



UNIVERSITY OF  
CAMBRIDGE

# Computer Science @ Cambridge



[www.cl.cam.ac.uk/admissions](http://www.cl.cam.ac.uk/admissions)



What is Computer Science at University Level?

The department past and present

The aims of our course

The course (“Tripos”) structure

The first year options

Employment prospects

The CS application process

Interviews and tests

Where to get more info

# What is CS?



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## Combines Elements of...

Natural Science

Maths

Natural Language

Engineering

Electronics

Philosophy

Technology

Psychology

## Teaches...

Critical thinking

Solution Evaluation

Rigorous problem analysis

Programming skills

Efficiency

Logic and proof

# Why Study it Here?



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All the usual Cambridge advantages apply: the College structure, the supervision system, the learning environment, the smart peers

But Computer Science here is particularly special: there is a rich history both in the technology *and* the teaching of the subject

# 80 Years Ago...



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We started as a part of the Mathematics Department in 1937

Back then we were the Mathematical Laboratory because the term  
“computer science” hadn't been invented



The world's first usable computer (EDSAC)  
was built here

# First Job Queue too..!



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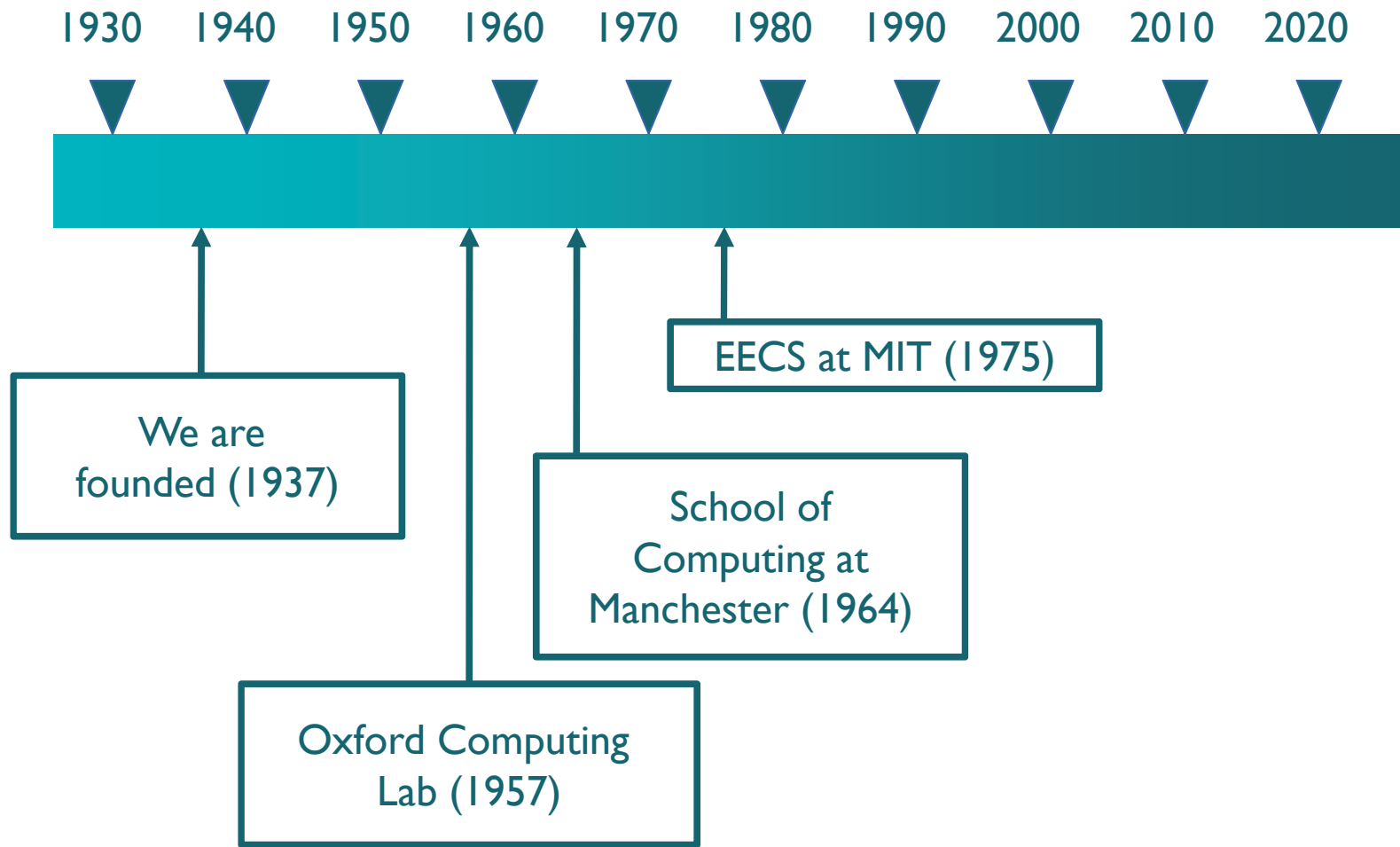


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# An (Abridged) Timeline



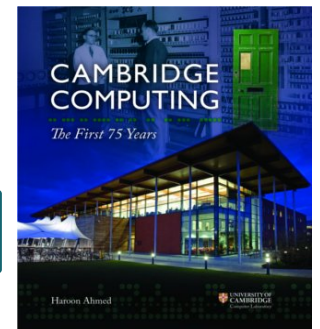
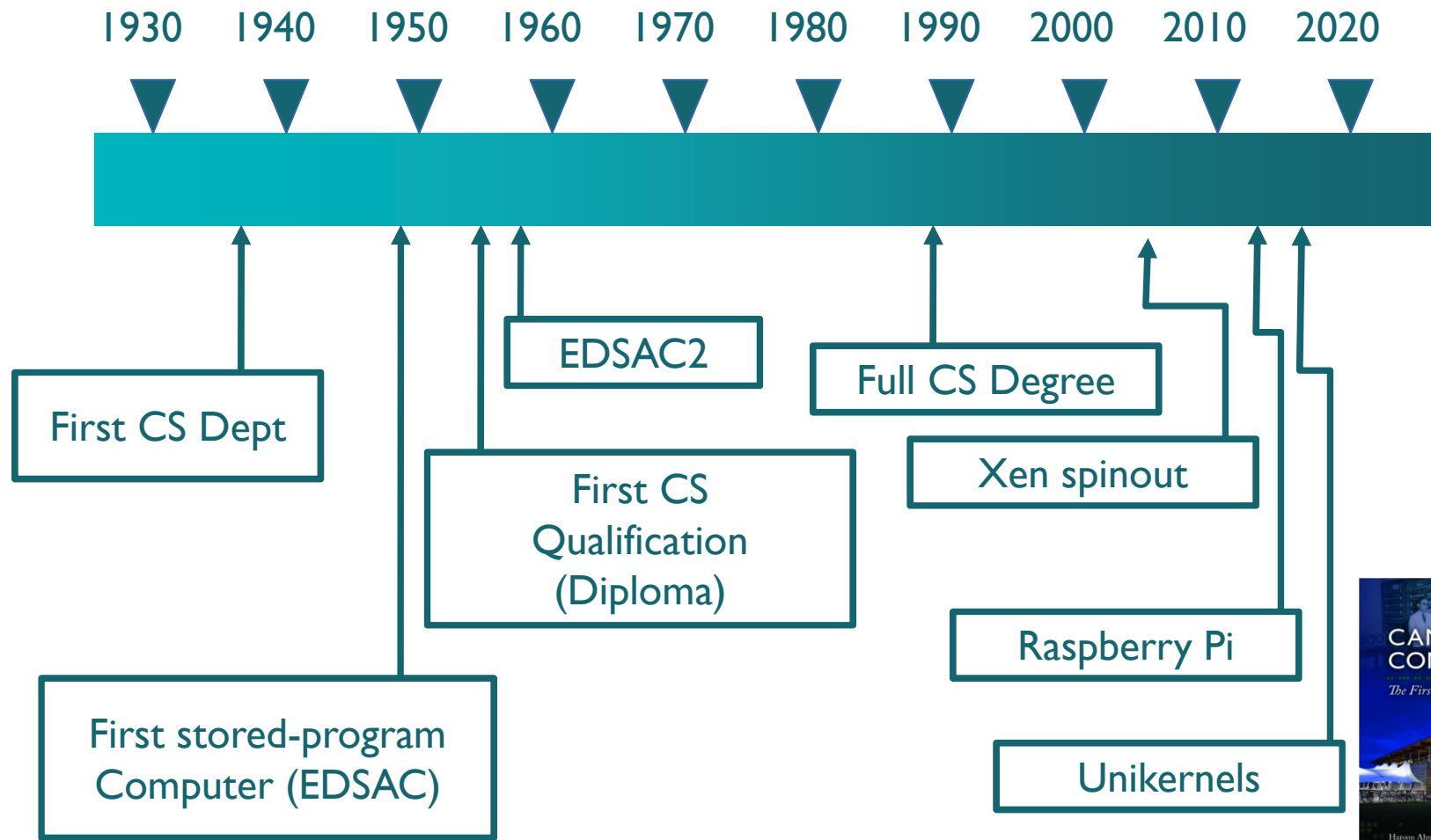
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# Department Highlights



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# The Lab Today



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Not forgetting...



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# Our Undergraduate Degree (the “Computer Science Tripos”)

[www.cl.cam.ac.uk/admissions](http://www.cl.cam.ac.uk/admissions)

# Our Aims



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To give an understanding of  
fundamental **principles** that will  
outlast today's **technology**

To produce graduates who **create**  
the future not just cope with it



# The Course



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Year 1

Year 2

Year 3

**B.A.**

## Part IA

Fundamentals  
Programming  
Electronics  
Maths  
[+Option]

## Part IB

Theory  
Systems  
Hardware  
Programming  
Group Project

## Part II

Free choice of  
advanced  
topics  
Personal project

# The Course



UNIVERSITY OF  
CAMBRIDGE

Year 1

Year 2

Year 3

Year 4  
(Optional)

**B.A.**

**M.Eng.**

## Part IA

Fundamentals  
Programming  
Electronics  
Maths  
[+Option]

## Part IB

Theory  
Systems  
Hardware  
Programming  
Group Project

## Part II

Free choice of  
advanced  
topics  
Personal project

## Part III

Free choice of  
research topics  
Research project

# The Course



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Year 1

Year 2

Year 3

Year 4  
(Optional)

**B.A.**

**M.Eng.**

## Part IA

Fundamentals  
Programming  
Electronics  
Maths  
[+Option]

## Part IB

Theory  
Systems  
Hardware  
Programming  
Group Project

## Part II

Free choice of  
advanced  
topics  
Personal project

**Needs a First**

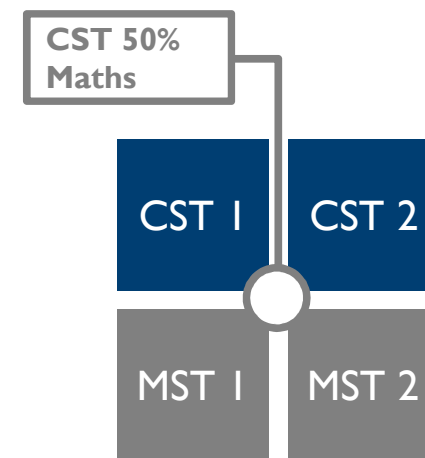
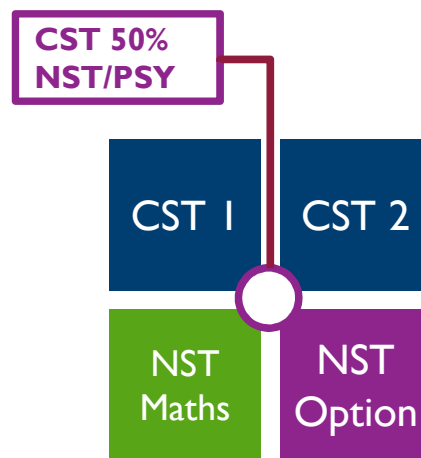
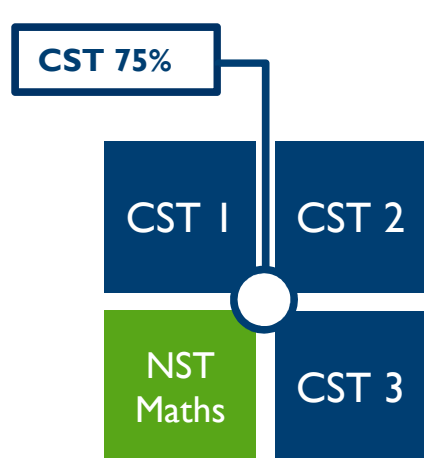
## Part III

Free choice of  
research topics  
Research project

# Our First Year Options



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There are always **four** exam papers to sit

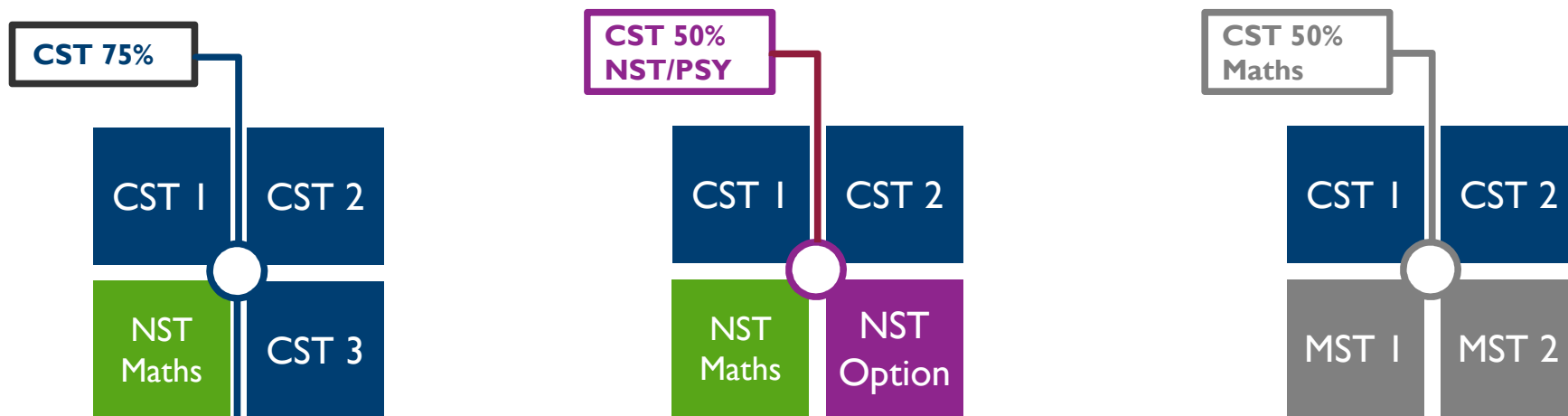
You spend a quarter of your first year studying material for each paper



# Our First Year Options



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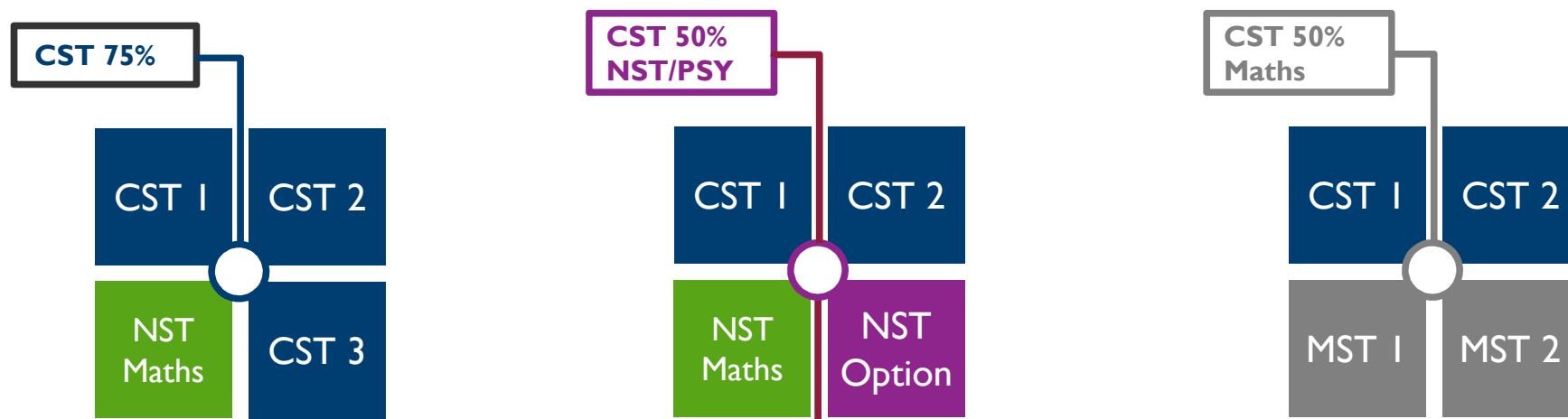


- > **Ran for first time in 2016-2017**
- > Three CS papers coupled to one maths
- > The material covers graphics, databases and machine learning
- > Intended for those with prior experience

# Our First Year Options



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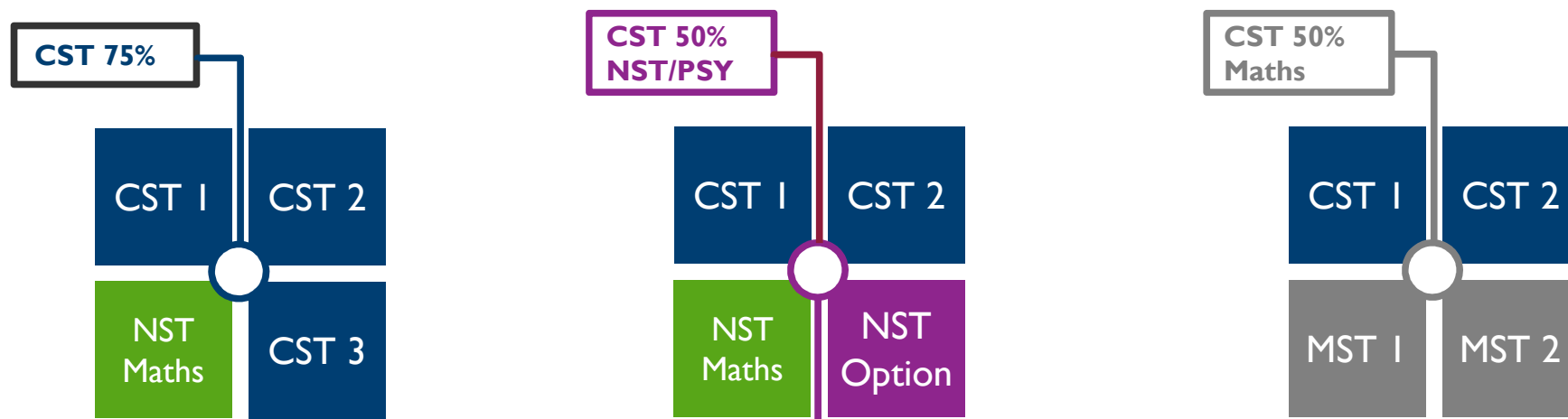
> Lets you study two CS papers, one maths and a Natural Sciences subject of your choice

> Physics, Chemistry, Evolution & Behaviour, Geology, Physiology of Organisms

# Our First Year Options



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> Lets you study two CS papers, one maths and a Natural Sciences subject of your choice

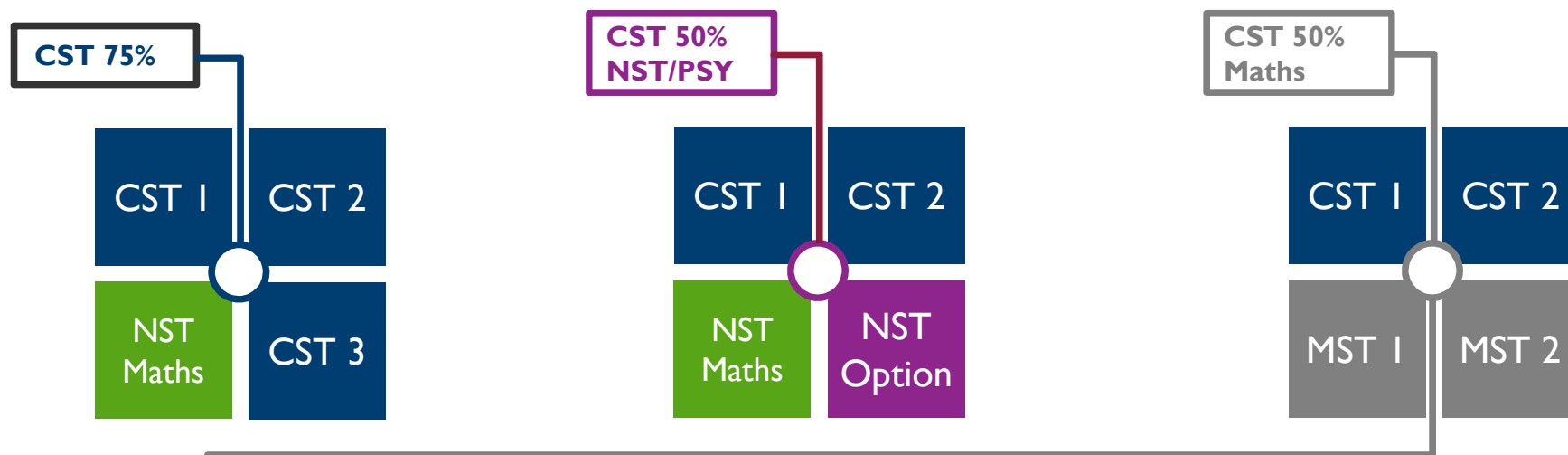
> Physics, Chemistry, Evolution & Behaviour, Geology, Physiology of Organisms

> **You can switch into the NST subject in the second year without any penalty** (nice option, rarely used)

# Our First Year Options



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> Lets you study two CS papers and two Maths papers from the Mathematical Sciences Tripos

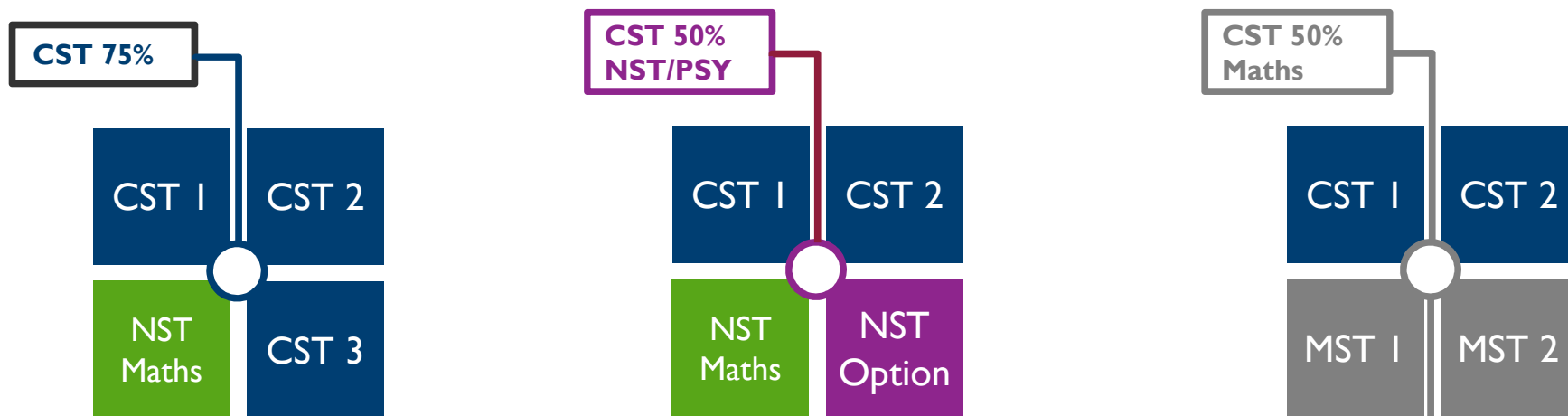
> Good way to do more maths in IA if you are more theory-oriented. But it's not an easy option.

> You cannot switch to mathematics in the second year

# Our First Year Options



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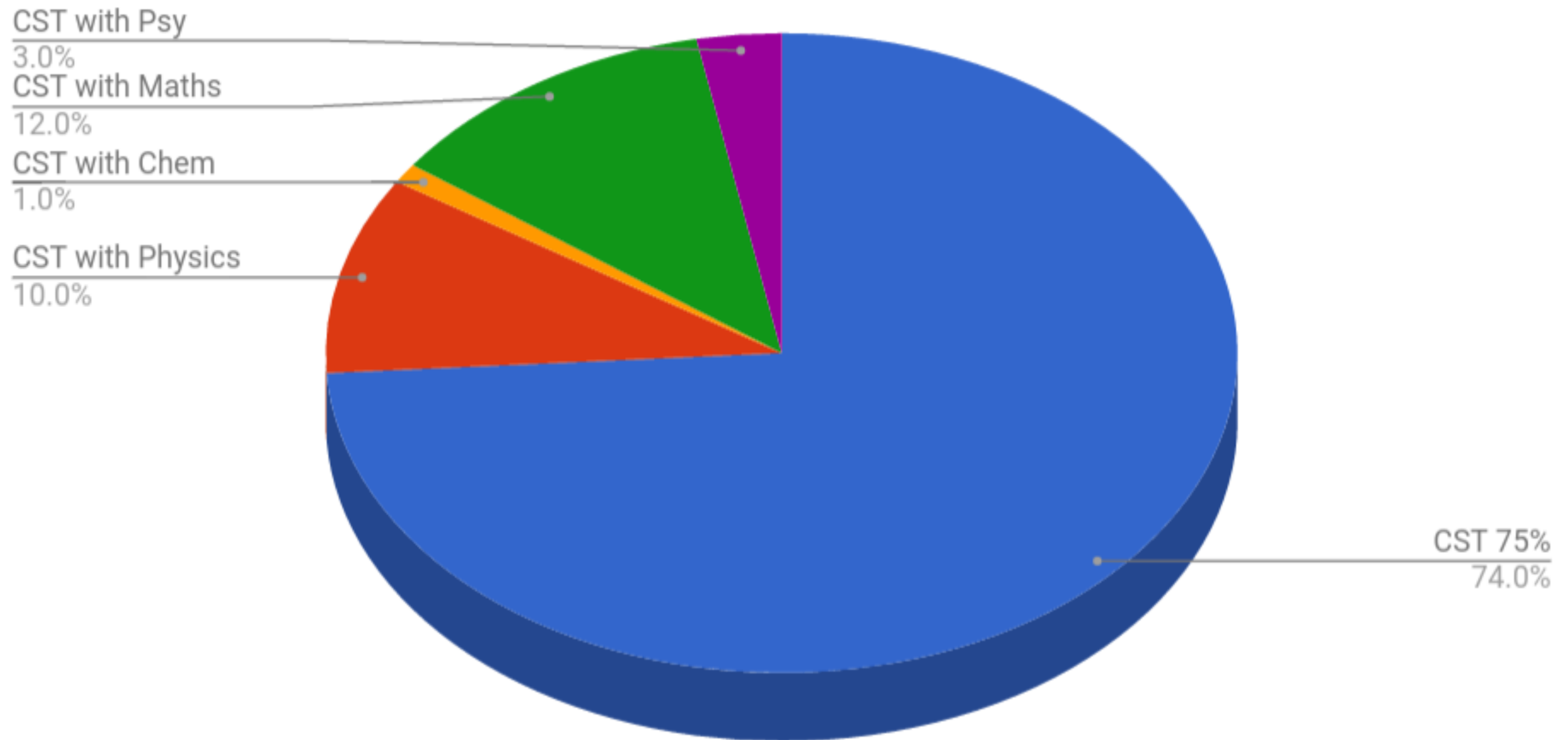
- > Lets you...  
the Math
- > Good...  
oriented
- > You can

Adds STEP Maths Requirement

# 2016 (2017) Intake Choices



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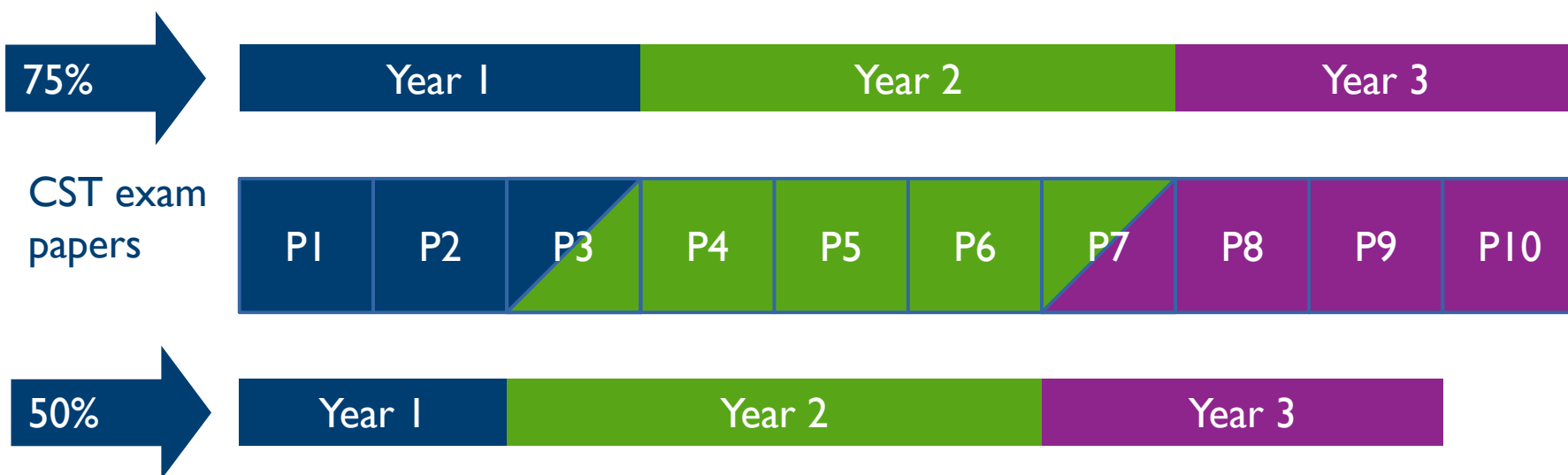


Total 100 CST Students (and 63 NSTs)

# Implications for Future Years



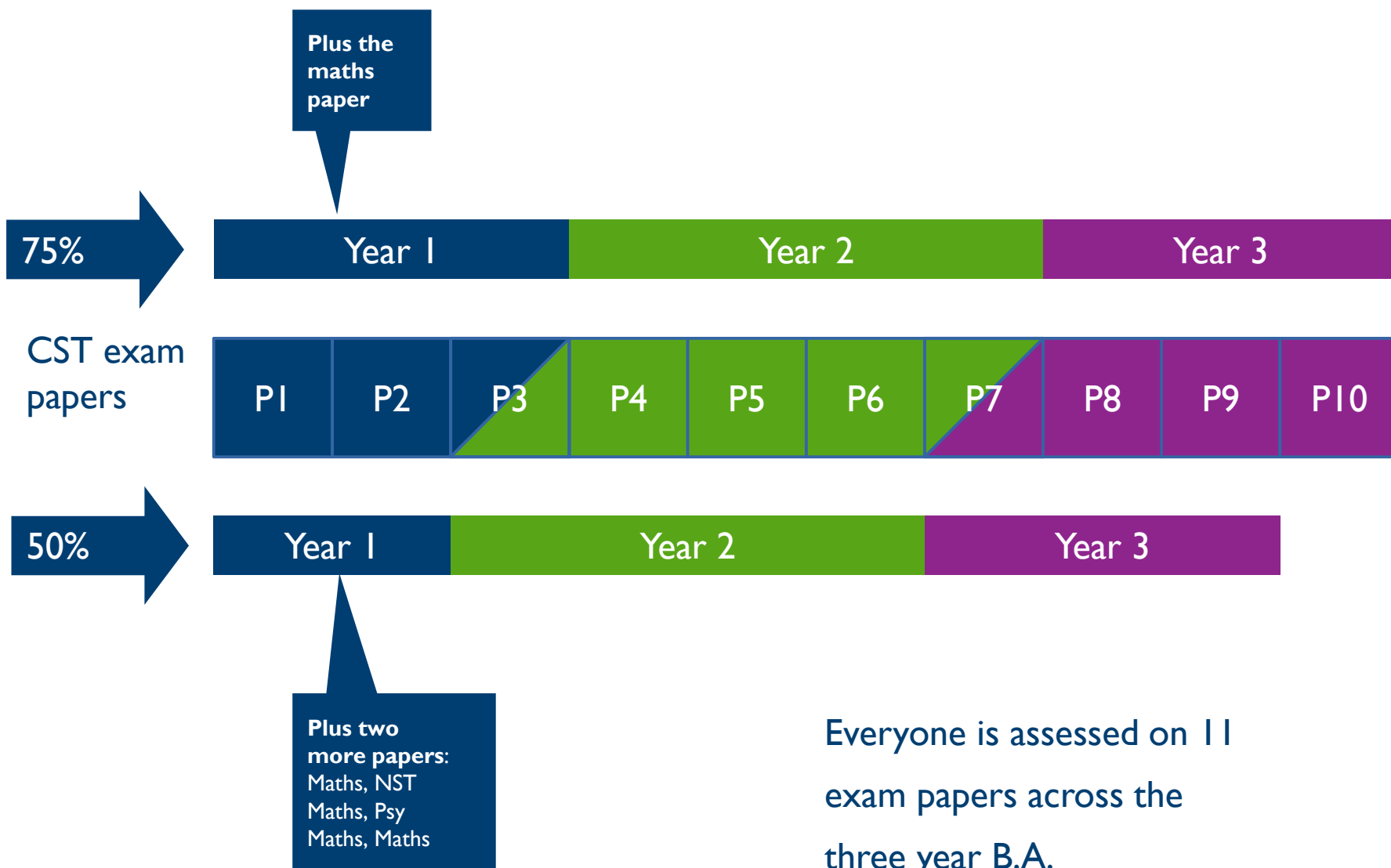
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# Implications for Future Years



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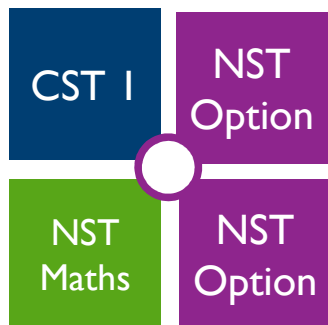
Everyone is assessed on 11 exam papers across the three year B.A.



# CS as an NST Option



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**You can select CST Paper 1 as an option within Natural Sciences**

It is possible to catch up CS Paper 2 in your summer vacation and switch to Computer Science in your second year (and some do)

# Practical skills



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Year 1

Weekly practicals to consolidate  
lecture material



Year 2

Weekly practicals to consolidate lecture  
material  
**Group Project** (team work)



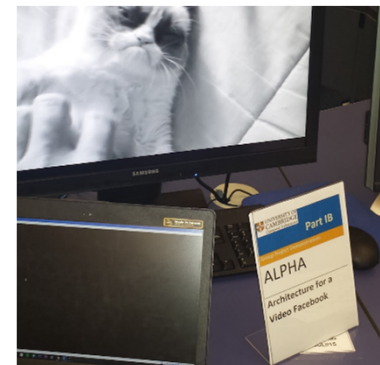
Year 3

**Personal project**



Year 4

**Research project**  
Some modules associated with  
additional practicals





Languages aren't important.

**Principles** are.

## As of today:

Java, C/C++ for imperative programming

ML for functional programming

Prolog for logic programming

Verilog for hardware programming

Python for data science

```
File Edit Options Buffers
*cr = ar*br -
*cj = aj*br +
}
int polar_discriminant
{
    int cr, cj;
    double angle;
    multiply(ar, a
    angle = atan2(
    return (int)(a
}
int fast_atan2(int y,
/* pre scaled for int1
{
    int yabs, angl
    int pi4=(1<<12
    if (x==0 && y=
        return
    }
    yabs = y;
    if (yabs < 0)
        yabs =
}
```



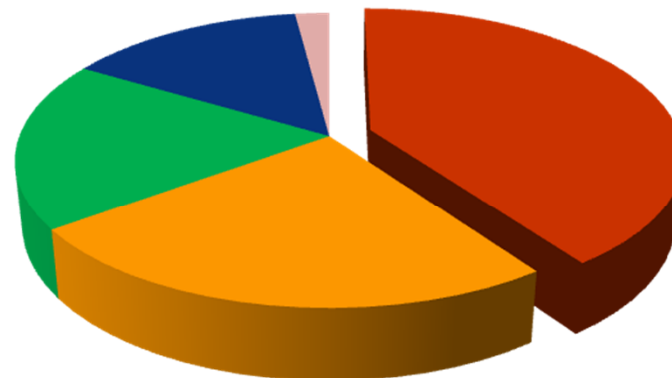
## You **DON'T** need programming experience

We teach from the ground up.

However, if you've never programmed before, how do you know you'll enjoy a degree that uses it?

## A survey of our first years...

- No experience (39%)
- Not much experience (24%)
- Some experience (18%)
- Quite a lot of experience (14%)
- Programming expert (2%)





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# Employment Prospects

[www.cl.cam.ac.uk/admissions](http://www.cl.cam.ac.uk/admissions)



## The Telegraph

Home Video News World Sport Business Money Comment Culture Travel Life Women Fashion  
Politics Investigations Obits Education Science Earth Weather Health Royal Celebrity Def  
University Further Education Student Primary Secondary School League Tables Professional Course

MELIÀ  
HOTELS & RESORTS



HOME » EDUCATION » EDUCATION NEWS

### Cambridge graduates 'the most employable in the world'

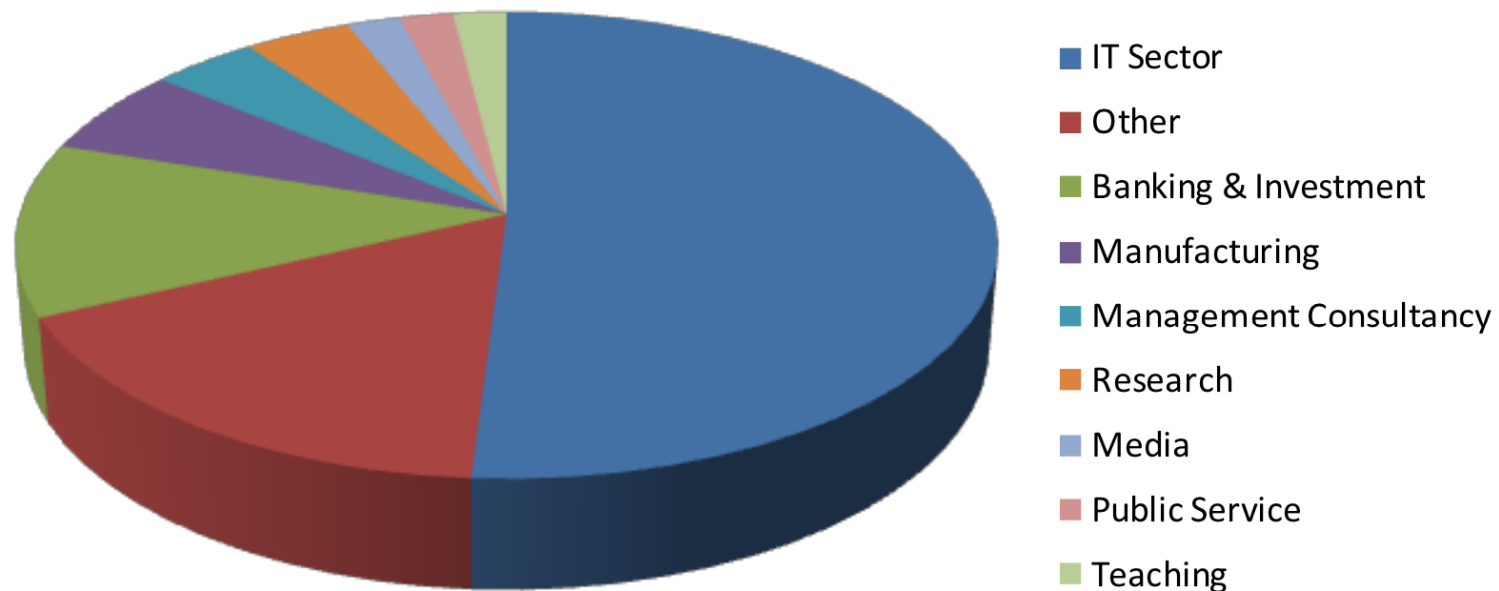
The Global Employability University Ranking, published by the International New York Times, names Cambridge as the world's top institution for graduate employment



Cambridge is the best university in the world for the employment of graduates, according to the Global Employability University Rankings.



The course gives vital skills for every sector. Good computer scientists go on to a multitude of careers: IT, business, politics, finance, science, engineering, education, arts



# Very sought-after graduates



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Jobs galore!

Our annual recruitment fair attracts 50+ companies, each looking to recruit 3 or 4 graduates on average

We only produce ~100 graduates in total!

Some of the Companies

Google, ARM, Amazon, Disney, Barclays, Cisco, BT, Mozilla, MathWorks, Citrix, Frontier, Red Gate, Morgan Stanley





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# Applications Process

[www.cl.cam.ac.uk/admissions](http://www.cl.cam.ac.uk/admissions)

# The Process



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Apply via UCAS

October

Supplementary  
Questionnaire

November/December

Written Test (CSAT)

Interview Day

Two Technical  
Interviews

(Early December)

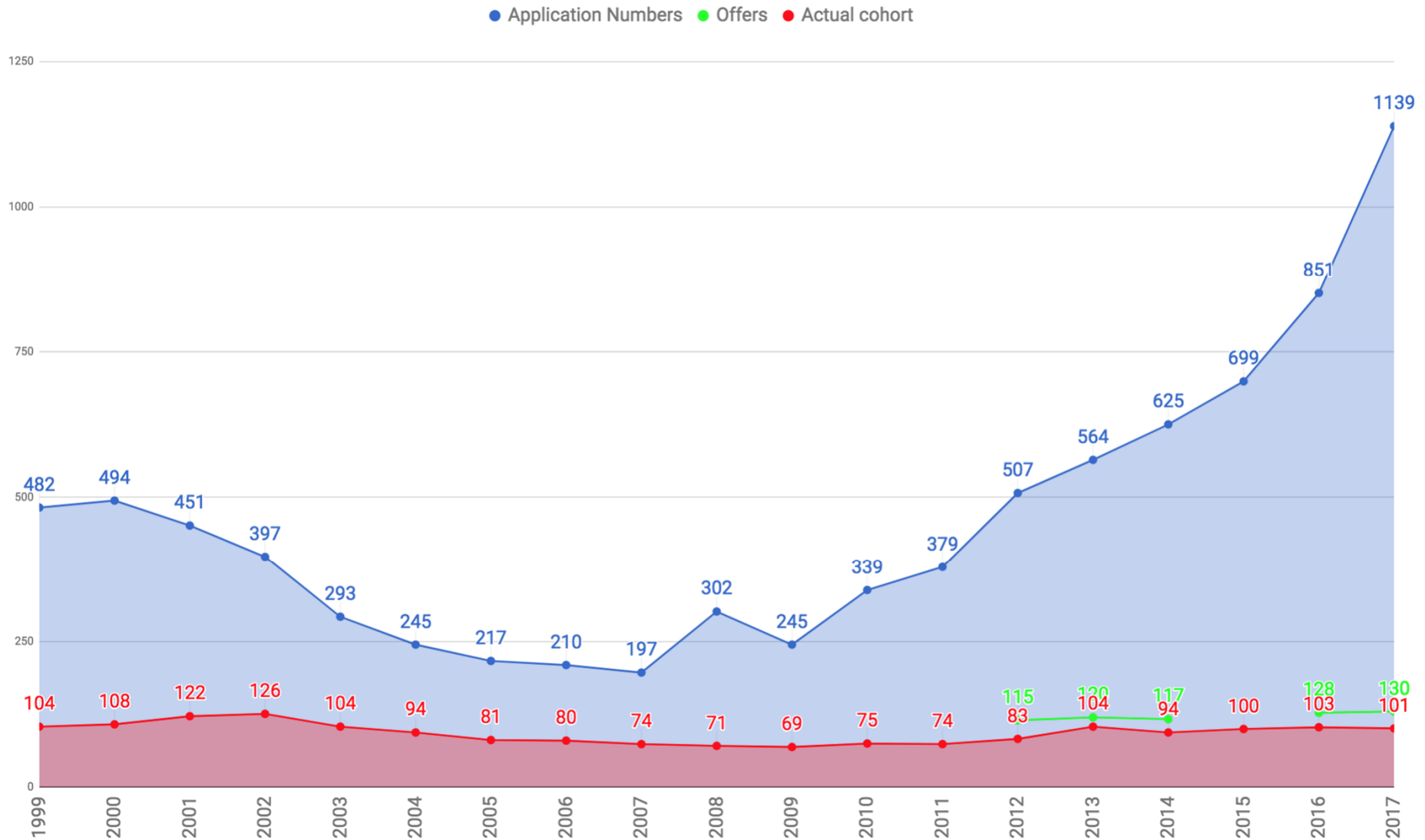
Admissions Pool

Early January

# Application Numbers



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The University is a combination of:

**Colleges** – these admit and look after students both in terms of welfare and academics. They arrange the supervisions we are famous for

**Departments** – these set syllabuses, provide lectures and handle exams. They also perform research (their 'day job')

**Administration** – there is a large number of admin-related entities: everything from finance to entrepreneurship to IT to dental services



**DoS** – Director of Studies. At least one per subject per College. In charge of the academic progress of the students in their subject. Key for the admissions process

**Admissions Tutor** – One per College. Makes the final decision on who gets in or pooled based on the recommendations of the DoSes.

# Choosing a College for CS



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Colleges are responsible for academic guidance, supervisions and pastoral care

They provide diverse communities where you build life-long friends and associations

**The best College for you is an individual choice**

Modern or classical buildings?  
Centre or out of town?  
Large or small CS cohort?  
More formal or more relaxed feel?  
How active is the DoS in teaching?  
What do past and present students say?  
etc...

**We can't tell you which College is right for you (sorry!). Visit them and talk to the Fellows, staff and students there.**





Every application is individual but usually all of these factors contribute to our decisions:

Exam predictions  
and  
results

Interviews

Personal  
statement

School  
references

Special  
circumstances  
(if any)

CSAT



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CSAT



# Prerequisites



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**A\*A\*A at A-Level**

**A-Level Maths**

is absolutely essential

**Further Maths**

AS is essential (if your school offers it)

A2 is desirable

AEA/STEP is useful

Not doing Further? We recommend doing at least AS  
Further in your A2 year





## Physical sciences

Very useful and desirable at admissions

Prerequisites for some first year options

## Electronics

Relevant and useful

But not as desirable as maths and physical sciences  
so please don't drop these in favour of electronics



## Computing/Computer Science

NOT a prerequisite

Good way to show interest in the subject and to “try before you buy”

However, the syllabuses overlap with our first year

**We don't recommend dropping maths (or even a physical science) in favour of Computing** in the A2 year: often better to drop Computing in A2



# Selection Factors



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Every application is individual but usually all of these factors contribute to our decisions:

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CSAT

# Interviews



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**~25 minutes each**

Questions related to CS but will not assume actual CS knowledge (unless we know you have it)

Questions start simple and ratchet up in difficulty. Our interest is in when you leave your comfort zone

Correct answers (and there may be multiple) aren't as important as you might think

**We are assessing your logical thinking and problem solving abilities and your motivation to study CS**

# Selection Factors



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# Selection Factors



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# Selection Factors



UNIVERSITY OF  
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CSAT



# The CSAT



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## Computer Science Admissions Test

It's there to help you!

[www.cl.cam.ac.uk/admissions](http://www.cl.cam.ac.uk/admissions)

# The CSAT



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## Computer Science Admissions Test

It's there to help you!

Another opportunity to shine, besides the interview.

[www.cl.cam.ac.uk/admissions](http://www.cl.cam.ac.uk/admissions)

# The CSAT



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## Computer Science Admissions Test

It's there to help you!

Another opportunity to shine, besides the interview.

Our interest: what you can do (not what you can't). We want you to do well (it's not there to catch you out).



## Computer Science Admissions Test

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Your choice of questions! Like pure maths more than algorithmic problems? No problem. Show us what you enjoy!



## Computer Science Admissions Test

It's there to help you!

Another opportunity to shine, besides the interview.

Our interest: what you can do (not what you can't). We want you to do well (it's not there to catch you out).

Your choice of questions! Like pure maths more than algorithmic problems? No problem. Show us what you enjoy!

No pass mark. We consider the positive aspects.



We have a CSAT stand upstairs in the Intel Lab today.  
Ask us anything about the CSAT.

[www.cl.cam.ac.uk/csat](http://www.cl.cam.ac.uk/csat)



## Instructions:

- The test duration is 120 minutes. Section A has 8 questions. Section B has 12 questions which are more challenging and worth more marks.
- All questions attempted are marked. Your best 5 questions from each section are considered. Partial answers are taken into account. You can choose the questions to answer and their order.
- Write only on the work-booklet provided and clearly label the question you are solving at the top of each page. Answers without working may not gain full marks. You should show sufficient working to make your solutions clear to the Examiner, but these need not be extremely thorough.
- Calculators, phones, watches, smart-glasses or other electronic devices or paper are **not** permitted.
- All paper must be handed in. Do not write on the cover or question sheets.
- **Do not** discuss any test questions with others (e.g. candidates at the same or another College, the Internet, or elsewhere), especially before March. You would disadvantage yourself.

## It is recommended that you:

- *take 5 minutes first to read through all questions,*
- *start with Section A and spend no more than 30 minutes on it,*
- *aim for 5 questions in each section; if you finish early then attempt more from Section B.*

Good luck!



Designed to aid **preparation** for the CSAT, with hints, related topics, worked solutions and more. Attempt first and reveal content gradually.

CS @ Cambridge

Course ▾

Open Days

Apply

CSAT

FAQ

Contact



## Practice Paper 1 Question 15

Does 30 divide  $n^5 - n$  for all positive integers  $n$ ?

- ▶ CSAT
- ▶ Practice [+] Platform
- ▶ Your choice
- ▶ Structure
- ▶ Expectations
- ▶ FAQs
- ▶ Contact

**Related topics** [+]

**Warm-up Questions** [+]

**Hints**

- **Hint 1** [+]
- **Hint 2** [+]
- **Hint 3** [+]
- **Hint 4** [+]

**Solution** [+]

< ^ >



If you have queries or suggestions about the content on this page or the CSAT Practice [+] Platform then you can write to us at [practice.plus@csat.io](mailto:practice.plus@csat.io). Please do not write to this address regarding general admissions or course queries.





- CSAT
- Practice [+] Platform
- Your choice
- Structure
- Expectations
- FAQs
- Contact



## Practice Paper 1 Question 15

Does 30 divide  $n^5 - n$  for all positive integers  $n$ ?

### Related topics [-]

- [Factorization](#)
- [Mathematical Induction](#)

The above links are provided as is. They are not affiliated with the Computer Science department or University of Cambridge unless otherwise specified.

### Warm-up Questions [-]

1. Factorise  $n^2 - 2n - 3$ .
2. Is  $n^2 + n$  always even when  $n$  is an integer?
3. Does 6 divide 100002? Try to reason about the divisors of both numbers.

### Hints

- [Hint 1 \[-\]](#)  
How do you split 30 into a product of prime factors?
- [Hint 2 \[-\]](#)  
Can you factorise  $n^5 - n$ ?
- [Hint 3 \[-\]](#)  
You should obtain  $n(n-1)(n+1)(n^2+1)$ . What can you say about the product of 3 consecutive numbers in terms of divisibility by 2 and 3?
- [Hint 4 \[-\]](#)  
If you assume that 5 divides  $n^5 - n$ , how can you prove that 5 divides  $(n+1)^5 - (n+1)$ ?

### Solution [-]

First notice that  $30 = 2 \cdot 3 \cdot 5$ . Since 2, 3 and 5 are all coprime we will prove that each of them divides  $n^5 - n$  and hence conclude that their product does too. We now factorise  $n^5 - n$ :

$$\begin{aligned}n^5 - n &= n(n^4 - 1) \\ &= n(n^2 - 1)(n^2 + 1) \\ &= n(n-1)(n+1)(n^2 + 1)\end{aligned}$$

The product  $(n-1)n(n+1)$  is of 3 consecutive numbers, hence necessarily both 2 and 3 must divide it. We must now prove divisibility by 5. There are several approaches to do this, but here we shall use induction. It's easy to verify the base case for  $n = 0$  or  $n = 1$ . Then do the inductive step:

$$\begin{aligned}(n+1)^5 - (n+1) &= n^5 + 5n^4 + 10n^3 + 10n^2 + 5n - n \\ &= n^5 - n + 5(n^4 + 2n^3 + 2n^2 + n)\end{aligned}$$

First part is divisible by 5 owing to the induction hypothesis, while the rest is obviously a multiple of 5.

# CSAT Fun for Today!



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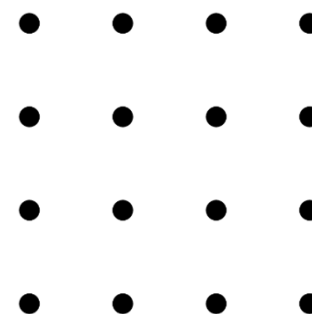
**Q1.** You have two numbers  $(a,b)$ . At each step you can either multiply just one number by 2, or add any number (negative included) to both. What is the minimum number of steps to get from  $(a,b)$  to  $(0,0)$ ? Justify.

# CSAT Fun for Today!



**Q1.** You have two numbers  $(a,b)$ . At each step you can either multiply just one number by 2, or add any number (negative included) to both. What is the minimum number of steps to get from  $(a,b)$  to  $(0,0)$ ? Justify.

**Q2.** You start at some fixed point on a Cartesian grid. You can move up, down, left or right. You make 5 moves. In how many different locations can you end up? Can you generalize to  $n$  moves?

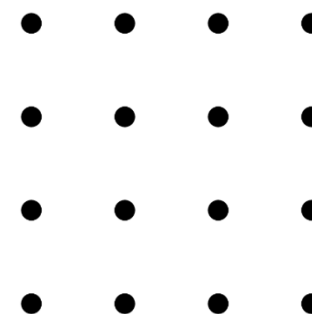


# CSAT Fun for Today!



**Q1.** You have two numbers  $(a,b)$ . At each step you can either multiply just one number by 2, or add any number (negative included) to both. What is the minimum number of steps to get from  $(a,b)$  to  $(0,0)$ ? Justify.

**Q2.** You start at some fixed point on a Cartesian grid. You can move up, down, left or right. You make 5 moves. In how many different locations can you end up?



The first 10 correct answers to either question presented at the CSAT stand win a limited edition CSAT 1337 t-shirt!

# What Now?



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## Upstairs you will find:

DoSes to answer those burning questions

Past students to get the real story from

The CSAT stand

Overviews of the syllabus

Examples of student projects

## More info...



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### Department

Ask us upstairs today! Visit website or email at  
[undergraduate.admissions@cl.cam.ac.uk](mailto:undergraduate.admissions@cl.cam.ac.uk)

### CSAT

Website ([www.cl.cam.ac.uk/csat/](http://www.cl.cam.ac.uk/csat/))  
Practice [+] Platform

### University

Prospectus  
Website ([www.cam.ac.uk](http://www.cam.ac.uk))

### Colleges

Websites, DoSes, Admissions Tutors  
Open days

[www.cl.cam.ac.uk/admissions](http://www.cl.cam.ac.uk/admissions)