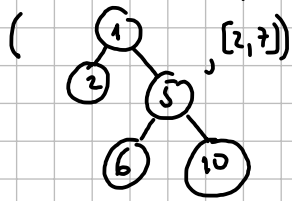


podatek

informacija



implementacija

modul / struktura

type queue = int list

let push q x = ...

tip podatka

struktura

kako je informacija predstavljena / organizirana

tree x int list

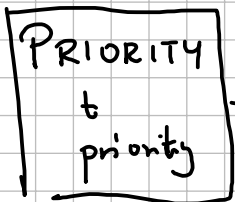
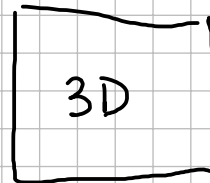
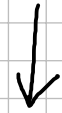
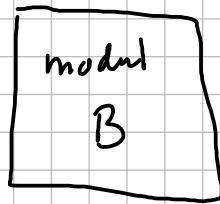
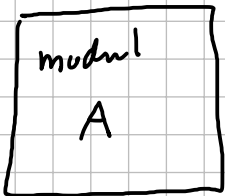
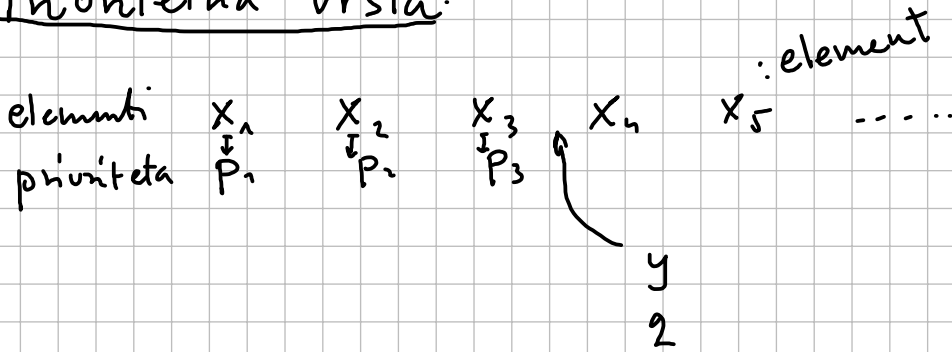
specifikacija

tip modula / signatura

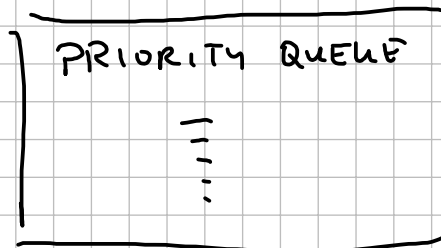
type queue

val push : queue -> int -> ...

Prioritetna vrsta:



List Queue
funktor



Podtipi

$$A \leq B$$

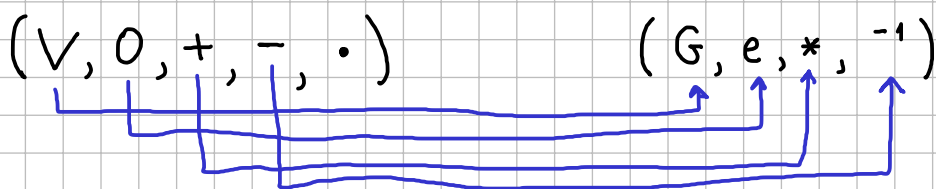
"A je podtip B"
velja, če lahko vrednosti tipa A uporabljamo, kot da bi imele tip B

Primeri:

$$\mathbb{R} \leq \mathbb{C}$$

realno število $x \in \mathbb{R}$ pretvornimo v $x + i \cdot 0 \in \mathbb{C}$

Vektorski Prostor \leq Abelova Grupa



Driver 2.0 je kompatibilen z Driver 1.7

$$\text{Driver 2.0} \leq \text{Driver 1.7}$$

Podatkovna baza:

OSEBA: ime	priimek	emšo	naslov
------------	---------	------	--------

Pravila:

$$A \leq A \quad \text{refleksivnost}$$

$$\frac{A \leq B \quad B \leq C}{A \leq C} \quad \text{transitivnost}$$

$$\frac{A \leq B \quad B \leq A}{A = B}$$

antisimetričnost } v splošnem ne velja

} \leq je šibka urejenost

$$\frac{A_1 \leq B_1 \quad A_2 \leq B_2}{A_1 \times A_2 \leq B_1 \times B_2} \quad \checkmark$$

int \leq float

$$\mathbb{Z} \leq \mathbb{R} \quad \text{int} \leq \text{float}$$

$$\sin: \mathbb{R} \rightarrow \mathbb{R}$$

$$\sin 42 \quad \checkmark$$

$$\left(\sin \frac{\pi}{6}\right) \text{div } 7 \quad \times$$

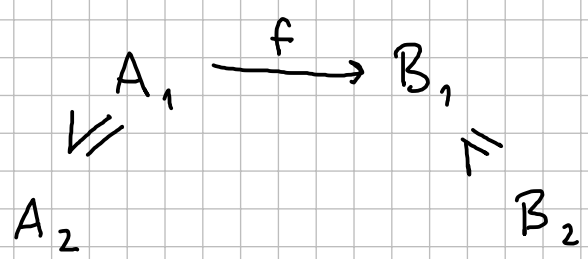
$$\mathbb{R} \not\leq \mathbb{Z}$$

Celoštevilsko deljenje

Pozor!

$$\frac{A_2 \leq A_1 \quad B_1 \leq B_2}{A_1 \rightarrow B_1 \leq A_2 \rightarrow B_2}$$

Relacija \leq je kontravariantna v domeni funkcije in kovariantna v kodomeni.



za vsaj $j \leq m$ obstaja $i \leq n$, da je $l_i = k_j$ in $A_i = B_j$

$$\{l_1: A_1; \dots; l_n: A_n\} \leq \{k_1: B_1; \dots; k_m: B_m\}$$

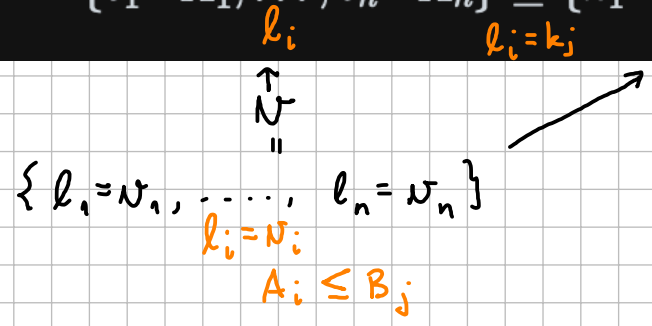
$$\{x: \text{float}, y: \text{float}, z: \text{float}\} \leq \{x: \text{float}, y: \text{float}\} \quad \checkmark$$

$$\{x: \text{float}, z: \text{float}, y: \text{float}\} \leq \{x: \text{float}, y: \text{float}\} \quad \checkmark$$

$$\{x: \text{float}, y: \text{int}\} \leq \{x: \text{float}, y: \text{float}\} \quad \times$$

float \neq int

za vsak $j \leq m$ obstaja $i \leq n$, da je $l_i = k_j$ in $A_i \leq B_j$

$$\{l_1: A_1; \dots; l_n: A_n\} \leq \{k_1: B_1; \dots; k_m: B_m\}$$


Spremenljiva polja

{ x: float, y: float }

point = { mutable x: float, y float }

→

```
class Point {
  float x;
  final float y;
}
```

Običajno velja:

{ x: int } ≤ { x: float }
v.x: int → v.x: float

predpostavljamo
int ≤ float

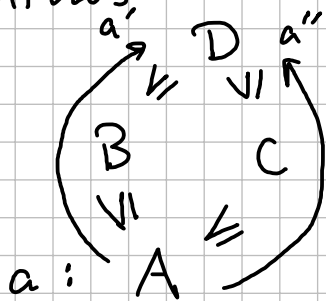
Potrebno:

če v: { mutable x: int } ≤ { mutable x: float }

potem : v.x ← 4.2 **ne gre**

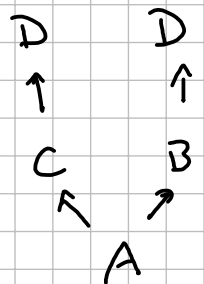
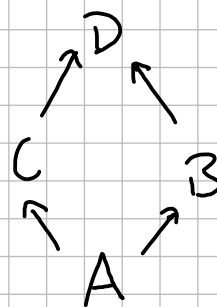
Sprememba stanja je kontravariantna
dostop (branje) stanja je kovariantno

Koherentnost:



Multiple inheritance

Class A extends B, C



Objektno programiranje

```
{ mutable x: int,  
  mutable y: int }
```

```
let f (... ) --  
  g  
  h
```

```
class Point {  
  int x, y; ?  
  .
```

```
metode { int f(... ) { this ... }  
        g  
        h
```

Objekt se lahko skljuje
sam nase

Objekt = rekurzivni zapis