CS 563: Software Maintenance And Evolution

Technical Writing

Oregon State University, Spring 2024

Harsh Truth of the Day

- Easier said than done
  - Tons of things to learn (e.g., structure, language/vocabulary, concise and complete)
  - Hard to keep all in mind (e.g., repeat the same mistakes to really have it in you)

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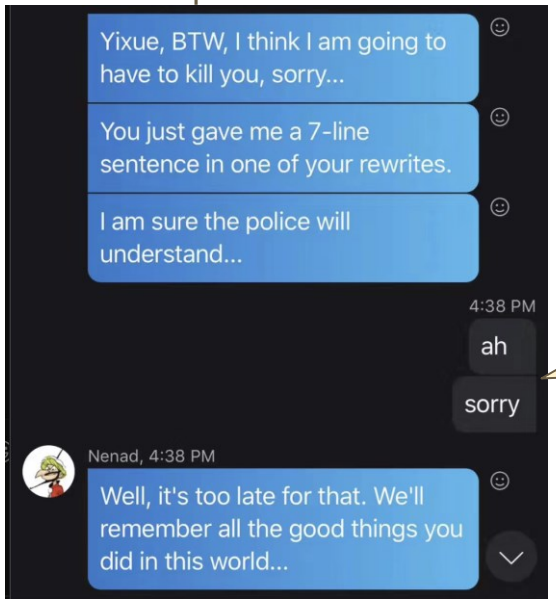

Don’t just say sorry and fix your mistake, instead make a note of the mistake.

Revision: use of short sentences

This sentence has five words. Here are five more words. Five-word sentences are fine. But several together become monotonous. Listen to what is happening. The writing is getting boring. The sound of it drones. It's like a stuck record. The ear demands some variety.

Now listen. I vary the sentence length and I create music. Music. The writing sings. It has a pleasant rhythm, a lilt, a harmony. I use short sentences. And I use sentences of medium length. And sometimes when I am certain the reader is rested, I will engage him with a sentence of considerable length, a sentence that burns with energy and builds with all the impetus of a crescendo, the roll of the drums, the crash of the cymbals—sounds that say listen to this, it is important.

Can you identify the difference between the structure of the first and second paragraphs?

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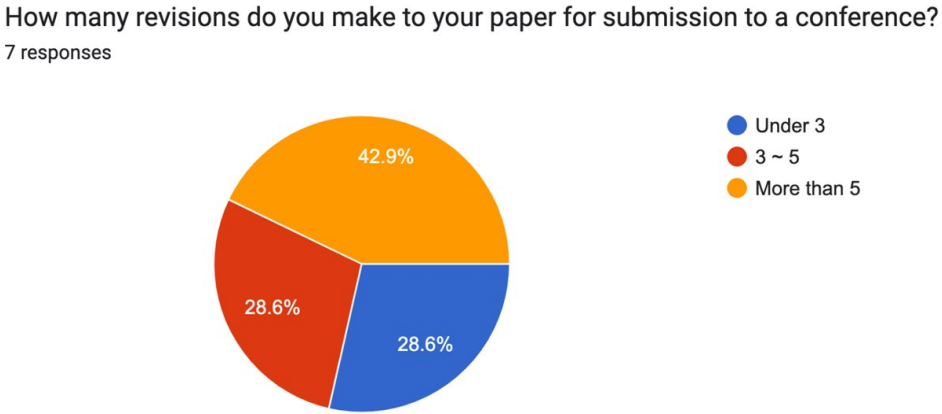
So write with a combination of short, medium, and long sentences. Create a sound that pleases the reader's ear. Don't just write words. Write music.

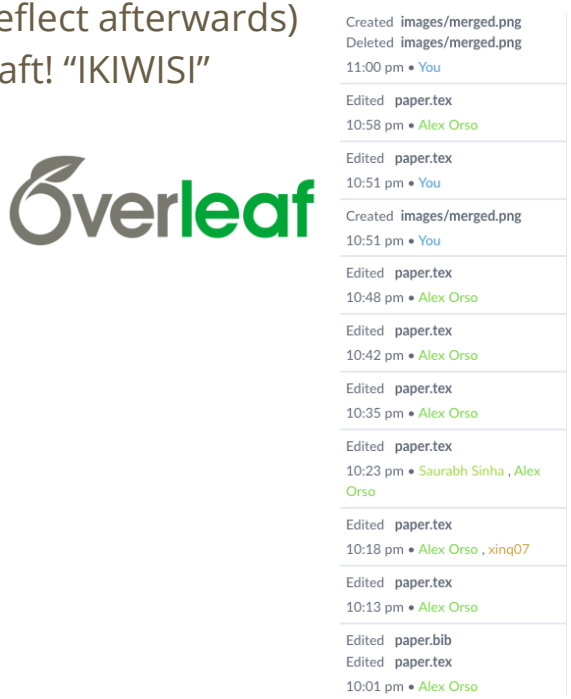
- Gary Provost

Don't just write words. Write music.

Harsh Truth of the Day

- Takes **significant effort** to get better (but will make everything easier :))
  - Start early!!! -- deadline is not the best time to learn (but do reflect afterwards)
  - Takes many iterations -- don't be afraid of writing bad first draft! "IKIWISI"





Harsh Truth of the Day

- SE conference deadlines are always AoE…
  - **5AM PT / 8AM ET**
  - General top SE conferences
    - ICSE (March/July)
    - ESEC/FSE (September)
    - ASE (May)
  - Program Language top conferences
    - OOPSLA (April & Dec)
    - PLDI (Nov)
  - Specific topic top conferences
    - ISSTA (October) -- software testing

What do we do in 30 min then?

- Key Principles (for **effective communication**)
- Best Practices (what you can do today)
- Common questions

Key Principles (not just for paper writing)

- **Know your audience**

  *"The most important thing in technical writing is keeping the (intended) audience in mind and making sure that your write up gives suitable organization, detail, background, explanations *for* the audience."*

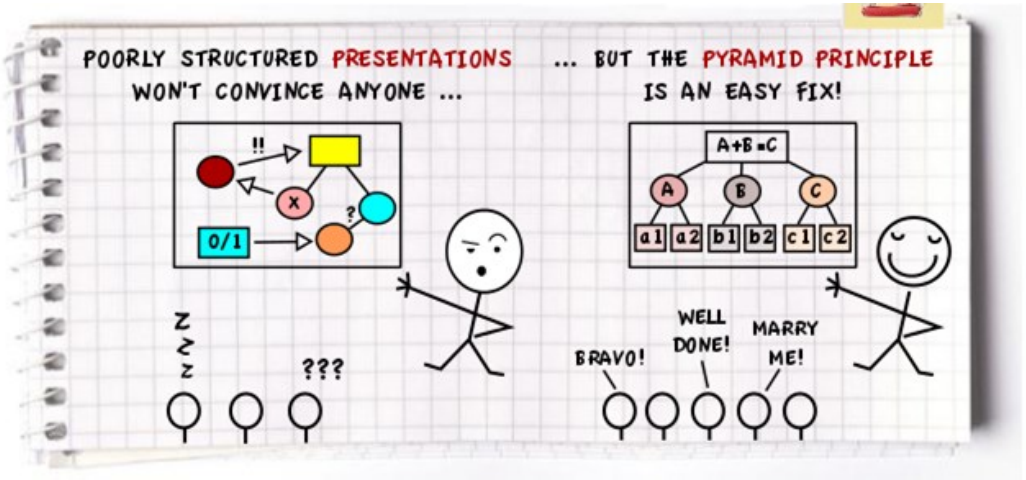
Reviewers may NOT be in your sub-field, and definitely CAN'T read your mind!

Hmm I don't understand... Reject!

Audience: reviewers + whoever reads your accepted paper (mostly in related field)

Key Principles (not just for paper writing)

- **Pyramid Principle/General-Specific (top-down structure)**
  - Tell me **where** you're going and **why**, then I'll listen to **how** you're getting there
  - High-level "branches" form coherent story & low-level "leaves" support "branch" with details (with "branches", we know what NOT to say as well)
  - Position yourself as being informed and organized (e.g., empirical study paper)



Q: how to write good abstract and intro conveying ideas of the paper?

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❶ Research has shown that caffeine does indeed reduce sleepiness and can lead to better academic performance since students can spend more time studying. ❷ Despite its effectiveness in counteracting sleepiness, caffeine can have a negative impact on subsequent sleep, which for many students may already be compromised. ❸ Specifically, caffeinated beverages consumed near bedtime at night can prolong sleep onset and reduce sleep efficiency and depth, thus affecting both sleep quality and duration. ❹ Most of the research on how caffeine affects sleepiness/alertness has focused on coffee or no-doze pills. ❺ However, a new kind of caffeinated drink has become increasingly popular, namely functional energy drinks (FEDs). ❻ FEDs are marketed as products that can improve both mental and physical performance. ❼ In addition to containing caffeine, FEDs have other active ingredients such as taurine, glucose, and glucoronolactone. ❽ Exactly how these ingredients together affect alertness remains unclear.

Key Principles (not just for paper writing)

- **Problem-Solution**
  - Tell me **what** problem are you solving and **why** is that important?
  - **How** do you solve it?
  - Position yourself for questioning, perceptive, and convincing

- Research Questions
  - Research hypotheses
    - Experiments
      - Validate hypotheses based on findings

Don't focus on the paper early on; focus on the research. Determine what research questions you want to answer and design experiments to answer them. The paper will come later.

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Clouds and Fog as a Source of Water in Chile

❶ Many of Chile's poor, northern coastal villages have suffered for years from water shortages, despite the abundance of cloud cover and fog in the region. ❷ When the cold air from the Pacific Ocean's Humboldt Current mixes with the warm coastal air, a thick, wet fog, called *camanchaca* by the Andes Indians, forms along with clouds (Darak, 2008). ❸ However, rather than developing into rain, the fog and clouds quickly evaporate in the hot sun. ❹ This lack of rainfall has imposed severe hardships on communities. ❺ They cannot grow crops and must carefully ration their water, which is often delivered by truck.

❻ To address this problem scientists in the 1990s implemented an interesting solution on El Tofo mountain near the village of Chungungo. ❼ Using conventional technology, they redevised a centuries-old method to capture the water droplets of the fog in a process referred to as fog harvesting (Schemenauer and Cereceda, 1991). ❽ In this method, triangular-weave polypropylene nets are attached to support posts to serve as water collectors. ❾ Each of these nets is designed to collect approximately 40 gallons of water each day. ❿ When the fog develops, droplets of water are trapped in the nets and join to form larger drops that then fall into a trough. ⓫ From the troughs the water drains through filters into a series of underground tanks. ⓬ The water is then piped to a 25,000-gallon storage tank, where it is chemically treated to kill disease-causing organisms. ⓭ Finally, the water flows to individual households, just as in traditional water systems. ⓮ This collection system can supply as much as 2,500 gallons per day, enough for a small community to drink, wash, and water small gardens. ⓯ The water is not only clean, but far less expensive than water delivered to the area. ⓰ Moreover, it is collected at no apparent cost to the environment.

⓱ Despite the initial success of fog harvesting in Chungungo, the system is, unfortunately, no longer in use (de la Lastra, 2002). ⓲ The availability of water led to a tripling of the population from 300 to 900, putting pressure on the water supply (IDRC, 2003). ⓳ Because the community lacked a clear commitment to the project (see Diehl, 2010, for a full explanation), they did not add new nets to increase the water supply, and instead petitioned for water to be piped in from 20 km away. ⓴ Although the village abandoned this viable alternative technology, the Chungungo experience has led to successful implementation of fog harvesting initiatives in other mountainous coastal areas of Chile, Ecuador, Mexico, and Peru, providing much needed fresh water to small communities.

Key Principles (not just for paper writing)

- **Use Figures/Tables/Examples**
  - Be prepared to iterate over figures too! :)
  - Each figure/example should convey necessary information that supports your story - **don't repeat the facts, instead describe the inference/implications**

Add a small concrete example early in the paper to motivate/frame the problem, and then illustrate the solution with the concrete example throughout the paper.

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TABLE 8. Strategies Used by Japanese Scientists When Writing in English

Writing Strategy	Percentage
Think mainly in Japanese but write in English	61%
Think in Japanese and English but write in English	16%
Think in English and write in English	23%

Okamura, 2000.

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Okamura, 2000.

Slightly more than three-fourths of the scientists surveyed adopted writing strategies that involved the use of their first language. Moreover, less than a quarter appear capable of writing directly in English. Overall, the figures would appear to suggest that most Japanese scientists have difficulties and frustrations when preparing papers for English-medium journals.

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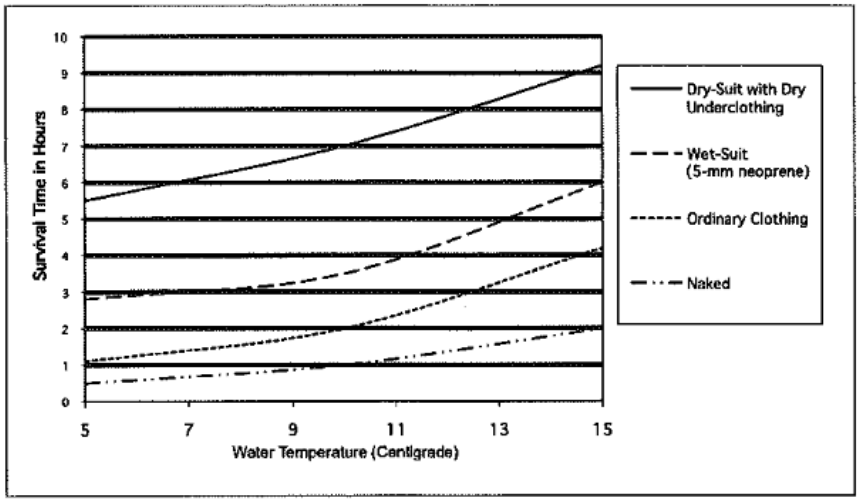
FIGURE 8. Survival Time in Water of Different Temperatures When Wearing Different Types of Clothing



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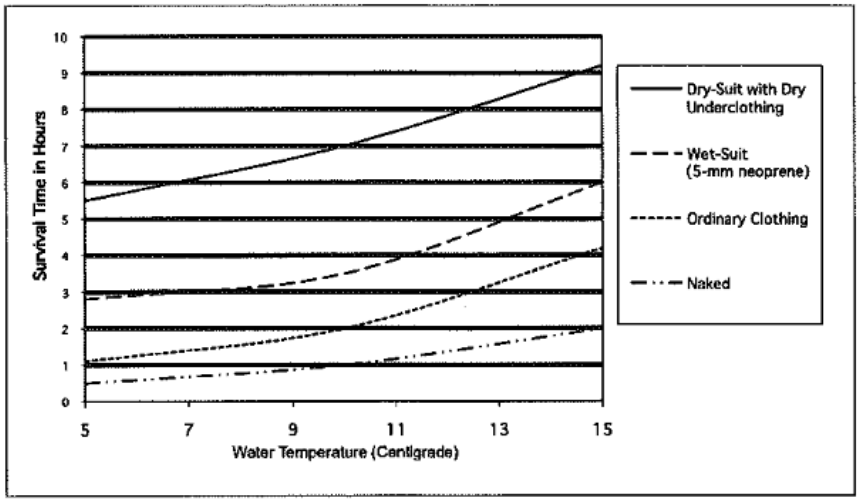

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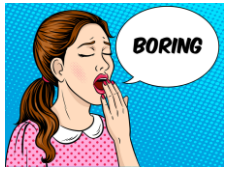
The figure shows how long people can survive in water when they wear different kinds of clothing that have different levels of insulation. Clothing has an influence on how long a person can survive. The effect of clothing is greater at warmer temperatures. A person wearing no clothing in cold water can survive only less than one hour.

Key Principles (not just for paper writing)

- **Be a storyteller, NOT a "journalist"**
  - Journalist: I did this, I did that… Here's the results X Y Z…
  - Storyteller: people have been struggling to solve this problem, I solved this problem!



Q: When writing a section/paragraph, all things I want to mention flood into my mind, so I feel hard to organize them.

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    - **Motivation:** This is such a huge problem! X Y Z motivated me to do this cool work
    - My solution is cool (e.g., the problem is challenging & my solution is novel)
    - Interesting results (e.g., counter-intuitive, lessons learned, actionable items)

Why

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- **Be a storyteller, NOT a "journalist"**
  - Journalist: I did this, I did that… Here's the results X Y Z…
  - Storyteller: once upon a time, I solved this cool problem woohoo!
    - **Motivation:** This is such a huge problem! X Y Z motivated me to do this cool work
    - My solution is cool (e.g., the problem is challenging & my solution is novel)
    - Interesting results (e.g., counter-intuitive, lessons learned, actionable items)
    - Easy to follow
      - pyramid principle to get the main idea cross
      - Keep terms consistent & "compilable"
      - Self-contained
      - Figures/tables/examples
      - Write music? :)
      - …
    - Show the potential
      - Reusable for other domains/future work
      - New discovery, lessons learned, actionable items

How

Q: When writing a section/paragraph, all things I want to mention flood into my mind, so I feel hard to organize them.

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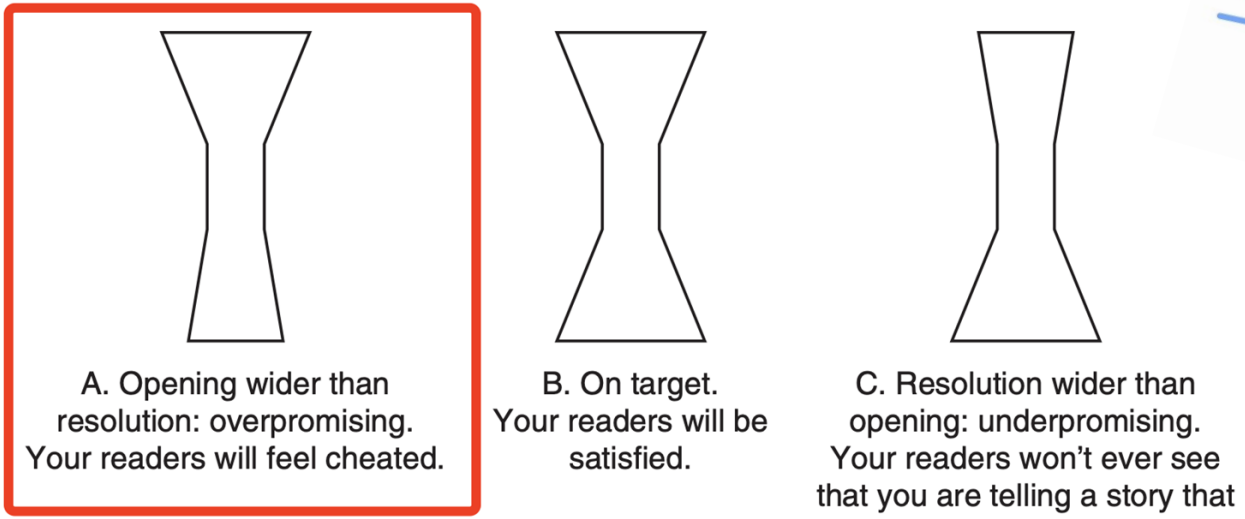

Figure 5.1. Matching the opening to the resolution.

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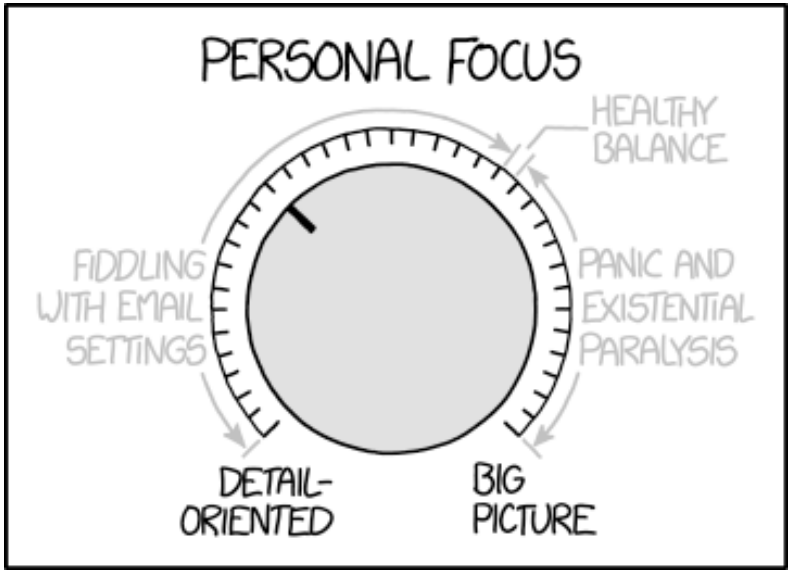
  - We can't be everything at once (e.g., manager's mind vs. worker's mind)



Key Principles (not just for paper writing)

- **Do multiple iterations (early!)**
  - We can't be everything at once (e.g., manager's mind vs. worker's mind)
  - E.g., structuring the paper, identifying key contributions and main message, finding citations, adding arguments, describing approach, interpreting results, drawing diagrams (how to present the approach, the results, the motivating example), paper cutting, etc…

What do we do in 30 min then?

- Key Principles (for effective communication)
- **Best Practices** (what you can do today)
- Common questions

Start with an Outline

- “Forces” you to implement the pyramid principle
- Easier to get feedback & faster iterations
- Save time (only supporting details, easier to edit, avoid rewriting)
- Informal language is OK (or even preferable)
  -- don’t let Perfectionism get in the way!

Start with an Outline (e.g., intro)

- Outline works really well for intro
- Distill outline from good papers (e.g., intros)

Q: I want to learn a systematic way to write a paper to increase quality and efficiency. It takes too much time for me to write a paper.

Start with an Outline (e.g., intro)

- If outlining is hard to start, then get your *ingredients* ready!
  - What problem are you solving? Why is it important? (**Motivation**)
  - How is it addressed (or not) currently? (**Literature**)
    - If completely missed, why do I care? (e.g., important problem, future impact)
    - If partially addressed, what's missing? (e.g., existing limitations)
  - How did you (or propose to) solve it? (**Challenges**, **Novelty**)
  - So what? (**Significance**, **Contributions**)
    - Promising results -- my tool works great (esp. Technique papers)
    - Lessons learned -- introducing new knowledge (esp. Empirical studies)
    - New methodology/metrics
    - Broader impact
    - ...

Q: I want to learn a systematic way to write a paper to increase quality and efficiency. It takes too much time for me to write a paper.

Writing Accountability Group/Peer Feedback

- Don’t forget about your teammates! :)
- It’s always easier to spot issues as non 1st author

Q: Keeping my writing simple and clear, while avoiding unnecessary grammatical complexity

Challenges to Writing Productivity

3 biggest myths about writing:		I will argue:
I need huge blocks of time.	→	Both unrealistic AND untrue.
I must be inspired to write.	→	No you don't.
Writing is what I do when I'm done thinking	→	Writing IS thinking.

National Center for Faculty Development & Diversity

Daily Writing Practice

12-Step Program

1. Hold a *Sunday Meeting*
2. Post your writing goals for the week
3. Start each day by reviewing your top priorities
4. Get your butt in your chair every day for at least 30 minutes
5. Set a timer
6. Manage your *resistance*
7. Stop when the timer goes off
8. Track your writing with a *daily check-in*
9. Give yourself a treat
10. Re-post your writing goals on Friday
11. Assess and adjust
12. Take the weekend off

National Center for Faculty Development & Diversity

Q: Keeping my writing simple and clear, while avoiding unnecessary grammatical complexity

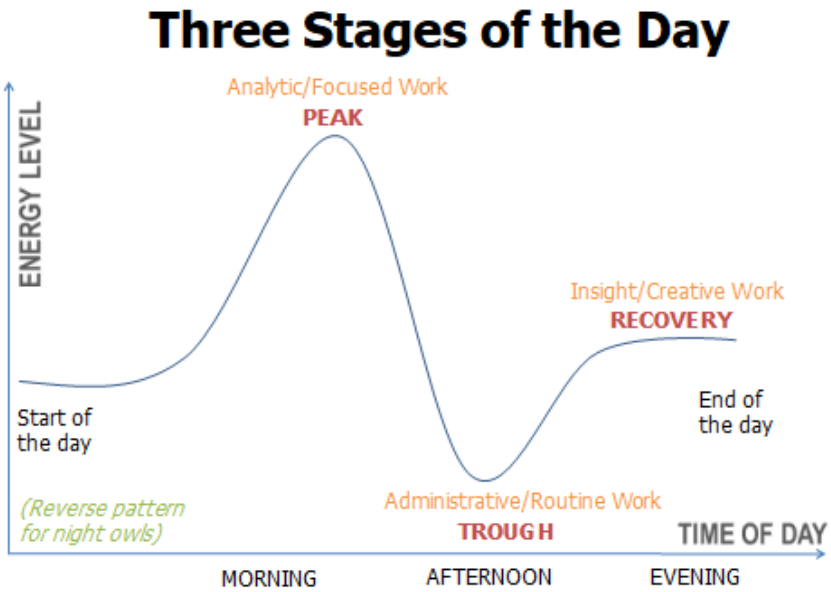
Write (bad) first draft!

- Write or Die: https://writeordie.com/

  Don’t be afraid to write bad text, or even to copy text from previous writings; Editing is easier than writing, and if you edit enough the original source text doesn't matter. Intro is the hardest to write, don't be afraid to start with the technical sections and work your way to the intro. Get lots of feedback, and then pick and choose which parts of it you think are useful.

Know Yourself :)

- When's ***your*** BEST writing time?



Read Good Papers!

- As a baby, we first learn by mimicking
- Just like learning a new language, you need **good input!**
- Build up your vocabulary (word choice), phrases (terminology), tone, structure, say more with less (condensing), etc

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Q: General idea about the **sections** that MUST be included in a paper?

Read it out loud

- Read draft too many times → easy to miss things
- You want fresh eyes or even ears!
- Can easily hear where the flow breaks (e.g., when you had to pause)

Paper Cutting

Prune the big limbs,

[Figure out what you don't need to say, then don't say it. Focus on your story, and only say things that support your storyline :)]

then shake out the dead leaves.

[Cut unnecessary words from the pieces that stay. Each word should do work: add content, clarify meaning, or provide coherence. Unnecessary words usually are: empty adjectives, redundant modifiers, the obvious, metadiscourse, verbosity. They are slackers! Get rid of them :)]

Literature Survey/Related Work

- Search ACM/IEEE libraries, Google Scholar (subscribe!)
- Check the “accepted papers” on the current year conference website
- Survey papers

Q: Making sure all relevant work is described and accounted for in terms of the new research.

Paper Structure

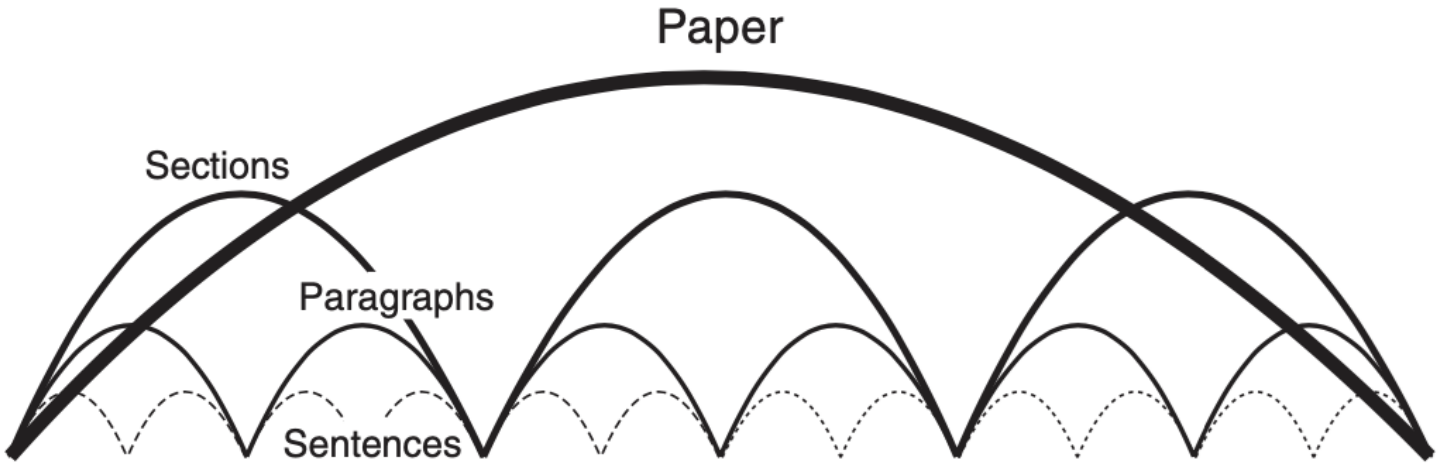

Figure 10.2. A story is a set of nested arcs.

Final Bonus :)

- Mark Harman: Draft Guidelines for My Students on Writing Software Engineering Research Papers
- Michael Ernst: How to write a technical paper or a research paper
- Arie van Deursen: Some Research Paper Writing Recommendations
- Chris Parnin: Error Codes for Paper Introductions
- My tweet: How to rescue bad draft (spoiler alert: you can't :) too late start early!)
- Still want more?
  - Joshua Schimel: Writing Science: How to Write Papers That Get Cited and Proposals That Get Funded
  - Joseph M. Williams, Gregory G. Colomb: Style: Toward Clarity and Grace
  - Joli Jensen: Write No Matter What
  - Couseara: Writing in the Sciences