



NagBody lectures: Iteration, recurrence and recursion

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Seminario de investigación,

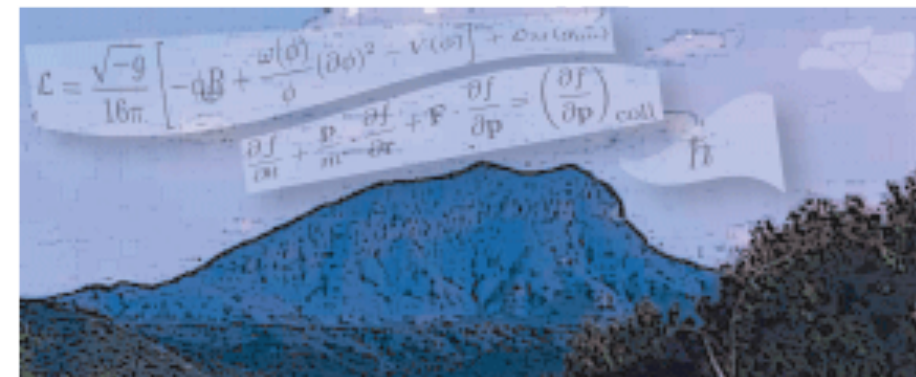
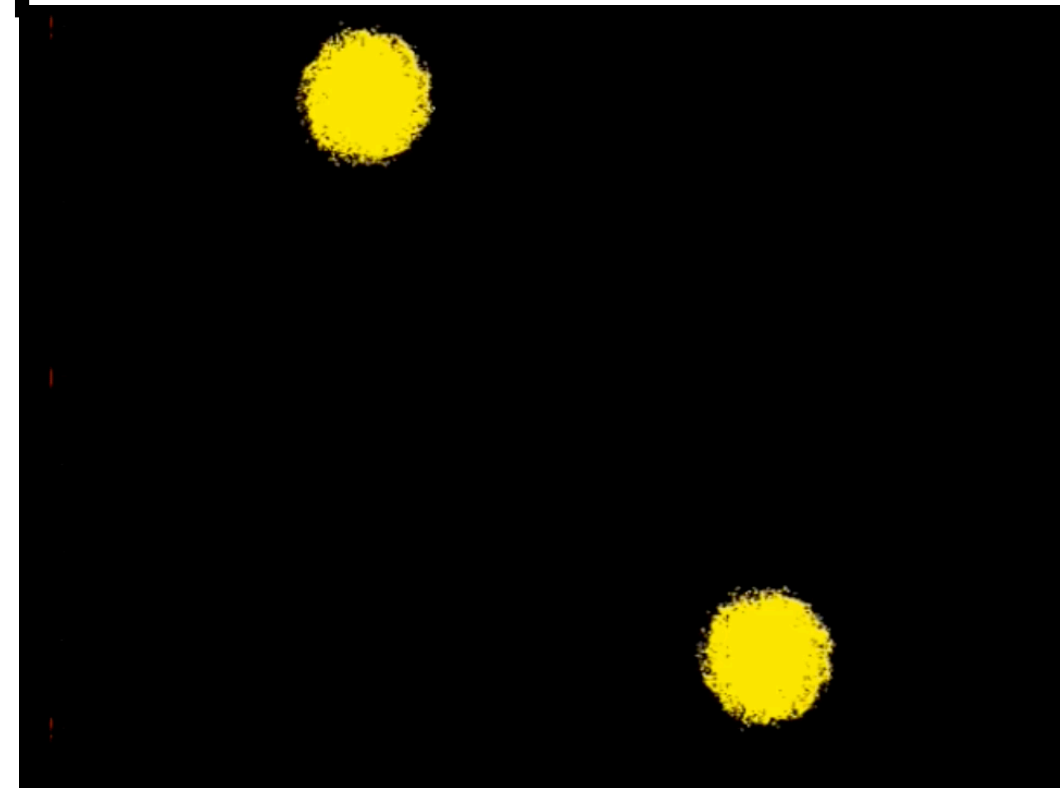
Departamento de Física,

Universidad de Guanajuato

3 de febrero al XX de junio de 2022

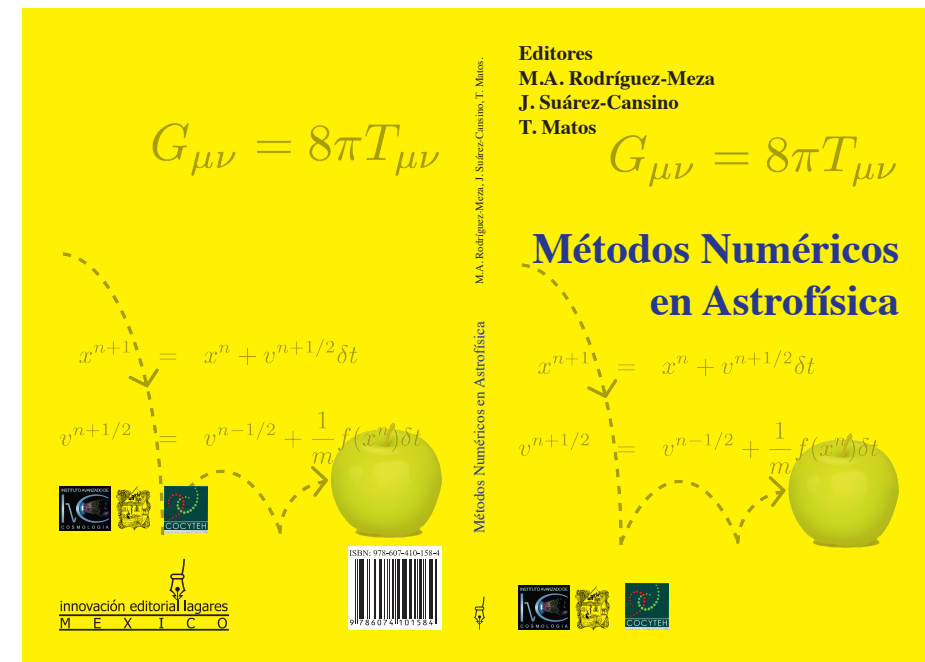
Sesiones virtuales (Zoom, Meet, etcétera)

quintessence
Group



References and material

- Cosmología numérica y estadística: NagBody kit (<http://bitbucket.org/rodriguezmeza>). Mario A. Rodríguez-Meza. And: https://github.com/rodriguezmeza/NagBody_lectures.git
- Métodos numéricos en astrofísica, capítulo I, Método de N-cuerpos en astrofísica. (https://www.researchgate.net/publication/316582859_Metodo_de_N-Cuerpos_en_Astrofisica)
- La estructura a gran escala del universo. Capítulo 22 en Travesuras cosmológicas de Einstein et al. https://www.researchgate.net/publication/316582400_La_estructura_a_gran_escala_del_universo_simulaciones_numericas
- https://www.researchgate.net/profile/Mario_Rodriguez-Meza
- https://www.researchgate.net/publication/314281416_Los_agujeros_negros_y_las_ondas_del_Dr_Einstein
- M.A. Rodríguez-Meza, Adv. Astron. 2012, 509682 (2012). arXiv: 1112.5201. (https://www.researchgate.net/publication/51967093_A_Scalar_Field_Dark_Matter_Model_and_Its_Role_in_the_Large-Scale_Structure_Formation_in_the_Universe)



Content:

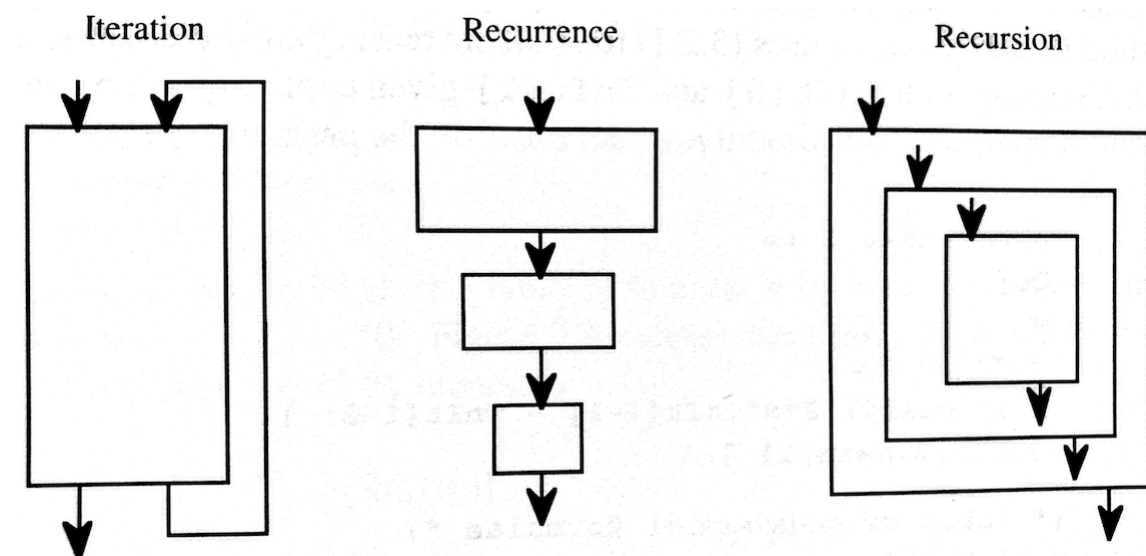
Recursion. Part II

- Iteration
- Recurrence
- Recursion



Concept of Iteration

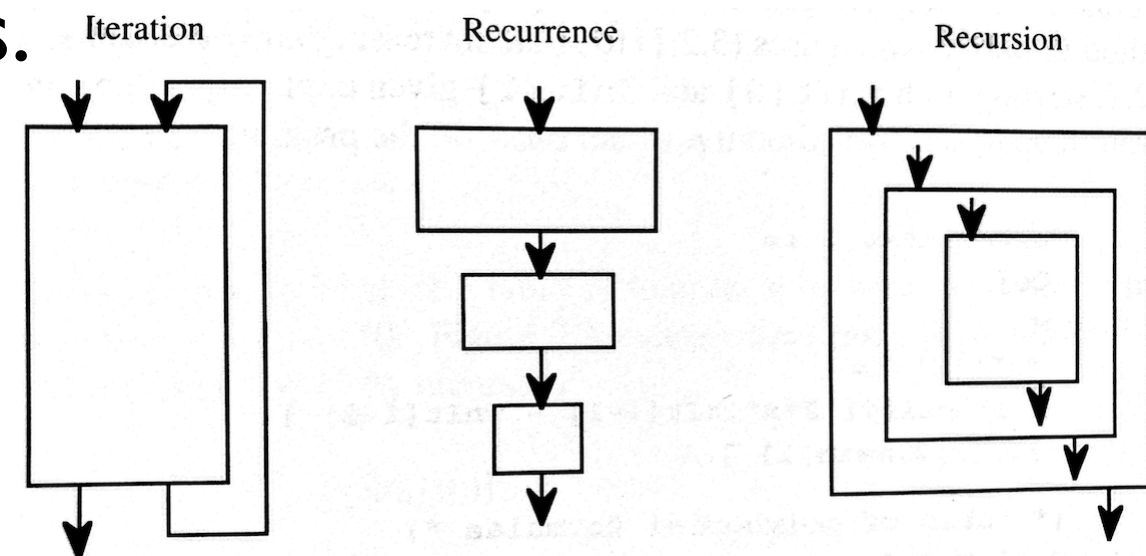
- In programming three different repetition patterns are distinguished: *Iteration*, *recurrence* and *recursion*.
- **Iteration**. Repetition of a numerical calculation, reusing the same algorithm, parameters, and perhaps memory locations, repeating calculation until a criterion, such as a convergence limit is satisfied.
- For example: Series.
- It is used: for and while loops.



Concept of Recurrence

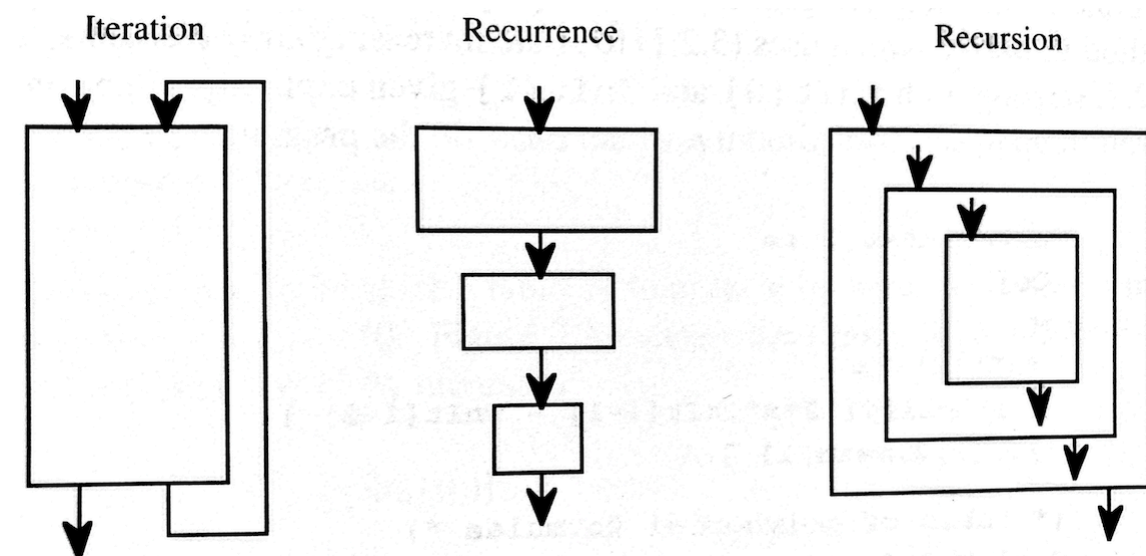
- **Recurrence.** A formula is used repeatedly to relate successive values of a function when a parameter changes by uniform steps.
- **Examples.** Power series terms. They are usually obtained by recurrence with respect to the number of the term in the series.
- In the figure. Procedure in each box is often the same.
- Only the value of a control parameter changes.

- Recurrence also requires a stopping criterion.
- Iteration and recurrence are very similar.



Concept of Recursion

- **Recursion.** A formula that refers to itself.
- In the figure each box has the same function.
- In C a copy of the function has to be saved for each recursion. The number of recursion must be finite.
- Must be a path out of each function copy.
- Remember there are two methods of recursion in C: basic and tail recursions.



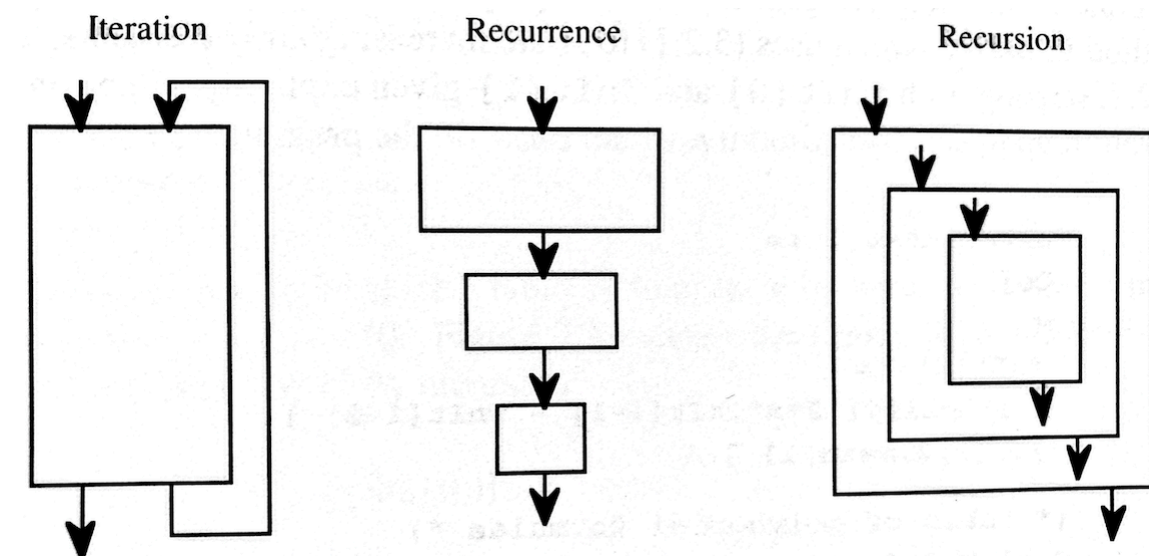
Concept of Recurrence

Homework: make program to compute the Chebyshev Polynomials in the three cases. Compare computing time.

- **Recurrence.** Recurrences are represented as recursive functions, a function that calls itself.
- Each successive call works on a more refined set of inputs, bringing us closer and closer to a solution.

$$T_0(x) = 1 \quad T_1(x) = x$$

$$T_n(x) = 2x T_{n-1}(x) - T_{n-2}(x)$$



Conclusions: Recursion. Part II

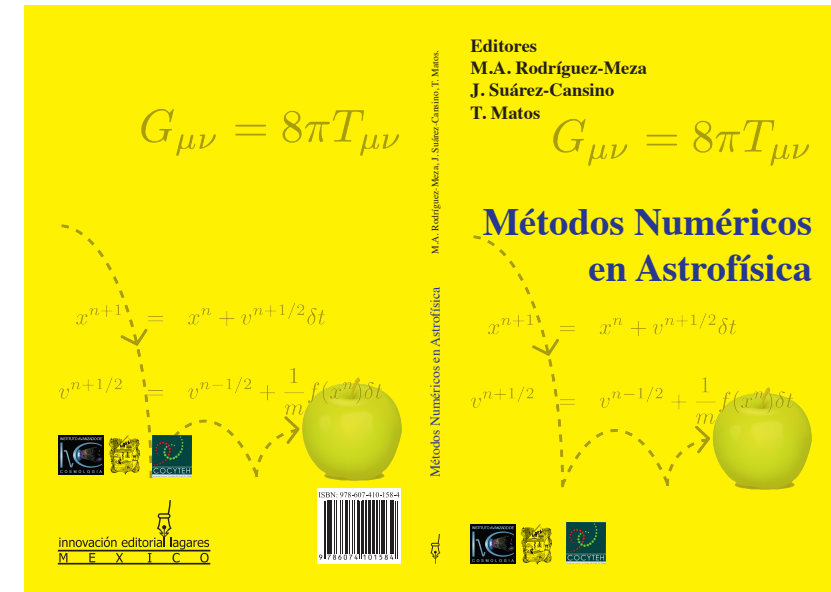
We have seen:

- Iteration.
- Recurrence.
- Recursion.



References and material

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See you!

