Matrícula (First-name Last-name) **CK0030: Homework 01**

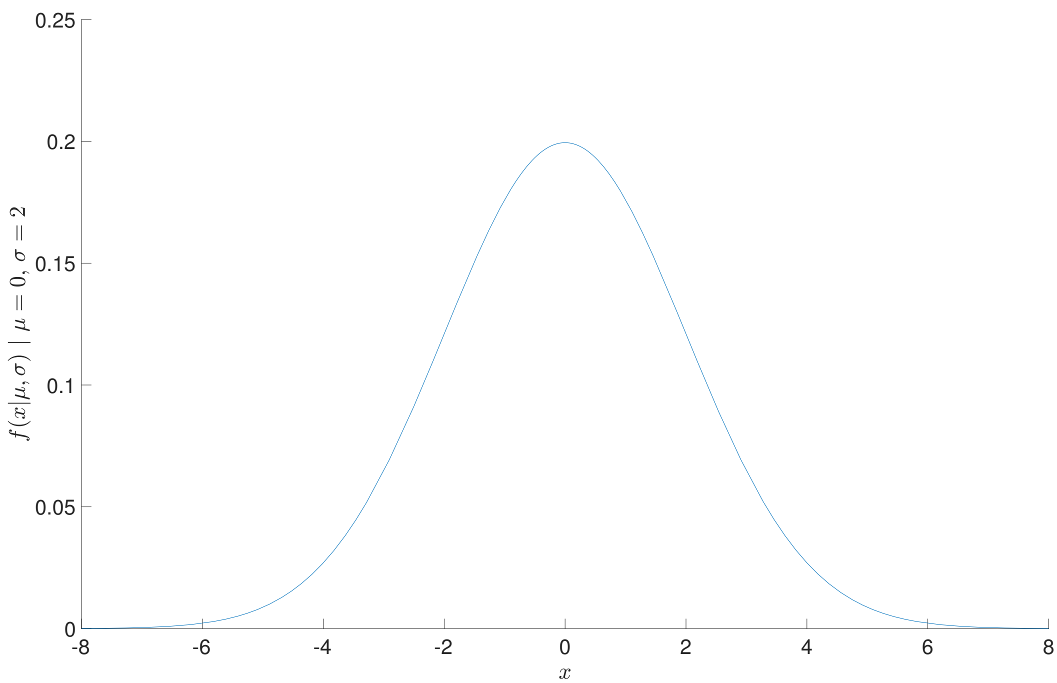
Exercise 1.1. How old will you be on Sunday April 23, 2017?

Express your age in *i*) centuries; *ii*) decades; *iii*) years; *iv*) months; *v*) days; *vi*) hours; *vii*) seconds; and *viii*) milliseconds. Write a program `my_age.py` (or a code snippet in a notebook) to answer the question: The code must contain the necessary arithmetics for converting your age, initially expressed in days (case *v*), into the other units, and printing the results to screen. For printing, choose an appropriate text format (both `printf` syntax and `string format` syntax can be used.)

[*Hint*]: For the sake of simplicity, assume that each month in the calendar has 30 days (all years will then be assumed to have 360 days.) You can also assume that you were born at 12:00 (mid-day.)

Exercise 1.2. Consider the Gaussian function $f(x|\mu,\sigma)$ with parameters μ and σ given by

$$f(x|\mu,\sigma) = \underbrace{\frac{1}{\sigma\sqrt{2\pi}}}_{a}\exp\Big[\underbrace{-\frac{1}{2}\Big(\frac{x-\mu}{\sigma}\Big)^2}_{b}\Big] = a(\sigma)\exp\Big[b(x|\mu,\sigma)\Big]. \quad (1)$$



The piece of code below was developed to evaluate the Gaussian at $x = 0.5$, when $\mu = 0$ and $\sigma = 2$

```
from math import sqrt, pi, exp

mu = 0
sigma = 2
x = 0.5
a = 1/sigma*sqrt(2*pi)
b = -0.5*(x-mu/sigma)**2
f = a*exp(b)

print '%.16f' % f
```

but, when executed to calculate $f(x = 0.5|\mu = 0, \sigma = 2)$, the printed result is `0.0000000000000000`.

The result is clearly wrong (see plot), explain why and show how to correct the code accordingly. Write a program `my_bell.py` (or a code snippet in a notebook) with a working version of the code.

Exercise 1.3. Write a program `my_identity.py` (or a code snippet in a notebook) that verifies the following mathematical identities. Whenever needed report/discuss potential rounding errors.

i) $1 = \log_a(a)$;

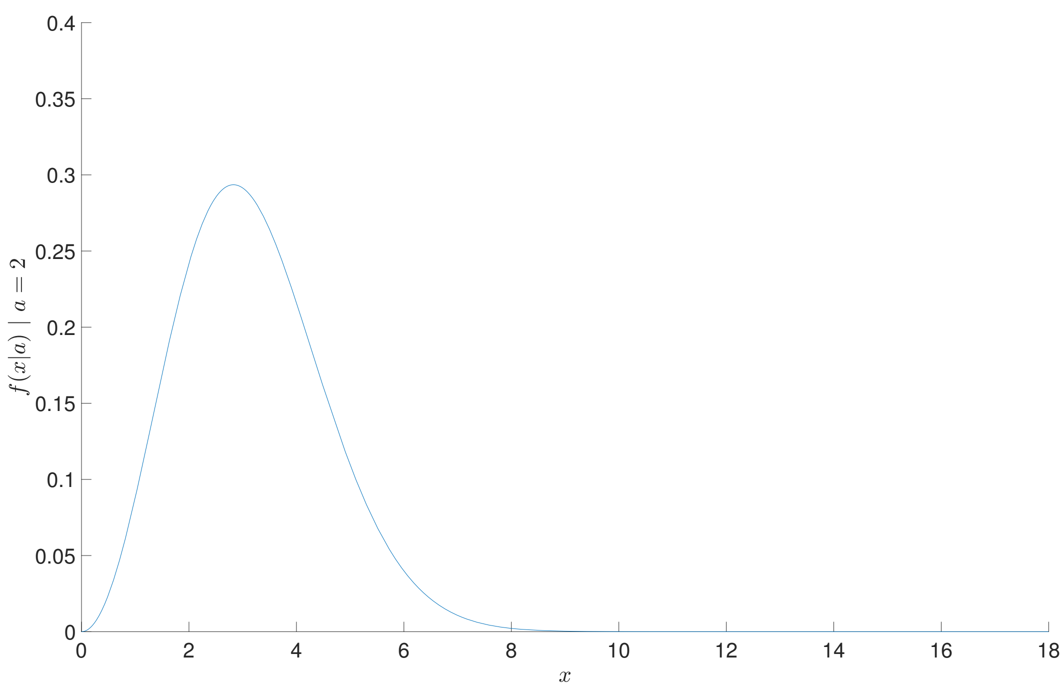
ii) $(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$;

iii) $\sin(a+b) = \sin(a)\cos(b) + \sin(b)\cos(a)$.

Exercise 1.4. The distribution of velocities x of the molecules of ideal gases is given by the form

$$\begin{aligned} f(x|a) &= \sqrt{\left(\frac{m}{2\pi kT}\right)^3} 4\pi x^2 \exp\left(-\frac{mx^2}{2kT}\right) \\ &= \sqrt{\frac{2}{\pi}}\left[\frac{x^2\exp\left(-\frac{x^2}{2a^2}\right)}{a^3}\right], \end{aligned} \tag{2}$$

m is the particle mass, T is the thermodynamic temperature and k is the Boltzmann's constant, $a = \sqrt{kT/m}$ is used to parameterise the function. Write a program `my_speed.py` (or a code snippet in a notebook) for evaluating the function $f(x|a)$ at $x \in \{0, 1, 2, 4, 8, 16\}$, when parameter $a = 2$.



[*Hint*]: To verify the correctness of the obtained results, you can use the plot of the function.

Instructions

[*Deadline*]: Submissions via SIGAA close Sunday April 23, 2017 at 23:59:59 (Fortaleza Time).

[*Delays*]: Delayed submissions via email to `rafa.olv.lima@gmail.com`. Delays will be penalised.

[*Solutions*]: You can write your solutions in either Portuguese or English language. Solutions must be submitted as PDF or Plain Text files; Other formats (`.doc`, `.docx`, `.rtf` etc.) will not be considered. The LaTeX template available at the course website is recommended, though not obligatory.

[*About code*]: If the code is short (i.e., at most 3-page long, overall), it is okay to paste it to your solution sheet. Otherwise, it is more appropriate to either package it (`zip`) together with your solution sheet, or provide a link in your submission for us to download it (Note: If you opt for the link, it is your responsibility/risk to make sure that the link is fully functioning also after deadline.)

[*Others*]: Collaborations and solutions inspired by other people's work will be tolerated only within the limits explained in the website. Plagiarism will not be tolerated and will be reported to the UFC.