# Labs for Module 2

Learn **How to use Logisim
(https://canvas.kth.se/courses/36215/pages/how-to-use-
logisim)**

## Equivalent gates using only NAND or NOR

- Build AND, OR, NAND, NOR, XOR and NOT gates using only NAND or NOR.
- Simulate the operation in Logisim.
- Check the operation on your breadboard.

## Some advice before building large circuits on the breadboard

1. Draw with actual gates, eg 3 x 2 input OR = 4 input OR
2. Use pin numbers from Quick Reference guide
3. Include VCC and GND
4. Save inverters by using one for each inverted literal
5. Check off connections as they are made
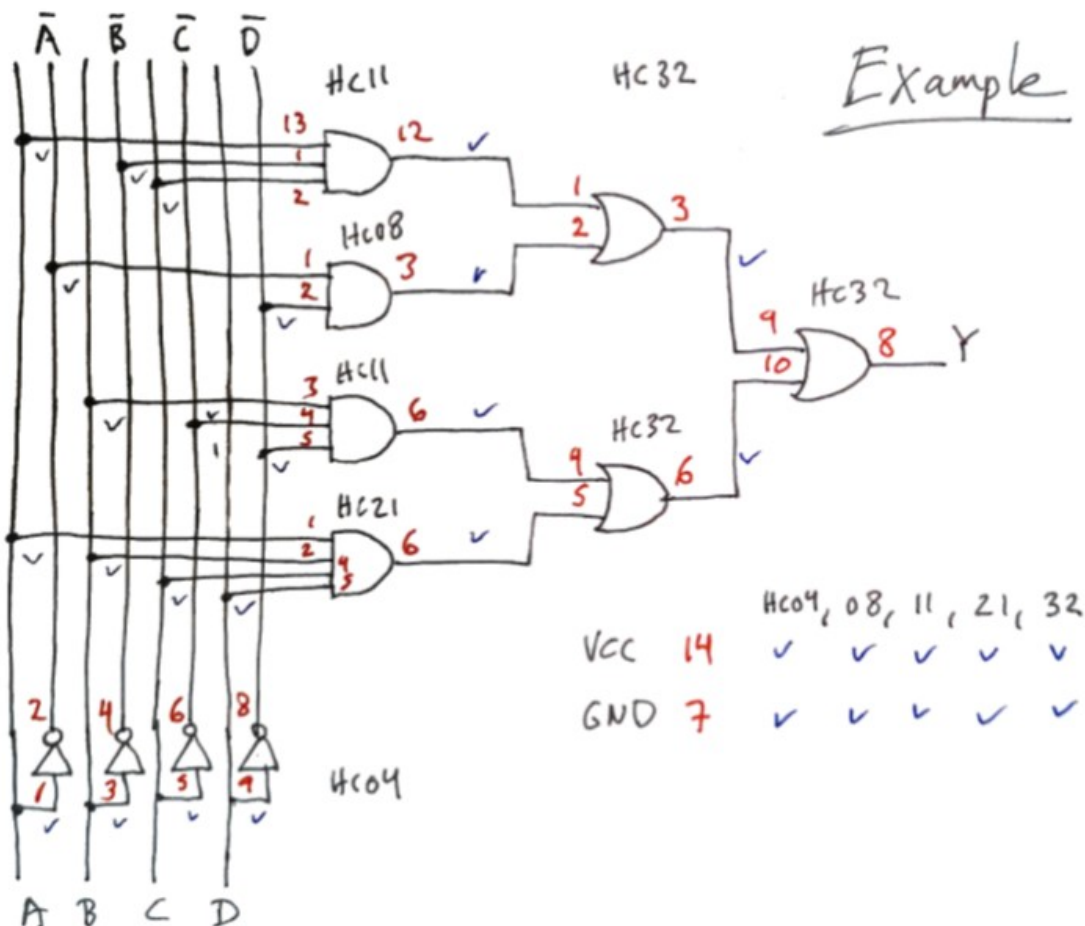
# Module 2 task to report in the written Lab Report and demonstrate

- From Your Date of Birth generate the 16 output bits for the truth table, see example below.
- FIXED bits are the same for all students.
- Draw a K map and simplify the expression for YDOB = f(q3 q2 q1 q0)
- Draw the schematics for YDOB using any gates or MUX you have in the Lab Kit.
- Check your design using Logisim.
- **Connect it on your breadboard and verify the truth table using 4 pushbuttons and an LED (OR the logic analyzer generator pin 7 - pin 4)**
- Take a photo of your working circuit.
- Demonstrate this circuit to a Lab Assistant.

Use only last digit of your year of birth, see example below:

| Year | Month | Day |
|------|-------|-----|
| 1986 | 12 | 3 |
| 6 | 12 | 3 |

| Yearbits | | | | Monthbits | | | | FIXED bits | | | Daybits | | | | | |
|----|----|----|----|----|----|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 2 | 1 | 0 | 3 | 2 | 1 | 0 | 2 | 1 | 0 | 4 | 3 | 2 | 1 | 0 | |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | Row |
| 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | Example |
| | | | | | | | | 0 | 0 | 1 | | | | | | YDOB |

| Row | q3 | q2 | q1 | q0 | Example | YDOB |
|-----|----|----|----|----|---------|------|
| 0 | 0 | 0 | 0 | 0 | 1 | |
| 1 | 0 | 0 | 0 | 1 | 1 | |
| 2 | 0 | 0 | 1 | 0 | 0 | |
| 3 | 0 | 0 | 1 | 1 | 0 | |
| 4 | 0 | 1 | 0 | 0 | 0 | |
| 5 | 0 | 1 | 0 | 1 | 1 | 1 |
| 6 | 0 | 1 | 1 | 0 | 0 | 0 |
| 7 | 0 | 1 | 1 | 1 | 0 | 0 |
| 8 | 1 | 0 | 0 | 0 | 0 | |
| 9 | 1 | 0 | 0 | 1 | 0 | |
| 10 | 1 | 0 | 1 | 0 | 1 | |
| 11 | 1 | 0 | 1 | 1 | 1 | |
| 12 | 1 | 1 | 0 | 0 | 0 | |
| 13 | 1 | 1 | 0 | 1 | 1 | |
| 14 | 1 | 1 | 1 | 0 | 1 | |
| 15 | 1 | 1 | 1 | 1 | 0 | |

| q3q2 \ q1q0 | 00 | 01 | 11 | 10 |
|-------------|----|----|----|----|
| 00 | 1 | 1 | 0 | 0 |
| 01 | 0 | 1 | 0 | 0 |
| 11 | 0 | 1 | 0 | 1 |
| 10 | 0 | 0 | 1 | 1 |