

CS 2110, Spring 2016 Homework H1 Due Friday, 19 February  
 (in class on 18 Feb or in the handback room, Gates 216, by 4PM Friday)

This homework concerns the video-module on the correctness of programs.

**Question 1.** Write the formula for the number of values in the range  $b..c$ : \_\_\_\_\_

**Question 2.** In the video on ranges, we gave a mnemonic for remembering the number of values in a range. Write that formula here:

\_\_\_\_\_

**Question 3.** Below are four array segments. To the right, using what you wrote in answering question 2, write the number of values in each segment in terms of the relevant variables.

$b$	$h$	$k$	$m$	$n$	$p$	$b[h..k]$ _____
	segment 1	segment 2	segment 3	segment 4		$b[k+1..m]$ _____
						$b[m+1..n-1]$ _____
						$b[n..p-1]$ _____

**Question 4.** State the formula that says segment  $b[p..q]$  is empty: \_\_\_\_\_

**Question 5.** Below, draw an array diagram that represents this assertion:

$$b[h..j-1] \leq x \ \&\& \ b[j] = x \ \&\& \ b[j+1..k] \geq x$$

**Question 6.** Write down the meaning of the Hoare triple  $\{B\} C \{D\}$  :

**Question 7.** Using the definition of the assignment statement  $\{R[x:= e]\} x = e; \{R\}$ , calculate the preconditions of the following assignment statements. You do not have to simplify them.

$\{ \quad \quad \quad \}$ $x = y + 1;$ $\{x * y = z\}$	$\{ \quad \quad \quad \}$ $y = 2 * x;$ $\{x + y + z = 2 * x\}$	$\{ \quad \quad \quad \}$ $y = y + 2;$ $\{x + y = 8\}$
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**Question 8.** Calculate the precondition of the following two sequences of assignments. It's recommended to simplify a precondition after calculating it before moving on the next step. Here's one reason to do that. Since  $x$  and  $y$  are being replaced in each one, it helps to keep the number of occurrences of them to a minimum. For example, you can rewrite

$$x = B \ \&\& \ y = x + A \quad \text{as} \quad x = B \ \&\& \ y = B + A .$$

{	}
t = x;	x = x + y;
{	}
x = y;	y = x - y;
{	}
y = t;	x = x - y;
{x = B and y = C}	{x = B and y = C}

**Question 9.** We gave the following rule for determining when an if-else statement is correct:

**Hoare triple for if-else:**

If  $\{Q \ \&\& \ B\} S1 \{R\}$  and  $\{Q \ \&\& \ !B\} S2 \{R\}$   
 then  $\{Q\} \text{if } (B) S1 \text{ else } S2 \{R\}$

Write below a similar rule for determining when an if-statement is correct:

**Hoare triple for the if-statement:**

If \_\_\_\_\_

then  $\{Q\} \text{if } (B) S1 \{R\}$