

## Tutorial Modelling Software-based Systems

### Tutorial 2 : Designing and verifying sequential algorithms using the Event-B modelling language

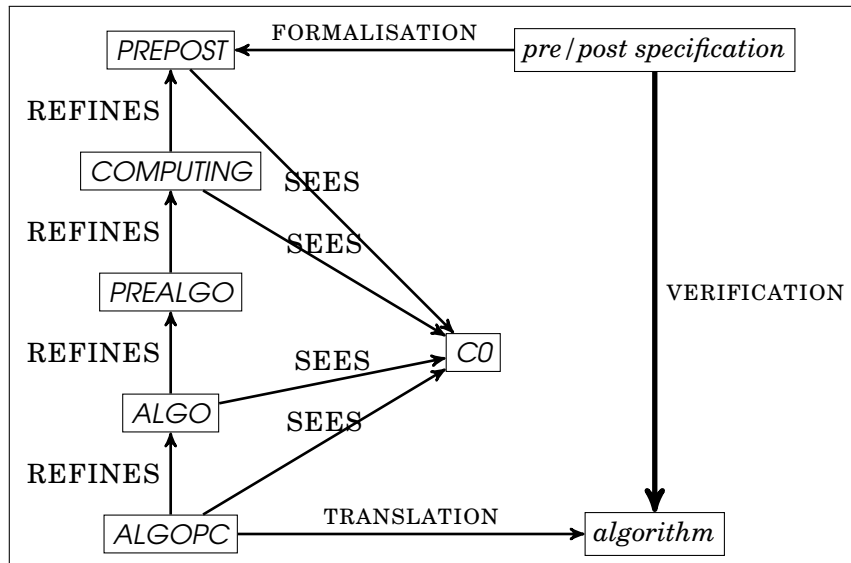
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#### Exercise 1 *fx1-tut2.zip*

We consider a finite sequence of integers  $v_1, \dots, v_n$  where  $n$  is the length of the sequence and is supposed to be fixed. Write an Event B specification modelling the computation of the value of the summation of the sequence  $v$ . You should define carefully  $v$ ,  $n$  and the summation of a finite sequence of integers.

#### Exercise 2 *fx2-tut2.zip*



Apply the pattern for computing the value  $n^2$  using the sequence  $(n+1)^2 = n^2 + n + n + 1$ . Write a C function with annotation that you will check with *Frama-c*.

#### Exercise 3 *fx3-tut2.zip*

Develop an algorithmic solution with the pattern for the problem of finding the number of occurrences of a value  $v$  value  $v$  satisfying a condition  $CO$  in a table  $t$  of dimension  $n$ . dimension  $n$ . The table is assumed to have a value in an envelope  $V$ . seems  $V$  and that  $CO$  is a part of  $V$ .

#### Exercise 4 *fx4-tut2.zip*

Apply this pattern to find the index  $i$  of  $t$  such that  $t(i) = v$ . Write a C function that you will check with *Frama-c*.

#### Exercise 5 *fx5-tut2.zip*

Apply this pattern to compute  $x^3$  using  $(i+1)^3 = i^3 + 3i^2 + 3i + 1$ . We use the following sequences :

- $z_0 = 0$  et  $\forall n \in \mathbb{N} : z_{n+1} = z_n + v_n + w_n$
- $v_0 = 0$  et  $\forall n \in \mathbb{N} : v_{n+1} = v_n + t_n$
- $t_0 = 3$  et  $\forall n \in \mathbb{N} : t_{n+1} = t_n + 6$
- $w_0 = 1$  et  $\forall n \in \mathbb{N} : w_{n+1} = w_n + 3$
- $u_0 = 0$  et  $\forall n \in \mathbb{N} : u_{n+1} = u_n + 1$

$$\begin{pmatrix} z(i+1) \\ v(i+1) \\ t(i+1) \\ w(i+1) \\ u(i+1) \end{pmatrix} = \begin{pmatrix} z_i + v_i + w_i \\ v_i + t_i \\ t_i + 6 \\ w_i + 3 \\ u_i + 1 \end{pmatrix} = \begin{pmatrix} 1 & 1 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} z(i) \\ v(i) \\ t(i) \\ w(i) \\ u(i) \end{pmatrix} + \begin{pmatrix} 0 \\ 0 \\ 6 \\ 3 \\ 1 \end{pmatrix}$$

*Write a C function from the development and use FRma-c for checking it.*