CS1021 Introduction to Computing

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South Leinster St

CS1021 and CS1022

CS1021 Introduction to Computing I (5 ECTS)

- Semester 1

- ICS, CSB and CSL

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CS1022 Introduction to Computing II (5 ECTS)

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- Semester 2

- ICS and CSB

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5 ECTS module (out of 60 ECTS for each full year of your degree)

ECTS European Credit Transfer and Accumulation System

5 ECTS means 5x25 or 125 hours of student effort expected

4 contact hours for 11 weeks = 44

leaves 81 or ≈ 6-7 hours of additional student effort expected per week

You'll learn how to write Assembly Language programs for an ARM CPU to solve a range of problems

Why bother?

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it's the best way to learn how computers really work
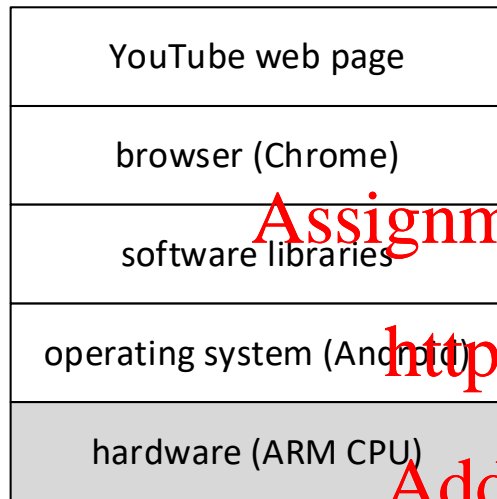
https://powcoder.com

you'll learn that computers DON'T work by MAGIC

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you'll learn that computers execute very simple instructions and that their power comes from being able to execute these simple instructions incredibly quickly

my desktop, for example, can execute 2,000,000,000,000 floating point operations per sec (2 TFLOPS)

INTRODUCTION

many layers of software between user and hardware

YouTube web page
browser (Chrome)
software libraries
operating system (Android)
hardware (ARM CPU)

many layers of software between user and the hardware BUT REMEMBER all software has to be converted into instructions that are executed by the hardware

- streaming video data across the network
- decompressing the video
- rendering the video
- …

- CS1021/22 concentrates on the "low-level" software executed by the hardware
- *"Mighty oaks from little acorns grow"*

INTRODUCTION

Semester 1

> 12 weeks (10-Sep-18 to 30-Nov-18), week 7 is a study week

Lectures

> Monday 14:00 in MacNeill (Hamilton H3)
>
> Tuesday 11:00 in LB01 (Lloyd Building)

Tutorials

> Thursday 09:00 in Goldsmith Hall or Thursday 13:00 in LB04
>
> No tutorials in week 1 or week 8 (used for a mid semester test) or week 12

Labs

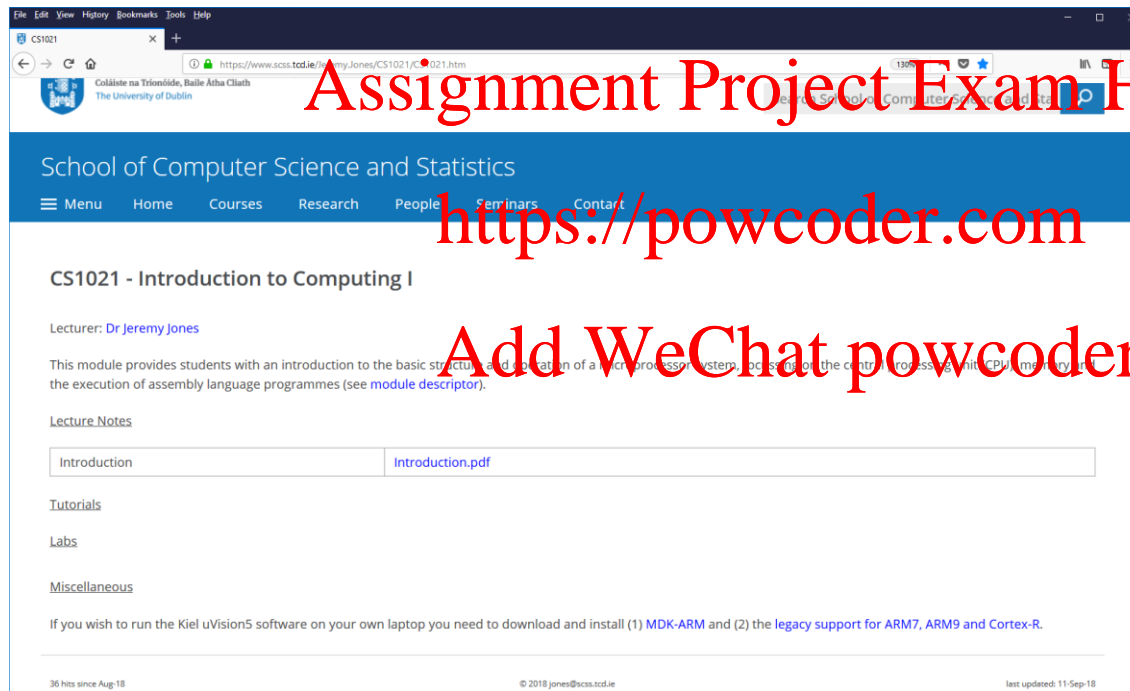> Friday 10:00 or 11:00 in ICT2/LG35/LG36 (O'Reilly Institute)
>
> labs start in Week 3

Check Blackboard for which Tutorial and Lab you should attend:

> http://mymodule.tcd.ie

CS1021 Website

- https://www.scss.tcd.ie/Jeremy.Jones/CS1021/CS1021.htm

- ALL lecture notes, tutorial questions and lab exercises will be available on this page
- lab submissions via Blackboard

Assessment

Paired Labs	Lab1 - week 3 Lab2 - week 4 Lab3 - week 5 Lab4 - week 6	40%
Individual Labs	Lab5 - week 9 Lab6 - week 11	
Mid-Year test	1 hour - week 8	20%
Practical Exam (Dec 2018)	1.5 hours – during exam period	40%

pass mark 40%

Supplemental (Aug 2019)

100% exam

Laptops/tablets/phones

- Laptops/tablets/mobile phones may **NOT** be used during lectures

- they are a distraction for you and other members of the class

- there are **exceptions** (eg if you are registered with the College Disability Service and require the use of a laptop, just let me know)

- you will need your laptop/tablet/phone during tutorials and labs for referring to course material, documentation etc.

- lecture notes very readable on a mobile phone

Attendance and Deadlines

- attendance at ALL lectures, tutorials and labs is compulsory (attendance will be taken during tutorials and labs)

- you MUST attend your own tutorial and lab sessions

- zero marks for late coursework without explanation – email Andrew Collins ancollin@scss.tcd.ie, the CS1021 Teaching Assistant (TA) if you are going to miss a tutorial or lab deadline

- inform your tutor if you are going to miss a deadline or are absent from College for more than a couple of days

Recipe for Success

- attend ALL lectures, tutorials and labs

- keep up to date by working through lecture notes, tutorials and labs in your own time and if you don't understand something seek help from classmates, demonstrators, TA's, me

- do ALL the tutorials and labs YOURSELF

- take pride in the lab answers you submit

- what you learn is cumulative, keep up to date and don't get left behind

- learning to program takes TIME and PRACTICE, it cannot be done the day before the exam (think 10,000 hours per Malcom Gladwell "*Outliers: The Story of Success*")

- AND don't wait to be told that …

    - you haven't been attending lectures, tutorials or labs
    - you haven't handed in coursework

CS1021 Learning Outcomes

At the end of the module you will be able to:

- describe the basic characteristics, structure and operation of a computer system

- represent and interpret information stored in binary form (integers, text, ...)

- design, write, test and document assembly language programs to solve simple problems

- translate high-level programming language constructs into their assembly language equivalents

- evaluate the efficiency of simple algorithms

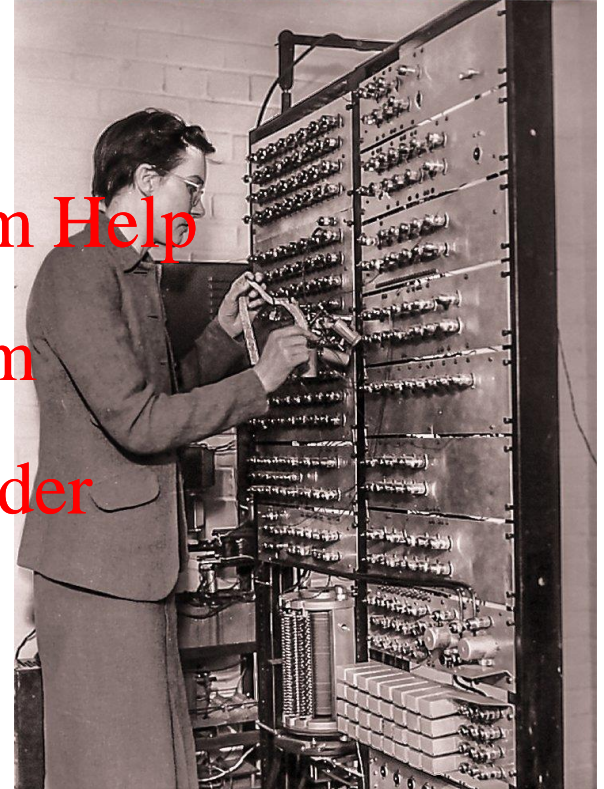- make use of appropriate documentation and reference material

Syllabus

- binary arithmetic

- ARM architecture

- fetch-decode-execute cycle

- arithmetic instructions

- condition codes and program flow

- bit manipulation

- accessing memory

- problem solving, algorithm and program development

- Keil uVision5 integrated development environment (IDE)

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INTRODUCTION

- assembly language first developed in 1947 by Kathleen Booth (née Britten) at Birkbeck College, University of London

- removed the need for programmers to program using binary codes

- replaced by high-level programming languages (eg Java used in CS1010)

- now mostly used when optimising programs for speed

Kathleen Booth (née Britten) - working on the APE(X)C computer ~1953

ARM Holdings plc

- Founded 1990, Cambridge England

- ARM Holdings do not manufacture their own CPUs, but licences its designs to other manufacturers (Qualcomm, Samsung, Huawei, NXP Semiconductors, …)

- known for their low power cost effective CPUs

- range of CPUs from those suitable for low cost IoT devices (ARM7TDMI) to supercomputers (Fujitsu A64FX)

- ARM is the most widely used instruction set architecture

- 15 billion ARM CPUs produced in 2015 (Intel circa 400 million)

- ARM CPUs used in more than 85% of the world's mobile devices

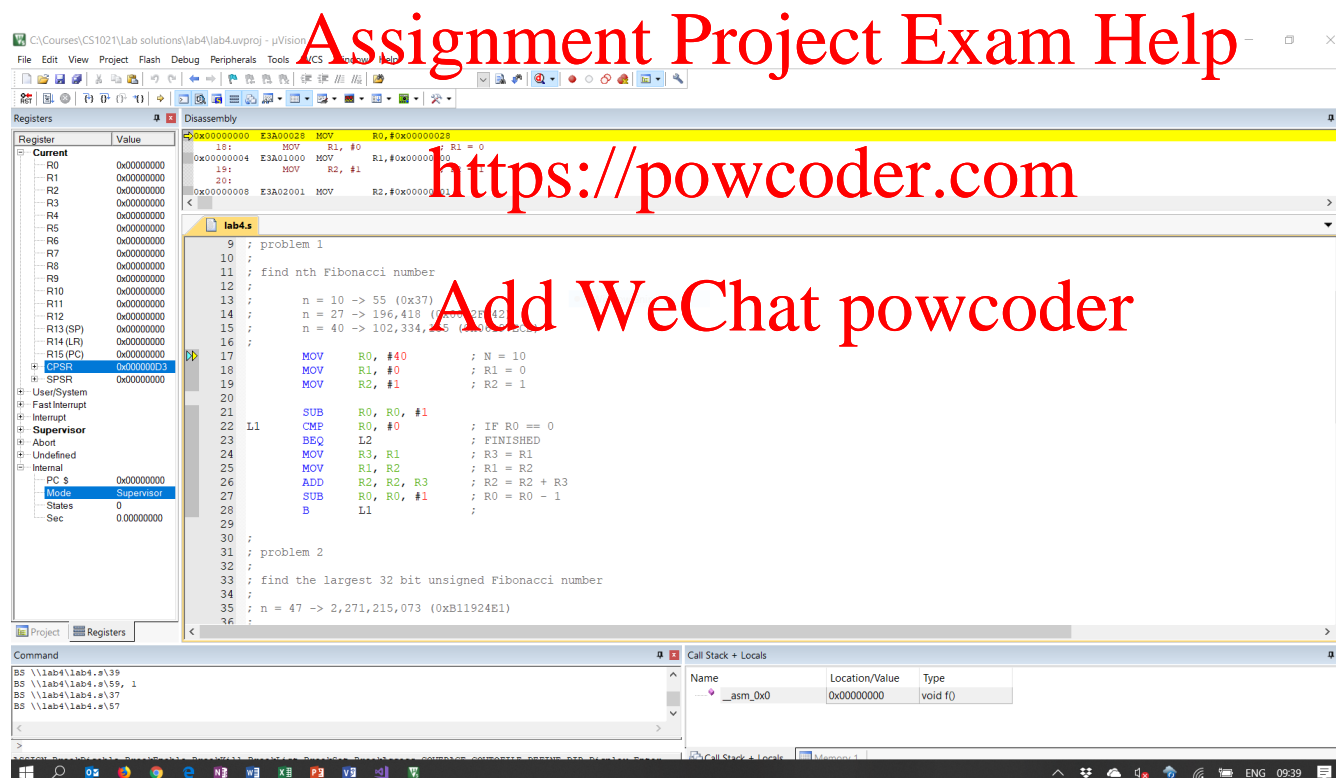- ARM Holdings is a very successful company

Keil uVision5 Integrated Development Environment (IDE)

- use in SCSS labs, but free download from Keil website to run on own laptop/desktop
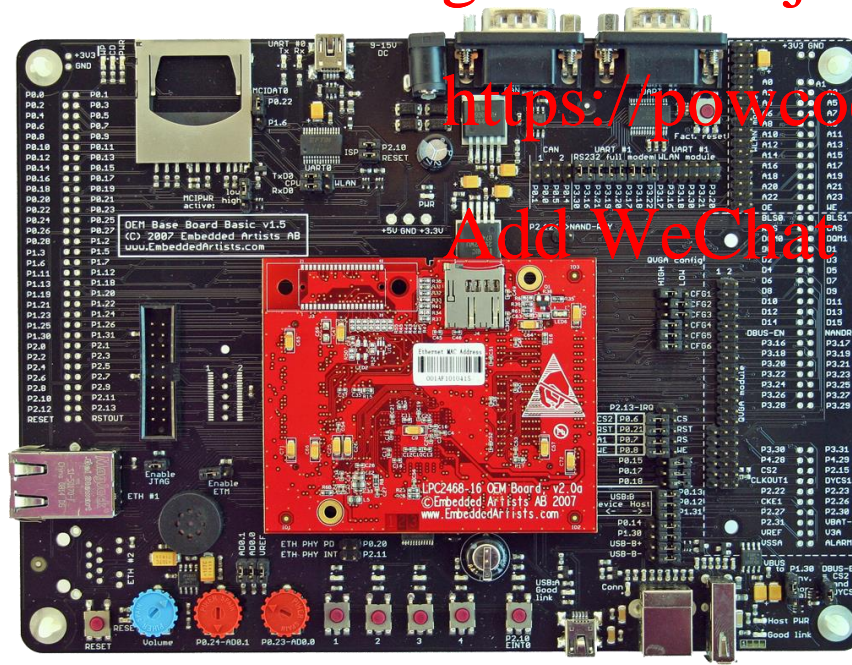- integrated editor, assembler, simulator and debugger

Keil uVision5 …

- can connect laptop/desktop to an ARM based Developer Kit via two USB cables so software can be downloaded and executed on the developer board rather than being simulated on the PC
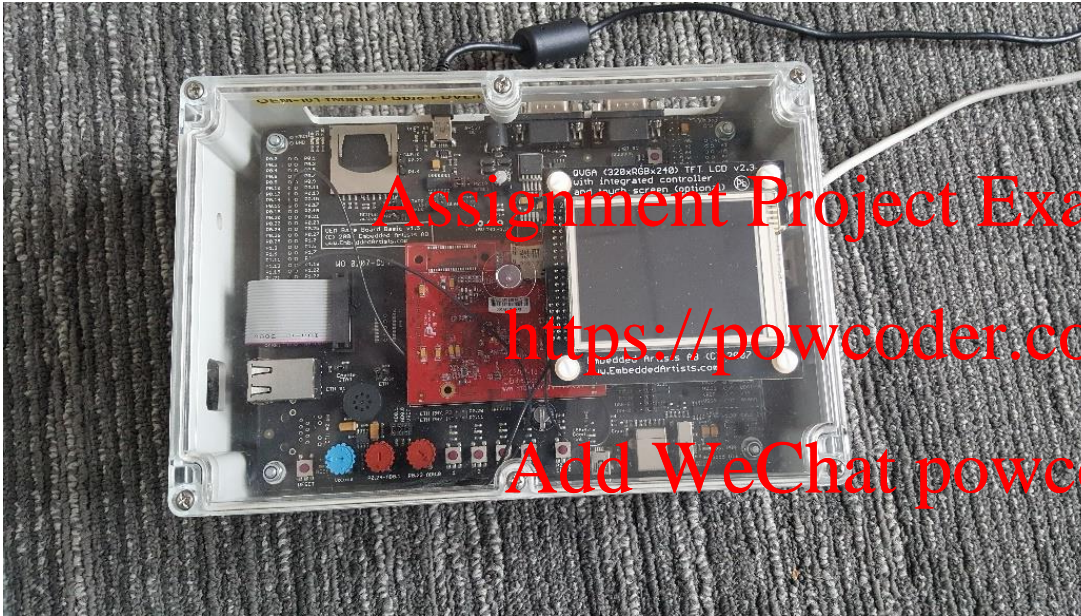
Embedded Artists LPC2468 Developer's Kit based on a NXP LPC2468 microcontroller

- ARM7TDMI-S 32-bit CPU
- Flash memory (512KiB)
- RAM (96KiB)
- 10/100 Ethernet
- USB 2.0
- A/D and D/A converters
- …

Embedded Artists LPC2468 Developer's Kit in LG35/36 Lab

- Note the two USB cables and the addition of a QVGA touch-screen LCD board

- CS1021 will mostly use the uVision 5 simulator
- CS1022 will mostly use the LPC2468 Developer's Kit

Keil uVision5 Quick Demonstration