

# CompositionMeasure for MaxDivergence

Michael Shoemate

This proof resides in “**contrib**” because it has not completed the vetting process.

Proves soundness of the implementation of `CompositionMeasure` for `MaxDivergence` in `mod.rs` at commit `f5bb719` (outdated<sup>1</sup>).

## 1 Hoare Triple

### Precondition

#### Compiler-Verified

Types matching pseudocode.

#### Caller-Verified

None

### Pseudocode

```
1 class CompositionMeasure(MaxDivergence):
2     def composability( # 
3         self, adaptivity: Adaptivity
4     ) -> Composability:
5         if matches(adaptivity, Adaptivity.FullyAdaptive):
6             raise "fully-adaptive composition is not currently supported for max-divergence"
7             return Composability.Concurrent
8
9     def compose(self, d_mids: Vec[Self_Distance]) -> Self_Distance:
10        d_out = 0.0
11        for d_mid in d_mids:
12            d_out = d_out.inf_add(d_mid)
13        return d_out
```

### Postcondition

**Theorem 1.1.** `composability` returns `Ok(out)` if the composition of a vector of privacy parameters `d_mids` is bounded above by `self.compose(d_mids)` under `adaptivity` adaptivity and `out`-composability. Otherwise returns an error.

*Proof.* By the postcondition of `InfAdd` we have that  $\sum_i d_{mids_i} \leq \text{compose}(d_{mids})$ .

Adaptivity	Sequential	Concurrent
Non-Adaptive	Theorem 1[DMNS06]	Theorem 1.8[VW21]
Adaptive	Theorem 1[DMNS06]	Theorem 1.8[VW21]
Fully-Adaptive	None	None

<sup>1</sup>See new changes with `git diff f5bb719..1d55c91 rust/src/combinators/sequential_composition/mod.rs`

This table is reflected in the implementation of **composability** on line 2.

□

## References

- [DMNS06] Cynthia Dwork, Frank McSherry, Kobbi Nissim, and Adam Smith. Calibrating noise to sensitivity in private data analysis. In Shai Halevi and Tal Rabin, editors, *Theory of Cryptography*, pages 265–284, Berlin, Heidelberg, 2006. Springer Berlin Heidelberg.
- [VW21] Salil Vadhan and Tianhao Wang. Concurrent composition of differential privacy, 2021.