

## COSC 91/191, Spring 2019

## Lecture 5

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## 1 Lesson 2: Actions

### When to not use nominalizations

There are many benefits of using verbs to describe key actions. Often, sentences are more concise without nominalizations because prepositions are omitted. For example, the sentence *A rewriting of the method will result in improvements in the cleanliness of our handling of special cases* contains many nominalizations (e.g., *cleanliness*) and prepositions. Removing these, it can be succinctly rewritten as *If we rewrite the method, we can handle more special cases cleanly*.

To be direct and clear, use subordinating conjunctions (e.g., *because*, *although*, or *if*). In the sentence, *The simplicity of our system resulted in our greater speed, despite the greater size of other systems*, the phrase *greater size* can be rewritten as *larger* and *although* can be used to draw a clear distinction. Taking these into account, the sentence will become stronger if it is rewritten as *Although other systems are larger, ours is faster because it is simpler*.

To further illustrate the benefits of changing nominalizations to verbs, we marked the following example to indicate where each part of the sentence occurs temporally:

*Determination<sup>4</sup> with respect to the use<sup>5</sup> of the data when its conditioning is<sup>2</sup> poor upon arrival<sup>1</sup> for operation<sup>3</sup> resides in a neural net.*

The nominalizations and prepositions make this sentence clearly out of order. Removing them and rearranging produces the following sentence which is temporally ordered:

*When data arrive<sup>1</sup> and are<sup>2</sup> so ill-conditioned that we cannot operate<sup>3</sup> on them, a neural net determines<sup>4</sup> whether to use<sup>5</sup> the data<sup>‡</sup>*

### When to use nominalizations

There are, however, some useful nominalizations. For example, *These results show great promise* and *This operation is polymorphic* both use nominalizations to refer to prior sentences. Additionally, nominalizations can be used to refactor trite phrases such as *the fact that* into more creative ones, e.g., *The fact that the program performs well speaks to its promise* becomes *The good performance of the program speaks to its promise*.

Similarly, changing the object of the verb into a nominalization can enhance clarity. *The server responded to what the client requested* can be written as *The server responded to the client's request*.

Finally, some nominalizations are our friends (in the computer science community), such as *high-performance computing* in *My research area is high-performance computing*.

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<sup>‡</sup>Note: Although *data* is plural, singular is also acceptable.

## 2 Lesson 3: Characters

In general, we want the characters to be in the verbs of our sentences. Take the following as an example:

- (a) *The CPU computed the result of integrating the function that characterized power consumption.*
- (b) *The CPU performed a computation to determine the integral of the function for the characterization of power consumption.*
- (c) *The computation was performed by the CPU for the determination of the integral of the function that gives the characterization of the power consumption.*

It is readily apparent that choice (c) is horrible. When asked to vote, the class was split between whether (a) or (b) sounded better. However, option (a) has the characters in *CPU*, *function*, and *consumption* and removes many of the nominalizations in choice (b).

As another example, the following sentence has similar issues with obscuring the characters: *Entry of data into the processor chip causes the direction of the data into the cache and it staying there until ejection.* Clearly, the characters are *data*, *processor chip*, and *cache*, which need to be the subjects of the verbs. To change the subjects to verbs, we must first find the nominalized verbs then reassemble them with good conjunctions. After performing these operations, we will then be left with a better structured sentence: *When data enters the processor chip, it is directed into the cache and stays there until it is ejected.*

Sometimes characters are missing from sentences, e.g., *An experiment was performed to study the speed of the system.* In this example, the agent performing the experiment is unnamed. In computer science, however, we often use *we* to refer to both the writer and reader together. In other cases, *we* can be used to refer to the entire community as well. If you need to refer to the authors specifically, you can use *I* or *the authors*. Consequently, the following are all correct options:\*

- *This chapter will familiarize you with the framework we shall use throughout the book to think about the design and analysis of algorithms.*
- *I/The authors discovered this algorithm during the course of my/our work on using columnsort as the basis for out-of-core sorting.*
- *If you have been introduced to any of these languages, you should have little trouble understanding the algorithms.*

### When to rework nominalizations and characters

A major consideration when reworking nominalizations and characters is understanding the voice you want to convey. For example, to remove the passive voice, the sentence *The operands were added by the ALU* can be easily changed to *The ALU added the operands*. Similarly, although both *The program will run fast if it creates few cache misses* and *The speed of the program depends on creation of few cache misses* are active, the second one feels more passive because the subjects are less concrete.

To determine which voice is more appropriate, you should ask yourself these three questions:

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\*There were significant objections to using the second person in academic papers. However, Tom was adamant that he liked “when authors talk to him” and prefers accessible, non-erudite writing.

1. *Must the reader know who is responsible?*

If no, then the passive voice is okay!

2. *Will an active or passive voice help readers move more smoothly through the text?*

In general, sentences should start with the familiar which sometimes requires using the passive voice. For example, the following sentences feel jarring given the unfamiliar addition at the beginning of the second sentence: *Although software caching was a common technique by the early 1960s, memory access times decreased in large part due to the advent of caches in hardware. IBM [new] designed the first hardware caches [familiar] in the mid 1960s.*

Utilizing the passive voice achieves a much nicer flow: *Although software caching was a common technique by the early 1960s, memory access times decreased in large part due to the advent of caches in hardware. The first hardware caches [familiar] were designed in the mid 1960s at IBM [new].*

3. *Will an active or passive voice have a more consistent point of view?*

Consider the following two paragraphs:

*By early 1945, the Allies had essentially defeated Germany; all that remained was a bloody climax. American, French, British, and Russian forces had breached its borders and were bombing it around the clock. But they had not yet so devastated Germany as to destroy its ability to resist.*

*By early 1945, Germany had essentially been defeated; all that remained was a bloody climax. Its borders had been breached by American, French, British, and Russian forces, and it was being bombed around the clock. It had not been so devastated, however, that it could not resist.*

The first paragraph is from the point of view of the Allies and the second is from the point of view of Germany. Since the Allies were the *doers* in the first example, it makes sense for their voice to be active. Similarly, since Germany had something *done to them* by the Allies, their voice is passive. Either way, the point of view should be consistent, or else nightmarish paragraphs like this one can occur:

*By early 1945, the Allies had essentially defeated Germany. Its borders had been breached, and they were bombing it around the clock. Germany was not so devastated, however, that the Allies would meet with no resistance. Though Germany's population was demoralized, the Allies still attacked their cities from the air.*

## Metadiscourse

In research, we typically use active words (and sometimes passive words) to describe what we did: *To determine which program was faster, we ran them on a cluster. (To determine which program was faster, they were run on a cluster.)* We also need some words to frame the story and tell the reader what will happen next. Words such as *first*, *second*, and *third* indicate the logic of the paper. Similarly, words such as *perhaps* and *clearly* describe our certainty, whereas *observe* and *recall* describe the actions of the reader. Most importantly, do not overuse these “throat clearing” words.

### 3 Lesson 4: Cohesion and Coherence

Cohesion and coherence are two integral components of academic writing. Cohesion is defined as words fitting well between consecutive sentences, whereas coherence is defined as sentences fitting well within a paragraph.

#### Cohesion

The character referenced at the end of a sentence should fit with the character at the beginning of the following sentence. For example, the following could use a cohesive sentence at the marked location:

*In order to reduce latency in accessing data, computer architects started designing caches in the 1960s. [Insert a sentence here.] Because such memory is relatively expensive, caches are much smaller than main memory.*

We want to create a sentence that starts with cache and ends with memory. The following is active but not cohesive:

*In order to reduce latency in accessing data, computer architects started designing caches in the 1960s. Fast, associative memory forms caches. Because such memory is relatively expensive, caches are much smaller than main memory.*

Whereas the following is passive and cohesive:

*In order to reduce latency in accessing data, computer architects started designing caches in the 1960s. A cache is typically made from a fast, associative memory. Because such memory is relatively expensive, caches are much smaller than main memory.*

The best solution, however, is one that combines the active voice with cohesiveness:

*In order to reduce latency in accessing data, computer architects started designing caches in the 1960s. A cache typically comprises<sup>†</sup> a fast, associative memory. Because such memory is relatively expensive, caches are much smaller than main memory.*

#### Coherence

The following paragraph is abysmally incoherent:

*In order to reduce latency in accessing data, computer architects started designing caches in the 1960s. The 1960s saw many cultural changes, and one of the focal points was San Francisco. In 1906, that beautiful city was ravaged by an earthquake. Seismic events occur all along the Pacific Rim. Indeed, the Pacific Rim has seen quite a diaspora, resulting in many fusion cuisines. Such cross-cultural cooking often appears on the television program Iron Chef.*

It is, however, an excellent example of how cohesiveness is not the same as coherency, as each pair of consecutive sentences is cohesive, yet the paragraph is incoherent. Topic sentences are helpful here, and you should continually ask yourself whether all of your sentences serve the purpose of the topic sentence.

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<sup>†</sup>Remember: nothing *is comprised of* anything. The whole comprises the parts.

## 4 Lesson 5: Emphasis

How you end your sentence will determine your readers' assessment of its strength and clarity. For example, the following paragraph ends weakly and takes a significant amount of time to reach the main verb:

*Average-case analysis and experimental results of the algorithms for sorting and searching on random data to determine which algorithms are best in practice are the subjects of this section.*

Rewriting the sentence to leave the main thought until the end forms a stronger sentence: *In this section, we analyze sorting and searching algorithms on random data, examining average cases and experimental results to determine which algorithms are best in practice.*

### Complex grammar and complex meaning

One pitfall is having new words at the beginning of sentences. For example, *Natarajan's assertion that columnsort takes longer than dsort because columnsort makes one additional pass appears in the last section of her paper* feels top-heavy with the bulk of new information at the beginning of the sentence. By starting with simple ideas and moving towards complex ones, the sentence can be better rewritten as *In the last section of her paper, Natarajan asserts that columnsort takes longer than dsort because columnsort makes one additional pass.*

To further elucidate this point, consider the following two paragraphs:

*We must first understand cache associativity in order to understand CPU performance. The hit rate, which is the frequency of the data we want residing in the cache, depends on the cache associativity, and CPU performance is better with higher hit rates. The number of cache lines that can be mapped into by a given byte in the RAM gives the associativity. Each cache line is a fixed-sized section of the cache. Although caches with low associativity are easier to design and, on their own, are more efficient than caches with high associativity, caches with high associativity usually have higher hit rates and therefore represent a better choice for good CPU performance.*

*When a CPU needs data from the RAM, it places that data into a small, fast memory on the CPU chip, which we call the cache. We must therefore understand how caches work in order to understand how quickly a CPU can operate. A cache is organized into several cache lines, each of a fixed size. Each byte in the RAM can map into a select set of cache lines, and we call the size of each such set the caches associativity. Caches with low associativity are easier to design and, on their own, more efficient, than caches with high associativity. But when we examine how often the data we want resides in the cache — the hit rate — we find that caches with high associativity usually have higher hit rates, thereby allowing the CPU to run faster.*

The second paragraph makes the implicit statements from the first paragraph explicit. Furthermore, the second paragraph moves the complex words to the end or middle of each sentence, whereas the first paragraph has everything in the beginning.

In general, a good rule of thumb is to never leave sentences without the important parts at the end. You can determine whether the emphasis is on the wrong portion by stressing verbally the last few words of each sentence and seeing whether you sound like “a jerk.”<sup>‡</sup>

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<sup>‡</sup>Or more of a jerk.

Finally, these three examples bring to light the role of sentence stress for emphasis:

*The classes P and NP differ, most theoreticians believe.*

*Most theoreticians believe that the classes P and NP differ.*

*Most theoreticians believe that  $P \neq NP$ .*

The last two options sound the best when said aloud.

## Four tactical revisions

There are four tactical revisions you can make to improve the emphasis of your sentences:

### 1. Trim the end.

The sentence *The program's memory footprint is small, so that it takes little space can be easily rewritten as* *The program's memory footprint is small.*

### 2. Shift peripheral words to the left.

Similarly, the order of *Quicksort runs well in most cases* can be shifted to produce a more impactful *In most cases, quicksort runs well.*

### 3. Avoid ending sentences with anticlimactic phrases.

Ending *Assigning one object to another is actually assigning references rather than copying objects, you should bear in mind* with *you should bear in mind* feels awfully anticlimactic. To remedy the sentence, simply shift the order around to produce *You should bear in mind that assigning one object to another is actually assigning references rather than copying objects.*

### 4. Shift new information to the right.

Similar to the second point, *new* information shifts to the right. For example, *It is simple to design direct-mapped caches. Fully associative caches are better for modeling than direct-mapped caches* can be quickly transformed to *It is simple to design direct-mapped caches. Better for modeling than direct-mapped caches are fully associative caches*, shifting the emphasis to *fully associative caches*.

## Syntactic devices for emphasis

There are a few other tricks to help with emphasizing the correct portion of your sentence:

1. Add *There are/is* to the beginning of the sentence to shift the important pieces to the right. For example, *Several design patterns recur in object-oriented programming* becomes *There are several design patterns that recur in object-oriented programming.*
2. Use passive verbs to flip the subject and object order of the sentence, i.e., *Using a cache can decrease effective memory-access times* could become *Effective memory-access times can be decreased by using a cache* or *We can decrease effective memory-access times by using a cache.*
3. Although it is passive, using a *what* can make a sentence more meaningful, i.e., *Error-correcting codes would solve the problem* becomes *What would solve the problem is error-correcting codes.*

4. Adding *it* to the beginning of the sentence changes *That a multithreaded version would run faster was obvious* to *It was obvious that a multithreaded version would run faster*.
5. The latter part of a sentence can be emphasized with *not only x, but y*. In other words, you can convert a weakly emphasized sentence like *Devices must be faster and more reliable* to *Devices must be not only faster, but more reliable*.
6. Changing the negative tone of the sentence to positive: *The changes make the device faster, not more expensive.* to *The changes make the device not more expensive, but faster*.
7. Utilizing pronoun substitution and ellipsis based on the subject, i.e., *When a disk fails, we can hot-swap to replace the disk* becomes *When a disk fails, we can hot-swap to replace it*.