Homework 5
posted Mar. 9, due Mar. 22 at the beginning of the class
(no late turn-ins will be accepted).
Please put a cover page over the homework. The grade
will be written on the second page.

1. (20 pts) Exercise 7.2
   a. Ex(BINOP(+,MEM(a.unEx( )), CONST(5))
   b. Nx(
      MOVE(
         MEM (  
            BINOP (+, 
               a.unEx(),
               BINOP (*, 
                  BINOP(+,
                     i.unEx(),
                     CONST(1)),
                     CONST(w))
            ),
         CONST(0))
      )
   )
   c. Nx(
      LABEL(s);
      RelCx(<, a.unEx( ), CONST(0)).unCx(t,f);
      LABEL(t);
      MOVE(MEM(a.unEx())), BINOP(+, MEM(a.unEx()), CONST(1)));
      JUMP(s);
      LABEL(f);
      )
   Here I use ‘;’ to represent sequence. One can also replace the RelCx(<,…)
   with a CJUMP as long as the semantics is not changed.
   d. Ex(RelCx(<, a.unEx(), b.unEx()).unEx())
   One can also expand RelCx into a sequence, resulting in the following

   Ex(
      ESEQ(
         (MOVE(TEMP(r), CONST(0));
         CJUMP(<, a.unEx(), b.unEx(), t, f);
         LABEL(t);
         MOVE(TEMP(r), CONST(1));
         LABEL(f);
2. (20 pts) Short-circuit evaluation of boolean expressions

When an IF condition or a While loop condition is a Boolean expression, e.g. \(a \&\& b\), often the truth value of that expression can be determined without evaluating all components of the expression. For example, if \(a\) is false, then we know \(a \&\& b\) must be false without even knowing the truth value of \(b\). The branch operation can take place as soon as the branch condition can be determined. This is called short-circuit evaluation of Boolean expression.

Please convert the following While loop into intermediate code using the idea of short-circuit boolean evaluation.

\[
\text{while } ( (a < d) \text{ || } (e < f) ) \quad t = t + 1;
\]

Introduce labels and temporaries as needed.

Note that the symbol “;” is used to represent these are SEQs of statements.

\[
\text{LABEL(loop);}
\text{CJUMP(<, a.unEx(), d.unEx(), L1, L2);}
\text{LABEL(L2);}
\text{CJUMP(<, e.unEx(), f.unEx(), L1, done);}
\text{LABEL(L1);}
\text{MOVE(TEMP(t), BINOP(+,TEMP( t), CONST(1));}
\text{JUMP(NAME(loop));}
\text{LABEL(done)}
\]