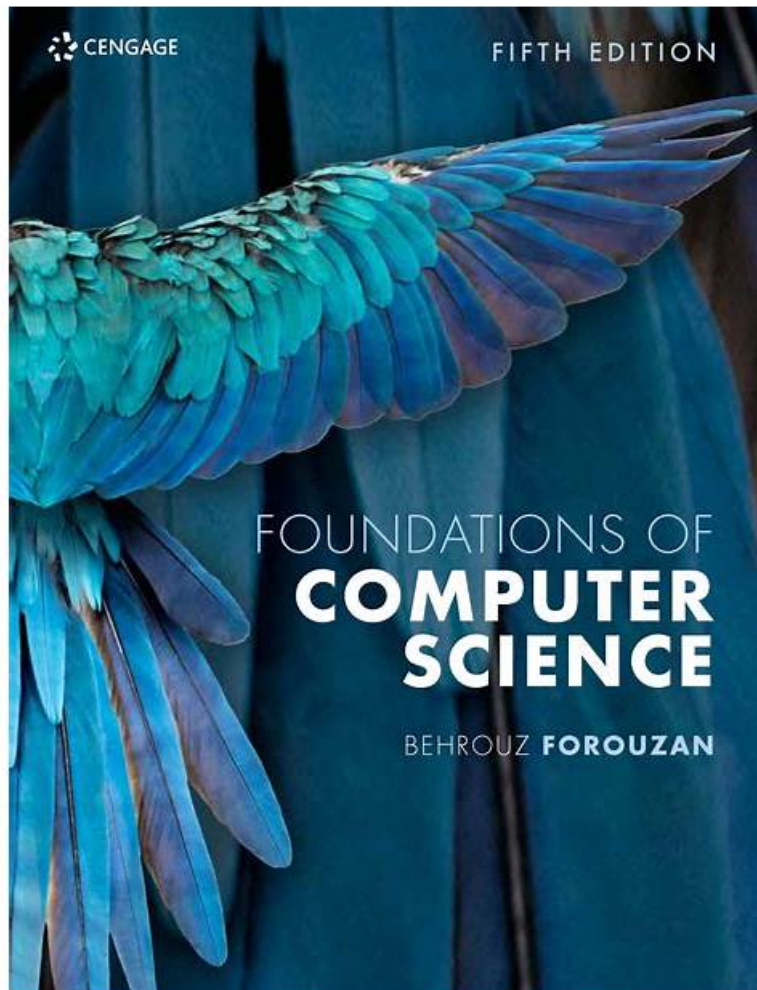


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### 問題 #50

What is the built-in data structure that implements a hash table in Python?

- A. Dictionary
- B. List
- C. Array
- D. Tuple

答案： A

#### 解題說明：

A hash table is a data structure that supports fast lookup, insertion, and deletion by using a hash function to map keys to positions in an underlying storage structure. In Python, the built-in data structure that provides hash-table behavior is the dictionary, written with curly braces like `{"a": 1, "b": 2}`. Dictionaries store key-value pairs and are designed so that accessing a value by key, such as `d["a"]`, is efficient on average.

Textbooks typically describe this expected efficiency as average-case constant time, often written as  $O(1)$ , assuming a good hash function and a well-managed table size.

Tuples and lists are sequence types. Lists provide indexed access by integer position, not hashing by arbitrary keys. Tuples are immutable sequences and likewise do not provide key-based hashing semantics. "Array" is not the core built-in mapping structure in Python; while Python has an array module and NumPy has arrays, neither is the built-in hash table abstraction for general key-value storage.

Python dictionaries require keys to be hashable, meaning the key's hash value is stable during its lifetime (common examples: strings, numbers, tuples of hashable items). This requirement is directly tied to hash-table implementation. Dictionaries are used throughout computer science applications:

symbol tables in interpreters, caches and memoization, frequency counting, indexing, and implementing graphs via adjacency maps.

### 問題 #51

What is a key advantage of using NumPy when handling large datasets?

- A. Interactive visualizations
- B. Automatic data cleaning
- C. Built-in machine learning algorithms
- D. Efficient storage and computation

答案： D

#### 解題說明：

NumPy's key advantage for large datasets is efficient storage and fast computation. Unlike Python lists, which store references to objects and can have per-element overhead, NumPy arrays store data in a compact, homogeneous format (single dtype) in contiguous or strided memory. This reduces memory usage and improves cache locality, which is crucial for performance on large arrays. Additionally, NumPy operations are vectorized: many computations run in optimized compiled code rather than interpreted Python loops. This enables large speedups for arithmetic, linear algebra, statistics, and transformations over entire arrays.

Option A is incorrect because NumPy itself does not provide full machine learning algorithms; those are typically found in libraries like scikit-learn, though they build on NumPy. Option B is incorrect because NumPy does not automatically clean data; data cleaning is usually done with pandas or custom logic. Option D is incorrect because interactive visualizations are typically handled by libraries like matplotlib, seaborn, or plotly, not by NumPy.

Textbooks in scientific computing highlight that NumPy forms the computational foundation of the Python data ecosystem. Its array model supports broadcasting, slicing, and efficient aggregations, all of which are essential when working with millions of numeric values. By combining compact memory layout with compiled numerical kernels, NumPy enables scalable analysis and simulation workloads that would be slow or memory-heavy using pure Python lists.

### 問題 #52

What is the output of `print(employees[3])` when `employees = ["Anika", "Omar", "Li", "Alex"]`?

- A. "Anika"
- B. "Omar"
- C. "Alex"
- D. "Li"

答案: C

解題說明:

Python lists are ordered sequences indexed starting from 0. This zero-based indexing is standard in many programming languages and is a core concept in data structures. For the list `employees = ["Anika", "Omar",`

`"Li", "Alex"]`, the mapping of indices to elements is: index 0 # "Anika", index 1 # "Omar", index 2 # "Li", index 3 # "Alex".

Therefore, the expression `employees[3]` selects the element at index 3, which is "Alex", and `print(employees[3])` outputs `Alex` (strings print without quotes in normal output).

Option A would be correct for `employees[1]`, option D would be correct for `employees[2]`, and option C would be correct for `employees[0]`. This kind of question tests understanding of list indexing, which is essential for iteration, slicing, and algorithm implementation.

# Textbooks also note the difference between indexing and slicing: indexing returns a single element, while slicing returns a sublist.

Here, because square brackets contain a single integer index, it is indexing. If you attempted an index that is out of range, Python would raise an `IndexError`, which reinforces careful reasoning about list length and positions. Understanding these fundamentals is critical for correctly manipulating datasets, where row/column positions and offsets frequently matter.

### 問題 #53

Which Python function would be used to check the data type of a variable `bmi`?

- A. `type(bmi)`
- B. `typeof(bmi)`
- C. `datatype(bmi)`
- D. `check(bmi)`

答案: A

解題說明:

Python provides the built-in function `type()` to determine the data type (more precisely, the class) of an object. Because Python is dynamically typed, variable names are references to objects, and the object itself carries its type information at runtime. Calling `type(bmi)` returns a type object such as `<class 'int'>`, `<class`

`'float'>`, or `<class 'str'>` depending on what value is currently bound to the name `bmi`. This is the standard, textbook-approved method for checking an object's type in Python.

Option C, `typeof(bmi)`, is common in JavaScript, not Python. Options A and B are not standard Python built-ins; they might exist in user code or other languages, but not in Python's core language. In typical coursework and professional usage, `type()` is the correct function.

Textbooks also discuss how `type()` differs from `instance()`. While `type()` directly reports the object's class, `instance(bmi, float)` is often preferred when you want to allow subclass relationships. For example, in object-oriented programming, a subclass instance should often be treated as an instance of its parent class, which `instance` supports. However, when the question asks specifically for the function used to "check the data type," the expected answer is `type()`.

# Understanding type inspection helps with debugging, writing robust functions, and reasoning about operations that are valid for different data types.

### 問題 #54

Which principle can be used to implement an algorithm to calculate factorial or Fibonacci sequence?

- A. Iterative programming
- B. Object-oriented programming
- C. Procedural programming
- D. Recursion programming

答案: D

解題說明:

Factorial and Fibonacci are classic examples used to teach recursion, a technique where a function solves a problem by calling itself on smaller subproblems. The key requirement for recursion is (1) a base case that stops further calls and (2) a recursive case that reduces the problem size. For factorial, the definition is  $n! = n \times (n-1)!$  with base case  $(0! = 1)$  (or  $(1! = 1)$ ). For Fibonacci,  $(F(n) = F(n-1) + F(n-2))$  with base cases  $(F(0)=0)$  and  $(F(1)=1)$ . These mathematical definitions map directly into recursive code, which is why textbooks frequently introduce recursion using these sequences.

While factorial and Fibonacci can also be computed iteratively, the question asks for the principle that can be used to implement such algorithms, and recursion is the canonical textbook answer. Recursion also connects to important CS topics: call stacks, activation records, and divide-and-conquer problem solving.

Option A ("procedural programming") and option D ("object-oriented programming") are broader paradigms rather than the specific technique used in the classic implementations. Option B ("iterative programming") is a valid alternative approach, but the standard instructional principle highlighted for these particular examples is recursion. Textbooks also note that naive recursive Fibonacci is inefficient (exponential time) unless optimized with memoization or converted to an iterative or dynamic programming approach.

## 問題 #55

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