Handy Fitting One Page "Cheat Sheet"

Fitting data with `scipy.optimize.curve_fit` is a good approach when you have noisy measurements of a quantity (call it y) at times or positions x, and a model that gives y as a function of x and some other parameters. For example, letting $x = t$, the height of a ball is

$$y(t, y_0, v_0, a) = y_0 + v_0 t + \frac{1}{2} a t^2. \tag{1}$$

If I have such a model, I can **first define my function as a model with x or t as the first argument, e.g.**

```
def model(t, y0, v0, a):
    return y0 + v0*t + 0.5*a*t**2
```

If I then have:

1. An array of measured values `y`
2. An array of measurement times/positions `t`
3. An array of uncertainties `uncertainty` on my measurements `y`

I can get the best-fit parameters and their uncertainties using

```
import numpy as np
from scipy import optimize
bestpar, covariance = optimize.curve_fit(model, t, y, sigma=uncertainty)
bestpar_uncertainty = np.sqrt(np.diag(covariance))
```

There are a couple more arguments to `curve_fit` that you might find useful:

- `p0=[par1guess, par2guess, ...]` Use this to supply initial guesses for your parameter values. You usually won't need this.
- `absolute_sigma` Set this to `True` to tell `curve_fit` to trust your measurement uncertainties. Setting this to `True` will not change your best-fit parameters, but it will change the uncertainties on your best-fit parameters.

Sometimes you might like to fit a model with more than one independent variable, for example

$$y(t, x, y_0, v_0, a, \gamma) = y_0 + v_0 t + \frac{1}{2} a t^2 + \gamma x \tag{2}$$

with independent variables x and t. In this case, you can use

```
def model(ind_vars, y0, v0, a, gamma):
    t, x = ind_vars
    return y0 + v0*t + 0.5*a*t**2 + gamma*x
```

and call `curve_fit` with

```
bestpar, covariance = optimize.curve_fit(model, [t, x], y, sigma=uncertainty)
```

There is certainly more to `curve_fit`, and to fitting a model in general, than we have discussed here. You'll probably see some of it in a statistics class if you take one. The brief summary above, though, will hopefully be useful to you in lab classes here and beyond.