

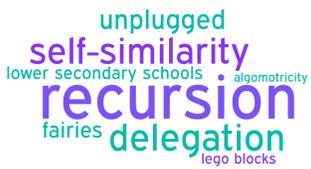
A playful tool to introduce lower secondary school pupils to recursive thinking

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A learning unit on recursion



We want lower secondary pupils to discover the main features of recursion.

Recursion is presented as a delegation of self-similar sub-tasks to “helpers”, that we call “fairies”.

We designed the learning unit according to our *algotricity* approach: first “unplugged”, motoric activities and the use of tangible objects to foster mental models of the topic under investigation; then a “plugged” (software supported) activity to foster abstraction and conceptualization.

In the “unplugged” activity pupils executed a recursive algorithm to compute the length of a string represented by a tower of LEGO blocks (where each block was labelled with a letter), each pupil executing a function call by following the instructions on a note. The plugged activity was based on *Fatine*: a software tool for reversing strings developed ad-hoc.

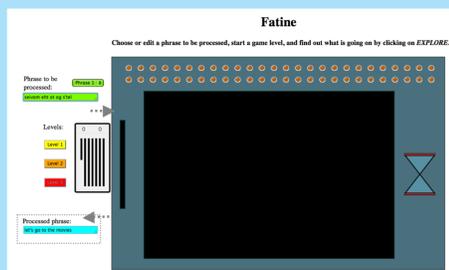
Then the class, by comparing the two algorithms, the one to compute the length of a word and the one to reverse a word, was able to identify the characteristics of recursion. Finally the pupils were guided to design a recursive algorithm which computes the powers of 2.

The software tool: “FATINE” (<http://aladdin.unimi.it/sw/fatine/>)

Level 1

The pupils can observe the execution of the algorithm from view points of increasing depth.

In the first level the computer is a “black box” receiving a string as input and returning its reversed form.



Level 2

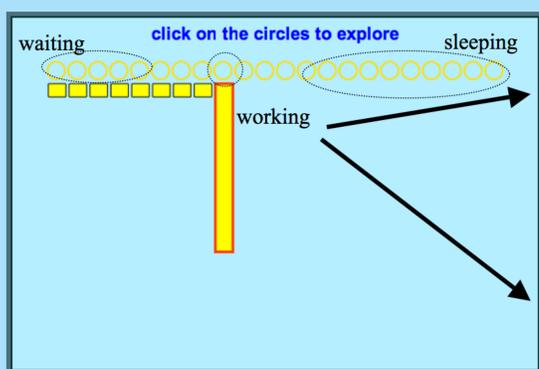
- The sequence of circles represents the recursion stack, each circle corresponding to a call of the recursive function.
- The tower represents the substring passed as argument, its height is proportional to the substring’s length.

- The tower shrinks while moving from left to right and grows as it moves back.
- To keep track of the phases, the sand in an hourglass changes its color: it is yellow in the first phase, orange in the second one, and red for the base case.



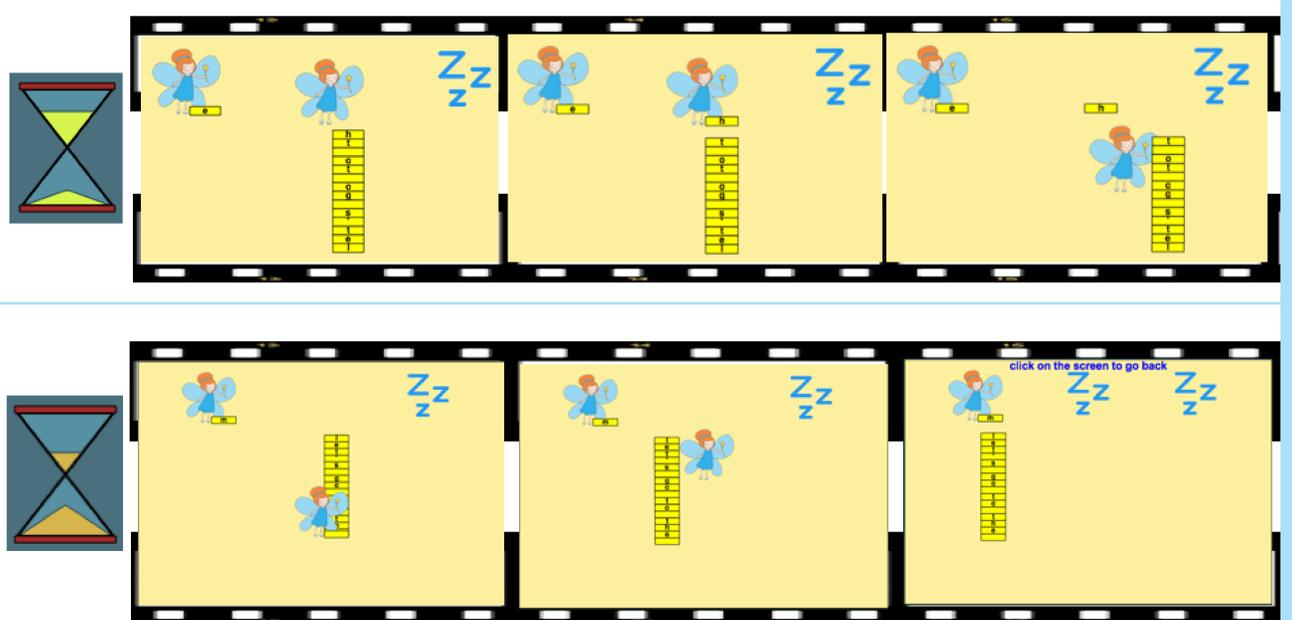
Level 3

The function is carried out by a little fairy. Pupils can stop the execution and see what each fairy is doing.



When a fairy is called, she wakes up and starts working:

- she receives the tower, detaches a block from the top of the tower and keeps it, passes the (sub-)tower on to the next fairy, and waits;
- she receives the tower again, attaches its block to the bottom of the tower, falls asleep anew.



Aknowledgements

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