Formais

$$\frac{(|\chi \wedge B|)\ C\ (|\chi|)}{(|\chi|)\ \text{while}\ B\{C\}\ (|\chi \wedge \neg B|)}$$

χ - invariante

$\top$

$\bot$

fat1 : y = 1; z = 0; while (z != x) {
z = z + 1;
y = y * z;

x = 5

y	z
1	0
1	1
2	2
6	3
24	4
120	5

$y = z!$

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Pot : $y = 1$

```
z = 0;
while (z != n) {
    z = z+1;
    y = y*x;
}
```

~~m~~ $n = 5$

y	z
1	0
x	1
x^2	2
x^3	3
x^4	4
x^5	5

$y = x^2$

Fat 2 : $(\mid x_0 = x \wedge x \geq 0 \mid)$

```
y = 1;
while (y != 1) {
    y = y * x;
    x = x - 1;
}
```

$(\mid y = x_0! \mid)$

x	y	
5	1	
4	5	5
3	20	$5 \cdot 4$
2	60	$5 \cdot 4 \cdot 3$
1	120	$5 \cdot 4 \cdot 3 \cdot 2$

$y = \frac{x_0!}{x!}$

Soma : $(| x_0 = x \ldots |)$ 　　　　　　36

```
z = 0;
while (x > 0) {
    z = z + x;
    x = x - 1;
}
```

$\left(| \, z = \dfrac{x_0 (x_0 + 1)}{2} \, | \right)$

x	z	
5	0	
4	5	5
3	9	5 + 4
2	12	5 + 4 + 3
1	14	5 + 4 + 3 + 2
0	15	

$$z = \frac{x_0 (x_0 + 1)}{2} - \frac{x (x + 1)}{2}$$

$(|\varphi|)$ while $B\{C\}$ $(|\psi|)$?

$$\frac{\vdash \varphi' \to \varphi \quad (|\varphi|)\ P\ (|\psi|) \quad \vdash \psi \to \psi'}{(|\varphi'|)\ P\ (|\psi'|)}$$

① Achar χ

② Provar $\vdash \varphi \to \chi$

③ Provar $\vdash \chi \wedge \neg B \to \psi$

Fat 1: $(|y = 1 \wedge z = 0|)$

while ( ) {

:

}

$(|y = x!|)$

$\vdash (y = 1 \wedge z = 0) \to y = z!$

$\vdash (y = z! \wedge z = x) \to y = x!$

Subir φ

① Achar χ

② Provar $\vdash \chi \wedge \neg B \to \varphi$

③ Subir χ por C, obtendo χ'

④ Provar $\vdash \chi \wedge B \to \chi'$

⑤ Colocar χ acima do while

⑥ Provar $\vdash \varphi \to \chi$

```
while (B) {
    (| χ' |)
    C
    (| χ |)
}
```

~~(|T|)~~ (|T|)

$(| 1 = 0! |)$ Impl

$y = 1;$

$(| y = 0! |)$ Atrib.

$z = 0;$

$(| y = z! |)$ Atrib.

while (z != x) {

$(| y = z! \wedge z \neq x |)$ $\chi \wedge B$

$(| y \cdot (z+1) = (z+1)! |)$ Impl.

$z = z + 1;$

$(| y \cdot z = z! |)$ Atrib.

$y = y * z;$

}

$(|y = z! \wedge x = z|)$

$(|y = x!|)$ Impl

① $\chi \quad y = z!$

② $\vdash (y = z! \wedge x = z) \to y = x!$

③ $\chi' : y(z+1) = (z+1)!$

④ $\vdash (y = z! \wedge z \neq x) \to y \cdot (z+1) = (z+1)!$

$\chi \qquad B \qquad \chi'$

⑤

⑥ $\vdash_{pai} (|T|)$ Fat 1 $(|y = x!|)$

int a[n],

$a[1], \ldots, a[n]$

$a[E]$

Problema: Dado um vetor $a[1], \ldots, a[n]$ calcule a soma de um segmento de soma mínima.

Ex.: [-1, 3, 15, $\underbrace{-6, 4, -5}_{-7}$]

[4, $\underbrace{-8, 3 -4}_{9}$, 10, $\underbrace{-6, -3}_{-9}$, 5]

Solução linear:

guarda 2 valores:

- s: a soma mínima até o ponto
- t: a soma mínima de todos os segmentos que terminem naquele ponto

```
k = 2;
t = a[1];
s = a[1];
  while (k != n+1) {
      t = min[t + a[k], a[k]);
      s = min (s, t);
      k = k+1;
  }
```

Simulação

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[4, -8, 3, -4, 8, -6, -3, 5]

K	t	s
2	4	4
3	-8	-8
4	-5	-9
5	-9	-10
6	-1	
7	-7	
8	-10	
9	-5	