

3. Calculate the average of daily temperatures stored in a sequential input file.
 a) Calculate the average of daily temperatures before the first temperature under the freezing point (in a sequential input file).

Specification:

$A = (x:\text{infile}(\mathbb{R}), a:\mathbb{R})$
 $Pre = (x=x_0 \wedge |x| \geq 1 \wedge x_0[1] > 0)$
 $Post = (a = \sum_{e \in x_0}^{e \geq 0} e / \sum_{e \in x_0}^{e \geq 0} 1)$

Analogy: two Summations

$t:\text{enor}(E) \sim x:\text{infile}(\mathbb{R}) (st, e, x:\text{read})$
 as long as $e \geq 0$
 $f(e) \sim e, 1$
 $s \sim s, c$
 $(H, +, 0) \sim (\mathbb{R} +, 0.0), (\mathbb{N} +, 0)$

Algorithm:

$s, c := 0.0, 0$ $st, e, x:\text{read}$	$e, s:\mathbb{R}, c:\mathbb{N}$ $st:\text{Status}$
$e \geq 0 \wedge st = \text{norm}$	
$s, c := s+e, c+1$	
$st, e, x:\text{read}$	
$a := s / c$	

Specification:

$A = (m:\mathbb{Z}, n:\mathbb{Z}, s:H)$
 $Pre = (m=m' \wedge n=n')$
 $Post = (Pre \wedge s = \sum_{i=m..n} f(i))$

Algorithm:

$s := 0$	
$i = m .. n$	$i:\mathbb{Z}$
$s := s+f(i)$	

- b) Calculate the average of daily temperatures after the first temperature under the freezing point (in a sequential input file).

Specification:

$A = (x: \text{infile}(\mathbb{R}), a: \mathbb{R})$
 $Pre = (x = x_0 \wedge |x| \geq 2 \wedge \exists i \in [1..|x|-1]: x_0[i] < 0)$
 $Post = (e', (st', e', x')) = \text{SELECT}_{e \in x_0} (e < 0 \vee st = \text{abnorm}) \wedge a = \sum_{e \in x'} e / \sum_{e \in x'} 1$

Analogy: Selection

$t: \text{enor}(E) \sim x: \text{infile}(\mathbb{R}) (st, e, x: \text{read})$
 $\text{cond}(e) \sim e < 0 \vee st = \text{abnorm}$

Two Summations

$f(e) \sim e, 1$
 $s \sim s, c$
 $H, +, 0 \sim (\mathbb{R} +, 0.0), (\mathbb{N} +, 0)$
 $t: \text{enor}(E) \sim x: \text{infile}(\mathbb{R}) (st, e, x: \text{read}) \text{ next}() \text{ instead}$

Algorithm:

st,e,x:read	e:ℝ
e>=0 ∧ st=norm	st:Status
st,e,x:read	
s, c := 0.0, 0	s:ℝ, c:ℕ
st,e,x:read	
st=norm	
s, c := s+e, c+1	
st,e,x:read	
a := s / c	

- c) Calculate the average of daily temperatures before and after the first temperature under the freezing point (in a sequential input file) if in the after version that first freezing temperature is included, too.

Specification:

$A = (x: \text{infile}(\mathbb{R}), a1, a2: \mathbb{R})$
 $Pre = (x = x_0 \wedge |x| \geq 2 \wedge \exists i \in [2..|x|]: x_0[i] \leq 0)$
 $Post = (a1, (st', e', x')) = \sum_{e \in x_0}^{e \geq 0} e / \sum_{e \in x_0}^{e \geq 0} 1$
 $\wedge a2 = \sum_{e \in (e', x')} e / \sum_{e \in (e', x')} 1$

Analogy: two Summations

$t: \text{enor}(E) \sim x: \text{infile}(\mathbb{R}) (st, e, x: \text{read})$
 as long as $e \geq 0$

$f(e) \sim e, 1$
 $s \sim s1, c1$
 $(H, +, 0) \sim (\mathbb{R} +, 0.0), (\mathbb{N} +, 0)$

Two Summations

$t: \text{enor}(E) \sim x: \text{infile}(\mathbb{R}) (st, e, x: \text{read})$
 without first()

$f(e) \sim e, 1$
 $s \sim s2, c2$
 $(H, +, 0) \sim (\mathbb{R} +, 0.0), (\mathbb{N} +, 0)$

Algorithm:

s1, c1 := 0.0, 0	e, s1:ℝ, c1:ℕ
st,e,x:read	st:Status
e≥0 ∧ st=norm	
s1, c1 := s1+e, c1+1	
st,e,x:read	
a1 := s1 / c1	
s2, c2 := 0.0, 0	s2:ℝ, c2:ℕ
st=norm	
s2, c2 := s2+e, c2+1	
st,e,x:read	
a2 := s2 / c2	