https://folk.ntnu.no/michaeng/tdt4205_21/
michael.engel@ntnu.no

Theoretical exercises
Spring 2021

Theoretical Exercises 4

Intermediate Representations

Please submit solutions on Blackboard by Friday, 12.03.2021 14:00h

4.1 DAGs (3 points)

Construct the DAG for the following expressions. Assume that the + operator is left-associative:

a. `a + b + (a + b)`

b. `a + b + a + b`

c. `a + a + (a + a + a + (a + a + a + a))`

4.2 Intermediate representations (4 points)

Translate each of the following expressions into

- a syntax tree
- as well as quadruples

for the three-address code (TAC) IR as described in lecture 12:

a. `a = b[i] + c[j]`

b. `a[i] = b*c - b*d`

c. `x = f(y+1) + 2`

d. `x = *p + &y`

4.3 Basic blocks and TAC analysis (3 points)

Consider the following TAC sequence:

```
1  a = input
2  b = input
3  t1 = a + b // line3
4  t2 = a * 2
5  c = t1 + t2
6  if a < c goto 8
7  t2 = a + b
8  b = 25      // line8
9  c = b + c
10 d = a - b
11 if t2 = 0 goto 17
12 d = a + b
13 t1 = b - c
14 c = d - t1
15 if c < d goto 3
16 c = a + b
17 output c    // line 17
18 output d
```

a. Indicate where new basic blocks start. For each basic block, give the line number such that the instruction in the line is the first one of that block.

b. Give names $B1$, $B2$, ... for the program's basic blocks in the order the blocks appear in the given listing. Draw the control flow graph making use of those names. Do not put in the code into the nodes of the flow graph, the labels Bi are sufficient.

c. Are there instructions which can be omitted (to optimize the code)? If so, give the line number(s) of the instructions.