

Computers

Computers

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<http://carlhenrik.com>

Introduction

Content of MSc

COMSM1201 Programming in C

COMSM1302 *Overview of Computer Architecture*

COMSM0103 Object Oriented Programming with Java

COMSM0016 Databases

COMSM0104 Web Technologies

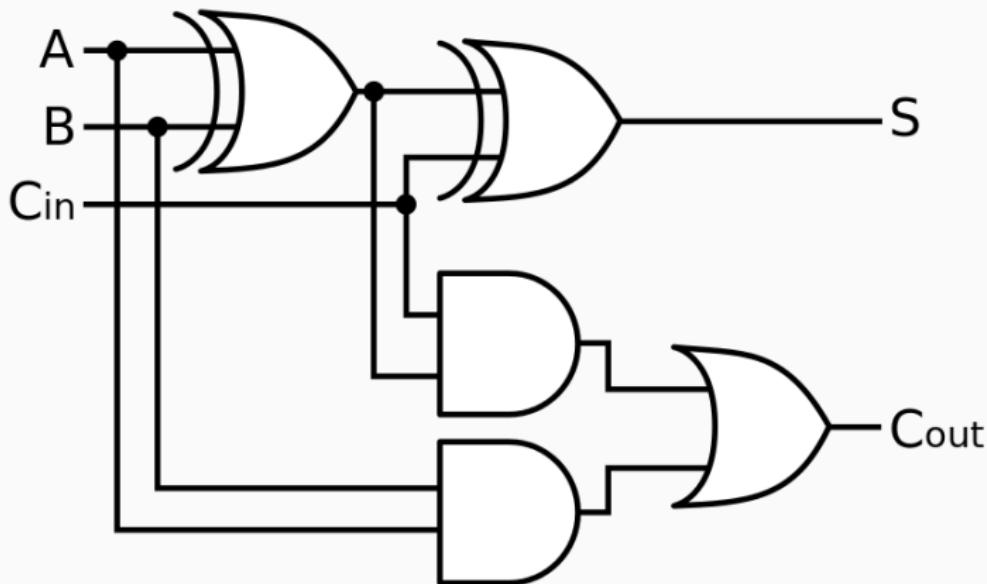
COMSM1401 Software Engineering and Group Project

COMSM2202 Research Skills

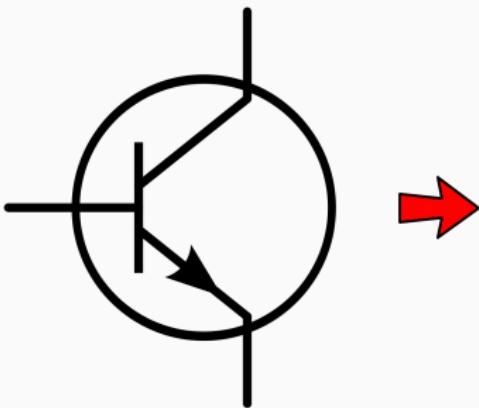
COMSM3201 MSc Project Computer Science



Content of Part I



Purpose of this unit?



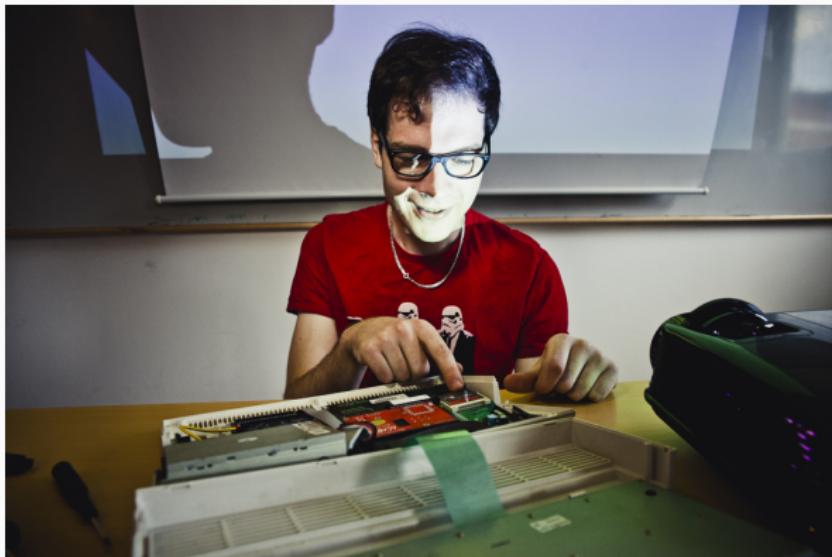
Code

```
int main(void)
{
    void *p = &tmp;
    int a = *(p+sizeof(int)*4);
    return a
}
```

Content of Part II

- What is a Computer?
- Processors and Execution of Code
- *Proper Coding*
- Connection to High-level languages
- Operating Systems

Who am I?



Why am I teaching this?



***** COMMODORE 64 BASIC V2 *****
64K RAM SYSTEM 38911 BASIC BYTES FREE
READY.

Raspberry Pi



Raspberry Pi¹

- What was your motivation in creating Raspberry Pi
 - what were you setting out to try and achieve?

¹<https://techcrunch.com/2012/10/14/>

raspberry-pi-the-small-computer-with-the-big-ambition-to-get-kids-codi

Raspberry Pi¹

- What was your motivation in creating Raspberry Pi
 - what were you setting out to try and achieve?
- *I was working at the university in Cambridge about six years ago and I had this awful experience of seeing the number of people applying for Computer Science every year going down and the sorts of things they'd have to do getting less and less impressive.*

¹<https://techcrunch.com/2012/10/14/raspberry-pi-the-small-computer-with-the-big-ambition-to-get-kids-coding/>

raspberry-pi-the-small-computer-with-the-big-ambition-to-get-kids-codi

Raspberry Pi ²

- Isn't it a bit of a paradox that we're surrounded by so much technology and yet engineering skills are declining?

²<https://techcrunch.com/2012/10/14/>

raspberry-pi-the-small-computer-with-the-big-ambition-to-get-kids-codi

Raspberry Pi ²

- Isn't it a bit of a paradox that we're surrounded by so much technology and yet engineering skills are declining?
- *These are appliances; your phone is an appliance, your tablet generally is an appliance. They're devices for consuming, not devices for producing. Producing is where the value is, producing is where the fun is.*

²<https://techcrunch.com/2012/10/14/>

raspberry-pi-the-small-computer-with-the-big-ambition-to-get-kids-codi

Producing is where the fun is!

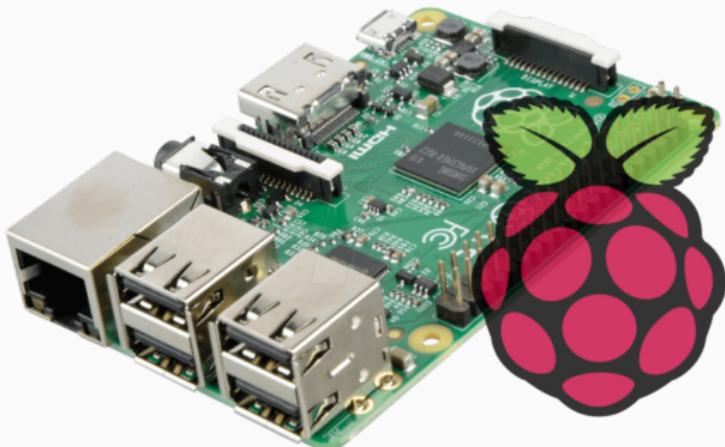
Week 7 ARM Assembly

Week 9 ARM Assembly

Week 10 High Level Languages

Week 11 Operating Systems

Raspberry Pi



Today Introduction

w6 Processors and Execution

w7 Assembly Language

w7 ARM Assembly

w10 ARM Assembly

w10 High Level Languages

w11 Operating Systems

w11 Operating Systems

Material



<https://github.com/carlhenrikek/COMSM1302>

Examination of Part II



Monday Week 12, 16th of December

Computers

Definition (Computer Science)

The systematic study (science) of algorithms

Definition (Algorithms)

an **ordered** set of **unambiguous**, **executable** steps that defines a **terminating** process

Computing



Computing³



³<https://computerhistory.org/>



Metamathematics



- Study of Mathematics by Mathematics

Gödels Incompleteness Theorem

Definition (Incompleteness Theorem)

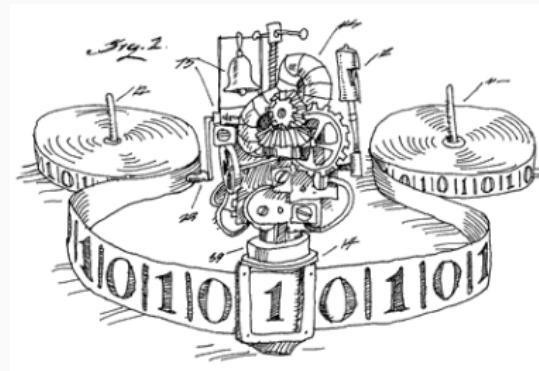
Any effectively generated theory capable of expressing elementary arithmetic cannot be both consistent and complete



Alan Turing



Turing Complete

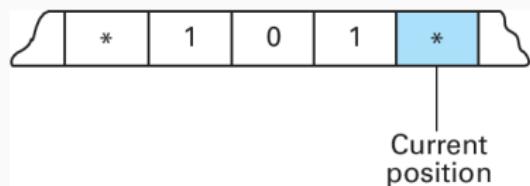


Turing Machine abstraction of what can be done by algorithmic computation

Church-Turing thesis a function on the natural numbers can be calculated by an effective method if and only if it is computable by a Turing machine.

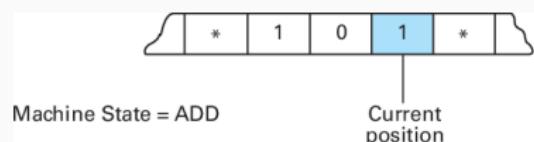
Computation

Current state	Current cell content	Value to write	Direction to move	New state to enter
START	*	*	Left	ADD
ADD	0	1	Right	RETURN
ADD	1	0	Left	CARRY
ADD	*	*	Right	HALT
CARRY	0	1	Right	RETURN
CARRY	1	0	Left	CARRY
CARRY	*	1	Left	OVERFLOW
OVERFLOW	(ignored)	*	Right	RETURN
RETURN	0	0	Right	RETURN
RETURN	1	1	Right	RETURN
RETURN	*	*	No move	HALT



Computation

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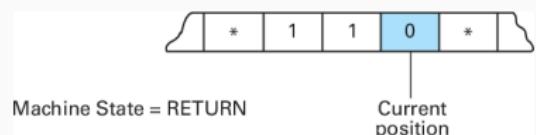
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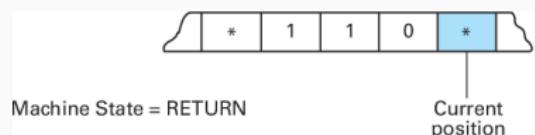
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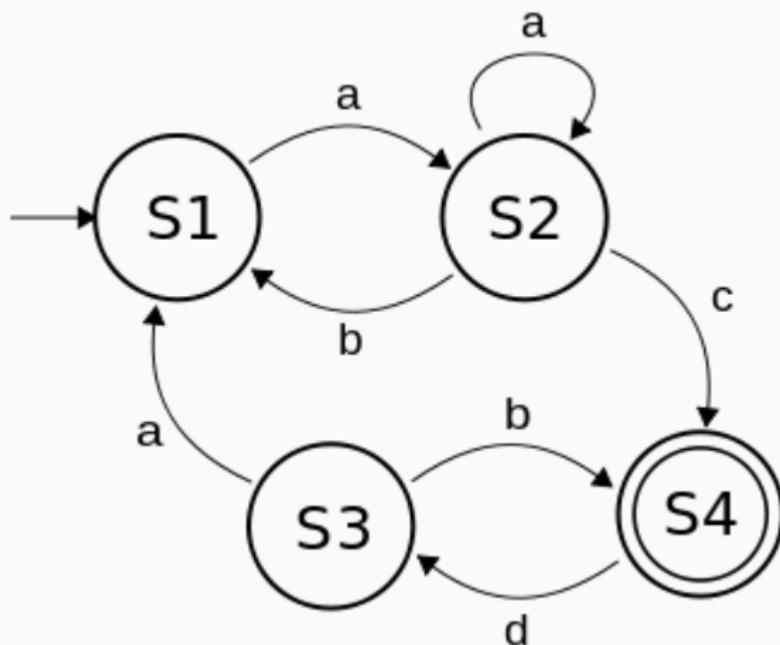


Computation

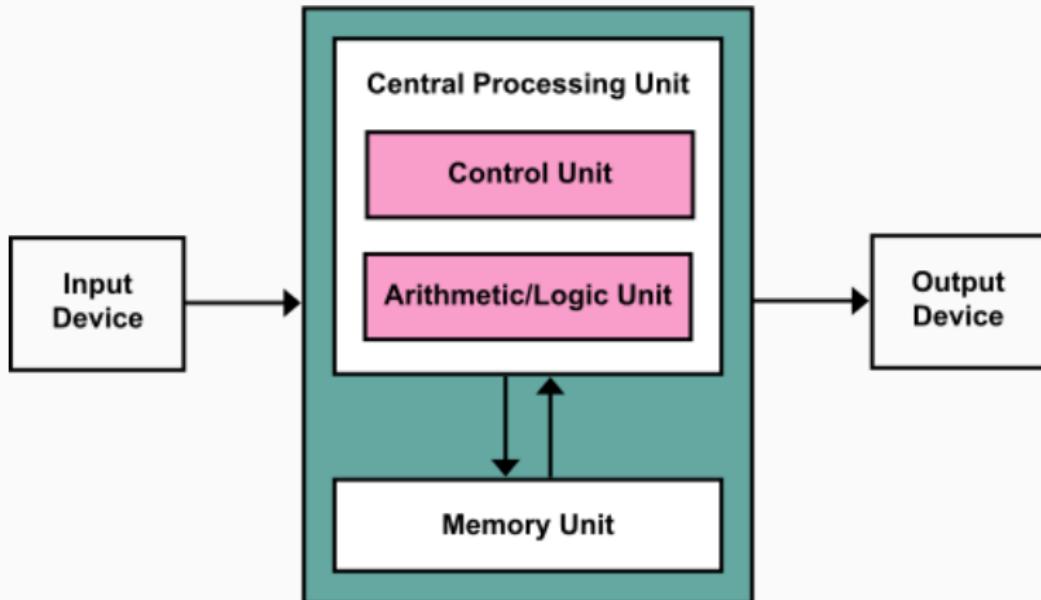
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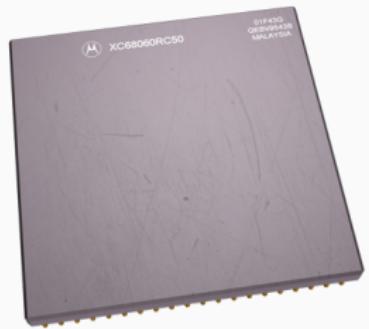
State Machine



Computer Architecture



Central Processing Unit



Control Unit

- Controls execution
- Fetches instruction
- Decodes instruction
- Flow

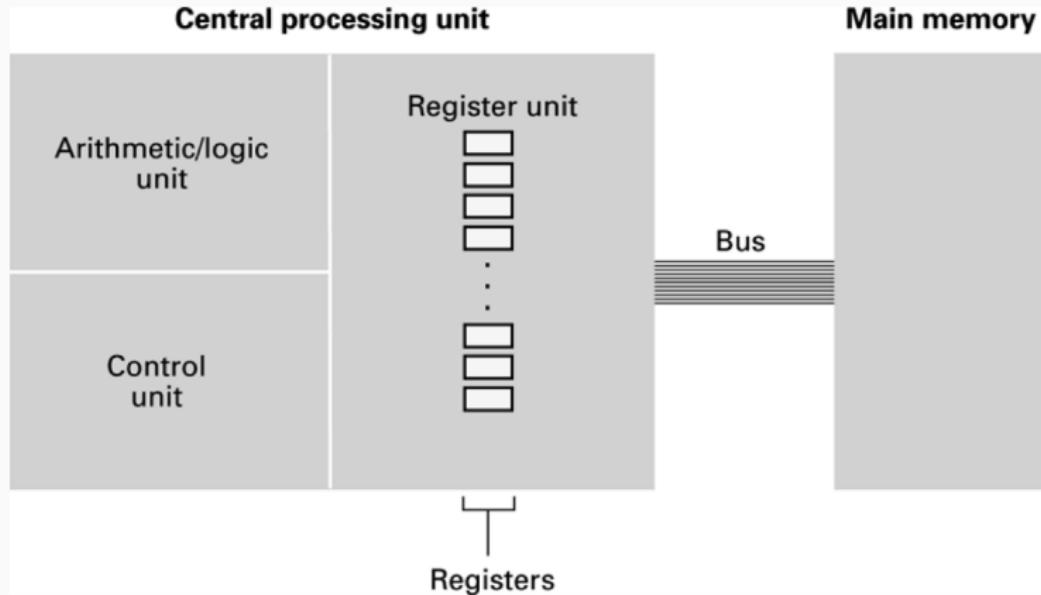
ALU

- Arithmetic and Logic Unit
- INPUT
 - operands
- OUTPUT
 - result of computation

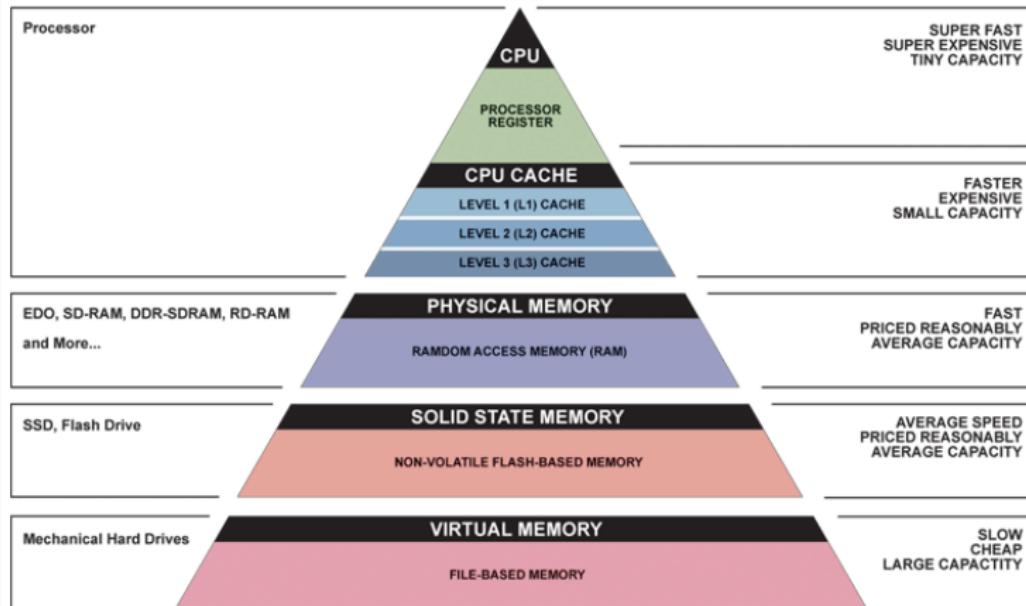
Registers

- Stores data in the CPU
- General Purpose
 - Data, Address
- Special Purpose
 - Program counter
 - Stack pointer
 - Status register

Computer



Memory



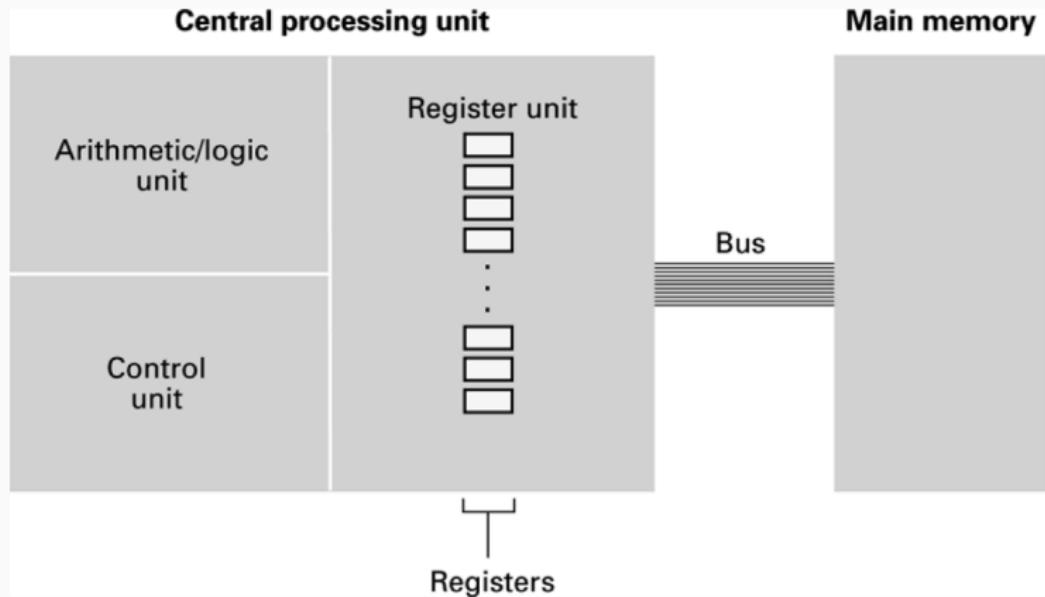
▲ Simplified Computer Memory Hierarchy
Illustration: Ryan J. Leng

Memory



- Connected to CPU by BUS
- Stores both data and instructions

Adressing



I/O - Input/Output

- Memory Mapped
 - Device connected to the same BUS
 - Allows for DMA
- Port Mapped
- Interrupt
 - Dedicated interrupt line
 - IRQ

Next time

- What happens when you start a computer?
- Execution of code
- Instructions

Summary

- What is the purpose of this unit?
- What is a computer?
- Elements of Electronic Computers

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