

# Practice Questions

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Prepared based off of the notes of CS245 Instructors, past and present.

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# Problem 1

Show partial and/or total correctness for the following program.

- 1  $\langle n \in \mathbb{N} \rangle$
- 2  $x = 0;$
- 3  $a = 0;$
- 4 while  $x \leq n$  {
- 5      $s = s + x;$
- 6      $x = x + 1;$
- 7 }
- 8  $\langle s = \frac{n(n+1)}{2} \rangle$

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## Problem 2

Show partial and/or total correctness for the following program.

①  $\langle n = 2k - 1, \text{for } k \in \mathbb{N}, k \geq 0 \rangle$

②  $s = 0;$

③  $x = 1;$

④ while  $x \neq n$  {

⑤      $s = s + x;$

⑥      $x = x + 2;$

⑦ }

⑧  $\langle s = (k - 1)^2 \rangle$

Use the invariant  $I := (s = (\frac{x-1}{2})^2)$

# Problem 3

## Problem

*Prove/disprove  $\{(\exists x(\exists yP(x,y)))\} \vdash (\exists y(\exists x(P(x,y))))$ , use ND or show an unsatisfied interpretation*

# Problem 4

## Problem

*Prove/disprove  $\{(\forall x(P(x) \rightarrow Q(x)))\} \vdash ((\exists x P(x)) \rightarrow (\exists x Q(x)))$ , use ND or show an unsatisfied interpretation*

# Problem 5

## Problem

*Prove/disprove  $\{(\exists x(P(x) \wedge Q(x)))\} \vdash ((\exists x P(x)) \wedge (\exists x Q(x)))$ , use ND or show an unsatisfied interpretation*