

# CSE 341: Programming Languages

Autumn 2005

Lecture 10 — Free Variables and Argument Substitution -  
Mini-Exercises

# Free Variables - Mini-Exercise 1

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What are the free variables in the following ML expressions?

```
a+b;
```

```
let val y=10  
in  
    x+y+10  
end;
```

## Free Variables - Mini-Exercise 2

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What are the free variables in the following ML expression?

```
let val x=1;
    val y=x+z
in
    let val y=10;
        val z=20;
    in
        w+x+y+z
    end
end;
```

# Argument Substitution - Mini-Exercise 1

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Use the rule that  $(\text{fn } x \Rightarrow e1) e2$  is equivalent to  $e3$  where  $e3$  is  $e1$  with every  $x$  replaced by  $e2$  (with some restrictions!)

For example,  $(\text{fn } x \Rightarrow x+y) 3$  is equivalent to  $3+y$

For each of these cases, either give the result of applying the rule, or say that it isn't possible (and why).

$(\text{fn } x \Rightarrow x + \text{let val } x=100 \text{ in } x+y \text{ end}) 3$

$(\text{fn } x \Rightarrow \text{let val } y=100 \text{ in } x+y \text{ end}) y$

$(\text{fn } x \Rightarrow 42) (1 \text{ div } 0)$

$(\text{fn } x \Rightarrow x+x+x) (\text{horrible } 100000)$