Cendrillon Sort

Shape Analysis

Pascal Jung* Thorsten Kober†

30. September 2015

Zusammenfassung

...

*358XXXX
†3583619

Inhaltsverzeichnis

1 Einführung

2 Allgemeiner Aufbau der Analyse

2.1 Kernprädikate

...

istGut und *istSchlecht*

...

```
%p istGut(v)
%p istSchlecht(v)
```

isArbitrary

...

```
%p isArbitrary(v)
```

2.2 Actions

...

Set_Ist_Gut_Halb, *Set_Ist_Gut_False* und *Set_Ist_Gut_True*

...

```
%action Set_Ist_Gut_Halb(lhs) {
  %t lhs + "->istGut = 1/2"
  {
    istGut(v) = (lhs(v) & 1/2) | (!lhs(v) & istGut(v))
  }
}

%action Set_Ist_Gut_False(lhs) {
  %t lhs + "->istGut = false"
  {
    istGut(v) = (lhs(v) & 0) | (!lhs(v) & istGut(v))
  }
}

%action Set_Ist_Gut_True(lhs) {
  %t lhs + "->istGut = true"
  {
    istGut(v) = (lhs(v) & 1) | (!lhs(v) & istGut(v))
  }
}
```

Set_Ist_Schlecht_Opposite

...

```
%action Set_Ist_Schlecht_Opposite(lhs) {
  %t lhs + "->istSchlecht = !" + lhs + "->istGut"
  {
    istSchlecht(v) = (!lhs(v) & istSchlecht(v)) | (lhs(v) &
        !istGut(v) & !isArbitrary(v))
  }
}
```

Is_Good und *Is_Not_Good*

...

```
%action Is_Good(lhs) {
  %t lhs + "->istGut == true"
  %f { lhs(v) & istGut(v) }
  %p E(v) lhs(v) & istGut(v)
}

%action Is_Not_Good(lhs) {
  %t lhs + "->istGut == false"
  %f { lhs(v) & istSchlecht(v) }
  %p A(v) !(lhs(v) & istGut(v))
}
```

Free_Arbitrary

...

```
%action Free_Arbitrary() {
  %t "Free_Arbitrary()"
  {
    t[n](v_1, v_2) = t[n](v_1, v_2)
    foreach(z in PVar) {
      r[n,z](v) = r[n,z](v)
    }
    is[n](v) = is[n](v)
  }
  %retain !isArbitrary(v) | |/{r[n, z](v): z in PVar}
}
```

3 Meilenstein A

In diesem ersten Meilenstein soll die Erzeugung einer einfach-verketteten Liste mit beliebig vielen Linsenobjekten analysiert werden. Insbesondere die folgenden Eigenschaften des Speichers nach dem Abarbeiten des entsprechenden Programmteils sind von Interesse:

- Keine Objekte sind verloren gegangen und liegen unerreichbar auf dem Heap. Ihre Analyse soll zeigen, dass nach dem entsprechendem Programmteil auf dem Heap lediglich Linsenobjekte existieren, die von der Programmvariable *LinsenTopf* aus erreichbar sind.
- Alle Linsenobjekte sind korrekt erzeugt, d.h eine Linse ist entweder gut oder schlecht. Niemals hat sie beide oder keine der Eigenschaften. Aus den von Ihrer Analyse erzeugten Strukturen muss hervorgehen, dass obige Eigenschaft gilt, also genau eines der beiden Attribute *istGut* und *istSchlecht* den Wahrheitswert true besitzt.

3.1 Eingabestrukturen

Da der zu untersuchende Programmabschnitt für die Erzeugung der Eingabestruktur von Meilenstein B zuständig ist, wird für dessen Analyse lediglich die leere Eingabestruktur benötigt.

3.2 TVP

...

```
L1  Malloc_L(linse)                          L1a // linse = malloc(sizeof(Linse));
L1a uninterpreted()                          L2  // linse->istGut = (rand() % 2) ? true
    : false;
L1a uninterpreted()                          L2a
L2  Set_Ist_Gut_True(linse)                  L3
L2a Set_Ist_Gut_False(linse)                 L3
L3  Set_Ist_Schlecht_Opposite(linse)         L4  // linse->istSchlecht = !linse->istGut
    ;
L4  Copy_Var_L(linsenTopf, linse)            L5  // linsenTopf = linse;
L5  Copy_Var_L(topf, linsenTopf)             L6  // topf = linsenTopf;
L6  uninterpreted()                          L7  // while( i <= n ) {
L6  uninterpreted()                          exit
L7  Malloc_L(linse)                          L7a //    linse = malloc(sizeof(Linse));
L7a uninterpreted()                          L8  //    linse->istGut = (rand() % 2) ?
    true : false;
L7a uninterpreted()                          L8a
L8  Set_Ist_Gut_True(linse)                  L9
L8a Set_Ist_Gut_False(linse)                 L9
L9  Set_Ist_Schlecht_Opposite(linse)         L10 //  linse->istSchlecht = !linse->
    istGut;
L10 Set_Next_L(topf, linse)                  L11 //    topf->next = linse;
L11 Copy_Var_L(topf, linse)                  L6  //    topf = linse;
                                                 // }

exit Set_Null_L(linse)                       exitA
exitA Set_Null_L(topf)                       exitB

exitB Assert_No_Good_n_Bad()                 error
exitB Assert_ListInvariants(linsenTopf)      error
exitB Assert_No_Leak(linsenTopf)             error
```

3.3 Zusicherungen

...

3.4 Ausgabestrukturen

...

4 Meilenstein B

In diesem Meilenstein soll der Abbau einer einfach-verketteten Liste mit beliebig vielen Linsenobjekten sowie der parallele Aufbau zweier disjunkter, die Linsenobjekte in gute und schlechte Linsen aufteilende einfach-verkettete Listen analysiert werden.

- Alle Linsen befinden sich am Ende des Sortiervorgangs in genau einem der beiden Töpfe für gute bzw. schlechte Linsen. D.h. jedes Linsenobjekt ist entweder von Programmzeiger *guteLinsen* oder *schlechteLinsen* aus erreichbar.
- Alle Linsen, die von *guteLinsen* aus erreichbar sind, haben definitive Werte für *istGut* und *istSchlecht*: *istGut* ist wahr und *istSchlecht* falsch für alle diese Linsenobjekte.
- Alle Linsen, die von *schlechteLinsen* aus erreichbar sind, haben definitive Werte für *istGut* und *istSchlecht*: *istGut* ist falsch und *istSchlecht* wahr für alle diese Linsenobjekte.

4.1 Eingabestrukturen

...

4.2 TVP

...

```
L0  Set_Null_L(linsenTopf)                  L1  // Linse* linsenTopf = NULL;
L1  Malloc_L(linse)                         L1a // linse = malloc(sizeof(Linse));
L1a uninterpreted()                         L2  // linse->istGut = (rand() % 2) ? true
    : false;
L1a uninterpreted()                         L2a
L2  Set_Ist_Gut_True(linse)                 L3
L2a Set_Ist_Gut_False(linse)                L3
L3  Set_Ist_Schlecht_Opposite(linse)        L4  // linse->istSchlecht = !linse->istGut
    ;
L4  Copy_Var_L(linsenTopf, linse)           L5  // linsenTopf = linse;
L5  Copy_Var_L(topf, linsenTopf)            L6  // topf = linsenTopf;
L6  uninterpreted()                         L7  // while ( i <= n ) {
L6  uninterpreted()                         L12
L7  Malloc_L(linse)                         L7a //  linse = malloc(sizeof(Linse));
L7a uninterpreted()                         L8  //  linse->istGut = (rand % 2) ? true:
      false;
L7a uninterpreted()                         L8a
L8  Set_Ist_Gut_True(linse)                 L9
L8a Set_Ist_Gut_False(linse)                L9
L9  Set_Ist_Schlecht_Opposite(linse)        L10 //  linse->istSchlecht = !linse->
    istGut;
L10 Set_Next_L(topf, linse)                 L11 //    topf->next = linse;
L11 Copy_Var_L(topf, linse)                 L6  //    topf = linse;
                                                // }

L12 Copy_Var_L(topf, linsenTopf)            L13 // topf = LinsenTopf;
L13 Is_Null_Var(topf)                       exit// while (topf) {
L13 Is_Not_Null_Var(topf)                   L14
L14 Copy_Var_L(linse, topf)                 L15 //  linse = topf;
L15 Get_Next_L(topf, topf)                  L16 //  topf = topf->next;
L16 Is_Good(linse)                          L17 //  if (linse->istGut) {
L16 Is_Not_Good(linse)                      L20
L17 Set_Next_Null_L(linse)                  L18 //
L18 Set_Next_L(linse, guteLinsen)           L19 //      linse->next = guteLinsen;
L19 Copy_Var_L(guteLinsen, linse)           L13 //      guteLinsen = linse;
                                                //    } else {
L20 Set_Next_Null_L(linse)                  L21 //
L21 Set_Next_L(linse, schlechteLinsen)      L22 //      linse->next = schlechteLinsen;
L22 Copy_Var_L(schlechteLinsen, linse)      L13 //      schlechteLinsen = linse;
                                                //    }
                                                // }

exit Set_Null_L(linse)                      exitA
```

```
exitA Set_Null_L(linsenTopf)            exitB

exitB Assert_No_Reachable_Arbitrary()                  error
exitB Assert_No_Good_n_Bad()                           error
exitB Assert_Good_Linsen(guteLinsen)                   error
exitB Assert_Bad_Linsen(schlechteLinsen)               error
exitB Assert_No_Leak_End(guteLinsen, schlechteLinsen) error
```

4.3 Zusicherungen

...

Fehler

...

4.4 Anpassungen

...

```
L0  Set_Null_L(linsenTopf)          L0a // Linse* linsenTopf = NULL;
// Program fix
L0a Set_Null_L(guteLinsen)          L0b // Linse* guteLinsen = NULL;
L0b Set_Null_L(schlechteLinsen)     L1  // Linse* schlechteLinsen = NULL;
L1  Malloc_L(linse)                 L1a // linse = malloc(sizeof(Linse));
```

4.5 Ausgabestrukturen

...

5 Meilenstein C

Im Quellcode ist eine alternative, elegantere Implementierung der Linsentopferzeugung (auskommentiert) vorhanden. Ersetzen Sie Ihre, bereits verifizierte Implementierung durch die Kürzere und stellen Sie sicher, dass Ihre Analyse weiterhin die Verifikationsziele der Meilensteine A und B erfüllt.

5.1 Eingabestrukturen

...

5.2 TVP

...

```
L0  Set_Null_L(linsenTopf)              L0a // Linse* linsenTopf = NULL;
// This corrects the program
L0a Set_Null_L(guteLinsen)              L0b // Linse* guteLinsen = NULL;
L0b Set_Null_L(schlechteLinsen)         L1  // Linse* schlechteLinsen = NULL;
L1  uninterpreted()                     L3  // jump into loop as condition is i <=
     n and i is for the first iteration 1 and n at least 1
L2  uninterpreted()                     optional
L2  uninterpreted()                     L3  // while (i <= n) {
L3  Malloc_L(linse)                     L4  //  linse = malloc(sizeof(Linse));
L4   uninterpreted()                    L5  //  linse->istGut = (rand() % 2) ?
    true: false;
L4  uninterpreted()                     L6
L5  Set_Ist_Gut_True(linse)             L7
L6   Set_Ist_Gut_False(linse)           L7
```

```
L7  Set_Ist_Schlecht_Opposite(linse)     L8  //  linse->istSchlecht = !linse->
    istGut;
L8   Set_Next_L(linse, linsenTopf)       L9  //  linse->next = linsenTopf;
L9  Copy_Var_L(linsenTopf, linse)        L2  //  linsenTopf = linse;
                                             // }

optional Set_Null_L(linse)               L12 // clean result structures

L12 Copy_Var_L(topf, linsenTopf)         L13 // topf = LinsenTopf;
L13 Is_Null_Var(topf)                    exit// while (topf) {
L13 Is_Not_Null_Var(topf)                L14
L14 Copy_Var_L(linse, topf)              L15 //  linse = topf;
L15 Get_Next_L(topf, topf)               L16 //  topf = topf->next;
L16 Is_Good(linse)                       L17 //  if (linse->istGut) {
L16 Is_Not_Good(linse)                   L20
L17 Set_Next_Null_L(linse)               L18 //      linse->next = NULL; //
    Additional statement for analysis, no semantic change
L18 Set_Next_L(linse, guteLinsen)        L19 //      linse->next = guteLinsen;
L19 Copy_Var_L(guteLinsen, linse)        L13 //      guteLinsen = linse;
                                             //    } else {
L20 Set_Next_Null_L(linse)               L21 //      linse->next = NULL; //
    Additional statement for analysis, no semantic change
L21 Set_Next_L(linse, schlechteLinsen)   L22 //      linse->next = schlechteLinsen;
L22 Copy_Var_L(schlechteLinsen, linse)   L13 //      schlechteLinsen = linse;
                                             //    }
                                             // }

exit Set_Null_L(linse)                   exitA   //clean result structures
exitA Set_Null_L(linsenTopf)             exitB

exitB Assert_No_Reachable_Arbitrary()                    error
exitB Assert_No_Good_n_Bad()                             error
exitB Assert_Good_Linsen(guteLinsen)                     error
exitB Assert_Bad_Linsen(schlechteLinsen)                 error
exitB Assert_No_Leak_End(guteLinsen, schlechteLinsen)    error
```

5.3 Zusicherungen

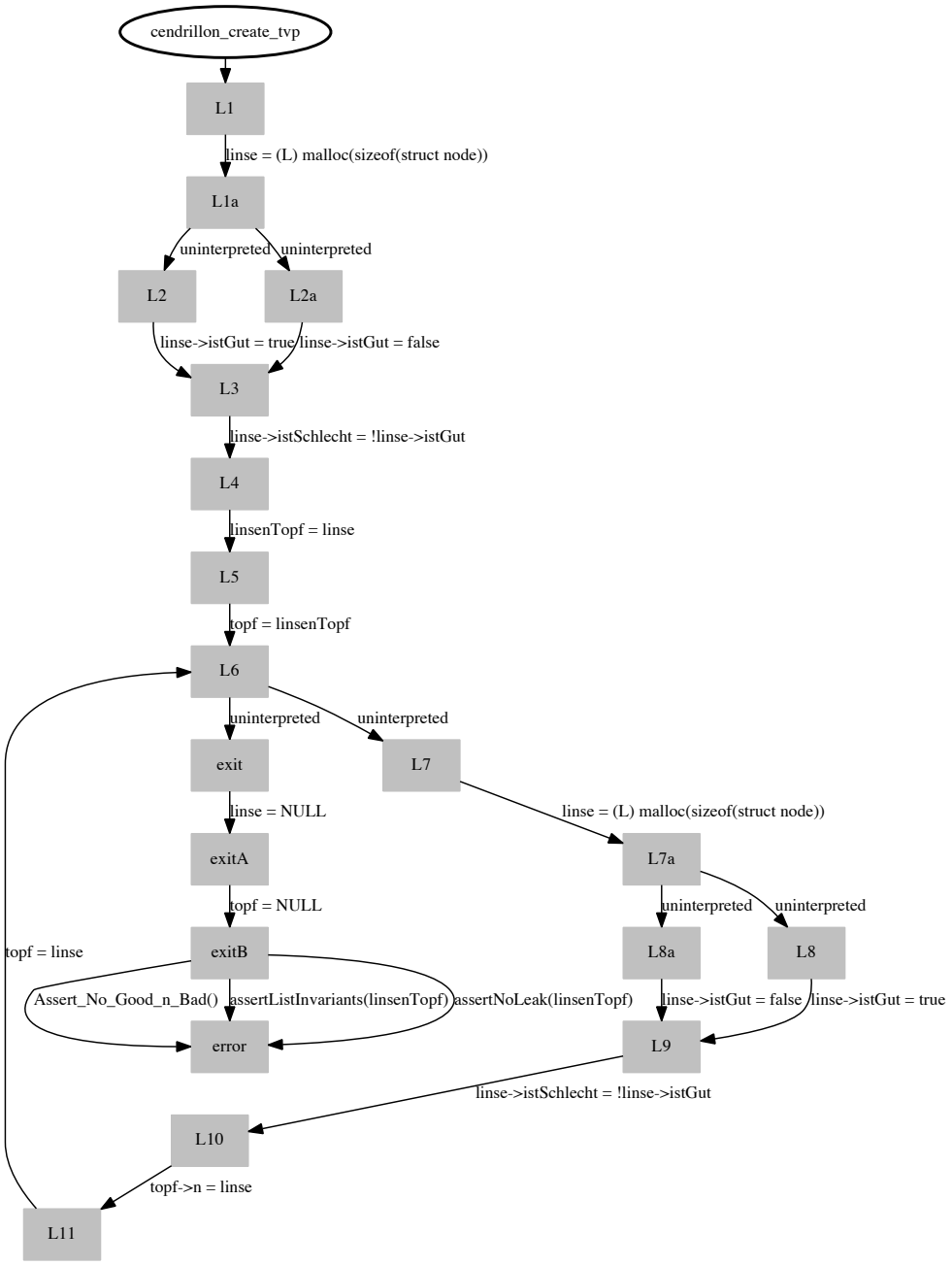
...

5.4 Ausgabestrukturen

...

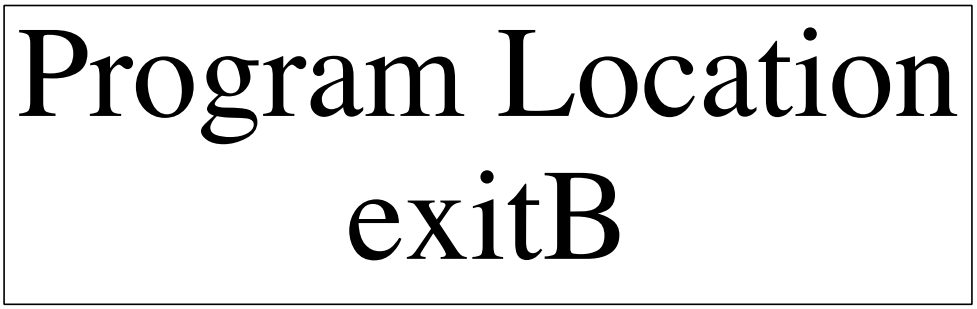
6 Anhang

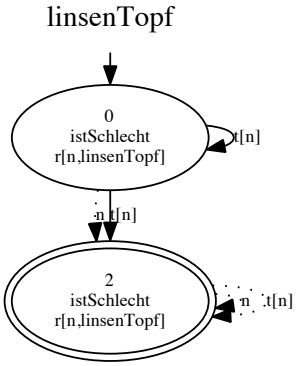
6.1 Analysebericht Meilenstein A

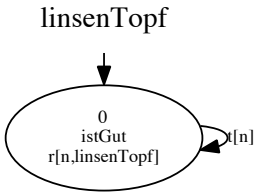


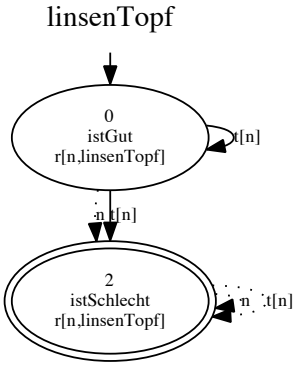
Program Location L1

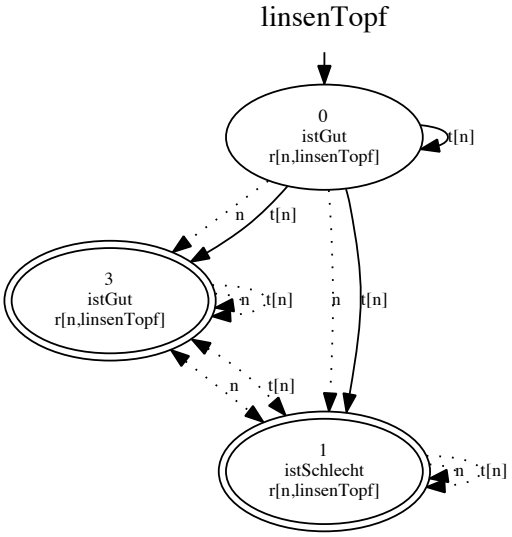
Structure with empty universe

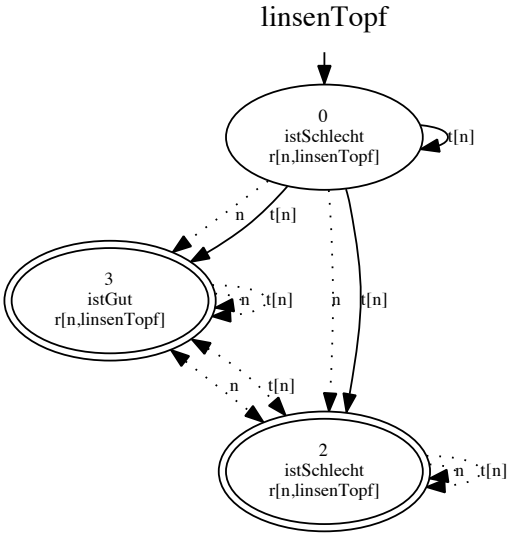

Program Location
exitB

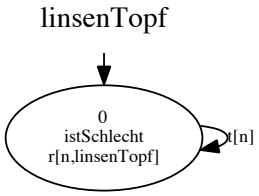

linsenTopf
0
istSchlecht
r[n,linsenTopf]
t[n]
n,t[n]
2
istSchlecht
r[n,linsenTopf]
n,t[n]

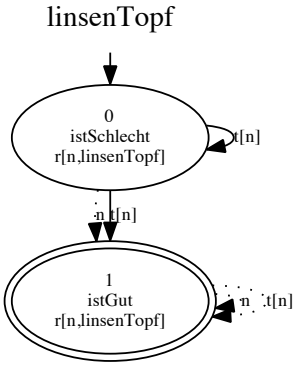

linsenTopf
0
istGut
r[n,linsenTopf]
t[n]

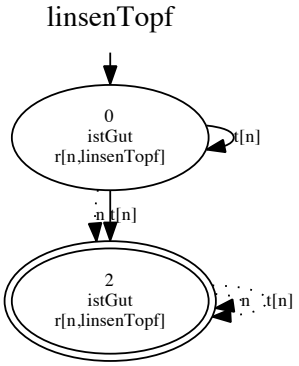

linsenTopf
0
istGut
r[n,linsenTopf]
t[n]
n t[n]
2
istSchlecht
r[n,linsenTopf]
n t[n]


linsenTopf
0
istGut
r[n,linsenTopf]
t[n]
n
t[n]
3
istGut
r[n,linsenTopf]
n
t[n]
n
t[n]
n
t[n]
1
istSchlecht
r[n,linsenTopf]
n
t[n]

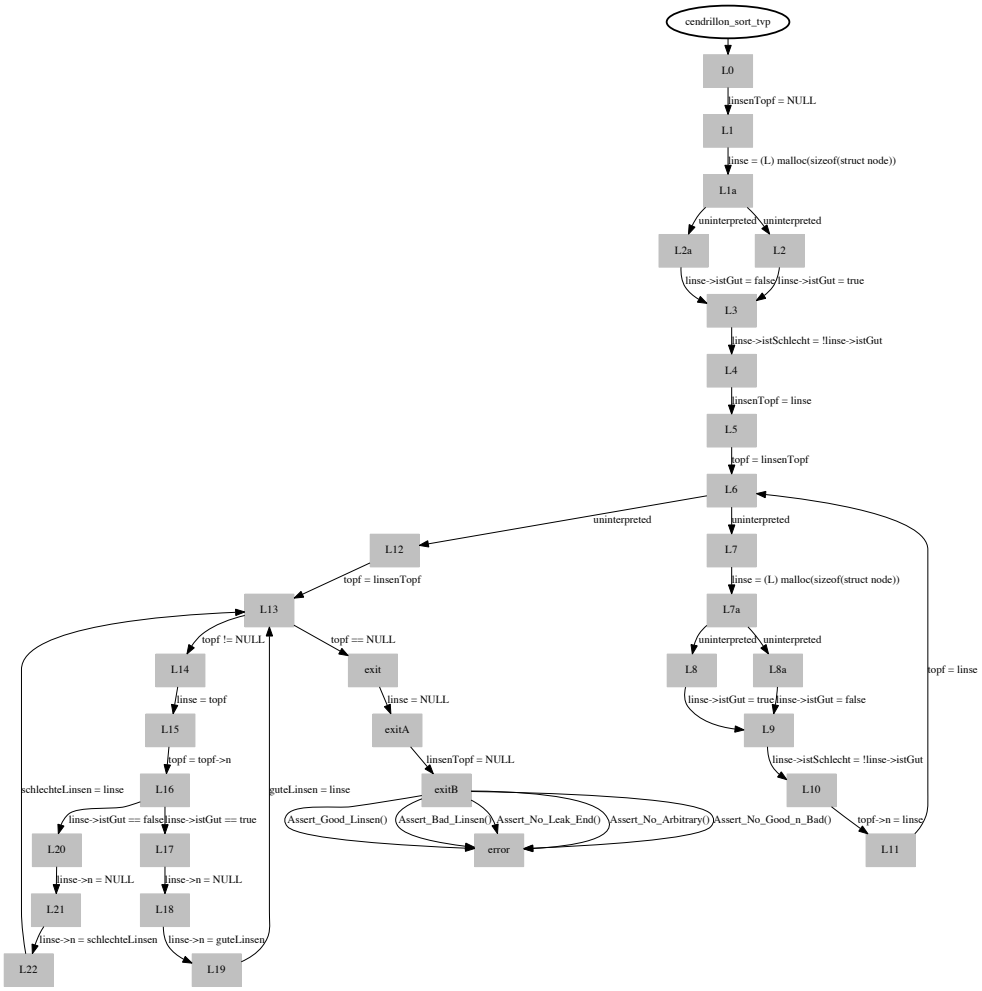

linsenTopf
0
istSchlecht
r[n,linsenTopf]
t[n]
n
t[n]
3
istGut
r[n,linsenTopf]
n
t[n]
n
t[n]
n
t[n]
2
istSchlecht
r[n,linsenTopf]
n
t[n]


linsenTopf
0
istSchlecht
r[n,linsenTopf]
t[n]

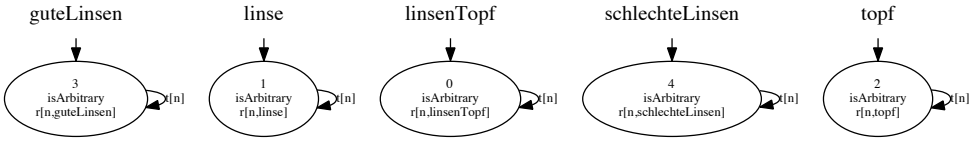

linsenTopf
0
istSchlecht
r[n,linsenTopf]
t[n]
n t[n]
1
istGut
r[n,linsenTopf]
n t[n]

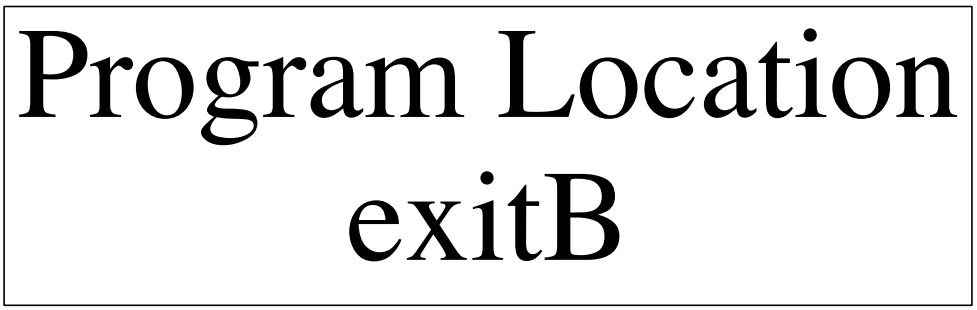

linsenTopf
0
istGut
r[n,linsenTopf]
t[n]
n t[n]
2
istGut
r[n,linsenTopf]
n t[n]

6.2 Analysebericht Meilenstein B

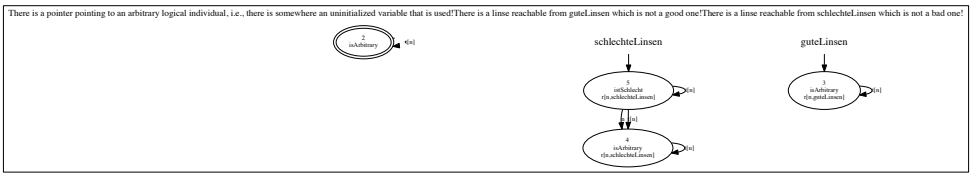


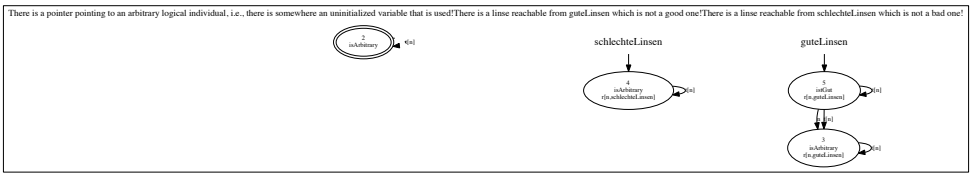
Program Location L0

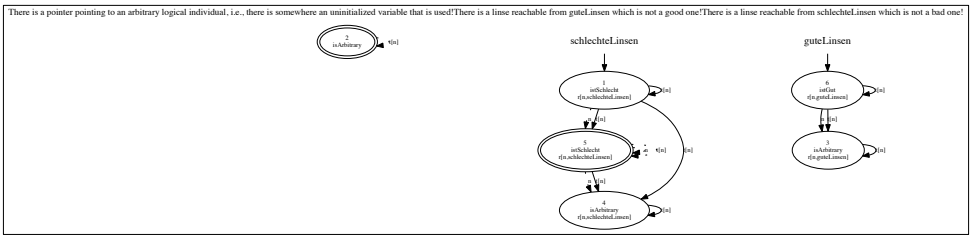

guteLinsen
3
isArbitrary
r[n,guteLinsen]
r[n]
linse
1
isArbitrary
r[n,linse]
r[n]
linsenTopf
0
isArbitrary
r[n,linsenTopf]
r[n]
schlechteLinsen
4
isArbitrary
r[n,schlechteLinsen]
r[n]
topf
2
isArbitrary
r[n,topf]
r[n]

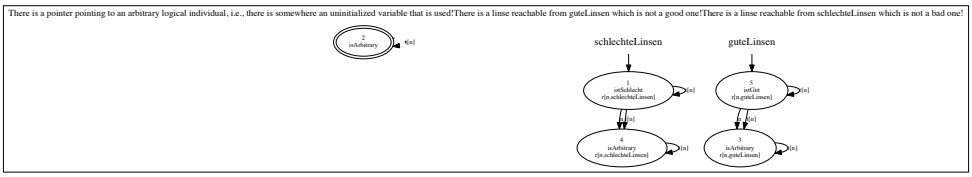

Program Location
exitB

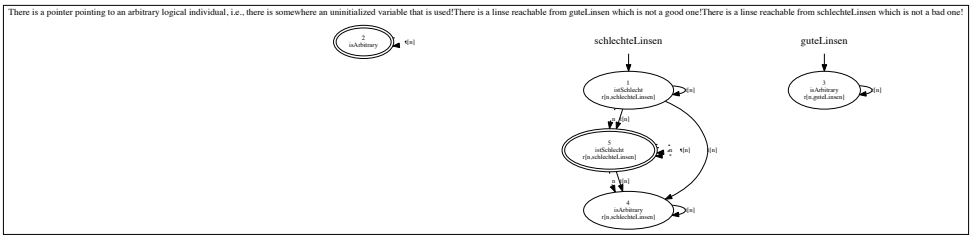
Messages for exitB

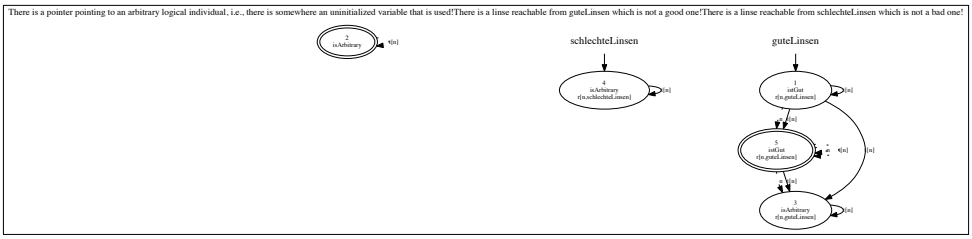

There is a pointer pointing to an arbitrary logical individual, i.e., there is somewhere an uninitialized variable that is used!There is a linse reachable from guteLinsen which is not a good one!There is a linse reachable from schlechteLinsen which is not a bad one!
2
isArbitrary
[n]
schlechteLinsen
5
istSchlecht
r[n,schlechteLinsen]
[n]
4
isArbitrary
r[n,schlechteLinsen]
[n]
[n]
guteLinsen
3
isArbitrary
r[n,guteLinsen]
[n]

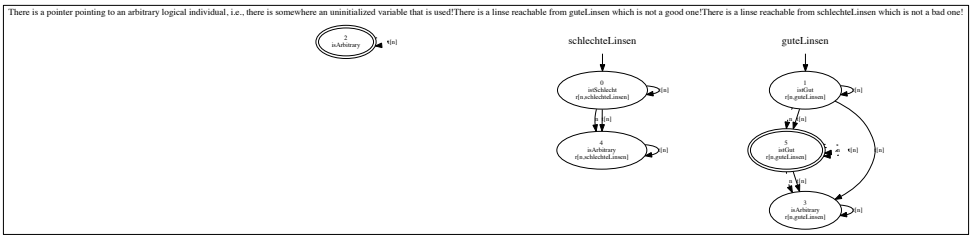

There is a pointer pointing to an arbitrary logical individual, i.e., there is somewhere an uninitialized variable that is used!There is a linse reachable from guteLinsen which is not a good one!There is a linse reachable from schlechteLinsen which is not a bad one!
2
isArbitrary
[n]
schlechteLinsen
4
isArbitrary
r[n,schlechteLinsen]
[n]
guteLinsen
5
isGut
r[n,guteLinsen]
[n]
[n]
3
isArbitrary
r[n,guteLinsen]
[n]

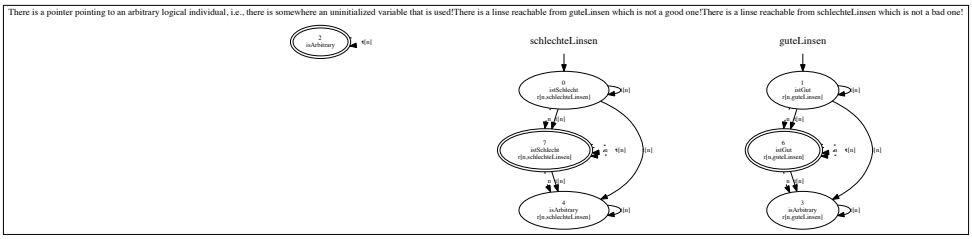

There is a pointer pointing to an arbitrary logical individual, i.e., there is somewhere an uninitialized variable that is used!There is a linse reachable from guteLinsen which is not a good one!There is a linse reachable from schlechteLinsen which is not a bad one!
2
isArbitrary
¥[n]
schlechteLinsen
1
istSchlecht
r[n,schlechteLinsen]
[n]
e
5
istSchlecht
r[n,schlechteLinsen]
¥[n]
[n]
4
isArbitrary
r[n,schlechteLinsen]
[n]
guteLinsen
6
istGut
r[n,guteLinsen]
[n]
e ¥[n]
3
isArbitrary
r[n,guteLinsen]
[n]

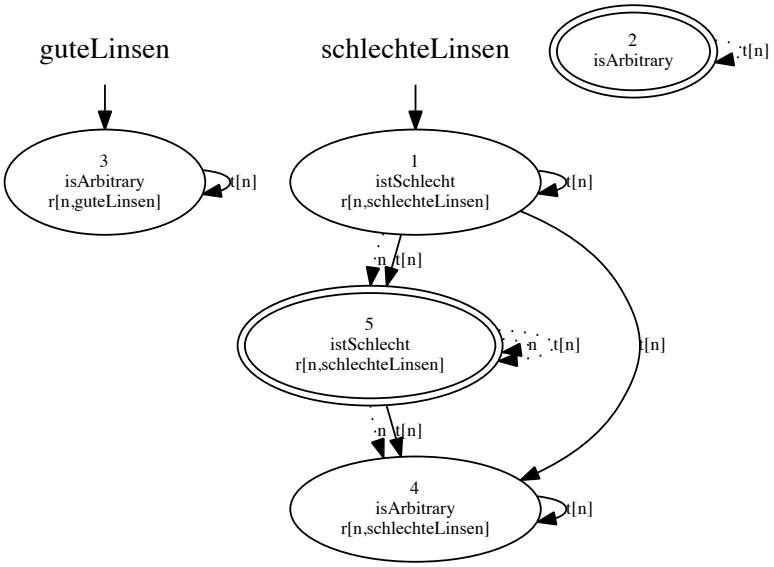

There is a pointer pointing to an arbitrary logical individual, i.e., there is somewhere an uninitialized variable that is used!
2
isArbitrary
[n]
There is a linse reachable from guteLinsen which is not a good one!
schlechteLinsen
1
istSchlecht
r[n,schlechteLinsen]
[n]
4
isArbitrary
r[n,schlechteLinsen]
[n]
[n]
There is a linse reachable from schlechteLinsen which is not a bad one!
guteLinsen
6
istGut
r[n,guteLinsen]
[n]
5
isArbitrary
r[n,guteLinsen]
[n]
[n]

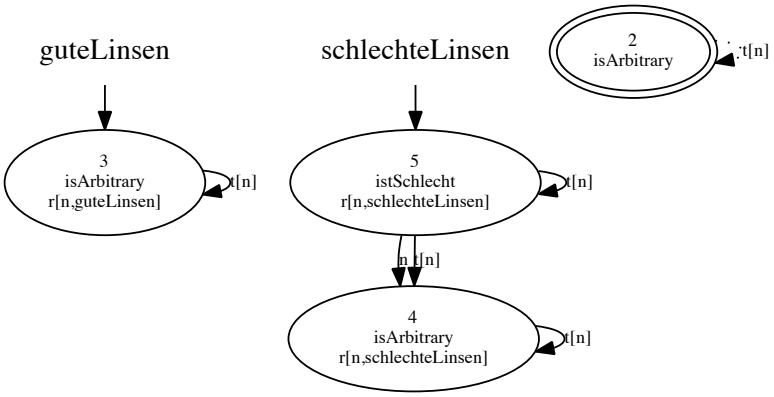

There is a pointer pointing to an arbitrary logical individual, i.e., there is somewhere an uninitialized variable that is used!There is a linse reachable from guteLinsen which is not a good one!There is a linse reachable from schlechteLinsen which is not a bad one!
2
isArbitrary
¥[n]
schlechteLinsen
1
istSchlecht
r[n,schlechteLinsen]
[n]
guteLinsen
3
isArbitrary
r[n,guteLinsen]
¥[n]
¥[n]
5
istSchlecht
r[n,schlechteLinsen]
¥[n]
[n]
¥[n]
4
isArbitrary
r[n,schlechteLinsen]
[n]

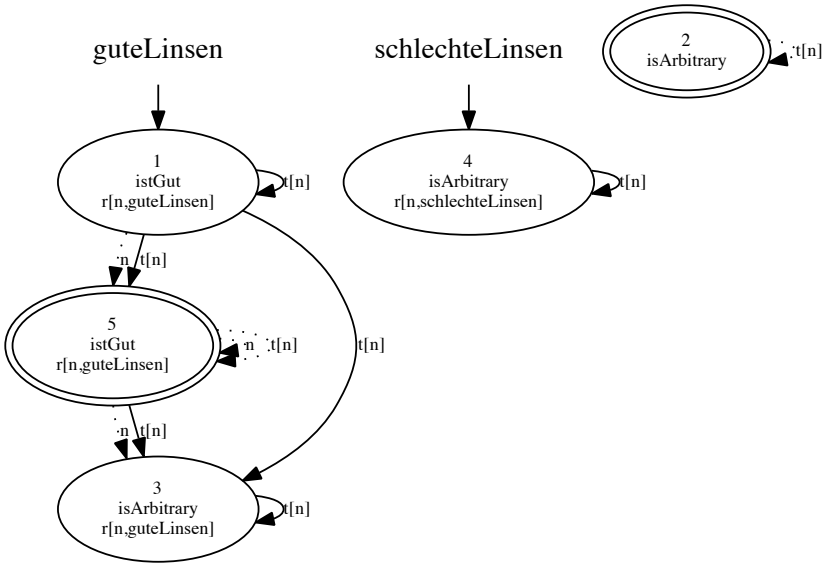

There is a pointer pointing to an arbitrary logical individual, i.e., there is somewhere an uninitialized variable that is used!There is a linse reachable from guteLinsen which is not a good one!There is a linse reachable from schlechteLinsen which is not a bad one!
2
isArbitrary
¶[n]
schlechteLinsen
4
isArbitrary
r[n,schlechteLinsen]
[n]
guteLinsen
1
istGut
r[n,guteLinsen]
[n]
[n]
5
istGut
r[n,guteLinsen]
¶[n]
[n]
[n]
3
isArbitrary
r[n,guteLinsen]
[n]

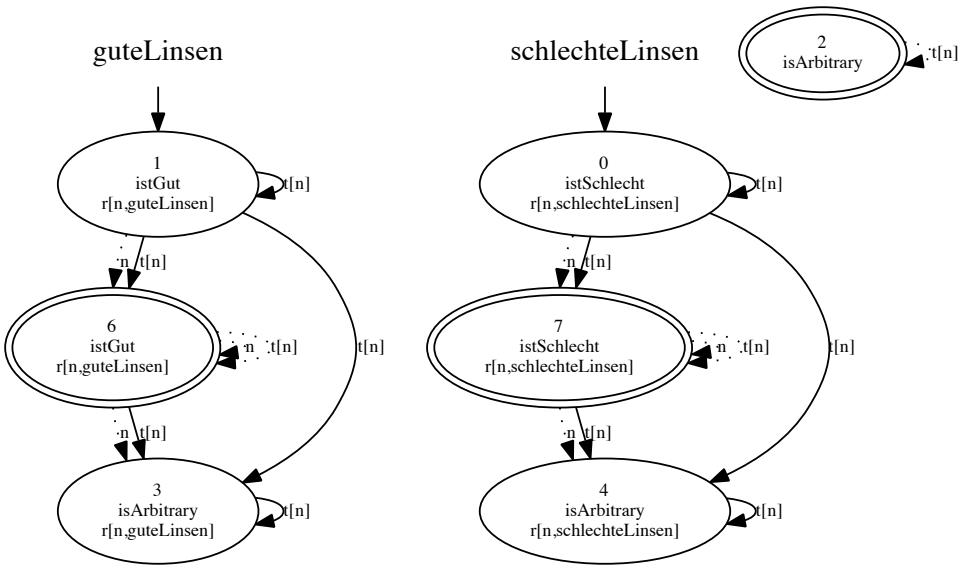

There is a pointer pointing to an arbitrary logical individual, i.e., there is somewhere an uninitialized variable that is used!There is a linse reachable from guteLinsen which is not a good one!There is a linse reachable from schlechteLinsen which is not a bad one!
2
isArbitrary
¶[n]
schlechteLinsen
0
istSchlecht
r[n,schlechteLinsen]
[n]
1
[n]
4
isArbitrary
r[n,schlechteLinsen]
¶[n]
guteLinsen
1
istGut
r[n,guteLinsen]
[n]
0
[n]
5
istGut
r[n,guteLinsen]
¶[n]
[n]
1
[n]
3
isArbitrary
r[n,guteLinsen]
¶[n]

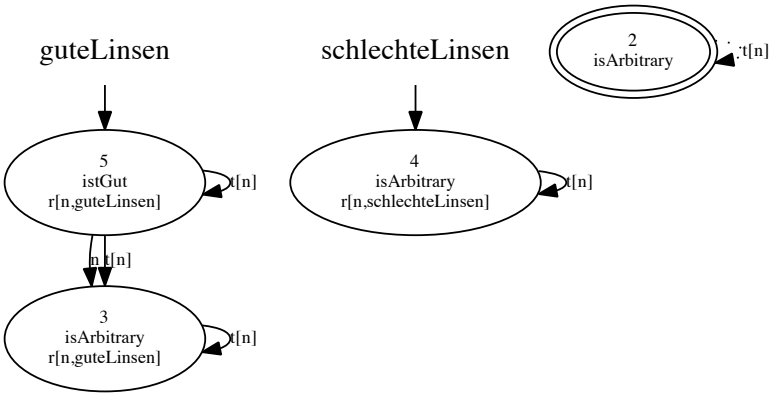

There is a pointer pointing to an arbitrary logical individual, i.e., there is somewhere an uninitialized variable that is used!There is a linse reachable from guteLinsen which is not a good one!There is a linse reachable from schlechteLinsen which is not a bad one!
2
isArbitrary
*[n]
schlechteLinsen
0
istSchlecht
r[n.schlechteLinsen]
*[n]
1
*[n]
2
istSchlecht
r[n.schlechteLinsen]
*
*
*[n]
[n]
3
*[n]
4
isArbitrary
r[n.schlechteLinsen]
*[n]
guteLinsen
1
istGut
r[n.guteLinsen]
*[n]
1
*[n]
2
istGut
r[n.guteLinsen]
*
*
*[n]
[n]
3
*[n]
3
isArbitrary
r[n.guteLinsen]
*[n]

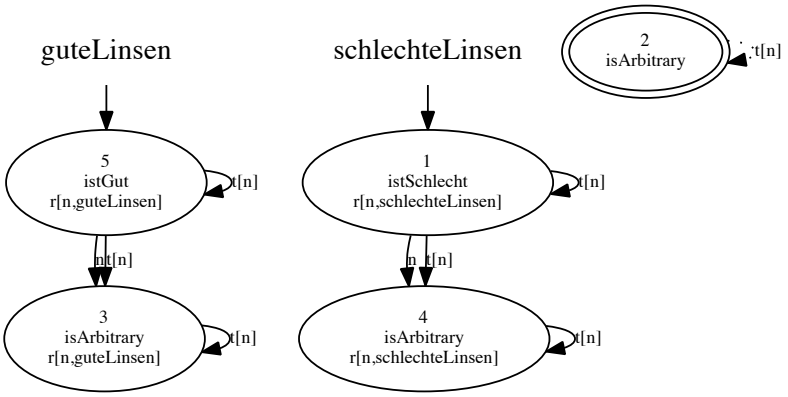

guteLinsen
schlechteLinsen
2
isArbitrary
t[n]
3
isArbitrary
r[n,guteLinsen]
t[n]
1
istSchlecht
r[n,schlechteLinsen]
t[n]
n
t[n]
5
istSchlecht
r[n,schlechteLinsen]
n
t[n]
t[n]
n
t[n]
4
isArbitrary
r[n,schlechteLinsen]
t[n]

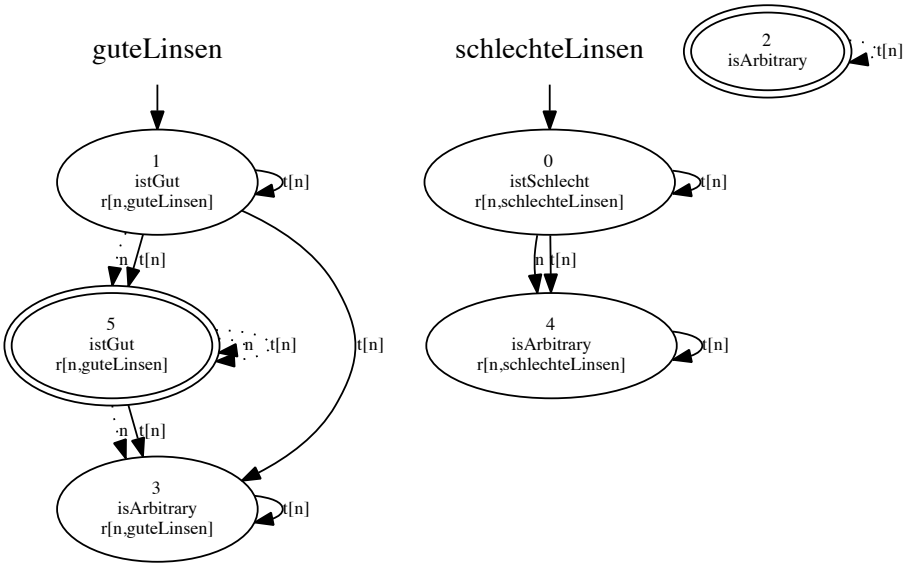

guteLinsen
schlechteLinsen
2
isArbitrary
t[n]
3
isArbitrary
r[n,guteLinsen]
t[n]
5
istSchlecht
r[n,schlechteLinsen]
t[n]
n,1[n]
4
isArbitrary
r[n,schlechteLinsen]
t[n]

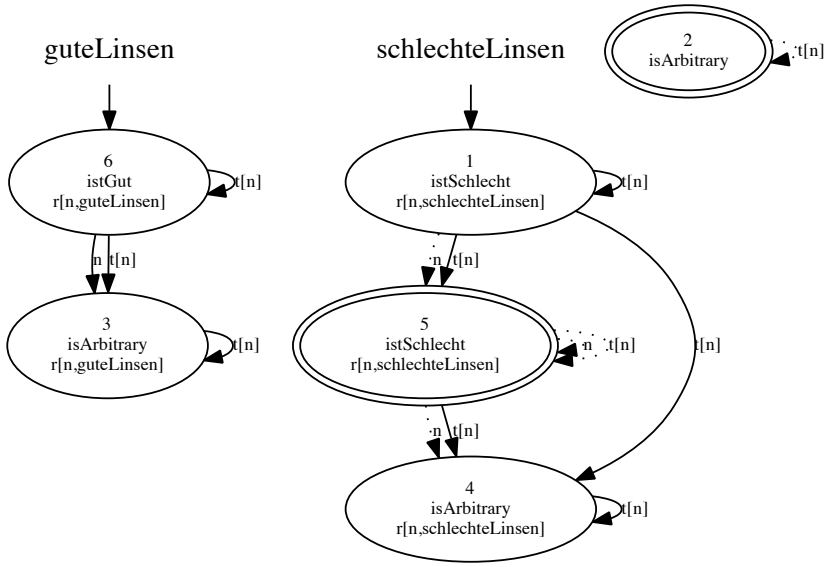

guteLinsen
schlechteLinsen
2
isArbitrary
·t[n]
1
istGut
r[n,guteLinsen]
t[n]
4
isArbitrary
r[n,schlechteLinsen]
t[n]
·n
·t[n]
5
istGut
r[n,guteLinsen]
·n
·t[n]
t[n]
·n
·t[n]
3
isArbitrary
r[n,guteLinsen]
t[n]


guteLinsen
1
istGut
r[n,guteLinsen]
t[n]
6
istGut
r[n,guteLinsen]
3
isArbitrary
r[n,guteLinsen]
schlechteLinsen
2
isArbitrary
0
istSchlecht
r[n,schlechteLinsen]
7
istSchlecht
r[n,schlechteLinsen]
4
isArbitrary
r[n,schlechteLinsen]


guteLinsen
schlechteLinsen
2
isArbitrary
t[n]
5
istGut
r[n,guteLinsen]
t[n]
n,t[n]
3
isArbitrary
r[n,guteLinsen]
t[n]
4
isArbitrary
r[n,schlechteLinsen]
t[n]

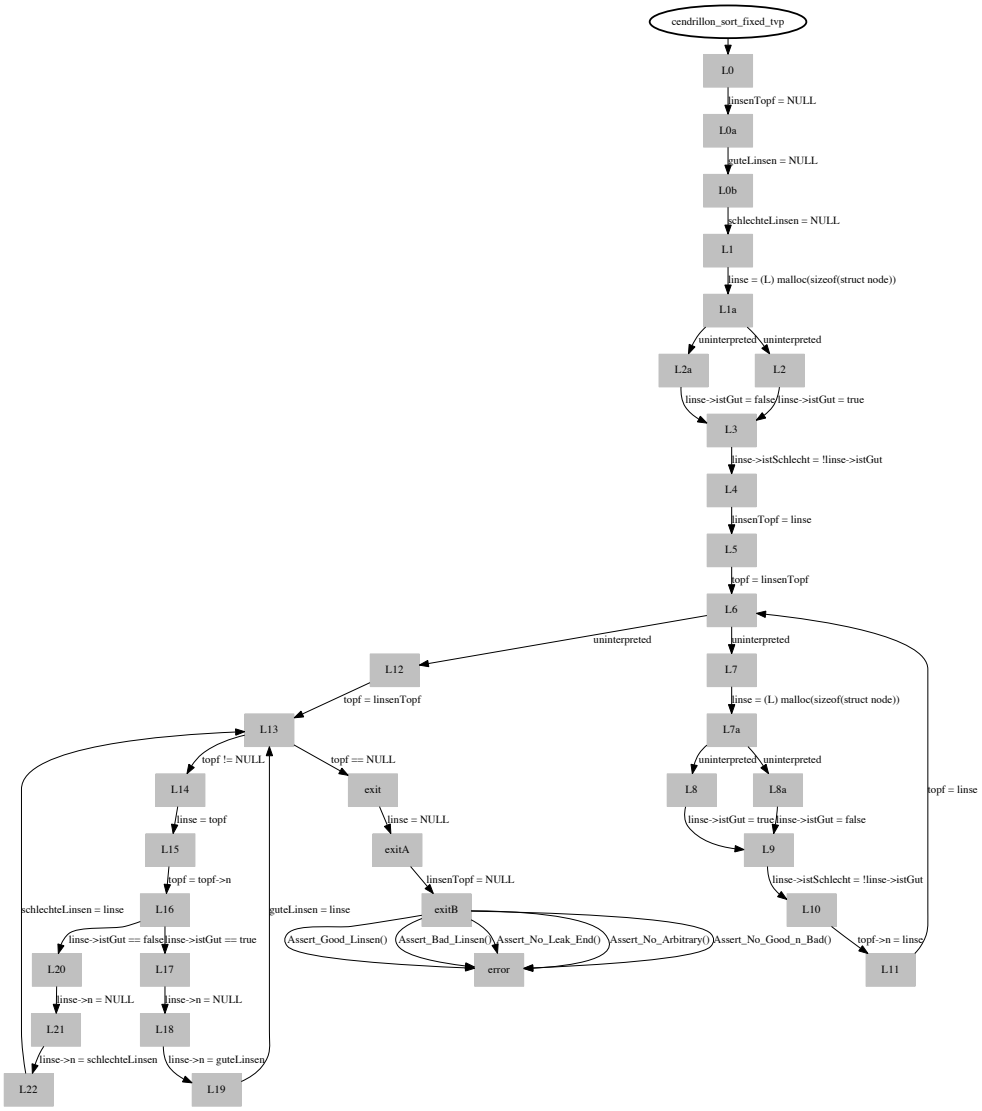

guteLinsen
schlechteLinsen
2
isArbitrary
5
istGut
r[n,guteLinsen]
1
istSchlecht
r[n,schlechteLinsen]
3
isArbitrary
r[n,guteLinsen]
4
isArbitrary
r[n,schlechteLinsen]


guteLinsen
schlechteLinsen
2
isArbitrary
t[n]
1
istGut
r[n,guteLinsen]
0
istSchlecht
r[n,schlechteLinsen]
5
istGut
r[n,guteLinsen]
4
isArbitrary
r[n,schlechteLinsen]
3
isArbitrary
r[n,guteLinsen]

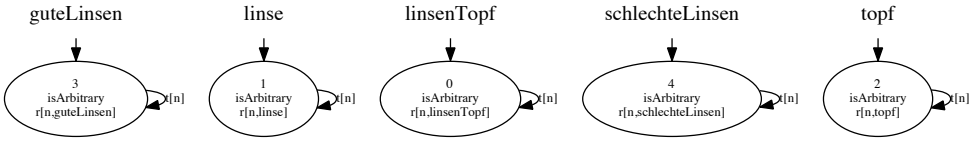

guteLinsen
schlechteLinsen
2
isArbitrary
t[n]
6
istGut
r[n,guteLinsen]
t[n]
n t[n]
3
isArbitrary
r[n,guteLinsen]
t[n]
1
istSchlecht
r[n,schlechteLinsen]
t[n]
n t[n]
5
istSchlecht
r[n,schlechteLinsen]
n t[n]
t[n]
n t[n]
4
isArbitrary
r[n,schlechteLinsen]
t[n]

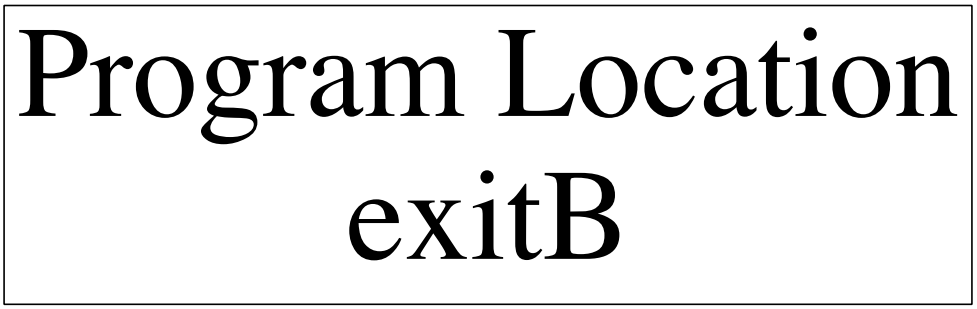
Program Location error

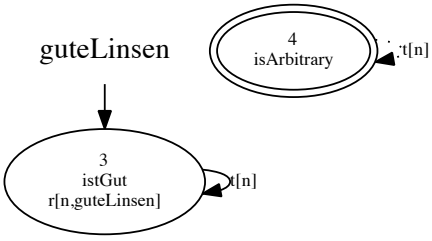
6.3 Analysebericht Meilenstein B (verbessert)

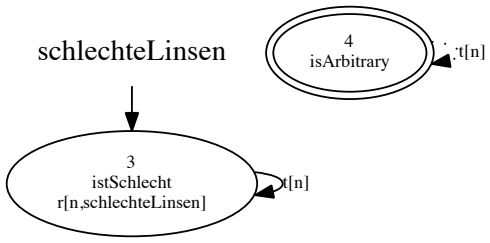


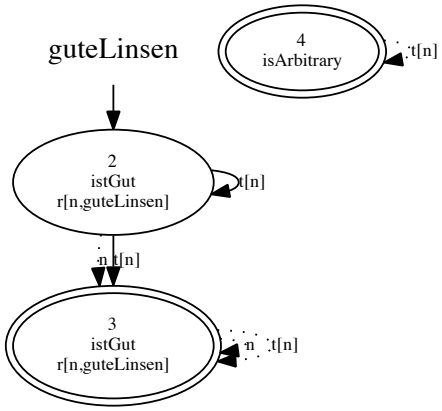
Program Location L0

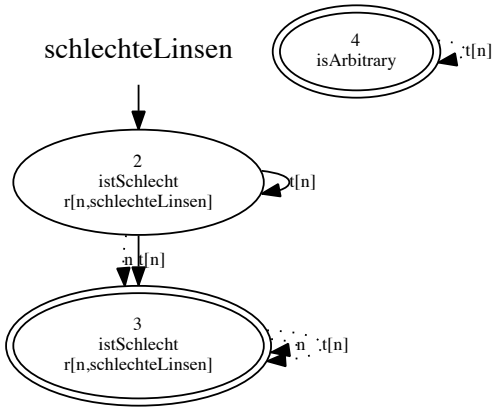

guteLinsen
3
isArbitrary
r[n,guteLinsen]
r[n]
linse
1
isArbitrary
r[n,linse]
r[n]
linsenTopf
0
isArbitrary
r[n,linsenTopf]
r[n]
schlechteLinsen
4
isArbitrary
r[n,schlechteLinsen]
r[n]
topf
2
isArbitrary
r[n,topf]
r[n]

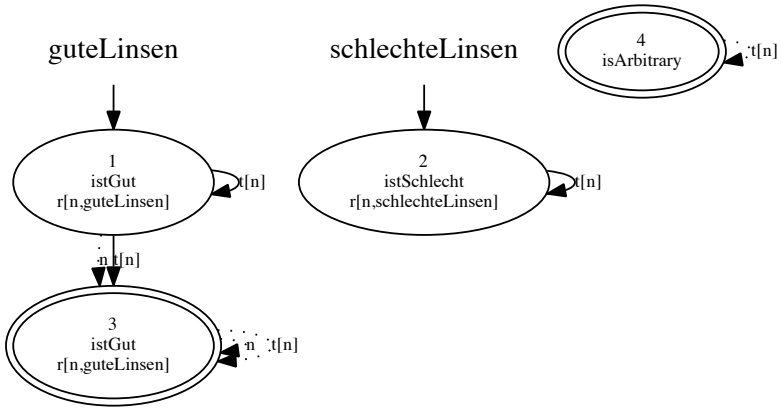

Program Location
exitB

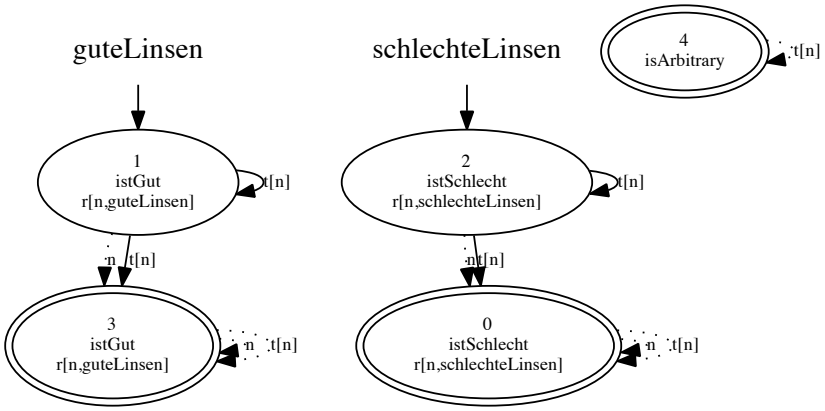

guteLinsen
4
isArbitrary
t[n]
3
istGut
r[n,guteLinsen]
t[n]

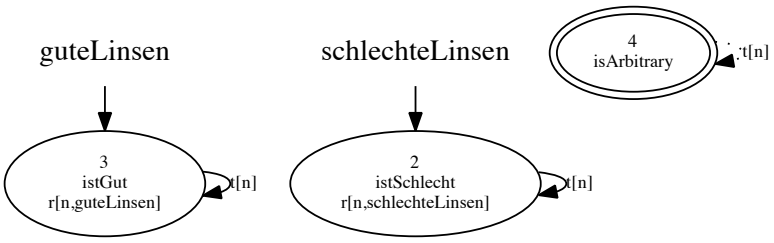

schlechteLinsen
4
isArbitrary
:t[n]
3
istSchlecht
r[n,schlechteLinsen]
t[n]

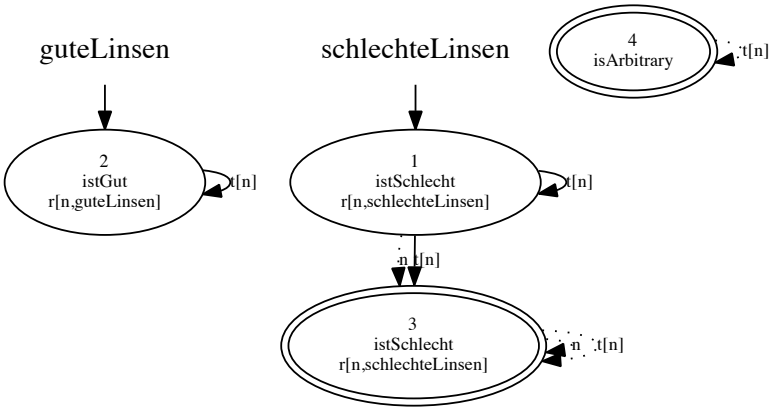

guteLinsen
4
isArbitrary
:t[n]
2
istGut
r[n,guteLinsen]
t[n]
n t[n]
3
istGut
r[n,guteLinsen]
n :t[n]


schlechteLinsen
4
isArbitrary
2
istSchlecht
r[n,schlechteLinsen]
3
istSchlecht
r[n,schlechteLinsen]


guteLinsen
schlechteLinsen
4
isArbitrary
t[n]
1
istGut
r[n,guteLinsen]
t[n]
2
istSchlecht
r[n,schlechteLinsen]
t[n]
n,t[n]
3
istGut
r[n,guteLinsen]
n
t[n]

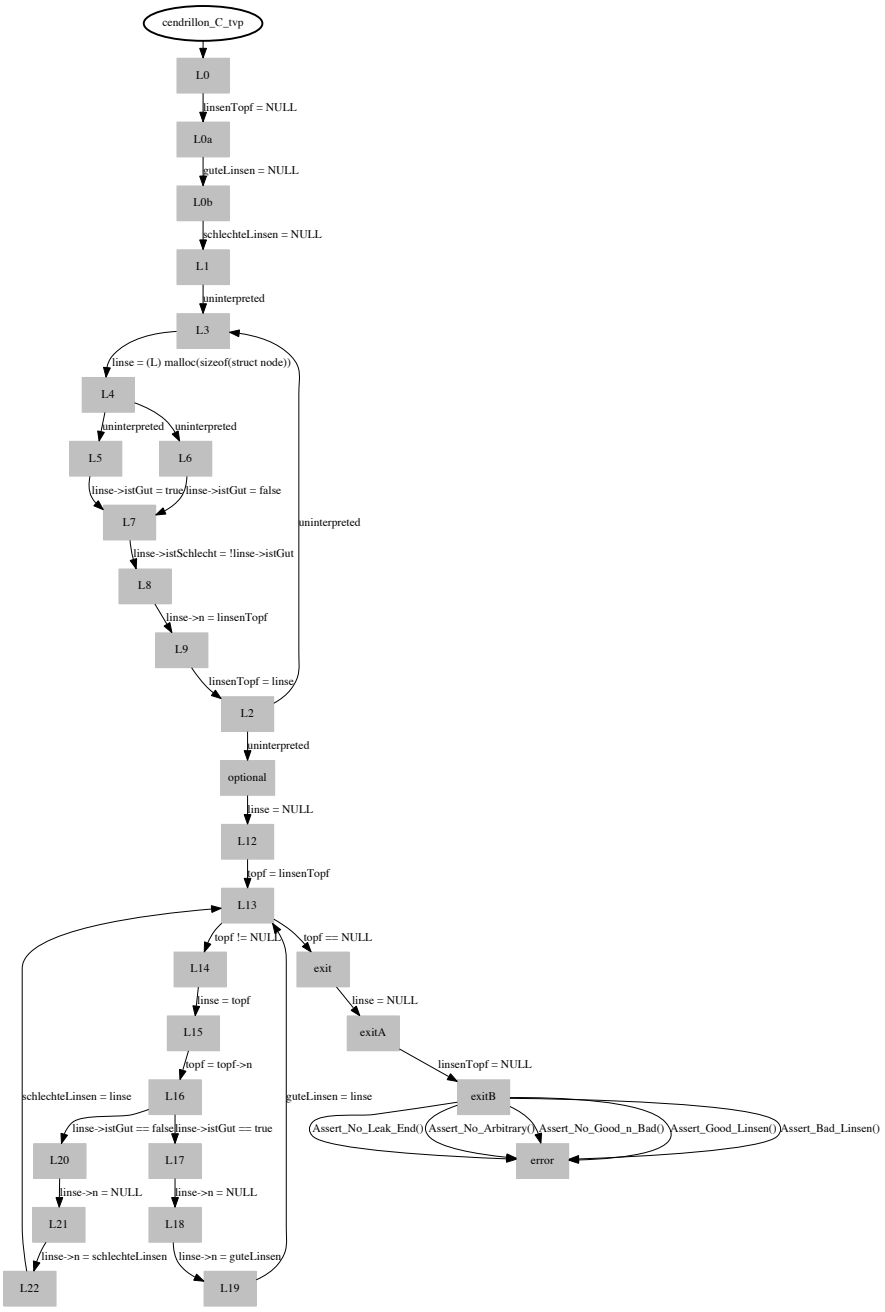

guteLinsen
schlechteLinsen
4
isArbitrary
:t[n]
1
istGut
r[n,guteLinsen]
t[n]
2
istSchlecht
r[n,schlechteLinsen]
t[n]
3
istGut
r[n,guteLinsen]
0
istSchlecht
r[n,schlechteLinsen]


guteLinsen
schlechteLinsen
4
isArbitrary
:t[n]
3
istGut
r[n,guteLinsen]
t[n]
2
istSchlecht
r[n,schlechteLinsen]
t[n]

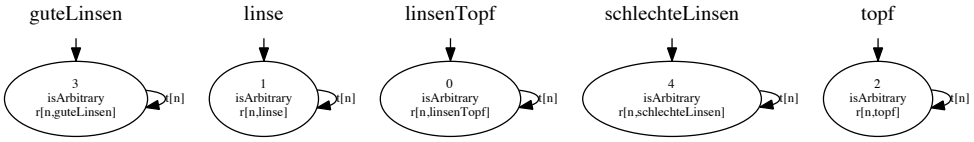

guteLinsen
schlechteLinsen
4
isArbitrary
:t[n]
2
istGut
r[n,guteLinsen]
t[n]
1
istSchlecht
r[n,schlechteLinsen]
t[n]
n
t[n]
3
istSchlecht
r[n,schlechteLinsen]
n
:t[n]

Program Location error

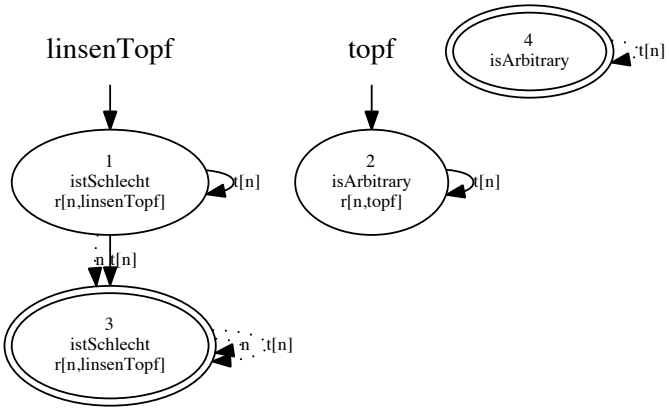
6.4 Analysebericht Meilenstein C

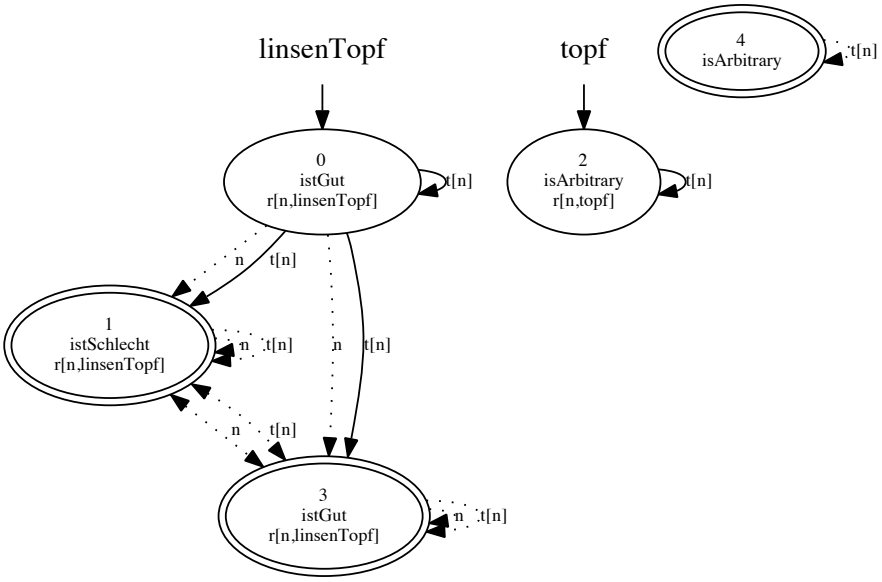


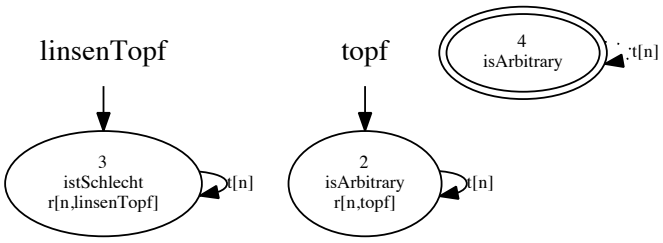
Program Location L0

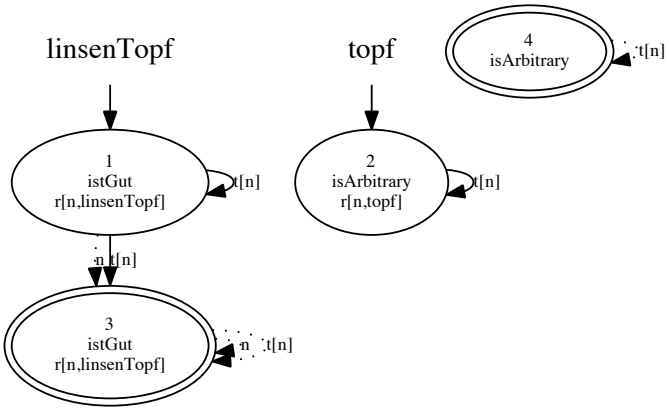

guteLinsen
3
isArbitrary
r[n,guteLinsen]
r[n]
linse
1
isArbitrary
r[n,linse]
r[n]
linsenTopf
0
isArbitrary
r[n,linsenTopf]
r[n]
schlechteLinsen
4
isArbitrary
r[n,schlechteLinsen]
r[n]
topf
2
isArbitrary
r[n,topf]
r[n]

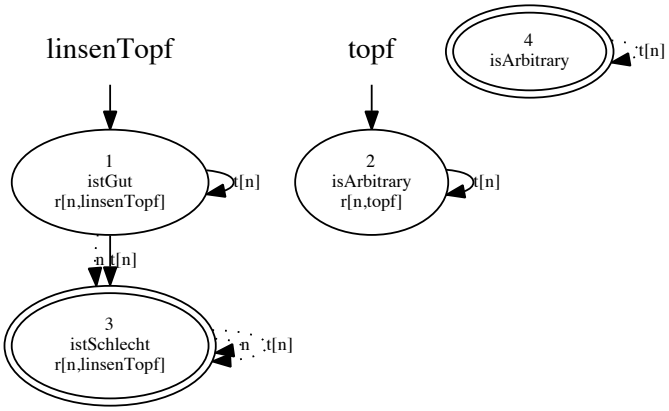
Program Location L12

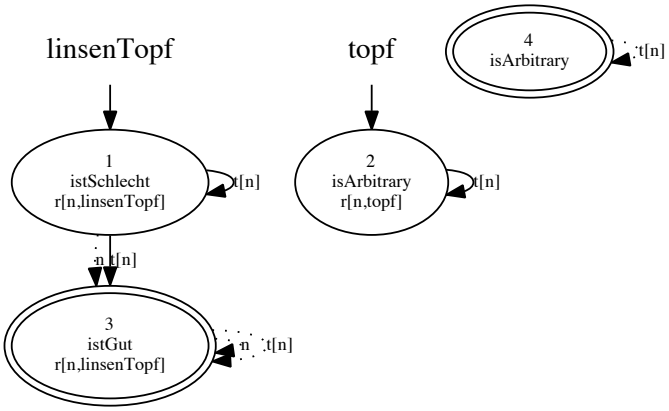

linsenTopf
topf
4
isArbitrary
t[n]
1
istSchlecht
r[n,linsenTopf]
t[n]
2
isArbitrary
r[n,topf]
t[n]
n
t[n]
3
istSchlecht
r[n,linsenTopf]
n
t[n]

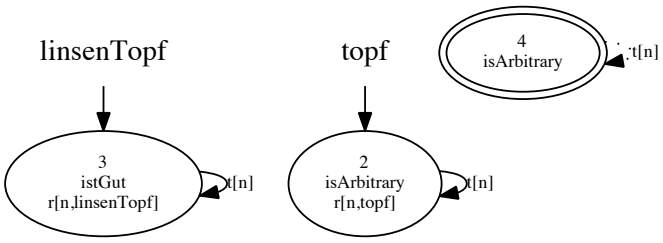

linsenTopf
topf
4
isArbitrary
t[n]
0
istGut
r[n,linsenTopf]
t[n]
2
isArbitrary
r[n,topf]
t[n]
n
t[n]
1
istSchlecht
r[n,linsenTopf]
n
t[n]
n
t[n]
n
t[n]
3
istGut
r[n,linsenTopf]
n
t[n]

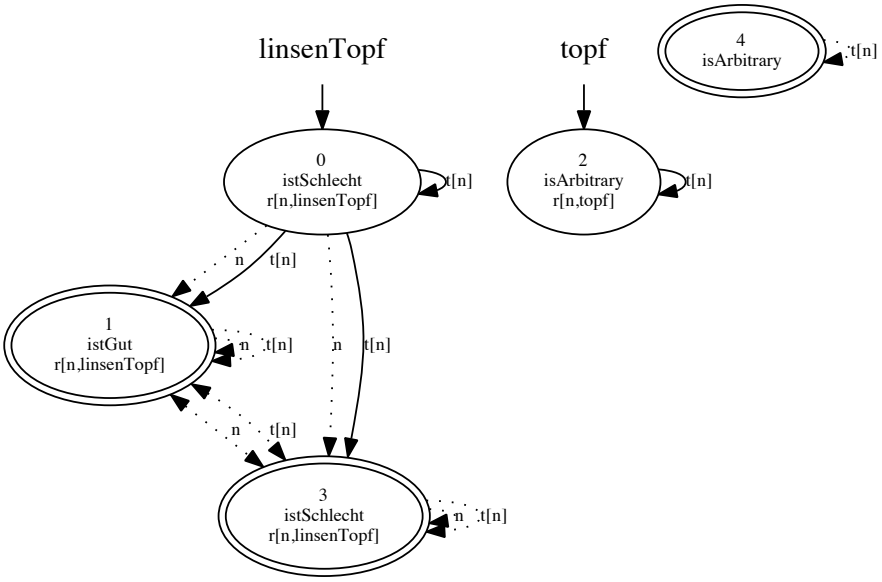

linsenTopf
topf
4
isArbitrary
:t[n]
3
istSchlecht
r[n,linsenTopf]
t[n]
2
isArbitrary
r[n,topf]
t[n]

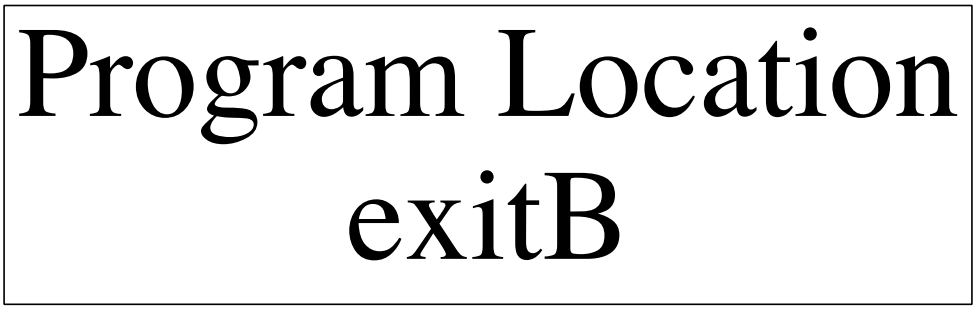

linsenTopf
topf
4
isArbitrary
t[n]
1
istGut
r[n,linsenTopf]
t[n]
2
isArbitrary
r[n,topf]
t[n]
t[n]
3
istGut
r[n,linsenTopf]
t[n]

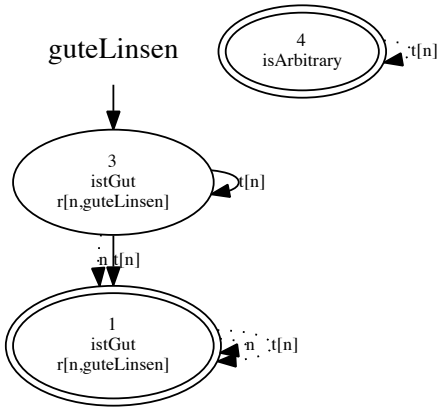

linsenTopf
topf
4
isArbitrary
t[n]
1
istGut
r[n,linsenTopf]
t[n]
2
isArbitrary
r[n,topf]
t[n]
n
t[n]
3
istSchlecht
r[n,linsenTopf]
n
t[n]

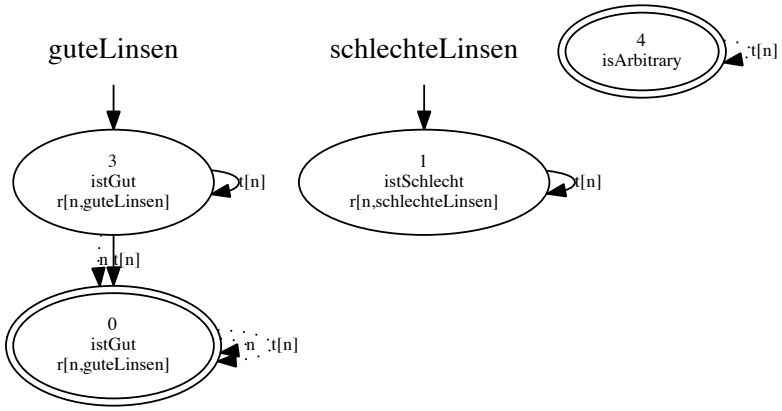

linsenTopf
topf
4
isArbitrary
t[n]
1
istSchlecht
r[n,linsenTopf]
t[n]
2
isArbitrary
r[n,topf]
t[n]
t[n]
3
istGut
r[n,linsenTopf]
t[n]

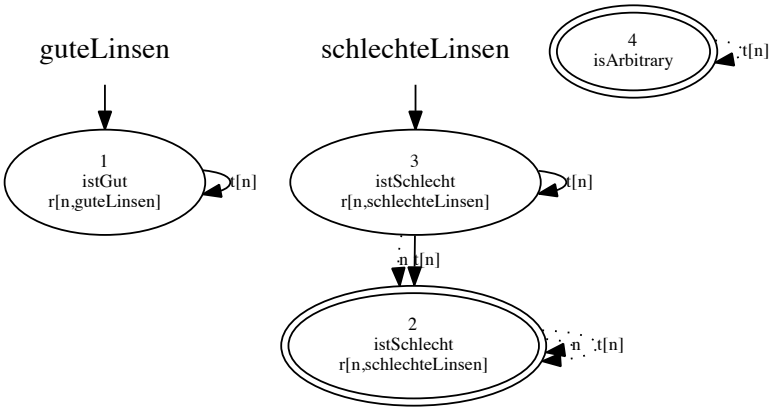

linsenTopf
topf
4
isArbitrary
:t[n]
3
istGut
r[n,linsenTopf]
t[n]
2
isArbitrary
r[n,topf]
t[n]

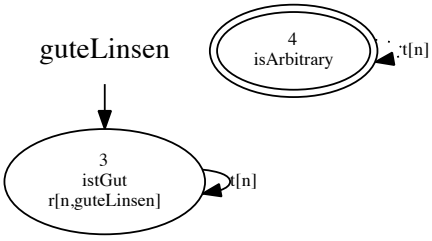

linsenTopf
topf
4
isArbitrary
t[n]
0
istSchlecht
r[n,linsenTopf]
t[n]
2
isArbitrary
r[n,topf]
t[n]
n
t[n]
1
istGut
r[n,linsenTopf]
n
t[n]
n
t[n]
n
t[n]
3
istSchlecht
r[n,linsenTopf]
n
t[n]

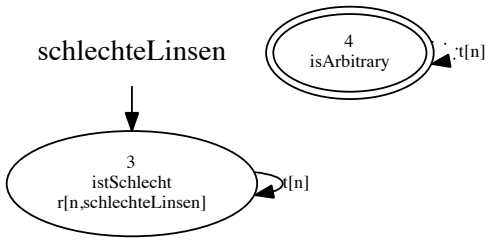

Program Location
exitB

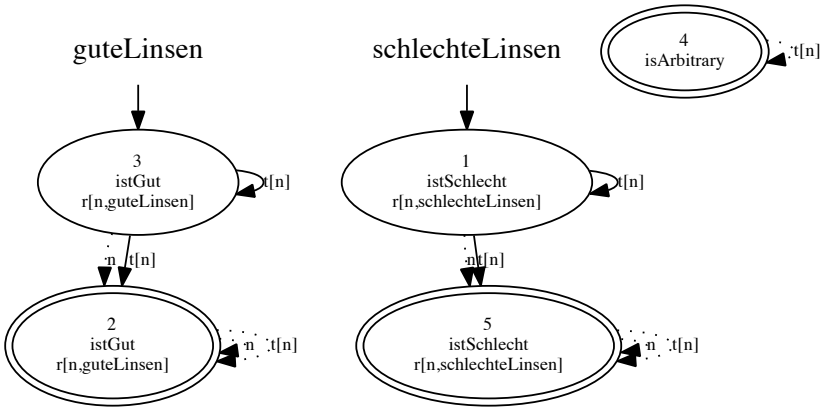

guteLinsen
4
isArbitrary
:t[n]
3
istGut
r[n,guteLinsen]
t[n]
:n t[n]
1
istGut
r[n,guteLinsen]
n :t[n]

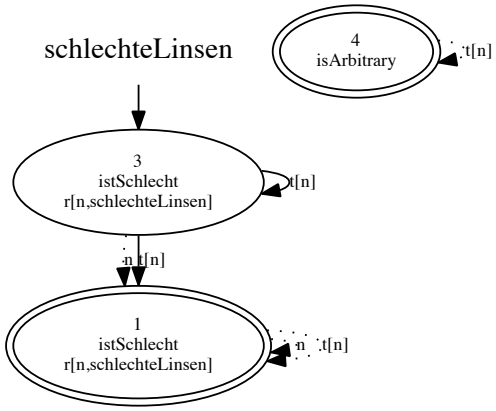

guteLinsen
schlechteLinsen
4
isArbitrary
t[n]
3
istGut
r[n,guteLinsen]
t[n]
1
istSchlecht
r[n,schlechteLinsen]
t[n]
0
istGut
r[n,guteLinsen]
t[n]

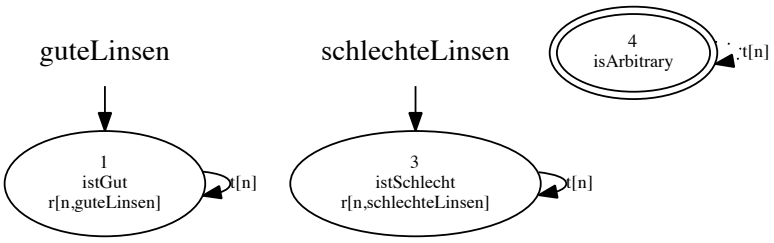

guteLinsen
schlechteLinsen
4
isArbitrary
1
istGut
r[n,guteLinsen]
3
istSchlecht
r[n,schlechteLinsen]
2
istSchlecht
r[n,schlechteLinsen]


guteLinsen
4
isArbitrary
:t[n]
3
istGut
r[n,guteLinsen]
t[n]


schlechteLinsen
4
isArbitrary
:t[n]
3
istSchlecht
r[n,schlechteLinsen]
t[n]


guteLinsen
schlechteLinsen
4
isArbitrary
:t[n]
3
istGut
r[n,guteLinsen]
t[n]
:n :t[n]
1
istSchlecht
r[n,schlechteLinsen]
t[n]
:n :t[n]
2
istGut
r[n,guteLinsen]
:n :t[n]
5
istSchlecht
r[n,schlechteLinsen]
:n :t[n]


schlechteLinsen
4
isArbitrary
:t[n]
3
istSchlecht
r[n,schlechteLinsen]
t[n]
1
istSchlecht
r[n,schlechteLinsen]
t[n]


guteLinsen
schlechteLinsen
4
isArbitrary
:t[n]
1
istGut
r[n,guteLinsen]
t[n]
3
istSchlecht
r[n,schlechteLinsen]
t[n]

Program Location error