INFDEV02-2

DEV Team

Abstraction, loop, and data structures.

Lecture Homework 2

Exercise 1 - Player Fill in the missing state values

```
class Vector2 :
  def __init__ (self,x,y):
   self.X=x
3
4
5
   self.Y=y
6
7
8
9
   class Player :
  def __init__ (self,name,x,y):
10
   self.Name=name
11
12
13
   self.Position=Vector2 (x,y)
14
15
16
17
  p1=Player ("Pippo",0,0)
18
19
20
21
  p2=Player ("Pluto",10,5)
```

```
globals
stack
heap
definitions

globals
stack
heap
definitions Vector2 __init__ (self,x,y) => ...
```

```
globals
stack
heap
                Vector2
                              __init__ (self,x,y) => ...
definitions
                           __init__ (self,name,x,y) => ...
               Player
globals
                                  self
                                         ref(0)
                                  name
stack
                                  у
                                  ret
                                          null
                                          Player
heap
                                  class
                Vector2
                              __init__
                                         (self,x,y) \Rightarrow \dots
definitions
                           _{-}init_{-} (self, name, x, y) => ...
                Player
globals
                                  self
                                         ref(0)
                                  name
stack
                                  ret
                                          null
                                          Player
                                  class
heap
                                  Name
                                          "Pippo"
                Vector2
                              __init__
                                         (self,x,y) \Rightarrow \dots
definitions
                           __init__ (self,name,x,y) => ...
               Player
globals
                                  self
                                         ref(1)
                                            0
                                  х
                                            0
                                  у
                                  ret
                                          null
stack
                                  self
                                  name
                                        "Pippo"
                                 х
                                  у
                                          null
                                  ret
                                          Player
                                  class
                                  Name
                                          "Pippo"
heap
                                 class
                                         Vector2
                Vector2
                                         (self,x,y) \Rightarrow \dots
                              __init__
definitions
                           __init__ (self,name,x,y) => ...
               Player
```

```
globals
                                            ref(1)
                                     self
                                               0
                                     х
                                               0
                                     у
                                             null
                                     ret
stack
                                    self
                                    name
                                            "Pippo"
                                    х
                                    у
                                    ret
                                             null
                                             Player
                                    class
                                    Name
                                             "Pippo"
heap
                                             Vector2
                                    class
                                    Х
                                                 0
                 Vector2
                                __init__
                                            (self,x,y) \Rightarrow \dots
definitions
                 Player
                             _{-}init_{-} (self, name, x, y) => ...
globals
                                     self
                                            ref(1)
                                     х
                                               0
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                                     У
                                             null
                                     ret
{\tt stack}
                                    {\tt self}
                                    name
                                            "Pippo"
                                    х
                                    у
                                    ret
                                             null
                                    class
                                             Player
                                             "Pippo"
                                    Name
                                    class
                                             Vector2
heap
                                    Х
                                                 0
                                1
                                    Y
                                __init__
                                            (self,x,y) \Rightarrow \dots
                 Vector2
{\tt definitions}
                 Player
                             _{-}init_{-} (self, name, x, y) => ...
```

```
globals
                                 self ref(1)
                                          0
                                 х
                                          0
                                 у
                                        ref(1)
                                 ret
stack
                                 self
                                       "Pippo"
                                name
                                х
                                у
                                ret
                                         null
                                class
                                         Player
                                Name
                                        "Pippo"
                                        Vector2
heap
                                 class
                                            0
                            1
                                Х
                                Y
                                            0
                             __init__
                                        (self,x,y) \Rightarrow \dots
               Vector2
definitions
               Player
                          __init__ (self,name,x,y) => ...
globals
                                  self
                                  name
stack
                                  у
                                  ret
                                         null
                                         Player
                                 class
                                        "Pippo"
                                 Name
                                        Vector2
heap
                                 class
                                            0
                                Х
               Vector2
                             __init__ (self,x,y) => ...
definitions
               Player
                          _{-}init_{-} (self, name, x, y) => ...
```

```
globals
                                self ref(0)
                                name
stack
                                У
                                       null
                                ret
                              class
                                         Player
                                        "Pippo"
                              Name
                              Position ref(1)
heap
                               class Vector2
                                          0
                               Y
                                          0
              Vector2
                            _{-}init_{-} (self,x,y) => ...
definitions
                         __init__ (self,name,x,y) => ...
              Player
globals
                                self
                                     ref(0)
                                name
stack
                                х
                                У
                                      ref(0)
                                ret
                                         Player
                              class
                                        "Pippo"
                             Name
                              Position ref(1)
heap
                               class Vector2
                               Х
                                          0
                          1
                               Y
                            __init__ (self,x,y) => ...
              Vector2
definitions
                         _{-init}_{-} (self, name, x, y) => ...
              Player
globals
stack
                                         Player
                              class
                              Name
                                        "Pippo"
                              Position ref(1)
heap
                               class Vector2
                          1
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                               Y
                                          0
              Vector2
                            __init__ (self,x,y) => ...
definitions
                         _{-}init_{-} (self, name, x, y) => ...
              Player
```

```
globals
                               p1 ref(0)
stack
                             class
                                        Player
                         0
                             {\tt Name}
                                       "Pippo"
                             Position ref(1)
heap
                               class Vector2
                               Х
                                         0
                         1
                               Y
                           _{-}init_{-} (self,x,y) => ...
              Vector2
definitions
                         __init__ (self,name,x,y) => ...
              Player
globals
                               p1 ref(0)
                                     ref(2)
                               self
                                    "Pluto"
                               name
                               x
                                        10
stack
                                        5
                               У
                                      null
                               ret
                             class
                                        Player
                             Name
                                        "Pippo"
                             Position ref(1)
                               class Vector2
heap
                               Y
                                         0
                               class Player
              Vector2
                           __init__ (self,x,y) => ...
definitions
              Player
                         _{-}init_{-} (self, name, x, y) => ...
```

```
globals
                                  p1 ref(0)
                                 self
                                        ref(2)
                                        "Pluto"
                                 name
                                           10
stack
                                           5
                                 у
                                         null
                                 ret
                                           Player
                                class
                                           "Pippo"
                               {\tt Name}
                               Position
                                           ref(1)
                                 class Vector2
{\tt heap}
                           1
                                 Y
                                            0
                                  class Player
                                  Name
               Vector2
                             __init__ (self,x,y) => ...
definitions
                          _{-}init_{-} (self, name, x, y) => ...
               Player
globals
                                  p1 ref(0)
                                  self ref(3)
                                  х
                                           10
                                           5
                                  У
                                         null
                                  ret
                                        ref(2)
{\tt stack}
                                 self
                                 name
                                        "Pluto"
                                           10
                                 х
                                           5
                                 у
                                 ret
                                         null
                                           Player
                                class
                                           "Pippo"
                               Name
                               Position
                                           ref (1)
                                 class Vector2
                                 Х
                                            0
heap
                           1
                                 Y
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                                  class
                                         Player
                           2
                                  Name
                                 class
                                         Vector2
                             __init__ (self,x,y) => ...
               Vector2
definitions
               Player
                          _{-init}_{-} (self, name, x, y) => ...
```

globals			p1 ref(0)
			self ref(3)
			x 10
			у 5
			ret null
stack		_	self ref(2)
			name "Pluto"
			x 10
			у 5
			ret null
		_	class Player
		0	Name "Pippo"
			Position ref(1)
			class Vector2
hoan		1	Х О
heap			Y O
		2	class Player
			Name
		3	class Vector2
		3	Х
definitions	Vector2	-	$_{-}$ init $_{-}$ (self,x,y) =>
	Player	i	<pre>.nit (self,name,x,y) =></pre>

globals		p1 ref(0)			
		self ref(3)			
		x 10			
stack		у 5			
		ret null			
		self ref(2)			
		name "Pluto"			
		x 10			
		у 5			
		ret null			
		class Player			
		O Name "Pippo"			
		Position ref(1)			
		class Vector2			
		1 X 0			
heap		Y O			
		class Player			
		Name			
		class Vector2			
		3 X			
		Υ			
definitions	Vector2	$_{-}$ init $_{-}$ (self,x,y) =>			
	Player	$_{-}$ init $_{-}$ (self, name, x, y) =>			

```
globals
                                 p1 ref(0)
                                       ref(3)
                                 self
                                          10
                                 у
                                        ref(3)
                                 ret
{\tt stack}
                                 self
                                        ref(2)
                                       "Pluto"
                                 name
                                          10
                                 х
                                           5
                                 У
                                 ret
                                         null
                                           Player
                               class
                               {\tt Name}
                                          "Pippo"
                                          ref(1)
                               Position
                                 class Vector2
                                 Х
                                            0
                           1
                                 Y
                                            0
heap
                                 class
                                         Player
                           2
                                 Name
                                        "Pluto"
                                 class
                                        Vector2
                                 X
                                           10
                           3
                                 Y
                                            5
                             __init__ (self,x,y) => ...
               {\tt Vector2}
definitions
                          __init__ (self,name,x,y) => ...
               Player
```

```
globals
                                  p1
                                       ref(0)
                                  self
                                         ref(2)
                                         "Pluto"
                                  name
                                            10
stack
                                            5
                                  у
                                           null
                                  ret
                                            Player
                                class
                                            "Pippo"
                                Name
                                Position
                                            ref(1)
                                  class
                                         Vector2
                            1
heap
                                  Y
                                             0
                                  class
                                           Player
                            2
                                          "Pluto"
                                  Name
                                          Vector2
                                  class
                                  X
                                             10
                            3
                                  Y
                                             5
                                         (self,x,y) \Rightarrow \dots
                Vector2
                              __init__
definitions
                Player
                           _{-init}_{-} (self, name, x, y) => ...
globals
                                  p1 ref(0)
                                  self
                                         ref(2)
                                  name
                                         "Pluto"
                                            10
stack
                                  х
                                            5
                                  У
                                          null
                                  ret
                                            Player
                                class
                                            "Pippo"
                                {\tt Name}
                                Position
                                            ref(1)
                                  class
                                         Vector2
                                  X
                                             0
                            1
                                  Y
                                             0
heap
                                class
                                            Player
                                Name
                                            "Pluto"
                                Position
                                  class
                                         Vector2
                                  Х
                                             10
                            3
                                  Y
                Vector2
                              __init__
                                         (self,x,y) \Rightarrow \dots
definitions
                Player
                           __init__ (self,name,x,y) => ...
```

```
globals
                                 p1 ref(0)
                                 self
                                        ref(2)
                                       "Pluto"
                                 name
                                          10
 stack
                                           5
                                 У
                                        ref(2)
                                 ret
                                           Player
                               class
                                          "Pippo"
                               Name
                               Position ref(1)
                                 class Vector2
                                 Y
                                           0
 heap
                               class
                                          Player
                                          "Pluto"
                           2
                               Name
                               Position
                                          ref(3)
                                 class Vector2
                                           10
                                 Х
                                 Y
                                            5
                Vector2
                             _{-}init_{-} (self,x,y) => ...
 definitions
                          __init__ (self, name, x, y) => ...
                Player
                                 p1 ref(0)
 globals
 {\tt stack}
                               class
                                          Player
                           0
                               Name
                                         "Pippo"
                               Position
                                          ref(1)
                                 class Vector2
                                 Х
                                            0
                           1
                                 Y
 heap
                               class
                                          Player
                               Name
                                          "Pluto"
                               Position ref(3)
                                 class Vector2
                                 Х
                                           10
                           3
                                 Y
                                            5
                             __init__ (self,x,y) => ...
                Vector2
 definitions
                          __init__ (self,name,x,y) => ...
                Player
p2=ref(2)
```

```
p1 ref(0)
globals
                             p2 ref(2)
stack
                           class
                                     Player
                                     "Pippo"
                           Name
                           Position ref(1)
                             class Vector2
                        1
                             Х
                                      0
                             Y
                                      0
heap
                           class
                                    Player
                                     "Pluto"
                           Name
                           Position ref(3)
                             class Vector2
                        3
                             Х
                                      10
                             Y
                                       5
                         __init__ (self,x,y) => ...
             Vector2
definitions
                       __init__ (self,name,x,y) => ...
             Player
```

Exercise 2 - List Fill in the missing state values

```
1
    class Empty :
 2
   def __init__ (self):
 3
   self.IsEmpty=True
 4
 5
 6
 7
    class Node :
   def __init__ (self,value,tail):
self.IsEmpty=False
 8
 9
10
11
   self.Value=value
12
13
   self.Tail=tail
14
15
16
   l=Node (1, Node (2, Node (3, Empty ()
17
18
   )
19
   )
20
   )
```

```
globals
stack
heap
definitions
globals
stack
heap
definitions
              Empty
                       __init__
                                 (self) => ...
globals
stack
heap
                             __init__ (self) => ...
              Empty
definitions
              Node
                       __init__ (self, value, tail) => ...
globals
                                self ref(0)
stack
                                ret
                                       null
heap
                                class Empty
                                       (self) => ...
              Empty
                             __init__
definitions
              Node
                       __init__ (self, value, tail) => ...
```

```
globals
                                self ref(0)
stack
                                ret
                                       null
                               class
                                        Empty
heap
                               IsEmpty
                                         True
                             __init__ (self) => ...
              Empty
definitions
                       __init__ (self, value, tail) => ...
              Node
globals
                                self ref(0)
stack
                                ret ref(0)
                               class
                                         Empty
heap
                               IsEmpty
                                         True
                             __init__ (self) => ...
              Empty
definitions
                       __init__ (self, value, tail) => ...
              Node
globals
{\tt stack}
                               class
                                         Empty
heap
                                         True
                               IsEmpty
                             __init__
                                      (self) => ...
              Empty
definitions
              Node
                       __init__ (self, value, tail) => ...
globals
                                self
                                value
stack
                                tail
                                ret
                                       null
                               class
                                         Empty
                                        True
heap
                               IsEmpty
                                 class
                                        Node
                             __init__ (self) => ...
              Empty
definitions
              Node
                       __init__ (self, value, tail) => ...
```

globals		
		self
stack		value
		tail
		ret null
		class Empty
heap		IsEmpty True
neap		class Node 1
		IsEmpty False
definitions	Empty	init (self) =>
delinitions	Node	init (self, value, tail) =>
globals		
		self
stack		value
Budck		tail
		ret null
		class Empty O
		IsEmpty True
heap		class Node
		1 IsEmpty False
		Value 3
definitions	Empty	init (self) =>
	Node	init (self, value, tail) =>
globals		
		self
stack		value
SUACK		tail
		ret null
heap		class Empty
		IsEmpty True
		class Node
		IsEmpty False 1
		Value 3
		Tail ref(0)
definitions	Empty	init (self) =>
	Node	init (self,value,tail) =>

globals		
		self
stack		value
		tail
		ref(1)
		class Empty
		O IsEmpty True
h		class Node
heap		IsEmpty False
		1 Value 3
		Tail ref(0)
a - 6 : ' · · '	Empty	init (self) =>
definitions	Node	init (self,value,tail) =>
globals		
stack		
		class Empty
		IsEmpty True
heap		class Node
пеар		IsEmpty False 1
		Value 3
		Tail ref(0)
definitions	Empty	init (self) =>
delinitions	Node	init (self,value,tail) =>
globals		
		ref(2)
stack		2
BUGUA		ref(1)
		null
		class Empty
		IsEmpty True
		class Node
heap		IsEmpty False
		Value 3
		Tail ref(0)
		2 class Node
definitions	Empty	init (self) =>
delinitions	Node	init (self, value, tail) =>

globals		
stack		ref(2) 2 ref(1) null
		Class Empty IsEmpty True
heap		class Node IsEmpty False Value 3
		Tail ref(0) class Node IsEmpty
definitions	Empty Node	init (self) => init (self,value,tail) =>
globals		
stack		ref(2) 2 ref(1) null
		class Empty IsEmpty True class Node
heap		IsEmpty False Value 3 Tail ref(0)
	_	class Node 2 IsEmpty Value
definitions	Empty Node	init (self) =>init (self, value, tail) =>

globals		
stack		ref(2) 2 ref(1) null
		Class Empty IsEmpty True
heap		class Node IsEmpty False Value 3 Tail ref(0)
		class Node IsEmpty Value
definitions	Empty Node	Tailinit (self) =>init (self, value, tail) =>
globals		
stack		ref(2) 2 ref(1) ref(2)
heap		class Empty IsEmpty True class Node IsEmpty False Value 3 Tail ref(0) class
definitions	Empty Node	Tailinit (self) =>init (self, value, tail) =>

```
globals
stack
                                class
                                          Empty
                                IsEmpty
                                          True
                                class
                                          Node
                                IsEmpty
                                          False
                                Value
                                            3
heap
                                Tail
                                         ref(0)
                                 class
                                         False
                           2
                                 Value
                                        ref(1)
               Empty
                             __init__
                                        (self) => ...
definitions
               Node
                        __init__ (self, value, tail) => ...
globals
                                        ref(3)
                                self
                                value
                                          1
{\tt stack}
                                        ref(2)
                                tail
                                ret
                                         null
                                class
                                          Empty
                                          True
                                IsEmpty
                                          Node
                                class
                                IsEmpty
                                          False
                                Value
                                            3
heap
                                Tail
                                         ref(0)
                                class
                                          Node
                                IsEmpty
                                          False
                                            2
                                Value
                                Tail
                                         ref(1)
                                  class
                                        Node
                             __init__ (self) => ...
               Empty
definitions
                                  (self, value, tail) => ...
               Node
                        __init__
```

```
globals
                                 self
                                        ref(3)
                                           1
                                 value
stack
                                 tail
                                        ref(2)
                                 ret
                                         null
                                 class
                                           Empty
                                 IsEmpty
                                           True
                                           Node
                                class
                                IsEmpty
                                          False
                                Value
                                             3
                                Tail
                                          ref(0)
heap
                                class
                                           Node
                                          {\tt False}
                                IsEmpty
                                Value
                                             2
                                Tail
                                          ref(1)
                                 class
                                           Node
                                 IsEmpty ____
                              __init__ (self) => ...
               Empty
definitions
               Node
                        __init__ (self, value, tail) => ...
globals
                                        ref(3)
                                 self
                                 value
                                           1
stack
                                 tail
                                        ref(2)
                                 ret
                                         null
                                 class
                                          Empty
                                 IsEmpty
                                           True
                                class
                                           Node
                                IsEmpty
                                          False
                                Value
                                             3
                                Tail
                                          ref(0)
                                           Node
heap
                                class
                                IsEmpty
                                          False
                            2
                                             2
                                Value
                                Tail
                                          ref(1)
                                 class
                                 IsEmpty
                            3
                                 Value
                              __init__
                                         (self) => ...
               Empty
definitions
               Node
                        __init__ (self, value, tail) => ...
```

```
globals
                                     ref(3)
                              self
                              value
                                        1
stack
                                     ref(2)
                              tail
                              ret
                                      null
                              class
                                        Empty
                              IsEmpty True
                              class
                                        Node
                              IsEmpty
                                        False
                                         3
                              Value
                                       ref(0)
                              Tail
                              class
                                        Node
heap
                              IsEmpty
                                       False
                              Value
                                          2
                              Tail
                                       ref(1)
                              class
                              IsEmpty [
                          3
                               Value
                               Tail
              Empty
                            __init__ (self) => ...
definitions
                      __init__ (self, value, tail) => ...
              Node
```

```
globals
                                 self
                                        ref(3)
                                           1
                                 value
stack
                                 tail
                                        ref(2)
                                        ref(3)
                                 ret
                                 class
                                          Empty
                                 IsEmpty
                                           True
                                           Node
                                class
                                IsEmpty
                                          False
                                Value
                                             3
                                Tail
                                          ref(0)
                                class
                                           Node
heap
                                          {\tt False}
                                IsEmpty
                                Value
                                             2
                                Tail
                                          ref(1)
                                 class
                                 IsEmpty
                            3
                                 Value
                                 Tail
                              __init__
                                         (self) => ...
               Empty
definitions
                        __init__ (self, value, tail) => ...
               Node
globals
stack
                                 class
                                          Empty
                                 IsEmpty
                                           True
                                class
                                           Node
                                IsEmpty
                                          False
                                Value
                                             3
                                Tail
                                          ref(0)
                                class
                                           Node
heap
                                IsEmpty
                                          {\tt False}
                            2
                                Value
                                             2
                                Tail
                                          ref(1)
                                 class
                                 IsEmpty
                            3
                                 Value
                                 Tail
               Empty
                              __init__
                                         (self) => ...
definitions
                        __init__ (self, value, tail) => ...
               Node
```

l=ref(3)		
globals		1
stack		
		$_{ m O}$ class Empty
		IsEmpty True
		class Node
		IsEmpty False
		Value 3
		Tail ref(0)
h		class Node
heap		IsEmpty False 2
		Value 2
		Tail ref(1)
		class
		IsEmpty
		Value
		Tail
definitions	Empty	init (self) =>
	Node	init (self, value, tail) =>

Exercise 3 - List print Fill in the missing code blocks

```
class :
   def __init__ (self):
2
3
4
5
6
   class :
7
   def __init__ (self, value, tail):
8
9
   self. = =
10
11
   self. = =
12
   self. = =
13
14
15
   l=Node ( , Node ( , Empty ()
17
18
   )
19
   )
20
21
22
  res=
23
   while((not 1. ____)):
res=( ____+str( ____. __))
24
25
26
27
   1=1.
28
29
  print ( )
30
     globals
     {\tt stack}
     heap
     definitions
     globals
     {\tt stack}
     heap
     definitions
                   Empty __init__ (self) => ...
```

```
globals
stack
heap
                             __init__ (self) => ...
               Empty
definitions
              Node
                       __init__ (self, value, tail) => ...
globals
                                self ref(0)
stack
                                ret
                                       null
                                 class Empty
heap
                             __init__ (self) => ...
               Empty
definitions
              Node
                       __init__ (self, value, tail) => ...
globals
                                self ref(0)
stack
                                ret
                                       null
                                         Empty
                               {\tt class}
heap
                               IsEmpty
                                         True
                             __init__ (self) => ...
               Empty
definitions
              Node
                       __init__ (self, value, tail) => ...
globals
                                self ref(0)
stack
                                ret
                                      ref(0)
                                class
                                         Empty
heap
                                IsEmpty
                                         True
                             __init__ (self) => ...
               Empty
definitions
              Node
                       __init__ (self, value, tail) => ...
globals
stack
                               class
                                         Empty
{\tt heap}
                                IsEmpty
                                          True
                             __init__ (self) => ...
               Empty
definitions
                       __init__ (self, value, tail) => ...
              Node
```

```
globals
                                self
                                        ref(1)
                                           2
                                value
stack
                                tail
                                        ref(0)
                                ret
                                         null
                                          Empty
                                class
heap
                                IsEmpty
                                          True
                                  class
                                         Node
                              __init__
                                       (self) => ...
               Empty
definitions
               Node
                        __init__
                                  (self, value, tail) => ...
globals
                                self
                                        ref(1)
                                value
                                           2
stack
                                        ref(0)
                                tail
                                ret
                                         null
                                class
                                          {\tt Empty}
                                IsEmpty
                                           True
heap
                                class
                                           Node
                                IsEmpty
                                          False
                              __init__ (self) => ...
               Empty
definitions
                                   (self, value, tail) => ...
               Node
                        __init__
globals
                                self
                                        ref(1)
                                           2
                                value
stack
                                        ref(0)
                                tail
                                ret
                                         null
                                class
                                          Empty
                                IsEmpty
                                           True
                                class
                                           Node
heap
                                IsEmpty
                                          False
                                Value
                                            2
                              __init__ (self) => ...
               Empty
definitions
                        __init__ (self, value, tail) => ...
               Node
```

```
globals
                                self
                                       ref(1)
                                          2
                                value
stack
                                tail
                                       ref(0)
                                ret
                                         null
                                class
                                          Empty
                                IsEmpty
                                          True
                                          Node
                               class
heap
                               IsEmpty
                                          False
                               Value
                                            2
                               Tail
                                         ref(0)
                             __init__
               Empty
                                        (self) => ...
definitions
               Node
                        __init__ (self, value, tail) => ...
globals
                                self
                                        ref(1)
                                          2
                                value
stack
                                tail
                                       ref(0)
                                ret
                                       ref(1)
                                class
                                          Empty
                                IsEmpty
                                          True
                               class
                                          Node
heap
                               IsEmpty
                                          False
                               Value
                               Tail
                                         ref(0)
                                        (self) => ...
               Empty
                             __init__
definitions
                       __init__ (self, value, tail) => ...
               Node
globals
stack
                                class
                                          Empty
                                IsEmpty
                                          True
                               class
                                          Node
heap
                               IsEmpty
                                          False
                               Value
                                            2
                               Tail
                                         ref(0)
                                        (self) => ...
                             __init__
               Empty
definitions
                       __init__ (self, value, tail) => ...
               Node
```

```
globals
                                       ref(2)
                               self
                                         1
                               value
stack
                               tail
                                       ref(1)
                                        null
                               ret
                               class
                                         Empty
                               IsEmpty
                                         True
                               class
                                         Node
                               IsEmpty
                                         False
heap
                               Value
                                           2
                               Tail
                                        ref(0)
                                 class
                                        Node
                             __init__ (self) => ...
              Empty
definitions
                       __init__ (self, value, tail) => ...
              Node
globals
                               self
                                       ref(2)
                               value
                                         1
stack
                               tail
                                       ref(1)
                               ret
                                        null
                               class
                                         Empty
                               IsEmpty
                                         True
                                         Node
                               class
                               IsEmpty
                                         False
heap
                               Value
                                           2
                               Tail
                                        ref(0)
                               class
                                         Node
                               IsEmpty False
                             \_init\_ (self) => ...
              Empty
definitions
                       __init__ (self, value, tail) => ...
              Node
```

```
globals
                                        ref(2)
                                self
                                          1
                                value
stack
                                tail
                                        ref(1)
                                         null
                                ret
                                class
                                          Empty
                                IsEmpty
                                          True
                                class
                                          Node
                                IsEmpty
                                          False
heap
                                Value
                                            2
                                Tail
                                         ref(0)
                                class
                                          Node
                                IsEmpty False
                                Value
                                            1
                              __init__ (self) => ...
               Empty
definitions
                        __init__ (self, value, tail) => ...
               Node
globals
                                self
                                        ref(2)
                                value
                                          1
stack
                                tail
                                        ref(1)
                                         null
                                ret
                                          Empty
                                {\tt class}
                                IsEmpty
                                          True
                                class
                                          Node
                                IsEmpty
                                          False
                                Value
                                            2
heap
                                Tail
                                         ref(0)
                                class
                                          Node
                                IsEmpty
                                          False
                                Value
                                            1
                                Tail
                                         ref(1)
                                        (self) => ...
               Empty
                             __init__
definitions
                        __init__ (self, value, tail) => ...
               Node
```

```
globals
                                       ref(2)
                                self
                                          1
                                value
stack
                                tail
                                       ref(1)
                                       ref(2)
                                ret
                                class
                                          Empty
                                IsEmpty
                                          True
                               class
                                          Node
                               IsEmpty
                                          False
                               Value
                                            2
heap
                               Tail
                                         ref(0)
                               class
                                          Node
                               IsEmpty
                                         False
                               Value
                                            1
                               Tail
                                         ref(1)
                             __init__ (self) => ...
               Empty
definitions
               Node
                       __init__ (self, value, tail) => ...
globals
{\tt stack}
                                class
                                          Empty
                                IsEmpty
                                          True
                               class
                                          Node
                               IsEmpty
                                          False
                               Value
                                            2
heap
                               Tail
                                         ref(0)
                               class
                                          Node
                               IsEmpty
                                          False
                                            1
                               Value
                               Tail
                                         ref(1)
                             __init__ (self) => ...
               Empty
definitions
              Node
                       __init__ (self, value, tail) => ...
```

```
globals
                                1 ref(2)
stack
                               class
                                         Empty
                               IsEmpty
                                         True
                               class
                                         Node
                               {\tt IsEmpty}
                                         False
                               Value
                                           2
heap
                               Tail
                                        ref(0)
                               class
                                         Node
                               IsEmpty
                                         False
                               Value
                               Tail
                                        ref(1)
                             __init__ (self) => ...
              Empty
definitions
                       __init__ (self, value, tail) => ...
              Node
                                     ref(2)
                               1
globals
                                     11 11
                               res
stack
                               class
                                         Empty
                               IsEmpty
                                         True
                               class
                                         Node
                                         False
                               IsEmpty
                               Value
                                           2
heap
                               Tail
                                        ref(0)
                               class
                                        Node
                               IsEmpty
                                         False
                               Value
                                           1
                               Tail
                                        ref(1)
                             __init__ (self) => ...
              Empty
definitions
              Node
                       __init__ (self, value, tail) => ...
```

```
1
                                     ref(2)
globals
                                       11 11
                                res
stack
                                class
                                         Empty
                                IsEmpty
                                          True
                               class
                                          Node
                               IsEmpty
                                         False
                               Value
                                            2
heap
                               Tail
                                         ref(0)
                               class
                                          Node
                               IsEmpty
                                         False
                           2
                               Value
                                            1
                               Tail
                                         ref(1)
                             __init__ (self) => ...
              Empty
definitions
               Node
                       __init__ (self, value, tail) => ...
                                1
                                     ref(2)
globals
                                      "1"
                                res
stack
                               class
                                         {\tt Empty}
                                IsEmpty
                                          True
                               class
                                          Node
                               IsEmpty
                                         False
                               Value
                                            2
heap
                               Tail
                                         ref(0)
                               class
                                          Node
                               IsEmpty
                                         False
                               Value
                                            1
                               Tail
                                         ref(1)
                                        (self) => ...
              Empty
                             __init__
definitions
                       __init__ (self, value, tail) => ...
              Node
```

```
1
                                     ref(1)
globals
                                       "1"
                                res
stack
                                class
                                         Empty
                               IsEmpty
                                          True
                               class
                                          Node
                               IsEmpty
                                         False
                               Value
                                           2
heap
                               Tail
                                         ref(0)
                               class
                                          Node
                               IsEmpty
                                         False
                           2
                               Value
                                           1
                               Tail
                                         ref(1)
                             __init__
                                      (self) => ...
              Empty
definitions
               Node
                       __init__ (self, value, tail) => ...
                                1
                                     ref(1)
globals
                                      "1"
                                res
stack
                               class
                                         {\tt Empty}
                                IsEmpty
                                          True
                               class
                                          Node
                               IsEmpty
                                         False
                               Value
                                           2
heap
                               Tail
                                         ref(0)
                               class
                                          Node
                               IsEmpty
                                         False
                               Value
                                           1
                               Tail
                                         ref(1)
                                        (self) => ...
              Empty
                             __init__
definitions
                       __init__ (self, value, tail) => ...
              Node
```

```
1
                                     ref(1)
globals
                                      "12"
                                res
stack
                                class
                                         Empty
                               IsEmpty
                                          True
                               class
                                          Node
                               IsEmpty
                                         False
                               Value
                                           2
heap
                               Tail
                                         ref(0)
                               class
                                         Node
                               IsEmpty
                                         False
                           2
                               Value
                                           1
                               Tail
                                         ref(1)
                             __init__ (self) => ...
              Empty
definitions
              Node
                       __init__ (self, value, tail) => ...
                                1
                                     ref(0)
globals
                                     "12"
                                res
stack
                               class
                                         {\tt Empty}
                               IsEmpty
                                          True
                               class
                                          Node
                               IsEmpty
                                         False
                               Value
                                           2
heap
                               Tail
                                         ref(0)
                               class
                                         Node
                               IsEmpty
                                         False
                               Value
                                           1
                               Tail
                                         ref(1)
                                        (self) => ...
              Empty
                             __init__
definitions
                       __init__ (self, value, tail) => ...
              Node
```

```
1
                                      ref(0)
globals
                                        "12"
                                 res
stack
                                 class
                                           Empty
                            0
                                 IsEmpty
                                           True
                                class
                                           Node
                                IsEmpty
                                           False
                                Value
                                             2
heap
                                Tail
                                          ref(0)
                                class
                                           Node
                                IsEmpty
                                           False
                            2
                                Value
                                             1
                                Tail
                                          ref(1)
                                        (self) => ...
                              __init__
               Empty
definitions
                        __init__ (self, value, tail) => ...
               Node
                                 1
                                      ref(0)
globals
                                        "12"
                                 res
stack
                                 {\tt class}
                                           Empty
                                 IsEmpty
                                           True
                                class
                                           Node
                                IsEmpty
                                           False
                                Value
                                             2
heap
                                Tail
                                          ref(0)
                                class
                                           Node
                                IsEmpty
                                           False
                                             1
                                Value
                                          ref(1)
                                Tail
                                         (self) => ...
                              __init__
               Empty
definitions
                        __init__
                                   (self, value, tail) => ...
               Node
                                     "12"
output
```

Exercise 4 - List transform Fill in the missing code blocks

```
.IsEmpty=False
10
   self. = value
11
12
   self.Tail=
13
14
15
16
17 | l=Node (1, Node (  , Node (3, Empty ()
18
19
   )
20
   )
21
22
  | x = [
23
24
   while((not _____ .IsEmpty)):
25
26
   x.Value=(x. | * | )
27
       =x.
28
     globals
     {\tt stack}
     heap
     definitions
     globals
     stack
     heap
     definitions
                    Empty
                            __init__ (self) => ...
     globals
     stack
     heap
                                  __init__ (self) => ...
                    Empty
     definitions
                    Node
                            __init__ (self, value, tail) => ...
     globals
                                     self ref(0)
     stack
                                     ret
                                            null
     heap
                                     class Empty
                                  __init__ (self) => ...
                    Empty
     definitions
                    Node
                            __init__ (self, value, tail) => ...
```

```
globals
                                self ref(0)
stack
                                ret
                                       null
                               class
                                        Empty
heap
                               IsEmpty
                                         True
                             __init__ (self) => ...
              Empty
definitions
                       __init__ (self, value, tail) => ...
              Node
globals
                                self ref(0)
stack
                                ret ref(0)
                               class
                                         Empty
heap
                               IsEmpty
                                         True
                             __init__ (self) => ...
              Empty
definitions
                       __init__ (self, value, tail) => ...
              Node
globals
{\tt stack}
                               class
                                         Empty
heap
                                         True
                               IsEmpty
                             __init__ (self) => ...
              Empty
definitions
              Node
                       __init__ (self, value, tail) => ...
globals
                               self
                                      ref(1)
                                         3
                               value
stack
                                      ref(0)
                               tail
                               ret
                                       null
                               class
                                         Empty
                               IsEmpty True
heap
                                 class
                                       Node
                             __init__ (self) => ...
              Empty
definitions
              Node
                       __init__ (self, value, tail) => ...
```

```
globals
                                self
                                        ref(1)
                                          3
                                value
stack
                                tail
                                        ref(0)
                                ret
                                         null
                                class
                                          Empty
                                IsEmpty
                                          True
heap
                                class
                                          Node
                                IsEmpty False
               Empty
                              __init__
                                       (self) => ...
definitions
               Node
                        __init__ (self, value, tail) => ...
globals
                                self
                                        ref(1)
                                          3
                                value
{\tt stack}
                                        ref(0)
                                tail
                                         null
                                ret
                                class
                                          Empty
                                IsEmpty
                                          True
heap
                                class
                                          Node
                                IsEmpty
                                          False
                                Value
                                            3
                              __init__ (self) => ...
               Empty
definitions
               Node
                                  (self, value, tail) => ...
                        __init__
globals
                                self
                                        ref(1)
                                value
                                          3
stack
                                tail
                                        ref(0)
                                ret
                                         null
                                class
                                          Empty
                                IsEmpty
                                          True
                                class
                                          Node
heap
                                IsEmpty
                                          False
                                Value
                                            3
                                Tail
                                         ref(0)
                             __init__
                                        (self) => ...
               Empty
definitions
                        __init__ (self, value, tail) => ...
               Node
```

```
globals
                                self
                                       ref(1)
                                          3
                                value
stack
                                tail
                                       ref(0)
                                       ref(1)
                                ret
                                class
                                         Empty
                                IsEmpty
                                          True
                                          Node
                               class
heap
                               IsEmpty
                                         False
                               Value
                                            3
                               Tail
                                         ref(0)
                             __init__
                                        (self) => ...
               Empty
definitions
               Node
                       __init__ (self, value, tail) => ...
globals
stack
                                class
                                         Empty
                           0
                                IsEmpty
                                          True
                               class
                                          Node
heap
                               IsEmpty
                                         False
                               Value
                                            3
                               Tail
                                         ref(0)
                             __init__ (self) => ...
               Empty
definitions
                       __init__ (self, value, tail) => ...
               Node
globals
                                self
                                       ref(2)
                                          2
                                value
{\tt stack}
                                       ref(1)
                                tail
                                ret
                                        null
                                class
                                         Empty
                                IsEmpty
                                          True
                               class
                                          Node
                               IsEmpty
                                         False
heap
                               Value
                                            3
                               Tail
                                         ref(0)
                                  class Node
                             __init__ (self) => ...
              Empty
definitions
               Node
                       __init__ (self, value, tail) => ...
```

```
globals
                                      ref(2)
                               self
                                         2
                               value
stack
                               tail
                                      ref(1)
                                        null
                               ret
                               class
                                         Empty
                               IsEmpty
                                         True
                               class
                                         Node
                               IsEmpty
                                         False
heap
                               Value
                                           3
                               Tail
                                        ref(0)
                                         Node
                               class
                               IsEmpty False
                             __init__ (self) => ...
              Empty
definitions
              Node
                       __init__ (self, value, tail) => ...
globals
                               self
                                      ref(2)
                               value
                                         2
stack
                                      ref(1)
                               tail
                                       null
                               ret
                               class
                                         Empty
                               IsEmpty
                                         True
                               class
                                         Node
                               IsEmpty
                                         False
heap
                               Value
                                           3
                               Tail
                                        ref(0)
                               class
                                         Node
                               IsEmpty False
                               Value
                                           2
              Empty
                             __init__ (self) => ...
definitions
                       __init__ (self, value, tail) => ...
              Node
```

```
globals
                                self
                                       ref(2)
                                          2
                                value
stack
                                tail
                                       ref(1)
                                ret
                                        null
                                class
                                         Empty
                               IsEmpty
                                         True
                                         Node
                               class
                               IsEmpty
                                         False
                               Value
                                           3
heap
                               Tail
                                         ref(0)
                               class
                                         Node
                                         False
                               IsEmpty
                                           2
                               Value
                               Tail
                                        ref(1)
                             __init__ (self) => ...
              Empty
definitions
              Node
                       __init__ (self, value, tail) => ...
globals
                                       ref(2)
                                self
                                          2
                                value
stack
                                       ref(1)
                                tail
                                ret
                                       ref(2)
                               class
                                         Empty
                               IsEmpty
                                         True
                               class
                                         Node
                               IsEmpty
                                         False
                                           3
                               Value
heap
                                         ref(0)
                               Tail
                               class
                                         Node
                               IsEmpty
                                         False
                               Value
                                           2
                               Tail
                                        ref(1)
                             __init__ (self) => ...
              Empty
definitions
              Node
                       __init__ (self, value, tail) => ...
```

```
globals
stack
                                class
                                          Empty
                                IsEmpty
                                          True
                               class
                                          Node
                               IsEmpty
                                          False
                               Value
                                            3
heap
                               Tail
                                         ref(0)
                               class
                                          Node
                               IsEmpty
                                         False
                               Value
                                            2
                               Tail
                                         ref(1)
                             __init__ (self) => ...
              Empty
definitions
              Node
                       __init__ (self, value, tail) => ...
globals
                                self
                                       ref(3)
                                value
                                          1
{\tt stack}
                                       ref(2)
                                tail
                                ret
                                        null
                                class
                                          Empty
                                IsEmpty
                                          True
                                          Node
                               class
                               IsEmpty
                                          False
                               Value
                                            3
heap
                               Tail
                                         ref(0)
                               class
                                          Node
                               IsEmpty
                                          False
                                            2
                               Value
                               Tail
                                         ref(1)
                                        Node
                                  class
                             __init__ (self) => ...
               Empty
definitions
                                  (self, value, tail) => ...
               Node
                       __init__
```

```
globals
                                self
                                        ref(3)
                                           1
                                value
stack
                                tail
                                        ref(2)
                                ret
                                         null
                                class
                                          Empty
                                IsEmpty
                                           True
                                class
                                           Node
                                IsEmpty
                                          False
                                Value
                                             3
                                Tail
                                          ref(0)
heap
                                class
                                           Node
                                          {\tt False}
                                IsEmpty
                                Value
                                             2
                                Tail
                                          ref(1)
                                class
                                           Node
                                IsEmpty False
                                        (self) => ...
               Empty
                              __init__
definitions
               Node
                        __init__ (self, value, tail) => ...
globals
                                        ref(3)
                                self
                                value
                                           1
stack
                                tail
                                        ref(2)
                                ret
                                         null
                                class
                                          Empty
                                IsEmpty
                                           True
                                class
                                           Node
                                IsEmpty
                                          False
                                Value
                                             3
                                Tail
                                          ref(0)
                                          Node
heap
                                class
                                IsEmpty
                                          False
                            2
                                Value
                                             2
                                Tail
                                          ref(1)
                                class
                                           Node
                                IsEmpty
                            3
                                          False
                                Value
                                             1
                              __init__ (self) => ...
               Empty
definitions
               Node
                        __init__ (self, value, tail) => ...
```

```
globals
                                      ref(3)
                               self
                               value
                                        1
stack
                                      ref(2)
                               tail
                              ret
                                       null
                              class
                                        Empty
                              IsEmpty True
                              class
                                        Node
                              IsEmpty
                                        False
                                          3
                              Value
                                       ref(0)
                              Tail
                                        Node
                              class
heap
                              IsEmpty
                                       False
                              Value
                                          2
                              Tail
                                       ref(1)
                              class
                                        Node
                              IsEmpty False
                          3
                              Value
                                          1
                              Tail
                                       ref(2)
              Empty
                            __init__ (self) => ...
definitions
                      __init__ (self, value, tail) => ...
              Node
```

```
globals
                                self
                                       ref(3)
                                          1
                                value
stack
                                tail
                                       ref(2)
                                       ref(3)
                                ret
                                class
                                          Empty
                                IsEmpty
                                          True
                                          Node
                               class
                               IsEmpty
                                          False
                               Value
                                            3
                               Tail
                                         ref(0)
                               class
                                          Node
heap
                                         False
                               IsEmpty
                               Value
                                            2
                               Tail
                                         ref(1)
                               class
                                          Node
                               IsEmpty
                                         False
                           3
                               Value
                                            1
                               Tail
                                         ref(2)
                                        (self) => ...
              Empty
                             __init__
definitions
                       __init__ (self, value, tail) => ...
              Node
globals
stack
                                class
                                          Empty
                                IsEmpty
                                          True
                               class
                                          Node
                               IsEmpty
                                          False
                               Value
                                            3
                               Tail
                                         ref(0)
                               class
                                          Node
heap
                               IsEmpty
                                         False
                               Value
                                            2
                               Tail
                                         ref(1)
                                          Node
                               class
                               IsEmpty
                                         False
                           3
                               Value
                                            1
                               Tail
                                         ref(2)
              Empty
                             __init__
                                        (self) => ...
definitions
                       __init__ (self, value, tail) => ...
               Node
```

```
globals
                                 1 ref(3)
stack
                                class
                                          Empty
                           0
                                IsEmpty
                                          True
                                          Node
                               class
                               IsEmpty
                                          False
                               Value
                                            3
                               Tail
                                         ref(0)
                               class
                                          Node
heap
                               IsEmpty
                                          False
                               Value
                               Tail
                                         ref(1)
                               class
                                          Node
                               IsEmpty
                                         False
                               Value
                                            1
                               Tail
                                         ref(2)
                             __init__ (self) => ...
               Empty
definitions
                        __init__ (self, value, tail) => ...
               Node
                                 1 ref(3)
globals
                                 x ref(3)
stack
                                class
                                          Empty
                                IsEmpty
                                          True
                               class
                                          Node
                               IsEmpty
                                          {\tt False}
                               Value
                                            3
                               Tail
                                         ref(0)
                                          Node
                               class
heap
                                          False
                               IsEmpty
                           2
                               Value
                                            2
                               Tail
                                         ref(1)
                               class
                                          Node
                               IsEmpty
                                          False
                               Value
                                            1
                               Tail
                                         ref(2)
                             __init__ (self) => ...
               Empty
definitions
                       __init__ (self, value, tail) => ...
               Node
```

```
1 ref(3)
globals
                                 x ref(3)
stack
                                class
                                          Empty
                                IsEmpty
                                          True
                               class
                                          Node
                                         False
                               IsEmpty
                               Value
                                            3
                               Tail
                                         ref(0)
                               class
                                          Node
heap
                               IsEmpty
                                         False
                           2
                               Value
                                            2
                               Tail
                                         ref (1)
                               class
                                          Node
                               IsEmpty
                                         False
                               Value
                                            1
                                         ref(2)
                               Tail
                             __init__
                                        (self) => ...
               Empty
definitions
               Node
                       __init__ (self, value, tail) => ...
                                 1 ref(3)
globals
                                 x ref(3)
stack
                                class
                                          Empty
                           0
                                IsEmpty
                                          True
                               class
                                          Node
                               IsEmpty
                                          False
                               Value
                                            3
                               Tail
                                         ref(0)
                               class
                                          Node
heap
                               IsEmpty
                                          False
                               Value
                                            2
                               Tail
                                         ref(1)
                                          Node
                               class
                               IsEmpty
                                          False
                               Value
                                            5
                               Tail
                                         ref(2)
                             __init__
                                        (self) => ...
               {\tt Empty}
definitions
               Node
                       __init__ (self, value, tail) => ...
```

```
1 ref(3)
globals
                                 x ref(2)
stack
                                class
                                          Empty
                                IsEmpty
                                          True
                               class
                                          Node
                                         False
                               IsEmpty
                               Value
                                            3
                               Tail
                                         ref(0)
                               class
                                          Node
heap
                               IsEmpty
                                         False
                           2
                               Value
                                            2
                               Tail
                                         ref (1)
                               class
                                          Node
                               IsEmpty
                                         False
                               Value
                                            5
                               Tail
                                         ref(2)
                             __init__
                                        (self) => ...
               Empty
definitions
               Node
                       __init__ (self, value, tail) => ...
                                 1 ref(3)
globals
                                 x ref(2)
stack
                                class
                                          Empty
                           0
                                IsEmpty
                                          True
                               class
                                          Node
                               IsEmpty
                                          False
                               Value
                                            3
                               Tail
                                         ref(0)
                               class
                                          Node
heap
                               IsEmpty
                                          False
                               Value
                                            2
                               Tail
                                         ref(1)
                                          Node
                               class
                               IsEmpty
                                          False
                               Value
                                            5
                               Tail
                                         ref(2)
                             __init__
                                        (self) => ...
               {\tt Empty}
definitions
               Node
                       __init__ (self, value, tail) => ...
```

```
1 ref(3)
globals
                                 x ref(2)
stack
                                class
                                          Empty
                                IsEmpty
                                          True
                               class
                                          Node
                                         False
                               IsEmpty
                               Value
                                            3
                               Tail
                                         ref(0)
                               class
                                          Node
heap
                               IsEmpty
                                         False
                           2
                               Value
                                           10
                               Tail
                                         ref (1)
                               class
                                          Node
                               IsEmpty
                                         False
                               Value
                                            5
                               Tail
                                         ref(2)
                             __init__
                                        (self) => ...
               Empty
definitions
               Node
                       __init__ (self, value, tail) => ...
                                 1 ref(3)
globals
                                 x ref(1)
stack
                                class
                                          Empty
                           0
                                IsEmpty
                                          True
                               class
                                          Node
                               IsEmpty
                                          False
                               Value
                                            3
                               Tail
                                         ref(0)
                               class
                                          Node
heap
                               IsEmpty
                                          False
                               Value
                                           10
                               Tail
                                         ref(1)
                                          Node
                               class
                               IsEmpty
                                          False
                               Value
                                            5
                               Tail
                                         ref(2)
                             __init__
                                        (self) => ...
               {\tt Empty}
definitions
               Node
                       __init__ (self, value, tail) => ...
```

```
1 ref(3)
globals
                                 x ref(1)
stack
                                class
                                          Empty
                                IsEmpty
                                          True
                               class
                                          Node
                                         False
                               IsEmpty
                               Value
                                            3
                               Tail
                                         ref(0)
                               class
                                          Node
heap
                               IsEmpty
                                         False
                           2
                               Value
                                           10
                               Tail
                                         ref (1)
                               class
                                          Node
                               IsEmpty
                                         False
                               Value
                                            5
                               Tail
                                         ref(2)
                             __init__
                                        (self) => ...
               Empty
definitions
               Node
                       __init__ (self, value, tail) => ...
                                 1 ref(3)
globals
                                 x ref(1)
stack
                                class
                                          Empty
                           0
                                IsEmpty
                                          True
                               class
                                          Node
                               IsEmpty
                                          False
                               Value
                                           15
                               Tail
                                         ref(0)
                               class
                                          Node
heap
                               IsEmpty
                                          False
                               Value
                                           10
                               Tail
                                         ref(1)
                                          Node
                               class
                               IsEmpty
                                          False
                               Value
                                            5
                               Tail
                                         ref(2)
                             __init__
                                        (self) => ...
               {\tt Empty}
definitions
               Node
                       __init__ (self, value, tail) => ...
```

```
1 ref(3)
globals
                                 x ref(0)
stack
                                class
                                          Empty
                                IsEmpty
                                          True
                               class
                                          Node
                                         False
                               IsEmpty
                               Value
                                           15
                               Tail
                                         ref(0)
                               class
                                          Node
heap
                               IsEmpty
                                         False
                           2
                               Value
                                           10
                               Tail
                                         ref (1)
                               class
                                          Node
                               IsEmpty
                                         False
                               Value
                                            5
                                         ref(2)
                               Tail
                             __init__
                                        (self) => ...
               Empty
definitions
               Node
                       __init__ (self, value, tail) => ...
                                 1 ref(3)
globals
                                 x ref(0)
stack
                                class
                                          Empty
                           0
                                IsEmpty
                                          True
                               class
                                          Node
                               IsEmpty
                                          False
                               Value
                                           15
                               Tail
                                         ref(0)
                               class
                                          Node
heap
                               IsEmpty
                                          False
                               Value
                                           10
                               Tail
                                         ref(1)
                                          Node
                               class
                               IsEmpty
                                          False
                               Value
                                            5
                               Tail
                                         ref(2)
                             __init__
                                        (self) => ...
               {\tt Empty}
definitions
               Node
                       __init__ (self, value, tail) => ...
```