Hes·so VALAIS WALLIS

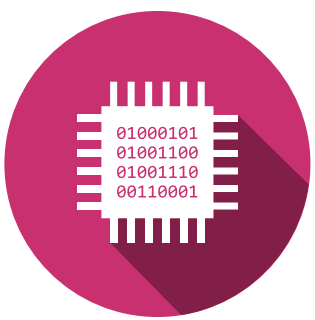
School of Engineering

Digital Design (DiD)

System on Chip

SoC

Systems Engineering program
Energy and Environmental Engineering program
Information and Communication Systems program



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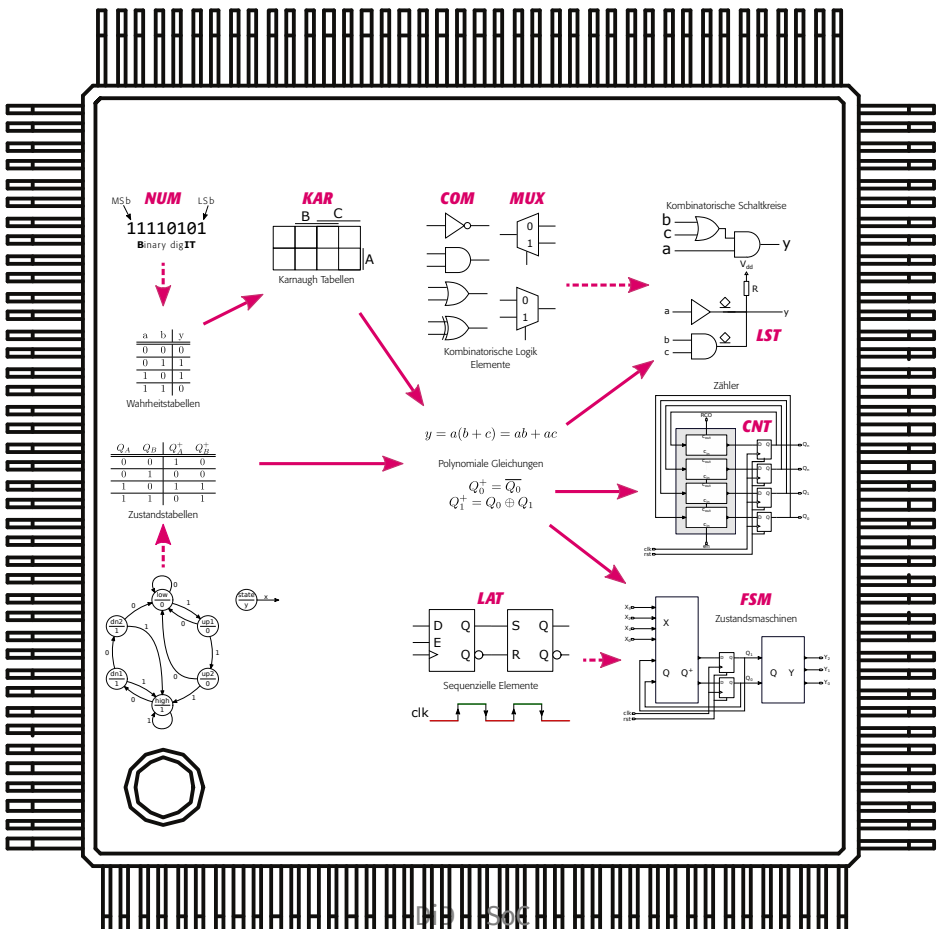
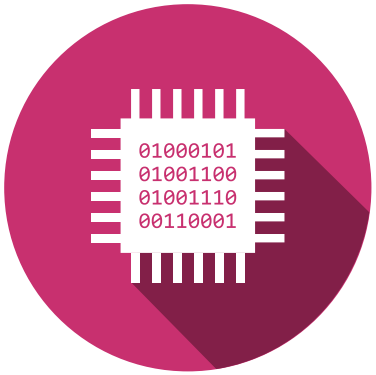
François Corthay francois.corthay@hevs.ch

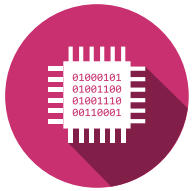
Current content of the topic in the course



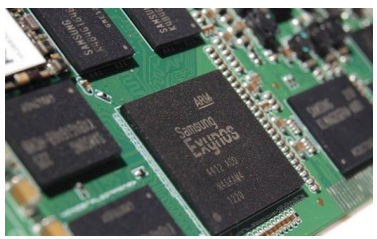


ARM vs. Intel

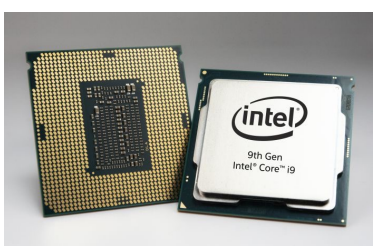
ARM vs. Intel



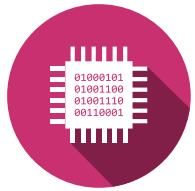
- ARM
  - Mobile Chips
  - Small and Light
  - Low Energy Consumption



- Intel
  - High End Powerful µProcessors
  - Broad Product Range



ARM vs. Intel

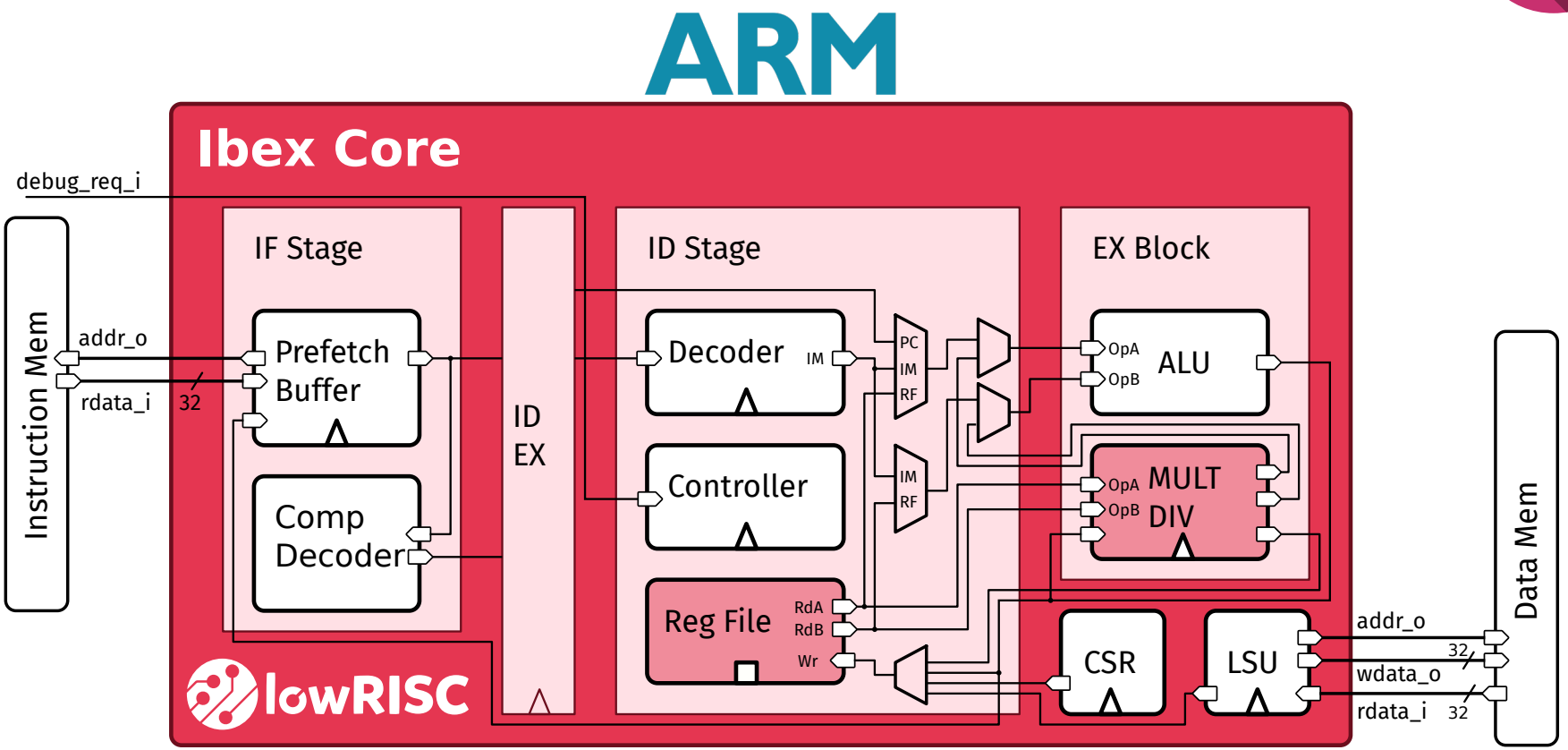


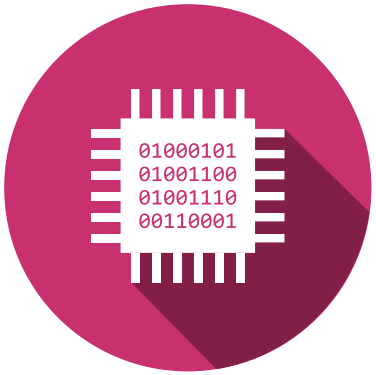
ARM

intel®

Typ	ARM	Intel
Architecture	RISC Reduced instruction set computer	CISC Complex instruction set computer
Speed	Moderate	Important
Power Consumption	Important	Moderate
Compiler	Important	Moderate

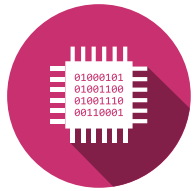
ARM RISC-V


ARM
Ibex Core
debug_req_i
Instruction Mem
addr_o
rdata_i
32
IF Stage
Prefetch Buffer
Comp Decoder
ID EX
ID Stage
Decoder
IM
Controller
Reg File
RdA
RdB
Wr
PC
IM
RF
IM
RF
EX Block
OpA
OpB
ALU
OpA
OpB
MULT
DIV
CSR
LSU
addr_o
32
wdata_o
rdata_i
32
Data Mem
lowRISC

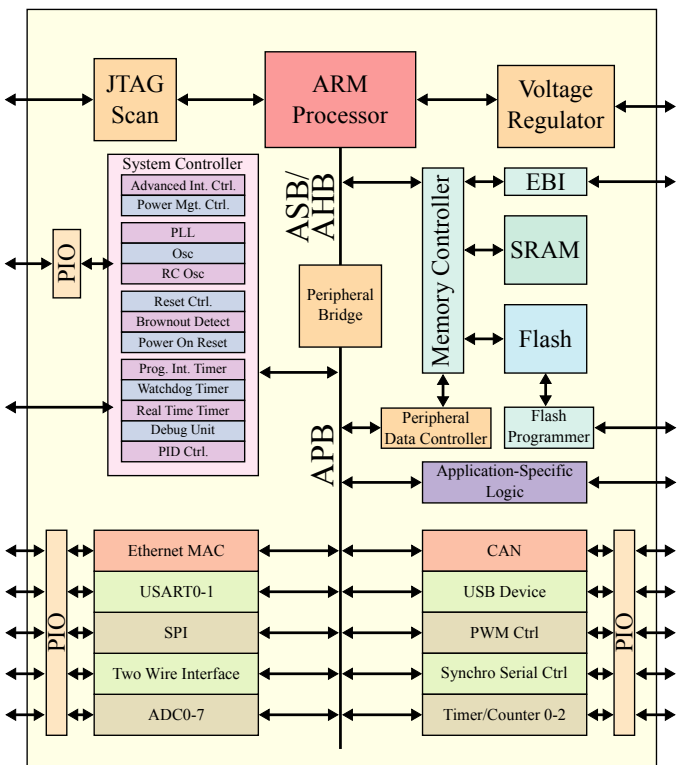


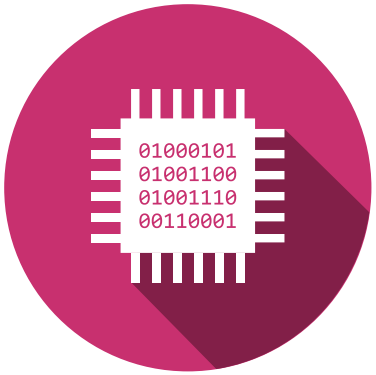
SoC Elements

SoC Elements



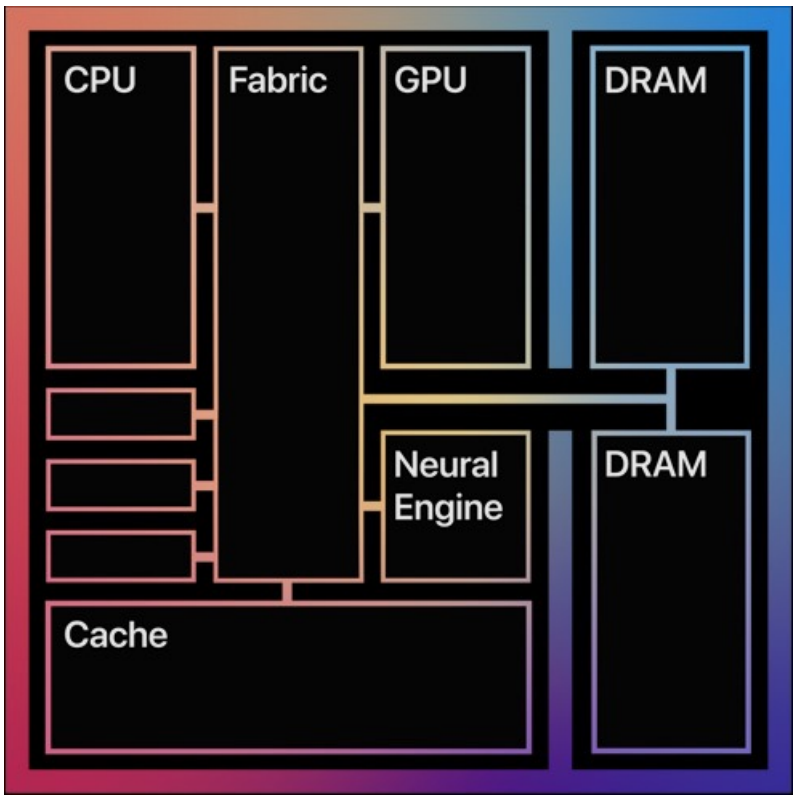
- Basic SoC
  - Bus
  - Processor(s)
  - Periphery
    - Thunderbolt
    - USB 2,3,4
    - PCI, PCI-E
    - CAN, RS232
  - Memory
    - Cache
    - RAM (Random Access Memory)
- Advanced SoC
  - GPU (Graphical Processing Unit)
  - DAC & ADC (Digital ⇔ Analog Converters)
  - Machine learning Core



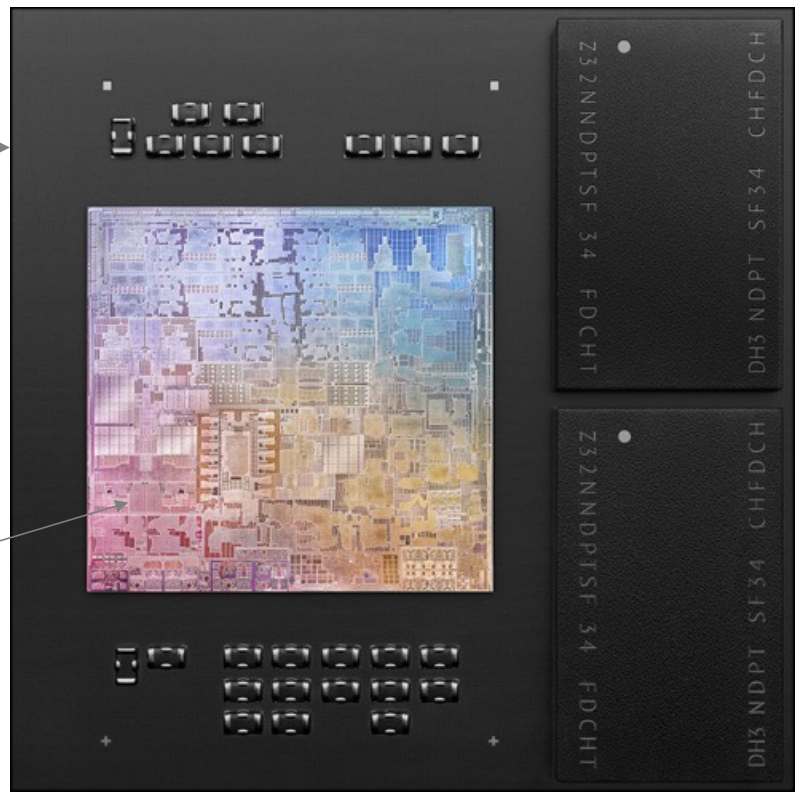


Example Apple M1

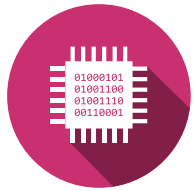
Apple M1



Apple M1



Apple M1

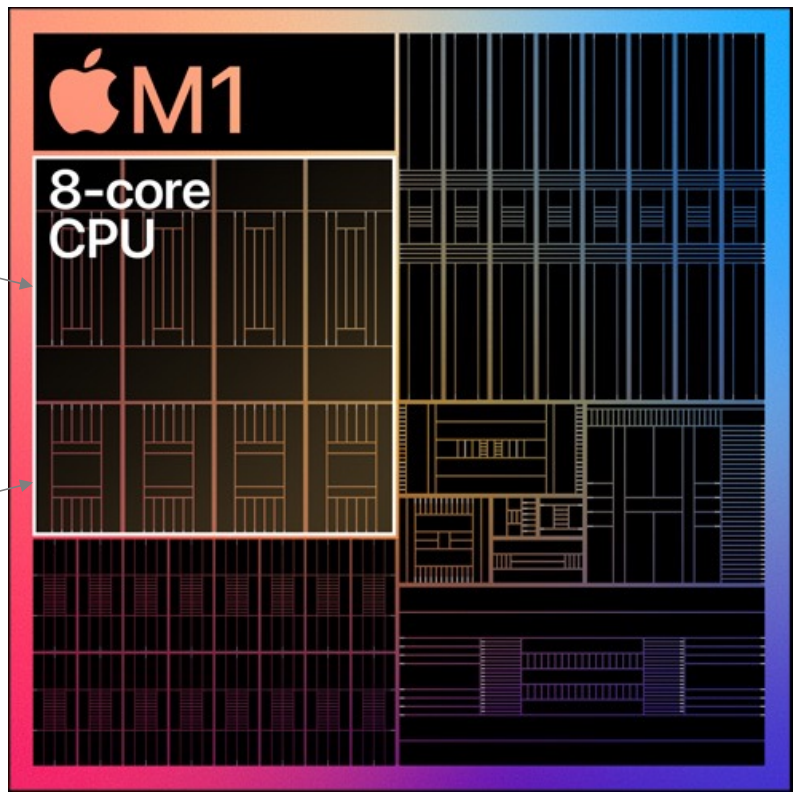


High-performance cores

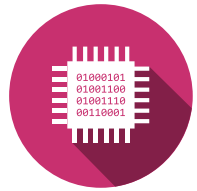
- Ultra-wide execution architecture
- 192KB instruction cache
- 128KB data cache
- Shared 12MB L2 cache

High-efficiency cores

- Wide execution architecture
- 128KB instruction cache
- 64KB data cache
- Shared 4MB L2 cache

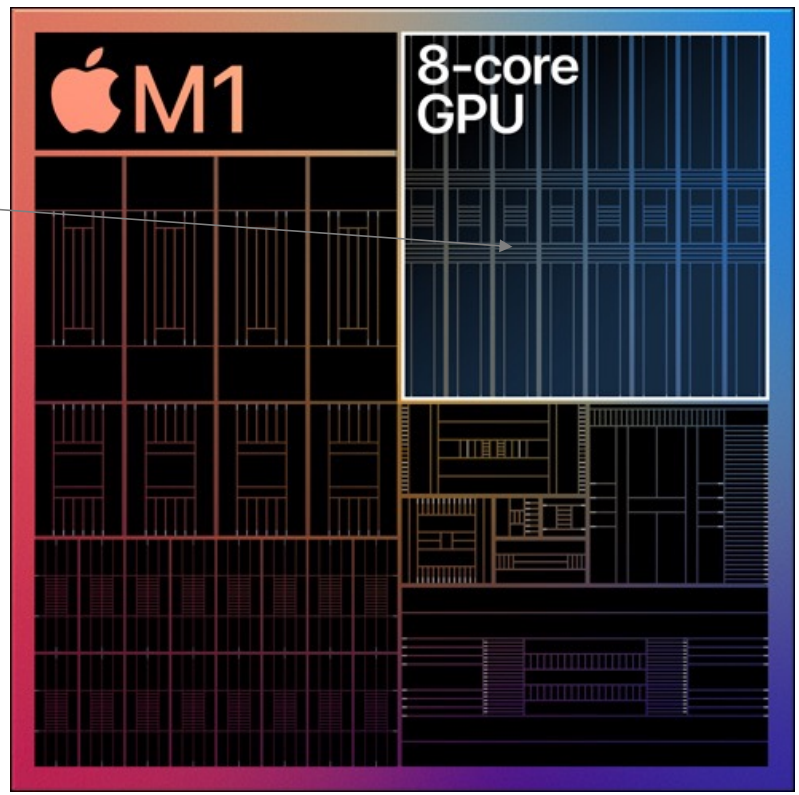


Apple M1

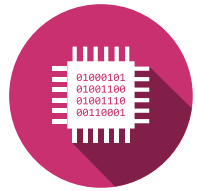


8-core GPU

- 128 execution units
- <24,567 concurrent threads
- 2.6 teraflops
- 82 gigatexels/second
- 41 gigapixels/second

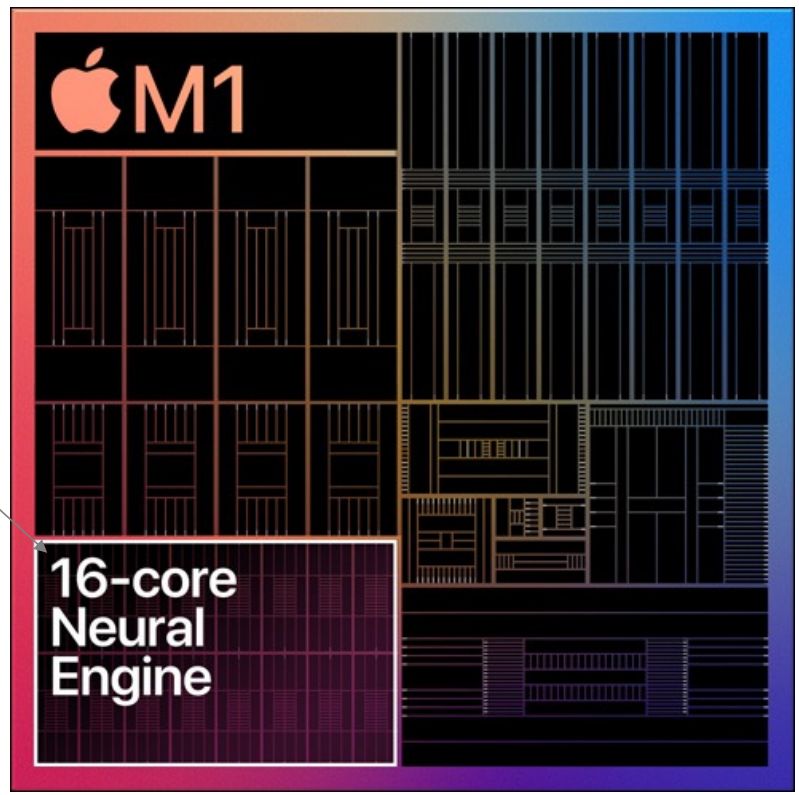


Apple M1

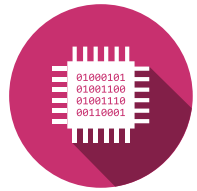


16-core Neural Engine

- Machine learning accelerator



Apple M1



Thunderbold

USB4.0

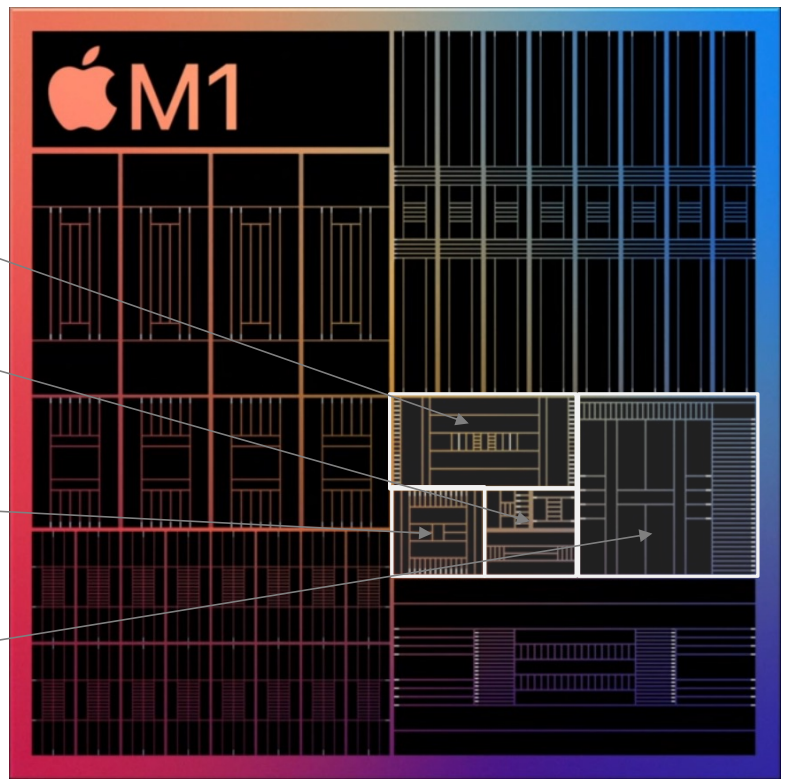
Media Encoder & Decoder

ISP (Image Signal Processing)

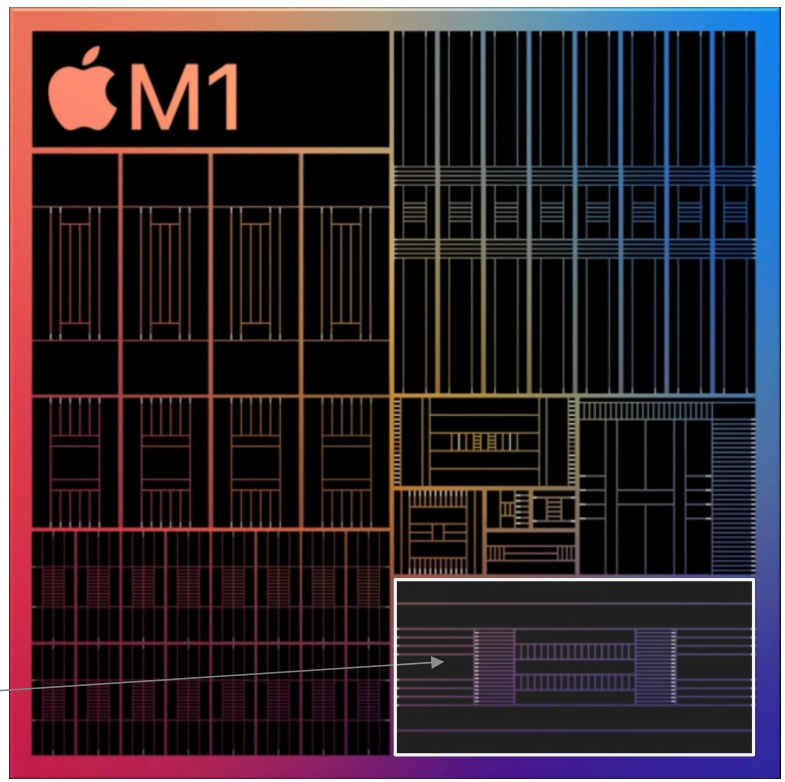
Performance Controller

Secure Enclave

- On the fly encryption
- Key storage

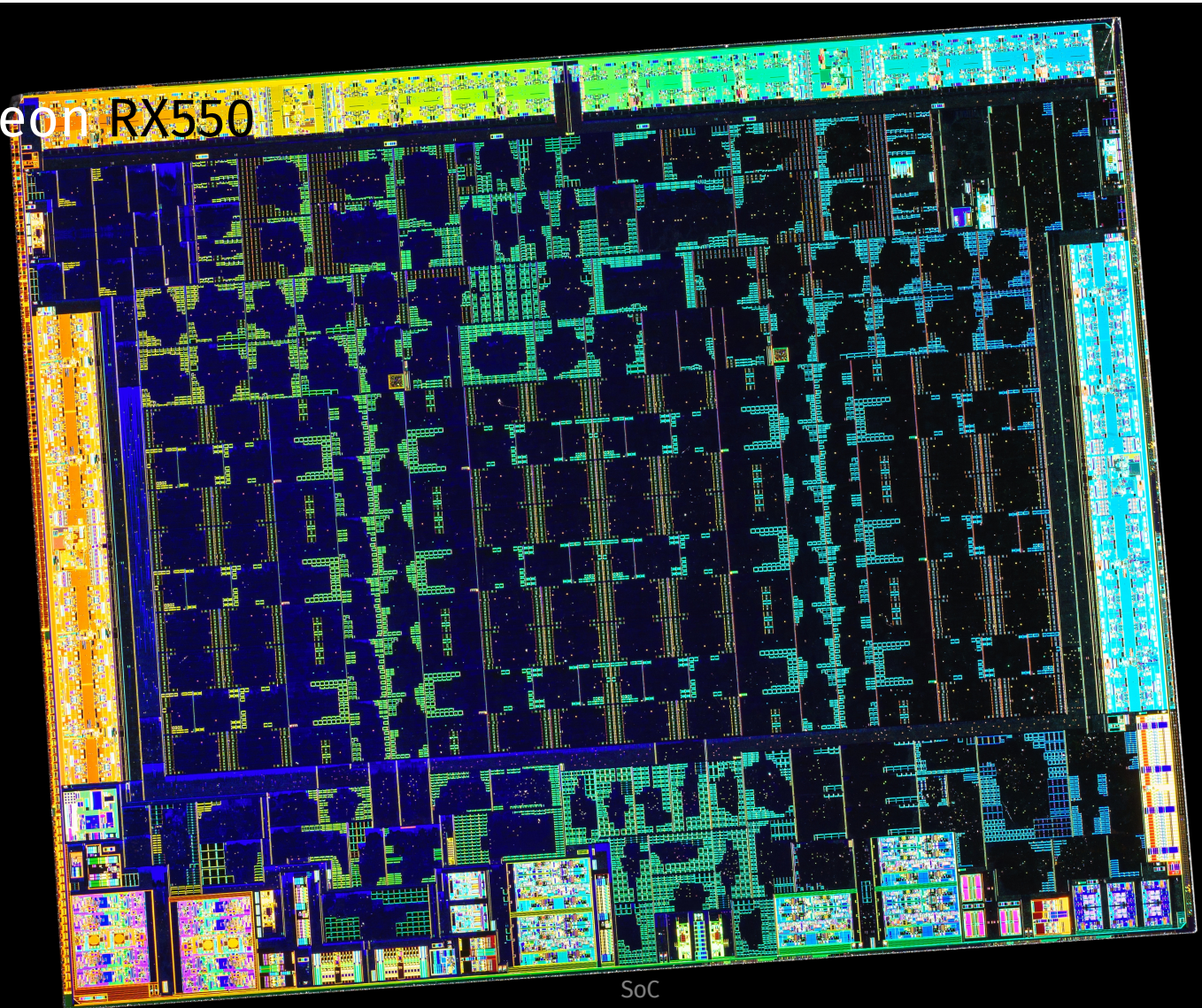


Apple M1



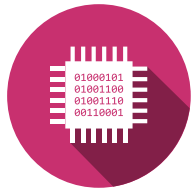
AMD Radeon RX550

7nm



SoC

References

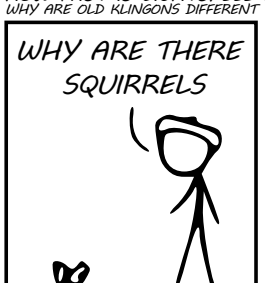


- [m1] (English) Apple M1
  https://www.apple.com/mac/m1/
- [soc] (Deutsch) SoC
  https://deacademic.com/dic.nsf/dewiki/377773
- [pic] (English) Fritzchens Fritz
  https://www.flickr.com/photos/130561288@N04/
- [ibex] (English) Ibex Risc-V
  https://awesomeopensource.com/project/lowRISC

QUESTIONS

CAN BE ASKED BY ANYONE ANYTIME

WHY ARE THERE MIRRORS ABOVE BEDS
WHY DO I SAY UH
WHY IS SEA SALT BETTER
WHY ARE THERE TREES IN THE MIDDLE OF FIELDS
WHY IS THERE NOT A POKEMON MMO
WHY IS THERE LAUGHING IN TV SHOWS
WHY ARE THERE DOORS ON THE FREEWAY
WHY ARE THERE SO MANY SVCHOST·EXE RUNNING
WHY AREN'T ANY COUNTRIES IN ANTARCTICA
WHY ARE THERE SCARY SOUNDS IN MINECRAFT
WHY IS THERE KICKING IN MY STOMACH
WHY ARE THERE TWO SLASHES AFTER HTTP
WHY ARE THERE CELEBRITIES
WHY DO SNAKES EXIST
WHY DO OYSTERS HAVE PEARLS
WHY ARE DUCKS CALLED DUCKS
WHY DO THEY CALL IT THE CLAP
WHY ARE KYLE AND CARTMAN FRIENDS
WHY IS THERE AN ARROW ON AANG'S HEAD
WHY ARE TEXT MESSAGES BLUE
WHY ARE THERE MUSTACHES ON CLOTHES
WHY WUBA LUBBA DUB DUB MEANING
WHY IS THERE A WHALE AND A POT FALLING
WHY ARE THERE SO MANY BIRDS IN SWISS
WHY IS THERE SO LITTLE RAIN IN WALLIS
WHY IS WALLIS WEATHER FORECAST ALWAYS WRONG
WHY ARE THERE MALE AND FEMALE BIKES
WHY ARE THERE BRIDESMAIDS
WHY DO DYING PEOPLE REACH UP
HOW FAST IS LIGHTSPEED
WHY ARE OLD KLINGONS DIFFERENT



WHY ARE THERE DINOSAUR GHOSTS
WHY IS THERE HELL IF

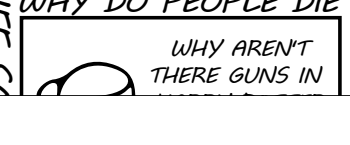
WHY DO IGUANAS DIE
WHY IS THERE CAFFEINE IN MY SHAMPOO
WHY HAVE DINOSAURS NO FUR
WHY DO TWINS HAVE DIFFERENT FINGERPRINTS
WHY ARE SWISS AFRAID OF DRAGONS
WHY AREN'T ECONOMISTS RICH
WHY DO AMERICANS CALL IT SOCCER
WHY ARE MY EARS RINGING
WHY IS 42 THE ANSWER TO EVERYTHING
WHY CAN'T NOBODY ELSE LIFT THORS HAMMER
WHY IS MARVIN ALWAYS SO SAD
WHY ARE THERE ANTS IN MY LAPTOP
WHY IS EARTH TILTED
WHY IS SPACE BLACK
WHY IS OUTER SPACE SO COLD
WHY ARE THERE PYRAMIDS ON THE MOON
WHY IS NASA SHUTTING DOWN
WHY ARE THERE TINY SPIDERS IN MY HOUSE
WHY DO SPIDERS COME INSIDE
WHY ARE THERE HUGE SPIDERS IN MY HOUSE
WHY ARE THERE LOTS OF SPIDERS IN MY HOUSE
WHY ARE THERE SPIDERS IN MY ROOM
WHY ARE THERE SO MANY SPIDERS IN MY ROOM
WHY DO SPYDER BITES ITCH
WHY IS DYING SO SCARY
WHY IS THERE NO GPS IN LAPTOPS
WHY DO KNEES CLICK

WHY ARE THERE FEMALE

WHY IS HTTPS CROSSED OUT IN RED
WHY IS THERE A LINE THROUGH HTTPS
WHY IS THERE A RED LINE THROUGH HTTPS ON TWITTER
WHY IS HTTPS IMPORTANT

WHY IS YKK ON ALL ZIPPERS
WHY ARE THERE WEEKS
WHY DO I FEEL DIZZY
WHY IS THERE A SWARM OF ANTS
WHY IS THERE PILEGRIM
WHY IS THERE LAVA
WHY ARE THERE SO MANY CROWS IN ROCHESTER
WHY IS TO BE OR NOT TO BE FUNNY
WHY DO CHILDREN GET CANCER
WHY IS POSEIDON ANGRY WITH ODYSSEUS
WHY IS THERE ICE IN SPACE
WHY IS THERE AN OWL IN MY BACKYARD
WHY IS THERE AN OWL OUTSIDE MY WINDOW
WHY IS THERE AN OWL ON THE DOLLAR BILL
WHY DO OWLS ATTACK PEOPLE
WHY ARE FPGA's EVERYWHERE
WHY ARE THERE HELICOPTERS CIRCLING MY HOUSE
WHY ARE THERE GODS
WHY ARE THERE TWO SPOCKS
WHAT IS https://xkcd.com/1256/
WHY DO THEY SAY T-MINUS
WHY ARE THERE OBELISKS
WHY ARE WRESTLERS ALWAYS WET

WHY IS LIFE SO
WHY ARE MY BOOBS ITCHY
WHY ARE CIGARETTES LEGAL
WHY ARE THERE DUCKS IN MY POOL
WHY IS JESUS WHITE
WHY IS THERE LIQUID IN MY EAR
WHY DO Q TIPS FEEL GOOD
WHY DO PEOPLE DIE



WHY ARE DOGS AFRAID OF FIR
WHY IS THERE NO KING IN E

Hes·so VALAIS WALLIS

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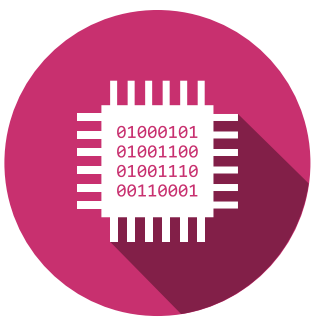
Hochschule für Ingenieurwissenschaften



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