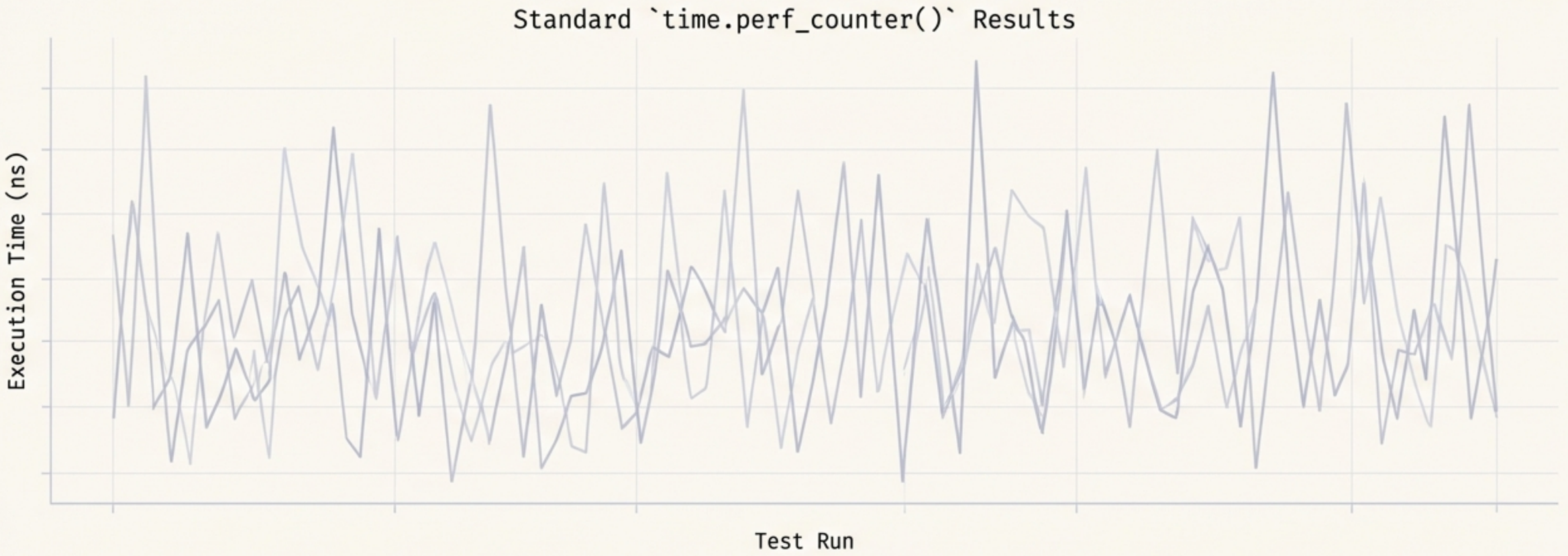
Your Python Benchmarks Are Lying to You



- Standard timing is plagued by noise from the operating system, garbage collection, and context switching.
- The result? Flaky tests, unreliable metrics, and performance changes that are impossible to track.
- You can’t trust the numbers. You can’t build reliable performance tests.

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Achieve Nanosecond-Precision Stability. Every Time.

Introducing `Performance_Measure__Session`: A high-precision benchmarking framework that produces statistically stable, reproducible performance metrics at nanosecond resolution.

It eliminates noise through a rigorous process of Fibonacci-based sampling, outlier removal, and dynamic score normalization.

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From Chaos to Control in Three Lines of Code

1. Import and Measure

```
from osbot_utils.testing.performance
import Perf

def fib(n):
    return n if n < 2 else fib(n-1) +
fib(n-2)

with Perf().measure('fib(10)'):
    fib(10)
```

2. Assert Performance in Tests

```
class Test_MyCode(TestCase):

    def test_fib_10(self):
        with Perf(padding=20) as perf:
            fib(10)

        perf.assert_time(20_000) # asserts
against a normalised score
```

That's it. This single session just ran **1,595 measurements**, removed outliers, and produced a CI-aware, normalised score for a stable assertion.

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Engineered for Trust: Our Design Philosophy

Statistical Robustness: Fibonacci sampling captures warm-up effects; outlier trimming removes GC noise.

Reproducible Scores: Dynamic normalization produces consistent values across runs for stable assertions.

CI-Aware Assertions: Automatic adjustment for slower GitHub Actions runners without code changes.

Zero Ceremony: A clean context manager pattern, fluent API, and sensible defaults get you started instantly.

Type_Safe Integration: All internal models use runtime type checking for maximum reliability.

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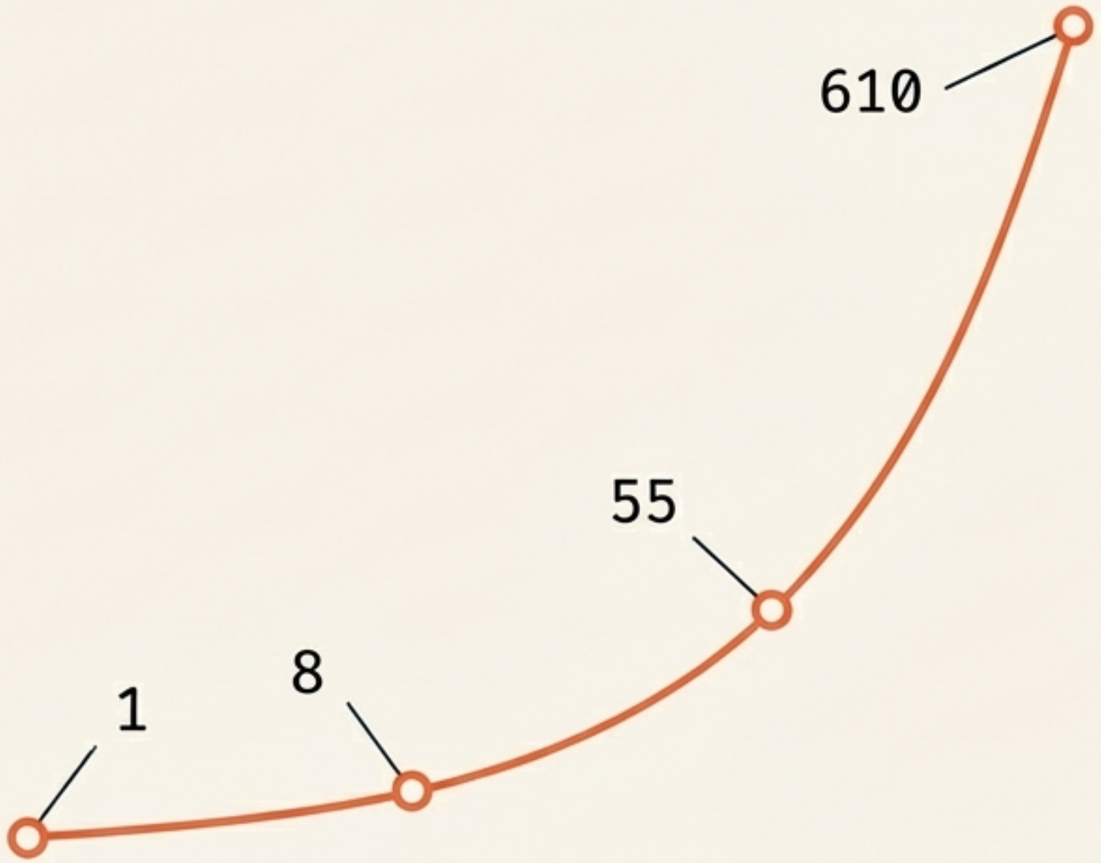
How We Capture the Full Performance Picture

The Fibonacci Measurement Loop: [1, 1, 2, 3, 5, 8, …, 377, 610]



Rapid Early Sampling: Catches cold-start and JIT behaviour.

Logarithmic Scaling: Captures warm-up and cache effects efficiently.

Large Final Samples: Provides the data needed for statistical stability.

Total Invocations: 1,595
per `measure()` call.

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Raw Power vs. Stable Assertions

`raw_score`

Weighted median-mean after outlier removal (60% median, 40% mean).

Debugging, deep performance analysis, understanding raw machine timing.

Run 1: **1,847 ns** | Run 2: **1,912 ns**

`final_score`

The `raw_score` dynamically normalized to a magnitude-appropriate precision.

Assertions, stable cross-environment comparisons.

Run 1: **2,000 ns** | Run 2: **2,000 ns**

Why two scores? Raw scores reflect slight machine variations. Final scores are stabilised for reliable assertions that don't flap.

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Conquer CI Flakiness. Zero Code Changes.

Performance assertions automatically adjust when a GitHub Actions environment is detected.

How it works:

- `assert_time(*expected): Automatically uses the last expected time × 5 as an upper bound.
- `assert_time__less_than(max_time): Automatically multiplies the threshold by 6.

> Write your tests for your local machine. We handle the rest.

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Core Usage Patterns: From a Script to a Test Suite

Basic Measurement (Context Manager)

For quick, one-off performance checks in a script.

```
with Perf().measure("my_func execution") as perf:
    my_func()
perf.print()
```

Reusable Session (Recommended for Test Suites)

The standard for test classes, preventing re-initialization overhead.

```
class Test_MyClass(TestCase):
    session: Perf

    @classmethod
    def setUpClass(cls):
        cls.session = Perf()

    def test_my_method(self):
        with self.session as _:
            _.measure("my_method")
            self.instance.my_method()
        self.session.assert_time(...)
```

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Advanced Patterns: Measure More Than Just Functions

Pattern 3: Measuring Class Instantiation

Use Case: Pinpointing performance costs in object creation.

```
class MyHeavyClass:
    # ... complex __init__ ...

with Perf().measure(MyHeavyClass):
    pass # The context manager handles the instar
```

Pattern 4: Chained Methods (Fluent API)

Use Case: Creating concise, readable, one-line measurements and assertions.

```
Perf().measure(my_func).print().assert_time(1000)
```

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Taming Slow Functions: Control Your Test Times

For functions running longer than 100ms, a full 1,595-invocation run is overkill. Use a faster mode to balance precision and speed.

Method	Invocations	Best For
`measure(target)`	1,595	Default, maximum precision for fast functions
`measure__fast(target)`	87	Balanced speed and precision
`measure__quick(target)`	19	Quick checks for very slow functions (>100ms)

```
# Use quick mode for a slow I/O-bound function
with Perf() as perf:
    perf.measure__quick(slow_database_call)
perf.print()
```

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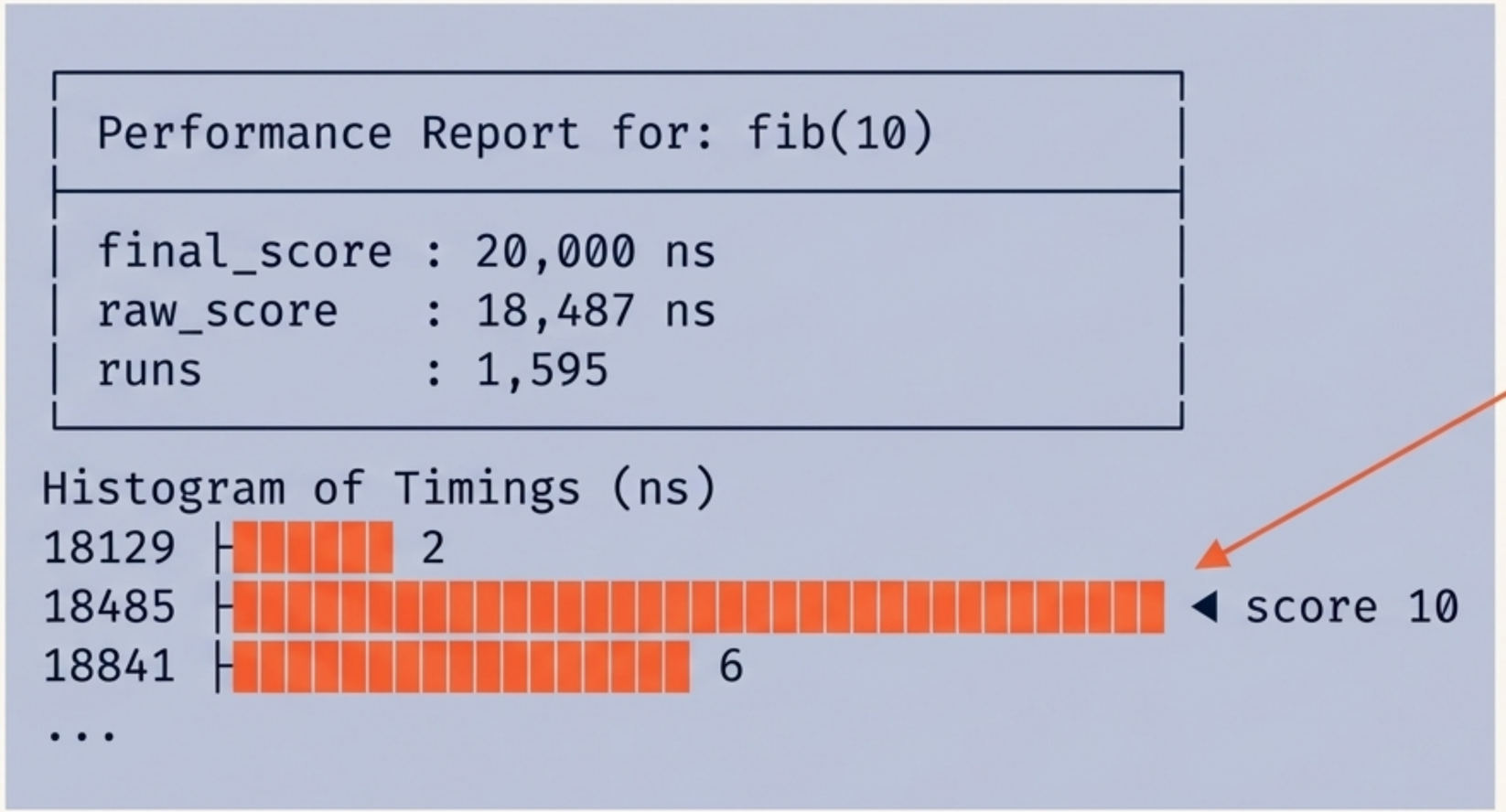
Go Deeper: From a Single Number to the Full Story

Need more than a final score? The detailed report shows the full distribution of your timings.



This marker shows exactly where your calculated score falls within the distribution of all 1,595 measurements.

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Best Practices for Robust Performance Tests

DOs

- **Use a class-level session** in test suites to avoid overhead.
- **Define time thresholds** as named class attributes (e.g., `TIME_FIB_10_NS = 20_000`).
- **Provide multiple expected values** for CI stability: `` `assert_time(20_000, 80_000)` ``.
- **Use** `` `assert_time__less_than` `` for flexible upper-bound checks.

DON'Ts

- **Create new sessions** inside each test method.
- **Measure functions with side effects** (I/O, network calls, randomness).
- **Use raw literal values** in assertions.
- **Skip printing output** when debugging a new test.

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Your Guide to Common Performance Hurdles

Assertion Passes Locally But Fails in CI.

- **Cause:** CI is slower than the automatic 5-6x multiplier allows for your specific test.
- **Solution:** Use `assert_time__less_than(max_value)` for a more generous upper bound, or add a higher expected value value `assert_time(local_val, ci_val)`.

Inconsistent Scores Between Runs.

- **Cause:** The function has variable execution time (I/O, network) or the system is under heavy load.
- **Solution:** Only measure pure, computational functions. Run tests in an isolated environment.

Score is 0ns.

- **Cause:** The function is too fast to measure reliably (sub-100ns).
- **Solution:** Wrap the target function in a loop to measure a larger, more stable unit of work.

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API Quick Reference

Core Session Methods

Method	Description
`measure(target)`	Runs the full 1,595-invocation measurement loop.
`measure__quick(target)`	Quick mode (19 invocations) for slow functions.
`measure__fast(target)`	Fast mode (87 invocations) for balance.
`print()`	Prints the one-line result.
`print_report()`	Prints the detailed report with histogram.
`assert_time(*expected)`	Asserts final score matches an expected value.
`assert_time__less_than(max)`	Asserts final score is below a threshold.

Key Parameters

* `assert_enabled: bool` (Default: `True`): Globally enable/disable all assertion methods.
* `target: Callable`: The function or class to measure.
* `loops: List[int]`: Provide a custom list of loop sizes to override the Fibonacci default.

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Your Checklist for Stable, Reliable Benchmarking

- [ ] Import `Perf` from `osbot_utils.testing.performance`.
- [ ] Create your session once in `setUpClass()`, not per-test.
- [ ] Use the context manager pattern: `with self.session as _:`.
- [ ] Define time thresholds with a clear naming convention.
- [ ] Provide multiple expected values for cross–environment stability (local first, CI last).
- [ ] Use `.print_report()` for deep analyss and `.print()` for quick checks.
- [ ] Use `assert_time()` for exact values and `assert_time__less_than()` for upper bounds.
- [ ] Use `measure__quick()` for slow functions (>100ms).
- [ ] Measure pure functions—no I/O, network, or randomness.
- [ ] Remember: CI gets a 5-6x multiplier automatically.

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