Compilation Methods SS 2013 - Assignment 6

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Exercise 1 (Register optimal evaluation of expression trees)

For each of the following two expressions

```
a * b + c * (d + e)
a + (b + (c + (d + e)))
```

1. Draw a tree in the style of Slide C-4.5.
2. Compute the attribute values: need, first, res, avail. Assume that 3 registers are available.
3. Write the generated instruction sequence, using machine instructions as given below.

```
load var, reg     // value of var ist loaded to register reg
add reg1, reg2    // reg2 = reg1 + reg2
mul reg1, reg2    // reg2 = reg1 * reg2
```

Exercise 2 (Register Allocation by Belady's Technique)

Consider the following piece of straight line code where `xi` denotes a variable allocated in memory, and `a` to `e` denote symbolic registers that are to be mapped to real registers `r1, r2, ...`.

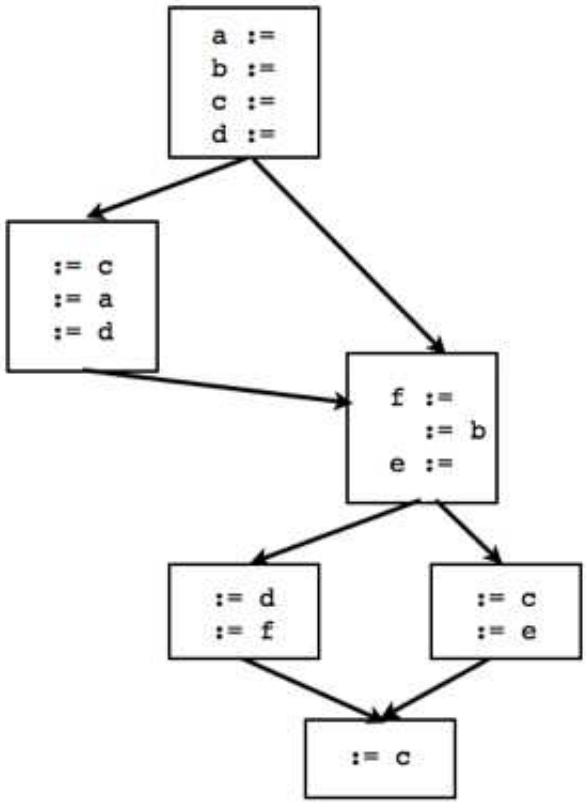
```
a := x1;
b := x2;
c := a+b;
d := c*a;
e := b+d;
```

a) Determine the lifetime of the values in `a` to `e`. Draw the interval graph for lifetimes. How many registers are needed to execute this sequence of assignments? Assign that number of registers to `a` to `e` and rewrite the sequence of assignments.

b) Assume that the above code needs `n` registers, but only `n-1` are available. Which register do you choose for spilling? Assign `n-1` to `a` to `e`, and rewrite the sequence of assignments with spill-code inserted.

Exercise 3 (Register Allocation by Graph Coloring)

Consider the following CFG. The basic blocks contain definitions and uses of the variables `a` to `f`:



a) Analyze the lifetimes of the variables, and represent overlapping lifetimes by an interference graph (see Slide 408). Determine *k*, i.e. the minimum number of registers needed to allocate each of `a` to `f` to a register.

b) Color the interference graph with *k* colors. That is, assign *k* physical registers to the symbolic registers `a` to `f`.