

beyond Typeclassopedia

There are quite a few type classes, that are completely fine the way they are defined in the [base](#) library. These are mostly part of the famous [Typeclassopedia](#).

- [Semigroup](#) and [Monoid](#)
- [Functor](#), [Applicative](#) and [Monad](#)
- [Foldable](#) and [Traversable](#)

This article is mainly an overview and doesn't try to explain each type class. I also want to point out some opinionated critique.

Typeclassopedia

The [Typeclassopedia](#) explains a few more type classes.

[Pointed](#) is a superclass of [Applicative](#) with just [pure](#). I am not against this separation, but can't think of an example of [Pointed](#), that isn't also [Applicative](#).

[MonadFix](#) is not as well known as some other type classes, but is actually quite useful. The [RecursiveDo](#) extension adds some syntactic sugar to [MonadFixes](#). This allows recursive bindings in *do*-notation.

CAUTION

I am only covering the “left” side of the [Typeclassopedia](#). The [Category](#) and [Arrow](#) type classes are not discussed here. I am also ignoring [Comonad](#) for now.

To conclude the [Typeclassopedia](#), let's look at [Alternative](#).

Alternative is a monoid

NOTE

[MonadPlus](#) `m` is equivalent to `(Alternative m, Monad m)`. It's an unnecessary alias, but it doesn't do any harm.

[Alternative](#) can actually be expressed with the other already introduced type classes.

CAUTION

The [QuantifiedConstraints](#) language extension is required.

```
class (Applicative f, forall x. Monoid (f x)) => Alternative f where

empty :: f a
empty = mempty

(<|>) :: f a -> f a -> f a
```

```
(<|>) = (<>)
```

NOTE

The **Applicative** `f` superclass is not necessary at all, but otherwise it would be an alias for `forall x. Monoid (f x)`.

The only problem is, that `base` introduces some **Monoid** instances, that don't work with this definition. **Maybe** for example uses a superclass constraint.

```
class Semigroup a => Monoid (Maybe a) where
  -- ...
```

The proposed **Alternative** doesn't work, because `forall a. Semigroup a` (from **Maybe**) is a stronger constraint than `forall x. (from Alternative)`. I am not quite sure, whether this change can actually break **Alternatives** laws. The **Maybe** example will be caught by the compiler at least.

TIP

The solution would be to use compatible instances. The currently used instances can still be made available with **newtypes**.

The **newtype** `Alt` already exists for the other direction **Alternative** `f` \Rightarrow **Monoid** `(f x)`.

The current situation isn't bad though, considering that **newtypes** are annoying to use. Maybe `idris` made the right choice with named implementations (multiple named instances in Haskell terms).

Another interesting change would be the separation of `(<|>)` and `empty`, similar to the separation of **Semigroup** and **Monoid** (or **Pointed** and **Applicative**).

The structure of **Applicative** and **Alternative** is similar to a semiring.

TIP

Applicative / Alternative	natural numbers	boolean algebra	algebra of types
<code>empty</code>	0	<i>false</i>	Void
<code>pure ()</code>	1	<i>true</i>	<code>()</code>
<code>< ></code>	+	<i>or</i>	Either
<code><*></code>	×	<i>and</i>	<code>(,)</code>

The **Typeclassopedia** is actually quite old by now and there are more additions in `base`.

base library

Let's start with **MonadFail**. This type class was a stupid idea to allow pattern matching in *do*-notation. Whenever writing actual code you should use a *case*-block. Patterns that *always* match are fine, but other patterns should just give a warning like "patterns are non-exhaustive".

Bifunctor, **Bifoldable** and **Bitraversable** are nice to have. Generalizations for **Trifunctor**, **Quadrofunctor**, etc. are missing though. I'm not sure how those type classes would be implemented

without boilerplate.

`MonadIO` is a type class for all monads, that use `IO` as the base monad. This is a useful type class, but it can be completely replaced with `MonadBase` from `transformers-base`. Additionally `MonadBaseControl` from `monad-control` could be added to `base`.

NOTE

I am in favor of completely removing `MonadIO`, which some people might find a bit harsh.

`MonadTrans` from `transformers` and `MonadTransControl` from `monad-control` also fit into the same category, but for monad transformers.

`Base` introduces `Contravariant` functors. Analogously to `Applicative` and `Alternative`, the `contravariant` library defines `Divisible` and `Decidable`. These two type class can be quite useful, but I haven't explored this direction any further.

NOTE

This didn't cover *all* type classes from `base`, but only the ones similar to the [Typeclassopedia](#).

Takeaways

- Classes like `Monoid` will often have multiple lawful instances, but Haskell requires us to use a `newtype` for each implementation. Instances should be chosen wisely.
- `Alternative` and `Applicative` can be thought of as monoids.
- `MonadFail` is a *fail*.
- `MonadBase` makes `MonadIO` unnecessary.
- `MonadBaseControl` and `MonadTransControl` would be a nice addition to `base`, including `MonadTrans` and `MonadBase`.
- Other type classes like `Num`, `IsString`, `IsList` or other stock classes deserve their own discussion.