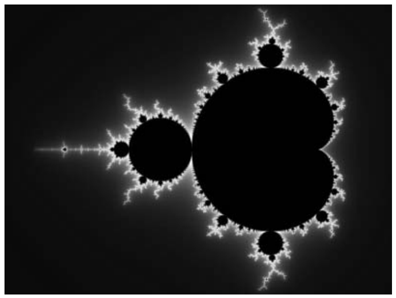
COMPSCI 111 / 111G

Mastering Cyberspace:
An introduction to practical computing

Introduction
Digital Information



Mandelbrot Fractal

Teaching Staff

Christof Lutteroth (Lecturer)

- From Germany; just submitted my PhD
- Room: 303.485 (4th floor CompSci building)
- Phone: 373-7599 Ext. 88114
- Email: lutteroth@cs.auckland.ac.nz
- Office hours: Mon 2pm - 4pm, Fri 2pm - 4pm
- If you have questions, come to my office at any time

Ann Cameron (Lab Tutor / Course Coordinator)

- Room: 303.594 (5th floor CompSci building)
- Phone: 373-7599 Ext. 84947
- Email: ann@cs.auckland.ac.nz
- Office hours: Tue 10am – 11am, Wed 2pm - 3pm, Fri 1pm - 2pm
- Come and see her if there are any problems

Teaching Staff

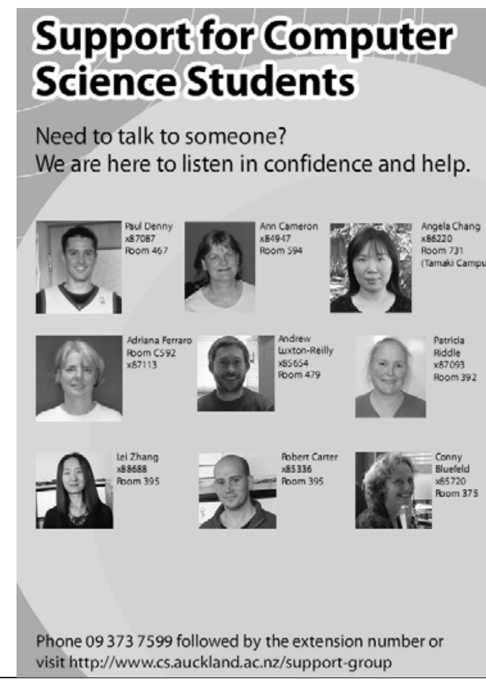
Andrew Luxton-Reilly (Lecturer)

- Room: 303.479 (4th floor CompSci building)
- Phone: 373-7599 Ext. 85654
- Email: andrew@cs.auckland.ac.nz
- Open door policy
- Office hours: Mo, Wed, Fri 10am - 11am

Mark Wilson (Lecturer)

- Room: 303.588 (5th floor CompSci building)
- Phone: 373-7599 Ext. 86643
- Email: mcw@cs.auckland.ac.nz
- Office hours: Mon 10am - 1pm

The CS Department has a student support group:



Course Content

Introduction
- Digital Information, Hardware, Software

Internet
- WWW, Email, Instant Messaging, Forum, Blog, Wiki
- Social issues and risks

Home / Office Applications and Publication Tools
- Word Processing, Spreadsheets, Databases
- HTML, PowerPoint, LaTeX

Programming
- Python

Special Topics
- History, social and legal issues

Course Requirements

Required reading
- No textbook for this course
- Coursebook is required - $25
  (available from Student Resource Centre in basement of building 303)
- Online resources (slides, web links) on course website:
  http://www.cs.auckland.ac.nz/compsci111s2c/

Assessment

• Labs	15%	Practical
• Test	20%	Theory
• Exam	65%	Theory

Must pass both practical and theory (≥50% each) !!!

Laboratories

Overview
- Designed to provide practical experience
- Prepare for labs by reading the coursebook and/or online sources
- Friendly atmosphere. Talk to other students.

Assessment
- Compulsory three hour lab each week (starts in week 2)
- 10 labs, worth 1.5% of final grade each
- 10% of each lab just for attendance
- Must hand in a lab report before the start of the following lab

Locations - All labs
- 303.131 - Old Tutorial Lab (OTL)

This week: Introduction to the OTL (Mo, Wed, Fri 2pm – 3pm)

Study

Time management
- 10 hours per course
  - 3 hours lectures
  - 3 hour lab
  - 4 hours reading

Internet resources
- http://www.cs.auckland.ac.nz/compsci111s2c/
- http://en.wikipedia.org/

Getting started
- Get coursebook from the Student Resource Centre
- Find the OTL, log into a computer, read your ec email
- Meet Ann Cameron in the OTL from 2pm – 3pm on Monday, Wednesday and Friday this week.

Who wants to be class representative?

DO YOU WANT A SAY IN YOUR EDUCATION, ACCESS TO CLASS PARTY FUNDING, KNOWLEDGE OF YOUR RIGHTS AS A STUDENT?

WELL DON'T JUST SIT THERE WITH YOUR EYES SHUT HOPING THE PROBLEMS WILL GO AWAY...

VOLUNTEER NOW TO BE A CLASS REP AND BECOME PART OF THE UNIVERSITY'S MOST IMPORTANT AND FUNDAMENTAL FORM OF STUDENT REPRESENTATION

WAVE

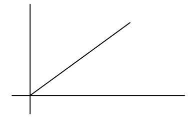
Welfare • Advocacy • Voice • Education

WAVE Support: Training, Funds for Class Parties, Ongoing Advice and Support
Contact us on: Phone: 309 0789 Ext. 251, e-mail: wave@auckland.ac.nz,
or visit us at the WAVE office, AUSA, Alfred Street (opposite the main library)

Digital Information

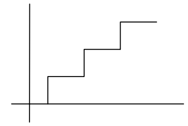
Information in real world is analogue

- Continuous signal
  Weight



Information stored by a computer is digital

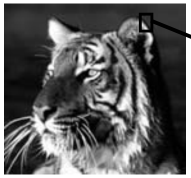
- Represented by discrete numbers
  Weight



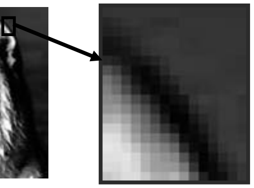
http://en.wikipedia.org/wiki/Digital

Encoding Information

Any information can be encoded using numbers:



Image

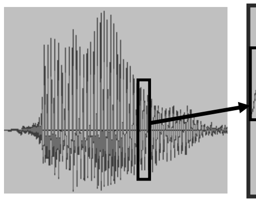


Pixels

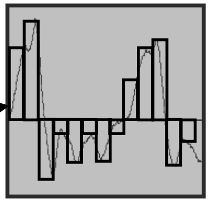
```
1111111111111111111111
0111111111111111111111
0000111111111111111111
0000001111111111111111
0000000001111111111111
4444400000111111111111
7544400000001111111111
5555440100000011111111
3336754400000000111111
2228355444400000011111
9992835754400000001111
9999923365750400000111
9999998366655440000001
99999928338674400000001
```

1. **Give each pixel colour a number.**
2. **Let the computer draw the numbers as coloured pixels, e.g. black = 0.**

Sound



Waveform



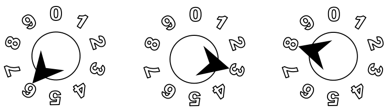
Samples

1. **Give each sample a number (height of green box).**
2. **Let the computer move the loudspeaker membrane according to the samples.**

Storing Decimal Numbers in a Machine

Series of dials

- Each dial goes from 0 to 9
- Store information digitally:
  - Finite number of states: 10 per dial
  - No in-between states
- Decimal number system
  - 1st dial from right: 1's
  - 2nd dial from right: 10's
  - 3rd dial from right: 100's
  - Etc.

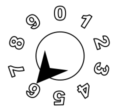


100's 10's 1's

6	3	8

Exercises

All of the following questions relate to dials that have 10 different states (0-9).



1. ***Given a machine that used 4 dials, how many different numbers could we represent?***

   $10 * 10 * 10 * 10 = 10^4 = 10000$ (from 0 to 9999)

2. ***If we wanted to represent 123 different colours, each encoded as a different number, how many dials do we need?***

   1 dial = 10 states (from 0 to 9) …not enough
   2 dials = 100 states (from 0 to 99) …still not enough
   3 dials = 1000 states (from 0 to 999) …yes!

Switches

A dial is complicated.
- Each dial has 10 different states (0, 1, 2, 3, 4, 5, 6, 7, 8, 9).
- Physically creating circuits that distinguish all 10 states is complicated
- Would need to distinguish 10 different strengths of electricity (voltages)

Switches are simple
- Each switch is off or on (0 or 1)
- Physically creating the circuits is easy
  - Switch on: electrical current can flow
  - Switch off: electrical current cannot flow


0


1

Binary Digits (Bits)

Each switch is known as a binary digit, or bit
- A bit can be either a 0 or a 1

 0

 1

We use them in groups

 0 0 1

3 bits

 0 0

2 bits

Using just 0 and 1 to represent numbers is called binary number system

http://en.wikipedia.org/wiki/Bit

Using Binary Numbers

Using 2 switches, how many different states can we have?

	Binary	Decimal
	0 0	0
	0 1	1
	1 0	2
	1 1	3

Exercises

3. How many different numbers can we represent using 3 bits?

$2 * 2 * 2 = 2^3 = 8$ (from 000 to 111)

4. How many different numbers can we represent using 4 bits?

$2 * 2 * 2 * 2 = 2^4 = 16$ (from 0000 to 1111)

Converting Binary to Decimal

What decimal number has the decimal digits 1521 ?

	1 * 1000	**+ 5 * 100**	**+ 2 * 10**	**+ 1 * 1**
=	$1 * 10^3$	$+ 5 * 10^2$	$+ 2 * 10^1$	$+ 1 * 10^0$
=	**1521**			

What decimal number has the binary digits 1101 ?

	$1 * 2^3$	$+ 1 * 2^2$	$+ 0 * 2^1$	$+ 1 * 2^0$
=	**1 * 8**	**+ 1 * 4**	**+ 0 * 2**	**+ 1 * 1**
=	**13**			

- **Go through the bits from right to left:**
  rightmost bit is worth 1, next bit worth 2, next bit worth 4 etc.
- **Add it all up**

Exercises

5. What decimal number has the binary representation 110 ?

$$1 * 2^2 + 1 * 2^1 + 0 * 2^0$$
$$= 1 * 4 + 1 * 2 + 0 * 1$$
$$= 6$$

Byte

Group the bits together into sets of 8

- 8 bits is known as a byte
- Can represent 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 = 2^8 = 256 different numbers
- Bytes are the common unit of measurement for memory capacity

One byte

How much bytes does a … roughly consume ?

- 1 page text document ≈ 30,000 bytes = 30 kilobytes (KB)
- 1 high-quality digital photo ≈ 2,000,000 bytes = 2 megabytes (MB)
- 1 high-quality movie ≈ 2,000,000,000 bytes = 2 gigabytes (GB)

http://en.wikipedia.org/wiki/Byte

Decimal Prefixes

Decimal prefixes

10^n	Prefix	Symbol	Decimal
10^0	none		1
10^3	kilo	k	1000
10^6	mega	M	1,000,000
10^9	giga	G	1,000,000,000
10^{12}	tera	T	1,000,000,000,000
10^{15}	peta	P	1,000,000,000,000,000
10^{18}	exa	E	1,000,000,000,000,000,000
10^{21}	zetta	Z	1,000,000,000,000,000,000,000
10^{24}	yotta	Y	1,000,000,000,000,000,000,000,000

http://en.wikipedia.org/wiki/SI_prefix

Using prefixes in Computer Science

Situation is very confused

- Designers of computers use multiples of 2

Incorrect, but in common usage

- 8 bits = 1 Byte (still correct)
- 1024 B = 1 KB (not 1000, therefore incorrect)
- 1024 KB = 1 MB
- 1024 MB = 1 GB

In binary, easier to caclulate with 1024:
$1{,}0000000000_{bin} = 1{,}024_{dec}$

Also in common use is the decimal usage (as seen on previous slide)

- 8 bits = 1 Byte
- 1000 B = 1 KB
- 1000 KB = 1 MB
- 1000 MB = 1 GB

Usage depends on industry conventions

Summary

Any information can be digitized

- Simply decide how to encode the information using numbers
- Computers use numbers to store all information

Computers are built with hardware that uses binary numbers

- Made up of bits (0's and 1's)
- We can convert a binary to a decimal number, and vice versa

Unit of measurement for information is a byte

- Computer industry uses decimal prefixes correctly and incorrectly

"There are 10 types of people in the world:
those who understand binary, and those who don't."