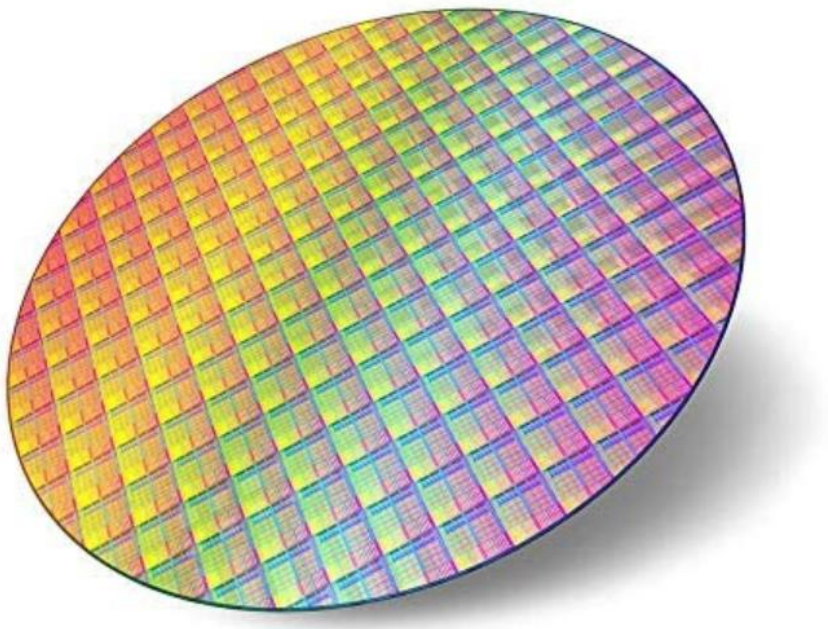
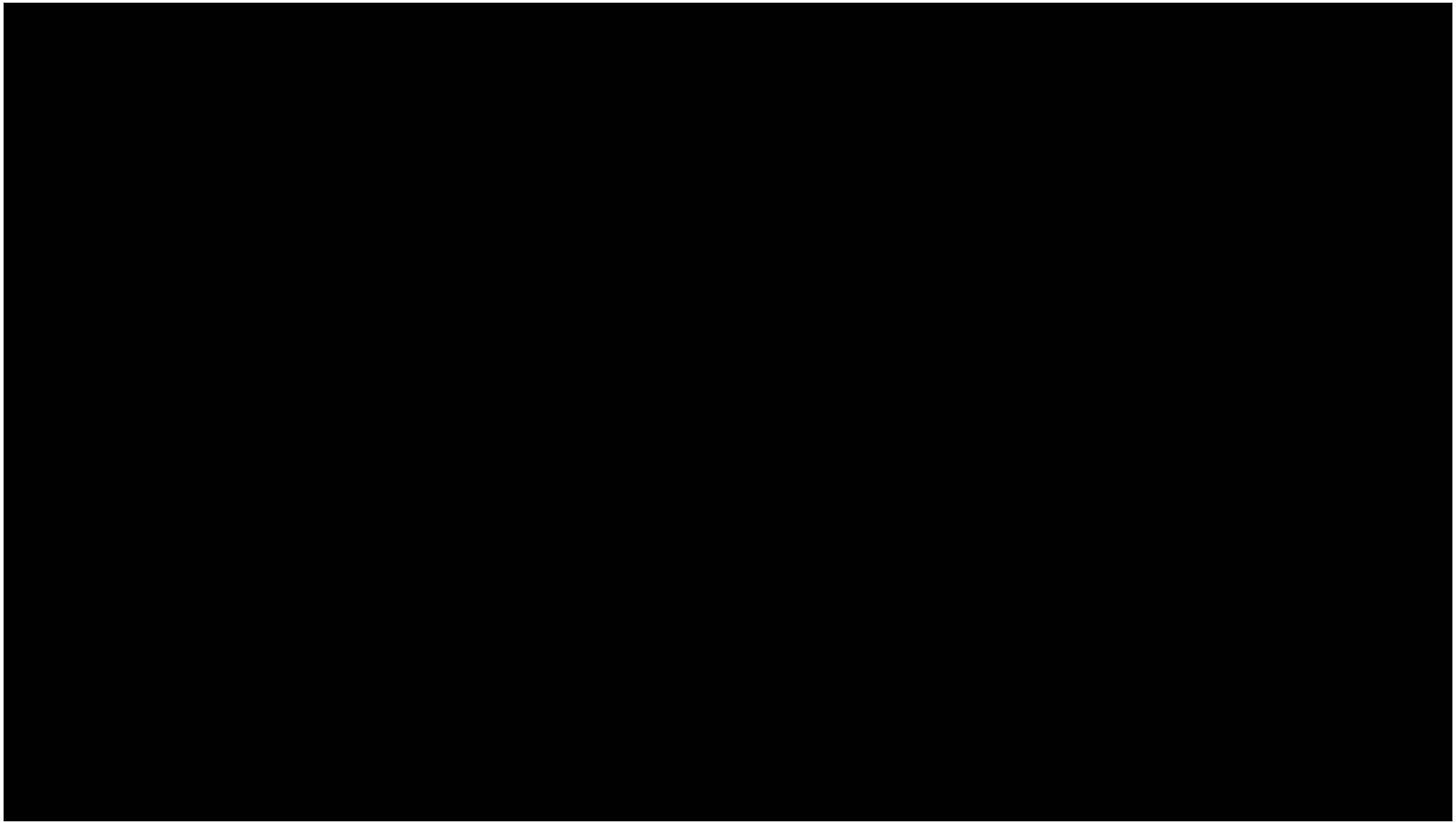
How to Become a Chip Designer at DTU



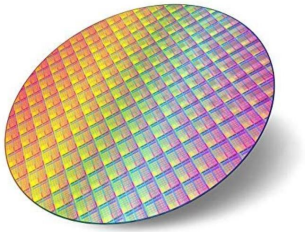
Martin Schoeberl

Technical University of Denmark

The President of the EC

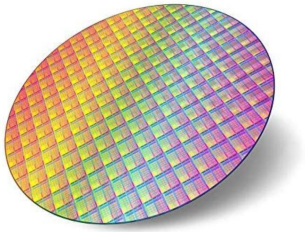


The European Chips Act



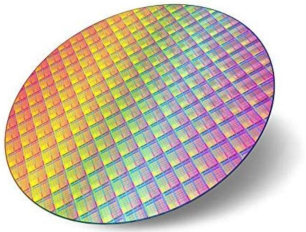
- Ursula von der Leyen: “There Is No Digital Without Chips”
- Ursula von der Leyen: “Chips are at the centre of the global technological race”
- EUR 15 billion in additional public and private investment
- A good time to become a chip designer!

Chip Design Education



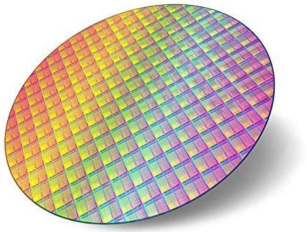
- We have the courses at DTU
- Analog and digital chip design
- From Bachelor to Master level
  - DTU Compute
  - DTU Electro
  - DTU Photonics

Related Programs



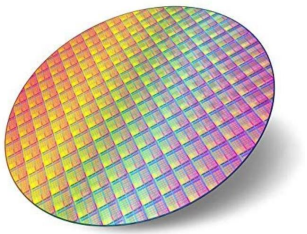
- Bachelor
  - Cyber Technology (CT)
  - Electrical Engineering (EE)
  - Software Technology (ST)
- Master
  - Communication Technologies and System Design (CT)
  - Computer Science and Engineering (CSE)
  - Electrical Engineering (EE)

Bachelor Courses

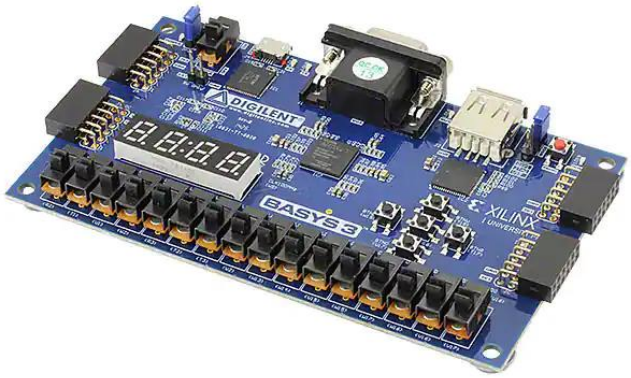


- Digital Electronics 1 & 2 (EE)
- Digital Hardware design for Communications (CT)
- Projects in Digital hardware design for Communications (CT)
- Computer Systems (ST)
- Computer Architecture and Engineering (EE + mix)
- Integrated analog electronics 1 (EE)

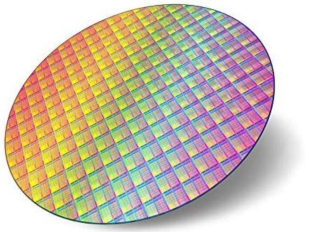
Digital Electronics 1 & 2



- 1st and 2nd semester EE
- Around 80 students
- Boolean Algebra
- Transistors, gates, and flip-flops
- (Small) sequential circuits
- Circuit delay and timing parameter
- Finite state-machine + data path
- Hardware description languages
  - VHDL and Chisel
- Projects with FPGA board
- CAD tools: Xilinx Vivado, IntelliJ IDE, GTKWave

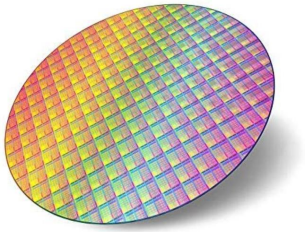


Integrated Analog Electronics 1



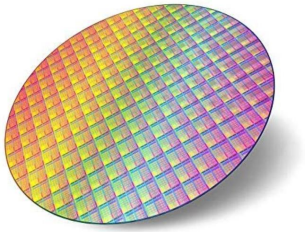
- Elective 5th semester EE
  - Follow-up of courses in signal processing and electrical circuits 1+2.
- 30+ students, mostly EE
- Runs in parallel with signals and linear systems in discrete time
  - Digital signal processing
  - Expands knowledge on signal processing
- Fundamentals of CMOS transistor
  - Shichman-Hodges model
  - Non-ideal components
- Basic amplifier gain stages
- Small-signal analysis
  - Amplifier transfer functions, pole/zero analysis.
- Two-stage operational amplifier
  - Analysis and design on paper

Master Courses



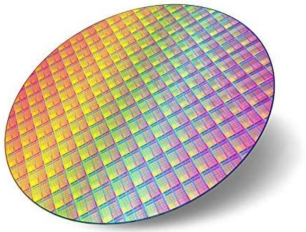
- Design of Digital Systems (CSE)
- Integrated analog electronics 2 (EE)
- Advanced Computer Architecture (CSE)
- FPGA design for communication systems (CT)
- VLSI Design
- Test of Digital Systems
- Design and layout of integrated CMOS circuits (EE)
- System level integrated circuit design (EE and PhD)
- Design of Arithmetic Processors
- Design of Asynchronous Circuits

Integrated Analog Electronics 2



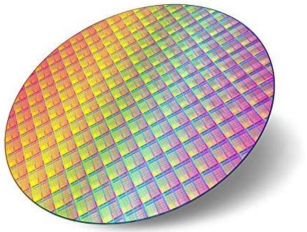
- Technical specialization spring(MSc.EE)
- 15+ students, mostly EE
- Following courses:
  - Design and layout of integrated CMOS circuits
  - System level integrated circuit design
- Advanced amplifier topologies
  - Folded-cascode amplifier, current mirror amplifier
- Noise analysis
- Transistor layout
- Data converters
  - Fundamentals of data converters
  - Digital-to-Analog and Analog-to-Digital converters
- Design of a two-stage operational amplifier
  - Analysis and design in CAD tool (Cadence)
  - Layout of op-amp in Design and layout of integrated CMOS circuits

Digital Master Courses



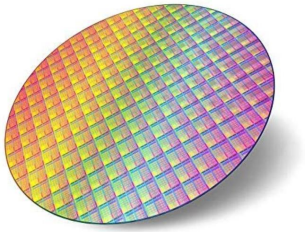
- VLSI Design
  - Classic chip design course
  - CMOS process
  - Timing and power dissipation
  - Design flow for ASICs and FPGAs
- Design of Digital Systems
  - Advanced digital design course (after DE 1 & 2)
  - RTL components and timing
  - Pipelining
  - FSM and data path
  - Design methodology with VHDL to describe the circuitry in an efficient way

Digital Master Courses



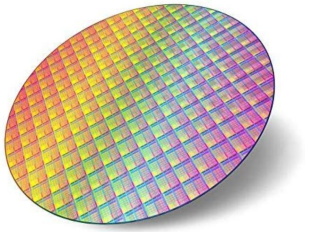
- Test of Digital Systems
  - Concepts and techniques of test of electronic circuits
  - Emphasis on the design for test
- Design of Arithmetic Processors
  - Application-specific acceleration
  - Arithmetic for Machine Learning
  - Approximate computing
- Design of Asynchronous Circuits
  - Circuits that operate without a global clock
  - Globally asynchronous locally synchronous circuits
  - Asynchronous control- and data processing circuits

Special Courses



- On demand setup
  - Single students or as a group
- Fall 2020: Verification of digital designs
  - 6 students
  - Some lectures, some reading up by students
  - Teaching to write testbenches and random test vector generation
- Spring 2022: Open-Source Chip Design
  - 12 students
  - Build an open-source chip with support from Google
  - Luca will present it later

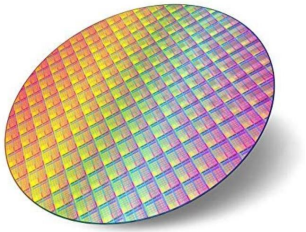
One Possible Path to a (Digital) Chip Design Engineer



- Start with EE Bachelor
  - Study line: Indlejrede systemer og programmering
- Continue with CSE MSc
  - Study line: Digital Systems
- And chose from relevant courses

- BSc ST has (almost) no digital design course
- MSc EE has no digital systems study line

Summary



- We need chip designers
- We have the education available at DTU
- EC is pushing for chip industry in the EU
- Danish industry is strong in chip design

- We need YOU!
- Let us build the silicon valley of Europe in the Copenhagen metropolitan area ☺