

# Homework 4

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CIS-623 STRUCTURED PROGRAMMING & FORMAL METHODS

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Question 1:

1 Find the weakest precondition:

$$wp(x = x + y, \neg(x > y))$$

$$\begin{aligned} wp(x = x + y, \neg(x > y)) &= \neg(x + y > y) \\ &= \neg(x > y - y) = \\ &= \neg(x > 0) = \\ wp &= [x \leq 0] \end{aligned}$$

Question 2:

2. Which of the following is valid?

$$[x < y] \ x = x + y \ [!(x > y)]$$

$$[!(x > y)] \ x = x + y \ [!(x > y)]$$

$$[(x + 3 < 0)] \ x = x + y \ [!(x > y)]$$

$W_x = [x \leq 0]$ .  
 The answer is  $[(x + 3 < 0)]$  because  
 $[(x + 3 < 0)] \rightarrow [x \leq 0]$ .

Question 3:

3. Find the weakest precondition

*wp( if  $y > 0$  then  $x = x + y$  else  $x = x - y$ ,  $x > 10$  )*

Handwritten solution on a piece of paper:

$$wp(\text{if } y > 0 \text{ then } x = x + y \text{ else } x = x - y, x > 10)$$

$$wp(x = x + y, x > 10) = x + y > 10$$

$$wp(x = x - y, x > 10) = x - y > 10$$

$$(y > 0) \rightarrow (x + y > 10) \wedge (\neg(y > 0) \rightarrow (x - y > 10))$$

$$wp = x + |y| > 10$$

Question 4:

4. Which of the following is valid.

$[x+y>10]$  if  $y>0$  then  $x=x+y$  else  $x=x-y$   $[x>10]$

$[x>10]$  if  $y>0$  then  $x=x+y$  else  $x=x-y$   $[x>10]$

$[y>10]$  if  $y>0$  then  $x=x+y$  else  $x=x-y$   $[x>10]$

The answer is  $[x+y>10]$  because  
 $[x+y>10] \rightarrow [x+|y|>10]$ .