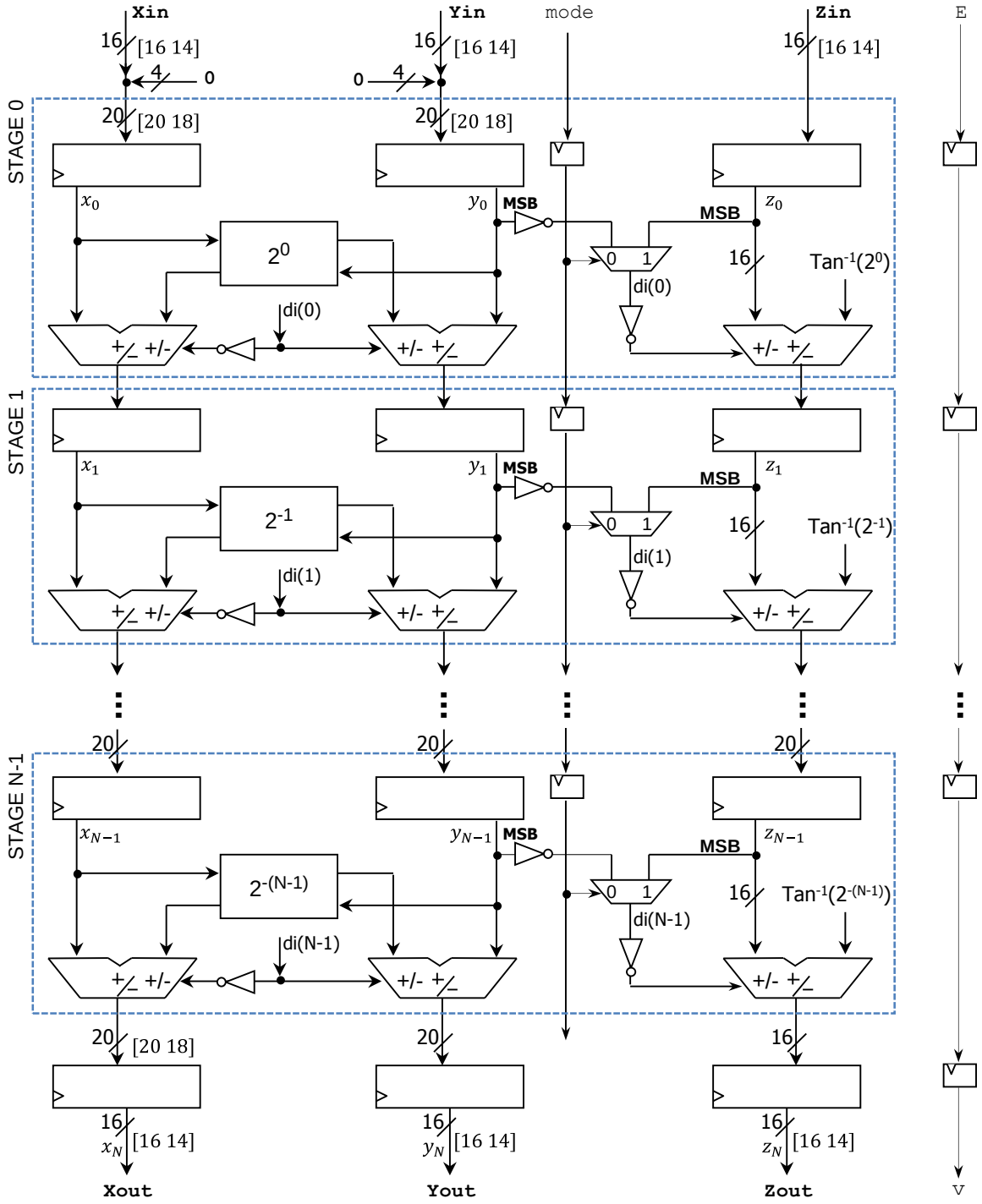
Homework 4

(Due date: December 2nd @ 7:30 pm)

Presentation and clarity are very important! Show your procedure!

PROBLEM 1 (60 PTS)

- Design the pipelined Circular CORDIC architecture with N iterations shown in the figure below.
- The circuit must be written in parametric VHDL code with N as the only parameter. $N = 4\ to\ 16$.
- Tip: Implement a stage i as a parametric component. Then on the top file, just instantiate 'N' of those components.



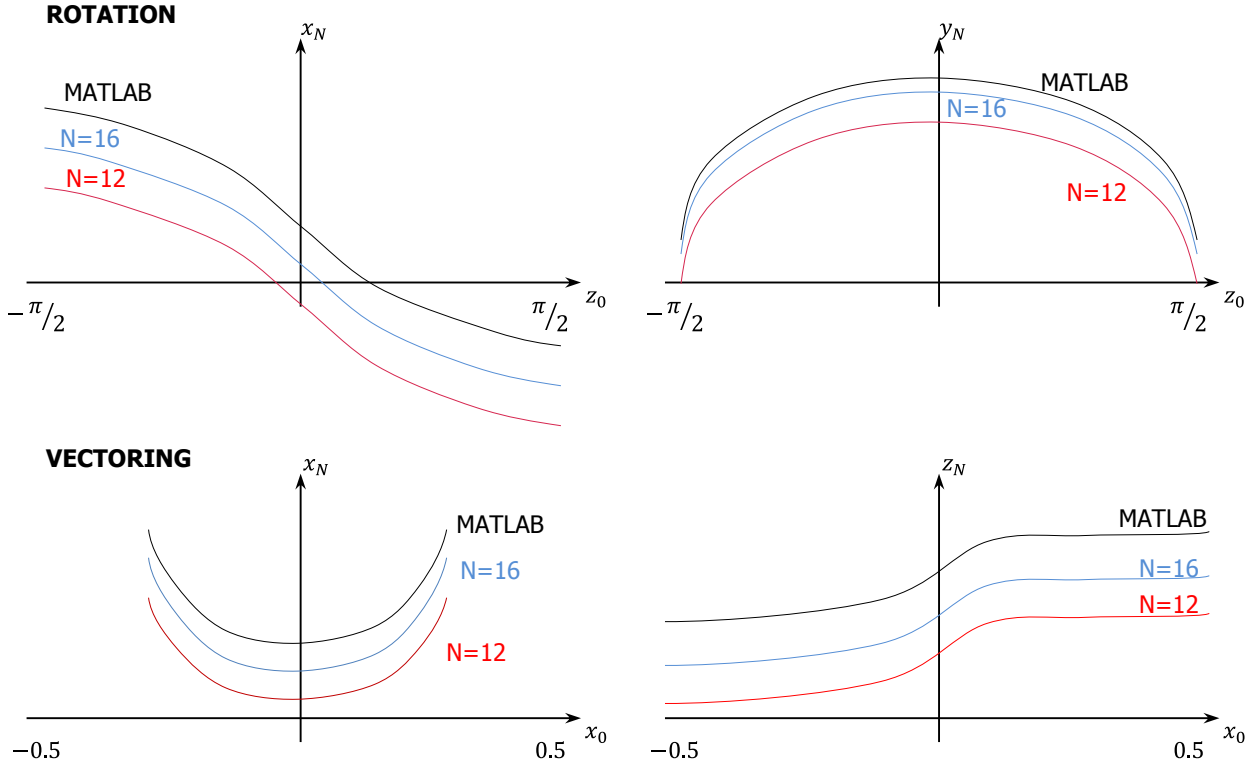
PROBLEM 2 (40 PTS)

- Create a testbench for your CORDIC circuit. The testbench should test the following cases for $N = 12$ and $N = 16$.
  - ✓ Rotation Mode: $x_0 = 0, y_0 = 1/A_n, z_0 = -\pi/2\ to\ \pi/2$. For z_0, we test 100 equally-spaced values between $-\pi/2\ to\ \pi/2$.
  - ✓ Vectoring Mode: $y_0 = 1, z_0 = 0, x_0 = -0.5\ to\ 0.5$. For x_0, we test 100 equally-spaced values between $-0.5\ to\ 0.5$.

- Your testbench must write the output results (x_N, y_N for rotation mode; x_N, z_N for vectoring mode) on a text file.

- MATLAB® (or Octave): Read data from the testbench output file and plot the results (for $N = 12, 16$ and for rotation and vectoring mode) along with the results of the functions (Rotation: $x_N \rightarrow -sin(z_0)$, $y_N \rightarrow cos(z_0)$. Vectoring: $x_N \rightarrow A_n\sqrt{x_0^2 + y_0^2}, z_N \rightarrow atan(y_0/x_0)$ to which the CORDIC results should converge.

- **Important considerations**:
  - ✓ The CORDIC algorithm in the vectoring mode for Z tends to: $z_n = z_0 + atan2(y_0, x_0)$. This is not exactly the arctangent function.
  - ✓ Keep in mind the range of convergence: for some arguments, the CORDIC results might not converge to the expected function (MATLAB®) values. The figure below is just referential.



Deliverables:

- Provide a printout of the plots.
- Upload the following files to Moodle (an assignment will be created):
  - ✓ VHDL code
  - ✓ VHDL testbench
  - ✓ Input text file for testbench
  - ✓ Output text file for testbench.