Introduktion til Programmering og Problemløsning (PoP)

Jon Sporring
Department of Computer Science
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UNIVERSITY OF COPENHAGEN

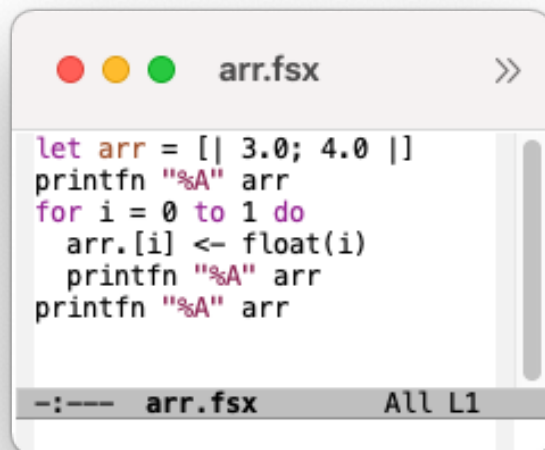# Hvor langt er I kommet med materialet?

https://tinyurl.com/mtx48bbp

Hvad er værdien og typen

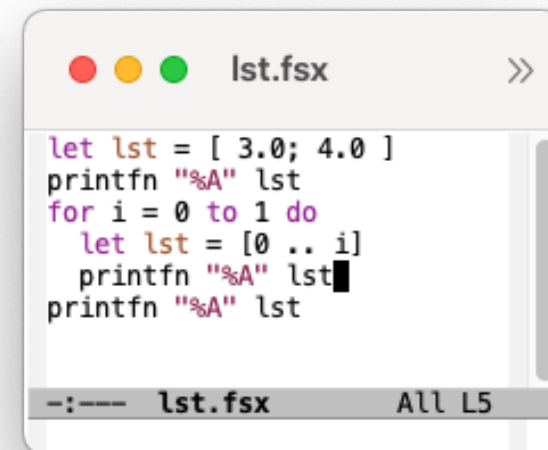https://tinyurl.com/4ethtv6t

Arrays vs. lists

Hvad skriver programmet?


```
arr.fsx

let arr = [| 3.0; 4.0 |]
printfn "%A" arr
for i = 0 to 1 do
  arr.[i] <- float(i)
  printfn "%A" arr
printfn "%A" arr

-:---   arr.fsx        All L1
```



```
lst.fsx

let lst = [ 3.0; 4.0 ]
printfn "%A" lst
for i = 0 to 1 do
  let lst = [0 .. i]
  printfn "%A" lst
printfn "%A" lst

-:---   lst.fsx        All L5
```

https://tinyurl.com/549mne7x

Funktioner som argumenter og returværdi

List.fold og List.foldBack

Hvad er typen?

    % fsharpi

    Microsoft (R) F# Interactive version 11.0.0.0 for F# 5.0
    Copyright (c) Microsoft Corporation. All Rights Reserved.

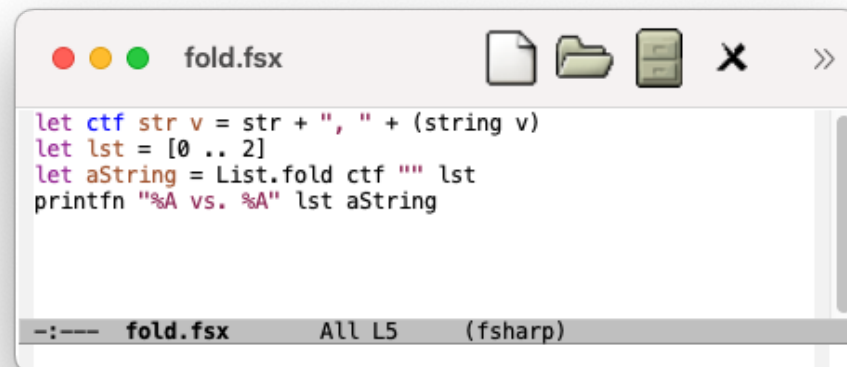   For help type #help;;   Vilkårlig type 'a og 'b

    > List.fold;;
    val it : (('a -> 'b -> 'a) -> 'a -> 'b list -> 'a)
    > List.foldBack;;
    val it : (('a -> 'b -> 'b) -> 'a list -> 'b -> 'b)

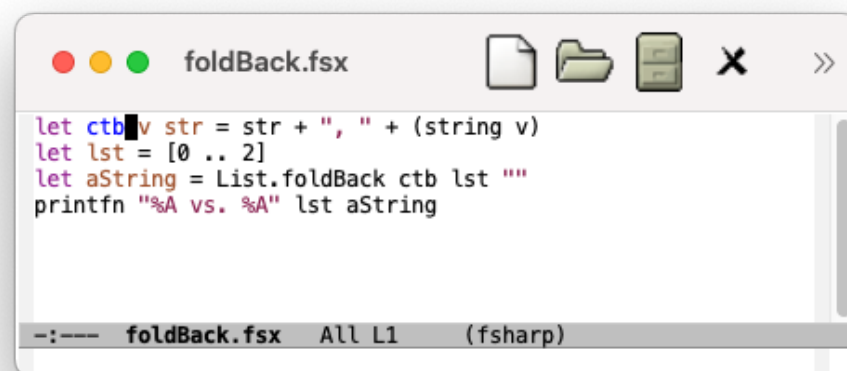List.fold tager en funktion f a b -> a, a, en liste af b og returnerer a typer.

```
let ctf str v = str + ", " + (string v)
let lst = [0 .. 2]
let aString = List.fold ctf "" lst
printfn "%A vs. %A" lst aString
```
-:--- fold.fsx   All L5   (fsharp)

List.fold: ctf (ctf (ctf "" 0) 1) 2

List.foldBack tager en funktion f a b -> b, en liste af a, b og returnerer b.

```
let ctb v str = str + ", " + (string v)
let lst = [0 .. 2]
let aString = List.foldBack ctb lst ""
printfn "%A vs. %A" lst aString
```
-:--- foldBack.fsx   All L1   (fsharp)

List.foldBack: ctb 0 (ctb 1 (ctb 2 ""))

List.fold og List.foldback med anonyme funktioner

Sum en liste af heltal:

List.fold (fun acc elm -> acc + elm) 0 [1..5]

List.foldBack (fun elm acc -> acc + elm) [1..5] 0

Debugging med printfn og sekvenser af udsagn:

List.fold (fun acc elm -> printfn "%d" acc; acc + elm) 0 [1..5]

List.foldBack (fun elm acc -> printfn "%d" acc; acc + elm) [1..5] 0

Hvor lang tid tager det?

```fsharp
open System.Diagnostics

let lst = [1UL..1000000UL]
let timer = Stopwatch()
let N = 3;

for i = 1 to N do
  timer.Reset()
  timer.Start()
  let af = List.fold (fun acc elm -> acc + elm) 0UL lst
  printfn "fold sum: %A" af
  timer.Stop()
  printfn "fold took: %d ms" timer.ElapsedMilliseconds

for i = 1 to N do
  timer.Reset()
  timer.Start()
  let ab = List.foldBack (fun elm acc -> acc + elm) lst 0UL
  printfn "foldback sum: %A" ab
  timer.Stop()
  printfn "foldback took: %d ms" timer.ElapsedMilliseconds
```

```
U:---  time.fsx      All L5      (fsharp)
Wrote /Users/jrh630/repositories/PoP.git/lectures/05Lists/src/time.fsx
```

```
% fsharpi time.fsx
fold sum: 500000500000UL
fold took: 37 ms
fold sum: 500000500000UL
fold took: 4 ms
fold sum: 500000500000UL
fold took: 2 ms
foldback sum: 500000500000UL
foldback took: 17 ms
foldback sum: 500000500000UL
foldback took: 11 ms
foldback sum: 500000500000UL
foldback took: 13 ms

% fsharpc time.fsx && mono time.exe
Microsoft (R) F# Compiler version 11.0.0.0 for F# 5.0
Copyright (c) Microsoft Corporation. All Rights Reserved.
fold sum: 500000500000UL
fold took: 162 ms
fold sum: 500000500000UL
fold took: 5 ms
fold sum: 500000500000UL
fold took: 2 ms
foldback sum: 500000500000UL
foldback took: 15 ms
foldback sum: 500000500000UL
foldback took: 12 ms
foldback sum: 500000500000UL
foldback took: 9 ms
```

Spørgsmål