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. No extra appliances are allowed in the exam.

1 (6p) Give short and clear definitions for the following.

a) What is copy propagation?
b) What is a control flow super graph?
c) What is divergence in SIMT execution?
d) What is loop coalescing?
e) What are cooperative thread arrays?
f) What is a MOP solution?

2 (6p) Without any optimizations, do register allocation for the following piece of code by using interference graphs. List all phases of the analysis.

```
b = read();
c = b * 2;
b = b + c;
d = b + 7;
a = read();
e = a + d;
b = d * b;
b = e - b + a;
write(b);
```

Based on your interference analysis, what is the minimum number of register needed (without spilling) and why?

3 (6p) List and classify *all* dependencies between the *statements* of the following loop nest. Explain and justify each dependence that you list.

```
for (i = 0; i < 64; i++)
  y[i] = 2*x[i,k];
  for (j = 0; j < 64; i++)
    x[i,k+1] = y[i] + 4*z[i,j];
  r[i] = x[i,k];
}
```

With vector length = 16, can you vectorize the loop? If so, explain the vectorization.

4 (6p) Considering polyhedral optimizations, write an essay that is not longer than 50 lines.