More Examples

```
x = a;
y = 0;
while(x != 0) {
   x = x - 1;
   y = y + 2;
}
assert(y == 2*a);
```

Input:

a … integer

```
{0 == 2*(a - a)} ↔ {true}
x = a;
{0 == 2*(a - x)}
y = 0;
{y == 2*(a - x)}
while(x != 0) {
  {y == 2*(a - x) ∧ x != 0}
  {y+2 == 2*(a - (x - 1))} ↔ {y+2 == 2*(a - x)+2}
  x = x - 1;
  {y + 2 == 2*(a - x)}
  y = y + 2;
  {y == 2*(a - x)}
}
{y == 2*a ∧ x == 0} ↔ {y == 2*(a - x) ∧ x == 0}
{y == 2*a}
```

```
s = 0;
i = 0;
while(i != n) {
  s = s + a[i];
  i = i + 1;
}
assert(s == ∑_{j=0}^{n-1} a[j]);
```

```
Input:
a … array of
    integers
n … length of a
```

$\{0 == 0\} \leftrightarrow \{true\}$

```
s = 0;
```

$\{s == \sum_{j=0}^{-1} a[j]\} \leftrightarrow \{s == 0\}$

```
i = 0;
```

$\{s == \sum_{j=0}^{i-1} a[j]\}$

```
while(i != n) {
```

$\{s == \sum_{j=0}^{i-1} a[j] \wedge i != n\}$

$\{s + a[i] == \sum_{j=0}^{i} a[j]\} \leftrightarrow \{s == \sum_{j=0}^{i-1} a[j]\}$

```
  s = s + a[i];
```

$\{s == \sum_{j=0}^{i} a[j]\}$

```
  i = i + 1;
```

$\{s == \sum_{j=0}^{i-1} a[j]\}$

```
}
```

$\{s == \sum_{j=0}^{n-1} a[j] \wedge i == n\} \leftrightarrow \{s == \sum_{j=0}^{i-1} a[j] \wedge i == n\}$

$\{s == \sum_{j=0}^{n-1} a[j]\}$

```
r = false;
i = 0;
while(i != n) {
  if(a[i] == x) {
    r = true;
  }
  i = i + 1;
}
```

Input:

a … array

n … length of a

x … value to look for in a

Hint:

$(\bigvee_{j=0}^{-1} \Phi)$ == false

assert(r == $(\bigvee_{j=0}^{n-1}$ a[j] == x));

{false == false} ↔ {true}

r = false;

{r == $(\bigvee_{j=0}^{-1}$ a[j] == x)} ↔ {r == false}

i = 0;

{r == $(\bigvee_{j=0}^{i-1}$ a[j] == x)}

while(i != n) {

  {(r == $(\bigvee_{j=0}^{i-1}$ a[j] == x)) ∧ i != n}

  {r == $(\bigvee_{j=0}^{i-1}$ a[j] == x)}

  if(a[i] == x) {

    {(r == $(\bigvee_{j=0}^{i-1}$ a[j] == x)) ∧ a[i] == x}

    {(true == $(\bigvee_{j=0}^{i}$ a[j] == x)) ∧ a[i] == x} ↔ {true ∧ a[i] == x} ↔ {a[i] == x}

    r = true;

    {r == $(\bigvee_{j=0}^{i}$ a[j] == x)}

  } else {

    {(r == $(\bigvee_{j=0}^{i}$ a[j] == x)) ∧ a[i] != x} ↔ {(r == $(\bigvee_{j=0}^{i-1}$ a[j] == x)) ∧ a[i] != x}

  }

  {r == $(\bigvee_{j=0}^{i}$ a[j] == x)}

  i = i + 1;

  {r == $(\bigvee_{j=0}^{i-1}$ a[j] == x)}

}

{r == $(\bigvee_{j=0}^{n-1}$ a[j] == x) ∧ i == n} ↔ {r == $(\bigvee_{j=0}^{i-1}$ a[j] == x) ∧ i == n}

{r == $(\bigvee_{j=0}^{n-1}$ a[j] == x)}

Hint:

$(\bigvee_{j=0}^{-1} \Phi)$ == false