# 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.

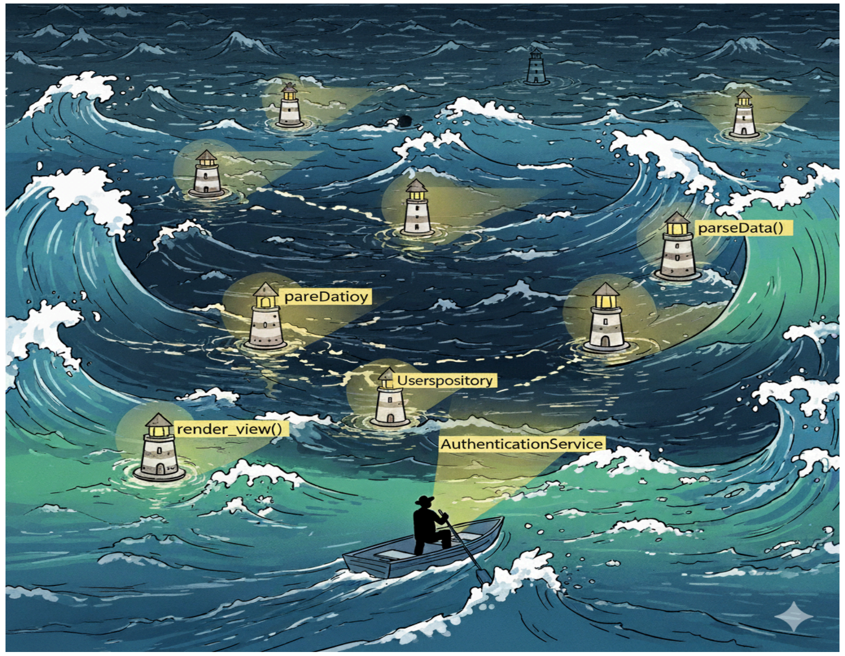
[†]Despite Python examples, all the mentioned strategies are **language-agnostic**.

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

- Phil Karlton

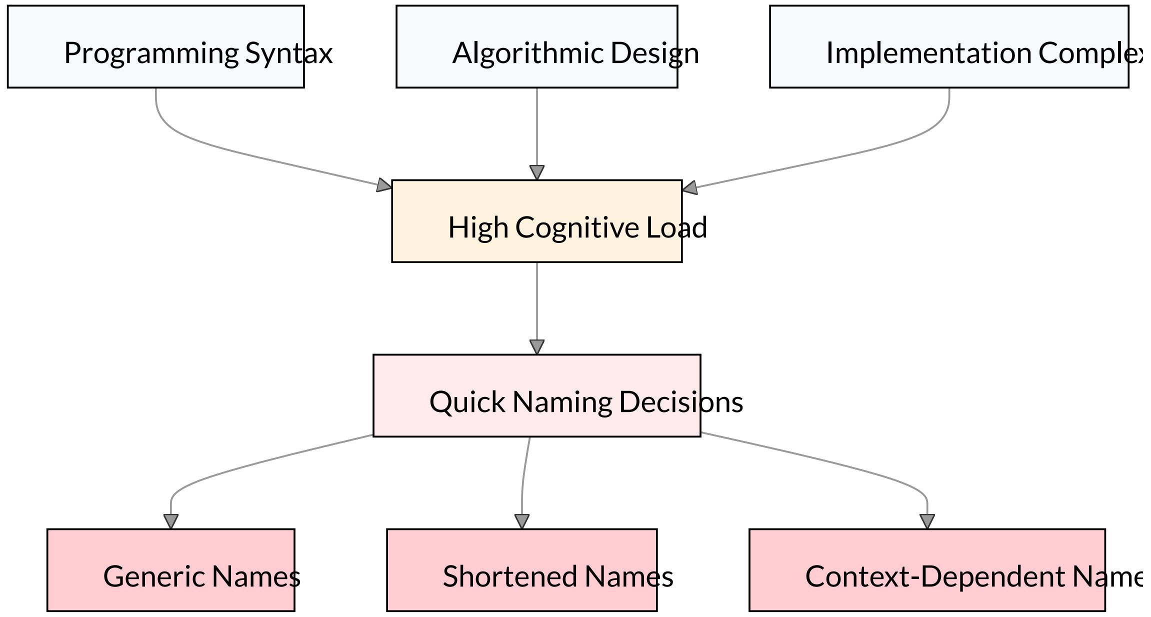
# Why naming matters

*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**

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

**Doing one thing each**

```python
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**

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

**Single purpose each**

```python
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:

```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 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.).

```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
```

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:

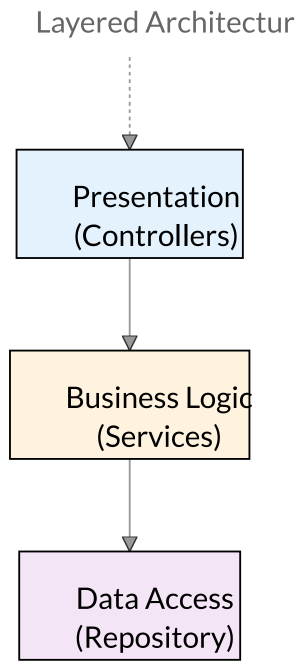
```
# vague business language
process_items_sequentially()
store_thing_temporarily()
```

```
# 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:

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

class HandleError:
    pass
```

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

class ErrorHandler:
    pass
```

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

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

```python
# 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**

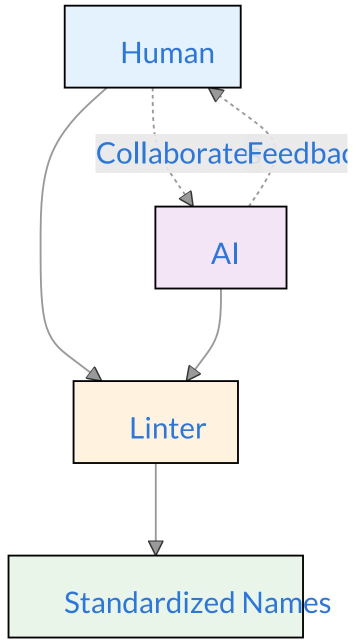
**Linters can enforce *syntax* but not *semantics*.** Good naming requires human understanding of both the problem and the solution.

# 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

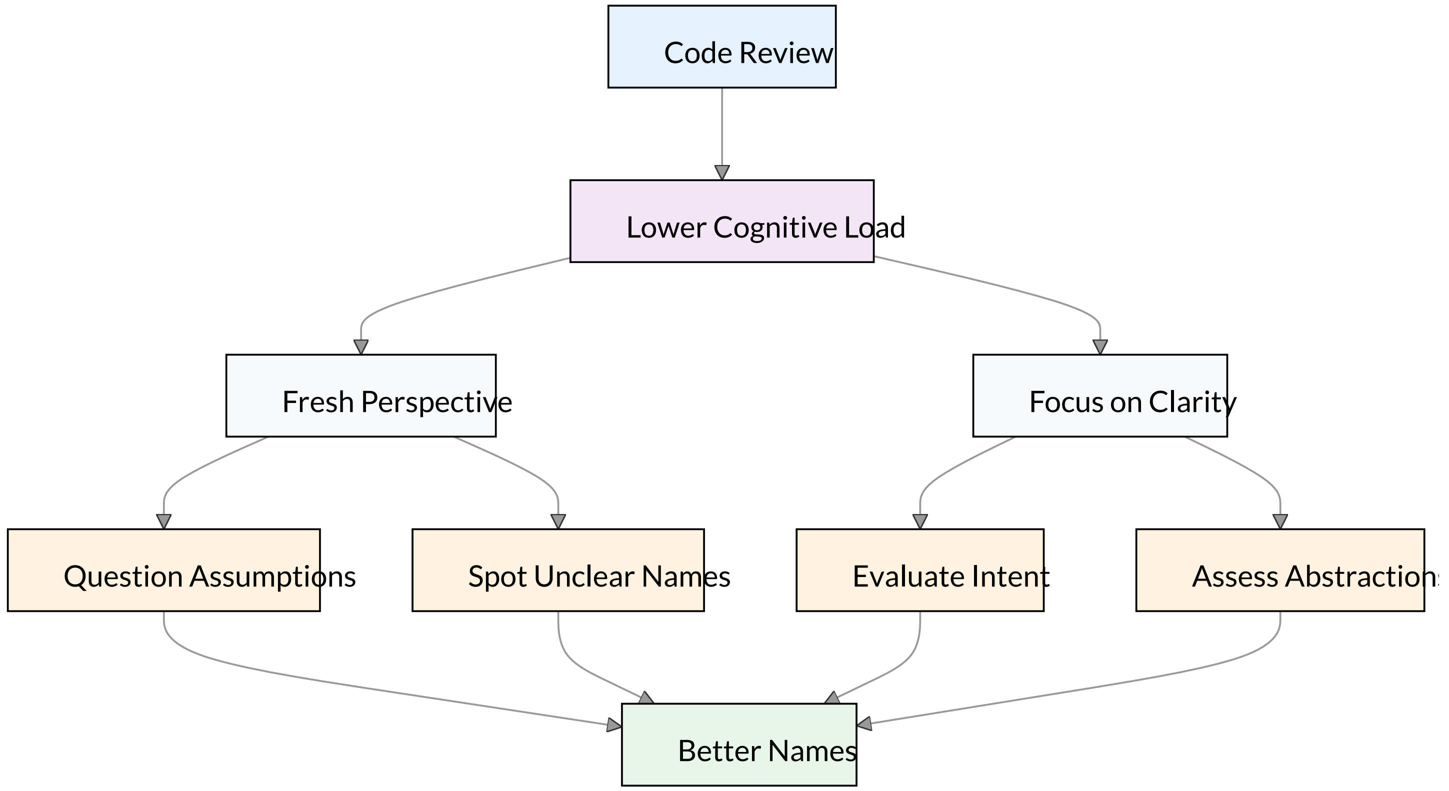


**Symbiotic Naming**

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**

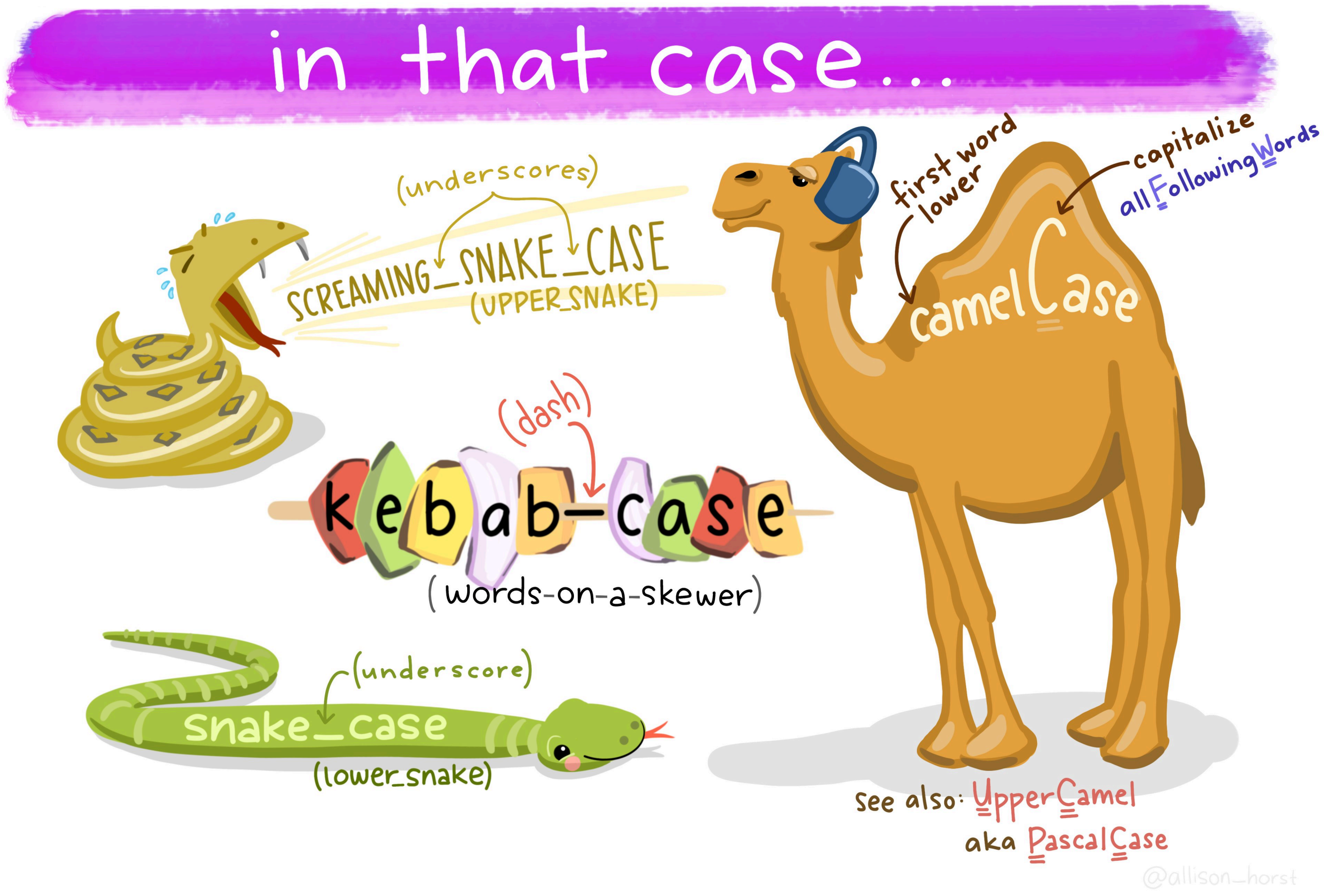
If you can't find a name that provides the right abstraction for the underlying entity, the design may be unclear.

***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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- Ousterhout, J. K. (2018). *A Philosophy of Software Design*. Palo Alto: Yaknyam Press. (**pp. 121-129**)
- 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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