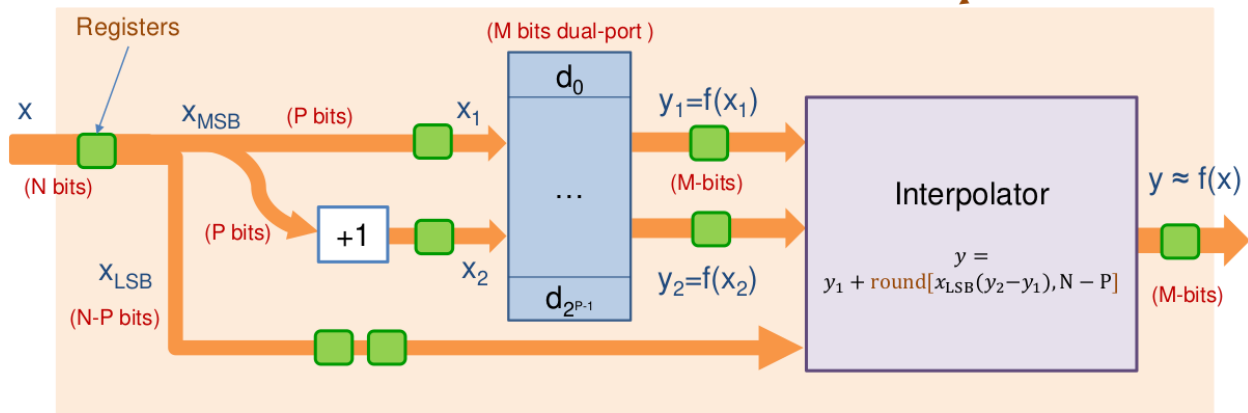Digital System Design Project

Fall 2022/23

For smooth functions, LUT-based methods can be made more memory-efficient, if they are combined with interpolation. The project purpose is to implement interpolation using the quadratic method.

The function you are going to work on is $y = x^2 - x^3$, $0 < x < 1$
(8-bit input and output)

First of all you have to create a LUT without interpolation for an 8-bit input which means your LUT must have 256 sluts. (25%)

Second, implement the function using linear interpolation using 64 slut memories.(25%)

The overall block-diagram of an interpolated LUT of length N using a two-port LUT of length P for pipelined FPGA-based implementation is as follows:

seen as an N-bit LUT from outside

Registers

(M bits dual-port)

d_0

x

x_{MSB} (P bits) x_1 $y_1 = f(x_1)$

(N bits)

(M-bits)

Interpolator

$y \approx f(x)$

(P bits) +1

...

x_{LSB} x_2 $y_2 = f(x_2)$
$d_{2^{P-1}}$

(N-P bits)

$y = $
$y_1 + \text{round}[x_{LSB}(y_2 - y_1), N - P]$

(M-bits)

Third, search how the quadratic method works and implement the function above using quadratic interpolation with 64 sluts. (25%)

Forth write a report that contains what you have done and also compare the accuracy of step 1, 2, and 3.(25%)

Feel free to ask any question
Good Luck