Dealing with the Second Hardest Thing in Computer Science

Thoughts on naming things for software development

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Source code for these slides can be found on GitHub.

What you'll learn today

- Why naming impacts code quality and maintainability
- Practical strategies for clear, consistent, and meaningful names
- Common naming pitfalls to avoid
- How naming improves software design and architecture
- Tools and techniques for better naming (AI, code review)

🎯 **Goal**

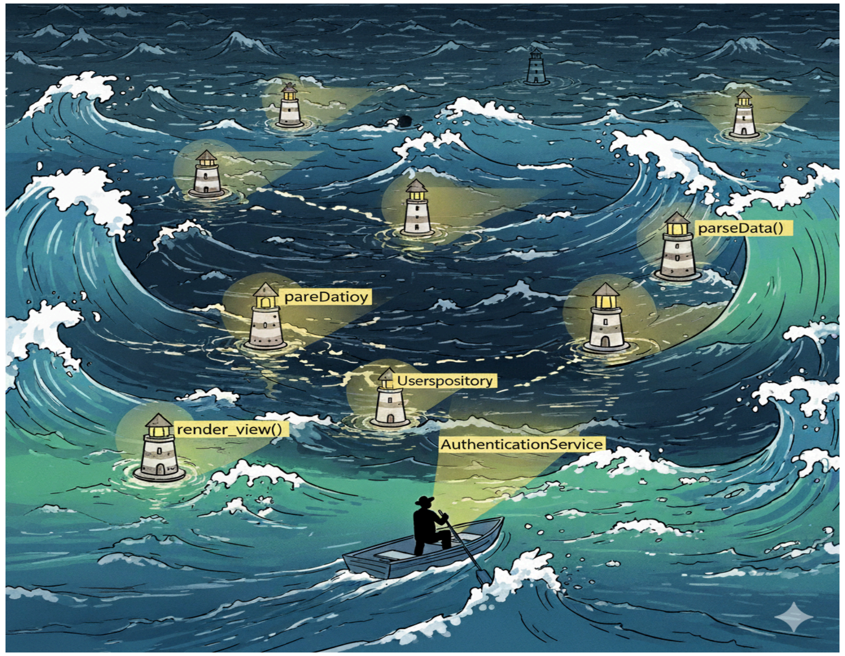
Transform naming from an afterthought into a deliberate practice that enhances code clarity and software maintainability.

“There are only two hard things in Computer Science: cache invalidation and naming things.”

- Phil Karlton

Why naming matters

Navigating the codebase with good names as beacons of clarity



The hidden cost of poor naming

Bad names create a cascade of problems that compound over time.

Immediate consequences:

- Code reviews take longer as reviewers struggle to understand intent
- Debugging becomes detective work instead of systematic analysis
- New team members need extensive onboarding to decode the codebase

Long-term impact:

- Technical debt accumulates as developers avoid touching poorly-named code
- Bug introduction rates increase due to misunderstanding
- Refactoring becomes risky when you can’t trust what code actually does

⚠ **The multiplication effect**

Poor naming spreads confusion throughout the entire system.

Good names pay dividends

Well-chosen names transform code from puzzles into stories.

Development velocity:

- Code reviews focus on logic rather than deciphering meaning
- Debugging targets the right components faster
- New features build confidently on existing foundations

Maintenance benefits:

- Refactoring becomes safe and predictable
- Bug fixes address root causes rather than symptoms
- Documentation writes itself when names are self-explanatory

The investment mindset

Time spent on naming is not overhead—it's an investment that pays compound interest.

Naming and good design

Illustrating benefits of thoughtful naming for software design using ***function*** as an example

Following Unix philosophy

Unix philosophy specifies the golden rule for writing good a function:
"Do One Thing And Do It Well."

Finding a descriptive name for a function can inform us if we are following this rule.

Consider a function to extract a table of regression estimates for a statistical model. For convenience, it also allows sorting the table by estimate.

Naming is hard

Trying to find a name highlights that the function is doing more than one thing.

```python
def extract_and_sort_estimates(model, sort="asc"):
    # code to extract estimates from model
    # code to sort table
    pass
```

Naming is easy

These individual functions are easier to read, understand, and test.

```python
def extract_estimates(model):
    # code to extract estimates from model
    pass

def sort_estimates(table, sort="asc"):
    # code to sort table
    pass
```

Functions with `and` or `or` in their names are dead giveaways that they don't follow the Unix philosophy.

Function parameter names

When it comes to writing a good function, finding a good name for a parameter can also reveal design problems.

E.g. a boolean or flag parameter name means function is doing more than one thing.

Consider a function that converts Markdown or HTML documents to PDF.

Boolean parameter necessary

Doing more than one thing.

```python
def convert_to_pdf(file, is_markdown=False):
    if is_markdown:
        # code to convert Markdown to PDF
        pass

    if not is_markdown:
        # code to convert HTML to PDF
        pass
```

Boolean parameter unnecessary

Doing one thing.

```python
def convert_md_to_pdf(file):
    # code to convert Markdown to PDF
    pass

def convert_html_to_pdf(file):
    # code to convert HTML to PDF
    pass
```

Naming: The Do's and Don'ts*

> *"The beginning of wisdom is to call things by their proper name."* - Confucius

* Despite Python examples, all the mentioned strategies are **language-agnostic**.

The Don’ts

You won’t have to remember any of these rules if you follow the following principle:

Names must be readable for the *reader*, not *author*, of code.

- **Don't use pop-culture references in names.** Not everyone knows them. E.g. `female_birdsong_recording` is a better variable name than `thats_what_she_said`.

- **Don't use slang.** You can't assume current or future developers to be familiar with them. E.g. `exit()` is better than `hit_the_road()`.

- **Avoid imprecise opposites**, since they can be confusing. E.g. parameter combination `begin`/`last` is worse than either `begin`/`end` or `first`/`last`.

- **Don't use hard-to-distinguish character pairs in names** (e.g., `l` and `I`, `O` and `0`, etc.). With certain fonts, `firstl` and `firstI` look identical.

- **Avoid unintended meanings.** Do your due diligence to check dictionaries (especially Urban dictionary!) if the word has unintended meaning. E.g. `cumulative_sum()` is a better function name than `cumsum()`.

- **Don’t use inconsistent abbreviations.** E.g. instead of using `numColumns` (*number* of columns) in one function and `noRows` (*number* of rows) in another, choose one abbreviation as a prefix and use it consistently.

- **Don’t misspell to save a few characters.** Remembering spelling is difficult, and remembering *correct misspelling* even more so. E.g. don’t use `hilite` instead of `highlight`. The benefit is not worth the cost here.

- **Don’t use commonly misspelled words in English.** Using such names for variables can, at minimum, slow you down, or, at worst, increase the possibility of making an error. E.g. is it `accumulate`, `accummulate`, `acumulate`, or `acummulate`?!

- **Don’t use numeric suffixes in names to specify levels.** E.g. variable names `level1`, `level2`, `level3` are not as informative as `beginner`, `intermediate`, `advanced`.

- **Don’t use unpronounceable names.** While this is the weakest requirement, pronounceable names enable easier verbal communication. E.g. `generate_timestamp()` is better than `genymdhms()`.

- **Don't use misleading abbreviations.** E.g., in Python, `str` conventionally refers to string type. Using `str` to mean "structure" in a function parameter will be misleading to other developers.

- **Don't allow multiple English standards.** E.g. using both American and British English standards would have you constantly guessing if the variable is named (e.g.) `centre` or `center`. Adopt one standard and stick to it.

- **Don't use similar names for entities with different meanings.** E.g. `PatientRecs` and `PatientReps` are easily confused because they are so similar. There should be at least two-letter difference: `PatientRecords` and `PatientReports`.

- **Avoid naming separate entities with homonyms.** Discussing entities named `waste` and `waist` is inevitably going to lead to confusion.

- **Don't use uncommon English words.** Stick to common parlance that most developers understand. E.g. `start_process()` is better than `commence_process()`, `get_list()` is better than `procure_list()`, `find_user()` is better than `ascertain_user()`.

- **Don’t use easily confused names.** Names that are too similar make great candidates for mistaken identity. E.g. `nn` and `nnn` are easily confused; use `n_square` and `n_cube` instead.

- **Don’t use unsearchable names.** Single letters and very generic terms are hard to find and replace in a codebase. E.g. parameters `a` and `f` should be `arr` and `fun`.

- **Don’t prioritize grammar over clarity.** Breaking grammatical rules can improve code readability. E.g. use `fishes`, `peoples`, `feedbacks` when the plural form aids comprehension.

- **Don’t let names become outdated.** Update names when functionality changes to avoid misleading future developers. E.g. if `get_means()` changes from returning precomputed values to computing on-the-fly, rename it to `compute_means()`.

The Do’s

Names should be self-documenting

How good a name is can be assessed by how detailed the accompanying comment needs to be.

Poor names require more comments:

```python
# function to convert temperature
# from Fahrenheit to Celsius scale
# temp is the temperature in Fahrenheit
def unit_converter(temp: float):
    pass
```

Good names are self-documenting:

```python
def fahrenheit_to_celsius(temp_fahrenheit: float):
    pass
```

Tip

Good names rarely require readers to read the documentation to understand what they represent.

Names should be specific

Generic names are widely used and acceptable for short-lived contexts. However, as scope and complexity increase, specific names become essential for clarity.

For longer loops, use meaningful names instead of `i`, `j`, `k`:

```
# abstruse
inventory[i][j]
```

```
# crystal clear
inventory[warehouse][product]
```

All variables are temporary in some sense. Calling one `tmp` is inviting carelessness.

```
# generic name
tmp = a + b
result = tmp * 2
```

```
# more descriptive
sum_values = a + b
result = sum_values * 2
```

Tip

Even when you *think* you need generic names, you are better off using more descriptive names.

Test function names should act as a comment

Unlike regular functions, long names are less problematic for test functions because they are not visible to users or called repeatedly throughout the codebase.

```
# bad: test1, my_test, retrieve_commands
# good: test_all_saved_commands_should_be_retrieved
```

Names should be difficult to misinterpret

Try your best to misinterpret candidate names and see if you succeed.

```python
# ambiguous - pixel positions?
def get_char_position(x: int, y: int):
    pass
```

```python
# clear - text positions!
def get_char_position(line_index: int, char_index: int):
    pass
```

How I interpret:

“x, y: pixel positions for a character”

In reality:

“x, y: line of text and character position in that line”

Tip

Precise and unambiguous names leave little room for misconstrual.

Names should be appropriately abstract

Find the right level of detail and domain focus—precise enough to be clear, concise enough to be readable, and focused on ***what*** rather than ***how***.

Use context to eliminate redundancy:

```
# redundant in context
Router.run_router()
BeerShelf.beer_count
```

```
# leverages context
Router.run()
BeerShelf.count
```

Choose problem domain over implementation details:

```
# implementation domain - how it works
binary_search_users()
sql_query_products()

# data structure in name
bonuses_pd  # pandas DataFrame
```

```
# problem domain - what it does
find_user()
fetch_products()

# implementation independent
bonuses      # any data structure
```

Find the precision sweet spot:

```
# too imprecise → okay → good → unnecessarily precise
d → days → days_since_last_accident → days_since_last_accident_floor_4_lab_23
```

Tip

Good names focus on purpose, include critical details, and remain meaningful across implementations.

Names should maintain standards

Standards **reduce cognitive burden**: readers can reuse knowledge across contexts.

Avoid conflicting meanings and maintain consistency:

```
# inconsistent - size means different things
size = len(x.encode('utf-8'))  # bytes
size = len(a)                  # elements

# inconsistent - different words, same concept
CreditCardAccount().retrieve_expenditure()
DebitCardAccount().fetch_expenditure()
```

```
# consistent - clear distinctions
byte_size = len(x.encode('utf-8'))
length = len(a)

# consistent - same word, same concept
CreditCardAccount().retrieve_expenditure()
DebitCardAccount().retrieve_expenditure()
```

Follow language and domain conventions:

```
# violates conventions
class playerentity:
    self.HairColor = ""
```

```
# follows conventions
class PlayerEntity:
    self.hair_color = ""
```

Use consistent prefixes for IDE tab completion:

```
# bad - scattered when tab-completing
parse_json()
xml_reader()
csv_processor()
```

```
# good - groups related functions
parse_json()
parse_xml()
parse_csv()
```

Tip

Following *a* convention consistently is more important than *which* convention you adopt.

Unnecessary details in names should be removed...

```
# okay
convert_to_string()
file_object
str_name  # Hungarian notation
```

```
# better
to_string()
file
name
```

Avoid redundancy

- In type names, avoid using *class*, *data*, *object*, and *type* (e.g. bad: `classShape`, good: `Shape`)
- In function names, avoid using *be*, *do*, *perform*, etc. (e.g. bad: `doAddition()`, good: `add()`)

but important details should be kept!

```
# okay
child_height
password
id
address
```

```
# better
child_height_cm
plaintext_password
hex_id
ip_address
```

Tip

If some information is critical to know, it should be part of the name.

Boolean names should be clear

Names for Boolean variables or functions should make clear what true and false mean. This can be done using prefixes (**is**, **has**, **can**, etc.).

```python
# not great
if child:
    if parent_supervision:
        watch_horror_movie = True
```

```python
# better
if is_child:
    if has_parent_supervision:
        can_watch_horror_movie = True
```

In general, use positive terms for Booleans since they are easier to process.

```python
# double negation - difficult
is_firewall_disabled = False
```

```python
# better
is_firewall_enabled = True
```

But if the variable is only ever used in its false version (e.g. `is_volcano_inactive`), the negative version can be easier to work with.

Tip

Boolean variable names should convey what true or false values represent.

Utilizing tools

Naming limitations of linters

Linters can only do so much when it comes to naming.

What they CAN do:

- Enforce naming conventions
- Check for reserved keywords
- Detect naming pattern violations
- Flag overly short or long names
- Ensure consistent formatting

What they CANNOT do:

- Understand the intent behind your code
- Suggest meaningful names based on context
- Assess whether names represent what entities do
- Determine problem domain consistency
- Evaluate clarity for future developers

ⓘ The fundamental limitation

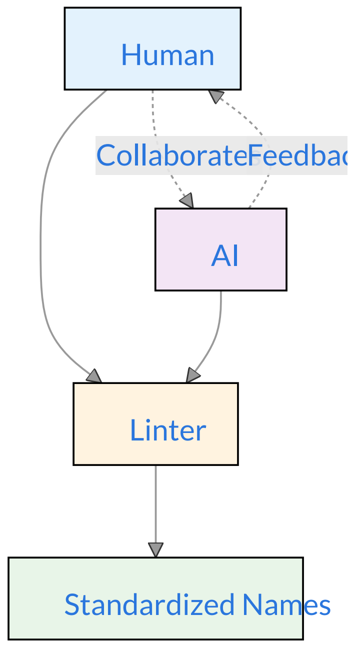
Linters can enforce *syntax* but not *semantics*. Good naming requires human understanding of both the problem and the solution.

Generative AI tools can be valuable allies

AI tools have context of your entire codebase and can provide meaningful names.

How AI tools can help:

- They see the whole function/class and understand relationships
- They recognize patterns across different programming domains
- They can spot inconsistent naming across your codebase
- They propose multiple naming options with rationales

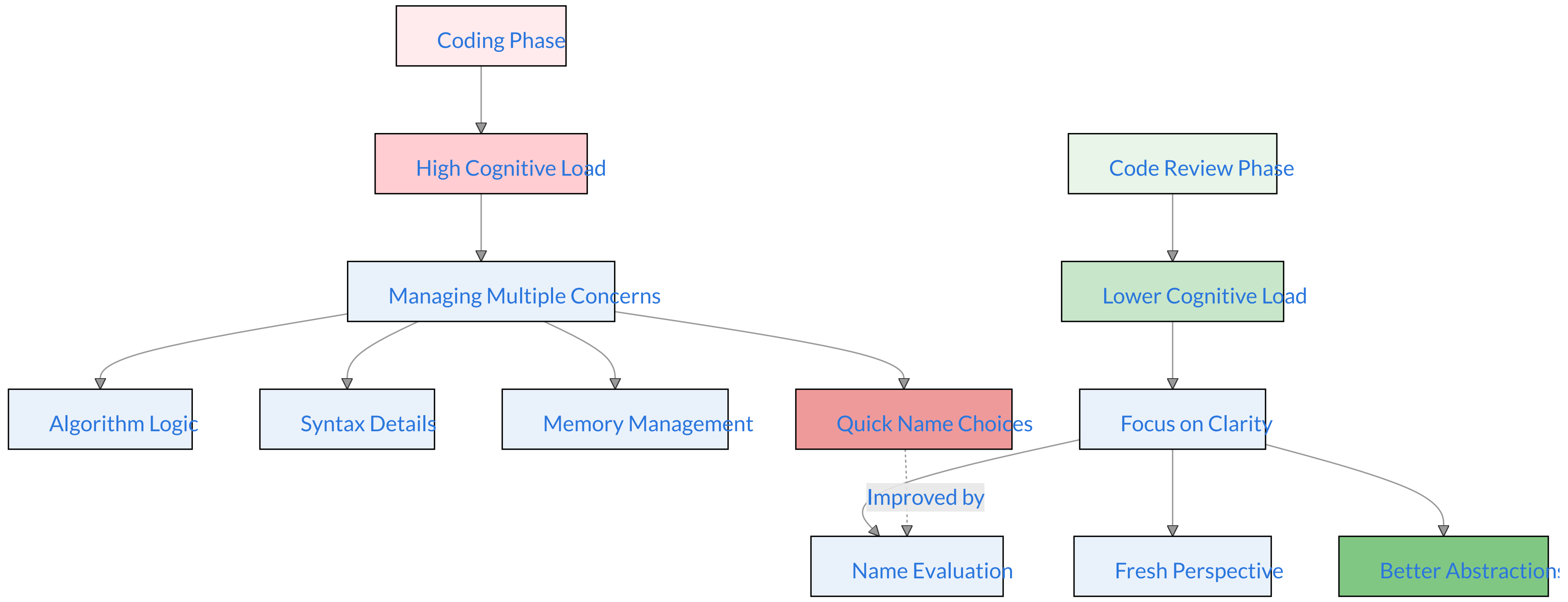


Symbiotic Naming

Try to come up with good names yourself. Then, ask AI tools to validate, assess, or suggest improvements.

Code Review: A fresh perspective

When coding, we operate at peak cognitive load and this mental overload makes it the worst time to choose thoughtful names.



The Code Review Advantage

It provides the mental space needed to evaluate whether names truly capture the intent and abstraction level of code.

Benefits of good names

> *“In your name I will hope, for your name is good.”* - Psalms 52:9

"What's in a name?" Well, everything!

- Intent-revealing names make the **code easier to read**.
- Trying to find good names forces you to detach from the problem-solving mindset and to **focus on the bigger picture** that motivates this change. This is critical for thoughtful software design.
- Searching for precise names requires clarity, and seeking such clarity **improves your own understanding** of the code.
- Naming precisely and consistently **reduces ambiguities and misunderstandings**, reducing the possibility of bugs.
- Good names **reduce the need for documentation**.
- Consistent naming **reduces cognitive overload** for the developers and makes the code more maintainable.

Naming is hard, but worth it

Invest time in good names early—they pay dividends by reducing system complexity.

The more you do it, the easier it will get!

“Using understandable names is a foundational step to producing quality software.” - Al Sweigart

Thank You

And Happy Naming! 😊

TL;DR Summary

***Principle*: Names are a form of abstraction**

“[T]he best names are those that focus attention on what is most important about the underlying entity, while omitting details that are less important.”

- John Ousterhout

***Importance*: Names are at the core of software design**

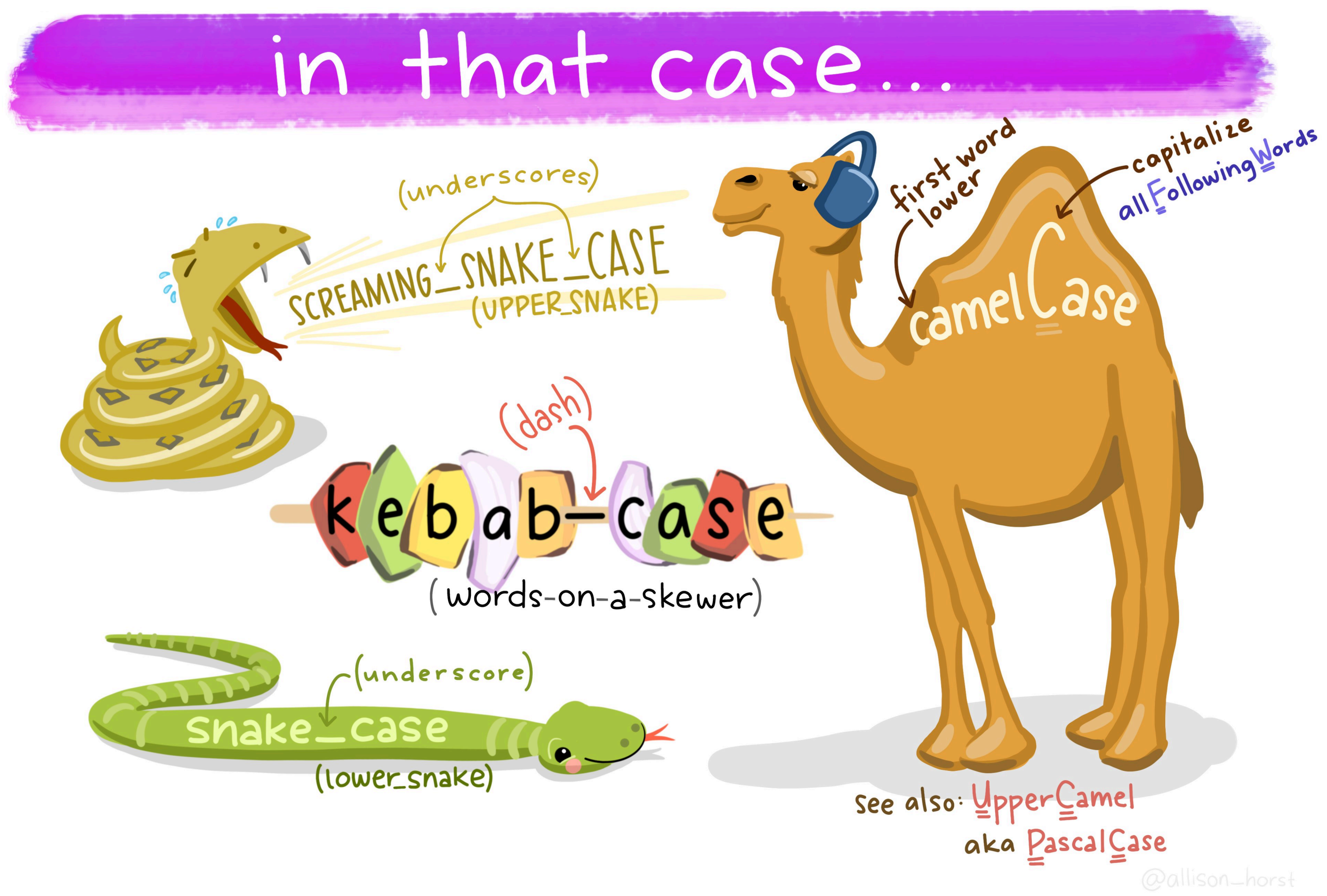
If you can’t find a name that provides the right abstraction for the underlying entity, the design may be unclear.

***Properties*: Good names are precise and consistent**

If a name is good, it is difficult to miss out on critical information about the entity or to misunderstand what it represents.

ICYMI: Available casing conventions

There are various casing conventions used for software development.



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Further Reading

For a more detailed discussion about how to name things, see the following references.

References

- McConnell, S. (2004). *Code Complete*. Microsoft Press. (**pp. 259-290**)
- Boswell, D., & Foucher, T. (2011). *The Art of Readable Code*. O'Reilly Media, Inc. (**pp. 7-31**)
- Martin, R. C. (2009). *Clean Code*. Pearson Education. (**pp. 17-52**)
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- Goodliffe, P. (2007). *Code Craft*. No Starch Press. (**pp. 39-56**)
- Padolsey, J. (2020). *Clean Code in JavaScript*. Packt Publishing. (**pp. 93-111**)
- Thomas, D., & Hunt, A. (2019). *The Pragmatic Programmer*. Addison-Wesley Professional. (**pp. 238-242**)
- Ottinger's Rules for Variable and Class Naming
- For a good example of organizational naming guidelines, see Google C++ Style Guide.

For more

If you are interested in good programming and software development practices, check out my other slide decks.

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