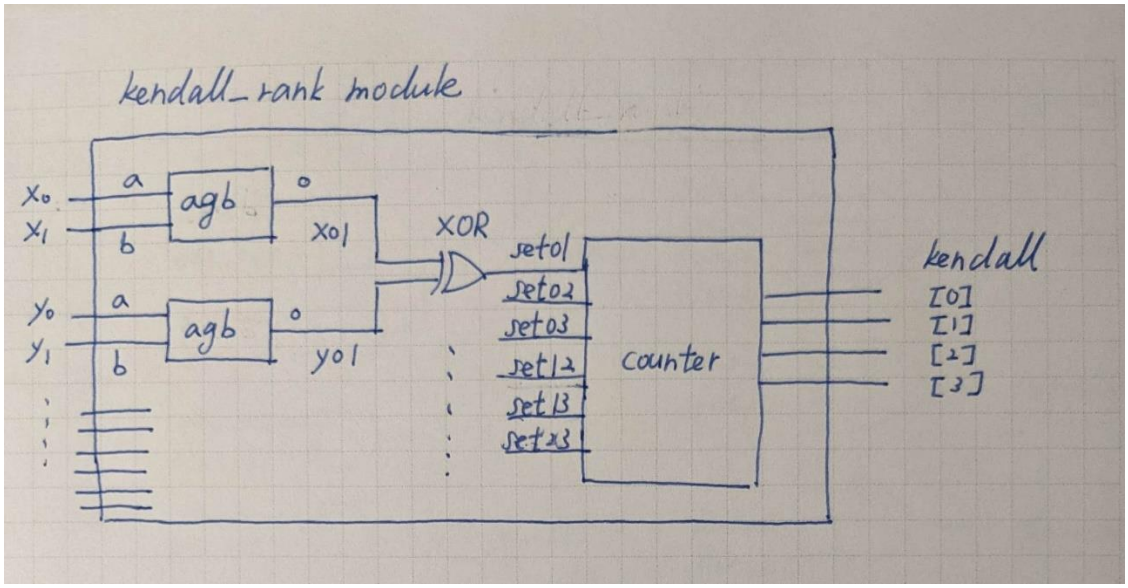
IC Design Homework 3

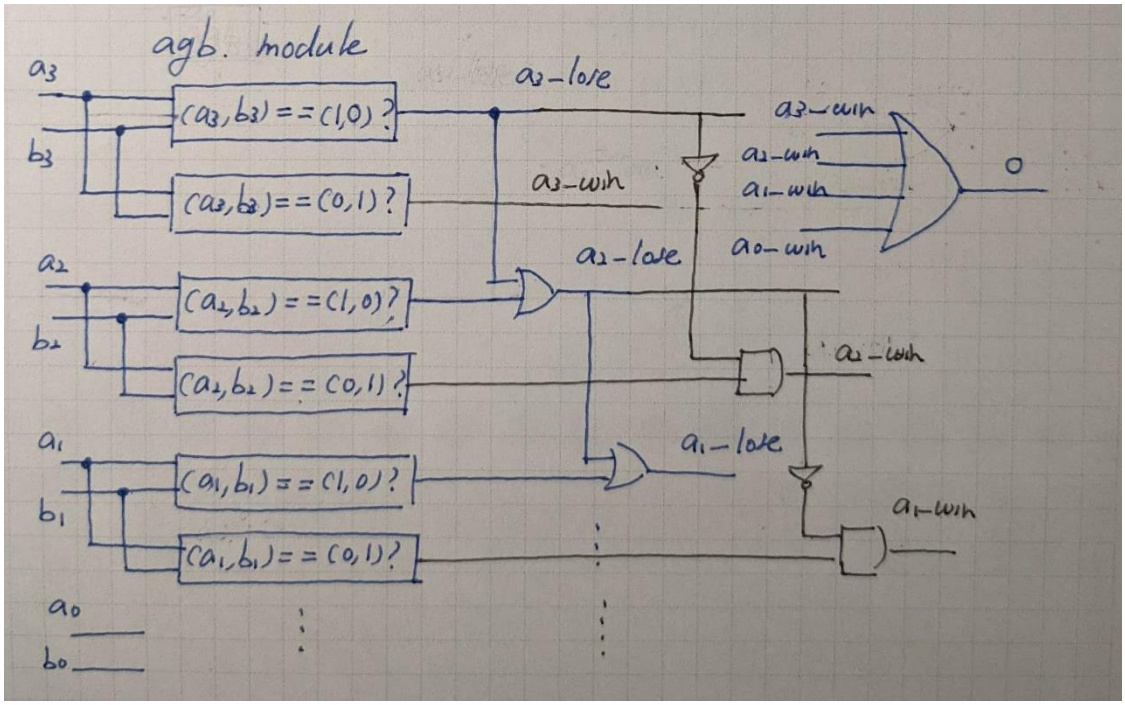
電機三 b08901201 胡雅晴

I. Circuit Diagram

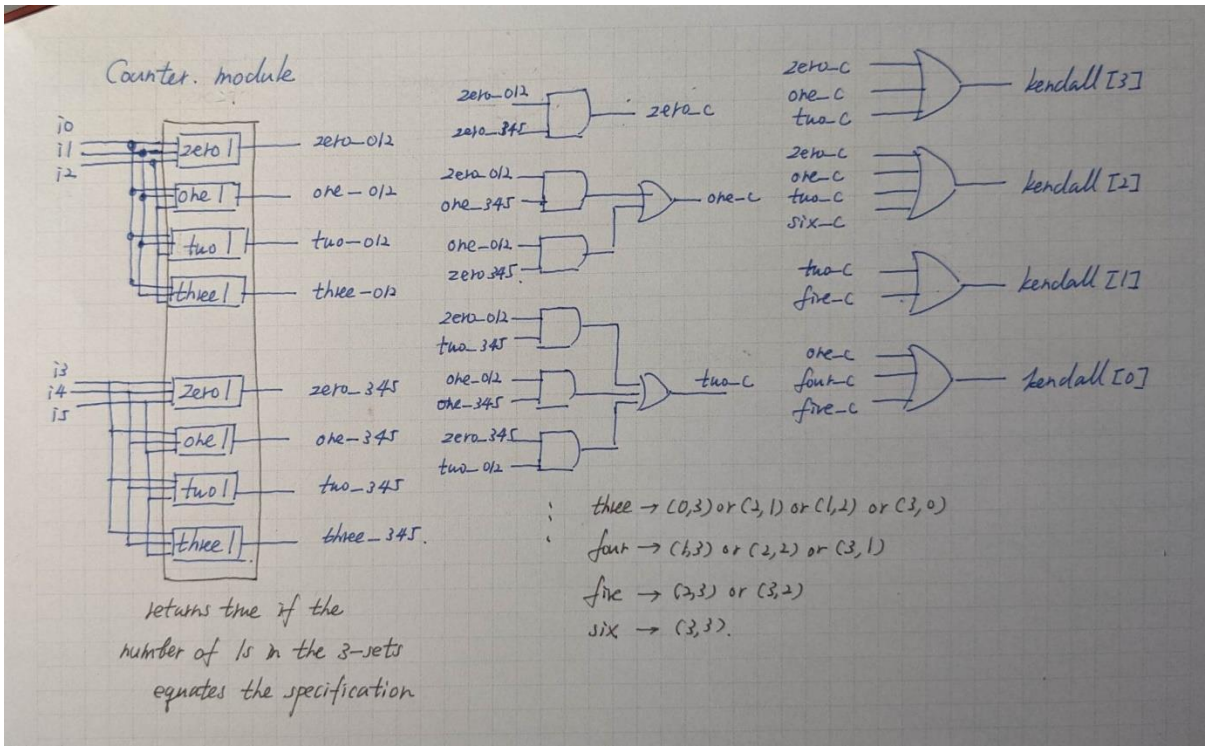
1. kendall_rank module



2. agb (a-greater-than-b) module



3. counter module



II. Discussion

1. Finding Concordant Pairs

(1) Compare all possible combinations of (x_i, x_j) and (y_i, y_j), where i != j.

(2) Compare the relationships of (x_i, x_j) and (y_i, y_j). If [$(x_i > x_j)$ AND $(y_i > y_j)$ OR $(x_i < x_j)$ AND $(y_i < y_j)$], then (i,j) is a concordant pair.

2. From Concordant Pairs to Kendall Coefficient

# of concordant pairs	kendall coefficient	kendall coefficient rounded	kendall coefficient in 4-bit signed number
6	1	1	0100
5	0.667	0.75	0011
4	0.333	0.25	0001
3	0	0	0000
2	-0.333	-0.25	1111
1	-0.667	-0.75	1101
0	-1	-1	1100

Through observing the outcomes for 0-6 concordant pairs, we conclude that the 4 output digits each displays TRUE under the following circumstances:

output digits	is TRUE when # of concordant pairs is
kendall[3]	0 OR 1 OR 2
kendall[2]	0 OR 1 OR 2 OR 6
kendall[1]	2 OR 5
kendall[0]	1 OR 4 OR 5

Thus we aim to find the kendall coefficient by finding out the number of concordant pairs by the following algorithm:
(1) Splitting the 6 inputs into two halves. For example, 101111 => (101), (111)
(2) Find how many 1s there are each in the two halves. For example, (101) => 2
(3) Generate flags that each represent if the number of concordant pairs equates a specific number. For example, there are 5 concordant pairs if there are [(two 1s in the first half AND three 1s in the second half) OR (three 1s in the first half AND two 1s in the second half)]
(4) Find kendall[0], kendall[1], kendall[2], kendall[3] by utilizing these flags.

3. Tactics in Improving Critical Path

- Paralleling over sequentialing.
- Use multiple small gates instead of few wide gates to process signals.
- Replacing NOT gates with NOR/NAND gates.
- Avoid costly gates such as IV, EN, FA1, ……