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EECS 3201: Digital Logic Design Lecture 1

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Quick Notes

- Course Name: Digital Logic Design, EECS 3201 (Any pharmacy or Music students here?!)
- Lecturer: Me!, iamer@cse.yorku.ca
- Office Hours: W & F after class
- TAs: Jingbo Zhao and Arhum Sultana
- Course Material: Textbook + Slides + Any notes posted on the course website or discussed during lectures/labs
- Textbook:
  - Digital Design, 5th Edition, M. Morris, Mano and Michael D. Ciletti
- Other References:
  - Fundametals of Digital Logic with Verilog Design, 3rd Edition, S. Brown and Z. Vranesic
  - Digital Arithmetic, Ercegovac and Lang
  - Digital Design, 4th Edition, John Wakerly
  - Advanced Digital Logic Design, Sunggu Lee
  - Other references (if any) will be stated in the last slide of the lectures
- Development Environment: Altera Quartus II

Course Policies

- Attending Lectures: IMPORTANT!
- Take notes during the lectures. Do not expect that everything said during the lecture will be documented in the slides
- I expect that anything "said" during a lecture or a lab session will be known by all students. So, if you do not attend, then please "at least" ask!
- It is your responsibility to check the course website regularly for any announcements or material
- I am open for *reasonable* interrupts during lectures for related questions

Course Assessment

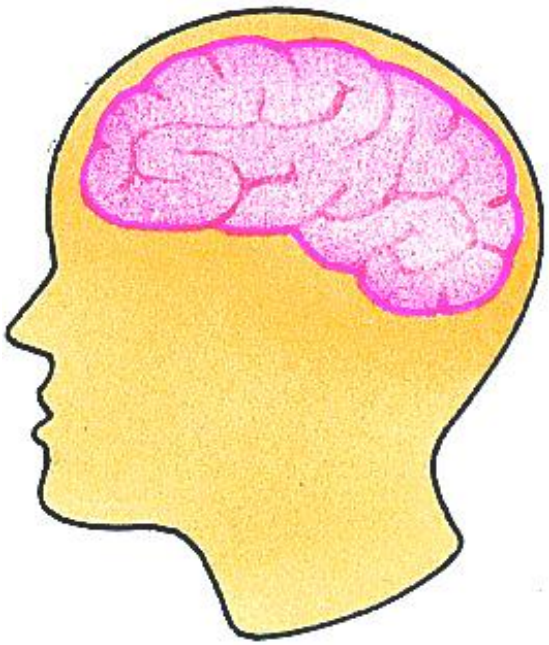
- Assignments (10%)
- Midterm (30%)
- Labs/Project(s) (15%)
- Final (45%)

- Total (100%)

Course Objective

DVD, BD, MP3, iPOD, PC, tablet, camera, cell phone, etc

Advanced combinational and sequential design, FSM, ICs, Arith. Circuits, Modern CAD tools usage, HDL (Verilog), FPGA, … etc.

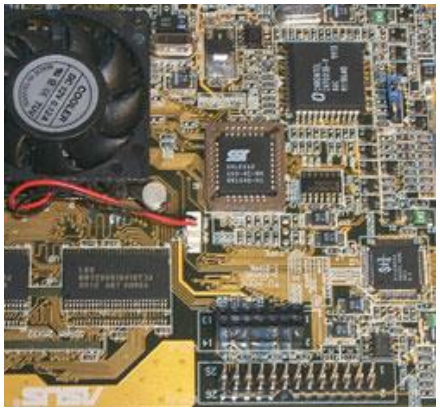


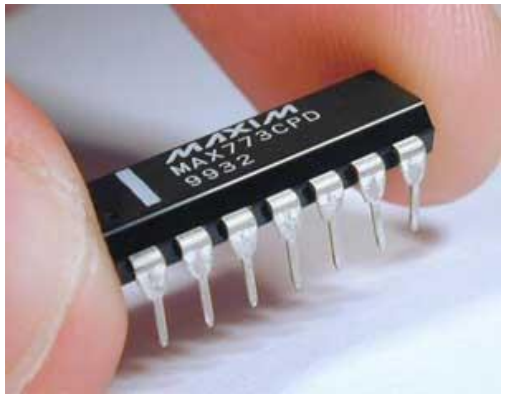
EECS 3201

What student knows about the word "digital" *before* EECS 3201

What student knows about the word "digital" *after* EECS 3201

What's inside your computer?





Computer **PCB** **IC**

This course introduces you to the design process of a typical IC

Integrated Circuits (ICs)

- Microelectronic *semiconductor* devices consisting of many interconnected transistors and other components
- Modern digital systems use ICs almost exclusively in their designs
- An IC is constructed ("fabricated") on a small rectangle (a "die") cut from a Silicon “wafer”
- Pure silicon is the basis for most integrated circuits. It provides the base, or *substrate* for the entire chip and is chemically doped to provide the N and P regions that make up the integrated circuit components
- ICs are small, reliable, cheap, and consume low power

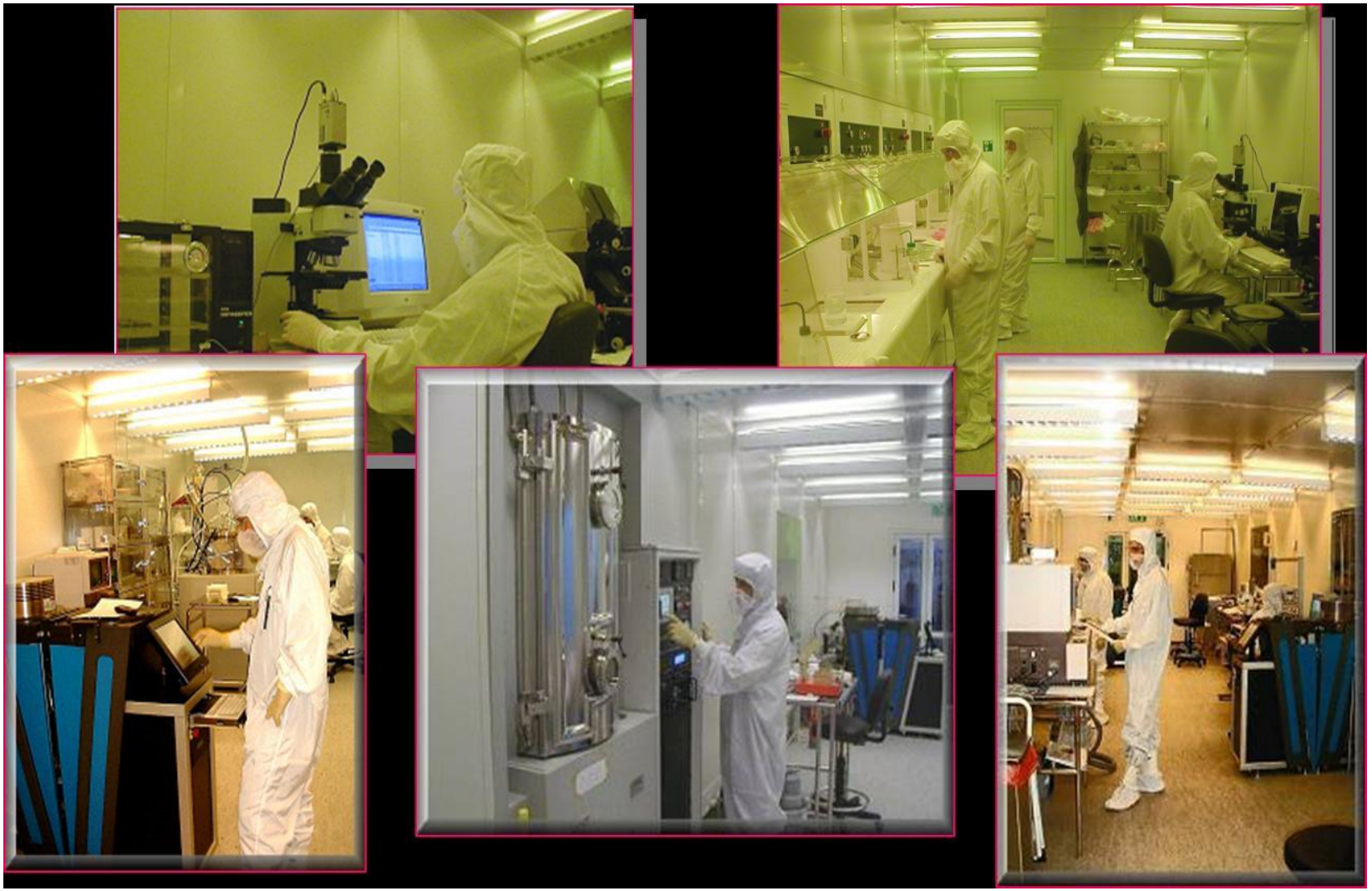
→ ***Quite a good deal!***

Where is an IC Fabricated?

- In a Fabrication Plant (Fab/Foundry)
- There are a few of them all-around the world
- Establishing a Fab costs billions of dollars

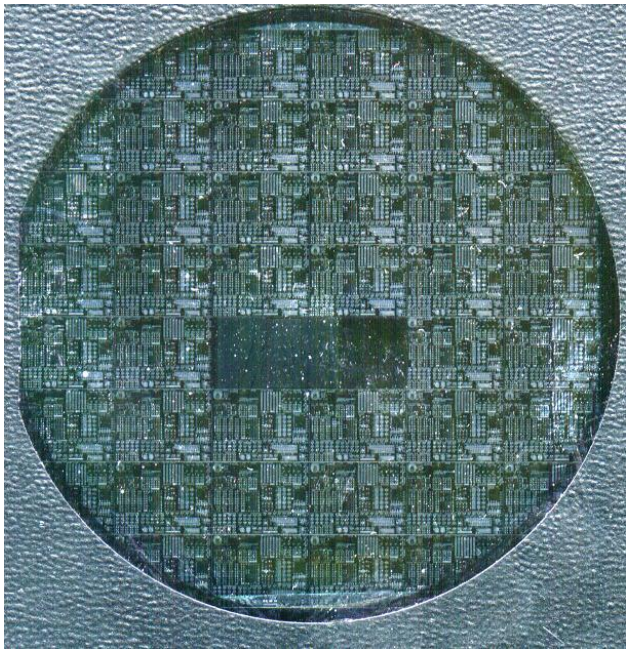
- This “Foundry Model” shows how business separates the design process from the manufacturing process

How does a Fab look like?



IC Manufacturing

- ICs are typically created on larger circular sheets of silicon called “wafers”
- A wafer is typically 100-300 mm in diameter, and about 4 mm thick
- A large silicon circuit is about 1 cm long
- In order to fabricate a number of chips, the wafer passes through thousands of steps including: thermal, chemical, cleaning, … etc
- Each IC is tested before and after “packaging”



A Silicon wafer

Fabrication Yield

- Due to the complexity of the manufacturing process, not every site on a wafer turns out to be a functional circuit
- The *fabrication yield* is the percentage of good sites to the total set of sites

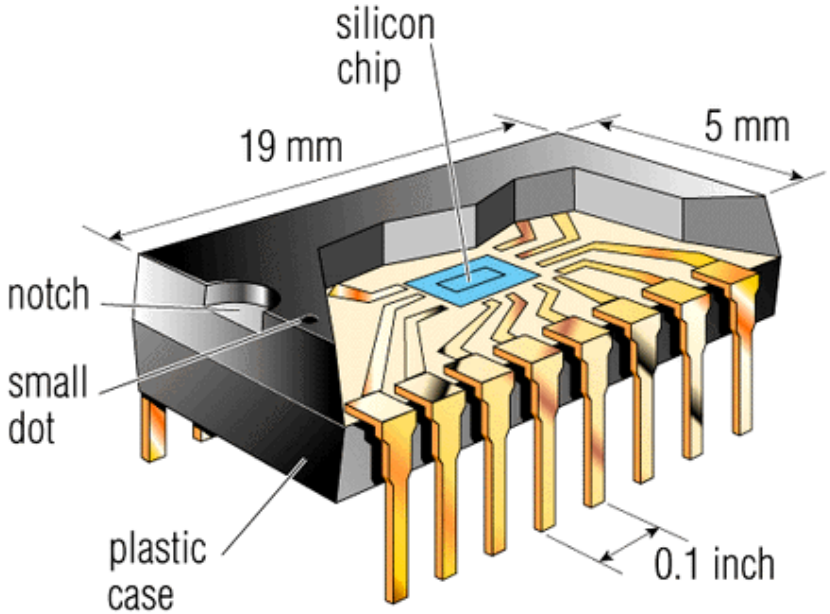
$$Y = \frac{N_G}{N_T} \times 100\%$$

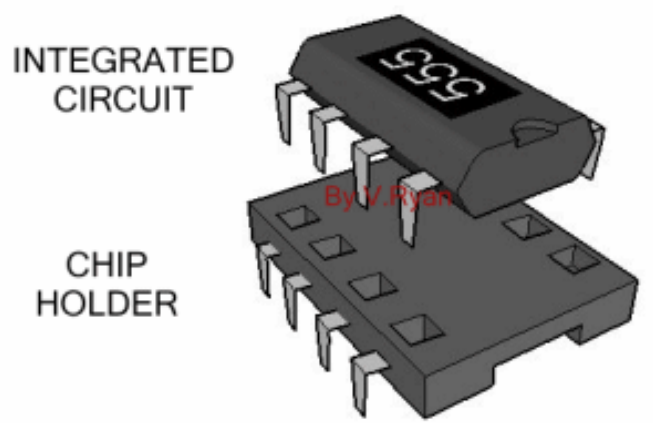
, where $N_G \rightarrow$ Number of Good (functional) sites

$N_T \rightarrow$ Total number of sites

- A good chip design made by a good process will have more than 90% yield. A yield below 70% wastes too much material, losing money!

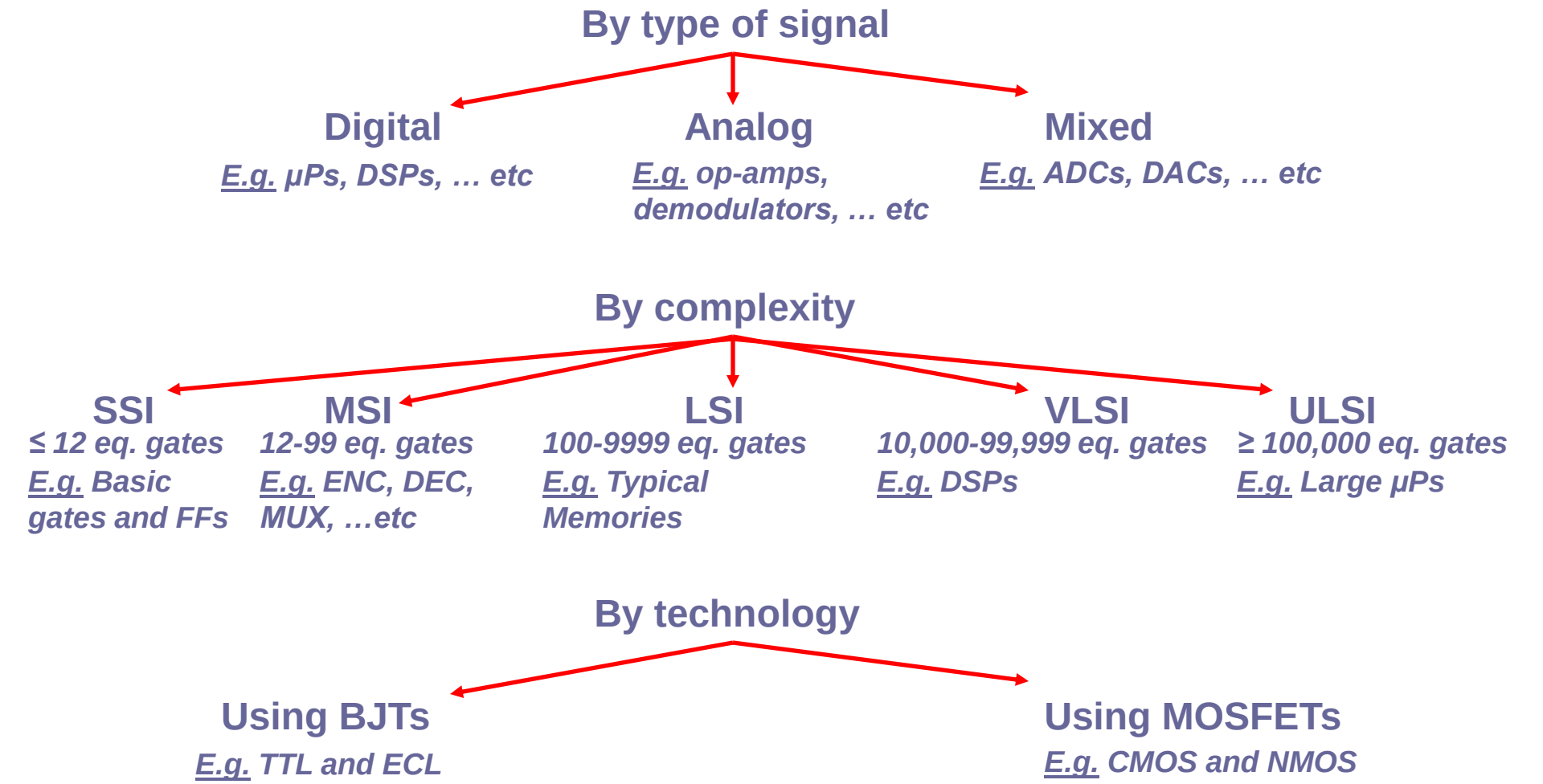
IC Package



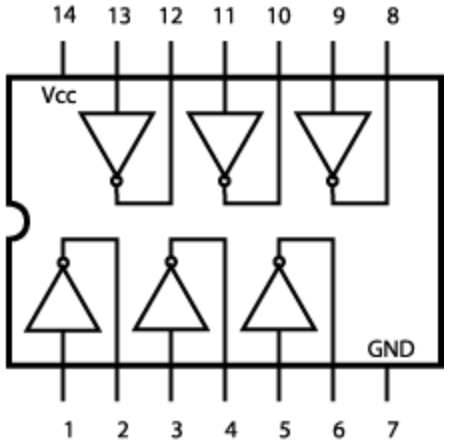


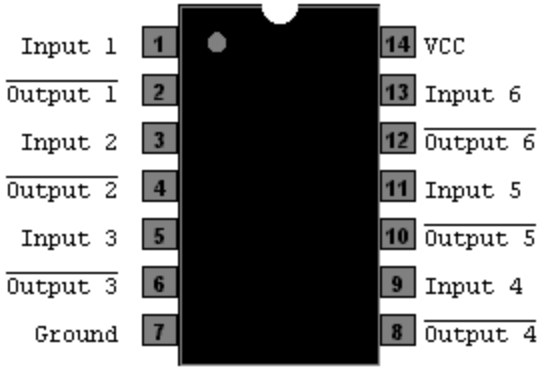
- The chip inside an IC is usually packaged inside a piece of black plastic with tiny pins protruding to allow connections to the circuit.
- It is often a good idea to solder a cheap chip holder to a PCB and then press the integrated circuit package into it

IC Classification



IC Examples





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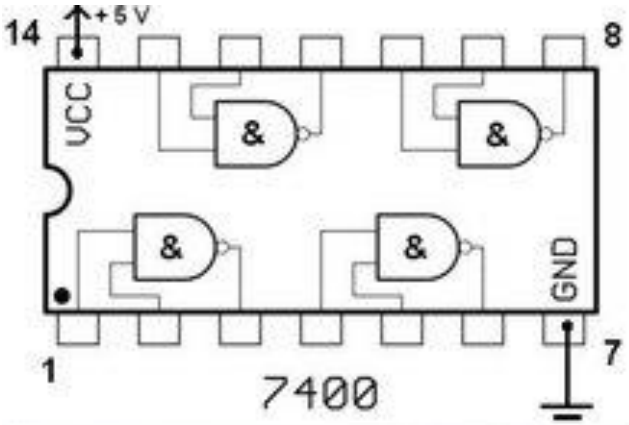

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References

- “Digital Fundamentals (6th Edition)”, Thomas L. Floyd, Prentice Hall, 2002
- “Introduction to VLSI Circuits and Systems”, John P. Uyemura, Wiley, 2001
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- http://www.wikipedia.com