PHSX 536: Homework #11

April 17, 2025

Grant Saggars

Problem 1

Add 31_{10} and 12_{10} by first converting the two numbers to binary then adding the binary numbers. You must show your work.

31_{10} in binary:

$$\begin{aligned} 31 \div 2 &= 15\text{r}1 \\ 15 \div 2 &= 7\text{r}1 \\ 7 \div 2 &= 3\text{r}1 \\ 3 \div 2 &= 1\text{r}1 \\ 1 \div 2 &= 0\text{r}1 \end{aligned}$$

Writing the remainders in reverse order:

$$31_{10} = 11111_2$$

12_{10} in binary:

$$\begin{aligned} 12 \div 2 &= 6\text{r}0 \\ 6 \div 2 &= 3\text{r}0 \\ 3 \div 2 &= 1\text{r}1 \\ 1 \div 2 &= 0\text{r}1 \end{aligned}$$

Writing the remainders in reverse order:

$$12_{10} = 1100_2$$

Solution:
Adding them:

$$\begin{array}{rr} & 11111 \\ + & 1100 \\ \text{carry} & 11100 \\ \hline & 101011 \end{array}$$

Problem 2

Subtract 12_{10} from 31_{10} by first converting the two numbers to binary and then performing the subtraction operation on the binary number. You must show your work.

Solution:
Using the same numbers I computer for 12_{10} and 31_{10} in Problem 1,

$$\begin{array}{rr} & 11111 \\ - & 01100 \\ \hline & \\ & 10011 \end{array}$$

Problem 3

In LTSpice, set up and test a clocked RS flip-flop. Determine the truth table by programming three voltage sources using the PWL option. The timing of the sources might look as shown below. The time scale could be in seconds, milliseconds, or some other unit. What is important is that you supply a sequence of pulses that cover all possible options for the truth table.

Solution:
I am currently having technical issues with LTSpice and am in communcation about it. If possible a revised solution will be submitted soon.