

# GCSE Computer Science

CPD Session for Leeds West Academy

**Leeds West Academy**

LEADING IN LEARNING



# Systems Architecture

- the purpose of the CPU
- Von Neumann architecture:
  - MAR (Memory Address Register)
  - MDR (Memory Data Register)
  - Program Counter
  - Accumulator
- common CPU components and their function:
  - ALU (Arithmetic Logic Unit)
  - CU (Control Unit)
  - Cache
- the function of the CPU as fetch and execute instructions stored in memory
- how common characteristics of CPUs affect their performance:
  - clock speed
  - cache size
  - number of cores
- embedded systems:
  - purpose of embedded systems
  - examples of embedded systems.

# Purpose of the CPU

3 marks:

- Fetch,
- decode,
- execute instructions

# Architecture

Practical Exercises

Google 'Peter Higginson LMC'

# Low Level Instructions

ADD 90

1 90

0001 0101 1010

# Low Level Instructions

ADD 90

1 90

0001 0101 1010

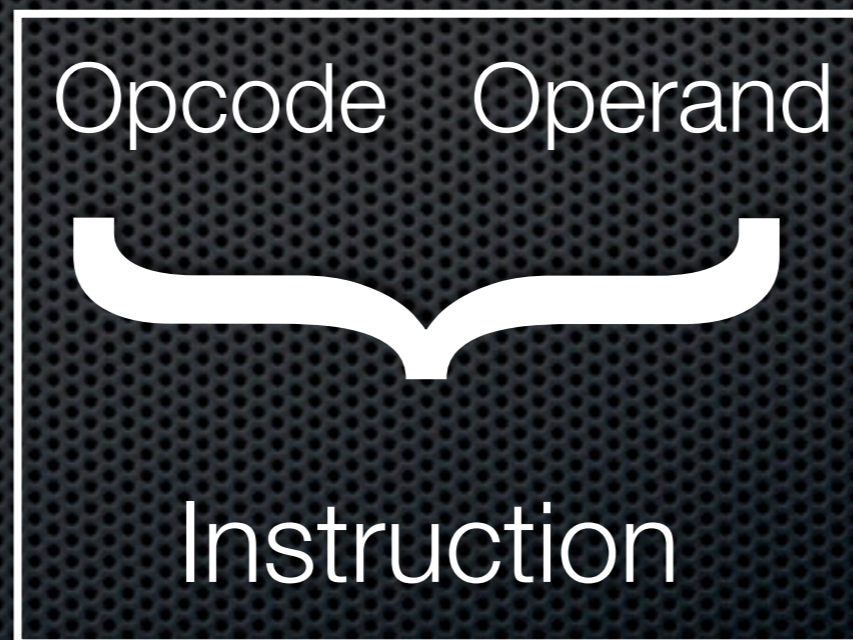
Opcode Operand

# Low Level Instructions

ADD 90

1 90

0001 0101 1010



# CPU Components

ALU (Arithmetic Logic Unit)

CU (Control Unit)

Cache (Registers)



# CPU Components

## **Arithmetic Logic Unit**

Responsible for carrying out arithmetic and logical operations (e.g. addition, inequalities)

# CPU Components

## Control Unit

Responsible for timing and control signals

MAY house the registers

*Awaiting confirmation by OCR*

The **control unit** is the most complex part of a processor. It takes the op-code bits from the instruction register plus a clock signal and generates all the signals necessary to cause the current instruction to be executed.

BCS Professional Examination Examiners Report 2004

# CPU Components

## Cache

Frequently used instructions and data

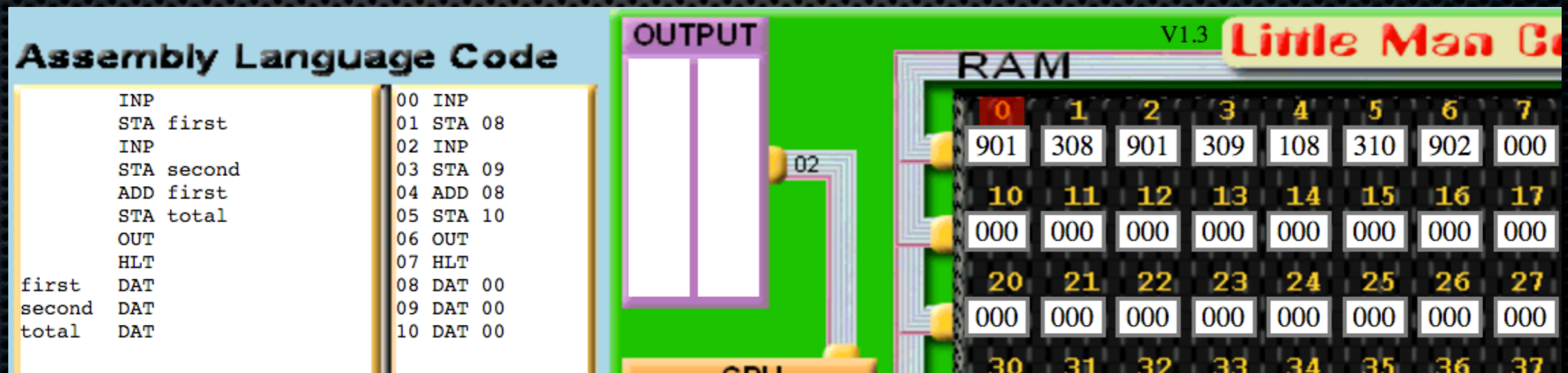
“Acts as a **buffer** between CPU and RAM”

# Von Neumann Architecture

Stored Program Concept

Instructions stored in RAM rather than fed in from outside

Requires special purpose registers



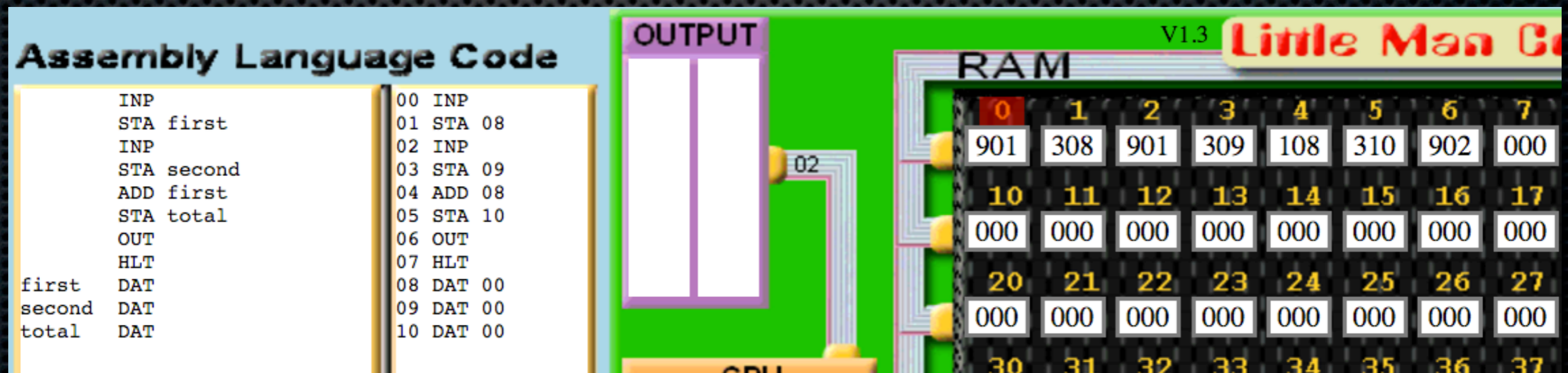
# Von Neumann Architecture

Where are you up to?

Transferring data

Which address to look at

Current value to work on



# Von Neumann Architecture

Where are you up to?

Transferring data

Which address to look at

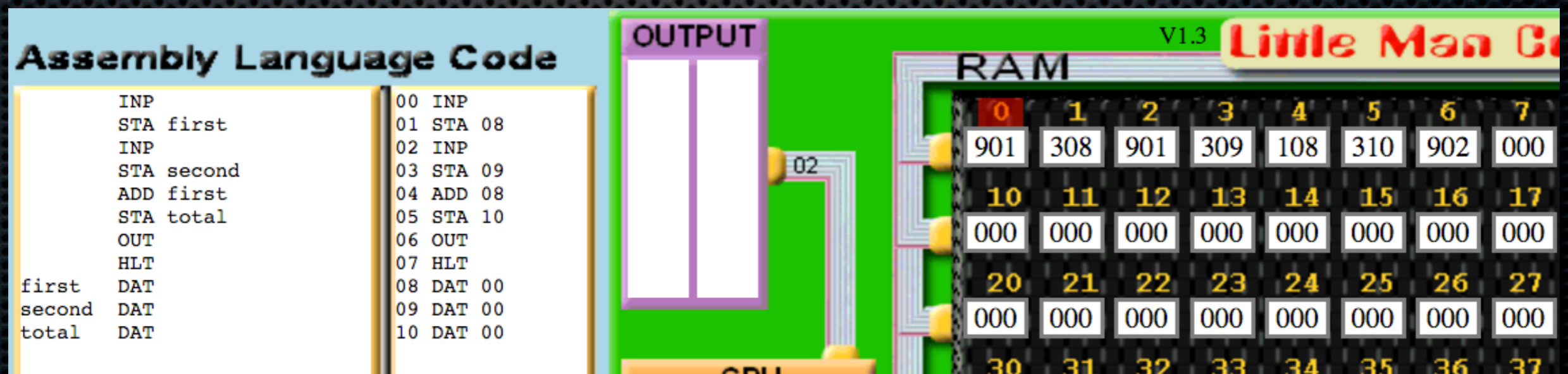
Current value to work on

Program Counter

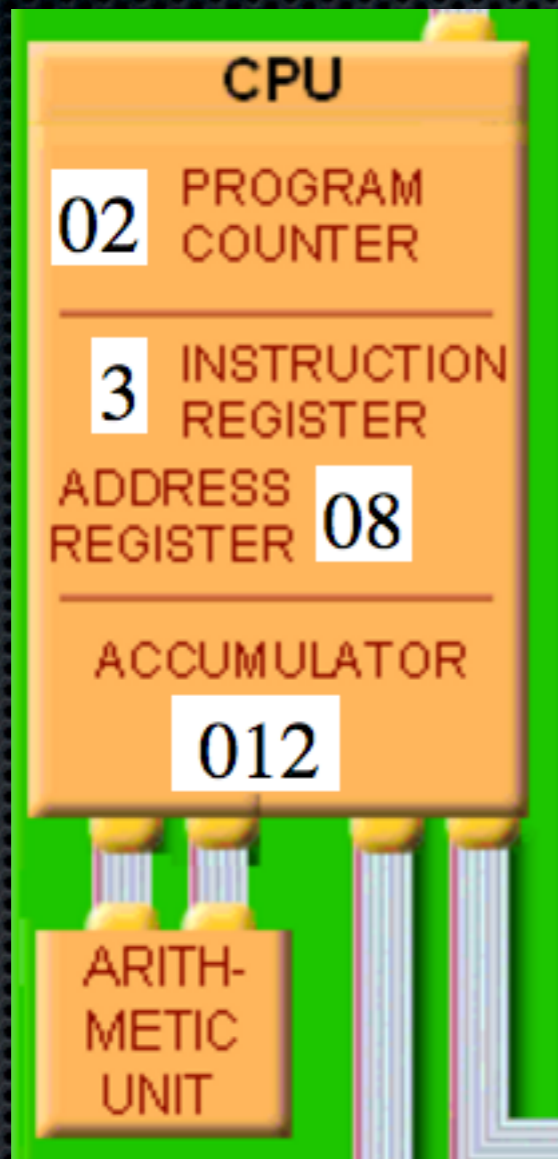
Memory Data Register

Memory Address Register

Accumulator



# Von Neumann Architecture



Program Counter

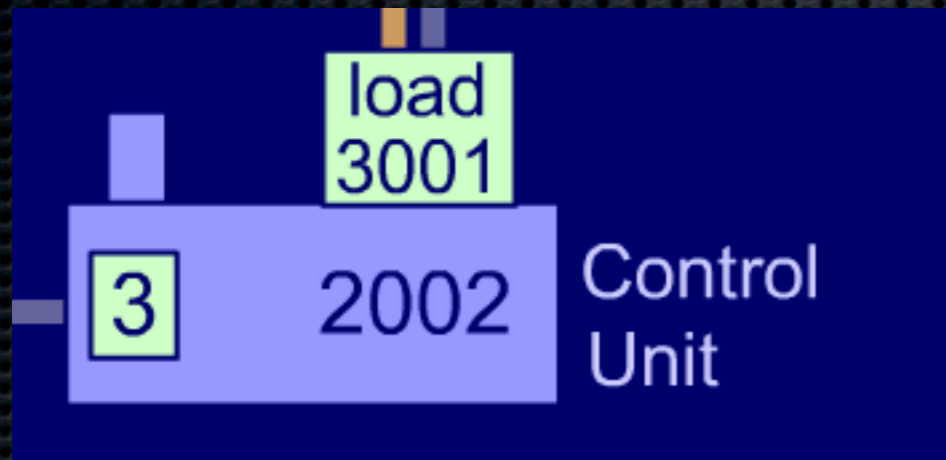
Memory Data Register

Memory Address Register

Accumulator

# Von Neumann Architecture

The address we are using



The address of the next instruction

The value currently being worked on



# Von Neumann Architecture

Program Counter

Memory Data Register

Memory Address Register

Accumulator

The value currently being worked on

The data just arrived

The address we are using

The address of the next instruction

# Von Neumann Architecture

The address of the next instruction

Program Counter

The data just arrived

Memory Data Register

The address we are using

Memory Address Register

The value currently being worked on

Accumulator

# CPU Performance

Clock Speed, Cores and Cache

# CPU Performance

## **Clock Speed**

The frequency with which the timing signals are sent

2GHz vs 1GHz

Twice as many instructions in the same time

# CPU Performance

## **Cores**

Can execute multiple instructions at the same time

Quad Core vs Single Core

**Nearly** 4 times as many instructions in the same time

**Or** allows instructions to be executed simultaneously

# CPU Performance

## Cache

Acts as a **buffer** between the CPU and RAM

1MB vs 256KB

More space for frequently used instructions / data

Means less time needed to fetch instructions / data

# Embedded Systems

## **Definition**

A computer system with a dedicated function  
(the opposite of a general purpose computer)

## **Examples**

Washing machine control unit, car ECU, router,  
set top box, digital clock, digital radio, etc...

## **Purpose**

Reduce costs, reduce size, improve reliability