Writing Perfect Papers

Baochun Li
Department of Electrical and Computer Engineering
University of Toronto

I have done some good work, but how do I write a great paper about it?

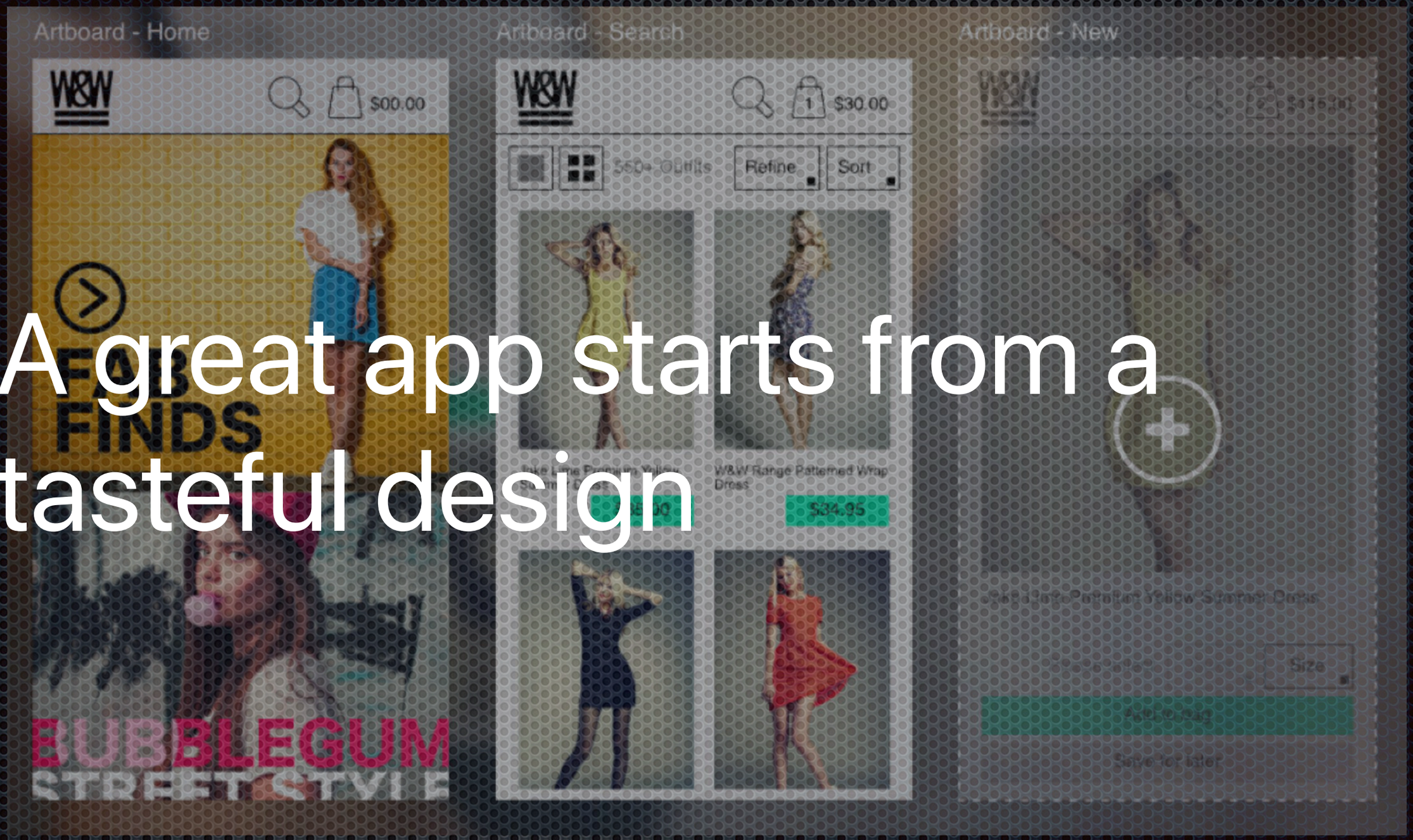
Let’s start from the very beginning

A top-down approach: from the big picture to tiny details

Our goal today: fine-tune the paper writing process, and get it perfect

How do I make a great movie?

A great movie starts from a powerful story



A great app starts from a tasteful design

I am going to talk about four things today

1

The story

2

The work

3

The art

4

The detail

1

The story

Three essential elements of a great story

My solution

My math proofs

My simulation results

I am very smart!

My math proofs

My simulation results

I am very smart!

I am smarter than you think

My simulation results

I am very smart!

I am smarter than you think

The thing actually works!

I am very smart!

I am smarter than you think

The thing actually works!

Writing a paper is not a mathematical contest

It’s about advancing the state-of-the-art

The problem

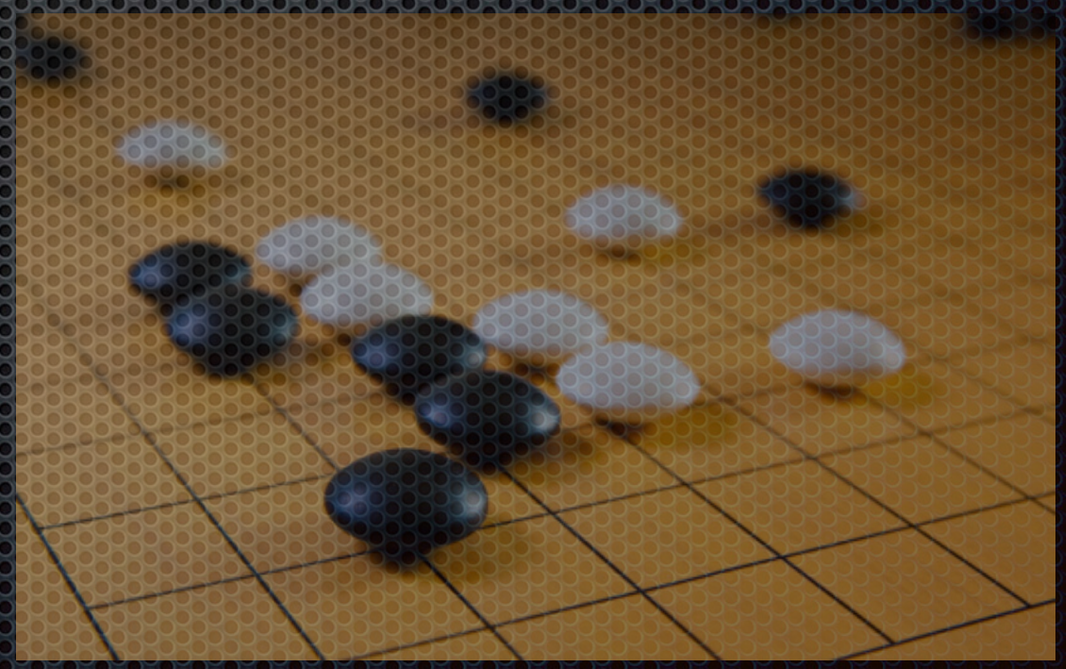
Why is it important?

What's new?

The problem

The problem

Doesn‘t have to be something trendy

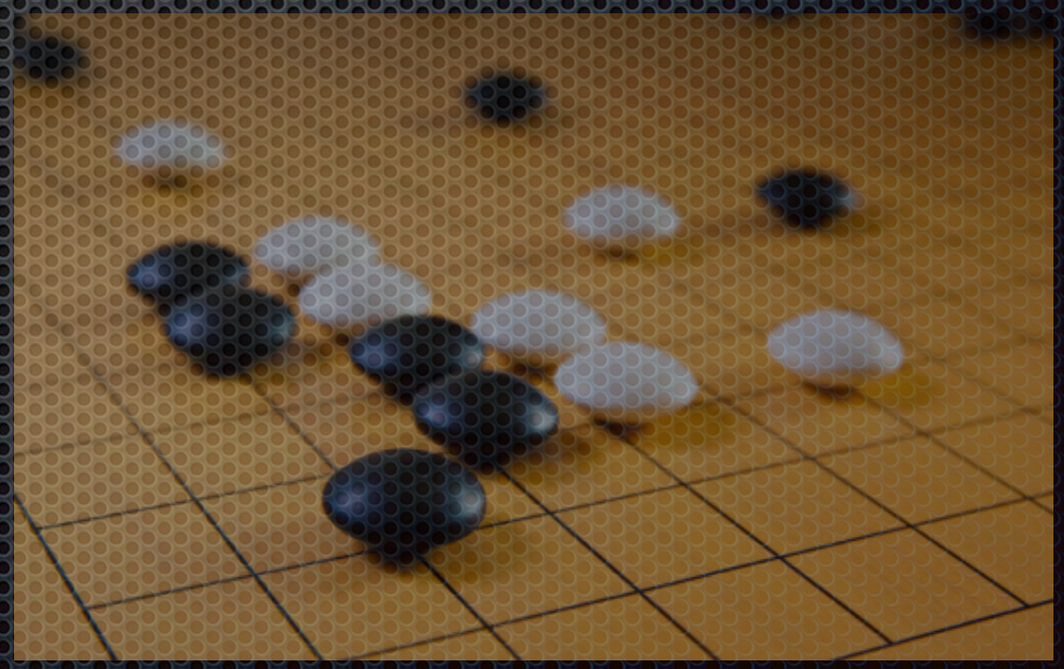


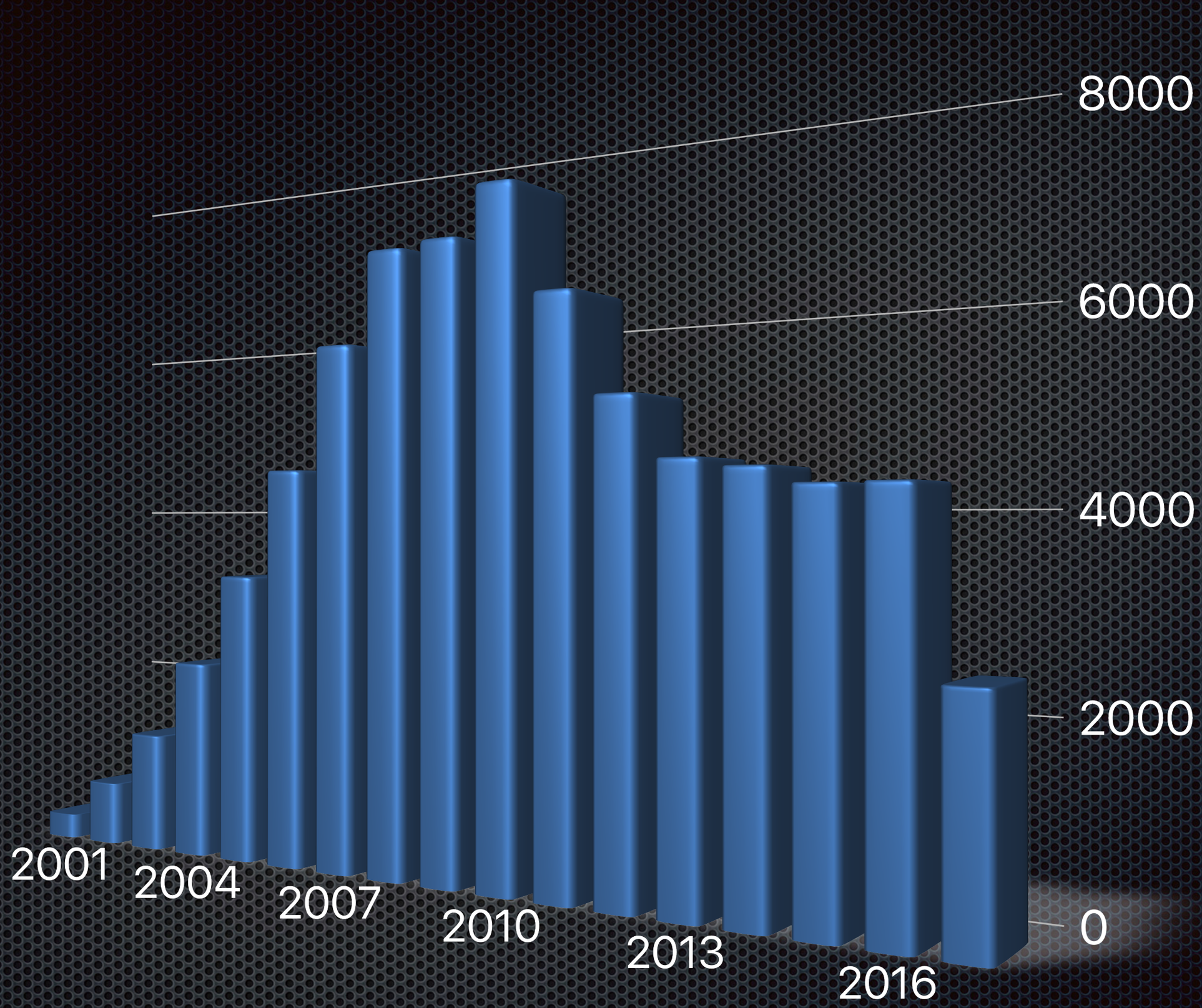
The problem

But has to be something you have passion for

The problem

Trendy problems may not be “hot” in the future





Google Scholar search: “P2P” in the paper title

Following the trend may lead to more “incremental” results — less exciting and less important

Be a contrarian and work against the trend

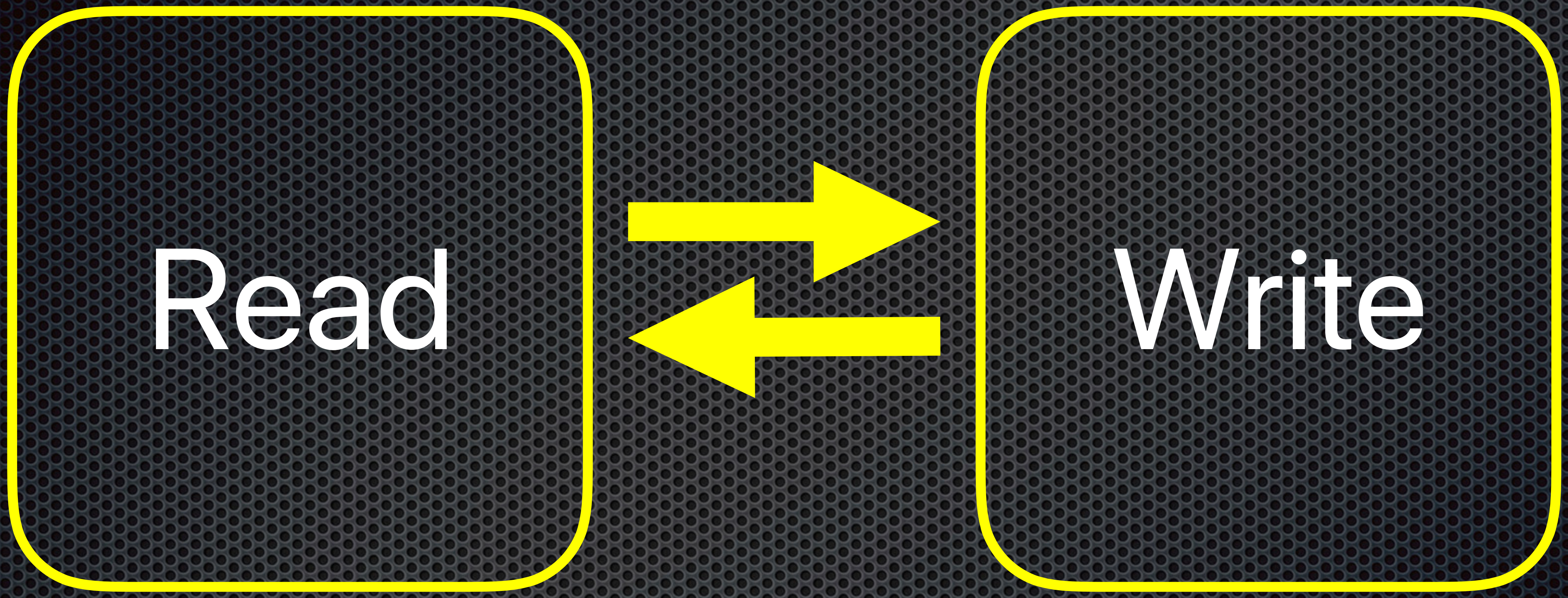
The problem

What about the specifics?

2

The work

Two things that you must do


Read
Write

Read

Goal: become an expert on the problem

Read

But how?

Read

Start from one paper

Read

Perhaps a highly cited seminal paper

Read

Then do an expanded-ring search

Read

Papers that cited this paper

Read

Papers that it cited

Read

Papers authored by the same researchers

Read

Don’t depend on a search engine

Read

Read quickly first

Read

Read more carefully if necessary later

Write about what you understood

Write

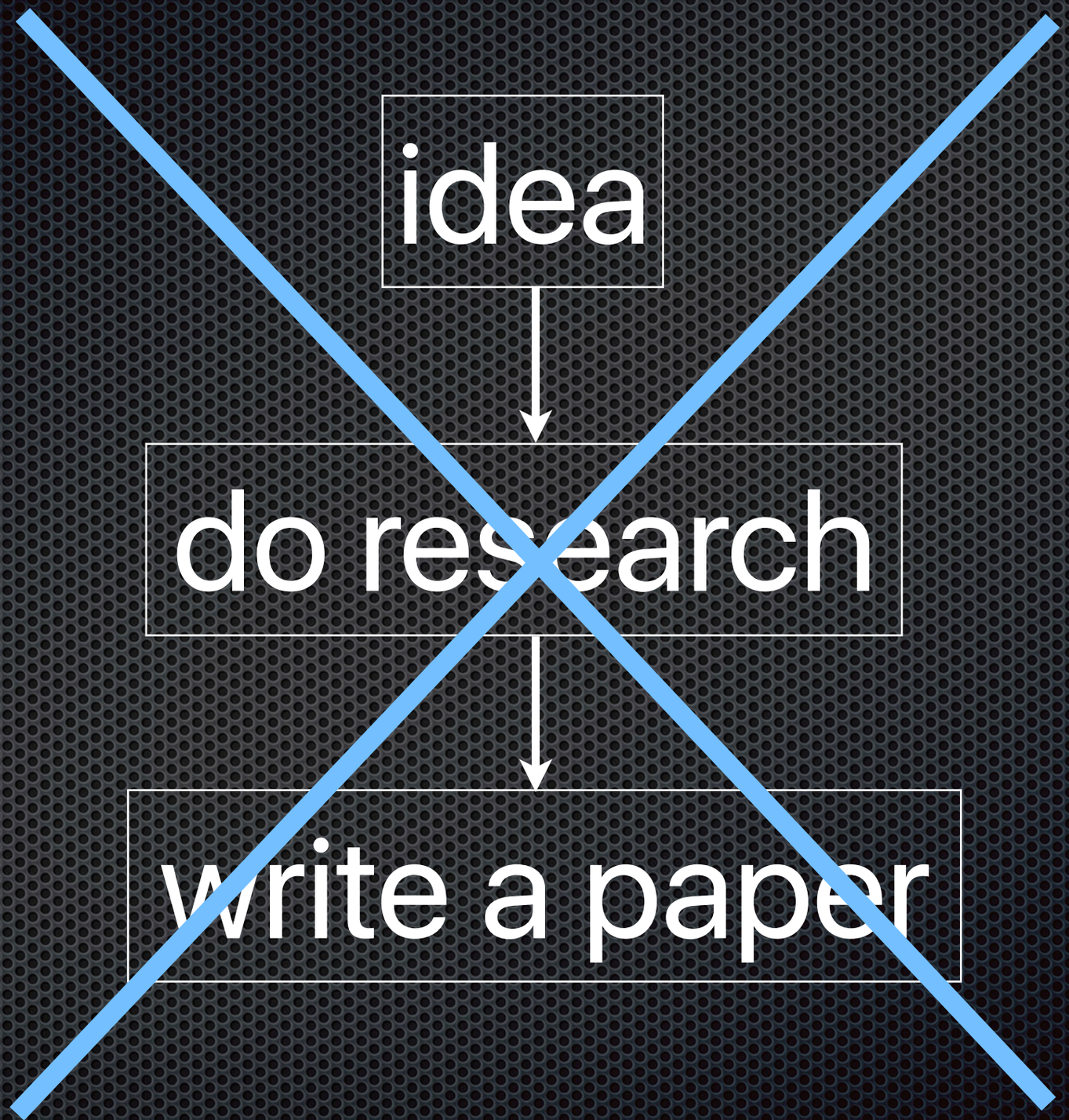
Write every day

Write

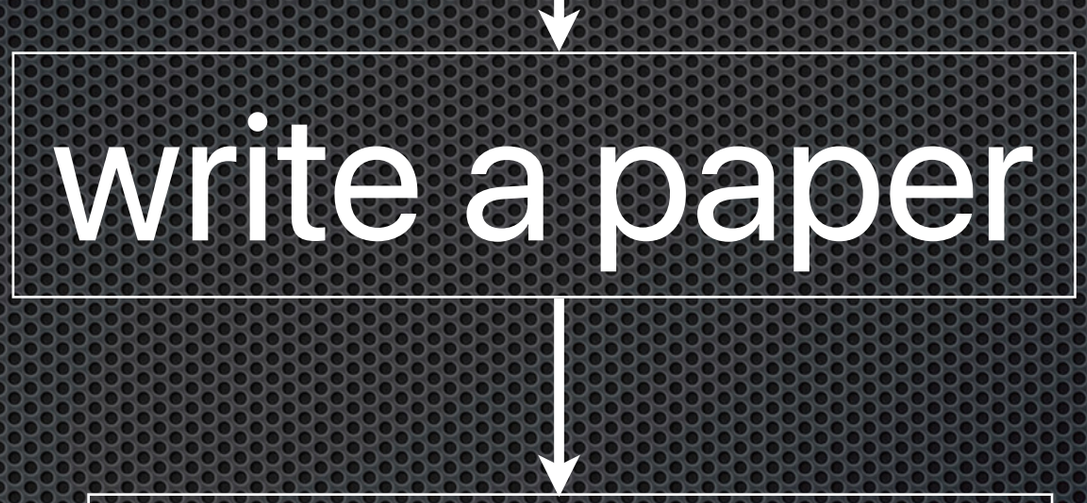
idea

do research

write a paper


idea
do research
write a paper

idea



If I don't have an idea, what do I write about?

Write

You write anyway

Write

Write about related work

Write

Write about what's challenging

Write

What about why the problem is important

Write

Write a survey paper

Write

Get it published

Write

Write about what's new in the context of related work

Write

The problem

Why is it important?

What's new?

Creating ideas interacts with writing closely

Write

Writing is the best way
to force yourself to think
clearly and be focused

Write

and to crystallize what you don't quite understand yet

Write

Writing also opens a dialogue

Write

For others to read

Write

To stimulate discussions with others

Write

That’s why writing is a slow and painful process

Write

Write in a crystal clear way

Write

Write about one problem and one solution

Write

Write with a flow of ideas
that's easy to follow

Keep your readers engaged throughout the paper

Write

Write your paper so that it's as easy to understand as absolutely possible

Write

Your readers don't have to work hard

Write

Write your paper slowly,
so that your readers can
read quickly

Write

3

The art

Pay attention to the title, abstract, introduction, and flow of ideas

Title:

2 lines, 10,000 readers

Abstract:

10 lines, 1,000 readers

Introduction:

100 lines, 100 readers

The rest of the paper:

1,000 lines, 10 readers

A

The title

Say I wrote a paper on sending large files quickly over the Internet

Which title is better?

"A Scheme for Rapid and Timely Downloading of Large Files in the Internet"

"Peer-to-Peer Real-Time Large-Scale Content Distribution: Methodologies and Performance"

"BitFedEx: Planet Scale Just-In-Time Data Distribution"

Which title is better? Why?

"A Scheme for Rapid and Timely Downloading of Large Files in the Internet"

"Peer-to-Peer Real-Time Large-Scale Content Distribution: Methodologies and Performance"

"BitFedEx: Planet Scale Just-In-Time Data Distribution"

What does a good title do?

It attracts a reader to read the abstract of the paper, or even the introduction

It reflects the essence of the new idea

It is as short as possible

It does not have to be a precise summary of the abstract

It does not need to include all the keywords

A SIGCOMM 2006 paper:

"Planet Scale Software Updates"

My ICDCS 2016 paper:

"Spectrum Matching"

David Tse (Stanford)'s talk in 2003: "Mobilize!"

B

The abstract

The abstract is a very important tool to attract readers to read the introduction

Again, it conveys essential information about the paper

It should be concise, and does not have to be long

A typical structure

One sentence to state the background

One sentence to state what the problem is

Two to four sentences to state the original contributions in the paper

One sentence to state that the solution works well, validated using analyses, simulations, or experiments

Remember the three essential elements

The problem

Why is it important?

What's new?

The introduction

If your title and abstract can get a reader to read the introduction, you are half way there

The remaining job: impress the reader with an exciting and clear introduction

The introduction is so important, that I rewrote or heavily revised the introduction in most of my 300+ papers

It is so important because we wish a reader to appreciate the work and cite it eventually, even if she only reads the introduction and nothing else!

Writing an impressive and clear introduction: advice

It should be self-contained, so that a reader short on time doesn't need to read the rest of the paper

It should be clear what the problem is

It should be easy to identify the main idea of the paper, and to understand why the main idea is original, and why it is important and exciting

The typical structure of the introduction

First (opening) paragraph

A general overview of the research field — these are basic facts needed to “warm up” the reader and to prepare for the problem statement

- Not too long — 2-3 sentences are good enough

General overview to warm-up the reader (the opening paragraph)

State the problem (challenge) and existing solutions (1-2 paragraphs)

Limitations of existing solutions that motivate this paper (2-3 paragraphs)

Proposed solution: main idea (1-2 paragraphs)

Then state the original contributions of the proposed work

What are the original highlights of the proposed solution? (1-2 paragraphs)

Why is the proposed solution different from and better than existing solutions?

State 1-2 most impressive highlights, not all of them

Make the originality of the paper crystal clear and stand out

You may use the sentence: “Highlights of our original contributions in this paper are as follows. First, … Second, … Finally, …”

The list of contributions drives the entire paper — the rest of the paper substantiates the claims you have made

The reader thinks: “Gosh, if they can really deliver this, that’ll be very exciting! I’d better read the rest of the paper.”

It is a good idea to include a table to compare important properties of the proposed solution with its “direct competitors” in the existing literature, highlighting your advantages

It’s also a great idea to show an intuitive example

Use examples

Your example shows how your main idea works in a special case

Use examples

Continue with more examples throughout the paper

Use examples

After each theorem is proved, or each algorithm described, explain the intuition with an example

Use examples

Your examples need to be simple

Use examples

They help readers to understand your solution well

Use figures

But always include a well-designed figure to illustrate an example

Use figures

It is a good idea to include many figures throughout the paper, anyway

D

The flow of ideas

Just like the storyboard when making a movie, the flow of ideas needs to be carefully designed

Flow of ideas

Example 1: related work

Where's related work?

Some prefer to place it after the introduction

Rationale: the section can be used to "warm up" the reader

Some others prefer to place it before the conclusion — my own preference

Rationale: After the introduction, readers don't understand your main idea yet, there's no point in talking about differences from related work

It really depends on the design of your flow of ideas

Flow of ideas

Example 2: experimental results

Most papers collect all the experimental results and put them at the end

But you don‘t have to

Because some negative or preliminary experimental results may be used to motivate the main idea in the paper

Then your flow of ideas can be:

“initial results — idea to improve — more results to show better performance”

You can even interleave experimental results with descriptions of your idea, if this provides the best flow

Flow of ideas

Example 3: space allocation

How many pages do I allocate for each section?

The short answer is: no one knows it better than you, because it depends on the flow of ideas

General rules of thumb

Don’t write a very long abstract (200 words), introduction (one page), related work (half a page), or concluding remarks (1-2 paragraphs)

Throughout the paper, make it self-contained, yet don’t use a lot of space for unnecessary background

Keep the motivation short and concise

4

The detail

A

Eliminate typographical and grammatical mistakes

First, eliminate all spelling mistakes by running your paper through a spell checker

Use a Unix command-line tool — for example, ispell — to check spelling: not Microsoft Word

Then fix grammar and usage problems by proofreading

Proofreading also helps you to fix the remaining spelling mistakes that a spell checker cannot catch

Example: instead of “must,” you wrote “mist”

You cannot rely on someone else to proofread for you, it’s your paper!

After you've proofread the paper, you can use grammarly.com to check for mistakes

B

Use transitional words, phrases, and sentences

Use transitions across the boundary of sentences, paragraphs and sections

Important for readers to follow your flow of ideas

If you don't add transitions, readers will need to add them subconsciously in their mind, anyway

You are asking readers to do the hard work!

Examples of transitions

Connecting two halves of a sentence —

as, since, or else

Connecting sentences —

However, In addition, Further, Nevertheless, Fortunately, Unfortunately, Surprisingly,

To make matters worse, to further exacerbate the problem, The bad news is,

The implications are two-fold, It turns out that, As an example, To take … a step further,

Examples of transitions

Connecting paragraphs and sections —

All previous examples can also be used

It only remains to see…

The simple answer to this question is,

The only challenge that remains now is,

To address this challenge,

We first present…

Next, we evaluate…

We are now ready to…

C

Use correct English

Keep punctuation marks inside the closing quotation mark

…making it a “shared secret key”.

Keep the punctuation mark inside the closing quotation mark

…making it a “shared secret key”.

…making it a “shared secret key.”

Don’t use long sentences with more than one comma in the middle of the sentence — and abuse “where,” “in which,” “whose,” “so that,” “such that”

Don’t use words that are too informal and colloquial —

“a lot of” is more colloquial than “a large number of”

Instead of “big,” use “substantial” or “large”

Don’t be too formal either

Overly formal words and phrases sometimes feel awkward

- “We endeavour to ascertain that…” — “We show that…”
- “It can be ascribed to…” — “It is due to…”
- “The overwhelming quantity of…” — “The exceedingly large number of…”

Do not use emotional words

A sentence from a student's first draft

An "easy" solution to solve the above problem is to share the private key of the original user with other group members as a group private key, however, it is like "suicide"...

Do not use emotional words

What? I am not sure if a reader wants to read something like this…

An “easy” solution to solve the above problem is to share the private key of the original user with other group members as a group private key, however, it is like “suicide”…

Similar emotional words: “kill,” “crazy,” “happy,” “fantastic,” “marvellous,” or “breathtaking”

Countable vs. uncountable nouns

If a word is countable, it is fine to use its plural form, and remember to use "a few," "a number of," "fewer"

- Instead of "less bits," use "fewer bits"

If not, do not invent its plural form (such as "performances," "advices," "equipments," "informations"), and use "less" or "lower" rather than "fewer"

Agreement of the verb with the subject

Examples —

"The figures above shows" vs. "The figures above show"

"These problems that lead to lower efficiency shows that" vs. "... show that"

"Its efficiency in energy savings are remarkable" vs. "... is remarkable"

Slows down reading dramatically — your paper can be rejected just because of these problems!

Articles as determiners

The articles “a” / “an” (the indefinite article) and “the” (the definite article) are frequently used incorrectly by Chinese students

Plural nouns are typically used without an article:

- “The source node receives acknowledgments” (not “the acknowledgments”)

The indefinite article is weaker than the definite article:

- “a large portion of” (not “the large portion of”)

But there's no need for "the" in section titles — instead of "The System Model," just say "System Model."

Articles can be tricky to use, but there are too many of them in a paper — pay attention!

Let’s take a look at one example sentence

The extent to which the users can effectively communicate with the service providers depend on the size of community.

Plural noun: “users” —
the definite article is not needed

The extent to which the users can effectively communicate with the service providers depend on the size of community.

Plural phrase: “service providers”

The extent to which users can effectively communicate with the service providers depend on the size of community.

Plural phrase: “service providers” —
the definite article is not needed, but it feels
strange without it, too

The extent to which users can effectively communicate with service providers depend on the size of community.

It would only be correct to use “their” as the determiner

The extent to which users can effectively communicate with their service providers depend on the size of community.

The extent to which users can effectively communicate with their service providers depend on the size of community.

The subject needs to agree with the verb

The extent to which users can effectively communicate with their service providers depend on the size of community.

The subject needs to agree with the verb

The extent to which users can effectively communicate with their service providers depends on the size of community.

The extent to which users can effectively communicate with their service providers depends on the size of community.

The noun “community” needs a determiner in front of it

The extent to which users can effectively communicate with their service providers depends on the size of community.

The extent to which users can effectively communicate with their service providers depends on the size of a community.

The community in question is a specific community, not an arbitrary one

The extent to which users can effectively communicate with their service providers depends on the size of a community.

The extent to which users can effectively communicate with their service providers depends on the size of the community.

This is good enough, but it's even better to reinforce the idea of which community is being discussed

The extent to which users can effectively communicate with their service providers depends on the size of the community.

Done!

The extent to which users can effectively communicate with their service providers depends on the size of their community.

Good news: most English problems are not hard to fix — just proofread every sentence with plenty of time!

D

Typeset your paper correctly and beautifully

Use LaTeX, no matter what

You do need to spend some time learning how to use LaTeX

But the typesetting results are dramatically better

No ligature

Efficient

efficient

Correct ligature

In fact, I refuse to work on a paper if it’s typeset in Word

There is a huge amount of useful information about LaTeX on the web

Draw figures using a vector-based application

Image-based drawing applications produce images that become fuzzy when scaled, and will be easily visible when your paper is printed

Best example of the application to avoid: PowerPoint — it only exports images

If you use a Mac, use Omnigraffle or Affinity Designer, both are killer apps

Proofread your bibliography

and make it consistent

Use BibTeX to typeset the bibliography in your paper

Include page numbers when possible

Spell author names correctly

Rather than downloading BibTeX entries from the web, it is much better to take a little bit of your time to type citation entries yourself, to get them consistent

When citing the same paper, researchers tend to use different styles —

R. Ahlswede, N. Cai, S.-Y. Li, and R. W. Yeung, "Network Information Flow," IEEE Transactions on Information Theory, vol. 46, no. 4, pp. 1204-1216, 2000.

R. Ahlswede, N. Cai, S.-Y. Li, and R. W. Yeung, "Network information flow," IEEE Trans. Inform. Theory, vol. 46, no. 4, pp. 1204-1216, 2000.

Keep a consistent style of abbreviating journal and conference titles throughout the bibliography

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1

The story

2

The work

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The art

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The detail

Baochun Li

iqua.ece.toronto.edu

Contact me

Baochun Li

iqua.ece.toronto.edu

bli@ece.toronto.edu