

### Functor in applicative

List : Type  $\rightarrow$  Type  
 $a \mapsto [a]$

fmap :  $(a \rightarrow b) \mapsto \text{List } a \rightarrow \text{List } b$

Maybe

$a \rightarrow b \rightarrow c$

fmap f [1, 2, 3] = [f 1, f 2, f 3]

+ :  $a \rightarrow a \rightarrow a$

fmap (+) [1, 2, 3] = [(+) 1, (+) 2, (+) 3]

~~pure (λ x → x) d =~~

pure (λ x → x) (\* ) d = d

pure f (\* ) pure d = pure (f d) ?

IO

$$\text{IO} : \text{Type} \rightarrow \text{Type}$$

$$\text{Int} \mapsto \text{IO Int}$$

Monoid:  $A, * : A \times A \rightarrow A, e : A$

$$e * x = x * e = x$$

$$(x * y) * z = x * (y * z) \quad \begin{matrix} 0 \\ 0 \end{matrix}$$

 $(\mathbb{N}, +, 0)$ 
 $(\mathbb{R}_{>0}, \cdot, 1)$ 
 $(\mathcal{P}([0,1]), +, (\lambda x, 0))$ 
 $(\text{List } (\mathbb{N}), ++, [])$ 
 $(\text{Maybe } a, *, \text{Nothing})$ 

$$\text{Just } x * \text{Nothing} = \text{Just } x$$

... ..

Monid

Kdaj je Maybe a monoid? Če je a že monoid

$$\text{Nothing} * \Delta = X$$

$$* \nabla \text{Nothing} = \text{Nothing} * X$$

$$\text{Just } \frac{x}{a} * \text{Just } \frac{y}{a} = \text{Just } \underbrace{(x * y)}_a$$

(N, +, 0) Maybe N? a

$$\text{Just } 0 * \text{Nothing} = 0$$

$$\text{Just } m + \text{Just } n = \text{Just } (m+n)$$

G generatorji	$g_1, g_2, g_3, \dots$	$\{a, b\}$	e
g	(e) $e+g=g$		a, b
	$g + (g+g)$		a+b, b+a
	$(g+g)+g$		a+a, b+b