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Homework 1

Problem 4

a) No. Because if we find the addition of (a+ib) and (a+ib) it does not result in (a+ib). And the meet of x and x should result in x.
b) No. Because if we find the multiplication of (a+ib) and (a+ib) it does not result in (a+ib). And the meet of x and x should result in x.
c) Yes
d) Yes

Problem 5

(a) The property set is the lattice of all subsets of the variables in the problem. As it is a must problem, $\leq$ is the superset operation.
Merge is the intersection operator. out(j)=$\{\cap$ in(i), i is successor of j$\}$
Transfer functions: in(j) = gen(j) $\cup$ (out(j) - kill(j))
For the expression, j: x=y+z, gen(j)=$\{$x$\}$, kill(j)=$\{\}$

(b) Yes, the functions are distributive and monotone.
Proof:
f(X V Y)
= gen(j) $\cup$ ((X$\cap$Y) $\cap$ pres(j))
= (gen(j) $\cup$ (X $\cap$ pres(j))) $\cap$ (gen(j) $\cup$ (Y $\cap$ pres(j)))
f(X) V f(Y)
= ((X $\cap$ pres(j)) $\cup$ gen(j)) $\cap$ ((Y $\cap$ pres(j)) $\cup$ gen(j))
As, f(X V Y) = f(X) V f(Y), the transfer function is monotone. And all monotone functions are distributive.

Problem 6

(a) The four classical dataflow analyses are bit vector dataflow analyses because they satisfies the two conditions as below:
1. The property space of the analyses are finite. As they are subsets of the universal set of reaching definitions, variables or expressions. They are related by subset or superset depending on whether they are must/may problems.
2. The transfer functions of all the analyses contain in(j), out(j), kill(j) and gen(j). Here kill(j) and gen(j) are the constants that do not depend on the in() or out(). Thus the kill(j) and gen(j) are the constants Y_f^1 and Y_f^2. Y the argument of the function is in(j) in forward problems and out(j) in backward problems.
Thus, they are bit vector dataflow analyses.