Practice 3.1

Practice sheets are not assessed. The intention is to use material from lectures in preparation for Competence tests and Assignments. You are encouraged to use `thing.[TAB]` and `thing?` in IPython.

Please review Lecture 3.1, sections on Random Numbers and Generators, the latter for solving differential equations of the form $\dot{x} = f(x)$.

Gaussian random numbers

The velocity distribution of gas molecules at thermal equilibrium is independent Gaussians for v_x, v_y, and v_z.

Using `randn` and `hist`, plot the **speed** distribution for gas molecules whose Gaussian width is $300\,\mathrm{m/s}$ in each direction.

What is the average **speed**?

Differential equations

Here's a trivial **generator** which makes the squared numbers up to some specified maximum:

```
def gen(N):
    for n in range(N):
        yield n**2

a = gen(10)
next(a), next(a), next(a), next(a), next(a)
```

```
(0, 1, 4, 9, 16)
```

A generator is like a function, except `yield` instead of `return`, and a generator **picks up where it left off** when you ask it for another value using `next`.

Generators are a convenient structure for solving differential equations of the form $\dot{x} = f(x)$. The simplest numerical method for this form of equation is **Euler's method**.

Here's Euler's method as a generator:

```
def euler(f, x0, dt):
    xn = x0
    while True:
        yield xn
        xn = xn + f(xn)*dt
```

Use it to solve the differential equation $\dot{x} = -\sin x$ with $x(0) = 3$ with time-step $\delta t = 0.1$, for $t \leq 0 \leq 10$.