

Inheritance, Overriding and Dynamic Binding


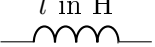
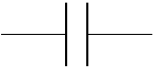

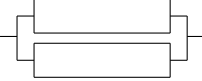
Prog1, Scala, L3

2015

1 Electrical Dipoles

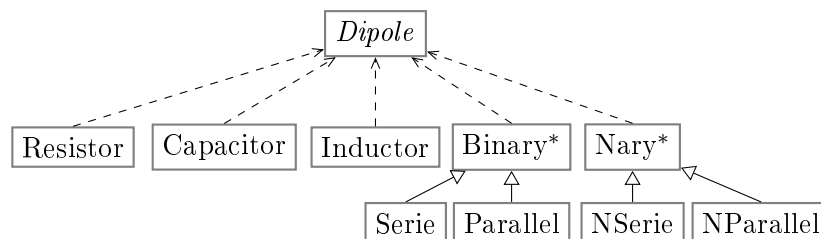
Every electrical circuit is composed of differing components such as resistors, capacitors, diodes and electromagnetic coils. They can be assembled in either series or parallel circuits. Depending on their component, each circuit present a specific resistance to the current when a voltage is applied. The **impedance** extends this notion of resistance to alternating currents.

Given ω the angular frequency of the current, the impedance z of the circuit can be computed as follows (with the constant $i = 1\angle\frac{\pi}{2} = e^{j\frac{\pi}{2}}$).

Symbol	Description	Impedance
r in Ω 	A resistor of value r expressed in ohms (noted Ω)	$z = r$
l in H 	An inductor of value l expressed in henries (noted H)	$z = i(\omega * l)$
c in F 	A capacitor of value c expressed in farad (noted F)	$z = i(\frac{-1}{\omega * c})$
	A serie circuit with 2 dipoles of impedance z_1 and z_2	$z = z_1 + z_2$
	A parallel circuit with 2 dipoles of impedance z_1 and z_2	$z = \frac{1}{\frac{1}{z_1} + \frac{1}{z_2}}$

1.1 Modeling Dipole

We will use the following class hierarchy to model the electrical dipoles.

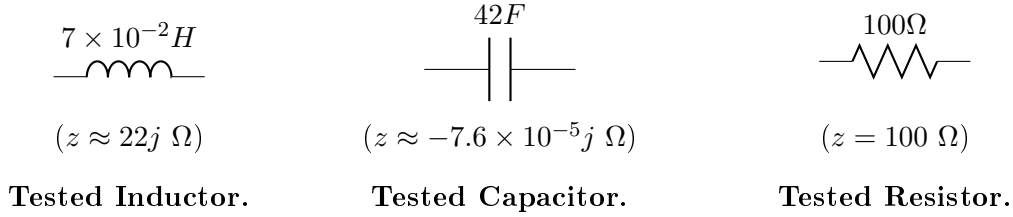


The *Dipole* trait provides an abstract method `impedance(omega:Double):Complex`, implemented in each concrete class of the hierarchy. The parameter `omega` represents the angular frequency of the current. The impedance is a complex number (only resistors have a real impedance).

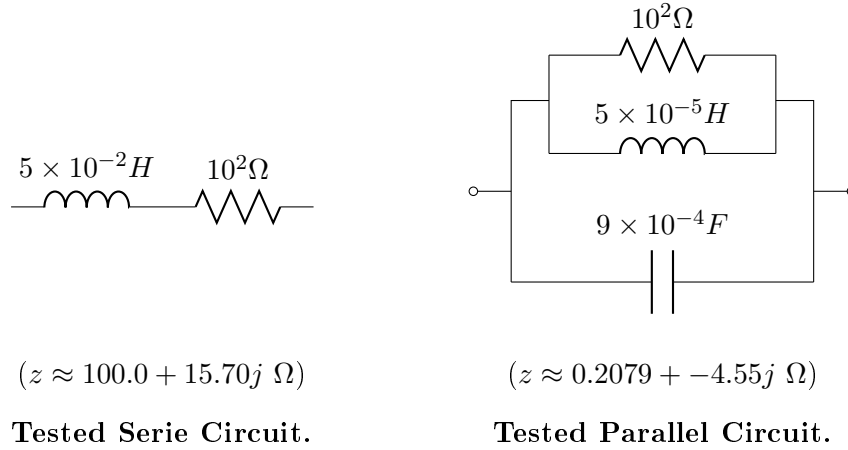
1.2 Implementing Dipole

Download and unpack the [provided code](#) to your local disk. Rename the `template` directory to `src`¹, open the sources with your favorite editor (or `geany` if you have no favorite editor yet). The provided code contains a `build.sbt` file for easy compilation, as well as a set of unit tests checking the features that you should implement. You should run the tests often during your work² to track your progress. Of course, the tests for a given feature will fail until you implement that feature.

▷ **Question 1:** We will first implement the simple dipoles. Fill the classes `Resistor`, `Capacitor` and `Inductor` in file `src/main/scala/dipole/SimpleDipoles.scala` to pass the first set of tests. You have to implement both `impedance()` and `toString()`.



▷ **Question 2:** We will now implement the binary circuits, either built in parallel or in serie. Check your implementation with the provided tests, that use the following circuits.



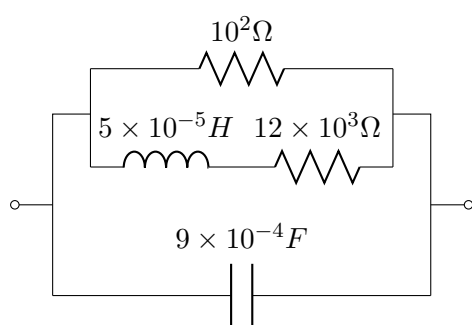
▷ **Question 3:** We will now implement N-ary circuits. The impedance of a serie circuit is simply given by $\sum_{i=1}^n \omega_i$ while the impedance of a parallel circuit is given by $\frac{1}{\sum_{i=1}^n \frac{1}{\omega_i}}$.

Note that you also have to implement a `Nary.::(head:Dipole)` method, enabling to build a new circuit by appending a dipole to the currently defined one.

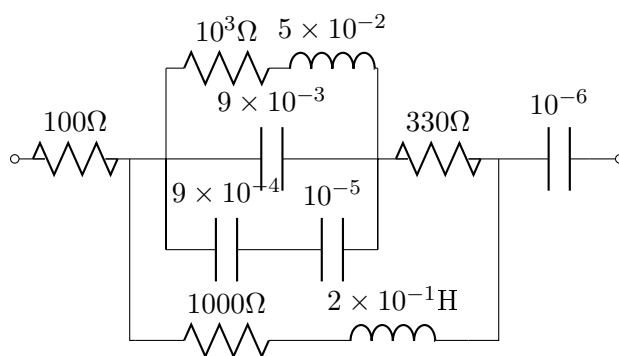
▷ **Question 4:** You will now fill the file `src/main/scala/dipole/Instances.scala` to define the following instances of dipoles:

¹mv template src

²sbt test



The dip1 dipole.



The dip2 dipole.