Dealing with the Second Hardest Thing in Computer Science

Transforming Code Clarity Through Better Names

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

🎯 Goal

Transform naming from an afterthought into a deliberate practice.

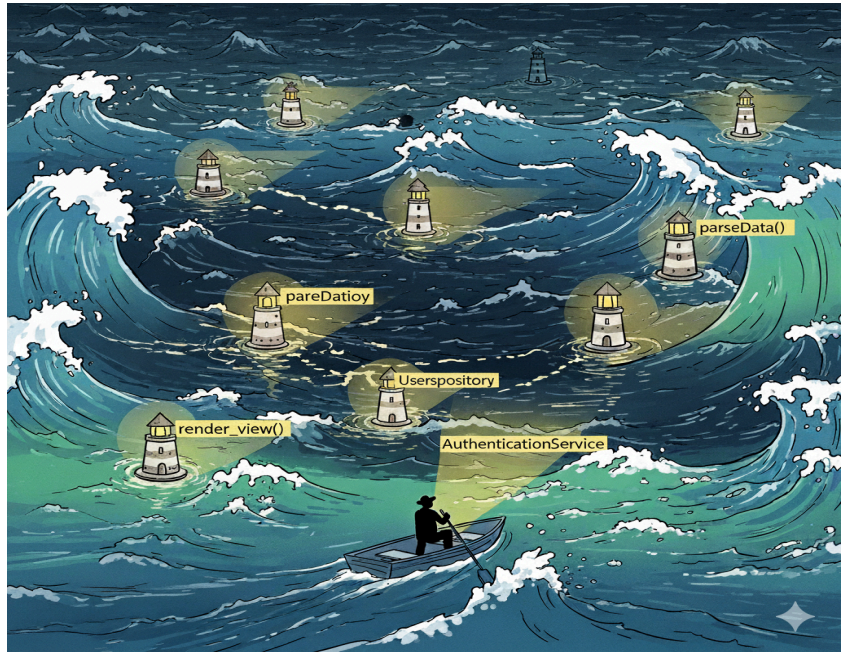
†Despite Python examples, all the mentioned strategies are **language-agnostic**.

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

- Phil Karlton

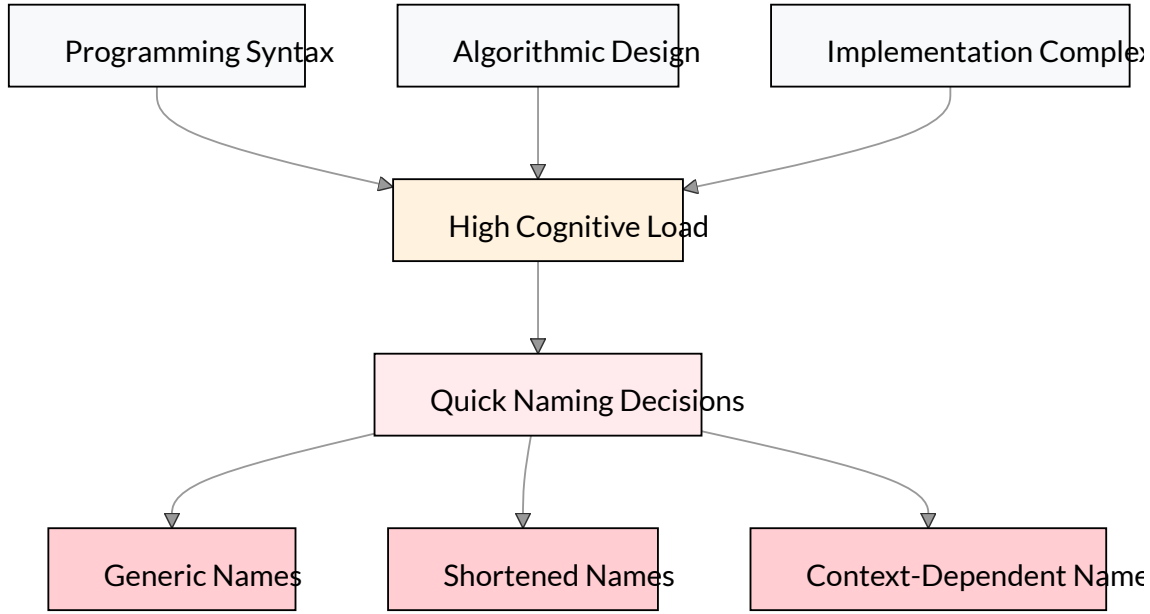
Why naming matters

Navigating the codebase with good names as beacons of clarity



Why naming is hard

Multiple cognitive demands exhaust mental capacity, leaving little for naming.



Result: Naming becomes reactive rather than deliberate

The hidden cost of poor naming

Immediate consequences:

- Longer code reviews due to unclear intent
- Debugging becomes detective work
- Extended onboarding for new team members

Long-term impact:

- Technical debt accumulation from avoidance
- Higher bug introduction rates
- Risky refactoring due to uncertainty

> ⚠ **The multiplication effect**
>
> **Poor naming spreads confusion throughout the entire system.**

Good names pay dividends

Development velocity:

- †ode reviews focus on logic, not deciphering
- Faster component targeting during debugging
- †onfident feature development

Maintenance benefits:

- Safe and predictable refactoring
- Root cause fixes over symptom patches
- Self-documenting code

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

Naming and good design

Illustrating naming benefits for software design using ***functions*** as examples

Following Unix philosophy

Unix Golden Rule: *"Do One Thing And Do It Well"*

Naming reveals if you're following this rule.

Doing multiple things

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

Doing one thing each

```
def extract_estimates(model):
    # extract estimates
    pass

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

Warning: Functions with `and` or `or` in names likely violate this principle!

Function parameter names

Parameter Naming Rule: Boolean/flag parameters often signal functions doing multiple things

Parameter names reveal design problems.

Multiple behaviors

```
def convert_to_pdf(file, is_markdown=False):
    if is_markdown:
        # convert Markdown
        pass
    else:
        # convert HTML
        pass
```

Single purpose each

```
def convert_md_to_pdf(file):
    # convert Markdown
    pass

def convert_html_to_pdf(file):
    # convert HTML
    pass
```

Insight: If you need a flag parameter, consider splitting into separate functions

Naming: The Do's and Don'ts

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

The Don’ts

Follow this principle instead of memorizing rules:

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

Tip	Why	Bad	Good
Confusion & Similarity			
Avoid imprecise opposites	Can be confusing	`begin`/`last`	`begin`/`end` or `first`/`last`
Don't use hard-to-distinguish characters	Look identical with certain fonts	`count0`, `counto`	`count_zero`, `count_letter`
Don't use similar names for different meanings	Easily confused, need 2+ letter difference	`PatientRecs`, `PatientReps`	`PatientRecords`, `PatientReports`
Avoid naming entities with homonyms	Leads to confusion in discussion	`waste`, `waist`	`garbage`, `body_circumference`
Don't use easily confused names	Too similar, mistaken identity	`nn`, `nnn`	`n_square`, `n_cube`
Consistency & Standards			
Don't use inconsistent abbreviations	Choose one prefix and use consistently	`numColumns`, `noRows`	`numColumns`, `numRows`
Don't allow multiple English standards	Causes constant guessing	`centre`, `center` (mixed)	`center` (consistent)
Don't use misleading abbreviations	Conflicts with language conventions	`str` (for "structure")	`structure`
Avoid misleading names	Wrong info is worse than no info	`get_means()` (incorrectly implies precomputed)	`compute_means()` (correctly indicates computation)

Tip	Why	Bad	Good
Communication & Clarity			
Don't use pop-culture references	Not everyone knows them	`thats_what_she_said`	`female_birdsong_recording`
Don't use slang	Can't assume familiarity	`hit_the_road()`	`exit()`
Avoid unintended meanings	Check Urban dictionary	`dump()`	`export_data()`
Don't use uncommon English words	Stick to common parlance	`commence_process()`	`start_process()`
Don't use unpronounceable names	Enables easier verbal communication	`genymdhms()`	`generate_timestamp()`
Technical & Maintainability			
Don't misspell to save characters	Correct misspelling is harder to remember	`hilite`	`highlight`
Don't use commonly misspelled words	Slows you down, increases errors	`accumulate` variants	`sum`, `collect`
Don't use numeric suffixes for levels	Not informative	`level1`, `level2`, `level3`	`beginner`, `intermediate`, `advanced`
Don't use unsearchable names	Hard to find and replace	`a`, `f`	`arr`, `fun`
Don't prioritize grammar over clarity	Plural forms aid comprehension	`fish` (for multiple)	`fishes`, `peoples`, `feedbacks`

The Do’s

Follow this principle instead of memorizing rules:

Good names reveal intention and eliminate guesswork.

Names should be self-documenting

Name quality correlates inversely with comment detail needed.

Poor names require more comments:

```
# 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:

```
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 in 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. Calling one `tmp` invites 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: test_retrieve_commands
# good: test_all_saved_commands_should_be_retrieved
```

Names should be difficult to misinterpret

Try to misinterpret candidate names.

```python
# ambiguous - what kind of size?
def get_size(
    file_path: str,
) -> int:
    pass
```

```python
# clear - character count!
def get_character_count(
    file_path: str,
) -> int:
    pass
```

How I interpret:

"File size in bytes on disk"

In reality:

"Number of characters in the file content"

> **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
```

Avoid encoding implementation details in names:

```
# implementation details encoded
binary_search_users()
sql_query_products()
bonuses_pd  # pandas DataFrame
hash_map_cache
```

```
# implementation independent
find_user()
fetch_products()
bonuses
cache
```

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** by enabling knowledge reuse 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()
```

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

Aside: Examples of Conventions

Programming Language specific

Language	Variables	Functions	Classes	Constants
Scala	`camelCase`	`camelCase`	`PascalCase`	`UPPER_SNAKE_CASE`
Kotlin	`camelCase`	`camelCase`	`PascalCase`	`UPPER_SNAKE_CASE`
Rust	`snake_case`	`snake_case`	`PascalCase`	`SCREAMING_SNAKE_CASE`
Swift	`camelCase`	`camelCase`	`PascalCase`	`camelCase`
Elixir	`snake_case`	`snake_case`	`PascalCase`	`@upper_snake_case`

Technology Stack specific

Layer	Convention	Examples
Database	`snake_case`	`user_profiles`, `created_at`
REST APIs	`kebab-case`/`snake_case`	`/user-profiles`, `user_name`
GraphQL	`camelCase`	`userProfile`, `orderItems`
CSS/HTML	`kebab-case`	`.nav-menu`, `#main-content`
DevOps	`kebab-case`	`my-app-deployment`
URLs/Routes	`kebab-case`	`/api/user-accounts`, `/admin/user-settings`
Event Names	`camelCase`/`kebab-case`	`userSignedIn`, `order-completed`

Consistency within each layer matters more than uniformity across layers

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.).

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

```
# 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.

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

```
# better
is_firewall_enabled = True
```

However, if the variable is primarily used in its false state (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.

Choose domain-appropriate names

Select terminology that matches your context: computer science terms for technical concepts, problem domain terms for business logic.

Use computer science terms for technical concepts:

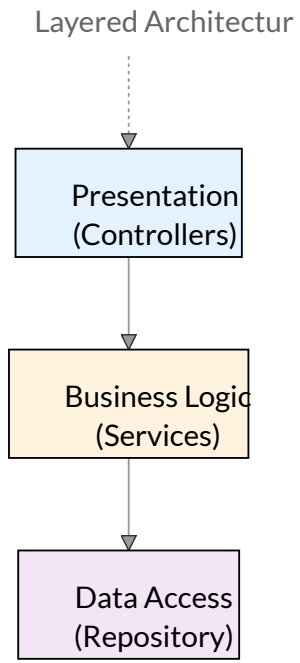
```
# vague business language
process_items_sequentially()
store_thing_temporarily()
```

```
# precise CS terminology
traverse_list()
push_to_stack()
```

Use problem domain terms for business concepts:

```
# generic technical terms
validate_input_data()
process_financial_records()
```

```
# domain-specific terms
validate_loan_application()
calculate_mortgage_payment()
```



> **Tip**
>
> **Choose names that are meaningful to both developers and domain experts.**

Use appropriate grammatical forms

Follow consistent patterns: nouns for entities and data, verbs for actions.

Classes and objects should use nouns:

```
# verb-based - confusing
class ProcessPayment:
    pass

class HandleError:
    pass
```

```
# noun-based - clear
class PaymentProcessor:
    pass

class ErrorHandler:
    pass
```

Methods that return values use nouns, action methods use verbs:

```
# inconsistent grammar
user.get_name()      # returns name
user.save()          # performs action
user.validate_age()  # returns boolean
```

```
# consistent grammar
user.name()          # returns name
user.save()          # performs action
user.is_adult()      # returns boolean
```

Tip

Grammatical consistency helps readers predict what methods do without reading documentation.

Utilizing tools

Naming limitations of linters

What they CAN do:

- Enforce naming conventions
- †heck 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

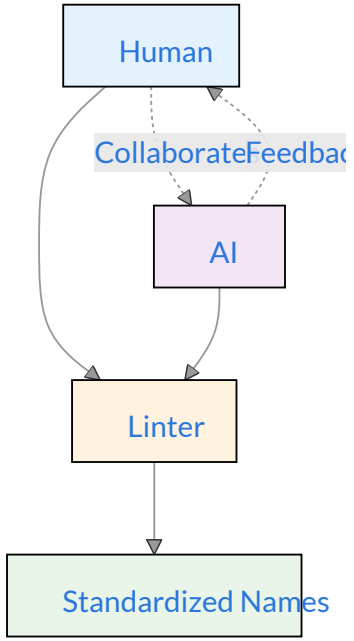
> ⓘ **The fundamental limitation**
>
> **Linters can enforce *syntax* but not *semantics*.** Good naming requires human understanding of both the problem and the solution.

Generative AI tools can be valuable allies

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

Why AI tools can help:

- Full context understanding of functions/classes
- Cross-domain pattern recognition
- Inconsistency detection across codebase
- Multiple naming suggestions with rationales

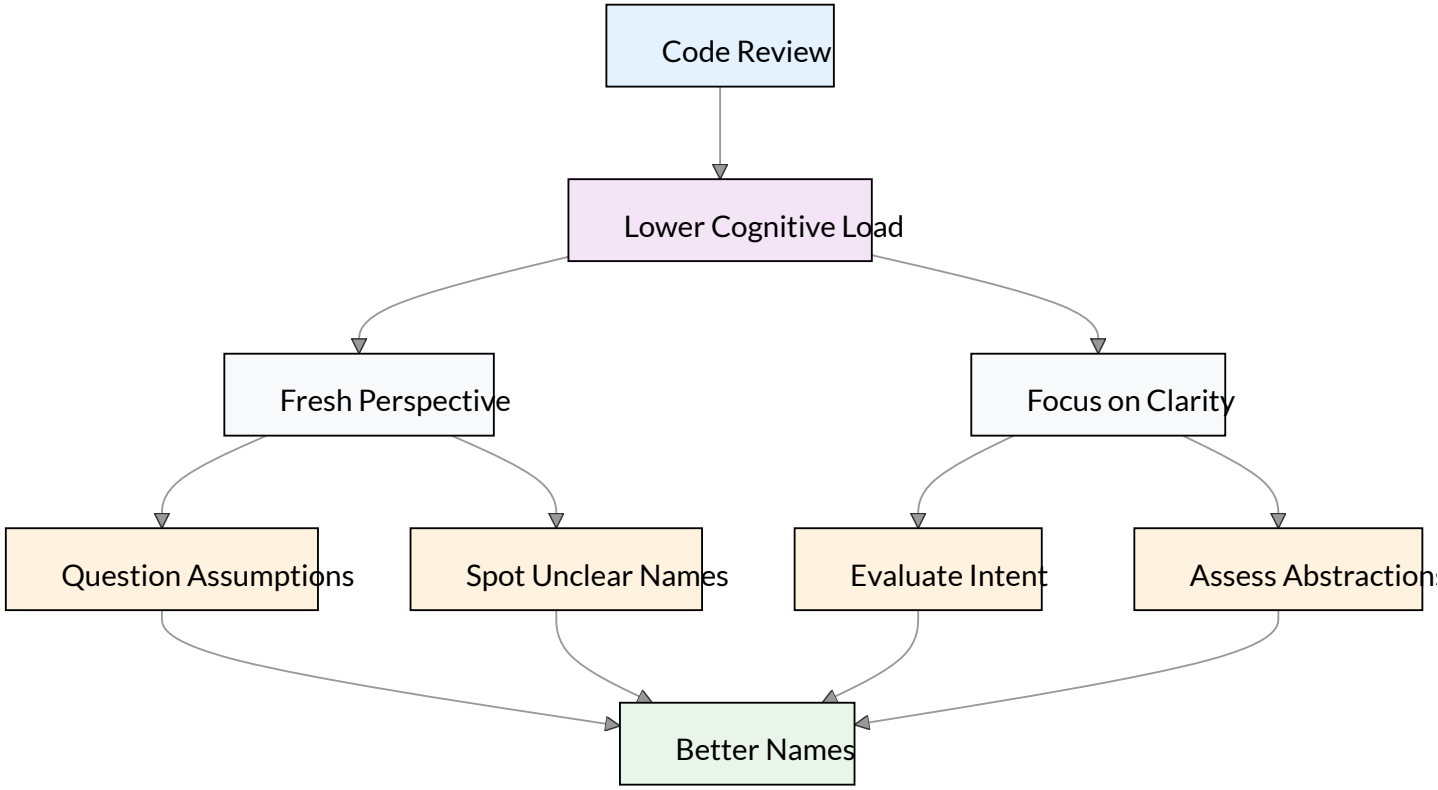


Symbiotic Naming

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

Code Review: A fresh perspective

Lower cognitive load + fresh perspective = ideal conditions for better naming.



Code review transforms naming from reactive to deliberate!

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 name something well, the design may be unclear.

Properties: Good names are precise and consistent

Good names prevent missing critical information or misunderstanding what entities represent.

ICYMI: Available casing conventions

There are various casing conventions used for software development.

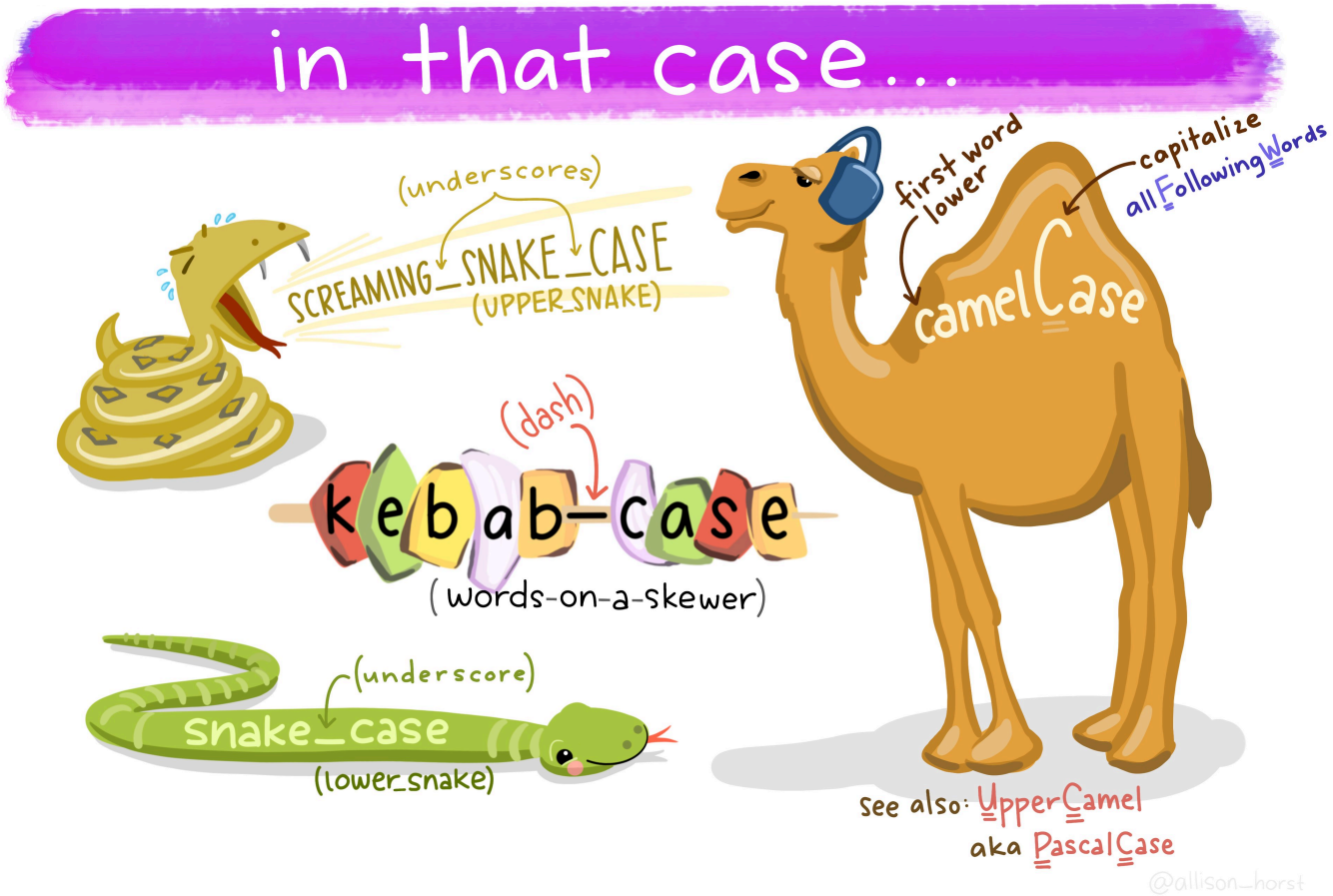


Illustration (CC-BY) by Allison Horst

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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