Manchester Metropolitan
University

Graduate Development & Employability

Week 1

Dr Killian O'Brien

k.m.obrien@mmu.ac.uk

Office hours: Mon 14:00 – 15:00, Fri 14:00 – 16:00
Call to DB 3.28 in the Dalton Building

Email

- Accessed via myMMU
- Your email address is:
  - Firstname.Initial.Surname@stu.mmu.ac.uk
  - 12345678@stu.mmu.ac.uk
- Always use your university account when corresponding with lecturers and university staff (so we know it is really you)
- An email is not an instant message – we will respond to you within 2 working days
- Always abide by email etiquette

Group Activity

- Working with your neighbours, discuss the email on the following slide and list all of the things that are wrong with the email with it (I count 10 but you may find more)
- Add your suggestions to the following Padlet

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Not university account (also unprofessional address)

From: crazylipz@gmail.com

To: j.shiach@mmu.ac.uk

Subject: Re:

No subject line

Improper salutation

Sup,

Poor grammar

Inappropriate use of humour

I werent able to make it in today. had to much fun last night lol. What I miss. Send me your slides quick.

Impolite demand

Inappropriate sign off

Thanx!!!!

No email signature

Spreading link to phishing site

For 10 easy get rich quick ideas click here ----> linky

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From: joe.bloggs@stu.mmu.ac.uk

To: j.Shiach@mmu.ac.uk

Subject: Absence in lecture today

Hi Jon,

I am a first-year student in your Linear Algebra class. I am not feeling well and I will be unable to attend the lecture that takes place this morning at 09:00. I know we were going to start looking at matrices and will do my best to catch up with the work I will have missed.

Regards,

Joe Bloggs

First Year Mathematics Student

Email joe.bloggs@stu.mmu.ac.uk

Phone: 01234 567891

Email Etiquette dos and don’ts

- Do have a clear subject line
- Do use a professional salutation (‘Hi’ is fine, ‘Dear …’ is more formal)
- Do proofread your email before hitting send
- Don’t use humour – it can be misinterpreted
- Don’t assume the reader knows what you are talking about
- Do be polite, especially if you are asking for something from the reader
- Do use a signature to say who you are and how you can be contacted
- Don’t `shoot from the hip’
- Do keep it brief and to the point
- Don’t overuse exclamation points

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Microsoft Teams

- Used for 1-1/group discussions and webinars
- Chat facility useful for quick questions/queries and sharing of files

- Teams etiquette
  - If you wouldn't do it in person, don't do it in teams.
  - Don't treat it like a group chat (no memes, gifs etc.)
  - Turn your camera on if possible but be careful about what is in your background (use blur or virtual background)
  - Mute yourself when not presenting/talking

Group Activity

- Working with your neighbours, list the attributes that you think employers most want from a graduate employee.
- Add your attributes to the following Padlet

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What employers want from a graduate employee

Bright Network

Activity

- In groups, list the topic areas that fall under the umbrella of ‘Mathematics’
- Add your topics to the following Padlet

Some Mathematical Topics

• Number systems	• Calculus	• Engineering
• Geometry	• Vector calculus	• Economics
• Trigonometry	• Fluid flow	• Game theory
• Algebra	• Dynamical systems	• Finance
• Linear algebra	• Chaos theory	• Statistics
• Graph theory	• Fractal geometry	• Optimisation
• Combinatorics	• Real analysis	• Probability
• Number theory	• Complex analysis	• Computer science
• Group theory	• Numerical analysis	• Cryptography
• Complexity theory	• Mathematical physics	• Artificial intelligence
• Logic	• Mathematical chemistry	• Data analytics
• Topology	• Mathematical biology	• **And many more!!!**

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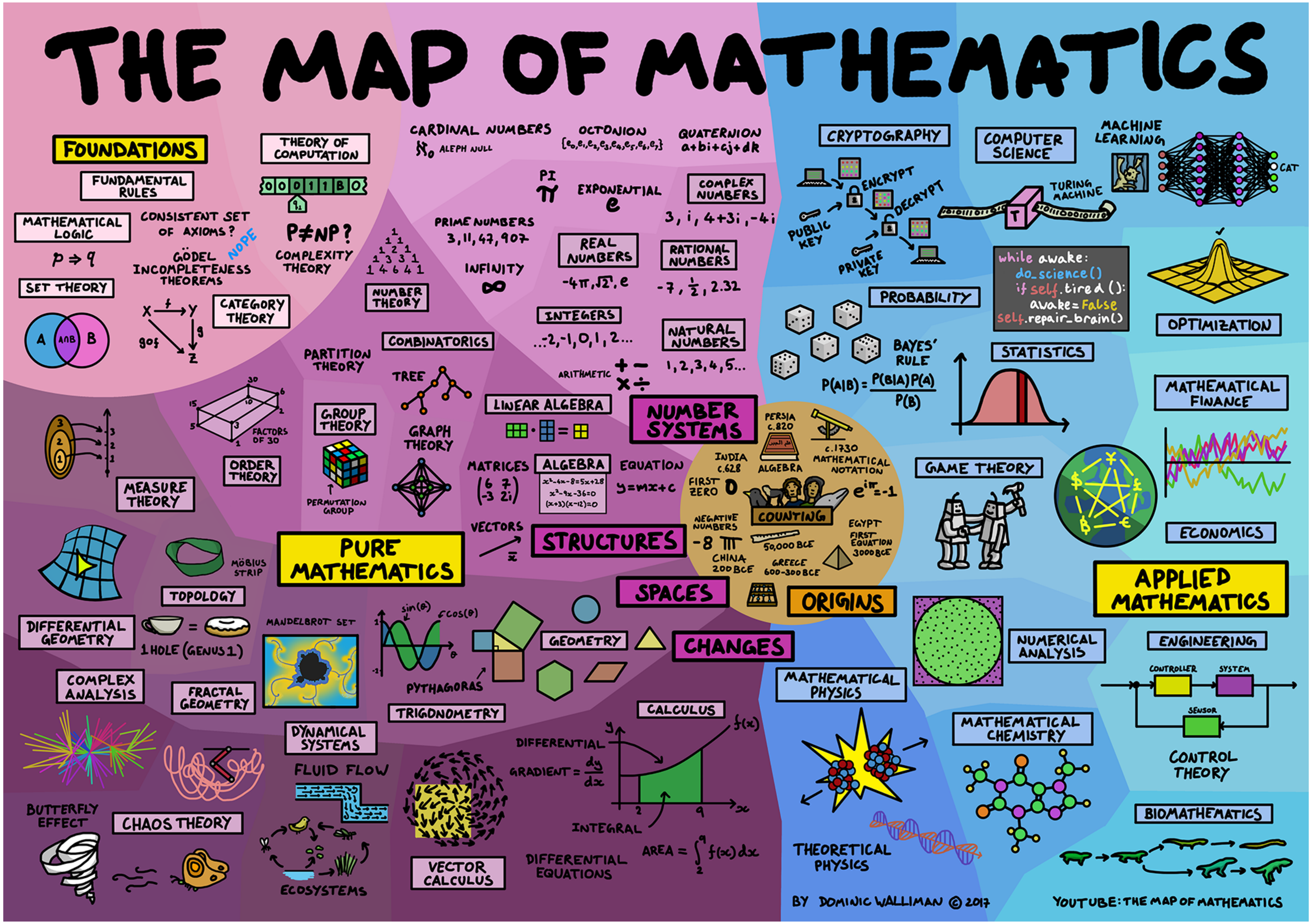


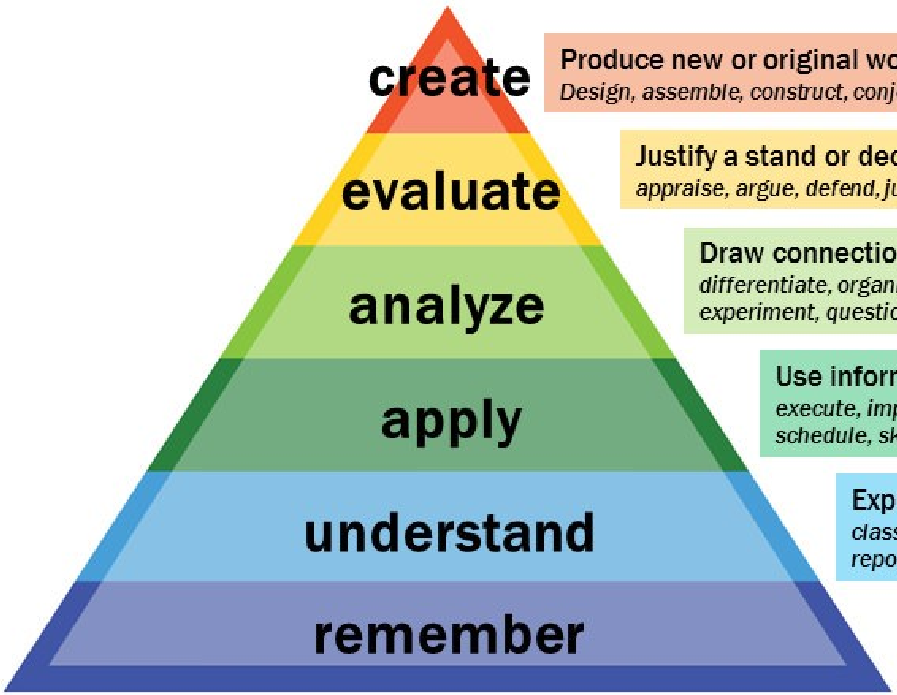
Dominic Walliman, 2017

Learning Mathematics

- Difficult to do it on your own!
- Can be challenging, but ultimately very rewarding
- You are unlikely to understand something straight away, be patient and work at it
- The more exercises you can do the better
- Seek out other sources, lots out there on the web
- You get out what you put in

- The default position of a mathematician is to be stuck

Bloom's Taxonomy



Produce new or original work
Design, assemble, construct, conjecture, develop, formulate, author, investigate

Justify a stand or decision
appraise, argue, defend, judge, select, support, value, critique, weigh

Draw connections among ideas
differentiate, organize, relate, compare, contrast, distinguish, examine, experiment, question, test

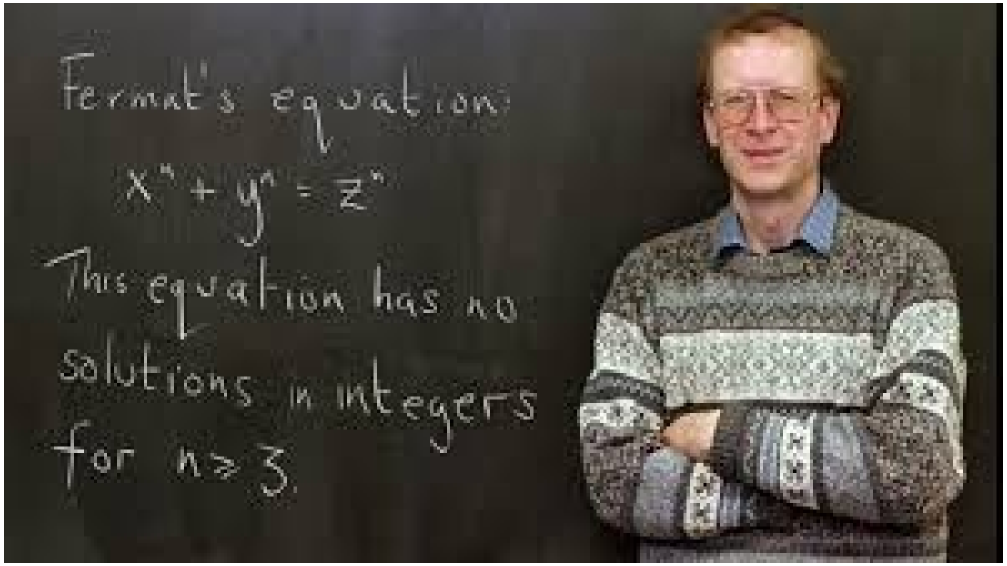
Use information in new situations
execute, implement, solve, use, demonstrate, interpret, operate, schedule, sketch

Explain ideas or concepts
classify, describe, discuss, explain, identify, locate, recognize, report, select, translate

Recall facts and basic concepts
define, duplicate, list, memorize, repeat, state

Fermat's Last Theorem

- Theorised by Pierre Fermat in 1637
- Proved by Andrew Wiles in 1993



"Perhaps I could best describe my experience of doing mathematics in terms of entering a dark mansion. One goes into the first room, and it's dark, completely dark. One stumbles around bumping into the furniture, and gradually, you learn where each piece of furniture is, and finally, after six months or so, you find the light switch. You turn it on, and suddenly, it's all illuminated. You can see exactly where you were."

Communicating Mathematics

- The way mathematicians communicate has evolved over the centuries to be clear and concise
- Uses lots of symbols, e.g., etc.
- A page of mathematics may look bewildering but it’s just communicating something to you
- Common abbreviations
    - E.g., - “for example” (*exempli gratia)*
    - I.e., - “that is” (*id est*)
    - cf. – “compare with” (*conferatur*)
    - iff – “if and only if”

Axioms, definitions, proofs etc.

- **Axiom** – a statement that we assume to be true, e.g.,
- **Definition** – an explanation of the meaning of a word, variable or equation
- **Proof** – an explanation of why something is true
- **Theorem** – a statement that has proven to be true

Proofs, definitions, corollary etc.

- **Proposition** – a true comment (usually less important than a theorem)

- **Conjecture** – a statement that we believe to be true but for which we have no proof

- **Corollary** – a statement that is true that is deduced from a proof or proposition

Example: Proof

Theorem: If $m \in \mathbb{Z}$ is even then m^2 is also even.

Proof: *Let* $m \in \mathbb{Z}$ *be even then by definition* $\exists n \in \mathbb{Z}$ *such that* $m = 2n$

$$m^2 = (2n)^2 = 4n^2 = 2(2n^2)$$

So m^2 *is also even.*

Symbol represents Q.E.D. (*Quad erat demonstrandum* – “which was to be demonstrated”)

$\blacksquare$

Example: Proof

Theorem: If $m \in \mathbb{Z}$ is odd then m^2 is also odd.

Proof: *Let* $m \in \mathbb{Z}$ *be odd then by definition* $\exists n \in \mathbb{Z}$ *such that* $m = 2n + 1$

$$m^2 = (2n+1)^2 = 4n^2 + 4n + 1 = 2(2n^2 + 2n) + 1$$

So m^2 *is also odd.*

$\blacksquare$

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Example: Proof by contradiction

Theorem: $\sqrt{2}$ is an irrational number

Proof: *Let's assume* $\sqrt{2}$ *is rational, let* $p, q \in \mathbb{Z}$ *which are co-prime such that* $\frac{p}{q} = \sqrt{2}$ *therefore* $2q^2 = p^2$.

So p^2 *is even and by the previous theorem so is* p. *Let* $p = 2m$ *for some* $m \in \mathbb{Z}$ *then*

$$2q^2 = (2m)^2 = 4m^2 \implies q^2 = 2m^2$$

Therefore, q *is also even. So* p *and* q *have a common factor of 2 and are not co-prime which is a contradiction.*

$\blacksquare$

Proof by Induction

Theorem (Mathematical Induction): Let $P(n)$ be a statement that is true for $n = 1, 2, \ldots$ where $\mathrm{n} \in \mathbb{N}$ then $P(n)$ is true for all n if

- $P(1)$ is true and
- $P(k) \Longrightarrow P(k+1)$ for all $k \in \mathbb{N}$

Example: Proof by induction

Theorem: the sum of the first n natural numbers is

$$\sum_{i=1}^{n} i = \frac{n(n+1)}{2}$$

Proof:

Step 1 (prove $P(1)$): Let $n = 1$,

$$\sum_{i=1}^{1} i = \frac{1(1+1)}{2} = \frac{2}{2} = 1$$

Which is true for $n = 1$.

Example: Proof by induction

Theorem: the sum of the first n natural numbers is

$$\sum_{i=1}^{n} i = \frac{n(n+1)}{2}$$

Step 2 prove $P(k) \Rightarrow P(k+1)$*: let* $n = k+1$

$$\sum_{i=1}^{k+1} i = \sum_{i=1}^{k+1} \frac{n(n+1)}{2} = (k+1) + \sum_{i=1}^{k} i = (k+1) + \frac{k(k+1)}{2}$$

$$= \frac{2(k+1) + k(k+1)}{2} = \frac{(k+1)(k+2)}{2} = \frac{(k+1)\big((k+1)+1\big)}{2}$$

Which is true for $n = k+1$ $\blacksquare$

Proofs

- Can be many proofs proving the same thing - there are over 371 proofs of Pythagoras' theorem!
- Proofs can be hard – Fermat's Last theorem published in 1637 and wasn't proven until 1994
- There are lots of problems yet to be proven
- Being certain of something is not a proof, we must show that it is true for each and every case
- The Riemann hypothesis has been checked for first 10,000,000,000,000 solutions but we still say it is unproven.