC 5
     R1 3 0 1000
     L1 1 2 1
     C1 2 3 0.0001
     '
```




```
ELAB.analyze(circuit)
```

```
Symbolic analysis successful (0.300184 sec).
```

Say, you want expressions for node voltages.

```
circuit.symbolic_node_voltages
```

```
ans =
```

$$\begin{pmatrix} v_1 = \mathrm{Vin} \\ v_2 = \dfrac{\mathrm{Vin}\ (C_1 R_1 s + 1)}{C_1 L_1 s^2 + C_1 R_1 s + 1} \\ v_3 = \dfrac{C_1 R_1\ \mathrm{Vin}\ s}{C_1 L_1 s^2 + C_1 R_1 s + 1} \end{pmatrix}$$

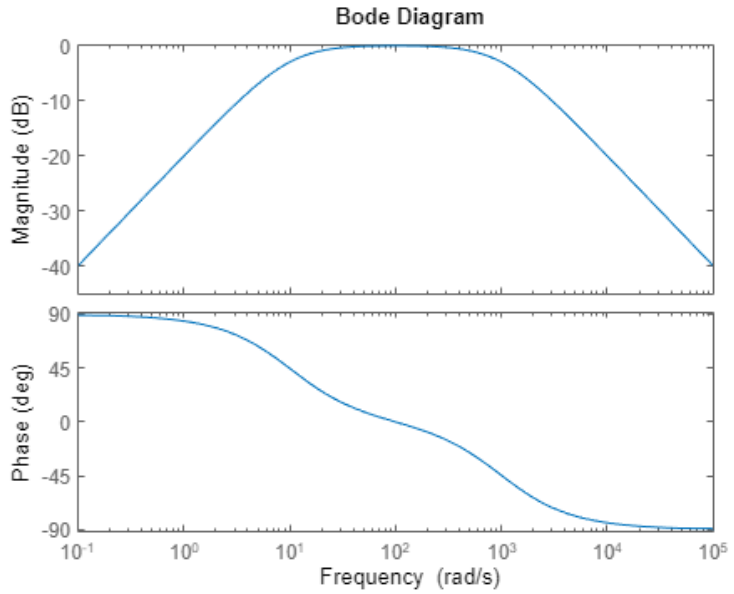
From the circuit, you can easily create a transfer function object, only giving the input and output nodes.

```
TF = ELAB.ec2tf(circuit, 1, 3)
```

```
Numerical evaluation successful (0.0717553 sec).
Transfer function object created successfully (1.429922e-01 sec).

TF =

         1000 s
  --------------------
  s^2 + 1000 s + 10000

Continuous-time transfer function.
```

Matlab can then be used to visualize the circuit behavior as with any other system. Plotting the Bode diagram, we see that this circuit acts as a band-pass-filter.

```
bode(TF)
```

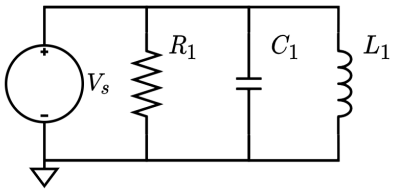


2. Parallel RLC

We can repeat the process to look at RLC in parallel.

```
circuit = Circuit('circuits/rlc_parallel.txt');
circuit.list
```

```
ans =
    'Iin 1 0 DC 2
     R1 1 0 1000
     L1 1 0 1
     C1 1 0 0.0001
     '
```




```
ELAB.analyze(circuit)
```

```
Symbolic analysis successful (0.173233 sec).
```

```
ELAB.evaluate(circuit)
```

```
Numerical evaluation successful (0.0413398 sec).
```

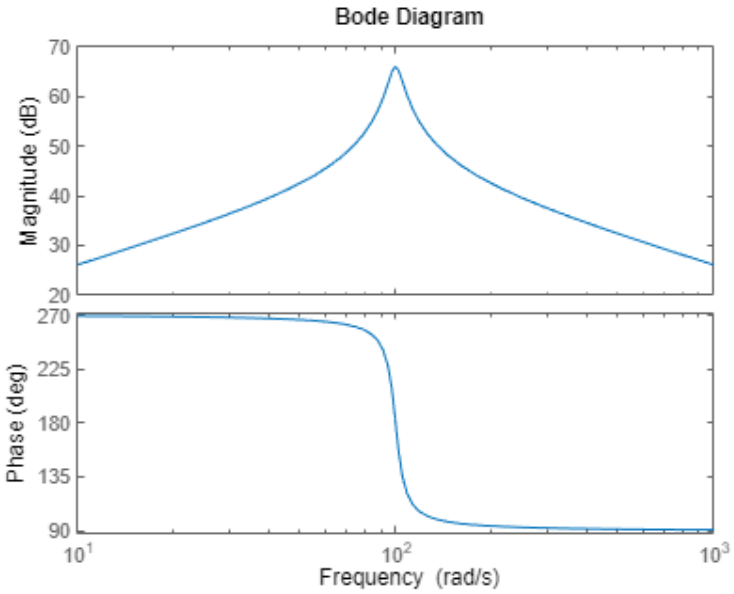
In this case, because there is only one node besides ground, the transfer function is just the voltage at node 1.

You can of course input the equation directly into Matlab's transfer function. Plotting the Bode diagram show that this configuration acts as a frequency isolator.

```
TF = ELAB.sd2tf(rhs(circuit.numerical_node_voltages(1)))
```

```
TF =

       -20000 s
  ------------------
  s^2 + 10 s + 10000

Continuous-time transfer function.
```

```
bode(TF)
```

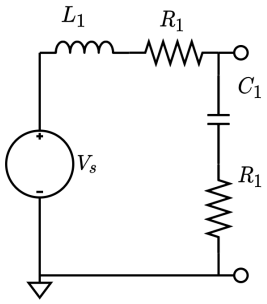


Feel free to try any combination of resistors, capacitors and inductors.

3. Arbitrary RLC-circuits

```
circuit = Circuit('circuits/rlc_mix.txt');
circuit.list
```

```
ans =
    'Vs 1 0 AC Vs
     R1 2 3 1000
     R2 4 0 1000
     L1 1 2 0.01
     C1 3 4 0.0000001
     '
```



```
ELAB.analyze(circuit)
```

```
Symbolic analysis successful (0.459353 sec).
```

```
ELAB.ec2sd(circuit,1,3)
```

```
Symbolic transfer function calculated successfully (5.369800e-03 sec).
ans =
```

$$\frac{v_3}{v_1} = \frac{C_1 R_2 s + 1}{C_1 R_1 s + C_1 R_2 s + C_1 L_1 s^2 + 1}$$

```
bode(ELAB.ec2tf(circuit,1,3))
```

```
Numerical evaluation successful (0.117279 sec).
Transfer function object created successfully (1.535527e-01 sec).
```