

## T-106.5450 Advanced Course on Compilers

The exam contains four questions. The maximum points for each question are listed in the beginning of the questions. Read the questions carefully. Give clear and compact answers. Remember to write the name of the course and your own personal information on each of the papers that you return.

- 1 (6p) Give short definitions for the following. (One point per question.)
  - a) What are affine transformations?
  - b) What is register spilling?
  - c) What is a MFP solution?
  - d) What is a call graph?
  - e) What is an induction variable?
  - f) What is loop permutation?
  
- 2 (6) Solve all reaching definition (i.e., may reach) at basic block boundaries for the following program by using iterative data-flow analysis. Give an short explanation and write down the data-flow equations that you used.

```
k=i+j
a=k-1
if k > 0 goto L2
L1: i = k * j
    goto L3
L2: k = k - 1
    b=k*j
    c=k+j
    if a > b goto L2
L3: i = i + j
    a=k+j
    if a > 0 goto L1
```
  
- 3 (6p) Considering the use of SSA in compilers, write an essay that is not longer than 50 lines. Use LLVM as the example.
  
- 4 (6) Write an essay that is not longer than 50 lines discussing inter-procedural analysis.