COMPUTER OPTION
IN METU EE DEPARTMENT

Overview

- Motivation

- Courses and Labs

- Feedback from Employers

- Invited Computer Option Graduates

- Research Opportunities

Motivation

- Computers are electronic devices

- Electrical and Electronics Engineers are the people that ***build*** the computers!

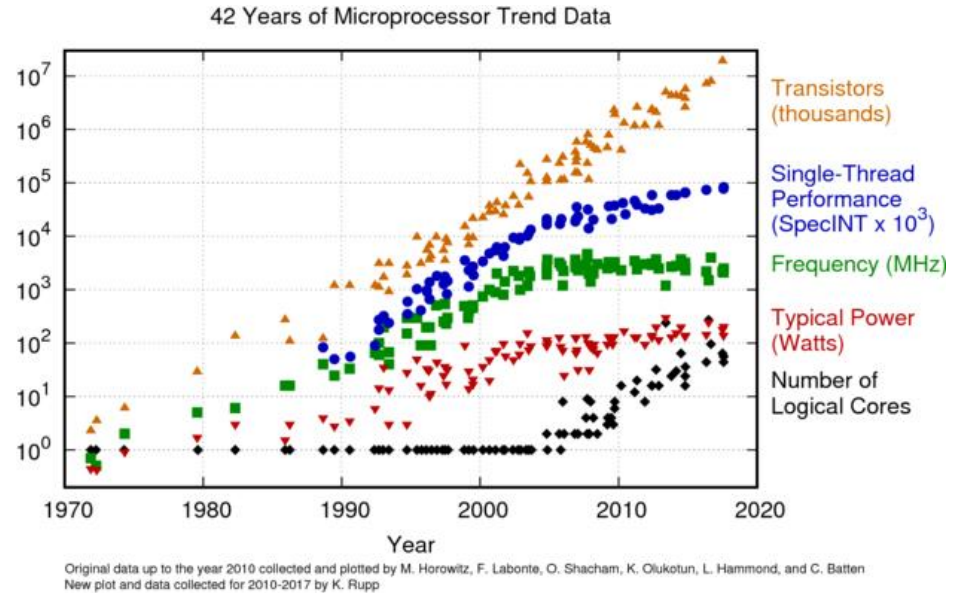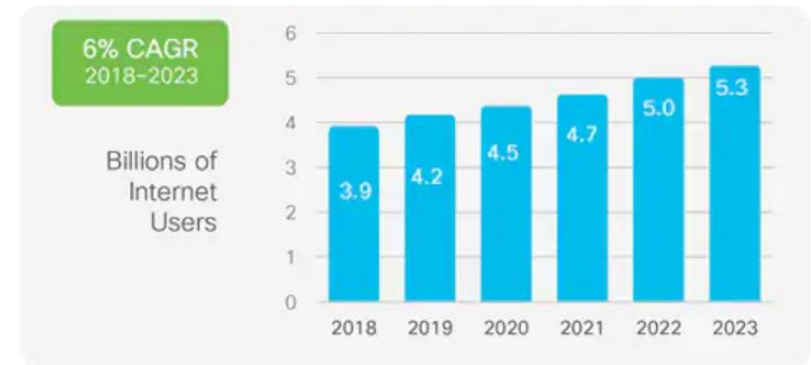Very dynamic field: All advances are at exponential rate: Never get bored, earn a lot of money ☺

42 Years of Microprocessor Trend Data

Original data up to the year 2010 collected and plotted by M. Horowitz, F. Labonte, O. Shacham, K. Olukotun, L. Hammond, and C. Batten
New plot and data collected for 2010-2017 by K. Rupp

Figure 1. Global Internet user growth

6% CAGR 2018–2023

Billions of Internet Users

2018	2019	2020	2021	2022	2023
3.9	4.2	4.5	4.7	5.0	5.3

Top Undergraduate Departments in the U.S in Computer Field

Rank	School	Department Title
1	MIT (Massachusetts Institute of Technology	Electrical Engineering & Computer Science
1	Carnegie Mellon University	Electrical and Computer Engineering
3	University of California–Berkeley	Electrical Engineering and Computer Sciences
4	Georgia Institute of Technology	Electrical and Computer Engineering
4	Stanford University	Computer Science (Electrical Engineering Department is separate)
6	University of Illinois–Urbana Champaign	Electrical and Computer Engineering

This year MIT and CMU are tied.

https://www.usnews.com/best-colleges/rankings/engineering-doctorate-computer

☞ Computer option is **a very popular option** in METU EE.
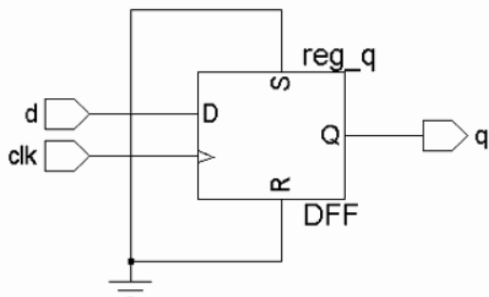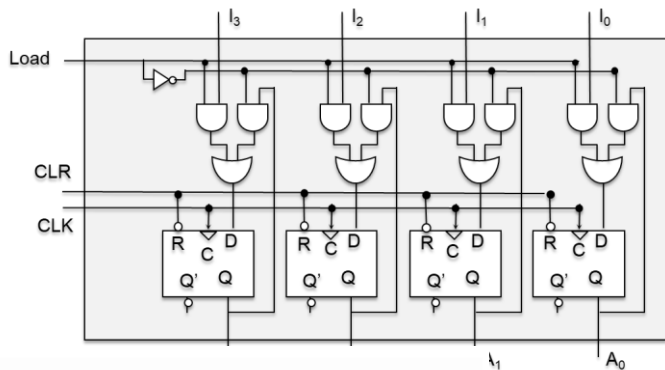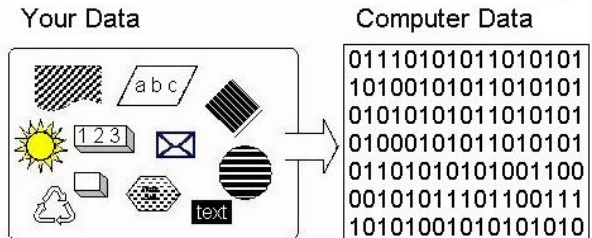
Course Overview

- Hardware (HW)
  - EE 312 Digital Micro Electronics
  - EE 314
  - EE 348 Logic design
  - EE 445 Computer Architecture I
  - EE 446 Computer Architecture II (with LAB)
  - EE 447 Introduction to Microprocessors (with LAB)
- Software (SW)
  - EE 441 Data Structures
  - EE 449 Introduction to Computational Intelligence
- Hardware-Software (HW-SW)
  - EE 442 Operating Systems
  - EE 444 Introduction to Computer Networks
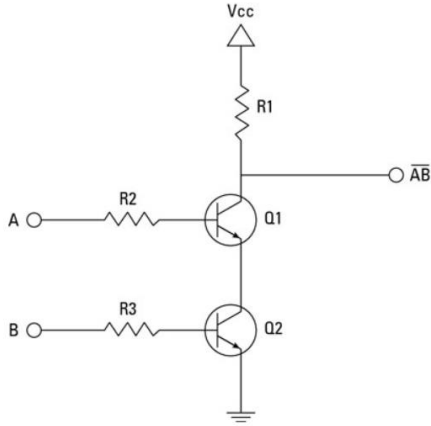
EE348
Introduction to Logic Design

- How does the computer store and manipulate information?

- Binary arithmetic

- Fundamental digital system components

- Arithmetic logic unit: Adders, Subtractors

- Data storage and memory: Registers

```
1  module ff (output reg q, input d,
2              input clk);
3
4      always @(posedge clk)
5          q <= d;
6
7  endmodule
```

EE314: Introduction to Hardware Description language

METU EE COMPUTER OPTION

Building and running a Computer with EE Courses


Abstraction

EE312

EE348

EE441-EE447

EE445-446

EE445-EE446
Computer Architecture I-I (HW)

HOW TO BUILD ANYᴄCOMPUTER

- Algorithmic state machines
- CPU organization
  - arithmetic logic unit
  - arithmetic algorithms
  - process control architectures
  - microprogramming
- ARM architecture
- Single-cycle, multi-cycle, pipelined architectures
- Memory organization
- Superscalar systems
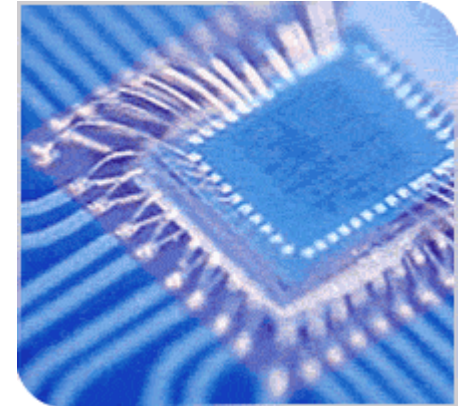
METU EE COMPUTER OPTION
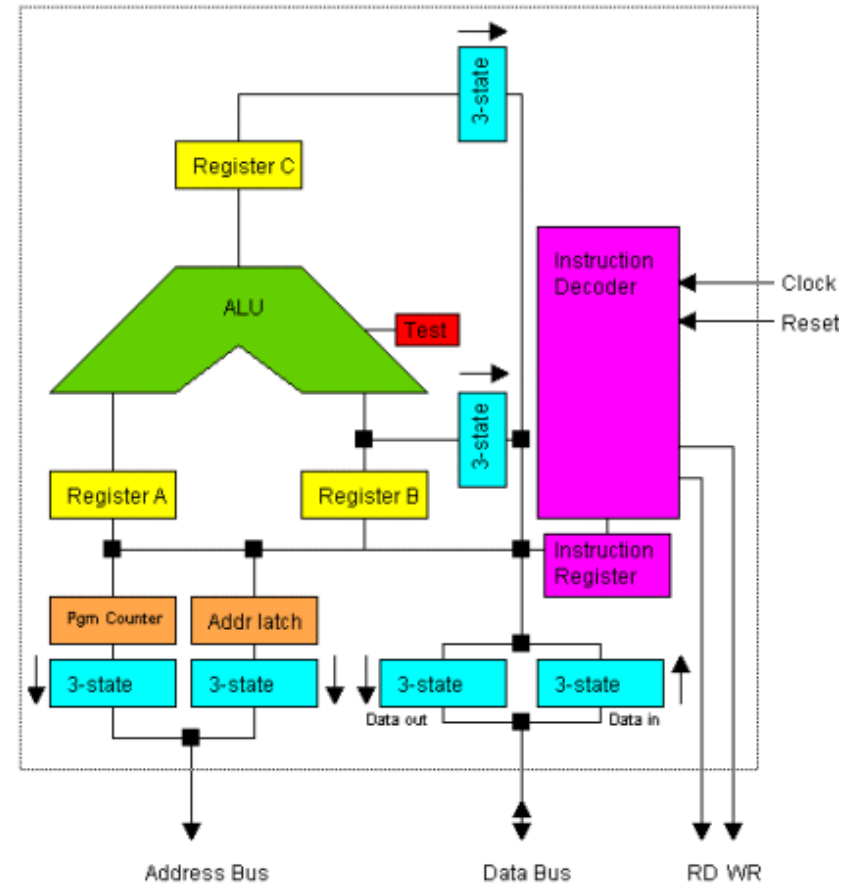
EE447 Microprocessors (HW)

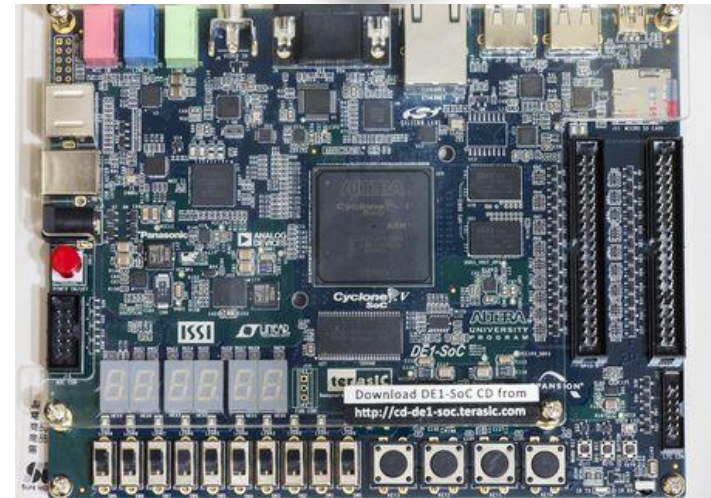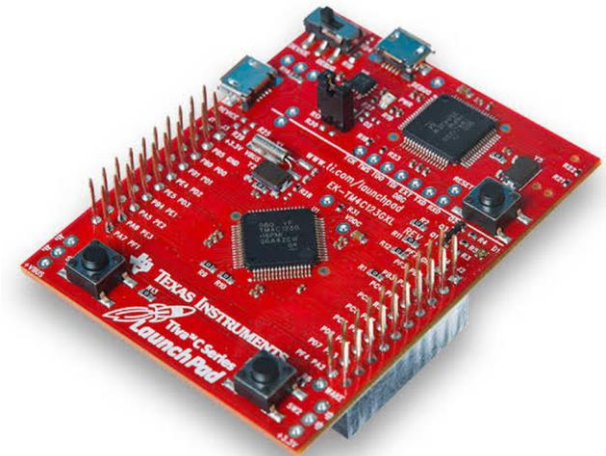**HOW TO PROGRAM AND USE A MICROPROCESSOR**

Useful for embedded system design

- Microprocessor/microcontroller architecture

- Memory interfacing

- Assembly programming

- I/O interfacing

- Interrupt processing

EE447-EE446 Laboratories

- Assembly language programming

- Using peripherals, test equipment

- Examples of hardware/software tradeoffs

- Interfacing of microprocessor with mechanical devices and with human users

- Input/output and timing

- Microprocessor communication with external systems.

- Design and Implementation of the designed computer components,
  - Implement the arithmetic algorithms
  - Single cycle – multicycle processor design

- Verilog design
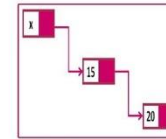
EE447-EE446 Laboratories

EE446 Example Project:
Pipelined Processor
Implementation with Verilog

EE447 Example Project:
Temperature Control with input
from heat sensor

Control Unit And Hazard Unit Schematically:

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EE441 Data Structures (SW)

HOW TO *EFFICIENTLY* ORGANIZE AND PROCESS DATA IN SOFTWARE

- C++ Overview, Object Oriented Programming

- Data Structures
  - Arrays, stacks, queues, linked lists
  - Trees, hash tables, graphs

- Algorithms:
  - Searching and sorting algorithms
  - Algorithm complexity Problem complexity
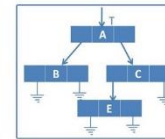
Sorting   Link list   list   spanning tree
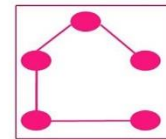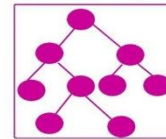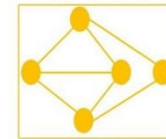
Tree   Graph   Stack   Hashing

$O(n2)$

Linear Time - $O(n)$

Algorithm Complexity

Logarithmic Time - $O(\log n)$

Constant Time - $O(1)$

Growth of input (n)
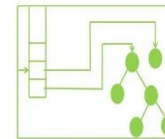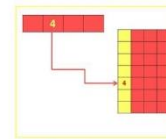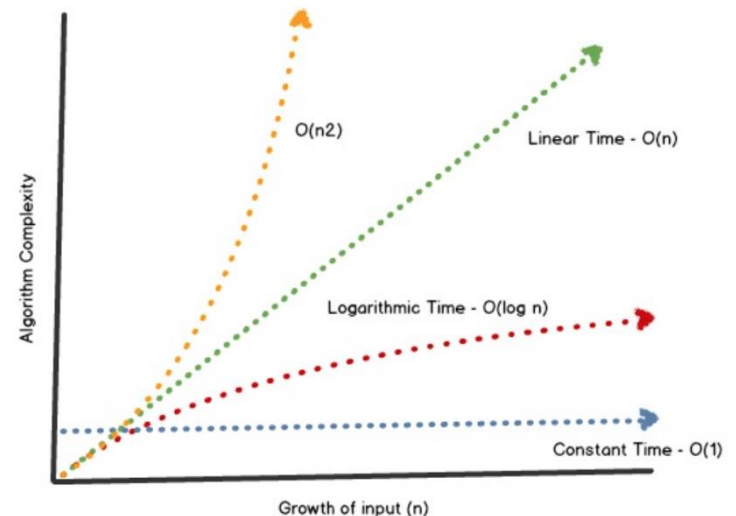
EE442 Operating Systems (SW-HW)

HARDWARE SOFTWARE INTERFACE, DATA AND PROCESS ORGANIZATION RUNNING ON A GIVEN HARDWARE

- concurrent processes, process scheduling
- memory management, virtual memory
- deadlocks, distributed systems
- the file system

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EE444 Computer Networks (SW-HW)

- Layered Internet computer network architecture

- Network applications

- Reliable transmission

- Addressing and Routing

- Device to device communication

- End-to-end (my computer in METU to some computer in China) communication

EE449 Introduction to Computational Intelligence (SW)

MODELING AND TRANSFORMATION OF INFORMATION AND KNOWLEDGE IN COMPUTERS, THEIR USE IN DECISION MAKING

- biologically and linguistically motivated computational paradigms,

- neural networks, evolutionary algorithms, fuzzy systems, bayesian networks,

- supervised, unsupervised, reinforcement learning.

neural networks

evolutionary algorithms

fuzzy systems

reinforcement learning
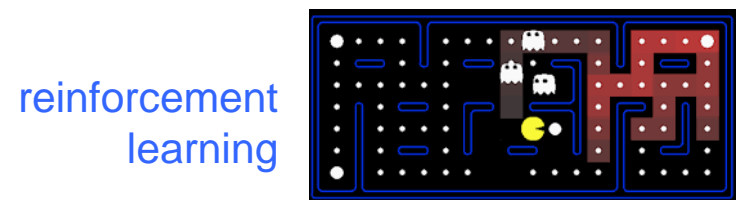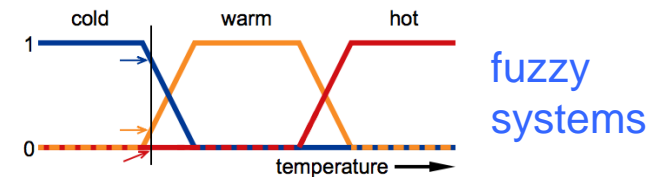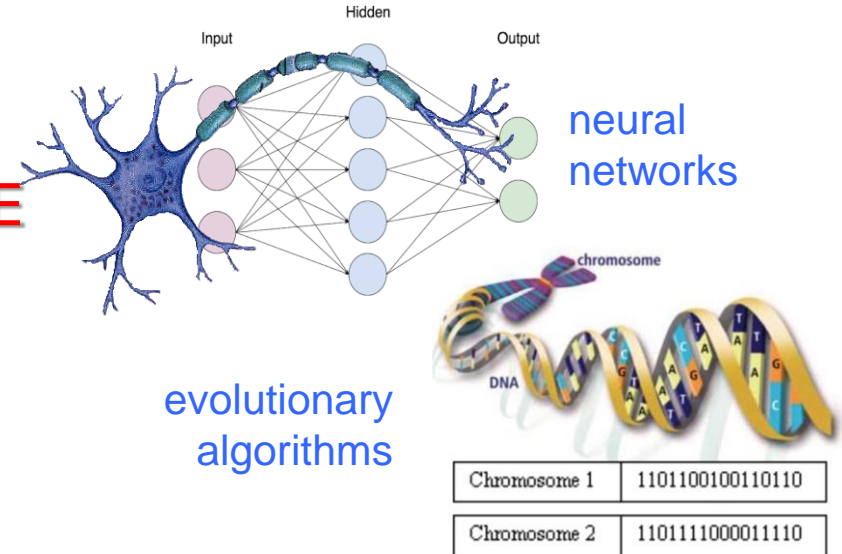
Carrier Paths

- Digital design and hardware development
- Embedded software development
- High-level software development
- Crossings between hardware and software fields

In Turkey

Mustafa Fatih Çemen · 2nd

Software Engineer

Istanbul, Turkey · **Contact info**

Bull Technologies

Software Engineer
Bull Teknoloji ve Ar-Ge A. Ş. · Full-time
May 2022 - Present · 1 yr 3 mos
İstanbul, Türkiye

5G User Plane Function(UPF) Module Design
- Specialised in QoS Enforcement Rule Implementation in 5G Networks.

Skills: C · Open vSwitch · Intel Dpdk

aselsan Aselsan
2 yrs 6 mos

• **Software Engineer**
Sep 2020 - May 2022 · 1 yr 9 mos

Fire Control Software Development in Korhan and Gökdeniz projects.

Efe Berkay YİTİM · 2nd

FPGA Design Engineer at Aselsan

Ankara, Ankara, Turkey · **Contact info**

aselsan FPGA Design Engineer
Aselsan · Full-time
Sep 2021 - Present · 1 yr 11 mos
Ankara, Türkiye

BİLGEM Candidate Engineer
TÜBİTAK BİLGEM
Nov 2020 - Aug 2021 · 10 mos
Ankara, Türkiye

Digital Design Engineer

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In Turkey

Kaan Çetinkaya · 2nd

Electrical and Electronics Engineer • Computer Science • Head of Software Engineering

Ankara. Turkev · Contact info

Head of Software Engineering
Plan-S Satellite and Space Technologies
Jan 2022 - Present · 1 yr 7 mos
Ankara, Turkey

Electrical and Electronics Engineer
Aselsan
Aug 2011 - Dec 2021 · 10 yrs 5 mos
Ankara, Turkey

Electrical and Electronics Engineering Intern
Turkish Aerospace Industries, Inc. (TAI)
Jun 2010 - May 2011 · 1 yr
Ankara, Türkiye

Barış Tiryaki · 2nd

Otonom Sürüş Gömülü Yazılım Geliştiricisi

Ankara, Turkey · Contact info

Otonom Sürüş Gömülü Yazılım Geliştirme
Ford Otosan · Full-time
Dec 2022 - Present · 8 mos
Ankara, Türkiye · Hybrid

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In Turkey

Atakan Çelikkol · 2nd

Software Developer

İzmir, Turkey · **Contact info**

Arf **Software Developer**
TEB Arf · Full-time
May 2022 - Present · 1 yr 3 mos

Skills: React.js · Java

Software Engineer
TTTech Auto
Jan 2020 - May 2022 · 2 yrs 5 mos

Electronics Engineer
Roketsan Roket Sanayii ve Ticaret. A. Ş.
Nov 2018 - Jan 2020 · 1 yr 3 mos
Ankara, Turkey

Nazım Kerem Mert · 2nd
Embedded Software Engineer

aselsan **Aselsan**
3 yrs 8 mos

• **Embedded Software Engineer**
Feb 2022 - Present · 1 yr 6 mos
Ankara, Türkiye

• **System Design Engineer**
Aug 2020 - Feb 2022 · 1 yr 7 mos
Yenimahalle, Ankara, Türkiye

Abroad

Osman Zeki ER · 1st
Software Development Engineer @ Amazon
Vancouver, British Columbia, Canada · Contact info

Experience

Software Development Engineer
Amazon · Full-time
Dec 2019 - Present · 3 yrs 8 mos
Vancouver, Canada

Software Design Engineer
TUSAŞ - Türk Havacılık ve Uzay Sanayii A.Ş. / Turkish Aerospace Industries, Inc. (TAI)
May 2018 - Jun 2019 · 1 yr 2 mos

Senior Software Engineer
AYESAS
Nov 2014 - May 2018 · 3 yrs 7 mos

Mehmet Ertug Afsin · 1st
FPGA Design Engineer at ASML
Eindhoven, North Brabant, Netherlands · Contact info

ASML **Embedded Logic and Firmware Design Engineer**
ASML · Full-time
Jul 2022 - Present · 1 yr 1 mo
Veldhoven, North Brabant, Netherlands · On-site

Skills: HDL Coder · Simulink · MATLAB · Intel Quartus Prime · Altera

Senior Hardware Design Engineer
Pycom · Full-time
Jan 2022 - Jul 2022 · 7 mos
Eindhoven, North Brabant, Netherlands

* STM32MP1 Arm Cortex A7 based CPU board design for the IoT project
Cost optimized area constrained board design...

aselsan **Aselsan**
Full-time · 9 yrs
Ankara, Turkey

Senior Digital Hardware Design Engineer
Jan 2015 - Dec 2021 · 7 yrs

Abroad

Çınar Gülden · 2nd
FPGA&SW Engineer
Amsterdam, North Holland, Netherlands ·

Software Engineer
WEBB Traders · Full-time
Apr 2022 - Present · 1 yr 4 mos
Amsterdam, North Holland, Netherlands

Skills: Linux · Electronic Trading · Python (Progr

FPGA Engineer
Quant.Capital GmbH & Co. KG · Full-time
Sep 2021 - Mar 2022 · 7 mos
Düsseldorf, North Rhine-Westphalia, Germany

TUALCOM
4 yrs 3 mos

● **FPGA Engineer**
Jul 2018 - Aug 2021 · 3 yrs 2 mos
Ankara, Turkey

Cagri E. · 2nd
Architect at Rain
Talks about #edgeai, #mlhardware, and #computerarchitecture

ML Hardware Architect
Rain · Full-time
Mar 2023 - Present · 5 mos
Remote

SoC Architect
Intel Corporation · Full-time
Jan 2022 - Mar 2023 · 1 yr 3 mos
Austin, Texas Metropolitan Area

Systems. Models. Explorations.

Machine Learning Software Engineer
AMD · Full-time
Apr 2020 - Jan 2022 · 1 yr 10 mos
Austin, Texas, United States

2014
mezunumuz-
Makine
öğrenmesi
donanımı

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Abroad

2007 mezunumuz-
Makine öğrenmesi

Kamil Nar · 2nd
Applied Scientist / Machine Learning Engineer
San Francisco, California, United States · Contact info

Machine Learning Engineer
Google
2021 - Present · 2 yrs 7 mos
San Francisco Bay Area

Applied machine learning research & engineering
multitask learning and revenue optimization.

Applied Scientist
Amazon
2020 - 2021 · 1 yr
San Francisco, California, United States

2017
mezunumuz -
Yazılım

Umay Geyikci · 2nd
Software Engineer at Google
Germany · Contact info

Software Engineer, Site Reliability Engineering
Google · Full-time
Sep 2022 - Present · 11 mos
Munich, Bavaria, Germany

Research Assistant
Stanford University
Sep 2018 - Dec 2021 · 3 yrs 4 mos
Stanford, California, United States

METU EE COMPUTER OPTION

Graduate Studies Abroad

Ahmet Avcıoğlu · 2nd
MSc Student in Electrical and Electronics Engineering at EPFL

Hakan Emre Gedik · 1st
Graduate Research Assistant
Austin, Texas Metropolitan Area · **Contact info**

Canberk Sönmez · 2nd
PhD student at EPFL, LAP.

Yağmur Eren · 2nd
KTH Royal Institute of Technology
Sweden · **Contact info**

Faculty and Research Areas

- *Gözde Bozdağı AKAR*
  - *Video coding and transmission*
  - *Object detection, superresolution*
  - *DSP programming*
- *Ece Güran SCHMIDT*
  - *Data plane hardware architectures for high speed computer networks; Cloud computing hardware and management*
  - *Hardware accelerated clouds*
  - *In-vehicle communication networks and vehicle connectivity*
  - *Resource management for computer systems; Embedded real-time systems and networks*
- *Uğur HALICI*
  - *Machine Learning, Deep Learning; Artificial Intelligence; Pattern recognition*
  - *Neurotechnologies; Brain computer interface; Brain signal and image analysis*
  - *Computer vision; Face and fingerprint recognition; Aerial/satellite images; 3D Modeling, Computational Aesthetics*

Faculty and Research Areas

- *Ahmed HAREEDY*
    - *Coding theory and machine learning*
    - *Data storage (solid-state, magnetic, and DNA-based).*
    - *Cloud, edge, and distributed computing systems.*
- *Serkan SARITAŞ*
    - *Information Security*
    - *Networked Control*
    - *Communication Theory*
    - *Game Theory*
- *Klaus SCHMIDT*
    - *In-vehicle communication networks and vehicle connectivity*
    - *Autonomous Vehicles and Intelligent Transportation Systems*
    - *Real time Embedded Systems*
- *İlkay ULUSOY*
    - *Signal Processing; Machine Learning*
    - *Computer Vision and Pattern Recognition*
    - *Probabilistic Graphical Models*

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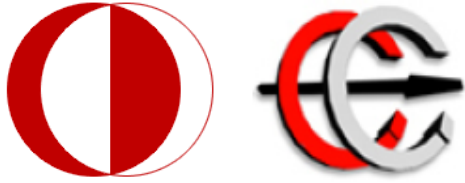
COMPUTER OPTION
IN METU EE DEPARTMENT

2022-2023