# Scientific Writing

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Inventing Harmonious Future

# Steps of Good Writing

### Macro-Level Discussions

- Organisation of the paper.
- General Issues of presentability.

### Micro-Level Discussions

- Stylistic Issues.
- Examples of Good and Bad Writing,

# Steps of Good Writing

Macro-Level Discussions

- Organisation of the paper.

- General Issues of presentability.

Micro-Level Discussions (Today's class)

- Stylistic Issues.

- Examples of Good and Bad Writing,

# Stylistic Issues: Use paragraphs

- Each paragraph should consist of a few sentences and convey a single idea.

- A paragraph should be related to the one before and the one following it.

- In general, a conversational tone giving signposts and clearly written transition paragraphs provides for pleasant reading.

# Stylistic Issues: Opening Paragraph

- The opening paragraph should be your best paragraph, and its first sentence should be your best sentence.

- If a paper starts badly, the reader will wince and be resigned to a difficult job of fighting with your prose.

- Conversely, if the beginning flows smoothly, the reader will be hooked and will not notice occasional lapses in the later parts.

- Do not start with a sentence of the form "An xxx is yyy."

# Opening Paragraph
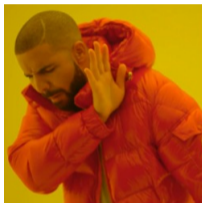
# Stylistic Issues: Some Genetal Guidelines

- Motivate the reader for what follows.

- Perhaps the most important principle of good writing is to keep the reader uppermost in mind:
  - What does the reader know so far?
  - What does the reader expect next and why?

# Stylistic Issues: Some Genetal Guidelines

- Motivate the reader for what follows.

- Perhaps the most important principle of good writing is to keep the reader uppermost in mind:
  - What does the reader know so far?
  - What does the reader expect next and why?

- When describing the work of other people it is sometimes safe to provide motivation by simply stating that it is interesting or remarkable.

- However, it is best to let the results speak for themselves or to give reasons why the things seem "interesting" or "remarkable".

# Basic Stylistic Issues

## Repeating Words

- Don't repeat similar words in the same or successive sentences.
- Avoid starting or repeating sentences with "The", "Thus", "Consequently", "Therefore" or "So", "Our".

## Stylistic Cliches

- Identify and avoid stylistic cliches.
- Example: Starting the abstract with "In this paper . . .".

# "We" vs "I"

"We": You and me together, not a formal equivalent of "I".

- "We" is often useful to avoid passive voice.

- Use "we" instead of "I" even in single author papers.
    - View it as a dialog between the author and the reader.

- "I" should be avoided unless the author's persona is important.

# Use of Symbols

- Symbols in different formulas must be separated by words:

  Bad: Consider $S_q$, $q < p$.

  Good: Consider $S_q$, where $q < p$.

- Do not start a sentence with a symbol:

  Bad: $x_n - a$ has $n$ distinct zeroes.

  Good: The polynomial $x_n - a$ has $n$ distinct zeroes.

- Do not use the symbols $\ldots$, $\Rightarrow$, $\forall$, $\exists$ etc.

  Replace them by the corresponding words.

# Use of Notations

- Do not use the same notation for two different things. Conversely, use consistent notation for the same thing when it appears in several places.

- For example, do not say "$A_j$ for $1 \leq j \leq n$" in one place and "$A_k$ for $1 \leq k \leq n$" in another place unless there is a good reason.

- It is often useful to choose names for indices so that $i$ varies from 1 to $m$ and $j$ from 1 to $n$, say, and to stick to consistent usage.

- Typographic conventions (like lowercase letters for elements of sets and uppercase for sets) are useful.

# Use of Subscripts/Superscripts in Notations

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    - $x_i$ is an element of $X$ ($\times$)
    - $x$ is an element of $X$ ($\checkmark$)

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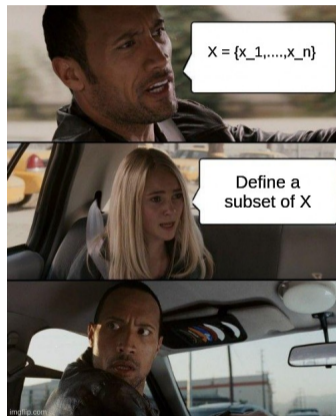    - $x$ is an element of $X$ ($\checkmark$)

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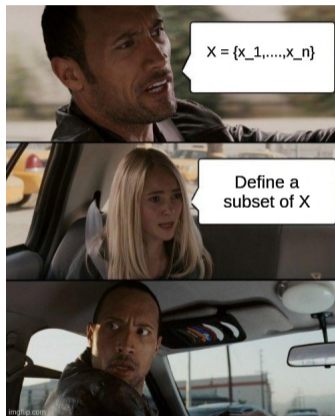
# Use of Subscripts/Superscripts in Notations



Now you need subscripted subscripts..!!

# Use of Subscripts/Superscripts in Notations

- **Do not get carried away by subscripts**, especially when dealing with a set that does not need to be indexed.

- **Do not name the elements** of $X$ unless necessary.

- **Try to avoid superscripts** unless necessary.

# A Note on Defining Notations

- All variables must be defined, at least informally, when they are first introduced.

- Try to state things twice, in complementary ways, especially when giving a definition.

- This reinforces the reader's understanding.

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- For example:

   Fine: $N^n$ denotes the set of $n$-tuples of nonnegative integers.

   Better: Let
   $$N^n := \{(b_1, \ldots, b_n) : b_i \in \mathbb{Z}^\star \text{ for } 1 \leq i \leq N\}$$

   be the set of $n$-tuples of nonnegative integers.

# A Note on Tenses

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- Either use present tense throughout the entire paper, or write sequentially.

- Sequential writing means that you say things like,

  "We saw this before. We will see this later."

- The sequential approach is more appropriate for lengthy papers.

- You can use it even more effectively by using words of duration:

  "We observed this long ago. We saw the other thing recently. We will prove something else soon."

# A Note on Punctuations

# Use of Punctuations

- No space before a punctuation symbol.

- One space after the symbol.

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For example:

Incorrect: We have done this . Now we will ...

Incorrect: We have done this.Now we will ...

Correct: We have done this. Now we will ...

# Use of Punctuations

- Use commas carefully:
    - Too many commas will interfere with the smooth flow of a sentence
    - Too few can make a sentence difficult to read.

- With a series of three or more words, phrases, or clauses insert comma before "and/or".

# Use of Punctuations

## Series of Two Words/Phrases/Clauses

Correct: Saikat and Shreya have chosen Cryptography as their research topic.

Incorrect: Saikat, and Shreya have chosen Cryptography as research topic.

# Use of Punctuations

## Series of Two Words/Phrases/Clauses

Correct: Saikat and Shreya have chosen Cryptography as their research topic.

Incorrect: Saikat, and Shreya have chosen Cryptography as research topic.

## Series of Three Words/Phrases/Clauses

InCorrect: Saikat, Shreya and Sougata have chosen Cryptography as their research topic.

Correct: Saikat, Shreya, and Sougata have chosen Cryptography as research topic.

# Use of Punctuations in Quotation

- **Commas** and **periods** should be placed **inside quotation marks**.

- **Other** punctuation (like colons, semicolons, question marks, exclamation marks) stay **outside** the quotation marks unless they are part of the quotation.

- It is generally best to go along with this well established (may be illogical) convention about commas and periods.

- However, don't use it when you are using quotation marks to describe some text as a **specific string of symbols**. For example:

      Always end your program with the word "end".

# Use of Punctuations in Parenthesis or Bracket

Punctuation should always be strictly logical with respect to parentheses and brackets.

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Examples:

- Any instantiation with a generic design (such as the ones in next section) violates the "ideal tweakable block cipher" assumption.

- All the 16 bits are active which cancels the difference of the S-box output (The difference 0xffff is invariant for any rotation operation.).

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# Use of Punctuations in Parenthesis or Bracket

Punctuation should always be strictly logical with respect to parentheses and brackets:

- Put a period inside parentheses if and only if the sentence ending with that period is entirely within the parentheses.

- The punctuation within parentheses should be correct, independently of the outside context.

- The punctuation outside the parentheses should be correct if the parenthesized statement would be removed.

# Use of Colons

- Do not overdo the use of colons.

- For example,

  Good: "Define it as follows:"
  Bad: "We have: $y = mx + c$"
  Note: The formula just completes the sentence!!

- The first word after a colon should be capitalized if the phrase following the colon is a full sentence.

- However, it shouldn't be capitalized if it is a sentence fragment.

# Use of That

- Do not omit "that" when it helps the reader to parse the sentence:

  Bad: Assume $G$ is a group.
  Good: Assume that $G$ is a group.

- Never use that before an expression:

  Bad: We have that $x = y$.
  Good: We have $x = y$.

- The words "assume" and "suppose" should usually be followed by "that" unless another "that" appears nearby.

# "Which" vs "That"

- Do not say "which" when "that" sounds better.

- Use "which" only when it is <span style="color:red">preceded by a comma</span> or <span style="color:red">by a preposition</span>, or when it is used <span style="color:red">interrogatively</span>.

- Experiment to find out which is better, "which" or "that", and you will understand this rule.

- For example:

    <span style="color:red">Bad</span>: Do not use commas which are not necessary.
    <span style="color:red">Good</span>: Do not use commas that are not necessary.

- Another common error is to say "<span style="color:red">less</span>" when the proper word is "<span style="color:red">fewer</span>".

# Mathematical Results (Theorem, Lemma etc)

- Capitalize names such as Theorem 1, Lemma 2, Algorithm 3 etc.

- The statement just preceding the result, should be a complete sentence or should end with a colon.

- Even better would be to replace the first sentence by a more suggestive motivation, tying the theorem up with the previous discussion.

- The statement of a theorem should usually be self-contained, not depending on the assumptions in the preceding text.

# Mathematical Results (Theorem, Lemma etc)

# A Note on Formulas

- Do not merely provide a sequence of formulas. Tie the concepts together with a running commentary.

- Display important formulas on a line by themselves.

- If you need to refer to some of these formulas from remote parts of the text, give reference numbers.

- Do not number all formulas; number only the important ones and the referred ones.

# A Note on Formulas

- Allowing formulas to get so long that they do not format well or are unnecessarily confusing violates the principle of name and conquer that makes mathematics readable.

- For example, if you are going to do a lot of formula manipulation in which the term $(c_i - c_j + 1)$ remains as a unit, then
  - $v = u + m(c_i + c_j - 1), \ w = u + n(c_i + c_j - 1)$ ×
  - $v = u + mc, \ w = u + nc$, where $c = c_i + c_j - 1$. ✓

- Don't use extraneous parenthesis: $c = (c_i + c_j) - 1$.

- Remember to place words between adjacent formulas. Don't use phrases such as "Add $p$ $k$ times to $c$."

- Linebreaks in the middle of formulas are undesirable.

# Use of Conjunctions in Formulas

Medwed et al. [84] initiated the investigation of the minimal conditions needed on the block cipher and the subkey generation to obtain side-channel security. They introduced a function

$$\text{MSGR} : \{0,1\}^{\kappa'} \times \{0,1\}^\rho \times \{0,1\}^n \to \{0,1\}^n \,,$$
$$(k, r, m) \mapsto E(h(k, r), m) \,, \tag{3}$$

for some function $h : \{0,1\}^{\kappa'} \times \{0,1\}^\rho \to \{0,1\}^\kappa$, and where $r$ is necessarily a random value for each evaluation. The idea of the scheme is that $E$ is crypto-

The second scheme of Dobraunig et al. [40] achieves security beyond the birthday bound, but it is based on a *tweakable* block cipher $\widetilde{E} : \{0,1\}^\kappa \times \{0,1\}^\rho \times \{0,1\}^n \to \{0,1\}^n$:

$$\text{DKM}^+2 : \{0,1\}^{\kappa'} \times \{0,1\}^\rho \times \{0,1\}^n \to \{0,1\}^n \,,$$
$$(k, r, m) \mapsto \widetilde{E}(h(k, r), r, m) \,. \tag{5}$$

# A Note on Relations

- You can give relations in two ways, either saying $p_i < p_j$ or $p_j > p_i$.

- The latter is for "people who are into dominance." The former is much easier for a reader to visualize after you have just said $p = (p_1, \ p_2, \ \ldots, \ p_n)$ and $i < j$.

- Similarly, do not say $i < j$ and $p_j < p_i$; keep $i$ and $j$ in the same relative position.
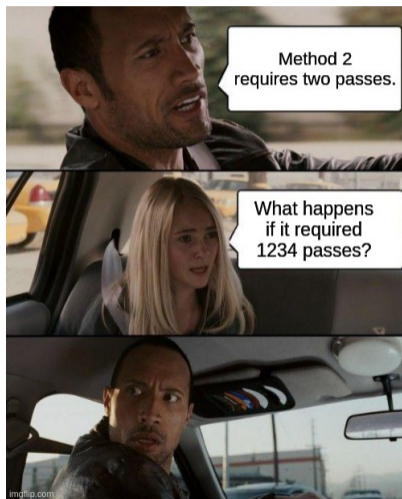
# Use of Numbers in Sentences
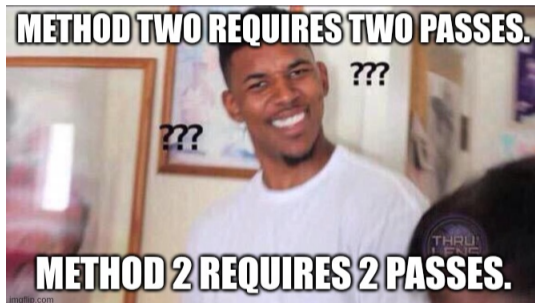
# Use of Numbers in Sentences

Numbers should be spelt out when used as adjectives, but not when used as names.

- For example, the following are bad:
  - The method requires 2 passes.
  - We must follow procedure three.

- Some good examples are:
  - Method 2 is illustrated in Fig. 1; it requires two passes.
  - The count was increased by 2.
  - The leftmost 2 in the sequence was changed to a 1.

# Use of Numbers in Sentences

# Use of Numbers in Sentences

Small numbers should be spelt out when used as adjectives, but not when used as names.

- For example, the following are bad:
  - The method requires one thousand two hundred and thirty four passes.
  - We must follow procedure three.

- Some good examples are:
  - Method 2 is illustrated in Fig. 1; it requires 1234 passes.
  - The count was increased by 2.
  - The leftmost 2 in the sequence was changed to a 1.

# Useful Phrases and Sentences

- An easy-to-read proof may contain phrases such as:
  - "The lemma is half proved."
  - "We divide the proof into two parts, first proving xxx and then proving yyy."

- Tell the reader what is going on or bring in new and helpful:
  - "We demonstrate the second conclusion by contradiction."
  - "There must be a witness to the unsortedness of P."

- Sentences should be readable from left to right without ambiguity. Don't use phrases such as
  - "Dan remarked in a paper about the scarcity of data." (×)
  - "In the theory of rings, groups and other algebraic structures are treated." (×)

# Useful Phrases and Sentences

- Use parallelism when parallel concepts are being discussed. For example:

    Bad: Formerly, science was taught by the textbook method, while now the laboratory method is employed.

    Good: Formerly, science was taught by the textbook method; now it is taught by the laboratory method.

- Keep sticky words spaced well apart. For example: Don't use "this" or "also" in consecutive sentences.

# Examples of Some Useful Phrases

- Central to this work is xxx.

- We focus on xxx in the context of yyy.

- Motivated by xxx, we investigate yyy.

- The contributions of this paper are twofold:
  - xxx.
  - yyy.

# Examples of Some Useful Phrases

- We demonstrate the applicability of our result by instantiating xxx.

- As a matter of fact, xxx performed in this work are yyy.

- It is fascinating to see that, as this work shows, xxx.

- This work opens up two different directions of possible future works:
  - xxx.
  - yyy.

# References

- Donald E. Knuth, Tracy Larrabee and Paul M. Roberts, <u>Notes from Mathematical Writing</u>, 1987.

Thank You..!!!