Definition 1. *Given categories $\mathcal{C}$ and $\mathcal{D}$, a natural transformation α from a functor $F : \mathcal{C} \to \mathcal{D}$ to a functor $G : \mathcal{C} \to \mathcal{D}$ is a family of functions $\alpha_a : Fa \to Ga$ for all $a \in \mathcal{C}$, such that the* nautrality square *condition holds: for $a, b \in \mathcal{C}, f : a \to b$, $\alpha_b \circ Ff = Gf \circ \alpha_a$. (Commutative diagram)*

Definition 2. *Functors from $\mathcal{C}$ to $\mathcal{D}$ forms a category called functor category, denoted as $[C, D]$ or $[C; D]$, with functors $C \to D$ as objects, and natural transformations between them as arrows.*

Example 1. `safeHead :: List a -> Maybe a`

Example 2. `maybeSingleton :: Maybe a -> List a`

Example 3. `alpha :: (Unit -> a) -> Maybe a`, *where* `alpha _ = Nothing`

Example 4. `beta :: (Unit -> a) -> Maybe a`, *where* `alpha f = Just (f ())`

Definition 3. *A terminal in C is ... A product in C is ...*

Definition 4. *A diagonal functor/constant functor $\Delta_d : C \to D$ for some object $d \in D$ maps anything in C to d, and maps every morphisms in C to 1_d.*

Definition 5. *A diagram F in C with shape J is a functor $F : J \to C$. A cone (n, ψ) is to F is a object $n : C$ along with a natural transformation $\psi_x : \Delta_n x \to Fx$.*

Definition 6. *Cones for F forms a category, with morphisms $f : (m, \psi) \to (n, \phi)$ to be the same morphism $f : m \to n$. (**Cone**)*[1]

Definition 7. *A limit for F is the terminal in **Cone** category. In other words, a limit is a cone (l, ϕ) that for every other cone (n, ψ), there is a unique morphism $u_n : n \to l$.*

Example 5. *Take J to be empty category, a cone is an arbitrary object, and the limit is the terminal object.*

Example 6. *Take J to be discrete category 2, the limit is the product objects.*

[1]inaccurate, f needs satisfy an extra condition to be a morphism in **Cone**.