

Exam 2 Study Sheet

1. What is it that makes one condition weaker than another.
 - a. Condition A is true whenever B is true, but B is true when A is not. B is weaker.
 $A < 1, A < 0$ $A < B, A \leq B$ $A, A \wedge B$ $A, A \vee B$ $A \Rightarrow B$
 - b. Condition A includes more states than condition B.
 - c. If two conditions are mutually exclusive, then technically neither is weaker.
 - d. If one condition is not contained in another, then technically neither is weaker.
 - e. Universally Quantified conditions, if the range of A is larger but contains the range of B and the conditions are the same then B is weaker.
 - e. Existentially Quantified conditions, if the range of A is larger but contains the range of B and the conditions are the same then A is weaker.
 - f. All else being equal, an existential quantifier is weaker than a universal quantifier
 - g. If quantifiers and ranges are the same, then strength depends on the condition.

2. Converting English statements to quantified statements.
 - a. Given a set of jars numbered from 1 to k, each jar has at least one penny and no jar has more than three pennies. Use Content(k) to symbolize the number of pennies in jar K.
 - b. Given the same set of jars, at least one jar has two pennies.
 - c. In every consecutive range of four integers or more integers, there is at least one multiple of 4.
 - d. There is a computer science professor who has holes in all of his shoes.

3. The variable x appears in each of the following. Is x bound or free (or both) in each expression.
 - a. $x+1$
 - b. $f(x)=x+1$
 - c. $(\forall x: 1 < x < n : x+1 < y+1)$
 - d. $(\exists x: 1 < x < n: y+1=2)$
 - e. $(\forall y: 1 < y < n : x+1 < y+1)$
 - f. $(\forall x: a < x < b: (\exists n: 1 < n < x: y+1=n))$

4. Given the following expression, perform the following substitutions, if possible.
 $(\forall x: a \leq x < y: b > x \wedge (\exists c: q \leq c < m: q + p = c + x))$

- a. E_z^a
- b. E_m^y
- c. E_d^p
- d. E_r^q
- e. E_y^x

5. Given the following statements and the following conditions, find the weakest precondition.

Exam 2 Study Sheet

- a. $x := x + 1;$ $x > 0$
- b. $x := x - 1;$ $y > 0$
- c. $x := x * x;$ $(\exists y: 1 < y < n: y = x + 1)$
- d. $x := a + b + c;$ $x > a$

6. Know how to simplify array assignments.