Homework 5
CS 4481

1. Use local value numbering to optimize the following code. You should show the key/value number table as well as the final optimized code. *Hint*: The optimized code will have only one change to the right-hand side of one of the instructions.

   a ← b − d
   c ← b
   b ← f
   e ← c − d
   f ← b − d

2. Use local value numbering with constant folding to optimize the following code. You should show the key/value number table, value number/value constant table, and the final optimized code.

   x ← 2 + 4
   y ← x + 3
   z ← w + y

3. Consider the following code, where `op` is an arbitrary operation, and ri refers to virtual register i:

   ```
   op r3, r6
   op r4, r5
   op r3, r2
   op r4, r1
   op r6, r2
   ```

   (a) (5 points) Using top-down local register allocation, fill out the following table. Assume you have five available registers, and assume that swapping doesn't require any additional registers. Ri refers to physical register i.

instruction	R1	R2	R3	R4	R5
`op r3, r6`					
`op r4, r5`					
`op r3, r2`					
`op r4, r1`					
`op r6, r2`					

   (b) (5 points) Using bottom-up local register allocation, fill out the following table. Assume you have four available registers, and assume that swapping doesn't require any additional registers. Ri refers to phyiscal register i.

instruction	R1	R2	R3	R4
`op r3, r6`				
`op r4, r5`				
`op r3, r2`				
`op r4, r1`				
`op r6, r2`				