Department of Electrical & Electronic Engineering

Information for Second Year Students

2021/2022, Autumn Term

GENERAL INFORMATION

All tutorial meetings are supposed to be held via MS Teams. You will be added to a channel by either your tutor or the Education Office.

College guidance on COVID-19 can be found here https://www.imperial.ac.uk/safety/safety-by-topic/laboratory-safety/biological-safety/covid-19-guidance/ Please read these pages to familiarise yourself with the College regulations.

1. Information concerning courses and regulations can be found on:
   Imperial College: http://www.imperial.ac.uk/students/

   Key departmental webpages:
   http://www.imperial.ac.uk/electrical-engineering/study/current-students-course-handbook/

2. Late coursework penalty:

   (a) Strict deadline rules are imposed by FoE. Late coursework will receive capped mark at pass if received within 24 hours of the deadline and 0 if later, unless there are mitigating circumstances.

   Deadlines for coursework should be available in the blackboard calendar. bb.imperial.ac.uk

   (b) The senior tutor (Esther Perea) must be informed of all mitigating circumstances.

   Mitigating circumstances information can be found on the web and students should be aware of those:

   http://www.imperial.ac.uk/electrical-engineering/internal/current-students-course-handbook/mitigating-circumstances-/

   Note that mitigating circumstances can take different forms. Please do not hesitate to ask for advice from tutor and senior tutor concerning the actions you can take.
   Circumstances that cause coursework delay should be discussed with the senior tutor and the course lecturer should be informed.

   Circumstances that cause absence from exams need medical proof and submission of a full mitigating circumstances form (go to the IC healthcare centre immediately). The UG office and senior tutor need to be informed immediately.

   Circumstances that cause long term hindrance should be disclosed to the senior tutor to evaluate which action should be taken: e.g. interruption of studies, extra GTA help, extra time during exams (etc).

3. Your tutor is your first contact point for academic and non-academic problems. He/she will be able to refer you to the appropriate people. Your tutor is also in charge building an academic information sheet about you with info on attendance, motivation etc. This info is used for supporting decisions in examiners' meetings.

4. The department has a Student Wellbeing Advisor. The Student Wellbeing Advisor enhances the support students receive from their personal tutors and will work collaboratively with Personal Tutors and Senior Tutors to provide wellbeing advice, support and mentoring to students within the department.

Kelly Greenwood is the department Student Wellbeing Advisor. Kelly will provide access to self-help resources, deliver workshops, and is available to speak to confidentially on a one-to-one basis. One-to-one support is intended to be short-term for students who require a quick response to wellbeing issues. Following an initial appointment, Kelly will signpost and refer students who require more specialist services or agencies, both internal and external.
Students can make appointments to speak to Kelly about a whole range of non-academic issues such as settling into College life and independent living, relationships, friendships or family worries, mental health, physical health, loneliness, accommodation, financial difficulties or any issue that is having an impact on a student's wellbeing and academic progress.

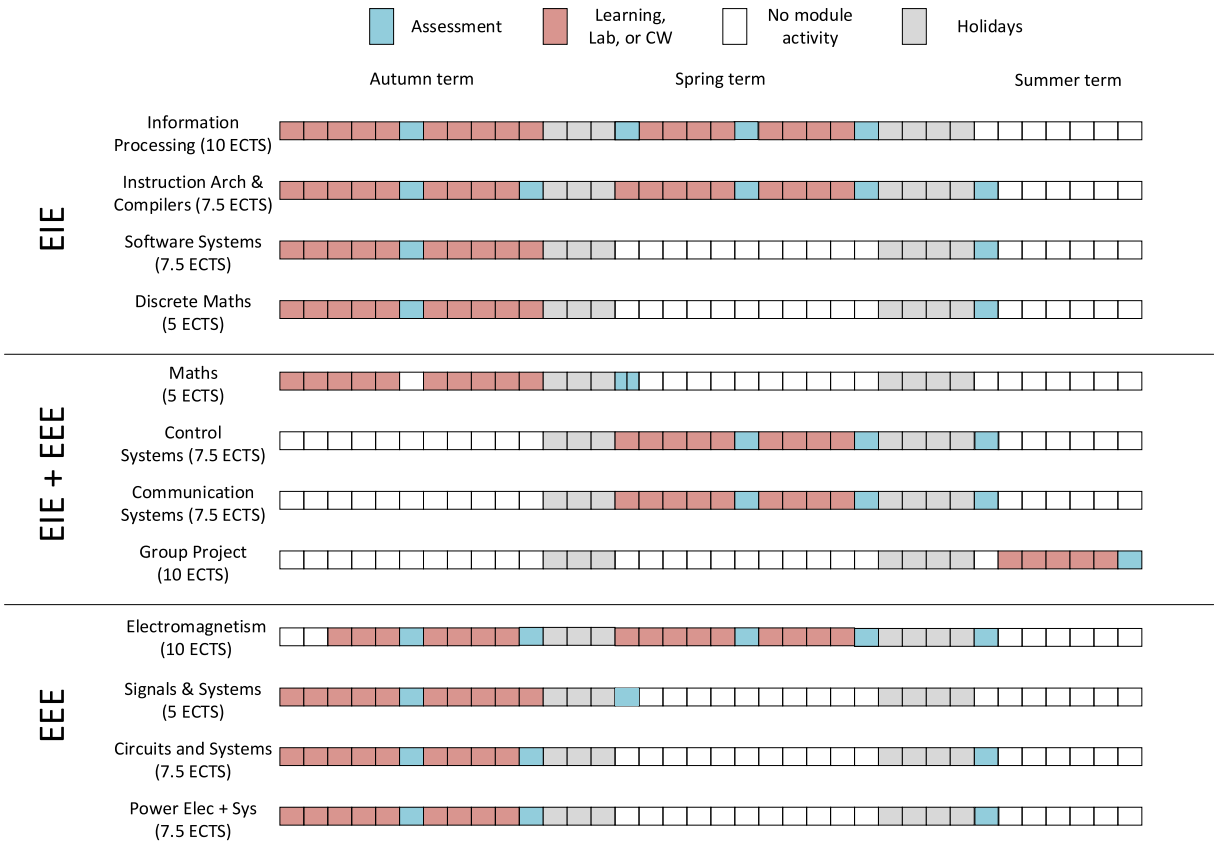
A description of how the role of personal tutor as seen by the college can be found on:

http://www.imperial.ac.uk/personal-tutors-guide/

Be there for tutorial sessions and re-schedule them if you are absent.

Your help in helping and keeping track of the students is very much appreciated.

COURSE TIMETABLE



Modules will be taught in three modalities:

- Remote synchronous (RS): Timetabled classes streamed live, online-only.
- Multi-mode (MM): Same as above, but some spectators will be allowed in the classroom.
- Remote asynchronous (RA): Pre-recorded for watching online in own time + RS classes

Teaching modes: key features

	Multi_Mode (MM)	Remote Synchronous (RS)	Remote Asynchronous (RA)
Timetabled	Y	Y	N
In class	Y	N	N
Booking required	Y	N	N
Given live	Y	Y	N
Recorded	Y	Y	Y
Streamed via Teams	Y	Y	N
Face mask required	Y	N	N
Supported by remote synchronous problems classes	Y	Y	Y

To know the delivery modality of each single module, check the EE catalogue:
EEE: http://intranet.ee.ic.ac.uk/electricalengineering/eecourses_t4/crslistug.asp?c=E2
EIE: http://intranet.ee.ic.ac.uk/electricalengineering/eecourses_t4/crslistug.asp?c=I2

INFORMATION ON THE WEB

Undergraduate handbook:

http://www.imperial.ac.uk/electrical-engineering/internal/current-students-course-handbook/

Useful contacts:

2nd year organiser:	Dr. Wei Dai
2nd year student representatives: (2020/21)	TBD TBD
1st year Maths course organiser: 2nd year Maths course organiser:	Dr. Daniel Nucinkis Prof Tom Pike and Prof Bruno Clerckx
2nd year lab organiser	Dr. Adam Bouchaala
Course director EIE:	Dr. John Wickerson
Course director EEE:	Dr. Adria Junyent-Ferre
Year Abroad Organiser:	Prof. Alessandro Astolfi
Facilities and Departmental Building Manager:	Mr. Zia Rahman
Education Office:	Ms Emma Rainbow, Ms Kay Hancox Miss Kate Farrar, Ms Ella Greenhalgh
Senior tutor:	Mrs. Esther Perea
Student wellbeing advisor:	Kelly Greenwood
Timetable manager:	Dr. Steven Wright
Exams officer:	Dr. Christos Papavassiliou

TUTORIAL PROBLEMS & SCHEDULE

The tutorial calendar is as follows:

- **Week 1-2: 1-1 meetings with your tutor**
- Week 3-4: 1st problem sheet
- Week 5-6: 2nd problem sheet
- **Week 7: 1-1 meetings with your tutor. Aim: to discuss the midterm exam done in week 6**
- Week 8-9: 3rd problem sheet
- Week 10-11: 4th problem sheet

Highlighted in bold are the 1-to-1 meetings. All other meetings will be in groups of 3 for 1 hour per group.

WEEKS 1 - 2

INTERVIEW

GETTING TO KNOW YOUR TUTOR

In the first tutorials, weeks 1-2, you will see each tutor individually. Please use this time to reflect on your past study approaches and timekeeping. Also reflect on your achievements in group projects, volunteering, summer job, etc. We want you to start collecting information to build a professional portfolio by the end of the 3rd year.

From week 3 you will see your tutor in a group of 3 tutees during the tutorial. You are expected to prepare the answers to the tutorial questions beforehand. Your tutor will register your attendance.

More details of tasks for the individual tutorials:

1. Report to your tutor your location (if you are in London, at home in the UK or abroad). Describe your studying environment to your tutor.

2. Where applicable, discuss summer work.

3. Reflect on your performance and realise where more work/effort/different study approach is needed. A questionnaire to help you with this can be found below.

4. Reflect on what you have learned in last year's group project. Learning experience can be from a technical point of view or also from a management point of view. What were your contributions, what went wrong and why did it go wrong, what would you do differently and how would you apply this knowledge in the 2nd year group project?

5. You are encouraged to submit a self-assessment, a statement about what you are good at, what you learned in the summer internship, in the group project, etc. This information can then be used for writing reference letters and will be kept in the student folder.

On the next page you can find some questions to reflect on:

STUDENT SELF-EVALUATION QUESTIONAIRE

Self-evaluation is judging the quality of your work, based on evidence and explicit criteria, for the purpose of doing better work.

1. Reflect on how you did last academic year:

- Were your 1st year grades as you expected? What are the reasons?
- What are your learning approaches? Do you prepare before lecture and review material after lecture? Do you solve problem sheets? Ask help from peers and course lecturers?
- Do you impose a timetable for keeping up with lectures and course deadlines while allowing a sufficient amount of time for extra-curriculum activities? If not, how do you handle the work? Was it successful?
- Did you attend all tutorials, labs, study groups and the tests? Why not?
- Do you know that your attendance and tutor feedback are important for decisions made at the examiners' meeting?
- What did you learn from the 1st year group project? How will you apply this know-how in the 2nd year group project?

2. Reference letter information:

You may submit a statement to your tutor about yourself which can then be used to write reference letters.

- Favourite subjects. Please list your favourite subjects and why you like them and how well you are performing in them.
- Have you done a summer placement a group project? What have you done, what was your role, what did you learn?
- What are your extra curriculum activities?
- Aims/dreams for the future
- Please give a brief description of what you would like to do in the future and how your study choices will be influenced by this.

COLLEGE STATEMENT ON PLAGIARISM

You are reminded that all work submitted as part of the requirements for any examination (including coursework) of Imperial College London must be expressed in your own words and incorporate your own ideas and judgments.

Plagiarism, that is the presentation of another person's thoughts or words as though they were your own, must be avoided, with particular care in coursework, essays and reports written in your own time. You are encouraged to read and criticize the work of others as much as possible. You are expected to incorporate this in your thinking and in your coursework and assessments. But you must acknowledge and label your sources.

Direct quotations from the published or unpublished work of others, from the internet, or from any other source must always be clearly identified as such. A full reference to their source must be provided in the proper form and quotation marks used. Remember that a series of short quotations from several different sources, if not clearly identified as such, constitutes plagiarism just as much as a single unacknowledged long quotation from a single source. Equally, if you summarize another person's ideas or judgments, figures, diagrams or software, you must refer to that person in your text, and include the work referred to in your bibliography. Departments are able to give advice about the appropriate use and correct acknowledgement of other sources in your own work.

The direct and unacknowledged repetition of your own work, which has already been submitted for assessment, can constitute self-plagiarism. Where group work is submitted, this should be presented in a way approved by your department. You should therefore consult your tutor or course director if you are in any doubt about what is permissible. You should be aware that you have a collective responsibility for the integrity of group work submitted for assessment.

The use of the work of another student, past or present, constitutes plagiarism. Where work is used without the consent of that student, this will normally be regarded as a major offence of plagiarism.

The College may submit your coursework to an external plagiarism detection service. By registering with the College you are automatically giving your consent for any of your work to be submitted to such a service.

Failure to observe these rules may result in an allegation of cheating. Cases of suspected plagiarism will be dealt with under the College's Policy,

See: http://www.imperial.ac.uk/student-records-and-data/for-current-students/undergraduate-and-taught-postgraduate/exams-assessments-and-regulations/plagiarism-academic-integrity--exam-offences/,

and may result in penalties being taken against any student found guilty of plagiarism.

WEEKS 3-4

Problem Sheet 1

1 Discrete Maths tutorial question 1

Question

Define the function

$$f(n) = (n \sin(n\pi/2))^2 + n^3 \cos^2(n\pi/2).$$

Which polynomial function $g(n)$ gives the tightest bound for the statement $f(n) = O(g(n))$? How about for $f(n) = \Omega(g(n))$ and $\Theta(g(n))$? In each case, prove your statement or show that it is not possible.

How does your answer change if you drop the requirement that $g(n)$ be a polynomial?

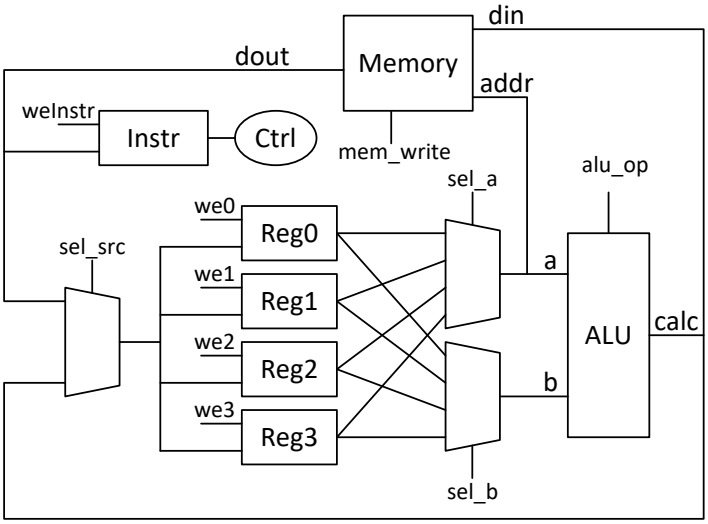
Question Sheet 1

1. How could a square wave of infinite duration be synthesized using only sinusoidal functions? Explain the main concept and provide an analytical solution for the case of an even-symmetric square wave with equal mark-space ratio.

This question may potentially be addressed in tutorials before the material is fully covered in lectures. Accordingly, the question has been set to encourage the development of concepts from the 1st year.

Instruction Architectures and Compilers

The following data-path is for a simple processor, which takes multiple cycles to execute each instruction. The program-counter is held in register 0.



1 : Identify the control signals that will need to be driven by the “Ctrl” logic.

2 : What type of logic component would you expect to drive we0..we3?

3 : For each of the following instructions, determiner the data-paths active over each cycle of the following instructions. The following page contains a set of data-paths you can draw on (virtually, or by printing it out) - use one row to represent one instruction, and the columns represent cycles within the instruction (you may not need all columns for all instructions).

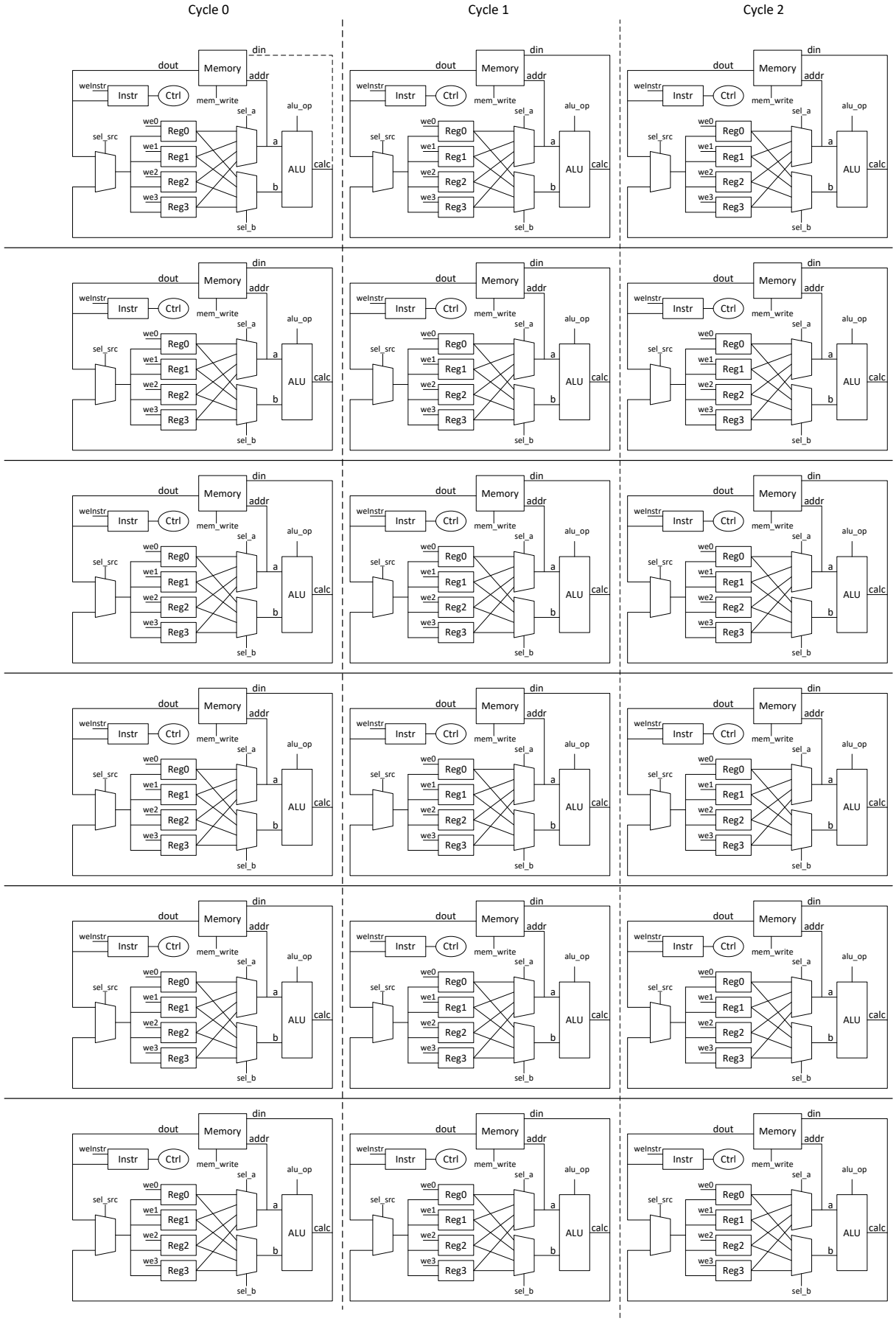
a : reg3 = reg1 + reg2

b : reg2 = mem[reg2]

c : pc = mem[reg2]

d : mem[reg3] = reg2

4 : How can a conditional branch be implemented in this processor?


Cycle 0
Cycle 1
Cycle 2
din
dout
Memory
addr
weInstr
Instr
Ctrl
mem_write
sel_a
alu_op
we0
Reg0
sel_src
we1
Reg1
we2
Reg2
we3
Reg3
a
ALU
calc
b
sel_b

ETHICS IN ENGINEERING

(Theme: bias in technology – proposed by a member of staff)

(i) Read this paper on Algorithmic Bias: A. Koene, "Algorithmic Bias: Addressing Growing Concerns [Leading Edge]," in IEEE Technology and Society Magazine, vol. 36, no. 2, pp. 31-32, June 2017. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7947257

(ii) Watch the video in this article of a 'racist' soap dispenser: https://www.iflscience.com/technology/this-racist-soap-dispenser-reveals-why-diversity-in-tech-is-muchneeded/

(iii) Read this review of a book by Caroline Criado Perez about gender bias in design: https://www.newstatesman.com/culture/books/2019/03/invisible-women-caroline-criado-perez-review

(iv) Think of an example of technology you have seen that has been designed with built-in bias for or against certain types of people. Be prepared to explain why it is biased, how it should be fixed and what underlying problems caused the bias.

WEEKS 5-6

Problem Sheet 2

Question Sheet 2

1. Consider the continuous-time signal

$$x(t) = \cos(2\pi t)\frac{\sin(\pi t)}{\pi t} + \sin(8\pi t)\frac{\sin(\pi t)}{\pi t}.$$

   (a) Sketch the term $\cos(2\pi t)\frac{\sin(\pi t)}{\pi t}$ for $0 \leq t \leq 1$.

   (b) State the requirements on the sampling interval that must be satisfied in order for the signal $x(t)$ to be uniquely reconstructed from its samples $x[n]$.

Software Systems Tutorial Question

Consider Microsoft Teams, both from the point of view of you as a user, and from an engineering point of view. Where necessary make reasonable guesses, and/or speculate wildly – you don't need to research this.

1. What are the nodes (physical pieces of hardware) that make up the system?
2. What types of network channels do you think connect these nodes together?
3. Identify some of the key data entities and relationships in the system.
4. When you attend a remote synchronous lecture, there may be up to 200 students viewing the same stream
    - Why might this present a performance challenge?
    - How do you think this is solved?

Tutorial Questions for Math II part B on probability and statistics

Question. Consider a random variable X. Is E(1/X)=E(1)/E(X)=1/E(X)?

ETHICS IN ENGINEERING

(Theme: face recognition – proposed by a member of staff)

(i) Read the paper "K. W. Bowyer, "Face recognition technology: security versus privacy," in IEEE Technology and Society Magazine, vol. 23, no. 1, pp. 9-19, Spring 2004", link: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1273467

(ii) Watch this video of use of face recognition in London: https://www.youtube.com/watch?v=-yvxbi5GMnA

(iii) List as many as possible positive uses of face recognition technology. Do the same for misuses of face recognition technology. Reflect and discuss whether you believe the positives outweigh the negatives or vice versa and possible ways to limit and control the misuse of this technology.

WEEK 7

1-to-1 meetings to discuss mid term exams

WEEKS 8-9

Problem Sheet 3

1 Discrete Maths tutorial question 2

Question

If A_i $(i = 0, \ldots, n-1)$ is a sorted array, write a recursive divide and conquer algorithm that doesn't use any global variables to find the index j such that $A_j = x$ (or return -1 if x is not in A).

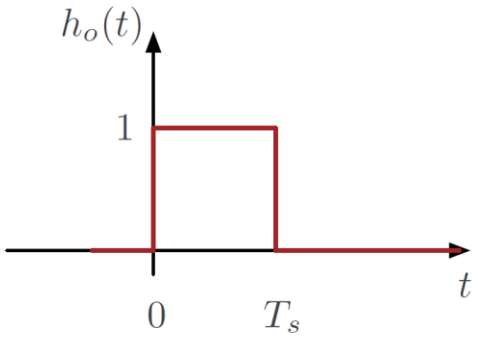
Use the master method to show how well your algorithm performs if function parameters are passed by value (i.e. a copy is made).

Use the master method to show how well your algorithm performs if function parameters are passed by reference (i.e. only a pointer is copied).

Bonus: write a version that doesn't use recursion and calculate its complexity.

Question Sheet 3

1. Find the Fourier transform of $h_o(t)$. Hence explain how a rectangular pulse of finite duration could be synthesized using only sinusoidal functions? Clarify the key differences between synthesizing period signals and nonperiodic signals.



Instruction Architectures and Compilers

1 : Provide formulae for computing the number of read stall cycles and write stall cycles for a given program executing on a given machine.

2 : a) A subset of the instructions for a machine M can be accelerated by n times using a coprocessor C. Given that a program P is compiled into instructions of M such that a fraction k belongs to this subset, what is the overall speedup that can be achieved using C with M?

(b) Given that the coprocessor C in part (a) above costs j times as much as M, calculate the minimum fraction of instructions for a program that C has to accelerate so that the combined system of M and C is j times faster than M.

ETHICS IN ENGINEERING

(Theme: use of personal data in technology – proposed by a member of staff)

(i) Watch the interview to Cambridge Analytica whistle-blower: https://www.youtube.com/watch?v=FXdYSQ6nu-M

(ii) Watch this clip from Netflix's "The Great Hack" in which Cambridge Analytica's CEO explains how they manipulated Trinidad and Tobago elections: https://www.youtube.com/watch?v=omc-5zj70M0

(iii) Political micro-advertising can target different messages at different voters, and can reinforce group biases. Is this use of technology bad for society? Should it be controlled? How?

The Cambridge Analytica scandal has deep roots in the academic world: Facebook was created by a university student; Cambridge Analytica was enabled by a university researcher. Do you think that this is an avoidable drawback of academic freedom, or do you think that something can be done to avoid these misuses?

WEEKS 10-11

Problem Sheet 4

Question Sheet 4

1. Consider the continuous-time system with system function

$$H(s) = \frac{s^2 + 2s + 17}{s^2 + 4s + 104}.$$

   (a) Find the poles and zeros of $H(s)$ and plot them on the s-plane.

   (b) Explain why this system is stable.

   (c) Calculate the magnitude of $H(j\omega)$ at $\omega = \{0, 4, 10, 20, 40\}$ rads/s and hence sketch the magnitude response of the system.

Software Systems Tutorial Question

1. ADSL connections provide greater downstream bandwidth than upstream bandwidth
    a. Why is that a good use of the physical channel's bandwidth?
    b. Connection-oriented protocols like TCP require traffic in both directions. Why can they still achieve good download rates if the upstream bandwidth is much smaller?

2. Consider the following SQL query, where SID and MID are primary keys in students and modules (respectively):

```
select students.Name,modules.Name from (
from (
 ( students inner join selections on students.SID=selections.MID )
  inner join modules on selections.MID=modules.SID
);
```

    a. How many columns does the query return?
    b. Assume there are 100 rows in students, 200 rows in selections, and 30 rows in modules. What is the maximum number of rows that could be returned?
    c. What does the query actually do?

Tutorial Questions for Math II part B on probability and statistics

Question. What is the difference between “independent” and “uncorrelated”?

ETHICS IN ENGINEERING

(Theme: impossible decisions in the engineering practice – the example of self-driving cars)

1. If you are not familiar with the trolley problem, please watch the first 13 minutes of this beautiful lecture of Prof Michael Sandel at Harvard University: https://www.youtube.com/watch?v=kBdfcR-8hEY
2. The trolley problem directly translates in the context of self-driving cars and how the engineers should design the AI of the car in difficult situations. MIT made a nice online tool to explore these problems, which is available at this link: http://moralmachine.mit.edu/ Have a go at the moral machine.
3. When self-driving cars will become commercial products, how do you think an engineer should solve this type of dilemmas? This type of technology will be the subject of strong public backslash whenever a big accident will happen. This could result in the involved company going bankrupt and even the entire technology being forbidden. Is there a way to defend against this eventuality?