Lecture 1

January 18, 2012

Course Overview

Course URL: `http://www.ee.nmt.edu/~rison/ee308`

Texts:

- Class Notes (`http://www.ee.nmt.edu/~rison/ee308`)
- **The HCS12/9S12: An Introduction to Software and Hardware Interfacing, 2nd Edition** by Han-Way Huang, ISBN 978-1435427426
- **Freescale Databooks on the MC9S12**

Grading:

- 20%: Homework due every Monday.
- 10%: Quiz every Friday
- 50%: Three midterms exams
- 20%: Final exam

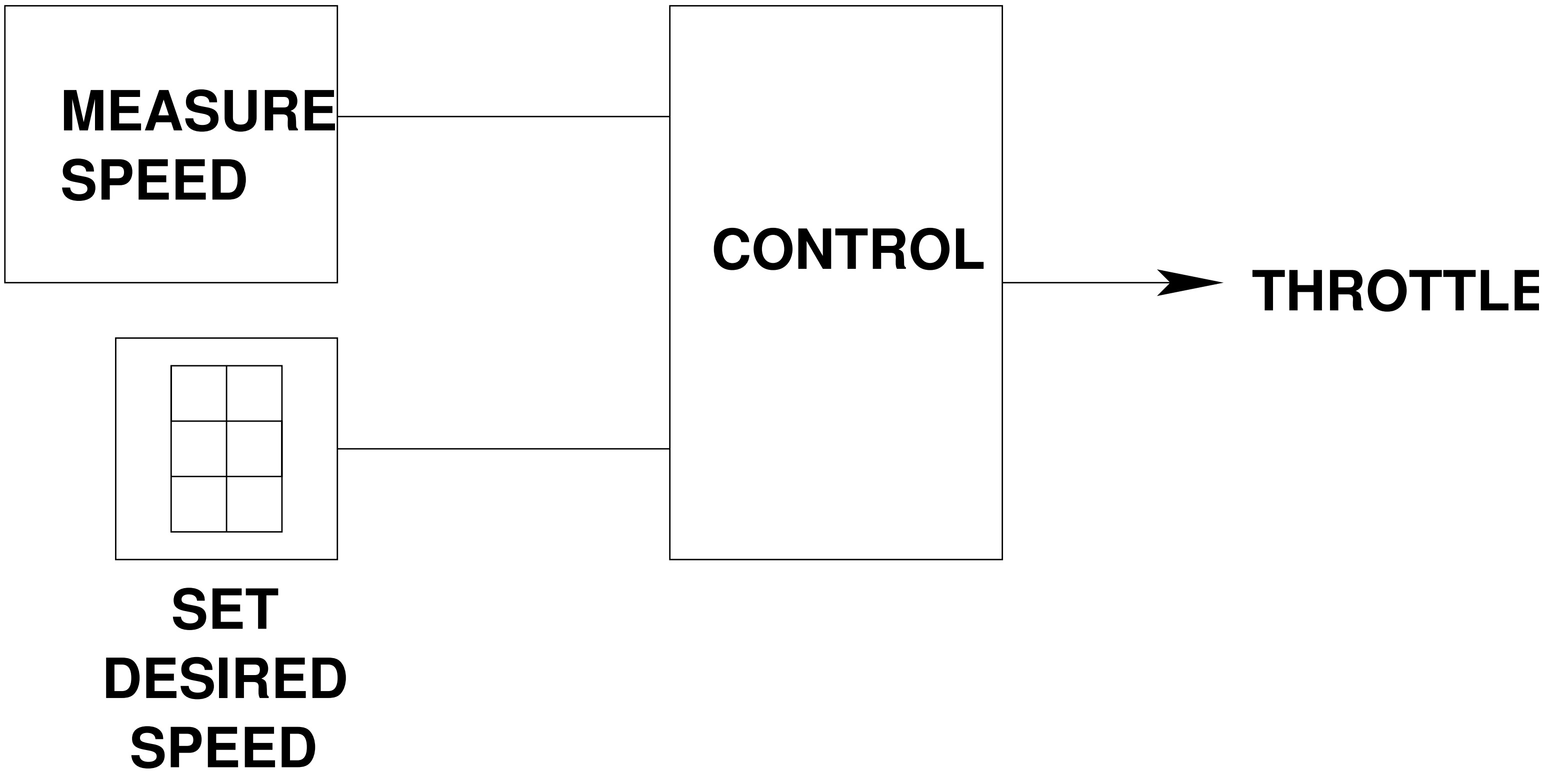
Outline:

- Introduction to the MC9S12 Microcontroller
- Binary and Hexadecimal Numbers
- Assembly Language Programming
- C Language Programming
- Introduction to MC9S12 Internal Peripherals
  - The MC9S12 Timer Subsystem
  - Interrupts using the Timer Subsystem
  - The MC9S12 Pulse Width Modulator Subsystem
- The MC9S12 Expanded Mode
  - Address and Data Buses and Timing
  - Adding Memory and External Peripherals
  - Interfacing to the MC9S12
- More MC9S12 Internal Peripherals
  - The A/D Converter Subsystem
  - The Serial Peripheral Interface
  - The Serial Communications Interface
- Using the MC9S12 in a Control Application

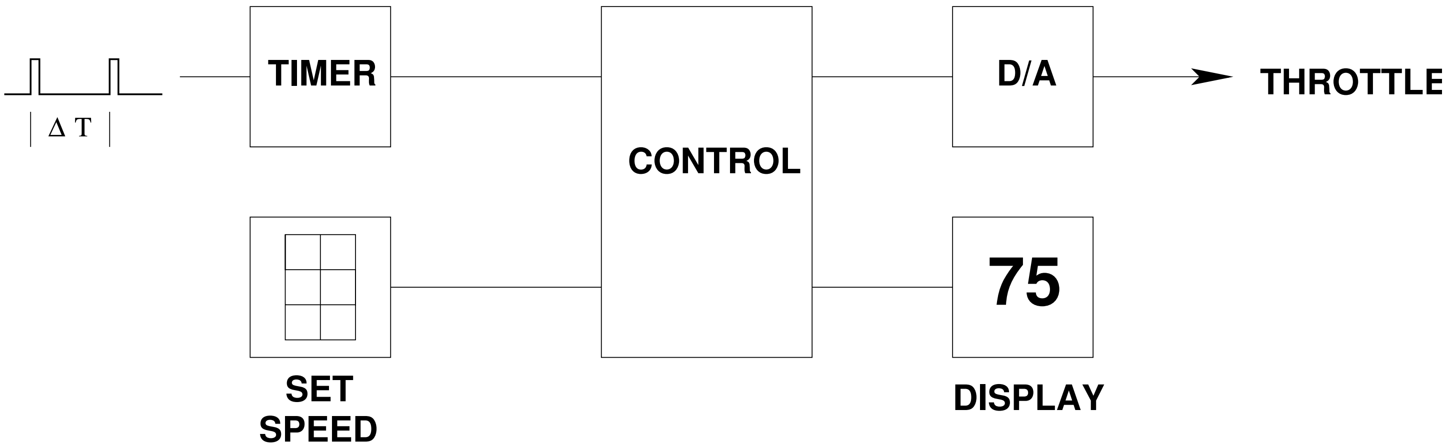
Lab Overview

- The lab meets Wednesday afternoons. **No labs this week.**
- Lab handouts will be posted on the EE 308 website:
  http://www.ee.nmt.edu/~rison/ee308
- The MC9S12 evaluation kits will be passed out in lab next week.
- **You need to bring a bound lab notebook to the first lab.**
- There will be a prelab for each lab. This must be done and turned in at the start of your lab section. The lab TA will verify that you have completed the prelab.
- Be prepared to answer questions about the pre-lab when you come to lab.
- If you do not complete the prelab before coming to lab, you will lose 50% of the points for that lab.

AUTOMOBILE CRUISE CONTROL

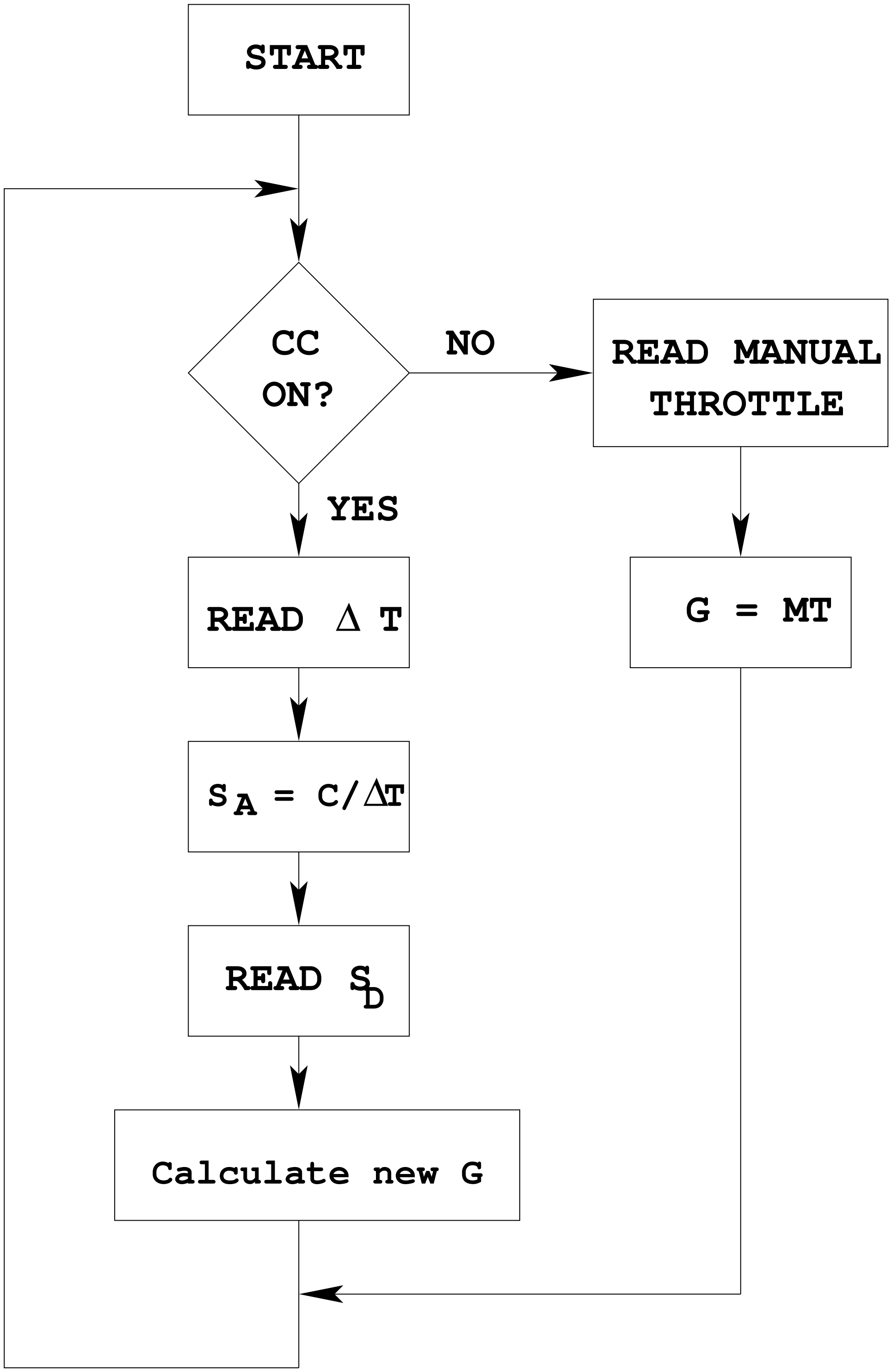


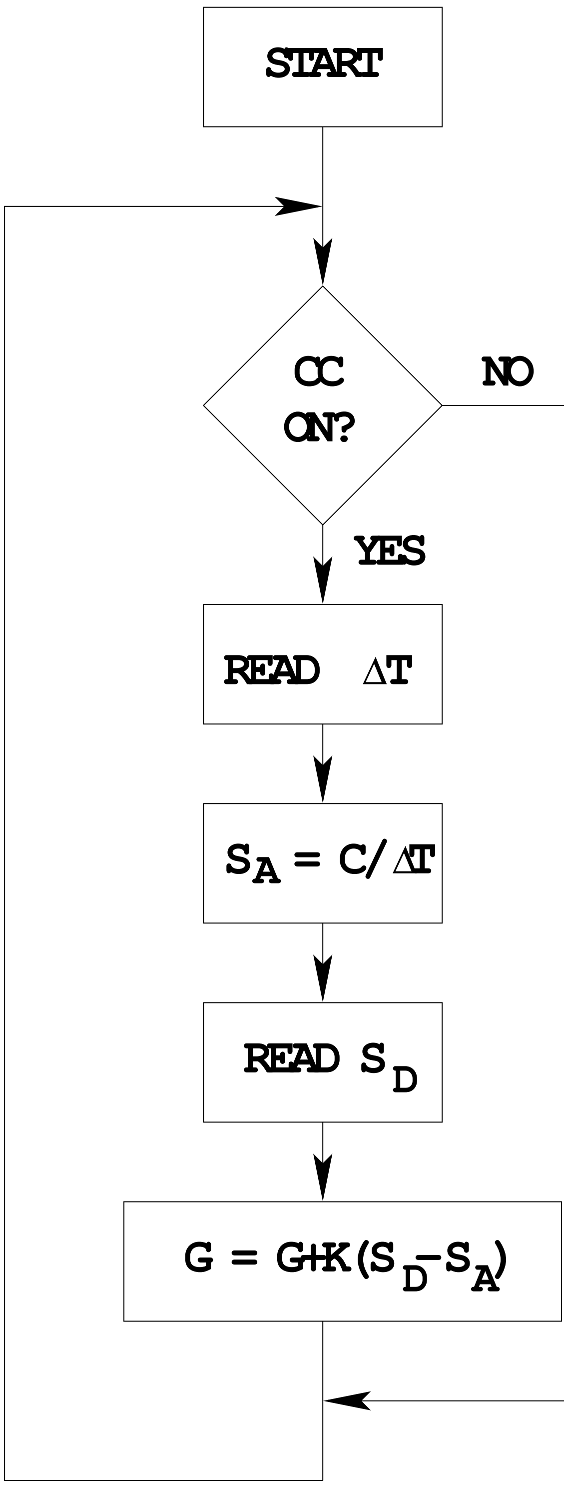
AUTOMOBILE CRUISE CONTROL



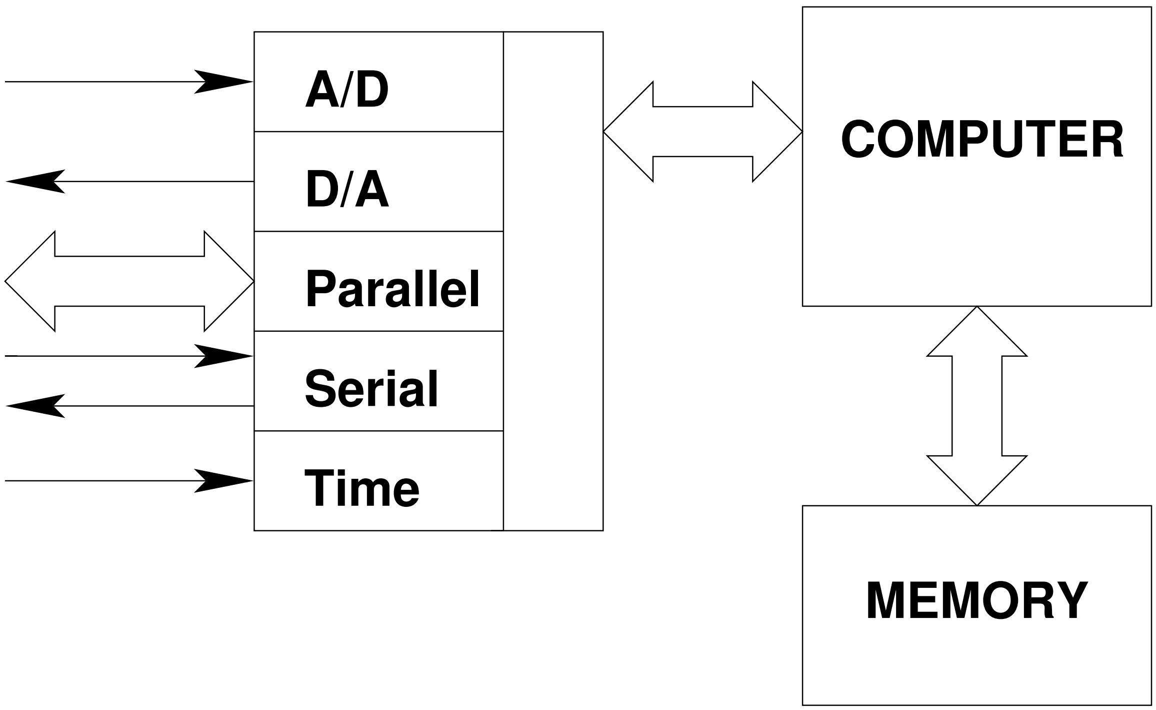
ΔT = time for one revolution of wheel.

Speed = $C/\Delta T$, where C is the circumference of the wheel

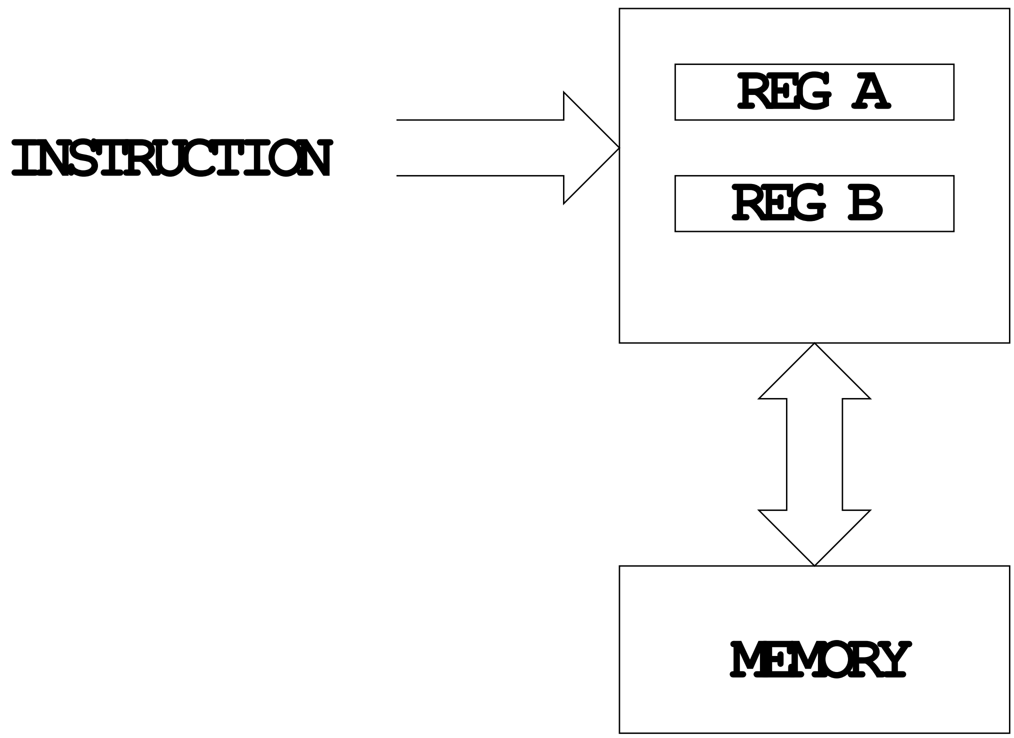

START
CC ON?
NO
READ MANUAL THROTTLE
YES
READ Δ T
G = MT
S_A = C/ΔT
READ S_D
Calculate new G


START
CC ON?
NO
READ MANUAL THROTTLE
YES
READ ΔT
G = MT
S_A = C/ΔT
READ S_D
G = G+K(S_D−S_A)

MICROCONTROLLER

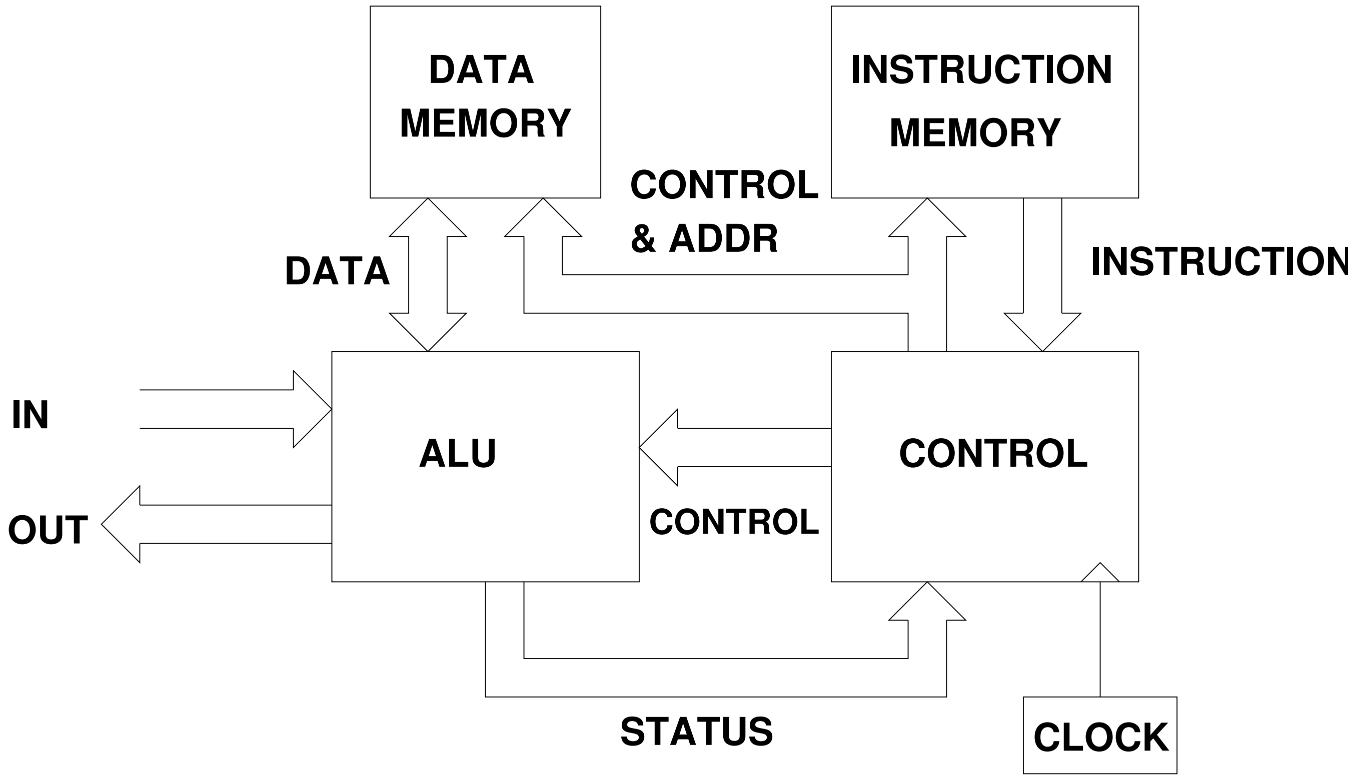


SIMPLE MICROPROCESSOR



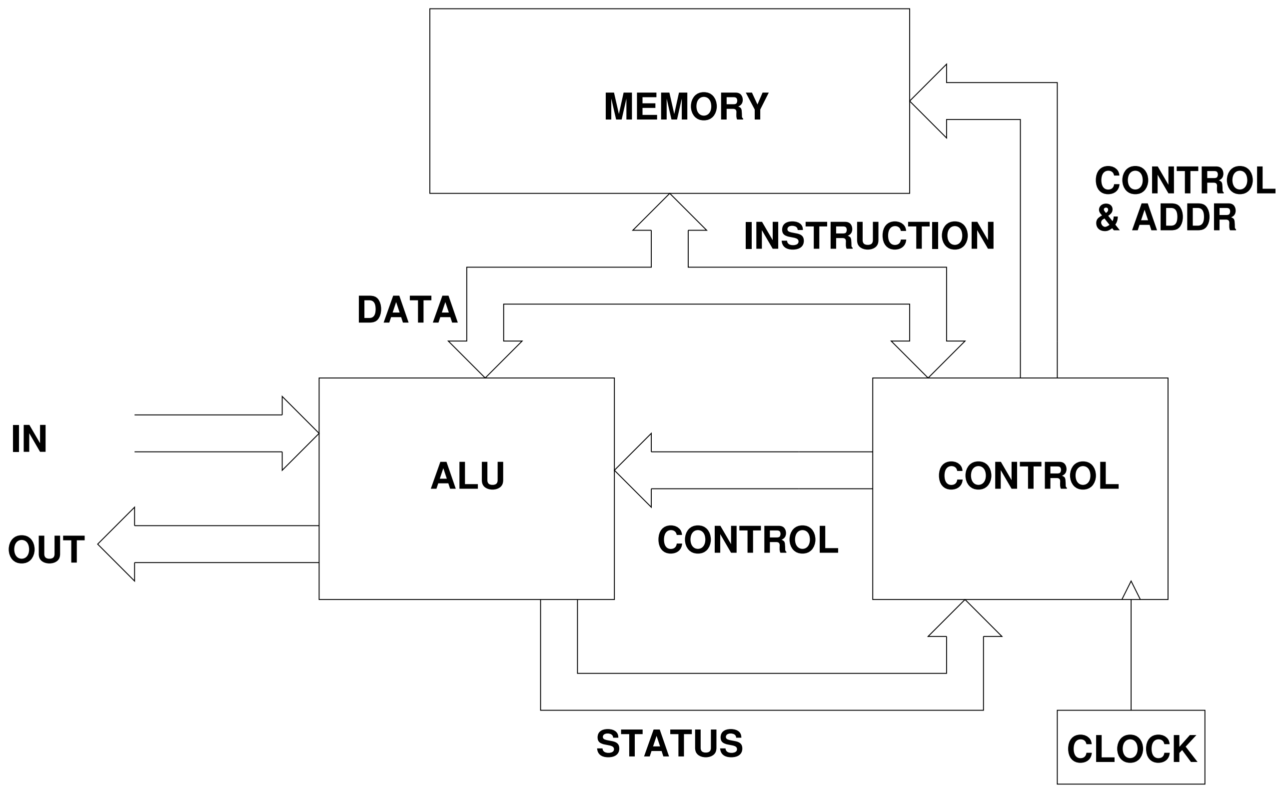
INSTRUCTION	ACTION
18 06	(A) + (B) => A
87	0 => A
5A 05	(A) => Address 5

HARVARD ARCHITECTURE MICROPROCESSOR



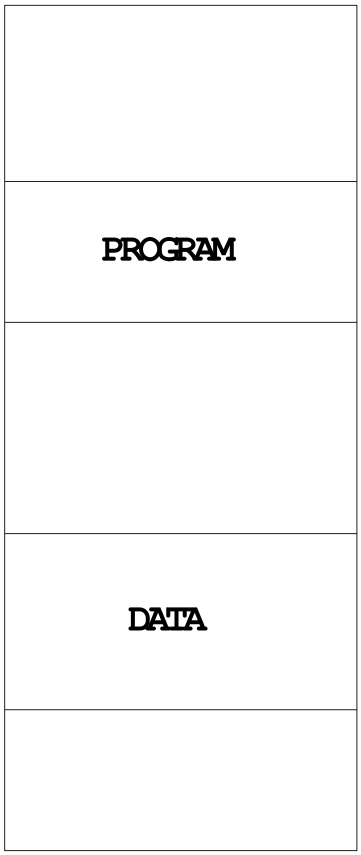
PRINCETON (VON NEUMAN) ARCHITECTURE

MICROPROCESSOR

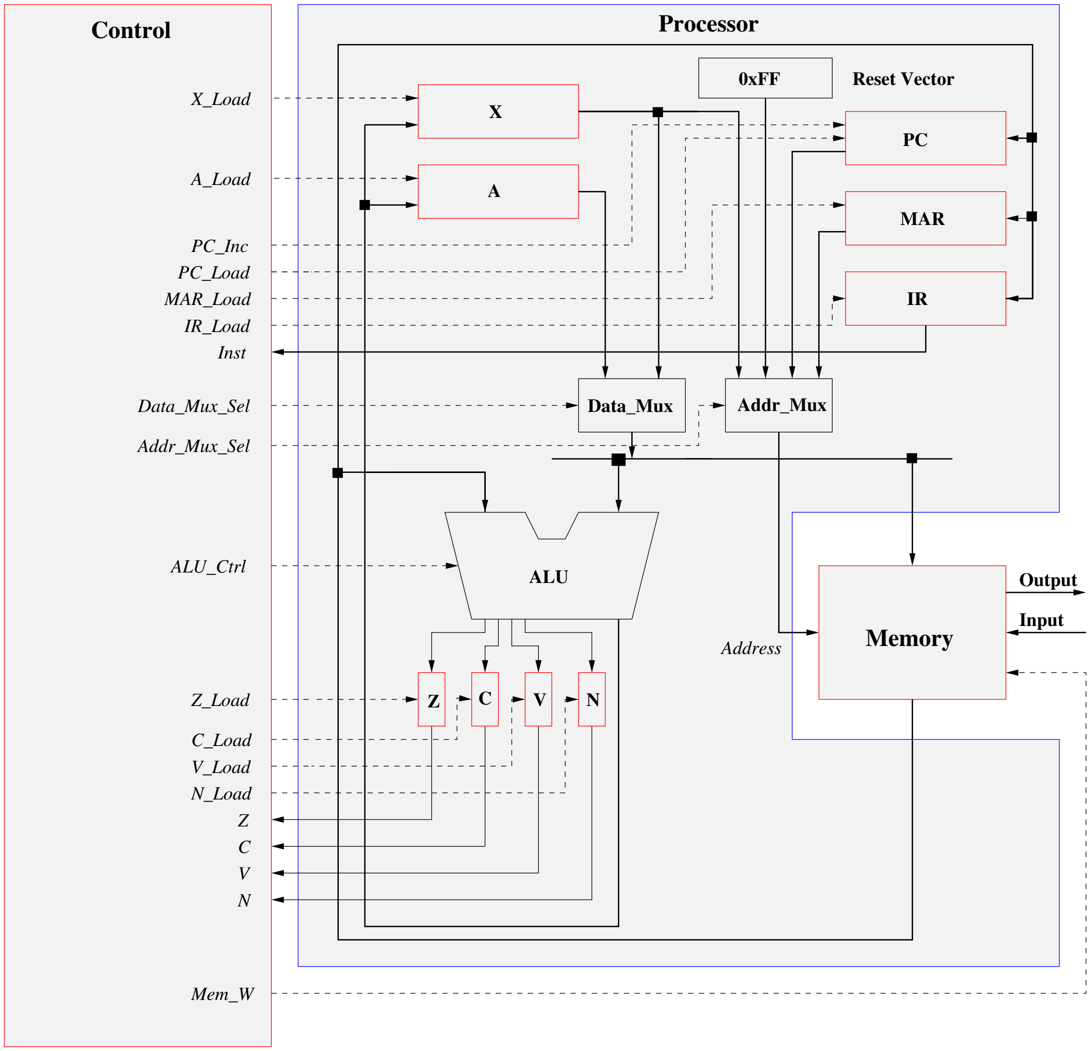


MEMORY MAP

(Princeton Architecture)



Function of memory determined by programmer


Control
X_Load
A_Load
PC_Inc
PC_Load
MAR_Load
IR_Load
Inst
Data_Mux_Sel
Addr_Mux_Sel
ALU_Ctrl
Z_Load
C_Load
V_Load
N_Load
Z
C
V
N
Mem_W
Processor
0xFF
Reset Vector
X
A
PC
MAR
IR
Data_Mux
Addr_Mux
ALU
Z
C
V
N
Address
Memory
Output
Input

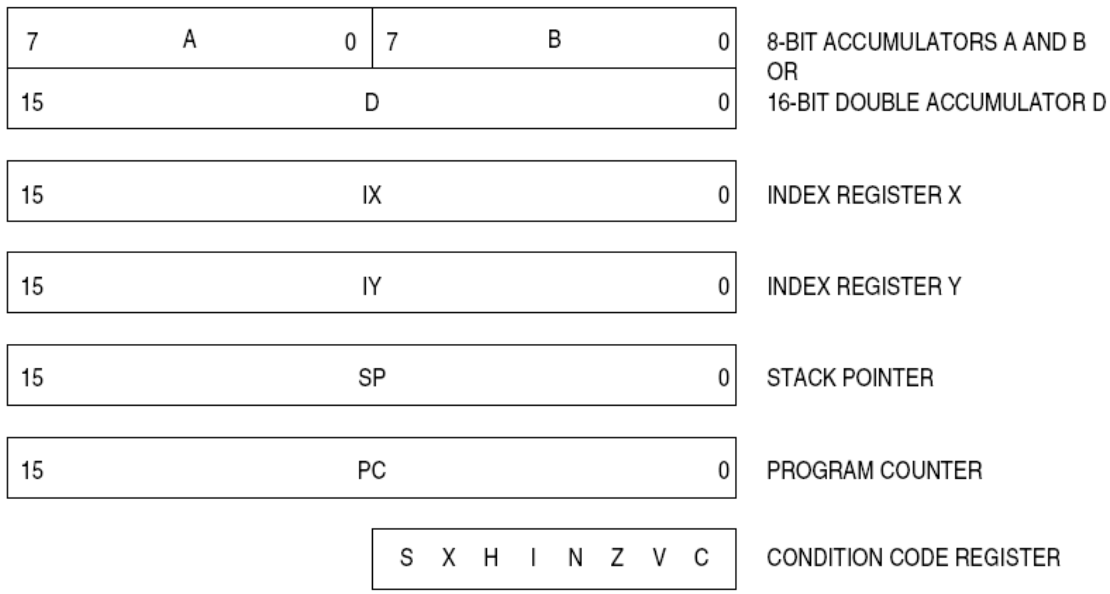


Figure 2-1. Programming Model

Binary	Hex	Decimal
0000	0	0
0001	1	1
0010	2	2
0011	3	3
0100	4	4
0101	5	5
0110	6	6
0111	7	7
1000	8	8
1001	9	9
1010	A	10
1011	B	11
1100	C	12
1101	D	13
1110	E	14
1111	F	15

Convert Binary to Decimal

1111011_2

$1 \times 2^6 + 1 \times 2^5 + 1 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$

$1 \times 64 + 1 \times 32 + 1 \times 16 + 1 \times 8 + 0 \times 4 + 1 \times 2 + 1 \times$

123_{10}

Convert Hex to Decimal

$82D6_{16}$

$$8 \times 16^3 + 2 \times 16^2 + 13 \times 16^1 + 6 \times 16^0$$

$$8 \times 4096 + 2 \times 256 + 13 \times 16 + 6 \times 1$$

33494_{10}