TypeScript vs Python:

Static, Strong, and Structural Typing Explained

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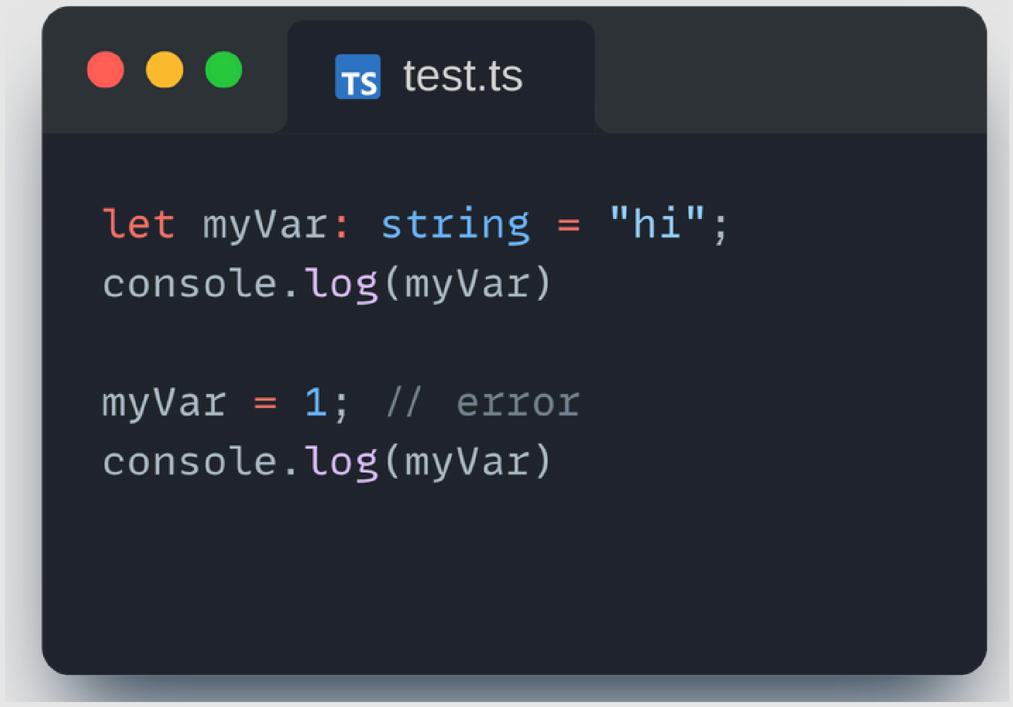
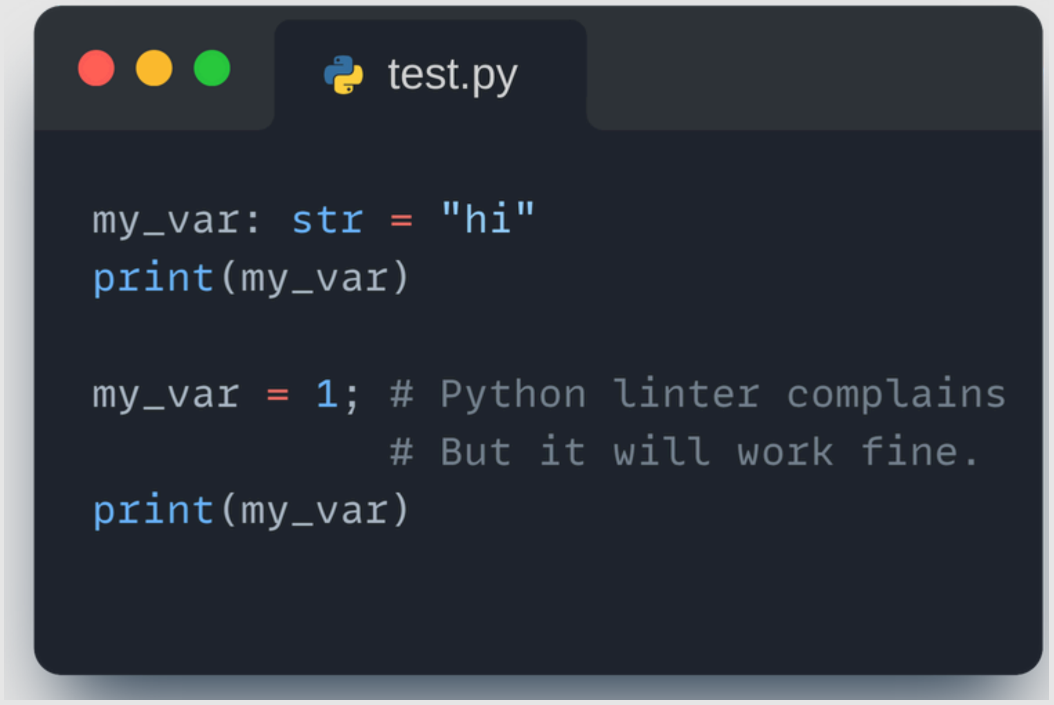
Static vs Dynamic Typing

TypeScript is a statically typed language, whereas Python is dynamically typed. In TypeScript, a variable's type is determined at compile time and cannot change at runtime, though its value can. In contrast, Python allows variables to change both their values and types dynamically, meaning a variable can be reassigned to a value of a different type.


test.ts

```typescript
let myVar: string = "hi";
console.log(myVar)

myVar = 1; // error
console.log(myVar)
```


test.py

```python
my_var: str = "hi"
print(my_var)

my_var = 1; # Python linter complains
            # But it will work fine.
print(my_var)
```

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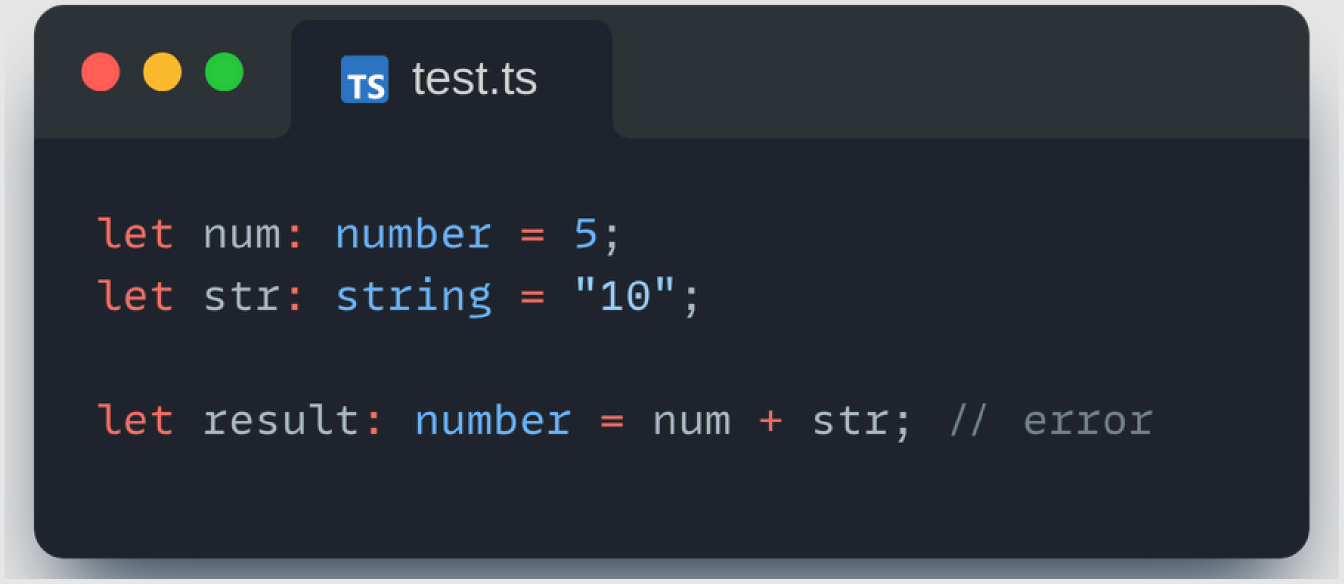
Strong vs Weak Typing

There is no real agreement on what "strongly typed" means, although the most widely used definition in the professional literature is that in a "strongly typed" language, it is not possible for the programmer to work around the restrictions imposed by the type system. TypeScript and Python are both strongly typed languages. The following piece of code will raise an error in TypeScript.



```typescript
let num: number = 5;
let str: string = "10";

let result: number = num + str; // error
```

Weak typing implies that the compiler does not enforce a typing discipline, or perhaps that enforcement can easily be subverted. An example of weakly typed language is JavaScript and you see the above piece of code work just fine in JavaScript.

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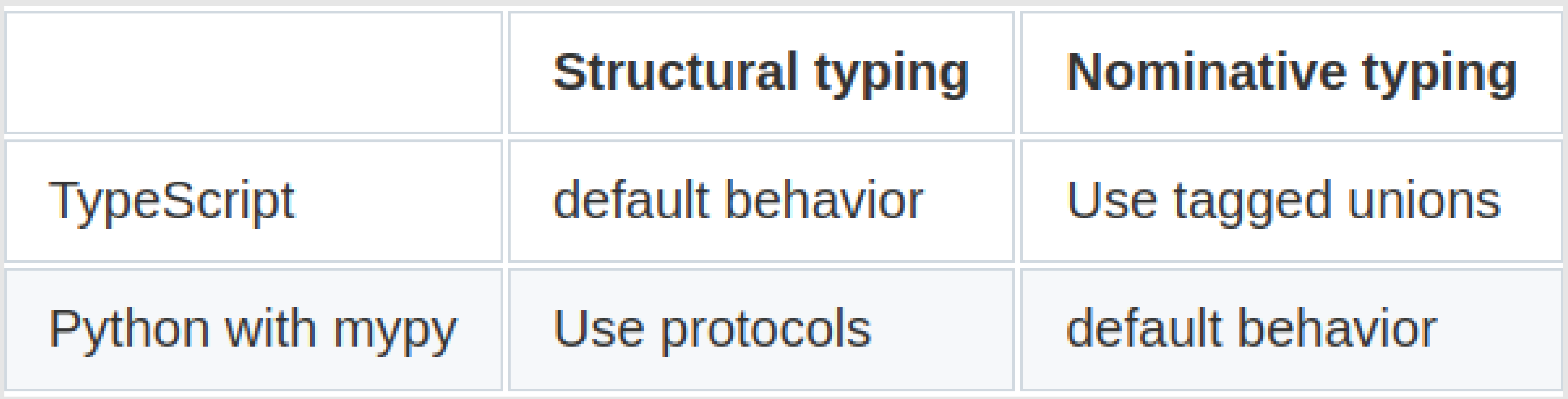
Structural vs Nominal Typing

- In a nominal system, comparisons between types are based on names and declarations. The Python type system is mostly nominal and to achieve structural typing, use protocols.

- In a structural system, comparisons between types are based on structure, e.g. in TypeScript, two types that have the same shape are effectively interchangeable. For nominal typing, use tagged unions.



	Structural typing	**Nominative typing**
TypeScript	default behavior	Use tagged unions
Python with mypy	Use protocols	default behavior

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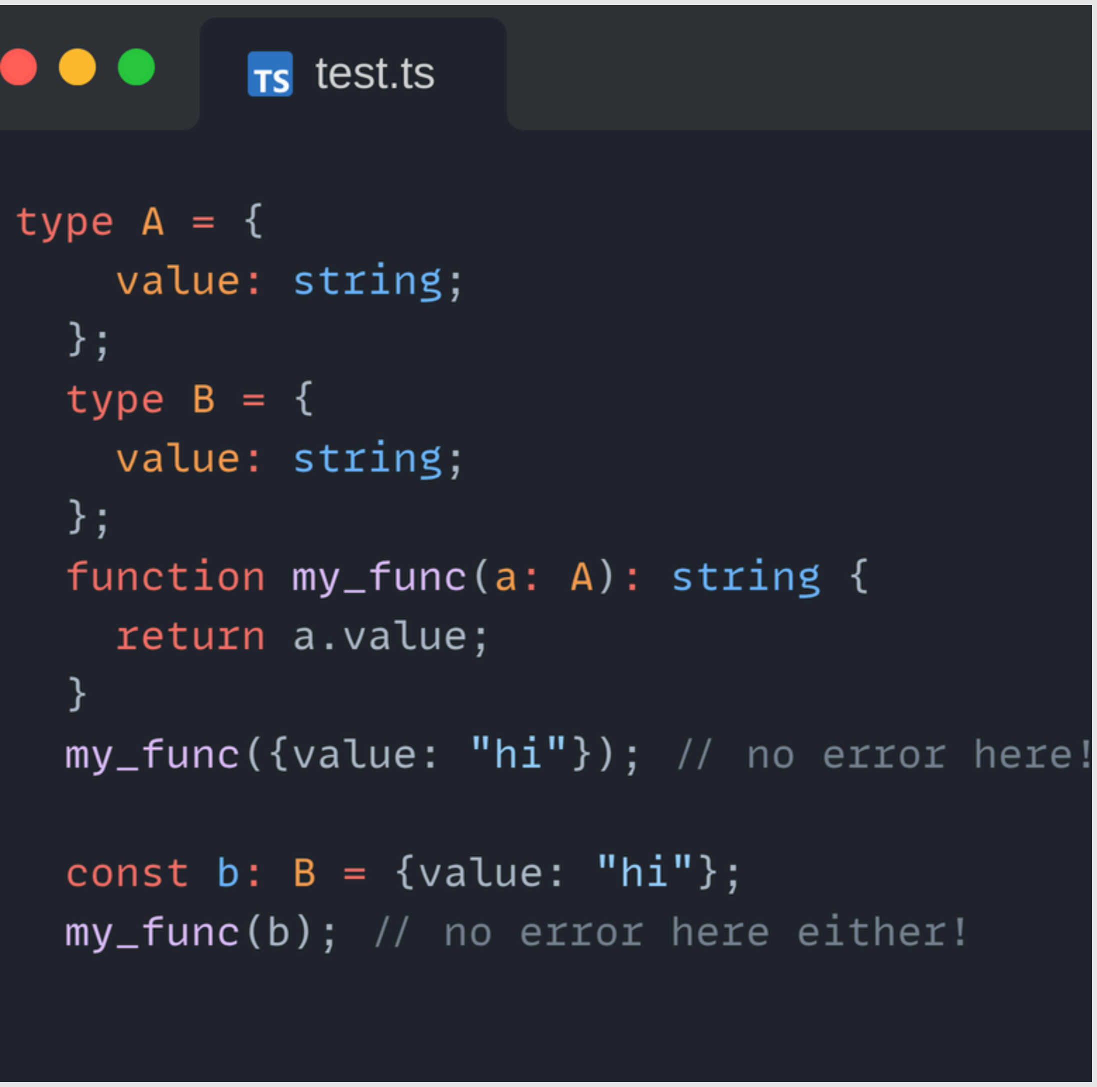
Default Behaviors

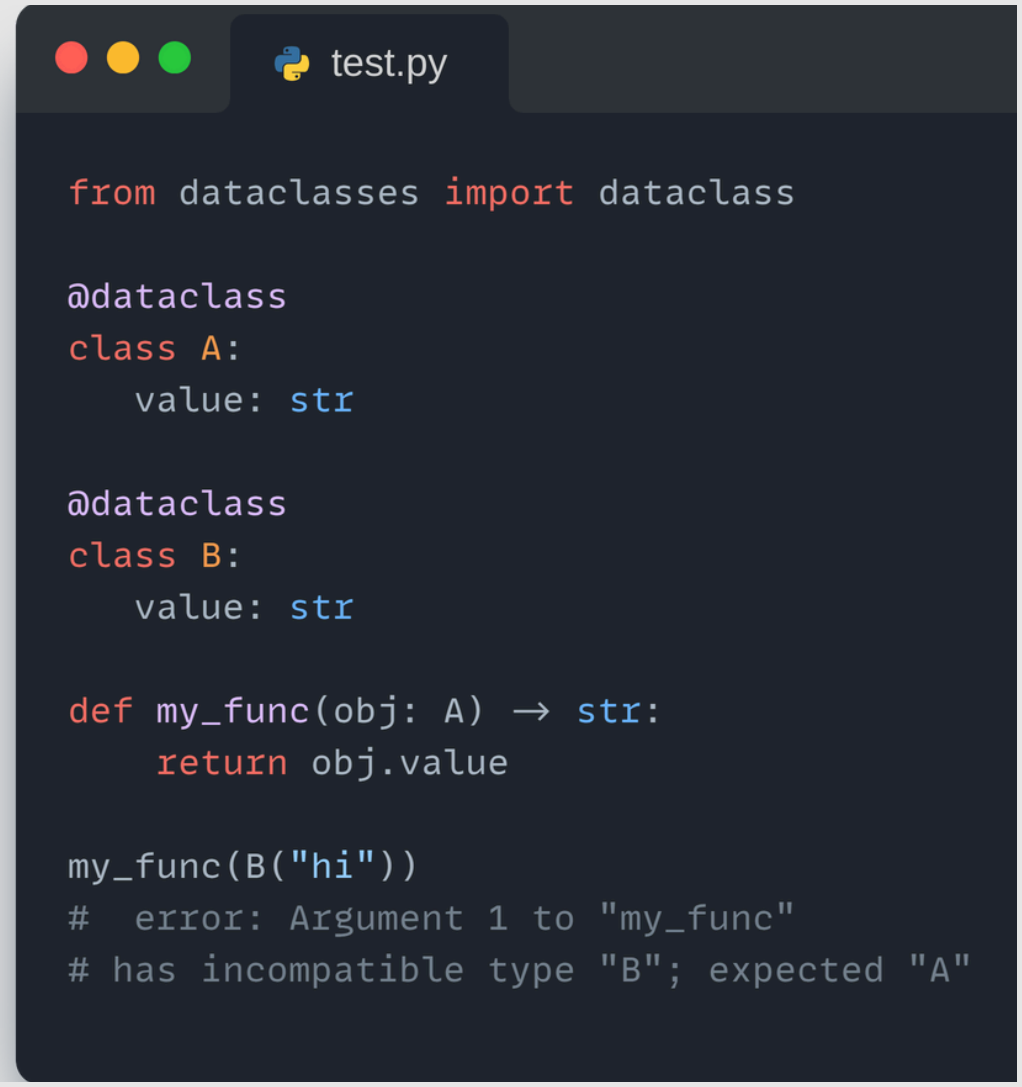
Structural Typing in TypeScript



```
type A = {
    value: string;
  };
  type B = {
    value: string;
  };
  function my_func(a: A): string {
    return a.value;
  }
  my_func({value: "hi"}); // no error here!

  const b: B = {value: "hi"};
  my_func(b); // no error here either!
```

Nominal Typing in Python



```
from dataclasses import dataclass

@dataclass
class A:
   value: str

@dataclass
class B:
   value: str

def my_func(obj: A) → str:
    return obj.value

my_func(B("hi"))
#  error: Argument 1 to "my_func"
# has incompatible type "B"; expected "A"
```

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Useful Links

- TypeScript for Pythonistas
- Python Type Checking (Guide)
- Why is TypeScript surpassing Python?
- Static vs Dynamic Typing: A Detailed Comparison
- Type Checking With Mypy
- What is the difference between a strongly typed language and a statically typed language?
- Structural vs. Nominal Types
- Typed Python For TypeScript Developers