HOW TO WRITE PAPERS SO PEOPLE CAN READ THEM
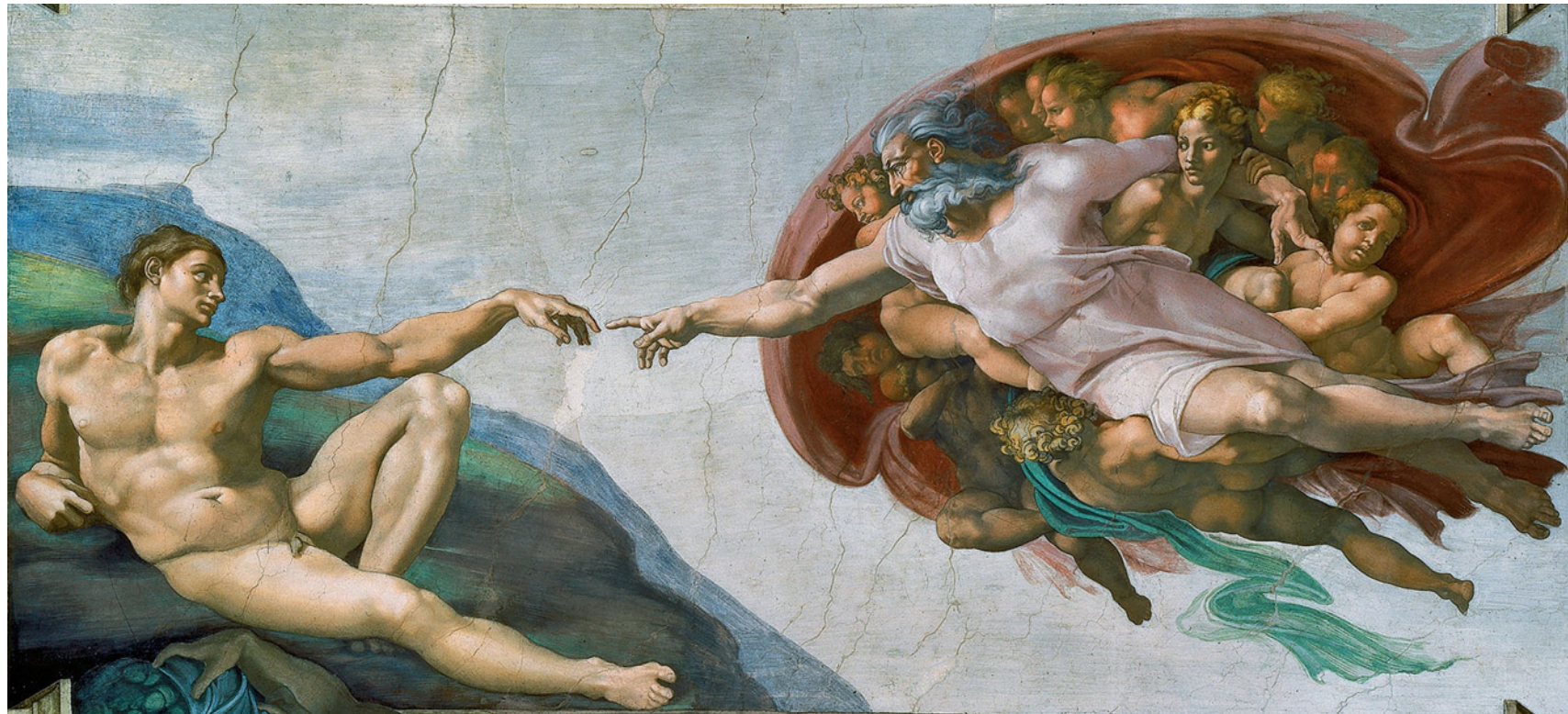

Derek Dreyer

MPI for Software Systems
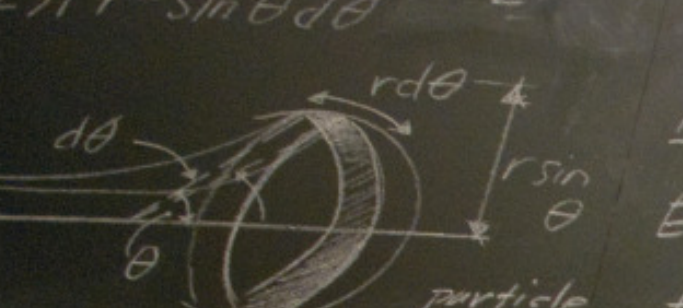
PLMW@POPL 2016
St. Petersburg, Florida

$$E^{tot}(x_j,t)=\sum_{n\neq j}' \frac{E_n^{ret}(x,t)+E_n^{adv}(x,t)}{2}$$

$$E^{free}(x_j,t)=\sum_n E_n^{ret}$$

$$E^{tot}(x_j,t)=\sum_n' E_n^{ret}(x_j,t)$$

$$+\sum_n \frac{E_n^{ret}(x_j,t)-E_n^{adv}(x_j,t)}{2}$$

$$E^{tot}(x_j,t)=\sum_{n\neq j} E_n^{ret}(x_j,t)+E^{damping}(x_j,t)$$

oscillating $X(t)=x_0\cos(wt)$

$E^2=p^2c^2+m^2c^2$

$P=\frac{h}{\lambda}=\frac{E}{c} \rightarrow E=h\nu \rightarrow E=\hbar w$

$E^{damping}(x_j,t)=\frac{Q}{6\pi c^3}$

$V(r,\vec{E})$ — TIME INDEPENDENT $V(r)$

$\psi(\vec{r},t)=\psi(\vec{r})e^{-iEt/\hbar}$

CONSTANT

$V(r,\vec{E})=V(\vec{r})$

$\Psi(x,t)=\int A(k)e^{i(kx-wt)}dk$
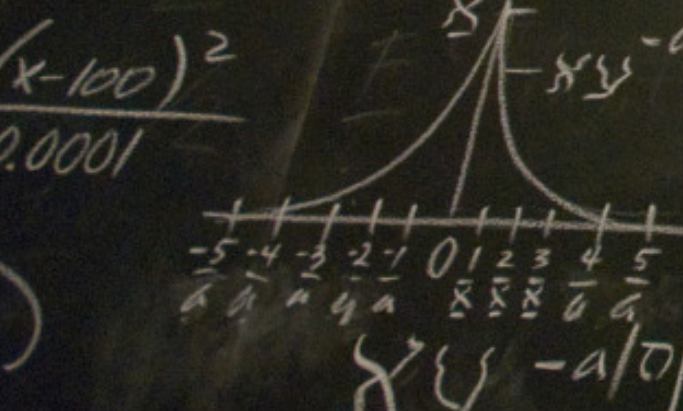
MOMENTUM × POSITION UNCERTAINTY
GREATER THAN CONSTANT $(\hbar/2)$

$(\hbar=h/2\pi=6.6\times10^{-34})$

$\Delta x=\sqrt{\ }$

$\Delta X=\sqrt{\ }$

$(x-100)^2$

0.0001

$(E/C)^2-p^2=(m_0c)^2$

$E(=mc^2)$

m_0c^2

$F=q[E+(v\times B)]$ $q=0$

$E\cdot B$

$\mathcal{E}=\oint_{\partial\Sigma(t)} d\vec{l}\cdot\vec{F}/q=\oint_{\partial\Sigma(t)}$

$d\vec{l}\cdot(E+v\times B)$

FARADAY $\mathcal{E}=-\frac{d\Phi_B}{dt}$

E-FIELD $\sim q$

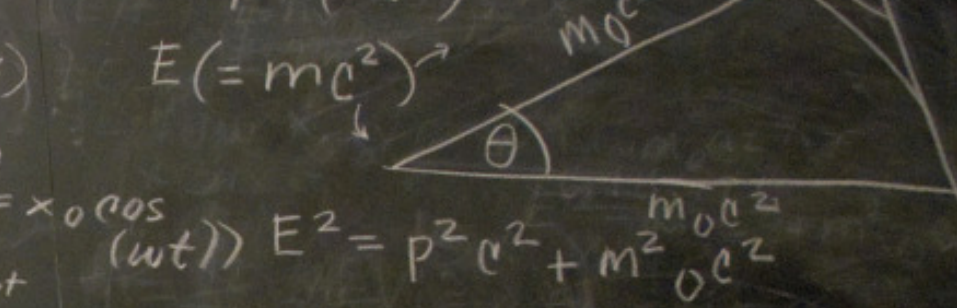$\Phi_B \rightarrow EMF$ $F=q(-\nabla\phi$

$E=-\nabla\phi-\frac{\partial A}{\partial t}$

$P=\sum_{i=1}^{n} m_i v_i=m_1v_1+m_2v_2+m_3v_3+m_nv_n$

$L=\sqrt{\ell(\ell+1)}\hbar$

$V=\frac{A}{r}-\frac{B}{r^m}$

All work and no play makes Jack a dull boy.
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- You may think you just lack the technical sophistication to understand them.

Have you read any PL papers lately?

- You may think you just lack the technical sophistication to understand them.

- But in fact, many papers are **poorly written**.

So if you can write clear, accessible papers…

- People will **enjoy** reading them!

- People will **learn** something from them!

- They will get **accepted** to POPL!

A piece of research
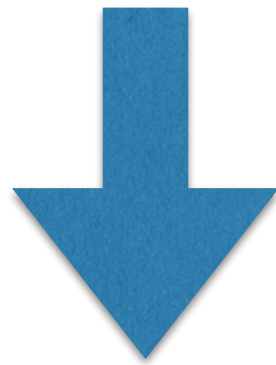
Writer

Reader

The good news

- There are **principles** you can follow that will help you write clearer, more readable prose

    - Based on how readers process information

The good news

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  – Based on how readers process information

WILLIAM STRUNK JR.
E.B. WHITE

"...still a little book, small enough and important enough to carry in your pocket, as I carry mine."
— Charles Osgood

The
ELEMENTS
of
STYLE

FOURTH EDITION

FOREWORD BY ROGER ANGELL

?

The good news

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"Be clear"

"Omit needless words"

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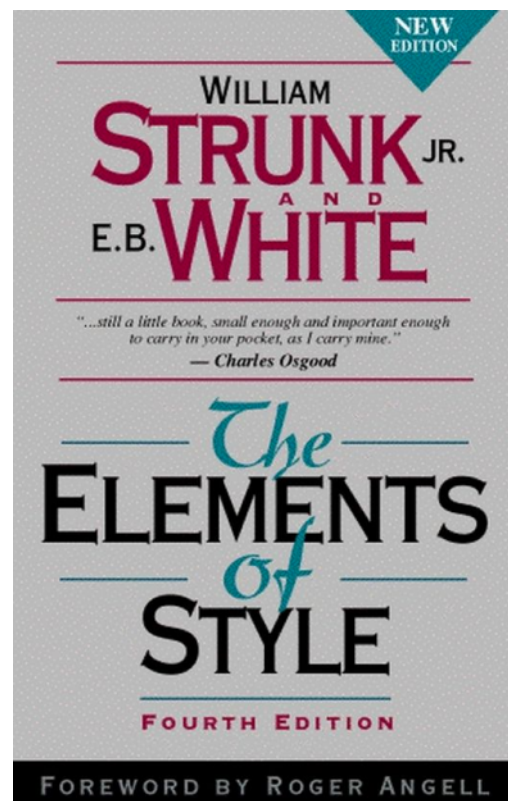
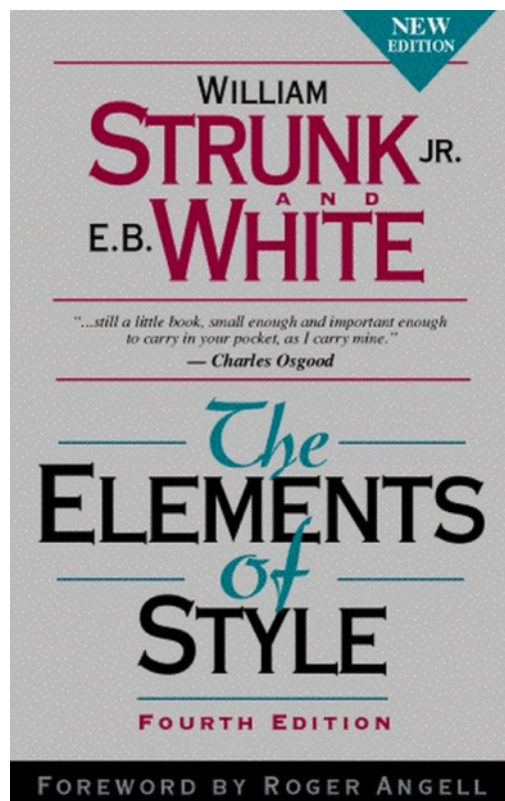

? "Be clear"

"Omit needless words"

…
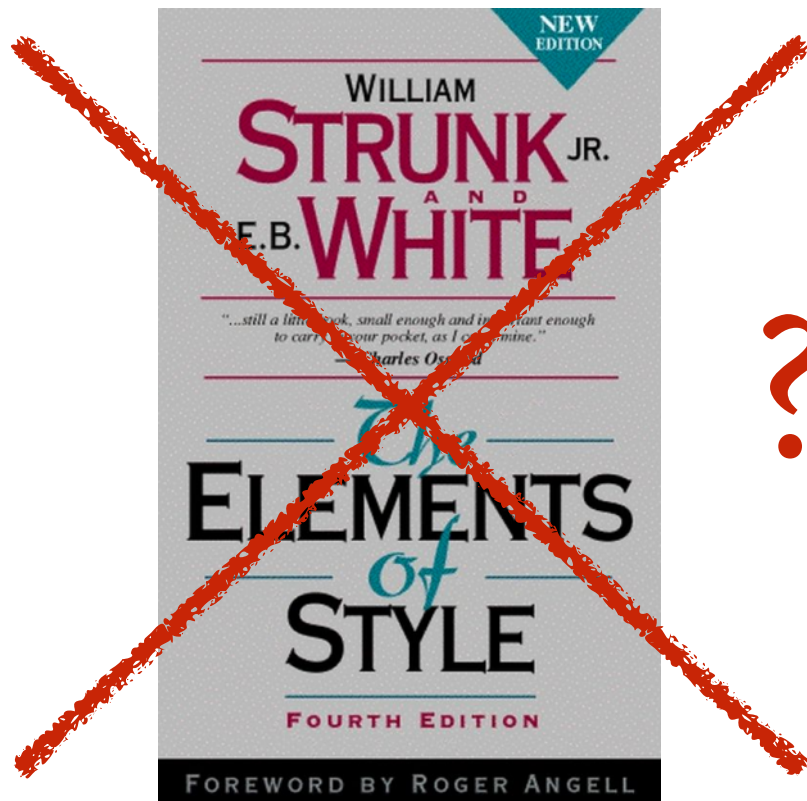
The good news

- There are **principles** you can follow that will help you write clearer, more readable prose

    – Based on how readers process information

- These principles are **constructive**:

    – Easy to check if your text satisfies these principles

    – If not, principles suggest improvements

Inspirations for this talk

- **Joseph M. Williams.** *Style: Toward clarity and grace.* 1990. (book)

- **Norman Ramsey.** *Learn technical writing in two hours per week.* (course notes)

    – http://www.cs.tufts.edu/~nr/pubs/two.pdf

- **Simon Peyton Jones.** *How to write a great research paper.* (talk)

    – http://research.microsoft.com/en-us/um/people/simonpj/papers/giving-a-talk/giving-a-talk.htm
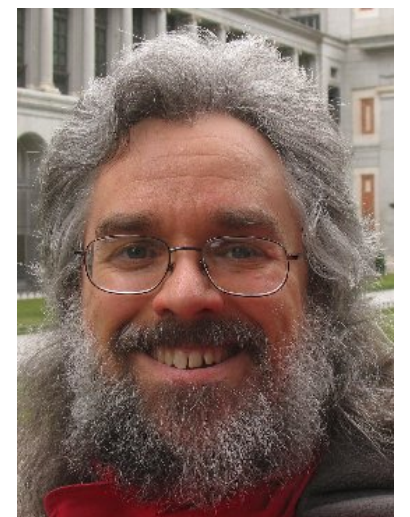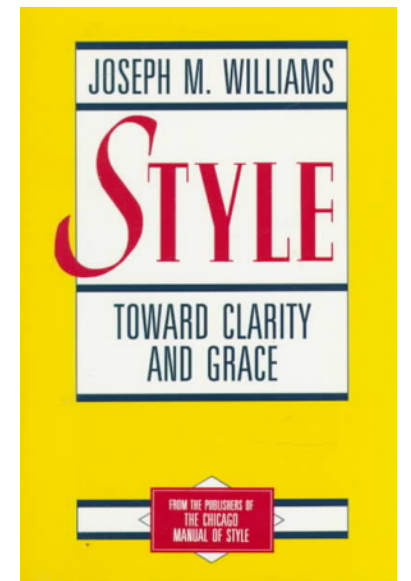
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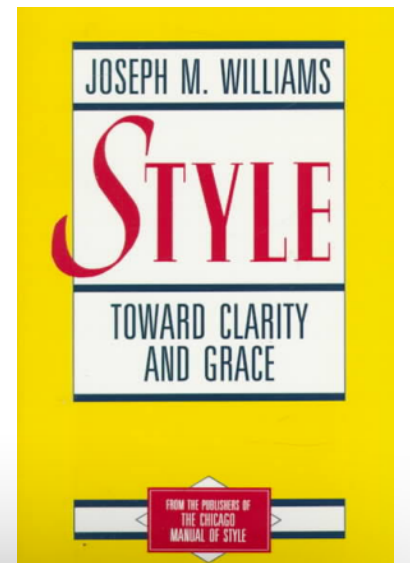
Talk developed jointly with
Rose Hoberman
@ MPI-SWS

- **Simon Peyton Jones.** *How to write a great research paper.* (talk)

  – http://research.microsoft.com/en-us/um/people/simonpj/papers/giving-a-talk/giving-a-talk.htm

Sentences & paragraphs

Flow

It should be clear how each sentence and paragraph relates to **the adjacent ones**

Does this text flow?

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Security proofs of cryptographic protocols are crucial for the security of everyday electronic communication. However, these proofs tend to be complex and difficult to get right. The game-playing technique, originally proposed by Jones et al., follows a code-based approach where the security properties are formulated in terms of probabilistic programs, called games. This is a general design principle for cryptographic proofs to ease their management.

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What does this game-playing technique have to do with what came before?

Old to new

- Begin sentences with old info

  – Creates link to earlier text

- End sentences with new info

  – Creates link to the text that follows

  – Also places new info in position of **emphasis**

Applying old-to-new

New information

Security proofs of cryptographic protocols are crucial for the security of everyday electronic communication. However, these proofs tend to be complex and difficult to get right. The game-playing technique, originally proposed by Jones et al., follows a code-based approach where the security properties are formulated in terms of probabilistic programs, called games. This is a general design principle for cryptographic proofs to ease their management.

Applying old-to-new

Security proofs of cryptographic protocols are crucial for the security of everyday electronic communication. However, these proofs tend to be complex and difficult to get right. To make it easier to manage such proofs, Jones et al. have proposed a new design principle, called the game-playing technique. This technique follows a code-based approach where the security properties are formulated in terms of probabilistic programs, called games.
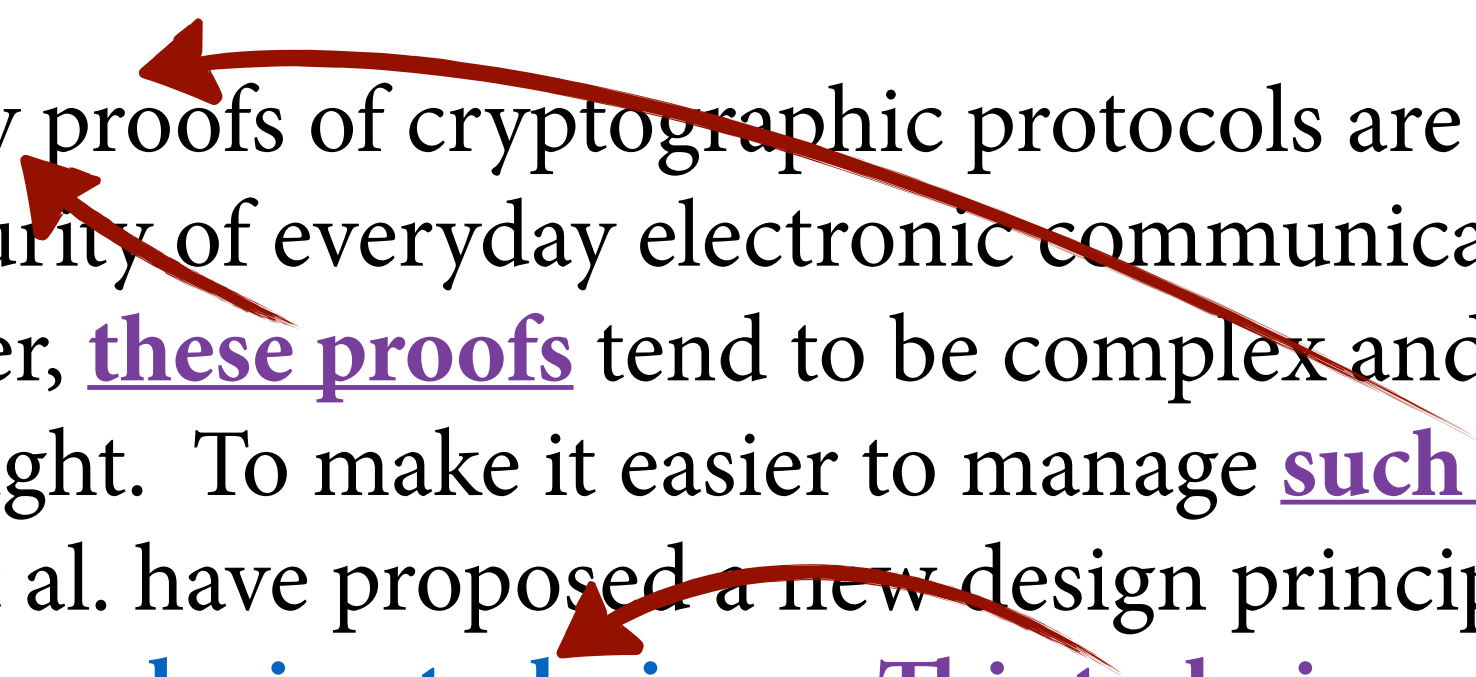
Old-to-new satisfied

Security proofs of cryptographic protocols are crucial for the security of everyday electronic communication. However, **these proofs** tend to be complex and difficult to get right. To make it easier to manage **such proofs**, Jones et al. have proposed a new design principle, called the **game-playing technique**. **This technique** follows a code-based approach where the security properties are formulated in terms of probabilistic programs, called games.

But flow is not enough!

What about this text?

Lions and tigers are some of the most dramatic and awe-inspiring species of cats. Most of these large cats, however, are currently facing extinction. A smaller cat that has been more evolutionarily successful is the house cat. Although house cats are currently the most popular pet in the world, they are in many ways anti-social. It would therefore be interesting to study whether house cats can be trained to be more sociable.

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What about this text?

Lions and tigers are some of the most ~~dramatic~~ and awe-inspiring species of cat ... the large cats, however ... A smaller ... successi... ats are curre... world, they are ... social. It would therefore ... esting to study whether house cats can be trained to be more sociable.

Has great flow, but is incoherent!

Coherence

It should be clear how each sentence and paragraph relates to **the big picture**

One paragraph, one point

- A paragraph should have one main point, expressed in a single **point sentence**

- **Typically** the point sentence should appear **at or near the beginning of the paragraph**

Get to the **point!**

No point sentence

Lions and tigers are some of the most dramatic and awe-inspiring species of cats. Most of these large cats, however, are currently facing extinction. A smaller cat that has been more evolutionarily successful is the house cat. Although house cats are currently the most popular pet in the world, they are in many ways anti-social. It would therefore be interesting to study whether house cats can be trained to be more sociable.

Point sentence up front

There appears to be a negative correlation between the charisma of a species and its ability to survive. Lions and tigers, for instance, are among the most majestic creatures in the animal kingdom, yet they are currently facing extinction. In contrast, the house cat is evolutionarily quite successful, even though it is mostly known for stupid pet tricks.

Flow & coherence

Create **flow** with **old to new**

Create **coherence** with
one paragraph, one point

Two other principles

- **Name your baby**:
  - Give unique names to things and use them consistently

- **Just in time**:
  - Give information precisely when it is needed, not before

Structure of
a research paper

A structure that works

- **Abstract** (1-2 paragraphs, 1000 readers)

- **Intro** (1-2 pages, 100 readers)

- **Main ideas** (2-3 pages, 50 readers)

- **Technical meat** (4-6 pages, 5 readers)

- **Related work** (1-2 pages, 100 readers)

A structure that works

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The CGI model for an abstract/intro

- **C**ontext:
  - Set the stage, motivate the general topic

- **G**ap:
  - Explain your specific problem and why existing work does not adequately solve it

- **I**nnovation:
  - State what you've done that is new, and explain how it helps fill the gap

An abstract for this talk

Context

Learning to write well is an essential part of becoming a successful researcher.

Gap

Learning to write well is an essential part of becoming a successful researcher. Unfortunately, many researchers find it very hard to write well because they do not know how to view their text from the perspective of the reader.

Innovation

Learning to write well is an essential part of becoming a successful researcher. Unfortunately, many researchers find it very hard to write well because they do not know how to view their text from the perspective of the reader. In this talk, we present a simple set of principles for good writing, based on an understanding of how readers process information. Unlike such platitudes as "Be clear" or "Omit needless words", our principles are *constructive*: one can easily check whether a piece of text satisfies them, and if it does not, the principles suggest concrete ways to improve it.

Introduction

- Like an expanded version of the abstract

- Alternative approach (SPJ): Eliminate Context

  – Start with a concrete example, e.g. "Consider this Haskell code…"

  – If this works, it can be effective, but I find it often doesn't work

  – It assumes reader already knows context

A structure that works

- Abstract (1-2 paragraphs, 1000 readers)

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"Main ideas" section

- Use **concrete illustrative examples** and high-level intuition

- Do **not** have to show the general solution (that's what the technical section is for)

Why have a "main ideas" section at all?

1. Forces you to have a **"takeaway"**

2. Many readers only care about the takeaway, not the technical details

3. For those who want the technical details, the main ideas are still useful as "scaffolding"

A structure that works

- Abstract (1-2 paragraphs, 1000 readers)

- Intro (1-2 pages, 100 readers)

- Main ideas (2-3 pages, 50 readers)

- Technical meat (4-6 pages, 5 readers)

- **Related work** (1-2 pages, 100 readers)

Related work

1. **It goes at the end** of the paper.

   - You can only properly compare to related work once you've explained your own.

2. **Give real comparisons**, not a "laundry list"!

   - Explain in detail how your work fills the **G**ap in a way that related work doesn't.

Summary of principles

- Old to new

- One paragraph, one point

- Name your baby

- Just in time

- CGI model for abstract/intro

- Have a "main ideas" section

- Compare with related work at the end