

Writing MSc projects

- ▶ General advice
- ▶ Discussion of some short pieces of mathematical writing
- ▶ Typesetting
- ▶ Questions?

General advice

- ▶ Writing mathematics is hard but rewarding.
- ▶ There is a lot of good advice available (often free, online): see links in handout.
- ▶ **Summary.** Spend time thinking about the original sources. Read your writing critically. Try to empathize with the reader.
- ▶ **Originality.**

General advice

- ▶ Writing mathematics is hard but rewarding.
- ▶ There is a lot of good advice available (often free, online): see links in handout.
- ▶ **Summary.** Spend time thinking about the original sources. Read your writing critically. Try to empathize with the reader.
- ▶ **Originality.**
 - ▶ Create your own examples
 - ▶ Give your own versions of existing proofs
 - ▶ Critically compare results, proofs, or cryptoschemes from different papers
 - ▶ For theorems: what happens if the hypotheses are weakened? Are stronger results known with stronger hypotheses?
 - ▶ In cryptography: often authors are more positive about their own efforts than those of their competitors. Critically compare the various claims and counterclaims.
 - ▶ Write a computer program (in a language of your choice) to test an open conjecture, or to attack a cryptoscheme.
 - ▶ You are not expected to solve an open problem.

Mathematical writing doesn't have to be full of equations

Here is a complete paper by Edward Nelson *Mathematical Pearls: A Proof of Liouville's Theorem*, Proceedings of the American Mathematical Society **12** (1961) 995.

A PROOF OF LIOUVILLE'S THEOREM

EDWARD NELSON

Consider a bounded harmonic function on Euclidean space. Since it is harmonic, its value at any point is its average over any sphere, and hence over any ball, with the point as center. Given two points, choose two balls with the given points as centers and of equal radius. If the radius is large enough, the two balls will coincide except for an arbitrarily small proportion of their volume. Since the function is bounded, the averages of it over the two balls are arbitrarily close, and so the function assumes the same value at any two points. Thus a bounded harmonic function on Euclidean space is a constant.

PRINCETON UNIVERSITY

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For a longer paper that is accessible and well-written see Hamming's original paper on coding theory.

Spot the errors and deficiencies in a fortunately non-existent project (there are MANY)

Prime numbers and cryptography

Prime numbers are essential to cryptography, Euclid's famous theorem has held generations of mathematicians spellbound in it's inescapable beauty.

Theorem. (Euclid, 400) There are infinitely many prime numbers, where a prime is a number only divisible by itself and 1. (Throughout this project, number means element of $\mathbb{N}$.)

Proof Let $2, 3, 5, \dots, p$ be the aggregate of primes up to p , and let $q = 2 \cdot 3 \cdot 5 \cdots p + 1$. Then q is not divisible by any of the numbers $2, 3, 5, \dots, p$. It is therefore either prime, or divisible by a prime between p and q . In either case there is a prime greater than p , which proves the theorem.

Avoid accidentally committing plagiarism

If you quote text verbatim, this must be made clear. Verbatim quoting may be appropriate for certain definitions or cryptoschemes that have to be specified very precisely.

Do not paraphrase someone else's account with acknowledging that you are following them closely.

Even if you cite the original paper, if you present as your own words a block of text that follows another author's paragraph and sentence structure, making only minor word changes or re-orderings, then you are committing plagiarism.

Accurate citation is vital (and worth 10 marks): refer to specific pages or theorems in a paper, e.g. [4, Theorem 3.3], or [Hamming, page 2].

Typesetting

These days almost every mathematician uses $\text{\LaTeX}$ to typeset their papers and lecture notes.

- ▶ Read *The (Not So) Short Introduction to $\text{\LaTeX}$* .
- ▶ Rather than start from scratch, you should modify someone else's file. There is a template available online (see handout for links).
- ▶ **Example:** document class declaration: change from `amsart` to `article`.

Any Questions?