

Elementos de Sistemas

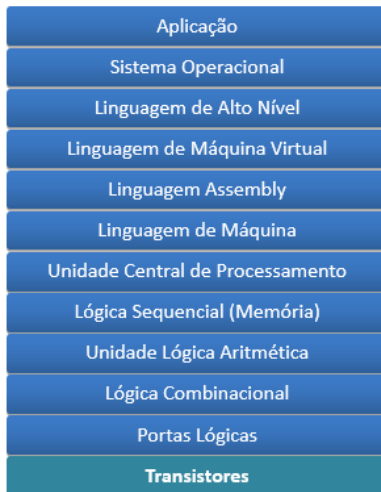
Transistores e CIs

Renan Trevisoli

Engenharia da Computação

21/08/2024

Camadas de abstração



Válvulas



¹By Stefan Riepl (Quark48) - Self-photographed, CC BY-SA 2.0 de,
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Insper

Válvulas



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Insper

Evolução

Moore's Law: The number of transistors on microchips doubles every two years

Moore's law describes the empirical regularity that the number of transistors on integrated circuits doubles approximately every two years. This advancement is important for other aspects of technological progress in computing – such as processing speed or the price of computers.

Our World
in Data

Transistor count

50,000,000,000

10,000,000,000

5,000,000,000

1,000,000,000

500,000,000

100,000,000

50,000,000

10,000,000

5,000,000

1,000,000

500,000

100,000

50,000

10,000

5,000

1,000

500

250

125

62.5

31.25

15.625

7.8125

3.90625

1.953125

0.9765625

0.48828125

0.244140625

0.1220703125

0.06103515625

0.030517578125

0.0152587890625

0.00762939453125

0.003814697265625

0.0019073486328125

0.00095367431640625

0.000476837158203125

0.0002384185791015625

0.00011920928955078125

5.9604644775390625e-05

2.9802322387695312e-05

1.4901161193847656e-05

7.450580596923828e-06

3.725290298461914e-06

1.862645149230957e-06

9.313225746154785e-07

4.656612873077392e-07

2.328306436538696e-07

1.164153218269348e-07

5.82076609134674e-08

2.91038304567337e-08

1.455191522836685e-08

7.275957614183425e-09

3.637978807091712e-09

1.818989403545856e-09

9.09494701772928e-10

4.54747350886464e-10

2.27373675443232e-10

1.13686837721616e-10

5.6843418860808e-11

2.8421709430404e-11

1.4210854715202e-11

7.105427357601e-12

3.5527136788005e-12

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1.1102230246251562e-13

5.551115123125781e-14

2.7755575615628905e-14

1.3877787807814452e-14

6.938893903907226e-15

3.469446951953613e-15

1.7347234759768065e-15

8.673617379884032e-16

4.336808689942016e-16

2.168404344971008e-16

1.084202172485504e-16

5.42101086242752e-17

2.71050543121376e-17

1.35525271560688e-17

6.7762635780344e-18

3.3881317890172e-18

1.6940658945086e-18

8.470329472543e-19

4.2351647362715e-19

2.11758236813575e-19

1.058791184067875e-19

5.293955920339375e-20

2.6469779601696875e-20

1.3234889800848437e-20

6.617444900424219e-21

3.3087224502121095e-21

1.6543612251060547e-21

8.271806125530273e-22

4.1359030627651365e-22

2.0679515313825682e-22

1.0339757656912841e-22

5.1698788284564205e-23

2.5849394142282102e-23

1.2924697071141051e-23

6.462348535570525e-24

3.2311742677852625e-24

1.6155871338926312e-24

8.077935669463156e-25

4.038967834731578e-25

2.019483917365789e-25

1.0097419586828945e-25

5.048709793414472e-26

2.524354896707236e-26

1.262177448353618e-26

6.31088724176809e-27

3.155443620884045e-27

1.5777218104420225e-27

7.888609052210112e-28

3.944304526105056e-28

1.972152263052528e-28

9.86076131526264e-29

4.93038065763132e-29

2.46519032881566e-29

1.23259516440783e-29

6.16297582203915e-30

3.081487911019575e-30

1.5407439555097875e-30

7.703719777548937e-31

3.8518598887744685e-31

1.9259299443872342e-31

9.629649721936171e-32

4.8148248609680855e-32

2.4074124304840427e-32

1.2037062152420214e-32

6.018531076210107e-33

3.0092655381050535e-33

1.5046327690525267e-33

7.523163845262633e-34

3.7615819226313165e-34

1.8807909613156582e-34

9.403954806578291e-35

4.7019774032891455e-35

2.3509887016445727e-35

1.1754943508222863e-35

5.8774717541114315e-36

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3.6734198463196445e-37

1.8367099231598222e-37

9.183549615799111e-38

4.5917748078995555e-38

2.2958874039497777e-38

1.1479437019748889e-38

5.739718509874444e-39

2.869859254937222e-39

1.434929627468611e-39

7.174648137343055e-40

3.5873240686715275e-40

1.7936620343357637e-40

8.968310171678819e-41

4.4841550858394095e-41

2.2420775429197047e-41

1.1210387714598524e-41

5.605193857299262e-42

2.802596928649631e-42

1.4012984643248155e-42

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3.5032461608120385e-43

1.7516230804060192e-43

8.758115402030096e-44

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2.736911063134405e-45

1.3684555315672025e-45

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1.710569414459003e-46

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2.1382117680737537e-47

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5.3455294201843845e-48

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1.019578823124768e-53

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2.54894705781192e-54

1.27447352890596e-54

6.3723676445298e-55

3.1861838222649e-55

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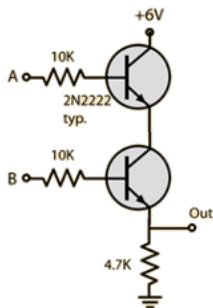
Transistores

- Vários tipos de transistores

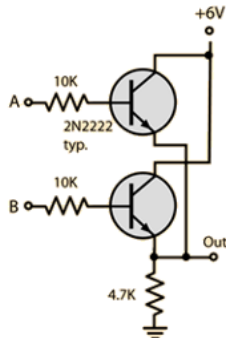
- BJT
- MOS
-

- Várias formas de realizar

- RTL
- TTL
- CMOS
-

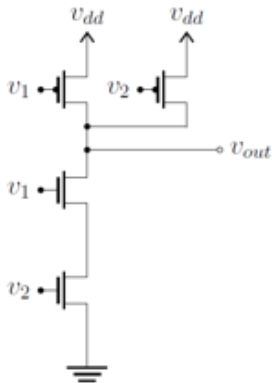


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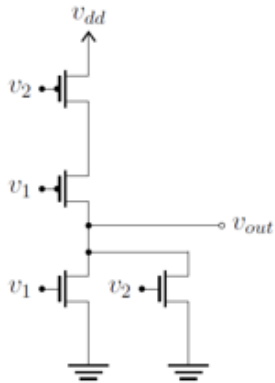


OR

CMOS



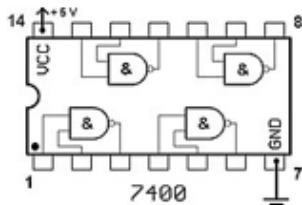
NAND



NOR

CI's

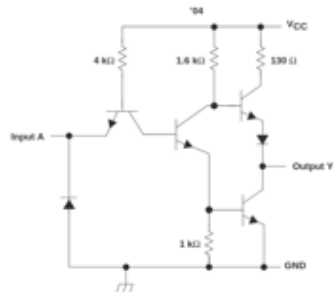
- 74XX



SN5404, SN54LS04, SN54S04,
SN7404, SN74LS04, SN74S04
HEX INVERTERS

SOI, NS209C - DECEMBER 1983 - REVISED JANUARY 2004

schematics (each gate)



Insper

Prática

- Lab. 1
- APS-A

Próxima aula

- Estudar: Teoria → Componentes
- Estudar: VHDL → Básico