INF3410/4411, Fall 2018

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Why take this course?

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Why do an ASIC?

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Well, why not?

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- Costly (development, design iteration time, production)
- Inflexible and low level of reusability

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So why bother?

- Ultimate performance (speed, power)
- Ultimate miniaturization
- Reliability (fewer points of failure)
- Very cheap for high volume production (e.g. CPUs)
- For (Mixed-Signal) Systems-on-Chip (SoC)

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Why do a Digital ASIC?

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See previous arguments for and against ASIC
The most important is the small price per piece for high volume production particularly for large scale systems-on-chip (SoC), e.g. CPU, but also FPGAs, GPUs, Microcontrollers etc. (mostly not 'full custom' design but automated 'synthesis'), but real understanding on a single transistor level is required for the ultimate performance in speed, miniaturization, power consumption. Analogous in SW of where it's worth to program in Assembler.

Content

The world is analog

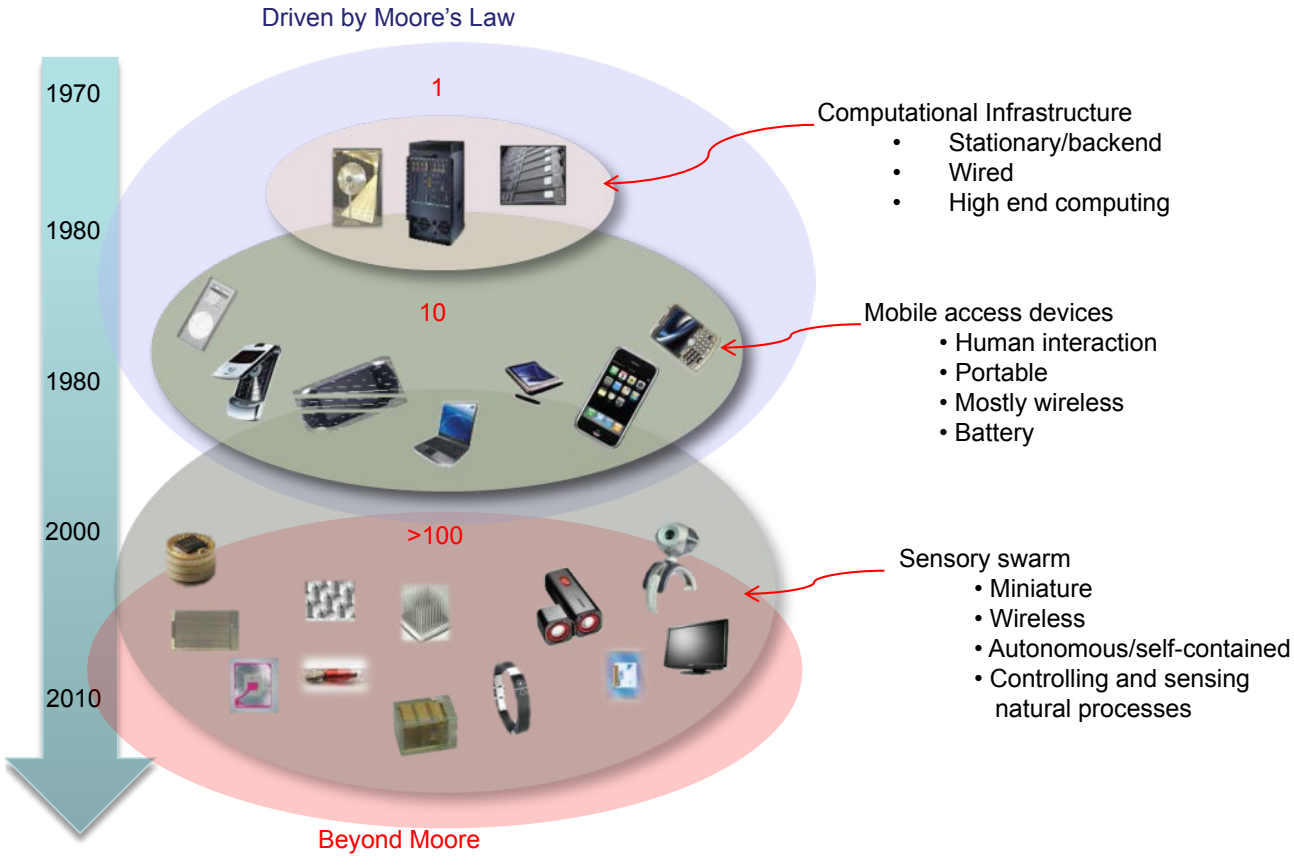
Analog electronics for sensor/actuator interfaces

$\Leftrightarrow$

$\Leftrightarrow$ user $\Leftrightarrow$

Ubiquitous Sensors Interfaces

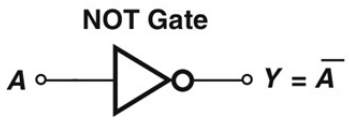
Trend to 'Cyberphysical Systems'

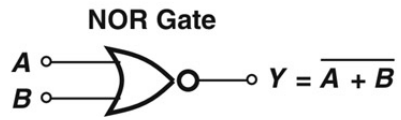


Even Computers are Analog ;-)

Where the digital abstraction breaks down

- Gates

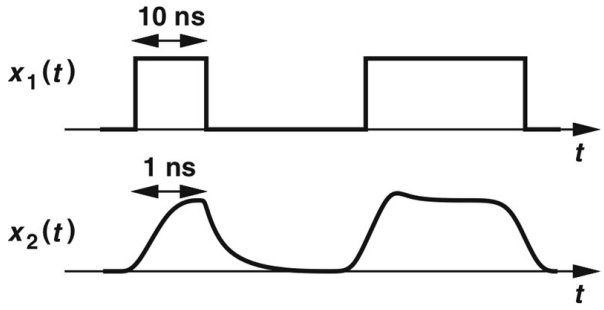




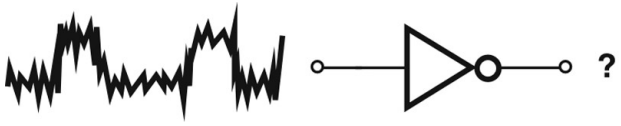
- Increasing speed
  - Why this degradation?
  - How do we improve performance?
  - Digital → analog
    - Going for speed…

100MHz

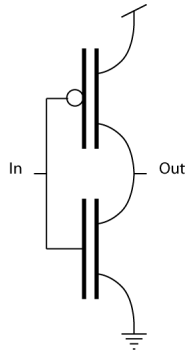
1GHz



- Noise/interference



  - Where does this noise originate?
  - How do we reduce this noise/interference?
  - Digital → analog
    - When scaling down size and scaling up complexity



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Amplifiers: importance

- What a switch is for digital electronics, amplifiers are for analog electronics:
  - the most important active element. (A switch *is* an amplifier.)
  - an abstraction/simplification of a physical device.
- An amplifier is required where-ever electronics (or a biological organism) interfaces with the real world, mediating between sensors and actuators and processing circuitry. (The world is analog.)
- Maintaining signal energy in processing requires amplification.

Amplifiers: definition

An amplifier is a device that linearly/monotonically projects an input signal range to an output signal range, increasing power (usually) and optionally changing the signal representation (transducer).

Amplifiers: example

Amplifiers: more examples

Ubiquitous electronic amplifiers

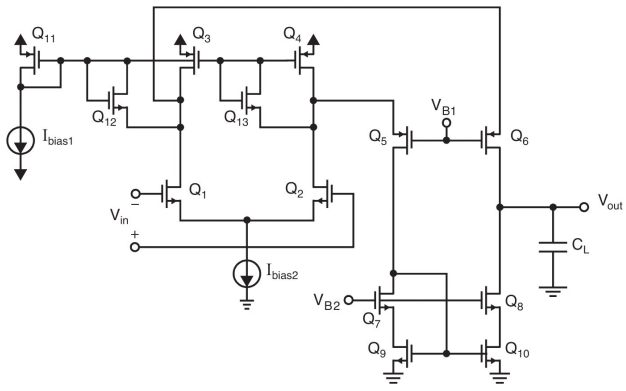

Figure 6.20
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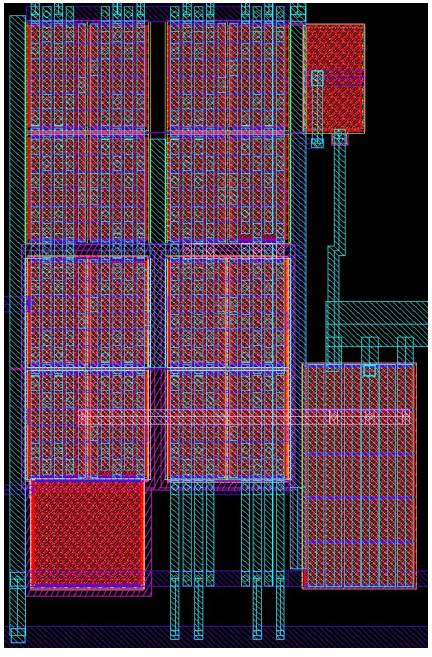
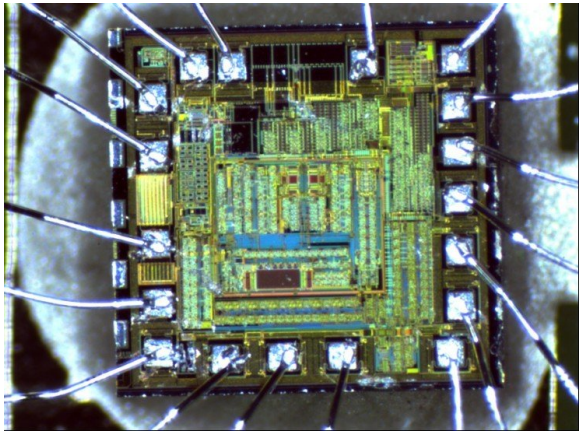
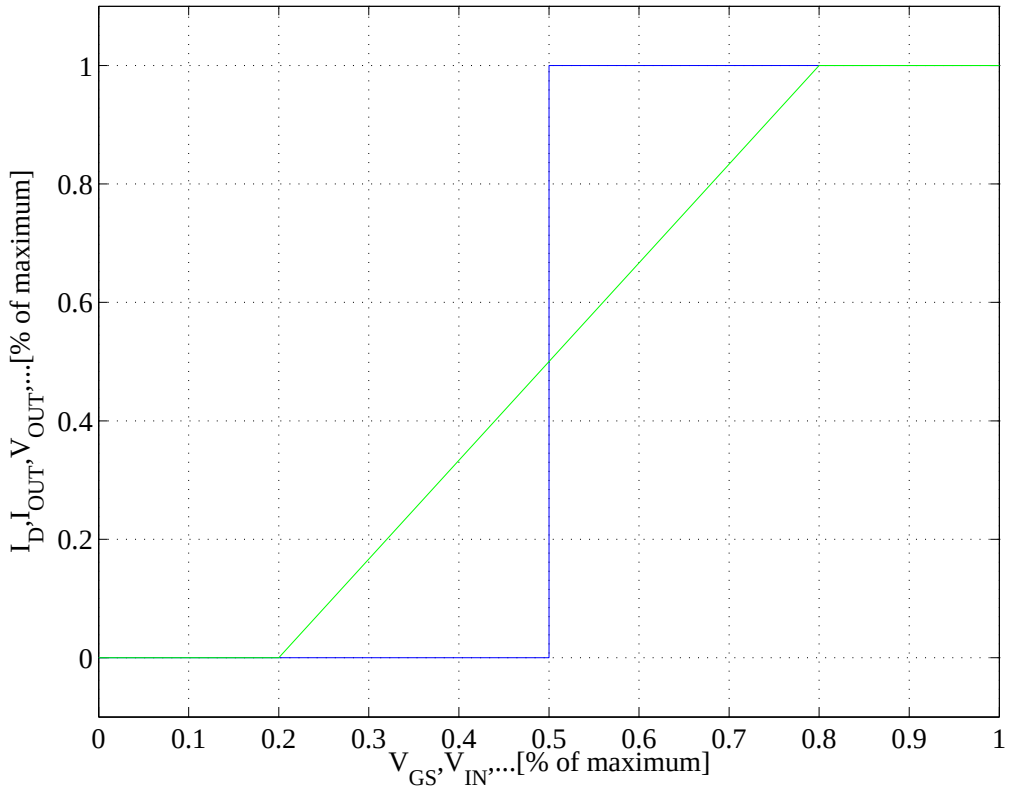




Switch vs. Amplifier



Content

Teaching	14 lectures (Mondays 12-14 in Smalltalk), lecture foils, podcast (no guarantee!), book: 'Microelectronic Circuits' by Sedra & Smith, International (!) 7th Edition, selected papers
Labs	3 tasks (counting 40% towards final mark, task 1 is only pass/not pass, lab assistant: Henrik Klev), workgroups with up to 3 students
Paper exercises	exercises in preparation for exam (!), Wednesdays 12-14, teaching assistant: Tohid Kahnshan
Tools	Cadence, matlab, solder iron, lab equipment
Skills	electronics, maths, physics, programming
Exam	written exam, counting 60% towards final mark, early in December