An introduction to pyMarmote and pyMarmoteMDP for Markovian modeling
A tutorial
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In a nutshell

Objective of this tutorial :

- present the capabilities of the `Marmote` library via its Python interface : `pyMarmote/ pyMarmoteMDP`
- `pyMarmote` : constructing Markov chains on *discrete* state spaces, determining their structure, computing various distributions
- `pyMarmoteMDP` : constructing Markov Decision Processes with discrete state and action spaces, computing the optimal policy for various criteria.

Tutorial outline

Tutorial files (and more) are available at :

`https://marmote.gitlabpages.inria.fr/marmote/python_downloads.html`

Their contents is as follows :

File	Topic
`Lesson0.pdf`	Introduction to the world of `Marmote`
`pyMarmote` Markov Chains and their manipulation (A. Jean-Marie)	
`Lesson1.ipynb`	Making Markov Chains
`Lesson2.ipynb`	Solving Markov Chains
`Lesson3.ipynb`	Working with state spaces
`Lesson4.ipynb`	Working with distributions
`Lesson5.ipynb`	Predefined Markov Chains

Tutorial outline (ctd)

File	Topic
pyMarmoteMDP Markov Decision Processes and their manipulation (E. Hyon)	
MDP_Lesson1.ipynb	Discounted MDP
MDP_Lesson2.ipynb	Additional methods
MDP_Lesson3.ipynb	Average MDP and policy handling (*)
MDP_Lesson4.ipynb	Total Reward MDP with two-D state space (*)
An application (A. Jean-Marie and E. Hyon)	
App_Lesson1.ipynb	The hysteresis queue / performance
App_Lesson2.ipynb	A tandem multi server system / optimal control

If you want to test

By installing pyMarmote

If you want to test while we talk (or after)

`https://marmote.gitlabpages.inria.fr/marmote/python_downloads.html`

Two possibilities :

- by installing pyMarmote and before it by installing `conda` ;
- by using Google Colab. [Preferred way]

By installing marmote, you can

- Run the notebooks.
  download the `all_notebooks.zip` file on your own computer, extract and run the notebooks with `jupyter`.
- Run the commented python files issued from the notebooks, download the `all_pythons.zip` file on your own computer and run them with `python`.

If you want to test

Without installing pyMarmote

If you want to test while we talk (or after) and you have a Google account : you can use Google Colab.

- go to the web page above (Python downloads)
- download the `all_notebooks_collab.zip` file on your own computer
- open Google colab `https://colab.google/` with your google account
- upload the notebook that you want to use (or all notebooks at once)
- execute the downloaded notebook. Notice that running the first cells (which installs the software) can take up to 4 minutes.

Instructions, examples (C++ and Python) and documentation :

`https://marmote.gitlabpages.inria.fr/marmote`

Why Marmote ? What can you expect from it ?

At the root of Marmote, the observation that :

- Markov modelers (especially students !) often develop their Markov software from scratch : modeling and solution algorithms (including simulation)
- Even basic from-the-book solution algorithms are not readily available
- Solving (numerically) the models is not even the hardest part : setting up the model (matrix) without bugs is often a headache
- Not even the solution to standard models is available.

We hope Marmote will fill these gaps and explain how in various lessons.

Pedagogical objectives

The focus is not just on numerical solution techniques.

We also want to address the difficulties encountered when passing from the theoretical model to computer code.

We would like to highlight Marmote's ability to address these issues. Namely

- abstraction / object hierarchy
- *modeling* Markov chains with (complex) sets, transitions
- the `MarmoteMDP` package for MDP modeling

Caveats

Words of caution :

- The Python interfaces `pyMarmote` and `pyMarmoteMDP` are recent developments : bugs and crashes are still possible !
- Bug reports welcome !
- Suggestions for improvements welcome !
- Test cases/Challenges welcome !