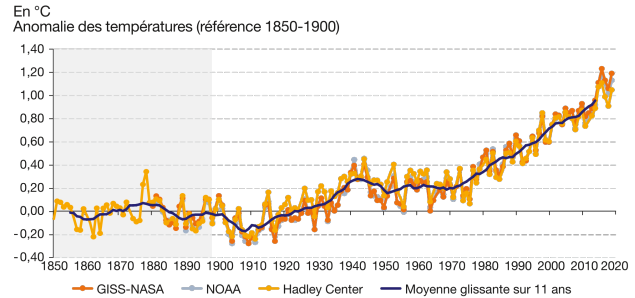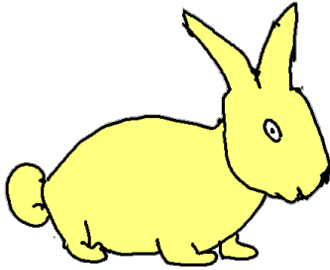# Our house is burning down and we're blind to it

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MACS205 – ODE

1 Motivation

My rabbit Bibi complains of being too hot. I told him he'd better go to the groomer to get his fleece cut but he replied that the problem is more fundamental: according to him, the climate is getting warmer!

If we listen to the IPCC, this would be due to the carbon cycle going haywire. On site `https://exchange.iseesystems.com/public/globeprogam/global-carbon-cycle-model-with-feedbacks/index.html` you can find a carbon cycle simulator. The equations seem correct but nothing says that the resolution algorithm used in this simulator is correct. In fact, I'm quite skeptical about the results and I'm afraid that environmental hackers have tampered with the results. I would preferr a program in which we control all the elements. It should indeed be ensured that what is calculated is in good agreement with reality. It seems that the concepts of consistency and stability are the key to guarantee the reliability of numerical methods...

I would need your help to confirm or refute the conclusions of the IPCC and to simulate the temperature variation for the years to come. Then we could check if we need to modify our carbon dioxyde emissions profile for Bibbi to stop complaining.

2 Learning Objectives

- Implement numerical methods for solving differential equations
- Explain the functions involved in a differential equation to study their properties
- Demonstrate the convergence of a numerical method
- Comparing the performance of numerical methods

3 Documents

- Handout
- Course Videos
- Worksheets
- File `carbone.py`

4 Deliverables

For Wednesday April 3rd, 2024 at 11:59 p.m., you will upload to e-campus:

- a presentation of 5 slides that describe your method and justify that it works correctly,
- the code of your numerical method in the language of your choice.

5 Roles

Activity leader

- Ensures that the group follows the planned steps
- Ensure that the important points of the discussion are noted by the secretary
- Facilitate discussion:
  - distributes the floor, encourages/seeks participation
  - moderates interventions
  - leads the group to clarify the ideas developed
  - if necessary, provide summaries of what was said or done

Scribe

- Note on the board the main points resulting from the exchanges (terms, points, questions, ideas, etc.): support and memory group discussion
- Do not filter graded information
- Organize the table according to the steps (so as to keep track of all the thinking not to wipe off).

Secretary

- Prepare a synthetic written record of the group's production
- Transmit this trace to all party members and the tutor.

Time keeper

- Ensures that the timing for each step and the general timing is respected: informs the group regularly (ex: we have 10 minutes left for this step)

6 Working plan

Step 1 - 5mn - Look at the document, organize the group, assign roles

Step 2 - 10mn - Read in detail and look at the equations

Common reading:

What questions does the subject raise?

In your opinion what are the important words of the subject?

Step 3 - 5mn - Understand and reformulate the problem

Summarize the identified problem (including deliverables) in written form

Appoint a rapporteur who will describe your summary.

Step 4 - 10mn- General sharing between all groups.

Step 5 - 15mn- Possible solutions

Generate possible ideas/actions to take to address the problem.

First individually for 5 minutes then shared within the group.

Step 6 - 10mn- Establish the necessary learning / the sub-problems to be addressed to answer the question

From the ideas and key words, draw up a list of learning to be carried out and sub-tasks to be completed. perform.

Learn about the resources available

Step 7 - 5mn - Establish an action plan

Distribute tasks taking into account time constraints.

Put this distribution in writing.

Personal work