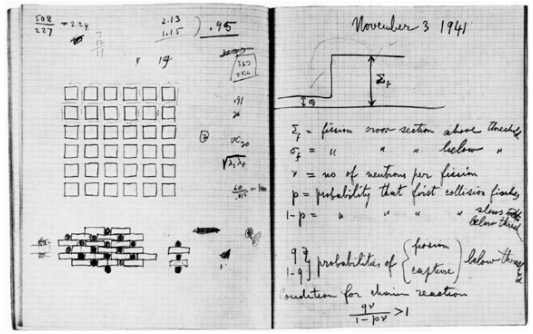
Using the IPython Notebook as Lab Notebook

Juergen Hasch

The lab notebook is a scientist's most valuable tool



The IPython / Jupyter notebook enables a similar workflow:

- Easy to use, just start scribbling your notes
- Add text, formulas, graphics, plots and do calculations
- Works for different programming languages
- Highly flexible and extendible

IPython extensions

e.g. input transformers for units:

```
In [1]: 1m + 10 cm
Out[1]: 1.1 m
```

Notebook extensions

e.g. Python code in markdown

```
In [15]: a = 2.123
```

The variable a is 2.123.

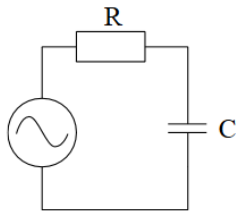
```
In [16]: b=Latex(r'$b = \frac{\epsilon}{2}$')
```

You can also embed Latex: $b = \frac{\epsilon}{2}$ in here!

Example

Example: Calculating an RC Circuit

We have a simple RC circuit, consisting of a voltage source U_0, a resistor with a value R and a capacitor with value C:



Let's start with calculating the capacitance of a simple parallel plate capacitor:

$$C = \frac{\epsilon_0 \cdot \epsilon_r \cdot A}{d}$$

In [1]:

```
%precision 2
A = 1 mm * 1 mm # Plate area
d = 1 um        # Plate distance
εr = 3       # Permittivity of dielectric material
C  = (eps0*εr*A) / d
```

The capacity is C=26.56 pF

The resistor is a thick film resistor:

$$R_s = \frac{\rho}{t} \quad , \quad R = R_s \cdot \frac{L}{W}$$

In [2]:

```
ρ = 10 Ohm * 1 mm # Material resistivity
t = 10 um         # Sheet thickness
L = 150 um        # Structure length
W = 10 um         # Structure width
Rs = ρ / t
R = Rs * L / W
```

Resistor value R = 15.00 kOhm

Calculate transient response of circuit

In [3]:

```
u0 = 1 V
tau = 1/(R*C)
t = pq.linspace(0,4/tau,100).us
```

In [4]:

```
i0 = u0/R
i = (i0*e**(-t*tau)).uA
```

The initial current is i_0 = 66.67 µA

Plot Current and Voltage over Time

In [5]:

```
plot(t.us_,i.uA_)
grid()
title('Circuit Current')
xlabel('Time in %s' % t.unit)
ylabel('Current in %s' %  i.unit);
```