Lab System C

Setup :

Installation :

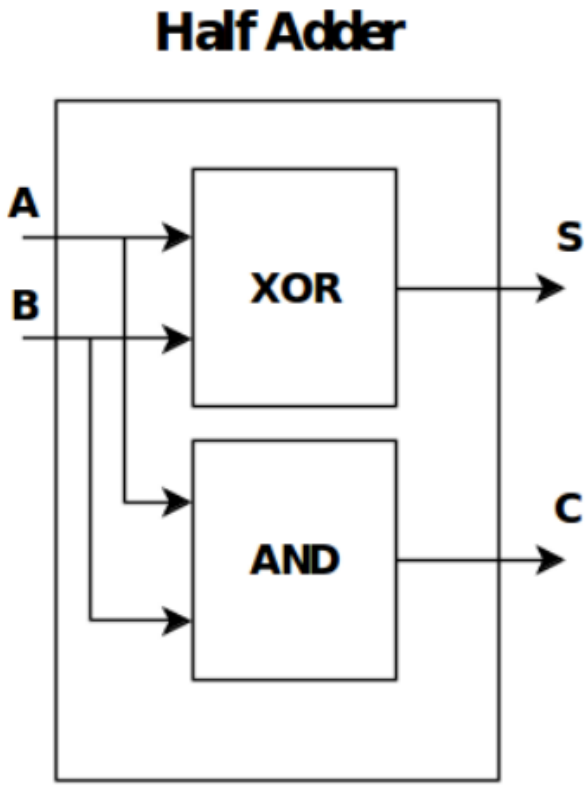
```
# Download packages
wget http://www.accellera.org/images/downloads/standards/systemc/systemc-2.3.3.gz
# Unpack the packages
tar -xzf systemc-2.3.3.gz
sudo mkdir /usr/local/systemc-2.3.3/
cd systemc-2.3.3 && mkdir objdir && cd objdir
# Installation
sudo ../configure --prefix=/usr/local/systemc-2.3.3/
sudo make -j$(nproc)
sudo make install
```

Visual Studio Code

```
# Add to include path
/usr/local/systemc-2.3.3/
/usr/local/systemc-2.3.3/include
```

Half adder :

Half Adder RTL model :



A Half Adder have two signals in et two signals out like in the picture. A et B are bool signal who represent the two bit to add, and S and C are bool signal too who represent the SUM and the CARRY of the add of A and B.

Our Half Adder are compose of two file `adder.h` and `adder.cpp`. The file `adder.h` declare all signal variable and all methodes, and the file `adder.cpp` implements all methodes and the module `Adder`.

Simulation environement :

After that we create a file main.cpp, who create an Half Adder and change the value of A and B to simulate the behavior of our Half Adder.

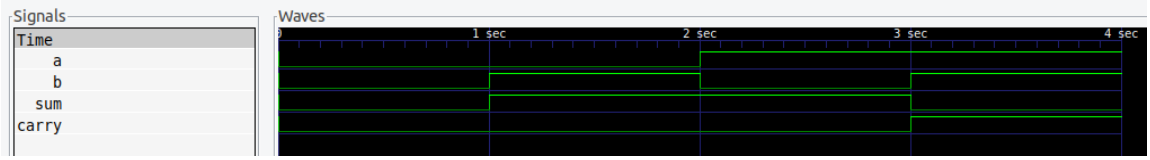
Check, TraceFile and assertion :

To check the good behaviour of our Half Adder we try tree différents way :

- First we print all the result on the terminal :

```
        SystemC 2.3.3-Accellera --- May 25 2023 12:22:42
        Copyright (c) 1996-2018 by all Contributors,
        ALL RIGHTS RESERVED

Info: (I702) default timescale unit used for tracing: 1 ps (tracefile.vcd)
a =   0
b =   0
+------
s = 0 0

a =   0
b =   1
+------
s = 0 1

a =   1
b =   0
+------
s = 0 1

a =   1
b =   1
+------
s = 1 0
```

- Secondly we create a tracefile.vcd, and we use GTKWave to visualize the signal



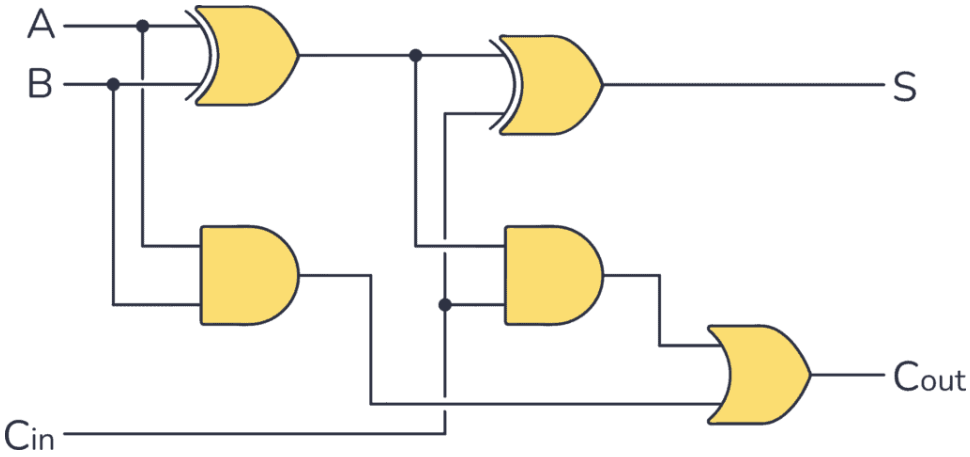
- Thirdly we implemented assertion to check the good computing (this way it's better for test huge behavior), if we have a wrong behavior the simulation stop and write an error

```
        SystemC 2.3.3-Accellera --- May 25 2023 12:22:42
        Copyright (c) 1996-2018 by all Contributors,
        ALL RIGHTS RESERVED

Info: (I702) default timescale unit used for tracing: 1 ps (tracefile.vcd)
a =   0
b =   0
+------
s = 0 0

a =   0
b =   1
+------
s = 0 0

adder: main.cpp:37: int sc_main(int, char**): Assertion `sum == (i ^ j)' failed.
Abandon (core dumped)
```

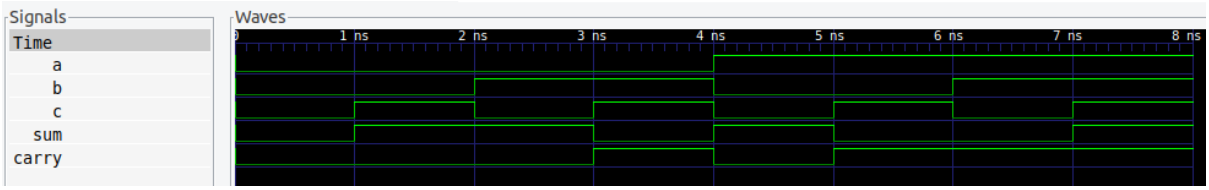
This three methods permite to check the good behavior of the model.

Nbit Adder :

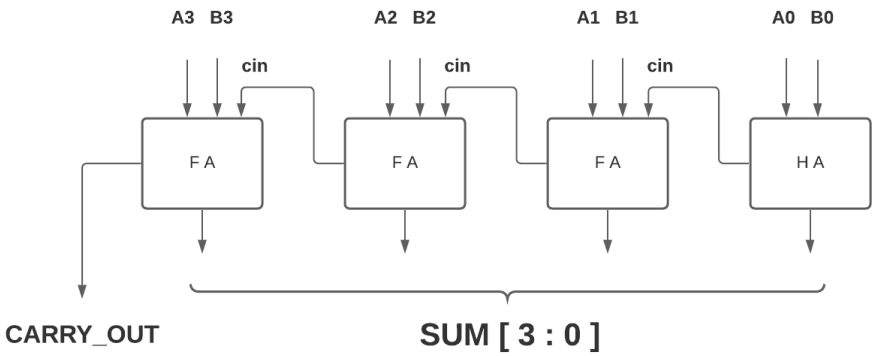
Full adder :



First we create a Full Adder with the behaviour of the picture above. The structure of the code are like previously on the Half Adder. And all check as prevously are implement.



Nbit adder :



For this part we just follow the screen of an Nbit Adder, and we just connected N Full Adder together to create the behavior expected. We also create all the verification stuff (Assertion, Random input generation and TraceFile, even is not really easy to saw the signal)

```
        SystemC 2.3.3-Accellera --- May 25 2023 12:22:42
        Copyright (c) 1996-2018 by all Contributors,
        ALL RIGHTS RESERVED

Info: (I702) default timescale unit used for tracing: 1 ps (tracefile.vcd)
a =   1 1 1 0 1 0 0 0
b =   1 0 1 0 1 1 0 0
+--------------------
S = 1 1 0 0 1 0 1 0 0
```

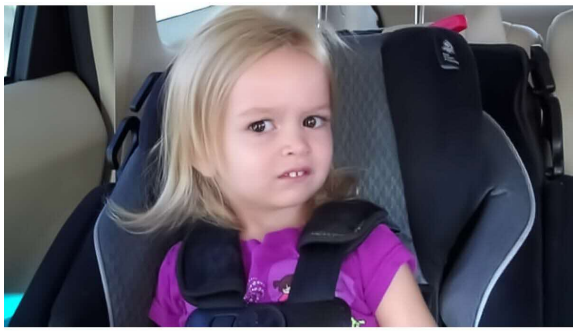
Grey Scale :

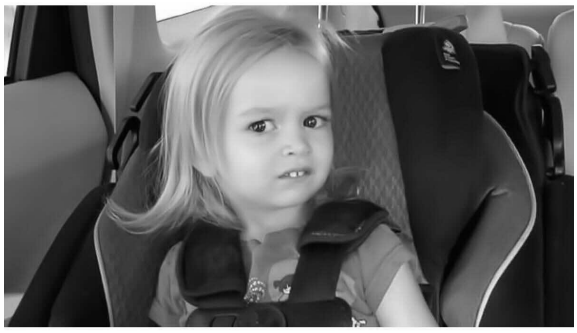
For create a clocked image grey scaler we create two functions of our `Grey Scale`, a `GreyScaleProcess()` and a `clock()`, the `clock()` are launch in a thread with a frequence of 1 nano seconde and and `GreyScaleProcess()` are sensitive to the rising edge of the `clock()`.

To compute the GreyScale, we use a simple function :

```
sc_uint<8> grey = (R.read() + G.read() + B.read()) / 3;
```

And to check the behavior of our GreyScale with also create a Image Process, who permite to read and save a BMP image. Just BMP image because of the header size.

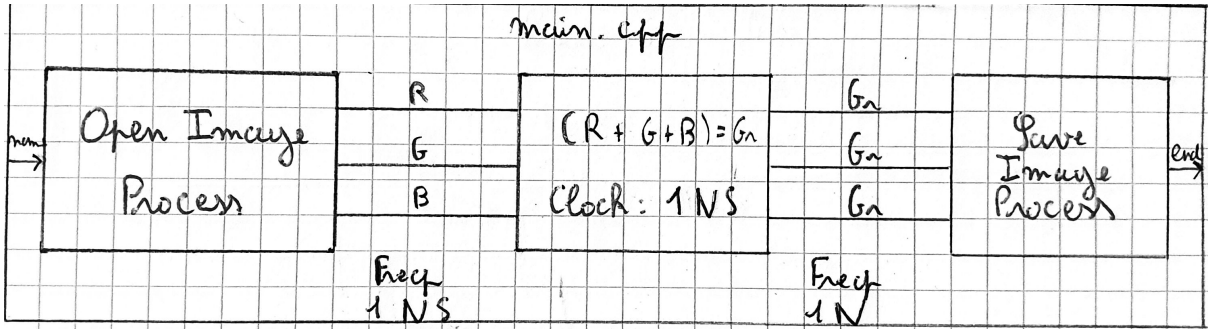


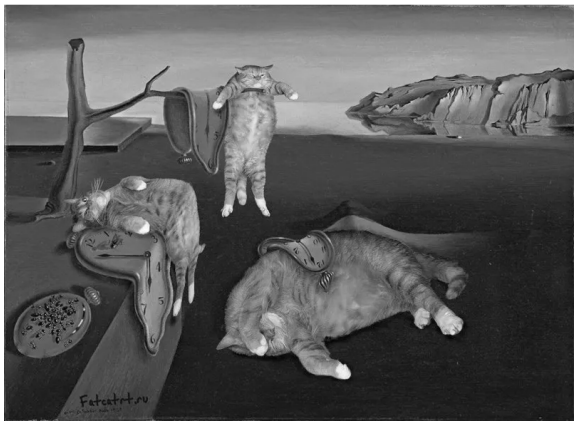


As we can see the behaviour seems good.

Hierarchical Channels :

For this part we just adapted the previous code to transmite informations on channels. So for that we separate all process in specific and individual process systemC : `read_image.h`, `save_image.h` and `grey_scale_h.h`. We also create a simulation environement in a `main.cpp`





As we can see the behaviour seems good.