1. The Power of Variable Names

Code Complete

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# 11.0 Python Keywords

<https://docs.python.org/3/reference/lexical_analysis.html#keywords>

### 2.3.1. Keywords

The following identifiers are used as reserved words, or *keywords* of the language, and cannot be used as ordinary identifiers. They must be spelled exactly as written here:

False class finally is return  
None continue for lambda try  
True def from nonlocal while  
and del global not with  
as elif if or yield  
assert else import pass  
break except in raise

## 11.1 Considerations in Choosing Good Names

* You can't give a variable a name the way you give a dog a name—because it's cute or it has a good sound. Unlike the dog and its name, which are different entities, a variable and a variable's name are essentially the same thing.
* Java Example of Poor Variable Names

Example 11-1.

x = x - xx;

xxx = fido + SalesTax( fido );

x = x + LateFee( x1, x ) + xxx;

x = x + Interest( x1, x );

What's happening in this piece of code? What do x1, xx, and xxx mean? What does fido mean?

Example 11-2. Java Example of Good Variable

Names balance = balance - lastPayment;

monthlyTotal = newPurchases + SalesTax( newPurchases );

balance = balance + LateFee( customerID, balance ) +

monthlyTotal;

balance = balance + Interest( customerID, balance );

In view of the contrast between these two pieces of code, a good variable name is readable, memorable, and appropriate.

**The Most Important Naming Consideration**

* The most important consideration in naming a variable is that the name fully and accurately describes the entity the variable represents. An effective technique for coming up with a good name is to state in words what the variable represents. Often that statement itself is the best variable name. It's easy to read because it doesn't contain cryptic abbreviations, and it's unambiguous. Because it's a full description of the entity, it won't be confused with something else. And it's easy to remember

**Problem Orientation**

* A good mnemonic name generally speaks to the problem rather than the solution. A good name tends to express the what more than the how. In general, if a name refers to some aspect of computing rather than to the problem, it's a how rather than a what. Avoid such a name in favor of a name that refers to the problem itself. A record of employee data could be called inputRec or employeeData. inputRec is a computer term that refers to computing ideas—input and record. employeeData refers to the problem domain rather than the computing universe.

**Optimum Name**

* Length: The optimum length for a name seems to be somewhere between the lengths of x and maximumNumberOfPointsInModernOlympics. Names that are too short don't convey enough meaning.
* Gorla, Benander, and Benander found that the effort required to debug a program was minimized when variables had names that averaged 10 to 16 characters (1990). Programs with names averaging 8 to 20 characters were almost as easy to debug.

Table 11-2. Variable Names That Are Too Long, Too Short, or Just Right

Too long:

numberOfPeopleOnTheUsOlympicTeam

numberOfSeatsInTheStadium

maximumNumberOfPointsInModernOlympics

Too short:

n, np, ntm

n, ns, nsisd

m, mp, max, points

Just right:

numTeamMembers, teamMemberCount

numSeatsInStadium, seatCount

teamPointsMax, pointsRecord

teamPointsMax

team\_points\_max

**The Effect of Scope on Variable Names**

* Cross-Reference Scope is discussed in more detail in Scope. Are short variable names always bad? No, not always. When you give a variable a short name like i, the length itself says something about the variable—namely, that the variable is a scratch value with a limited scope of operation.
* A study by W. J. Hansen found that longer names are better for rarely used variables or global variables and shorter names are better for local variables or loop variables (Shneiderman 1980).
* If you have variables that are in the global namespace (named constants, class names, and so on), consider whether you need to adopt a convention for partitioning the global namespace and avoiding naming conflicts.

**Computed-Value Qualifiers in Variable Names**

* Many programs have variables that contain computed values: totals, averages, maximums, and so on. If you modify a name with a qualifier like Total, Sum, Average, Max, Min, Record, String, or Pointer, put the modifier at the end of the name.
* This practice offers several advantages. First, the most significant part of the variable name, the part that gives the variable most of its meaning, is at the front, so it's most prominent and gets read first. Second, by establishing this convention, you avoid the confusion you might create if you were to use both totalRevenue and revenueTotal in the same program.
* An exception to the rule that computed values go at the end of the name is the customary position of the Num qualifier. Placed at the beginning of a variable name, Num refers to a total: numCustomers is the total number of customers. Placed at the end of the variable name, Num refers to an index: customerNum is the number of the current customer.
* But, because using Num so often creates confusion, it's probably best to sidestep the whole issue by using Count or Total to refer to a total number of customers and Index to refer to a specific customer.

**Common Opposites in Variable Names**

Cross-Reference

For a similar list of opposites in routine names, see "Use opposites precisely" in Good Routine Names.

* Use opposites precisely. Using naming conventions for opposites helps consistency, which helps readability. Pairs like begin/end are easy to understand and remember. Pairs that depart from common-language opposites tend to be hard to remember and are therefore confusing.

## 11.2 Naming Specific Types of Data

In addition to the general considerations in naming data, special considerations come up in the naming of specific kinds of data. This section describes considerations specifically for loop variables, status variables, temporary variables, boolean variables, enumerated types, and named constants.

**Naming Loop Indexes**

Cross-Reference

For details on loops, see Chapter 16.

* Guidelines for naming variables in loops have arisen because loops are such a common feature of computer programming. The names i, j, and k are customary:

Example 11-4. Java Example of a Simple Loop Variable Name

for ( i = firstItem; i < lastItem; i++ )

{ data[ i ] = 0; }

* If a variable is to be used outside the loop, it should be given a name more meaningful than i, j, or k. For example, if you are reading records from a file and need to remember how many records you've read, a name like recordCount would be appropriate:

Example 11-5. Java Example of a Good Descriptive Loop Variable Name

recordCount = 0;

while ( moreScores() )

{

score[ recordCount ] = GetNextScore();

recordCount++;

}

* Because code is so often changed, expanded, and copied into other programs, many experienced programmers avoid names like i altogether.

Example 11-6. Java Example of Good Loop Names in a Nested Loop

for (teamIndex = 0; teamIndex < teamCount; teamIndex++)

{ for (eventIndex = 0; eventIndex < eventCount[teamIndex];

eventIndex++)

{ score[teamIndex][eventIndex] = 0;}

}

* Carefully chosen names for loop-index variables avoid the common problem of index cross-talk: saying i when you mean j and j when you mean i. They also make array accesses clearer:

score[teamIndex][eventIndex] is more informative than score[i][j].

* If you have to use i, j, and k, don't use them for anything other than loop indexes for simple loops—the convention is too well established, and breaking it to use them in other ways is confusing.

**Naming Status Variables**

Status variables describe the state of your program.

Here's a naming guideline: Think of a better name than flag for status variables. It's better to think of flags as status variables. A flag should never have “flag” in its name because that doesn't give you any clue about what the flag does. For clarity, flags should be assigned values and their values should be tested with enumerated types, named constants, or global variables that act as named constants.

Example 11-8.

C++ Examples of Better Use of Status Variables

if ( dataReady ) ...

if ( characterType & PRINTABLE\_CHAR ) ...

if ( reportType == ReportType\_Annual ) ...

if ( recalcNeeded == True ) ...

dataReady = true;

characterType = CONTROL\_CHARACTER;

reportType = ReportType\_Annual;

recalcNeeded = false;

**Naming Temporary Variables**

Temporary variables are used to hold intermediate results of calculations, as temporary placeholders, and to hold housekeeping values.

They're usually called temp, x, or some other vague and non descriptive name. In general, temporary variables are a sign that the programmer does not yet fully understand the problem.

Example 11-11. C++

Example with a "Temporary" Variable Name Replaced with a Real Variable

// Compute roots of a quadratic equation.

// This assumes that (b^2-4\*a\*c) is positive.

discriminant = sqrt( b^2 - 4\*a\*c );

root[0] = ( -b + discriminant ) / ( 2 \* a );

root[1] = ( -b - discriminant ) / ( 2 \* a );

This is essentially the same code, but it's improved with the use of an accurate, descriptive variable name.

**Naming Boolean Variables**

* Done

Use done to indicate whether something is done. The variable can indicate whether a loop is done or some other operation is done. Set done to false before something is done, and set it to true when something is completed. error Use error to indicate that an error has occurred.

* found

Use found to indicate whether a value has been found.

* success or ok

Use success or ok to indicate whether an operation has been successful.

* If you can, replace success with a more specific name that describes precisely what it means to be successful.
* Give boolean variables names that imply true or false. Names like done and success are good boolean names because the state is either true or false; something is done or it isn't; it's a success or it isn't. Names like status and sourceFile, on the other hand, are poor boolean names because they're not obviously true or false.
* Some programmers like to put Is in front of their boolean names. Then the variable name becomes a question: isdone isError isFound isProcessingComplete Answering the question with true or false provides the value of the variable. A benefit of this approach is that it won't work with vague names: isStatus? makes no sense at all. A drawback is that it makes simple logical expressions less readable: if ( isFound ) is slightly less readable than if ( found ).
* Use positive boolean variable names. Negative names like notFound, notdone, and notSuccessful are difficult to read when they are negated—

**Naming Enumerated Types**

Cross-Reference

For details on using enumerated types, see Enumerated Types.

When you use an enumerated type, you can ensure that it's clear that members of the type all belong to the same group by using a group prefix, such as Color\_, Planet\_, or Month\_.

Example 11-12.

Visual Basic Example of Using a Prefix Naming Convention for Enumerated Types

Public Enum Color

Color\_Red

Color\_Green

Color\_Blue

End Enum

**Naming Constants**

Cross-Reference

For details on using named constants, see Named Constants.

When naming constants, name the abstract entity the constant represents rather than the number the constant refers to. FIVE is a bad name for a constant (regardless of whether the value it represents is 5.0). CYCLES\_NEEDED is a good name. CYCLES\_NEEDED can equal 5.0 or 6.0. FIVE = 6.0 would be ridiculous.

## 11.3 The Power of Naming Conventions

Some programmers resist standards and conventions—and with good reason. Some standards and conventions are rigid and ineffective—destructive to creativity and program quality. This is unfortunate since effective standards are some of the most powerful tools at your disposal. This section discusses why, when, and how you should create your own standards for naming variables.

**Why Have Conventions?**

* Conventions offer several specific benefits: They let you take more for granted. By making one global decision rather than many local ones, you can concentrate on the more important characteristics of the code. They help you transfer knowledge across projects. Similarities in names give you an easier and more confident understanding of what unfamiliar variables are supposed to do. They help you learn code more quickly on a new project.
* They reduce name proliferation. Without naming conventions, you can easily call the same thing by two different names. For example, you might call total points both pointTotal and totalPoints.
* They compensate for language weaknesses. You can use conventions to emulate named constants and enumerated types. The conventions can differentiate among local, class, and global data and can incorporate type.
* They emphasize relationships among related items. If you use object data, the compiler takes care of this automatically. If your language doesn't support objects, you can supplement it with a naming convention. Names like address, phone, and name don't indicate that the variables are related. But suppose you decide that all employee-data variables should begin with an Employee prefix. employeeAddress, employeePhone, and employeeName leave no doubt that the variables are related. Programming conventions can make up for the weakness of the language you're using.
* The power of naming conventions doesn't come from the specific convention chosen but from the fact that a convention exists, adding structure to the code and giving you fewer things to worry about.

**When You Should Have a Naming Convention**

* When multiple programmers are working on a project
* When you plan to turn a program over to another programmer for modifications and maintenance (which is nearly always)
* When your programs are reviewed by other programmers in your organization
* When your program is so large that you can't hold the whole thing in your brain
* When the program will be long-lived enough that you might put it aside for a few weeks or months before working on it again
* When you have a lot of unusual terms that are common on a project and want to have standard terms or abbreviations to use in coding

## 11.4 Informal Naming Conventions

Most projects use relatively informal naming conventions such as the ones laid out in this section.

**Guidelines for a Language-Independent Convention**

Here are some guidelines for creating a language-independent convention:

* Differentiate between variable names and routine names. The convention this book uses is to begin variable and object names with lower case and routine names with upper case: variableName vs. RoutineName(). Differentiate between classes and objects.

Example 11-17.

Each of these options has strengths and weaknesses.

Option 1: Differentiating Types and Variables via Initial Capitalization

Widget widget;

LongerWidget longerWidget;

Option 2: Differentiating Types and Variables via All Caps

WIDGET widget;

LONGERWIDGET longerWidget

Option 3: Differentiating Types and Variables via the “t\_” Prefix for Types

t\_Widget Widget;

t\_LongerWidget LongerWidget;

Option 4: Differentiating Types and Variables via the “a” Prefix for

Variables

Widget aWidget;

LongerWidget aLongerWidget;

6 Option 5: Differentiating Types and Variables via Using More Specific

Names for the Variables

Widget employeeWidget;

LongerWidget fullEmployeeWidget;

* Identify global variables. One common programming problem is misuse of global variables.
* Identify member variables. Identify a class's member data. Make it clear that the variable isn't a local variable and that it isn't a global variable either.
* Identify type definitions. Naming conventions for types serve two purposes: they explicitly identify a name as a type name, and they avoid naming clashes with variables.

To avoid confusion, you can prefix the type names with t\_, such as t\_Color and t\_Menu.

* Identify named constants. Named constants need to be identified so that you can tell whether you're assigning a variable a value from another variable (whose value might change) or from a named constant.

In C++ and Java, the convention is to use all uppercase letters, possibly with underscores to separate words, RECSMAX or RECS\_ MAX

* Identify elements of enumerated types. Elements of enumerated types need to be identified for the same reasons that named constants do—
* Identify input-only parameters in languages that don't enforce them. Sometimes input parameters are accidentally modified.
* Format names to enhance readability. Two common techniques for increasing readability are using capitalization and spacing characters to separate words.

other languages also allow the use of the underscore (\_) separator.

* Try not to mix these techniques; that makes code hard to read.

**Guidelines for Language-Specific Conventions**

Follow the naming conventions of the language you're using.

* [PEP Index](http://legacy.python.org/dev/peps/) > PEP 8 -- Style Guide for Python Code

<http://legacy.python.org/dev/peps/pep-0008/>

* Code Style - Python Guide

<http://docs.python-guide.org/en/latest/writing/style/>

* Google Python Style Guide: roto!!!

<https://google-styleguide.googlecode.com/svn/trunk/pyguide.html>

* Java Conventions Further Reading For more on Java programming style, see The Elements of Java Style, 2d ed. (Vermeulen et al. 2000).

In contrast with C and C++, Java style conventions have been well established since the language's beginning: i and j are integer indexes. Constants are in ALL\_CAPS separated by underscores. Class and interface names capitalize the first letter of each word, including the first word—for example, ClassOrInterfaceName. Variable and method names use lowercase for the first word, with the first letter of each following word capitalized—for example, variableOrRoutineName. The underscore is not used as a separator within names except for names in all caps. The get and set prefixes are used for accessor methods.

**Sample Naming Conventions**

The standard conventions above tend to ignore several important aspects of naming that were discussed over the past few pages—including variable scoping (private, class, or global), differentiating between class, object, routine, and variable names, and other issues.

Table 11-3. Sample Naming Conventions for C++ and Java

## **11.5 Standardized Prefixes**

Further Reading

For further details on the Hungarian naming convention, see "The Hungarian Revolution" (Simonyi and Heller 1991).

Standardizing prefixes for common meanings provides a terse but consistent and readable approach to naming data. The best known scheme for standardizing prefixes is the Hungarian naming convention, which is a set of detailed guidelines for naming variables and routines (not Hungarians!) that was widely used at one time in Microsoft Windows programming.

is no longer in widespread use, the basic idea of standardizing on terse, precise abbreviations continues to have value. Standardized prefixes are composed of two parts: the user-defined type (UDT) abbreviation and the semantic prefix.

**User-Defined Type Abbreviations**

The UDT abbreviation identifies the data type of the object or variable being named. UDT abbreviations might refer to entities such as windows, screen regions, and fonts. A UDT abbreviation generally doesn't refer to any of the predefined data types offered by the programming language.

**Semantic Prefixes**

Semantic prefixes go a step beyond the UDT and describe how the variable or object is used. Unlike UDTs, which vary from project to project, semantic prefixes are some-what standard across projects.

Table 11-7 shows a list of standard semantic prefixes.

Semantic prefixes are formatted in lowercase or mixed uppercase and lowercase and are combined with the UDTs and with other semantic prefixes as needed.

## 11.6 Creating Short Names That Are Readable

The desire to use short variable names is in some ways a remnant of an earlier age of computing. Older languages like assembler, generic Basic, and Fortran limited variable names to 2–8 characters

In modern languages like C++, Java, and Visual Basic, you can create names of virtually any length; you have almost no reason to shorten meaningful names.

It's a good idea to be familiar with multiple techniques for abbreviating because no single technique works well in all cases.

**General Abbreviation Guidelines**

Here are several guidelines for creating abbreviations. Some of them contradict others, so don't try to use them all at the same time.

* Use standard abbreviations (the ones in common use, which are listed in a dictionary).
* Remove all non leading vowels. (computer becomes cmptr, and screen becomes scrn. apple becomes appl, and integer becomes intgr.)
* Remove articles: and, or, the, and so on.
* Use the first letter or first few letters of each word.
* Truncate consistently after the first, second, or third (whichever is appropriate) letter of each word.
* Keep the first and last letters of each word.
* Use every significant word in the name, up to a maximum of three words.
* Remove useless suffixes—ing, ed, and so on.
* Keep the most noticeable sound in each syllable.
* Be sure not to change the meaning of the variable.

Iterate through these techniques until you abbreviate each variable name to between 8 to 20 characters or the number of characters to which your language limits variable names.

**Phonetic Abbreviations**

Some people advocate creating abbreviations based on the sound of the words rather than their spelling. Thus skating becomes sk8ing, highlight becomes hilite, before becomes b4, execute becomes xqt, and so on.

**Comments on Abbreviations**

You can fall into several traps when creating abbreviations. Here are some rules for avoiding pitfalls:

* Don't abbreviate by removing one character from a word.
* Abbreviate consistently. Always use the same abbreviation. For example, use Num everywhere or No everywhere, but don't use both.
* Create names that you can pronounce. Use xPos rather than xPstn and needsComp rather than ndsCmptg.
* Create names that you can pronounce. Use xPos rather than xPstn and needsComp rather than ndsCmptg. Apply the telephone test—if you can't read your code to someone over the phone, rename your variables to be more distinctive (Kernighan and Plauger 1978).
* Avoid combinations that result in misreading or mispronunciation. To refer to the end of B, favor ENDB over BEND.
* Use a thesaurus to resolve naming collisions.
* Document extremely short names with translation tables in the code. In languages that allow only very short names, include a translation table to provide a reminder of the mnemonic content of the variables. Include the table as comments at the beginning of a block of code.
* Document all abbreviations in a project-level "Standard Abbreviations" document.

The general issue illustrated by this guideline is the difference between write-time convenience and read-time convenience. This approach clearly creates a write-time inconvenience, but programmers over the lifetime of a system spend far more time reading code than writing code.

Remember that names matter more to the reader of the code than to the writer. Read code of your own that you haven't seen for at least six months and notice where you have to work to understand what the names mean.

**Kinds of Names to Avoid**

* Avoid misleading names or abbreviations.

FALSE is usually the opposite of TRUE and would be a bad abbreviation for "Fig and

Almond Season."

* Avoid names with similar meanings.

input and inputValue, recordNum and numRecords, and fileNumber and fileIndex are

o semantically similar

* Avoid names like clientRecs and clientReps. They're only one letter different from each other, and the letter is hard to notice.
* Avoid names that sound similar, such as wrap and rap.
* Avoid numerals in names.

If the numerals in a name are really significant, use an array instead of separate variables. If an array is inappropriate, numerals are even more inappropriate. For example, avoid file1 and file2, or total1 and total2.

* misspelling highlight as hilite to save three characters makes it devilishly difficult for a reader to remember how highlight was misspelled.
* Avoid words that are commonly misspelled in English.
* Don't differentiate variable names solely by capitalization. If you're programming in a case-sensitive language such as C++,
* Avoid multiple natural languages. In multinational projects, enforce use of a single natural language for all code, including class names, variable names, and so on.
* more subtle problem occurs in variations of English. If a project is conducted in multiple English-speaking countries, standardize on one version of English
* Avoid the names of standard types, variables, and routines.
* Don't use names that are totally unrelated to what the variables represent. Sprinkling names such as margaret and pookie throughout your program virtually guarantees that no one else will be able to understand it. Avoid your boyfriend's name, wife's name, favorite beer's name,
* Avoid names containing hard-to-read characters. Be aware that some characters look so similar that it's hard to tell them apart.

## CHECKLIST: Naming Variables General Naming Considerations

* Does the name fully and accurately describe what the variable represents?
* Does the name refer to the real-world problem rather than to the programming-language solution?
* Is the name long enough that you don’t have to puzzle it out?
* Are computed-value qualifiers, if any, at the end of the name?
* Does the name use *Count* or *Index* instead of *Num*?

**Naming Specific Kinds Of Data**

* Are loop index names meaningful (something other than *i*, *j*, or *k* if the loop is more than one or two lines long or is nested)?
* Have all “temporary” variables been renamed to something more meaningful?
* Are boolean variables named so that their meanings when they’re *True* are clear?
* Do enumerated-type names include a prefix or suffix that indicates the category—for example, *Color\_* for *Color\_Red*, *Color\_Green*, *Color\_Blue*, and so on?
* Are named constants named for the abstract entities they represent rather than the numbers they refer to?

**Naming Conventions**

* Does the convention distinguish among local, class, and global data?
* Does the convention distinguish among type names, named constants, enumerated types, and variables?
* Does the convention identify input-only parameters to routines in languages that don’t enforce them?
* Is the convention as compatible as possible with standard conventions for the language?
* Are names formatted for readability?

**Short Names**

* Does the code use long names (unless it’s necessary to use short ones)?
* Does the code avoid abbreviations that save only one character?
* Are all words abbreviated consistently?
* Are the names pronounceable?
* Are names that could be mispronounced avoided?
* Are short names documented in translation tables?

**Common Naming Problems: Have You Avoided...**

* ...names that are misleading?
* ...names with similar meanings?
* ...names that are different by only one or two characters?
* ...names that sound similar?
* ...names that use numerals?
* ...names intentionally misspelled to make them shorter?
* ...names that are commonly misspelled in English?
* ...names that conflict with standard library-routine names or with predefined variable names?
* ...totally arbitrary names?
* ...hard-to-read characters?

## Key Points

* Good variable names are a key element of program readability. Specific kinds of variables such as loop indexes and status variables require specific considerations.
* Names should be as specific as possible. Names that are vague enough or general enough to be used for more than one purpose are usually bad names.
* Naming conventions distinguish among local, class, and global data. They distinguish among type names, named constants, enumerated types, and variables.
* Regardless of the kind of project you’re working on, you should adopt a variable naming convention. The kind of convention you adopt depends on the size of your program and the number of people working on it.
* Abbreviations are rarely needed with modern programming languages. If you do use abbreviations, keep track of abbreviations in a project dictionary or use the Standardized Prefixes approach.