Adder

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Adders play a crucial and effective role in computational tasks. The speed of computer operations greatly impacts overall performance, and optimizing these operations can significantly enhance processing speed. Therefore, various methods have been developed to reduce calculation time and accelerate processing.

16 bit Ladner Ficher Adder

This adder belongs to the family of prefix adders and is described using VHDL. In Figure 1, you can see the diagram illustrating its structure.

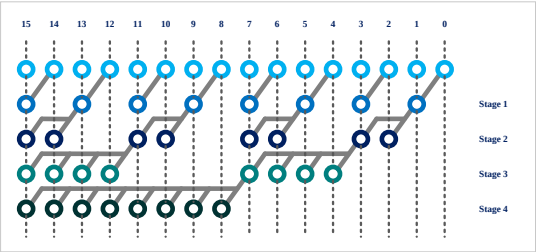

Figure 1: *16 bit Ladner Ficher Adder*

Binary signed with 16 digit

- Note: This method of binary decimal (BD) encoding is used in multipliers/dividers.
- Note: In BD encoded multipliers, two fewer bits are required.

x	x^h	x^l	x^h	x^l
0	0	0	0	0
1	0	1	0	1
$\overline{1}$	1	0	1	1

In this adder, we require a TW component, which operates based on the inputs from the previous stage (these inputs determine the value of P) and the inputs of the current stage. According to the diagram below, it calculates P_{i-1}, W_i, *and* T_{i+1}.

$$P_i = \begin{cases} 0, & \text{if } (x_i, y_i) \text{ both NonNegative } (t_{i+1} \geq 0) \\ 1, & \text{otherwise } (t_{i+1} \leq 0) \end{cases}$$

$$x_i + y_i = 2t_{i+1} + w_i$$

Using Previous Digit	$x_i + y_i$	P_{i-1}	t_{i+1}	w_i
	2	-	1	1
	1	$0(t_i \geq 0)$		
	1	$1(t_i \leq 0)$	1	-1
	0	-	-1	1
	-1	$0(t_i \geq 0)$	-1	-1
		$1(t_i \leq 0)$		
	-2	-	-1	1

Python Codes

In Python, we implemented the Carry Lookahead Adder (CLA) in the `Carry_Lookahead_Adder.py` file and the Carry Skip Adder (CSA) in the `Carry_Skip_Adder.py` file. We also tested these functions in the `main.py` program.

References

[Alipour Fraydani and Taati, 2024] Alipour Fraydani, A. and Taati, H. (2024). Homework on Computer Arithmetic, University of Tehran. *Unpublished Manuscript*, Department of Electrical Engineering, University of Tehran.