Functional Programming   WS 2007/2008   LVA 703018

Solutions

1.

$$\text{take } 2 \ [5; 7; 2; 4] \rightarrow^* \textbf{if } 2 <= 0 \textbf{ then } [] \textbf{ else } 5 :: \text{take } (2 - 1) \ [7; 2; 4]$$
$$\rightarrow^* \textbf{if false then } [] \textbf{ else } 5 :: \text{take } (2 - 1) \ [7; 2; 4]$$
$$\rightarrow^* 5 :: \text{take } (2 - 1) \ [7; 2; 4]$$
$$\rightarrow^* 5 :: \text{take } 1 \ [7; 2; 4]$$
$$\rightarrow^* 5 :: \textbf{if } 1 <= 0 \textbf{ then } [] \textbf{ else } 7 :: \text{take } (1 - 1) \ [2; 4]$$
$$\rightarrow^* 5 :: \textbf{if false then } [] \textbf{ else } 7 :: \text{take } (1 - 1) \ [2; 4]$$
$$\rightarrow^* 5 :: 7 :: \text{take } (1 - 1) \ [2; 4]$$
$$\rightarrow^* 5 :: 7 :: \text{take } 0 \ [2; 4]$$
$$\rightarrow^* 5 :: 7 :: \textbf{if } 0 <= 0 \textbf{ then } [] \textbf{ else } 2 :: \text{take } (0 - 1) \ [4]$$
$$\rightarrow^* 5 :: 7 :: \textbf{if true then } [] \textbf{ else } 2 :: \text{take } (0 - 1) \ [4]$$
$$\rightarrow^* 5 :: 7 :: []$$
$$= \quad [5; 7]$$

2.

```
let list_max xs = fold1 Pervasives.max xs;;
```

3.

```
let rec mirror = function
 | Empty -> Empty
 | Node (l, a, r) -> Node (mirror r, a, mirror l)
;;
```

4. (a)

$$\mathcal{S}\mathsf{ub}(t) = \{\lambda xy.x \ ((\lambda xz.y) \ z) \ w,$$
$$\lambda y.x \ ((\lambda xz.y) \ z) \ w,$$
$$x \ ((\lambda xz.y) \ z) \ w,$$
$$x \ ((\lambda xz.y) \ z),$$
$$(\lambda xz.y) \ z,$$
$$\lambda xz.y,$$
$$\lambda z.y,$$
$$w,$$
$$x,$$
$$y,$$
$$z$$
$$\}$$

(b)

$$\mathcal{V}\mathsf{ar}(t) = \{w, x, y, z\}$$
$$\mathcal{BV}\mathsf{ar}(t) = \{x, y, z\}$$
$$\mathcal{FV}\mathsf{ar}(t) = \{w, z\}$$

(c) No, since following β-step is possible:

$$\lambda xy.x \ \underline{((\lambda xz.y) \ z)} \ w \rightarrow_\beta \lambda xy.x \ (\lambda z'.y) \ w$$