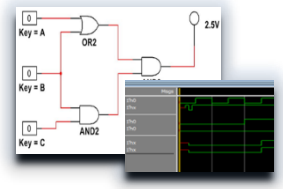
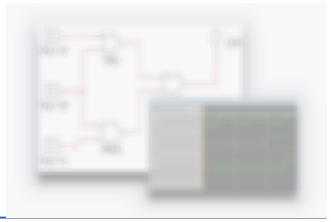


ECE119 – Ψηφιακή Σχεδίαση

Διδάσκοντες Εργαστηρίου: Δ. Καραμπερόπουλος
Α. Φεύγας
Δ. Γαρυφάλλου

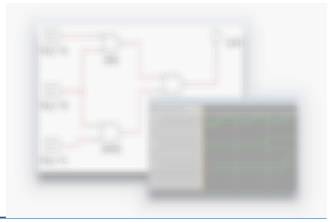
- Lab 7: Multiplexers and Demultiplexers

Περιεχόμενα Εργαστηριακού Μαθήματος



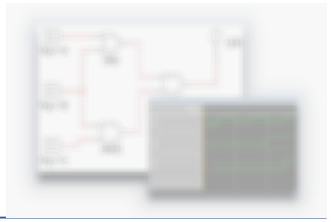
- Εισαγωγή
- Lab 1: Multisim Circuit Simulation and Basic Gates
- Lab 2: Truth Tables and Basic Logic Gates
- Lab 3: Logic Gates Explored and Boolean Algebra
- Lab 4: Karnaugh Maps
- Lab 5: Binary Conversion and Adders
- Lab 6: Encoders and Decoders
- **Lab 7: Multiplexers and Demultiplexers**
- Lab 8: Latches and Sequential Logic Circuits
- Lab 9: Flip-Flops
- Lab 10: Sequential Circuits - FSM

Multiplexers and Demultiplexers



- **Multiplexers** are combinational logic circuits for which there are multiple potential inputs but there is always only one output.
- **Demultiplexers** are the opposite in that there is always one input but there are multiple potential outputs.
- Both multiplexers and demultiplexers have a bit (or multiple bits) called **selector bit(s)** which is responsible for determining which input or output is chosen.
- Like encoders and decoders, multiplexers and demultiplexers can be broken down into circuit components but are typically represented by chips for visual simplification.
- In this lab, we will analyze multiplexers and demultiplexers in both their circuit and chip forms.

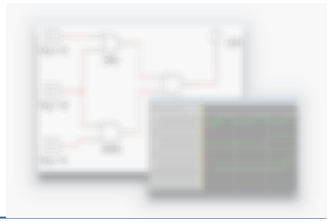
Learning Objectives



In this lab, students will:

- Reflect on the similarities and differences between encoders and multiplexers
- Examine the function of a basic 2-to-1 Multiplexer using logic gates

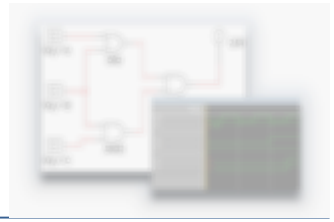
Expected Deliverables



In this lab, you will collect the following deliverables:

- Sum-of-Products Boolean functions for 2-to-1 Multiplexer
- Sum-of-Products Boolean functions for 1-to4 Demultiplexer
- Image of circuit
- Observations of demultiplexer behavior
- Conclusion questions

Multiplexers (1/3)

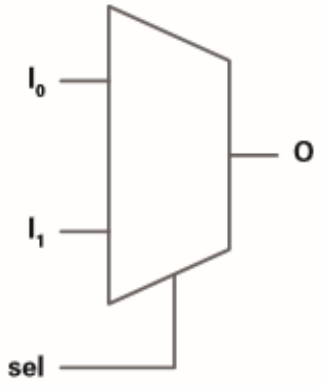


The **multiplexer**, abbreviated **MUX**, is a combinational logic circuit which has multiple data inputs, one or more select inputs and one output.

- It passes the data on one of the inputs, depending on the selection signals, to the output
- With the help of this logic circuit, multiple signals can share the same data output
- Multiplexers have **2^s inputs** and **s selector lines**, which determine which of the inputs to output.
- Multiplexers are one of the most widely used combinational circuits, their application areas include:
  - Data routing
  - Operation sequencing
  - Parallel-to-serial conversion
  - Waveform generation

Multiplexers (2/3)

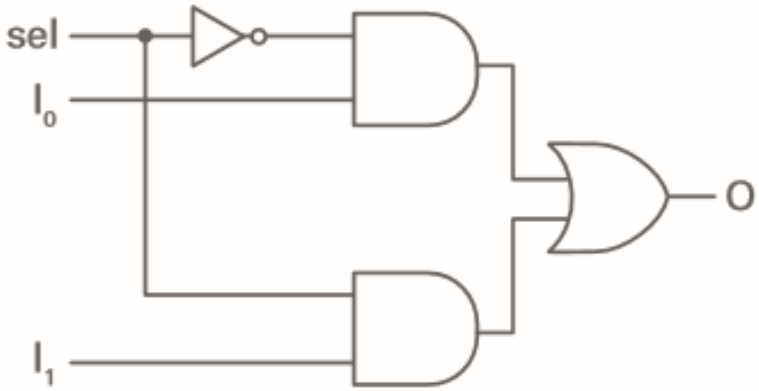
- The simplest circuit is the 2-to-1 multiplexer, with the graphical symbol presented in the leftmost figure.
- Its functionality is described by the joining truth table.
- The multiplexer below is only 1-bit wide since bit line is connected to a single output bit line.



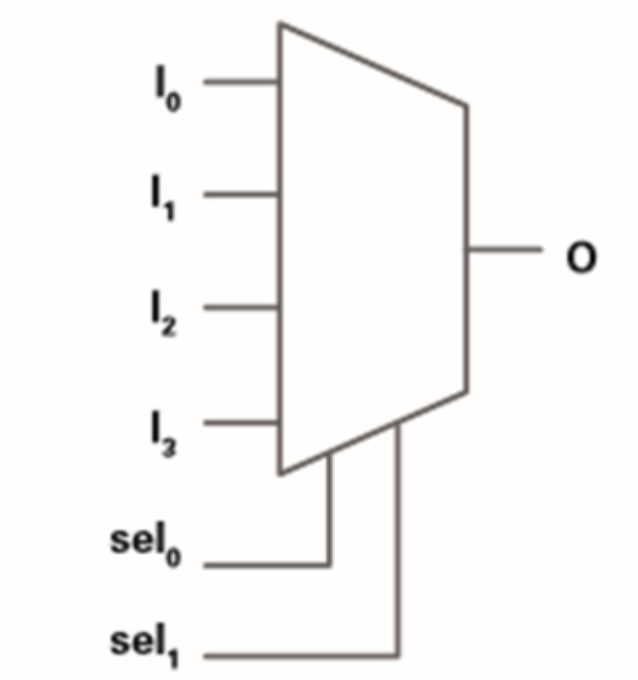
sel	I_0	I_1	O
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

sel	O
0	I_0
1	I_1

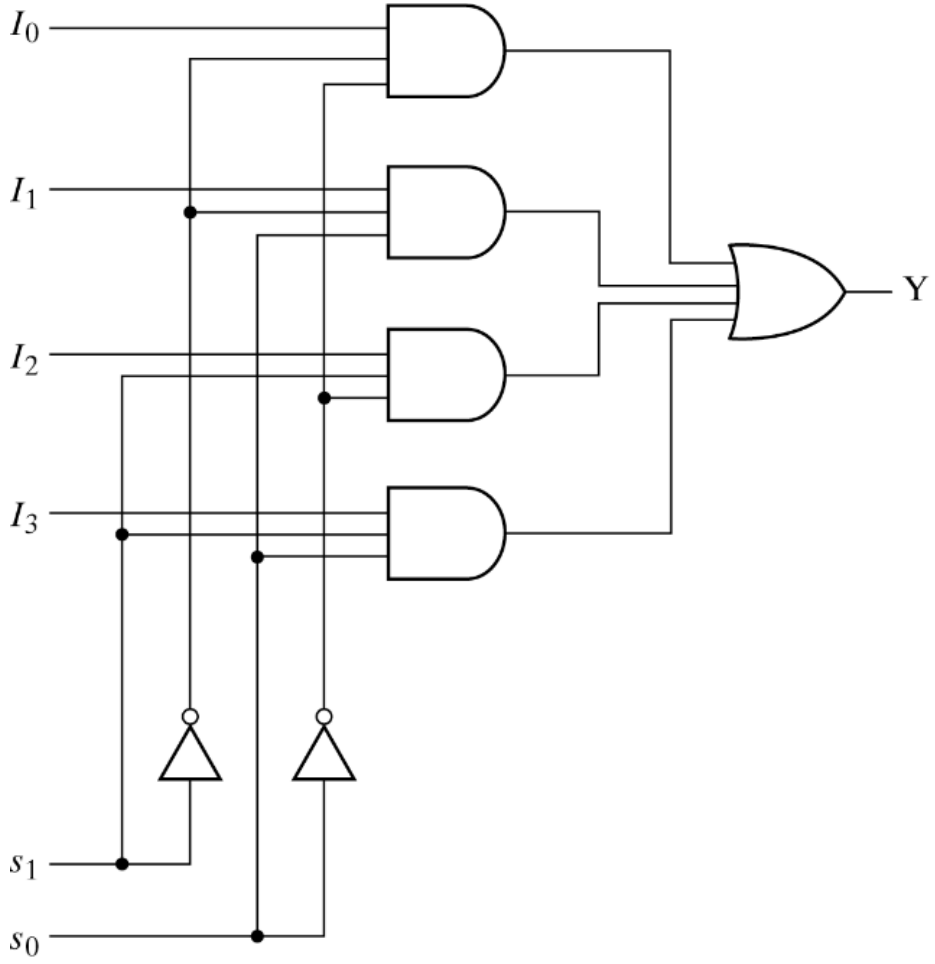
2-to-1 MUX



Multiplexers (3/3)

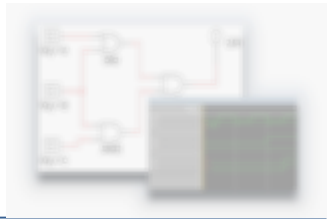


sel_1	sel_0	O
0	0	I_0
0	1	I_1
1	0	I_2
1	1	I_3



4-to-1 MUX

Demultiplexers (1/2)

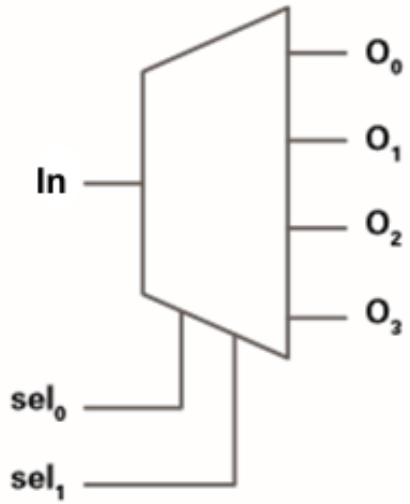


Demultiplexers (DEMUX) have the opposite function of a multiplexer

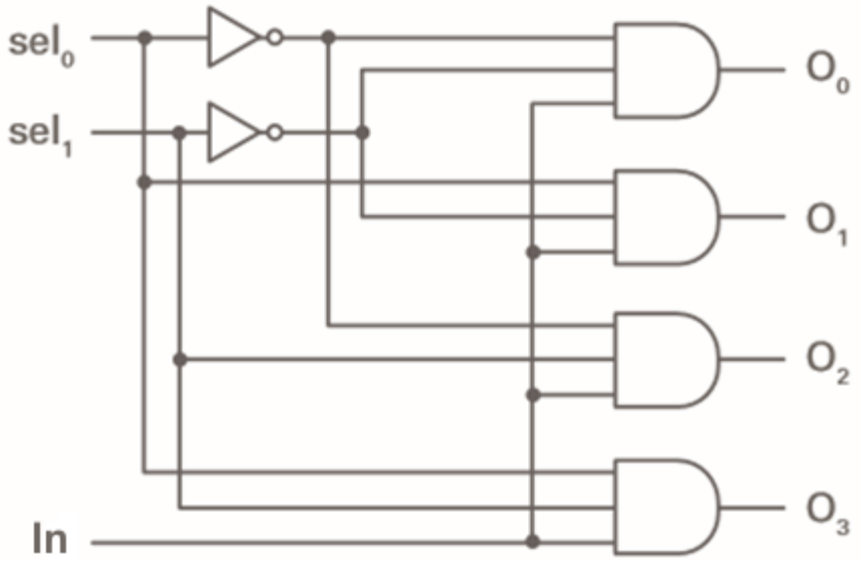
- It places the value of a single data input on several data outputs depending on a selection signal
- Usually demultiplexers have **s select inputs** and **2^s outputs**
- Since demultiplexers take one input and connect it to many outputs, some of their uses are for communication (two-way communication usually includes both multiplexers and demultiplexers) and for serial to parallel converters

Demultiplexers (2/2)

- The graphical symbol for a 1-to-4 demultiplexer is shown below (left) as well as the corresponding 1-to-4 DEMUX truth table (center) and the CLC (right)



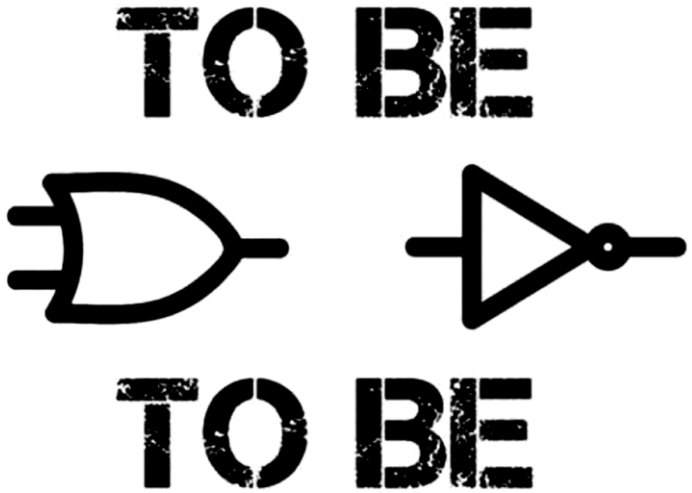
sel_1	sel_0	O_3	O_2	O_1	O_0
0	0	0	0	0	In
0	1	0	0	In	0
1	0	0	In	0	0
1	1	In	0	0	0



1-to-4 DEMUX

Ευχαριστώ για την προσοχή σας!

- **Ερωτήσεις / Απορίες ;**



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