Performative Benchmarking of Unidata MetPy in a CI/CD Workflow

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airspeed velocity (asv)

- airspeed velocity is an open-source Python benchmarking software
- For given versions of software, asv creates environments to emulate the software's state
- asv compiles benchmarking results into an easily digestible web page

```python
def time_lcl(self, timeslice):
    """Benchmarks the LCL function over a 3d cube of data"""
    mpcalc.lcl(self.timeslice.pressure, self.timeslice.temperature,
               self.timeslice.dewpoint)
```

Figure 1: Snippet showing asv benchmark code for MetPy's LCL calculation

CI/CD

- Continuous Integration/Continuous Deployment involves automatic, frequent builds and tests of code
- Jenkins is a CI/CD platform run on a Unidata machine, which provides consistent benchmarking hardware

Benchmarking MetPy quantifies its speed and identifies necessary changes for an efficient user experience

Comparative Benchmarking

- Compares the speed of two branches to identify performance changes

Comparing against main branch

Comparing test_cpp_ cape branch

dewpoint function: 98% slower

wet_bulb_ temperature function: 97% faster

```
| +/-  | Before <main>  | After <test_cpp_cape>  | Ratio  | Benchmark (Parameter)                  |
|------|----------------|------------------------|--------|----------------------------------------|
| +    | 2.46±0.2ms     | 4.85±4ms               | 1.98   | time_dewpoint                          |
| -    | 8.09±0.7s      | 281±10ms               | 0.03   | time_wet_bulb_temperature              |
|      | 852±70µs       | 866±40µs               | 1.02   | time_pressure_to_height_std            |
```

pressure_to_height_std function: 2% slower (insignificant)

Figure 4: A sample of comparative benchmarking results on a C++ branch

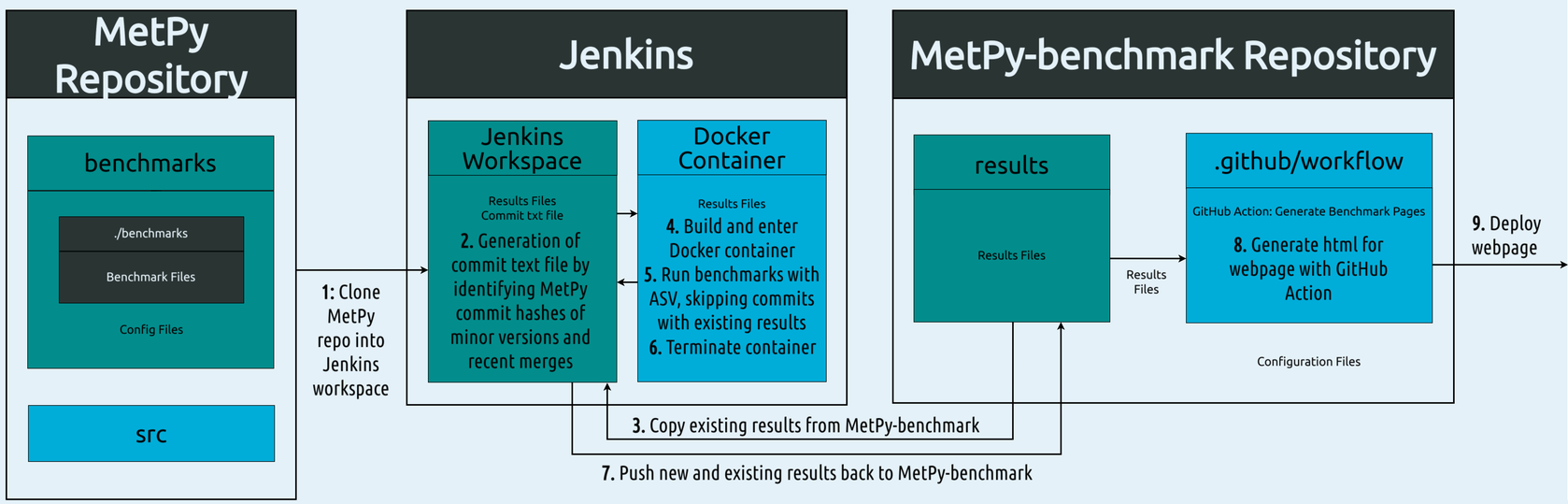

Figure 3: A flowchart demonstrating the Continuous Integration/Continuous Development workflow used for benchmarking MetPy; the workflow triggers weekly

References

Droettboom, M., P. Virtanen, and a. Developers, 2011: airspeed velocity (Version 0.6.4) https://github.com/airspeed-velocity/asv

May, R. M., Goebbert, K. H., Thielen, J. E., Leeman, J. R., Camron, M. D., Bruick, Z., Bruning, E. C., Manser, R. P., Arms, S. C., and Marsh, P. T., 2022: MetPy: A Meteorological Python Library for Data Analysis and Visualization. Bull. Amer. Meteor. Soc., 103, E2273-E2284, https://doi.org/10.1175/BAMS-D-21-0125.1.

Static Page

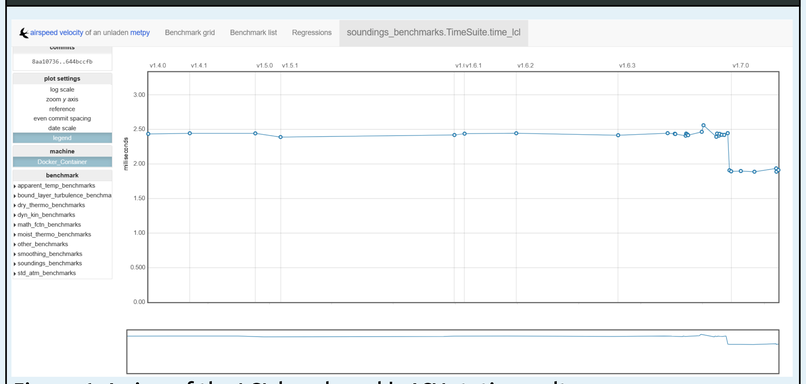

Figure 6: A view of the LCL benchmark's ASV static results page

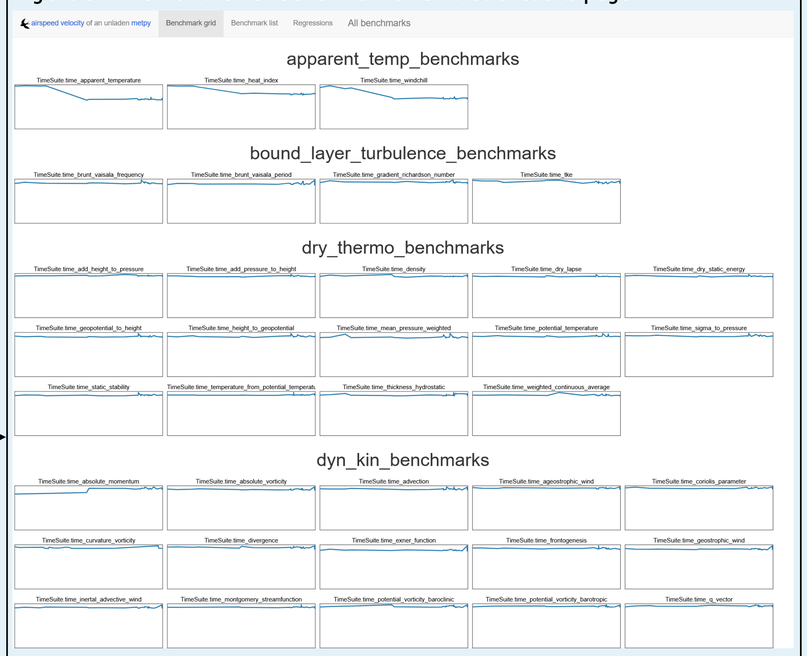

Figure 5: An overview of the ASV results page benchmark grid

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