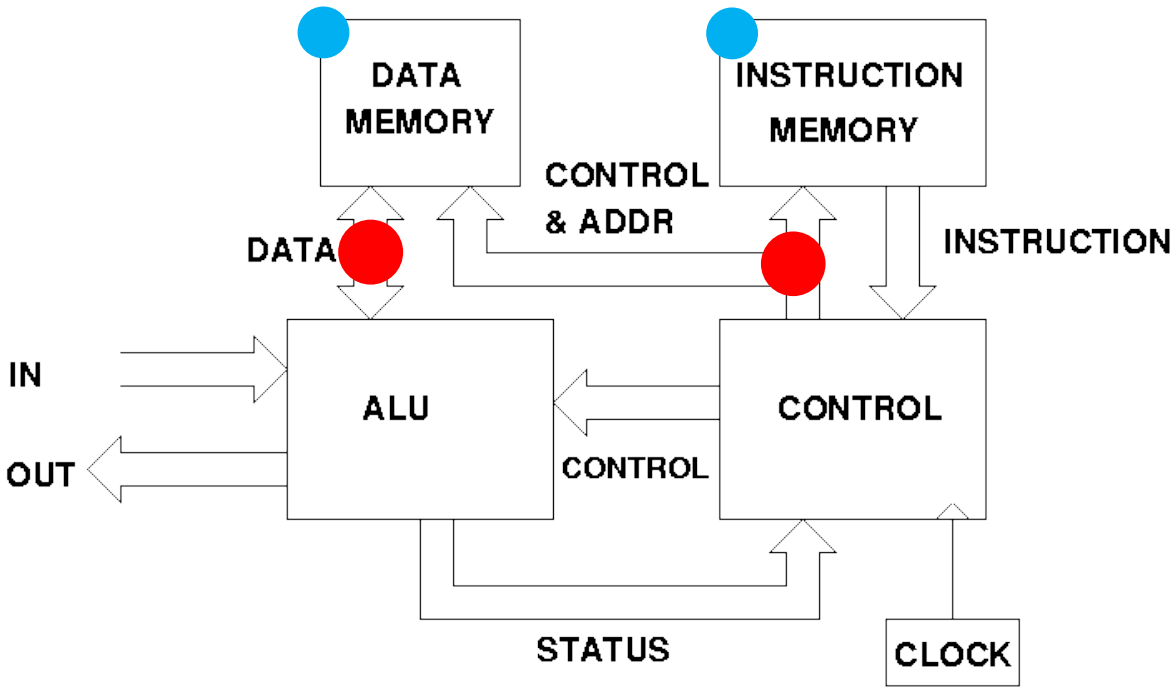
Microprocessor Architecture Princeton, Harvard, MIT

Session 2.4

PH435

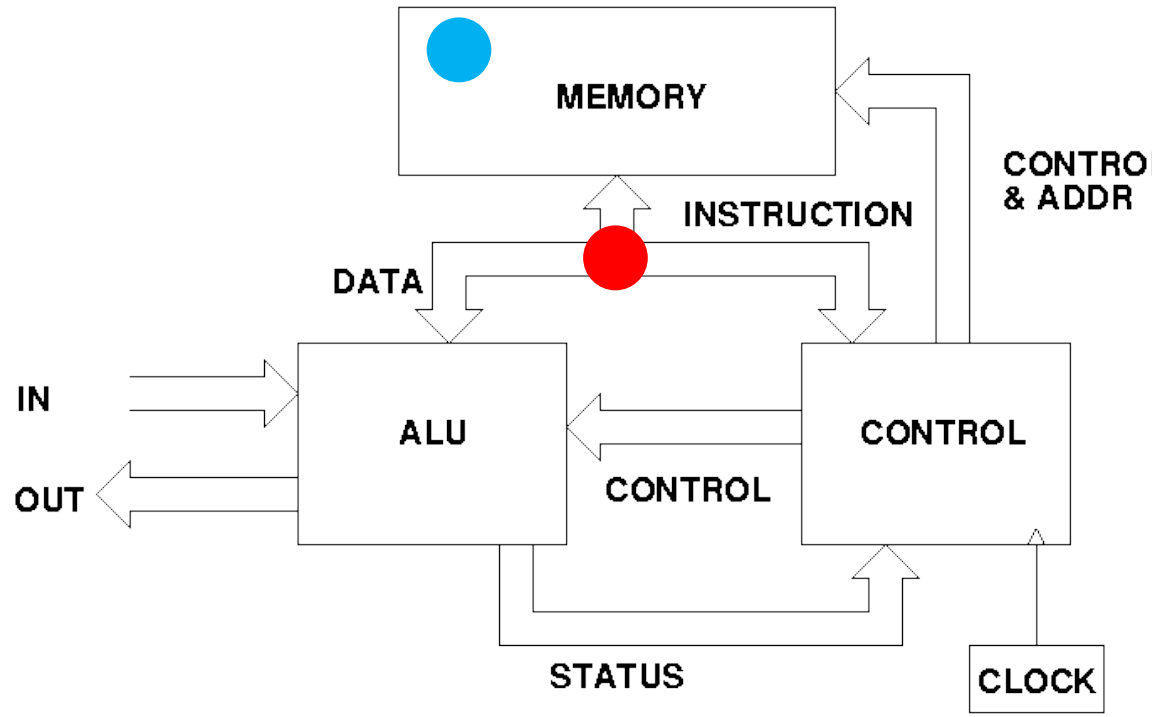
HARVARD ARCHITECTURE

MICROPROCESSOR



PRINCETON (VON NEUMAN) ARCHITECTURE

MICROPROCESSOR



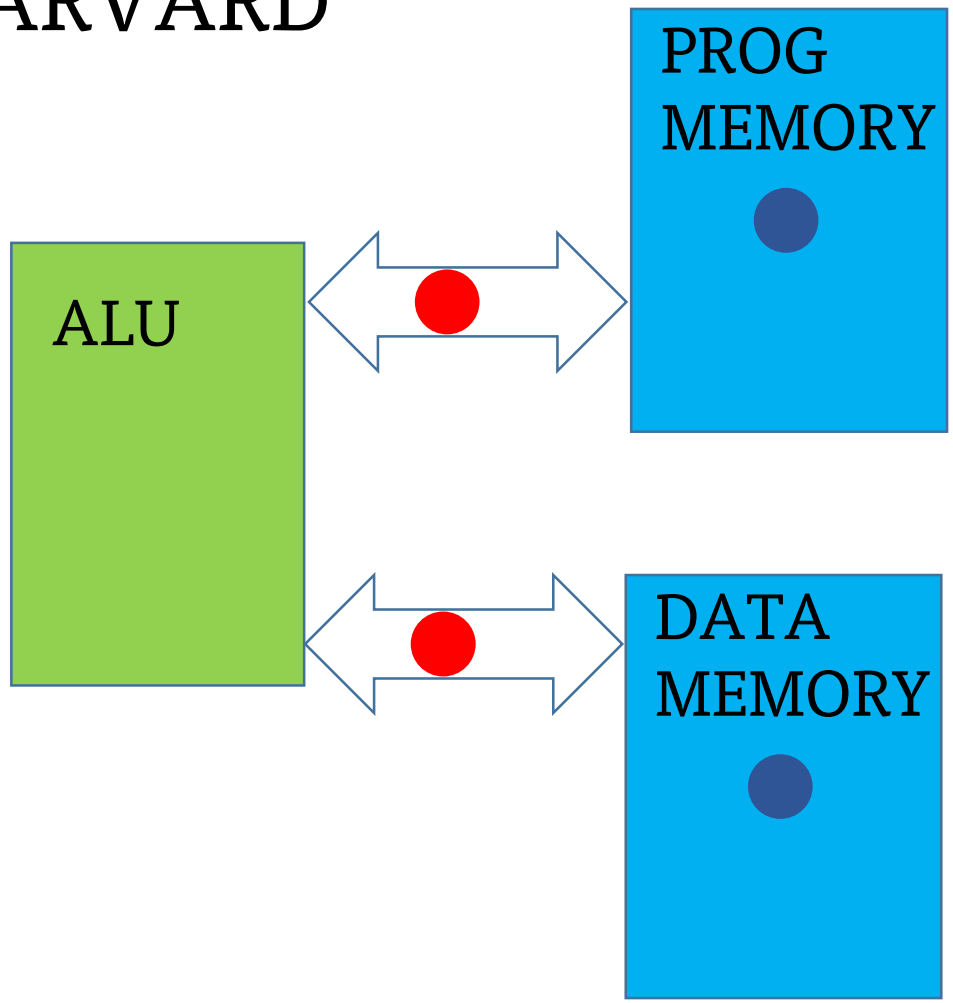
Each manufacturer has specific designs of the wiring layout, address spaces, control lines etc.

Even the clock speed at which the ALU operates may be different from the memory access clock speed.

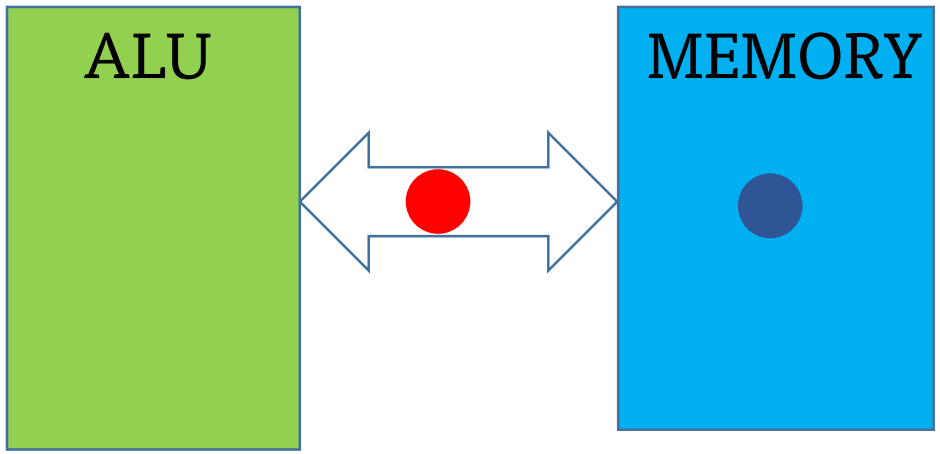
Unless you plan to become a CPU designer, it is not interesting to study all the different processor details!
We will focus on the simple Atmega328 in this course

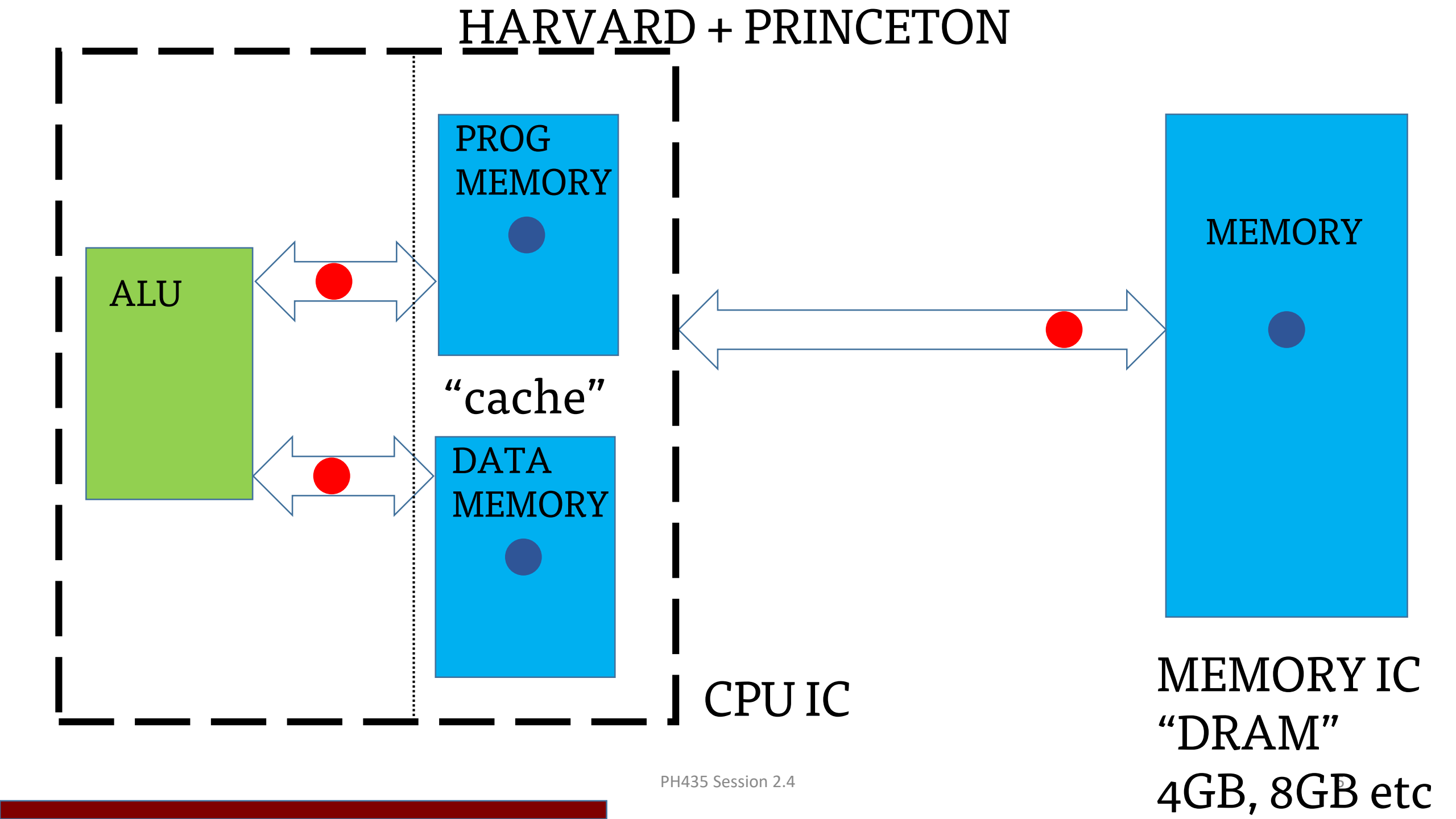
Dominated by a few manufacturers: Intel, ARM, now Apple, Google
- Latest generation hardware details are often proprietary secrets (shared only with OS developers)

HARVARD

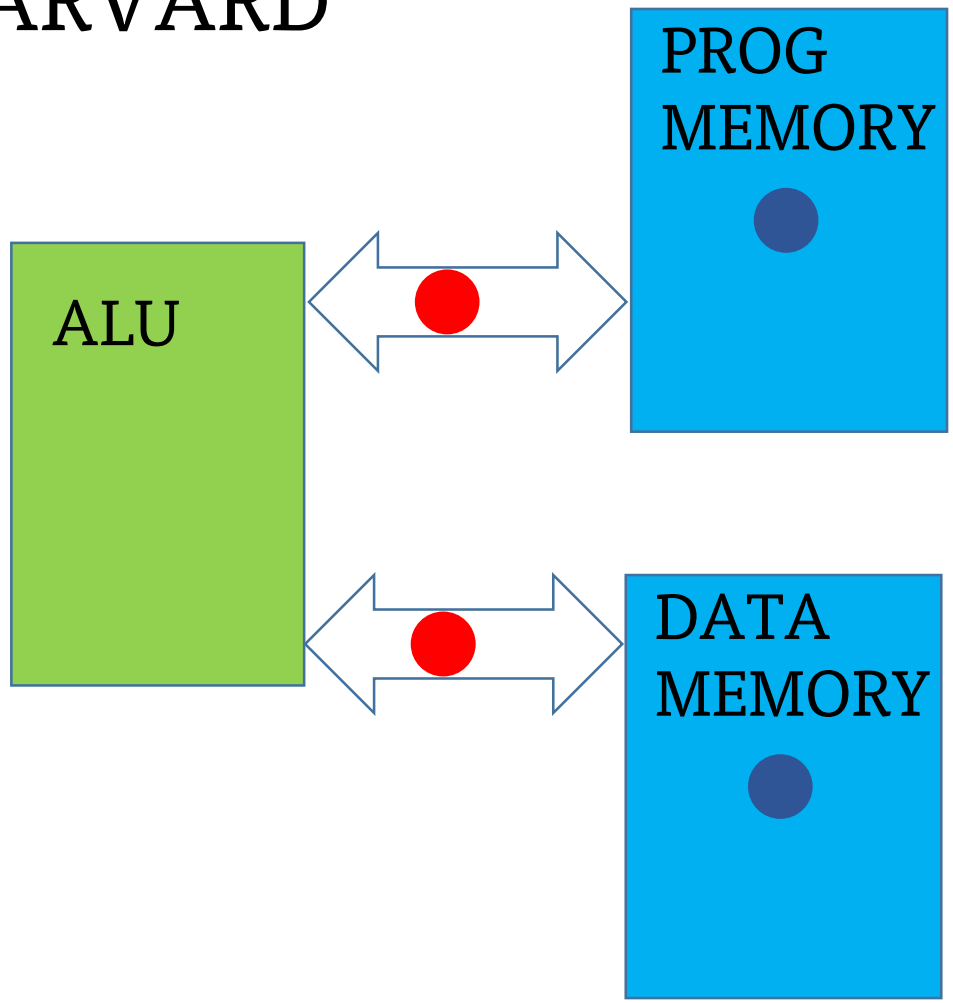


PRINCETON

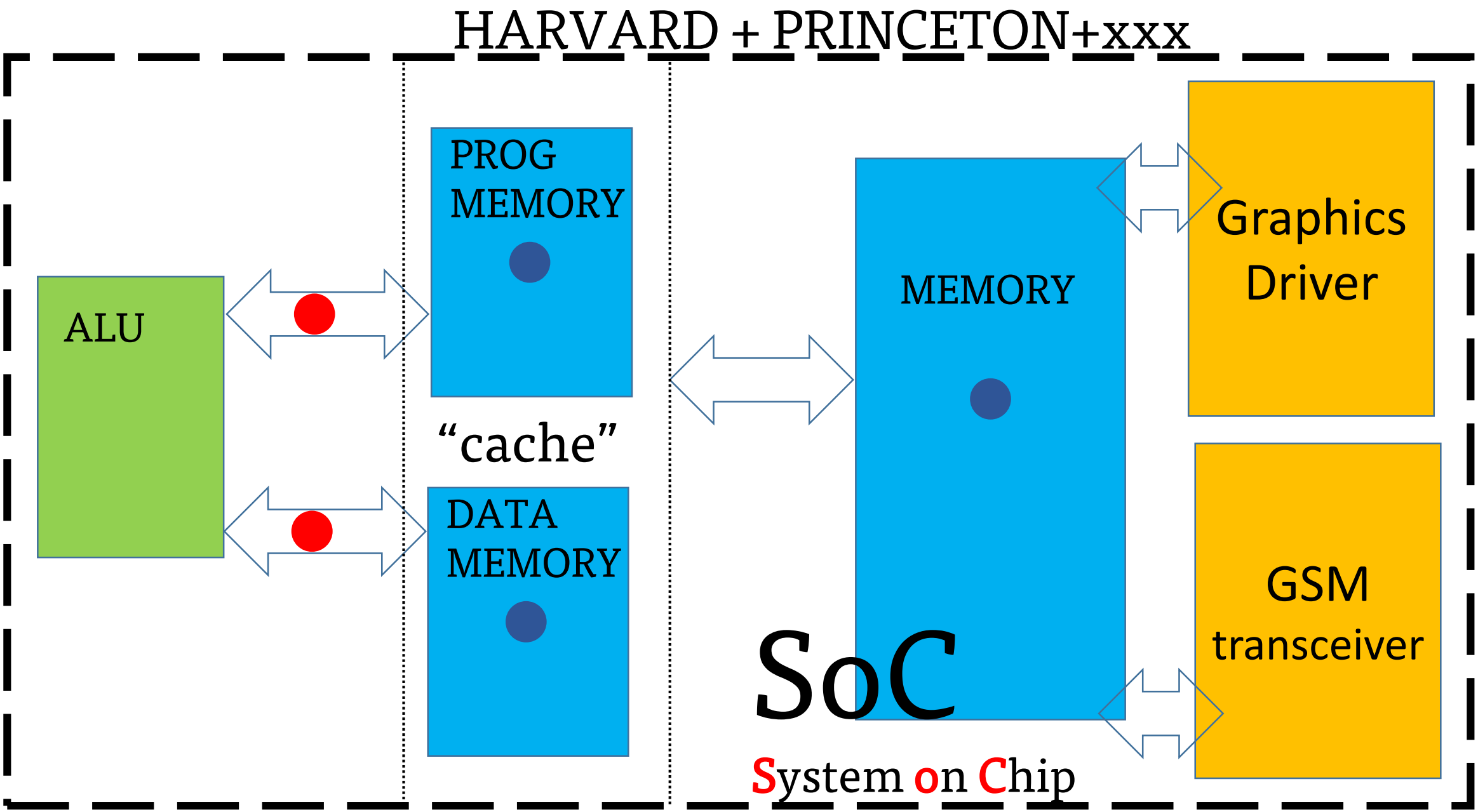



HARVARD + PRINCETON
PROG MEMORY
ALU
"cache"
DATA MEMORY
CPU IC
MEMORY
MEMORY IC
"DRAM"
4GB, 8GB etc

HARVARD



Interlude
– demo on multithreading


HARVARD + PRINCETON+xxx
PROG MEMORY
ALU
"cache"
DATA MEMORY
MEMORY
Graphics Driver
GSM transceiver
SoC
System on Chip

References:

Real-time Embedded systems: Design principles and Engineering practices, by X. Fan (2015)

Relevant chapters uploaded to Moodle as 2.3_appendix.. With publisher's permission

Set of lecture notes from course EE308 (New Mexico Tech)

http://www.ee.nmt.edu/~rison/ee308_spr00/lectures.html

Linux Kernel Programming :

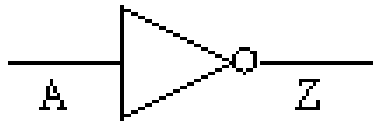
http://tldp.org/index.html
https://kernelnewbies.org/
https://www.cs.utexas.edu/users/ygz/378-03S/ (course on Linux kernel programming)

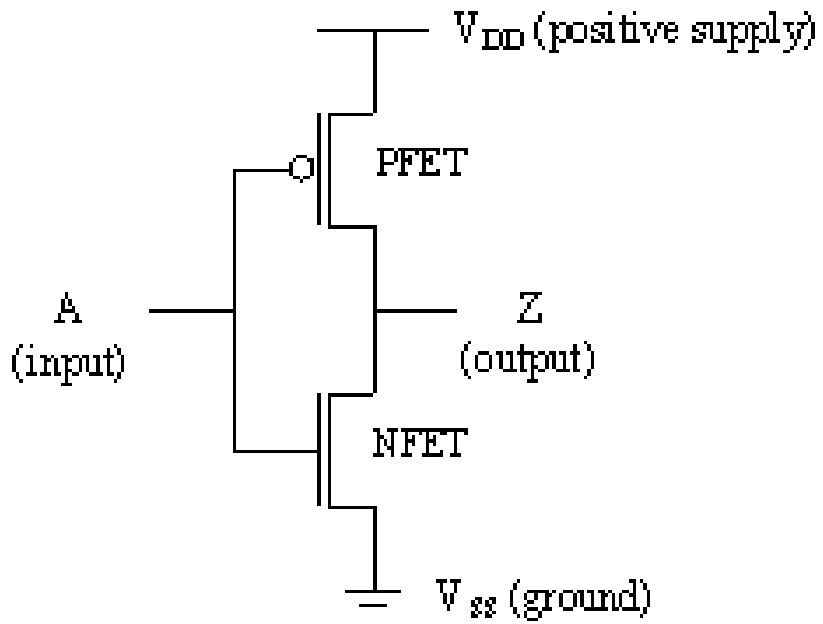
Other websites that discuss bleeding edge technology:

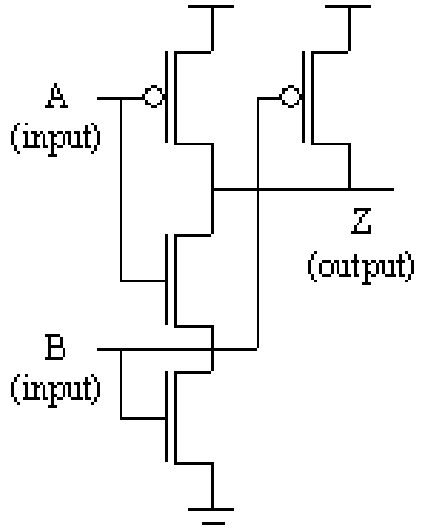
https://www.tomshardware.com/

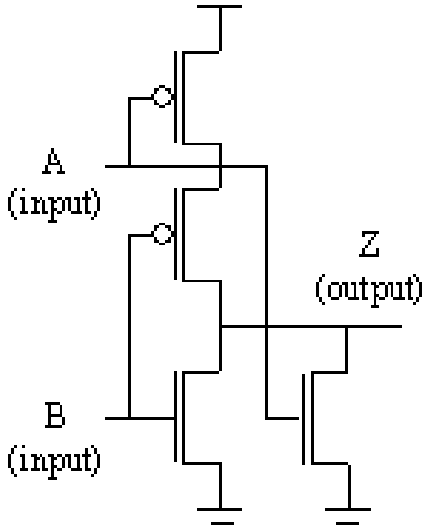
Limits on Computation Speed

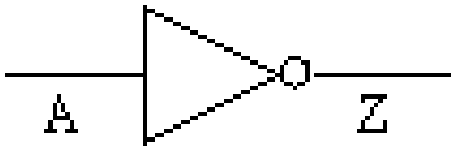
ALL Digital Operations are built out of the following 3 Primitive gates

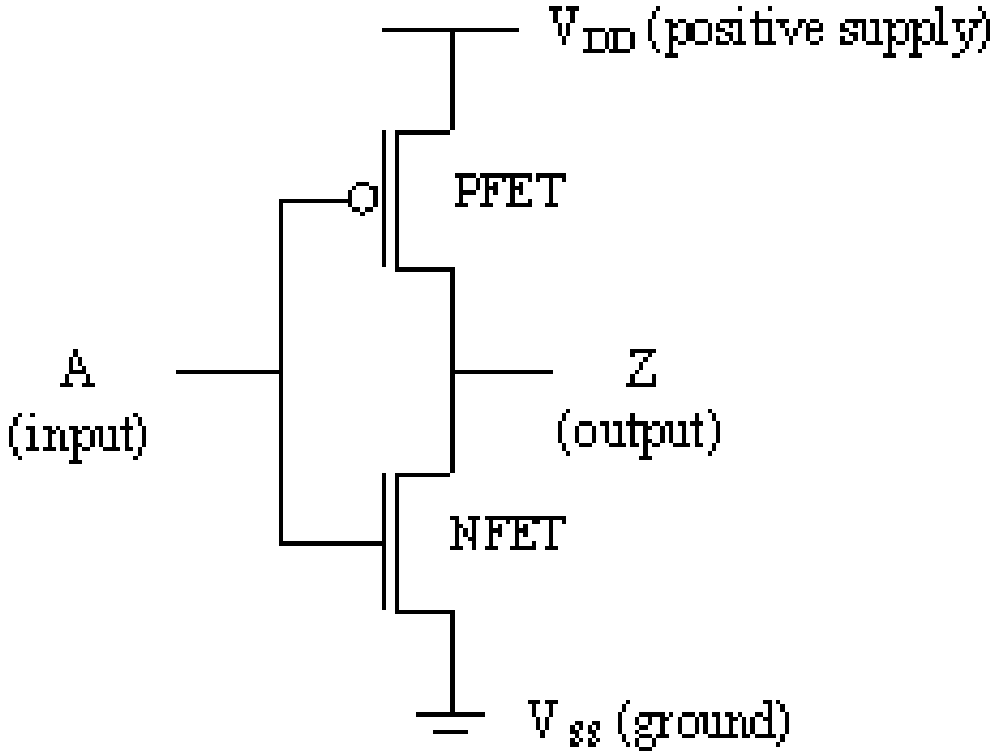












Examine the power consumption of this gate.

Assume that the gates of each MOSFET draw neglible current (i.e. Z drives the gate of a MOSFET in the next gate – hence Z needs to supply neglible current.