

Solutions to the 2004 Sample Exam for CSE3322

Question 1

- (a) 5
- (b) 5
- (c) 1
- (d) 5
- (e) 4
- (f) 2
- (g) 4
- (h) 1
- (i) 2
- (j) 1
- (k) 3
- (l) 3
- (m) 4
- (n) 5
- (o) 3.

Question 2

A possible solution is:

```
exception Empty;

fun last [] = raise Empty
| last [x] = x
| last (x::xs) = last xs;
```

Question 3

A possible solution is:

```
exception NoSuchElement;

fun find f [] = raise NoSuchElement
| find f (x::xs) =
    if (f x) then x
    else (find f xs);
```

Question 4

- (a) datatype Shape = Circle of real * real * real
 | Box of real * real * real * real
- (b) exception NoSuchElement;
- ```
fun circle (x,y) r = Circle(x,y,r);

fun box (x,y) w h = Box(x,y,w,h);
```
- (c) fun between x y z = x < y andalso y < z:real;
- ```
fun contains (Circle(x,y,r)) (x1,y1) =
      ((x1-x)*(x1-x) + (y1-y)*(y1-y) )< r*r
|   contains (Box(x,y,w,h)) (x1,y1) =
      (between x-0.5*w x1 x+0.5*w) andalso
      (between y-0.5*h y1 y+0.5*h);
```

Question 5

- (a) $(a \mid b)^+$
- (b)

$S \rightarrow X$ condition $X.na = X.nb$
 $X1 \rightarrow a X2$ condition $X1.na = X2.na + 1, X1.nb = X2.nb$
 $X1 \rightarrow a$ condition $X1.na = 1, X1.nb = 0$
 $X1 \rightarrow b X2$ condition $X1.na = X2.na, X1.nb = X2.nb + 1$
 $X1 \rightarrow b$ condition $X1.na = 0, X1.nb = 1$

Question 6

- (a) $FIRST(A) = \{a, \epsilon\}$ $FIRST(B) = \{b, \epsilon\}$ $FIRST(S) = \{a, b, \epsilon, +\}$
- (b) $FOLLOW(A) = \{+\}$ $FOLLOW(B) = \{\$\}$ $FOLLOW(S) = \{\$\}$
- (c)

stack	input	
\$S	a+b\$	P1
\$B+A	a+b\$	P3
\$B+Aa	a+b\$	advance
\$B+A	+b\$	P4
\$B+	+b\$	advance
\$B	b\$	P5
\$Bb	b\$	advance
\$B	\$	P6
\$	\$	accept

- (d) No, it is not the correct table. Entry for [S,\$] should be P2.

Question 7

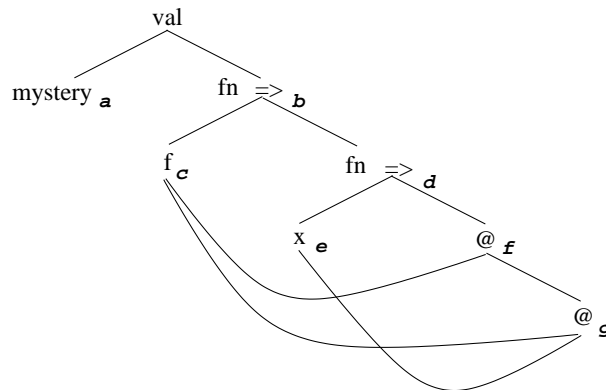
- (a)
- { $S' \rightarrow S, S \rightarrow A+B, S \rightarrow B, A \rightarrow \cdot, A \rightarrow \cdot aA, B \rightarrow \cdot bB, B \rightarrow \cdot$ }
 - { $A \rightarrow a.A, A \rightarrow \cdot, A \rightarrow \cdot aA$ }
 - { $B \rightarrow b.B, B \rightarrow \cdot, B \rightarrow \cdot bB$ }
 - { }
 - { $S \rightarrow A.+B$ }
 - { $S \rightarrow B.$ }
 - { $S' \rightarrow S.$ }

(b)

stack	input	action
0	a+b\$	s1
0a1	+b\$	reduce by $A \rightarrow \epsilon$ goto(1,A)
0a1A6	+b\$	reduce by $A \rightarrow aA$ goto(0,A)
0A3	+b\$	s8
0A3+8	b\$	s2
0A3+8b2	\$	reduce by $B \rightarrow \epsilon$ goto(2,B)
0A3+8b2B7	\$	reduce by $B \rightarrow bB$ goto(8,B)
0A3+8B9	\$	reduce by $S \rightarrow A+B$ goto(0,S)
0 S 5	\$	accept

Question 8

(a)



(b)

- a = b val
- b = c → d function definitio
- d = e → f function definition
- c = g → f function application
- c = e → g function application

(c) $(e \rightarrow e) \rightarrow e \rightarrow e$