CSSE2010/CSSE7201

Semester 2, 2021

Lecture 1

Course Introduction
Bits, Bytes and Binary

School of Information Technology and Electrical Engineering
The University of Queensland

Today’s Outline

- Course Intro, Organisation and Admin
- Assessment details
- Course Blackboard – quick walkthrough
- Technical Content – Binary Numbers

Welcome !

CSSE2010/CSSE7201 – Introduction to Computer Systems

- ❑ CSSE2010-IN
- ❑ CSSE2010-EX
- ❑ CSSE7201-IN
- ❑ CSSE7201-EX

Course Staff

- Course Coordinator and Lecturer:
  Dr Chamith Wijenayake
  - Office: St Lucia Campus 78-537
  - Email: c.wijenayake@uq.edu.au
  - Office Hours: TBC
- A large group of tutors

READ THE ECP

Study formula:1L-2P-1L-2P-3S-1E

What’s This Course All About?

We will learn about Computers in different aspects

Source: Google Images

W13

W12

Software

W11

W10

W09

W08

W07

W06

W05

Hardware

W04

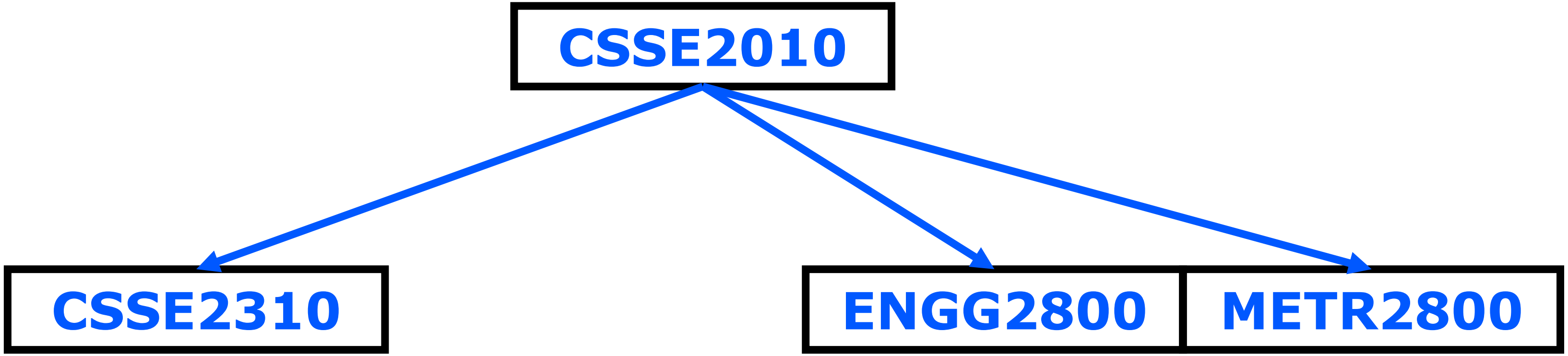
W03

W02

W01

Where does this course lead?

- Follow on courses



Computer Systems Principles & Programming

Engineering Team Project 1

→ COMS3200 – Computer Networks 1
→ COMP3301 – Operating Systems Architecture
→ CSSE3010 – Embedded Systems Design & Interfacing

Course Learning Activities (ECP Sections 3 and 4)

- **Run in two modes: Internal (IN) and External (EX)**
- **Lectures: Monday 6-7pm** and **Wednesday 9am-10am**. Conducted via zoom and recorded. Zoom meeting ID on Blackboard
- **Learning Labs (Prac sessions):**
  - **Internal (IN) mode: COVID-19 guidelines must be followed at all times**
    - **In-person at 47-104, two sessions per week**
    - Sign up for a pair of sessions PRA-FD-x-P1, PRA-FD-x-P2, 5 pairs to select from
    - **Students will be loaned a lab kit which must be returned or purchased by the end**
    - **If you drop the course or change to EX mode you must return/purchase the kit**
  - **External (EX) mode:**
    - **Online over zoom, two sessions per week**
    - Sign up for a pair of sessions PRA-EX-x-P1, PRA-EX-x-P2, 2 pairs to select from
    - **Students need to acquire an Arduino Uno and some other components by week 6**
    - If you are an EX student from Brisbane, you still need to acquire your own hardware
- Practice exercise

Contact eait.mytimetable@uq.edu.au for any sign on issues

Staying Healthy @ UQ

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

- Stay home if you are unwell
- Cover your mouth and nose when you sneeze or cough
- Avoid touching your face
- Wash your hands thoroughly
- Don't share personal items
- Clean surfaces
- 1.5M
  Maintain space between each other
- Put used tissues in the bin
- Call your General Practitioner (doctor) or UQ Health Care and explain your symptoms

CRICOS 00025B

? Need the facts? **about.uq.edu.au/coronavirus-advice-uq-community**

Assessment Details – ECPs Section 5

CSSE2010-IN/EX

- **Weekly quizzes (10%=1.25% * 8)**
- **Assignment 1 (20%)**
  - Part 1 – 1-hr timed MCQ quiz (10%)
  - Part 2 - Digital logic design (10%)
- **Assignment 2 (20%)**
  - AVR microcontroller programming
  - 10% pass hurdle
- **Final Exam (50%)**
  - 40% pass hurdle
  - IN: invigilated written exam on campus
  - EX: invigilated (ProctorU) online exam

CSSE7201-IN/EX

- **Weekly quizzes (5%=0.625% * 8)**
- **Assignment 1 (20%)**
  - Part 1 – 1-hr timed MCQ quiz (10%)
  - Part 2 - Digital logic design (10%)
- **Assignment 2 (25%)**
  - AVR programming + ISA questions
  - 10% pass hurdle
- **Final Exam (50%)**
  - 40% pass hurdle
  - IN: invigilated written exam on campus
  - EX: invigilated (ProctorU) online exam

Resources

- Course Blackboard site
  - Announcements
  - Readings
  - Notes
  - Software downloads
  - Discussion Board (Edstem) for technical matters
  - Other admin matters and also course content – make use of consultation hours and email me at c.wijenayake@uq.edu.au to book an appointment
- No textbook required
  - Some references listed in course profile

TurningPoint Polls (App or Web)

These polling questions are not assessed

- App:
  - Select “East Asia” region
- Web:
  - http://responsewaresg.net/
- To respond
  - Join as guest – no sign-in required
  - Enter the session ID (usually csse2010s2)
  - **Enter your student number as the user ID**

Role of Teaching Staff and Students

- What is Teaching?
  - One definition:
    "*The purposeful creation of situations from which motivated learners should not be able to escape without learning or developing*" [Cowan 1998]

What should I be doing to be successful in this course:

✓ Attend the two weekly lectures (watch the recording otherwise)

✓ Spend some time going through the lecture content by yourself

✓ Attend the two lab sessions weekly – complete the lab tasks fully

✓ Revise the weekly content and do the quiz

✓ Complete the additional exercises given

1L
2P
1L
2P
3S
1E

Some Questions for You… First – make sure response setup works

TurningPoint

- App region is “East Asia”
- Web address is http://responsewaresg.net/
- Guest (not signin)
- Enter Session ID: **csse2010s2**
- Enter student number (as User ID)

What degree program are you studying?

0% A. B Engineering (Hons)

0% B. B Information Technology

0% C. B Computer Science

0% D. B Science

0% E. B Arts

0% F. M Information Technology

0% G. Other

10

What year level are you in?

0%	1. First Year
0%	2. Second Year
0%	3. Third Year
0%	4. Fourth Year
0%	5. Fifth Year or higher

10

Are you in IN or EX mode?

1. IN
2. EX

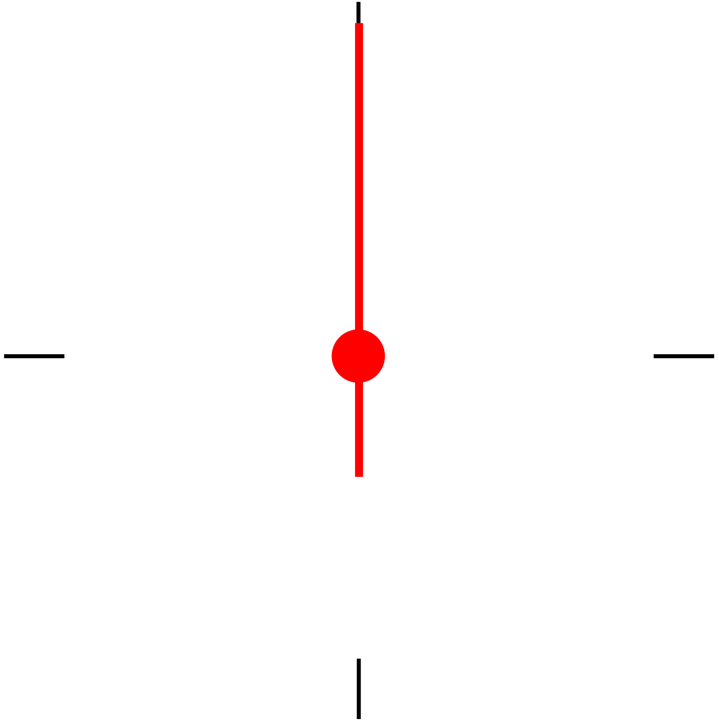
0%

0%

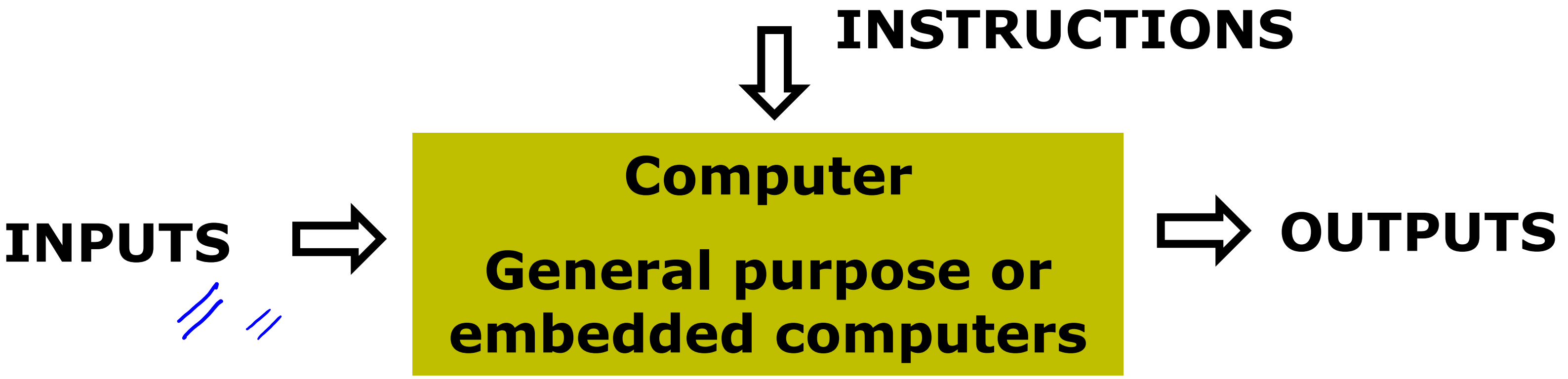
10

Short Break

- Stand up and stretch



Computers and Binary Numbers



INSTRUCTIONS

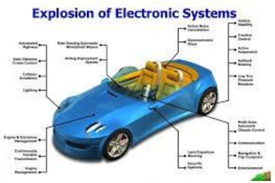
INPUTS

Computer

General purpose or embedded computers

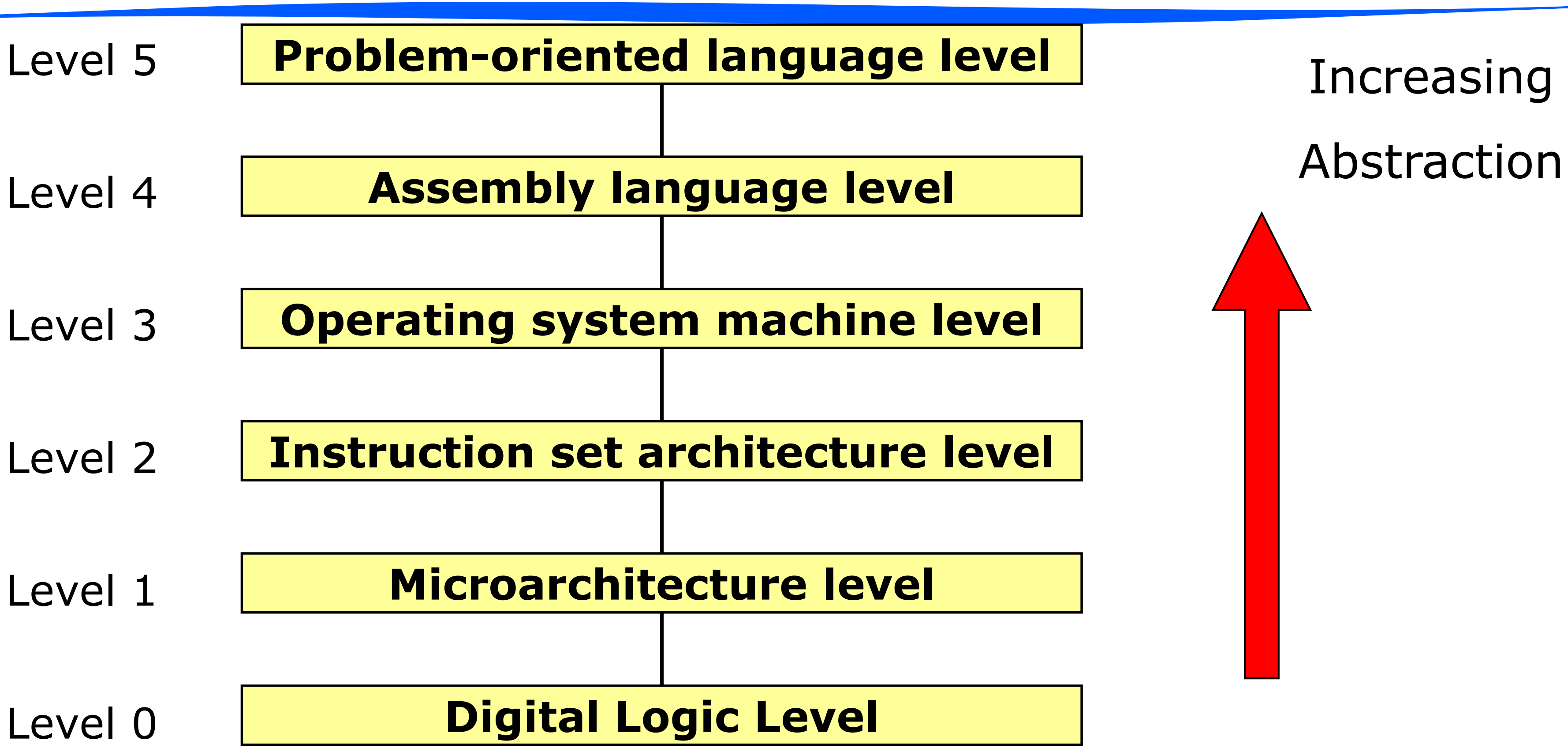
OUTPUTS

101001010110101001111010101001011100011010101



Binary representation of digital data

A Computer at Different Levels of Abstraction



Level 5 Problem-oriented language level

Level 4 Assembly language level

Level 3 Operating system machine level

Level 2 Instruction set architecture level

Level 1 Microarchitecture level

Level 0 Digital Logic Level

Increasing Abstraction

Bits, Bytes and Binary Numbers

- Computers represent everything in binary
- Bit = binary digit (0 or 1)
- Byte = 8 bits
  - e.g.

0	**1**	**0**	**1**	**0**	**1**	**1**	**1**

- Modern computers deal with words which are usually a power of 2 number of bytes, e.g.
  - 1, 2, 4, or 8 bytes = 8, 16, 32, 64 bits

Representing **Whole** (Unsigned) Numbers in Binary

- Each bit position has a value:

	9	8	7	6	5	4	3	2	1	0
....	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
	512	**256**	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**

← Bit position

← Value (Powers of 2)

- Converting binary to decimal:
  Add values of each position where bit is 1

7	6	5	4	3	2	1	0
1	**0**	**0**	**1**	**0**	**0**	**0**	**1**

128 + **16** + **1** = **145**

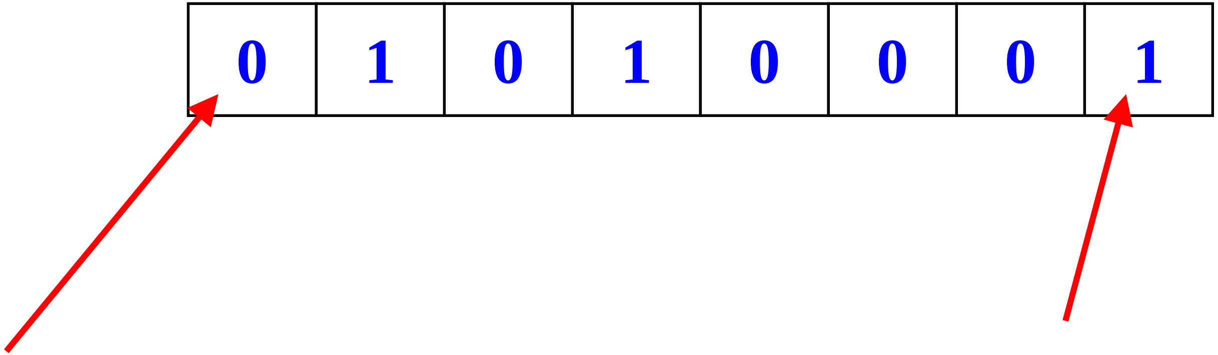
Converting Decimal to Binary

- **Example**
  - Convert 53 (decimal) to binary
- **Method 1**
  - rewrite n as sum of powers of 2 (by repeatedly subtracting largest power of 2 not greater than n)
  - Assemble binary number from 1’s in bit positions corresponding to those powers of 2, 0’s elsewhere

Converting Decimal to Binary (cont.)

- **Example**
  - Convert 53 (decimal) to binary
- **Method 2** – building up bits from the right (least significant)
  - Divide n by 2
  - Remainder of division (0 or 1) is next bit
  - Repeat with n = quotient

Least and Most Significant Bits



0	1	0	1	0	0	0	1

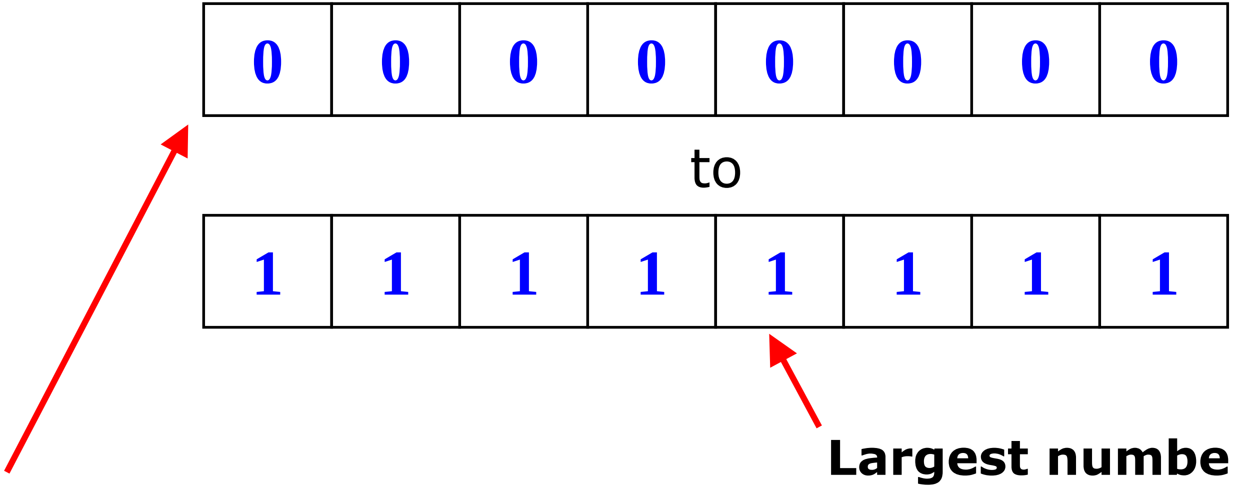
Most significant bit (MSB) – the bit position that’s “worth” the most ($2^7 = 128$, in this case)

Least significant bit (LSB) – the bit position that’s “worth” the least ($2^0 = 1$)

For an n-bit unsigned word, the MSB is worth $2^{(n-1)}$

Number Range

- Assuming whole (**unsigned**) numbers…



0	0	0	0	0	0	0	0

to

1	1	1	1	1	1	1	1

Smallest number that can be represented: all 0’s

Value is 0.

Largest number that can be represented: all 1’s

For an n-bit word, the largest representable number is $(2^n)-1$, e.g. 255 in this case

Other Radices

- **Radix** = number system base
- A radix-k number system
  - k different symbols to represent digits 0 to k-1
  - Value of each digit is (from the right) k^0, k^1, k^2, k^3, …
- Often convenient to deal with
  - **Octal** (radix-8) - Symbols: 0 1 2 3 4 5 6 7
    - One octal digit corresponds to 3 bits
  - **Hexadecimal** (radix-16) - Symbols: 0 1 2 3 4 5 6 7 8 9 A B C D E F
    - One hexadecimal digit corresponds to 4 bits (useful!)

Dec	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Oct	0	1	2	3	4	5	6	7	10	11	12	13	14	15	16	17	20	21
Hex	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	10	11

Exercise

- Convert 26_{10} to octal and hexadecimal

You have 1½ minutes

How Do We Know the Radix?

- What's the value of 101 or 747? How do we know the radix?
- Can use a subscript, e.g. 101_2 or 101_{16}

Other options …

- **Hexadecimal**

■ Leading 0x,	e.g. 0x101, 0x747	C language, Atmel AVR
■ Trailing h,	e.g. 101h, 747h	Some assembly languages
■ Leading $,	e.g. $747	Atmel AVR Assembly

- **Octal**

■ Leading 0,	e.g. 0101, 0747	C language, Atmel AVR
■ Trailing q,	e.g. 101q, 747q	Some assembly languages
■ Leading @,	e.g. @747	Some assembly languages

- **Binary**

■ Leading 0b,	e.g. 0b101	Atmel AVR Assembly, Some C
■ Trailing b,	e.g. 101b	Some assembly languages
■ Leading %,	e.g. %101	Some assembly languages

We'll mostly use these

Reminders

- No labs on Mon-Wed of week 1 – i.e. only one session for week 1. From week 2, you will have 2 lab sessions per week.
- Lab 1 – you will learn more about different binary representation formats for signed numbers
- Sign up for a pair of lab sessions
- Any issues, email eait.mytimetable@uq.edu.au