CMSC 430 Practice Problems 6

1. Value Numbering

Consider performing value numbering on the following code:

(1) \( i + 1 \)  
// \( a := i + 1 \)
(2) \( a := (1) \)
(3) \( a + b \)  
// \( c := a + b \)
(4) \( c := (3) \)
(5) \( d := 1 \)  
// \( d := 1 \)
(6) \( i + d \)  
// \( e := i + d \)
(7) \( e := (6) \)
(8) \( d + 2 \)  
// \( f := d + 2 \)
(9) \( f := (8) \)

(a) What are in the CODE, SYMBOLS, AVAIL, and CONSTANTS tables?
(b) What is the output code?

2. Static Single Assignment.

Consider the following program:

```plaintext
procedure foo
  a, b, c, i, j, k, n : integer
  a = 6
  b = 12
  c = 14
  i = a * b
  j = 9
  read n

  if (i > c) then
    i = i/2
  else
    i = c/2

  if (c < 0) then
    c = -c

  k = 0
  while (k < n) do
    i = i + (i & (1 << k))
    k = k + 1
  end while

  if (j == 9) then
    b = b + a
  return (b + i)
end foo
```

(a) Construct a control flow graph for the program.
(b) Construct a dominator tree for the resulting CFG.
(c) What is the iterated dominance frontier for variables \( c \) and \( i \)?
(d) Generate the SSA form for this program.
(e) Show the result of conditional constant propagation.