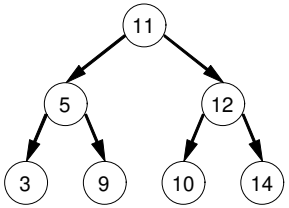
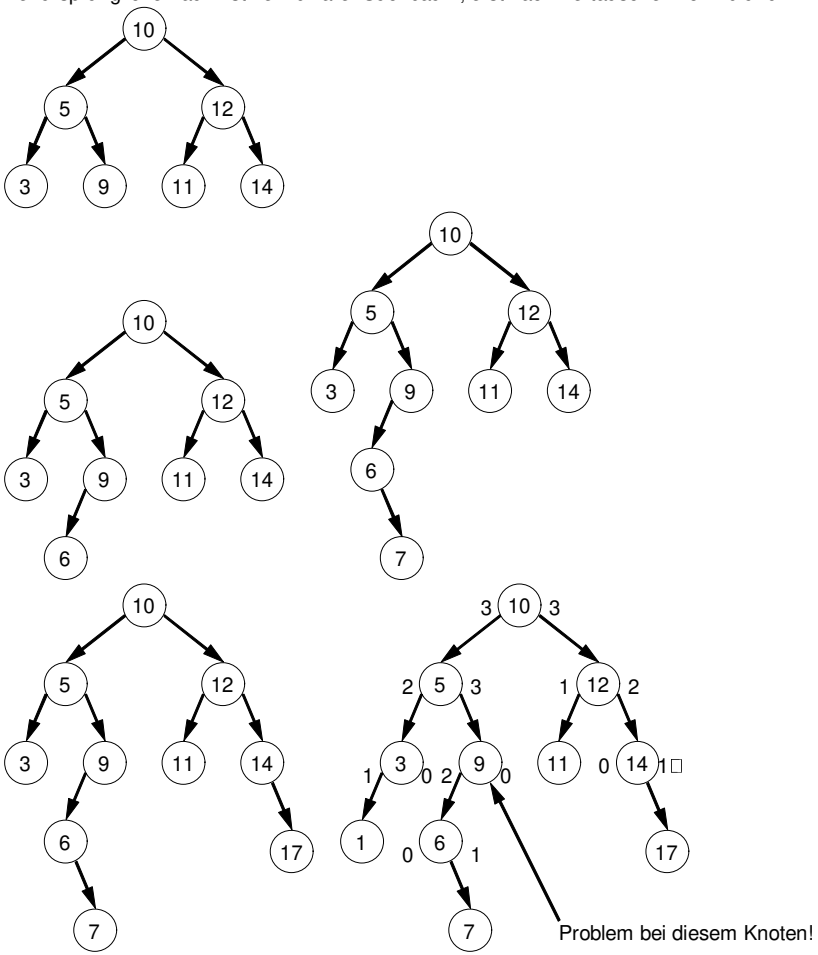
1) Binärbäume

Gegeben sei folgender Binärbaum:



Überprüfen Sie, ob ein binärer Suchbaum vorliegt (und korrigieren Sie den Baum bei Bedarf).
Fügen Sie folgende Elemente in den natürlichen (= nicht balancierten), möglicherweise korrigierten, binären Suchbaum ein: 6, 7, 17, 1.
Ist der resultierende Binärbaum ein AVL-Baum? Begründen Sie Ihre Antwort!

Der ursprüngliche Baum ist kein binärer Suchbaum, erst nach Vertauschen von 10 und 11:



Der entstandene binäre Suchbaum ist kein AVL-Baum!

2) Bäume

Gegeben sei der folgende Knotentyp.

```
TYPE
   Tree = POINTER TO NodeDesc;
   NodeDesc = RECORD
      left, right: Tree;
      val: INTEGER
   END;
```

Implementieren Sie einen Algorithmus der bestimmt wieviele Knoten ein Baum besitzt. Die Prozedur soll die folgende Schnittstelle haben.

```
PROCEDURE NumberOfNodes (t: Tree) : INTEGER;
```

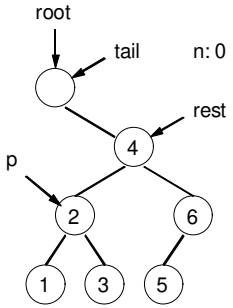
Achten Sie auch auf den Sonderfall, dass ein leerer Baum (t=NIL) übergeben wird.

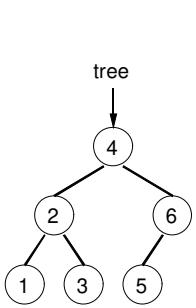
```
PROCEDURE NumberOfNodes (t: Tree) : INTEGER;
BEGIN
  IF t = NIL THEN RETURN 0
  ELSE RETURN 1 + NumberOfNodes(t.left) + NumberOfNodes(t.right)
  END
END NumberOfNodes;
```

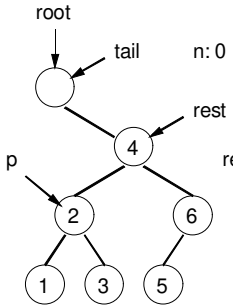
3) Balancierung von Bäumen

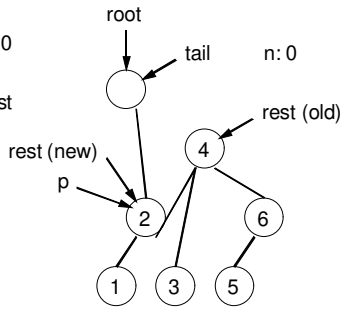
Zeigen Sie, wie der folgende Baum schrittweise in eine Rebe umgewandelt wird. Verwenden Sie dazu den in der Vorlesung besprochenen Algorithmus *TreeToVine*. Geben Sie den Baum für jede Iteration der WHILE-Schleife an.

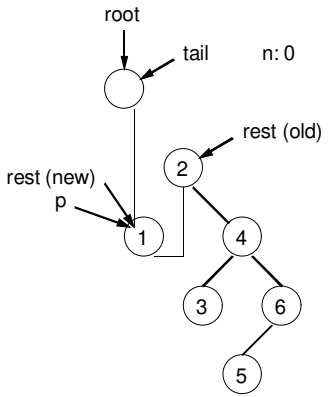
```
PROCEDURE TreeToVine (VAR root: BinTree; VAR n: INTEGER);
  VAR tail, rest, p: BinTree;
BEGIN
  tail := root; rest := root.right;
  n := 0;
  WHILE rest # NIL DO
    IF rest.left = NIL THEN  (* move tail down *)
      tail := rest; rest := rest.right; INC(n)
    ELSE  (* rotate *)
      p := rest.left; rest.left := p.right; p.right := rest; rest := p;
      tail.right := p
    END
  END
END TreeToVine;
```

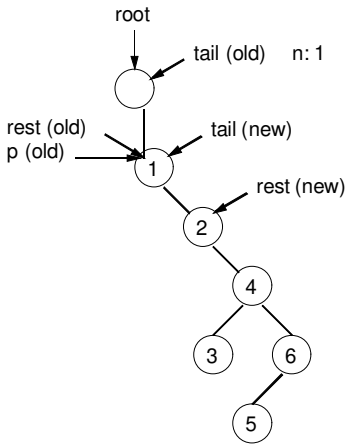


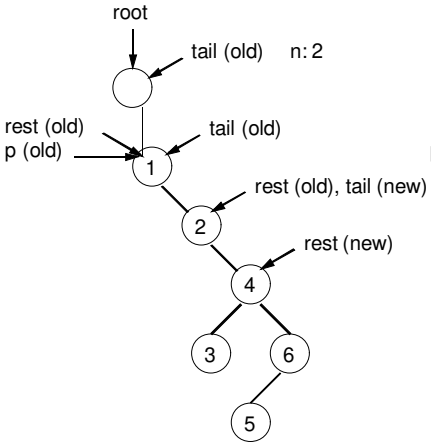

tree
4
2
6
1
3
5

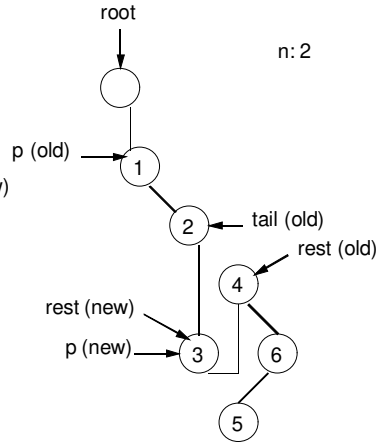

root
tail
n: 0
rest
p
4
2
6
1
3
5

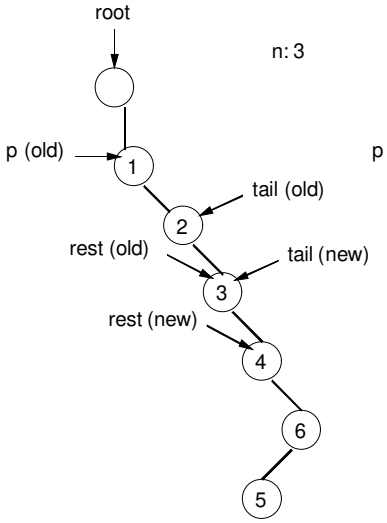

root
tail
n: 0
rest (old)
rest (new)
p
4
2
6
1
3
5

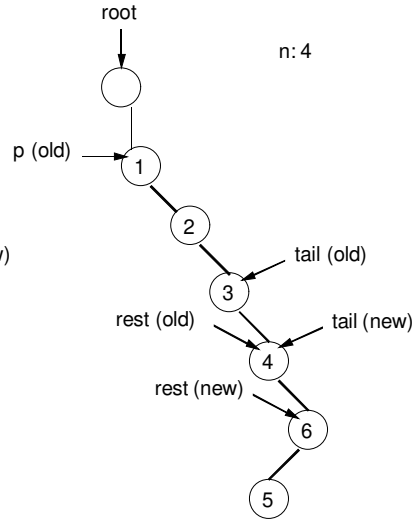

root
tail
n: 0
rest (old)
rest (new)
p
2
1
4
3
6
5

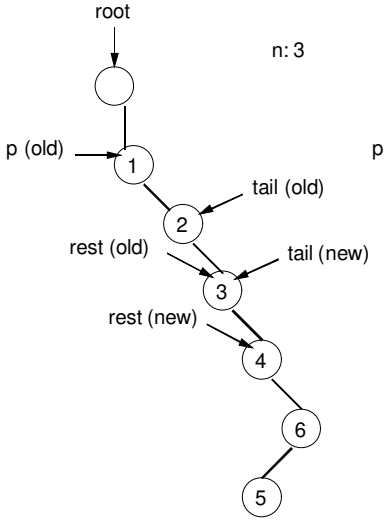

root
tail (old)
n: 1
rest (old)
p (old)
tail (new)
rest (new)
1
2
4
3
6
5

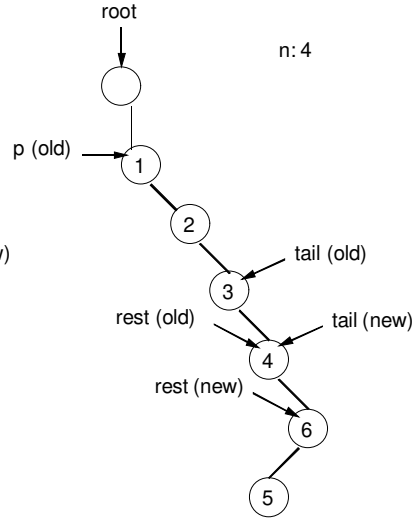

root
tail (old)
n: 2
rest (old)
p (old)
tail (old)
rest (old), tail (new)
rest (new)
1
2
4
3
6
5

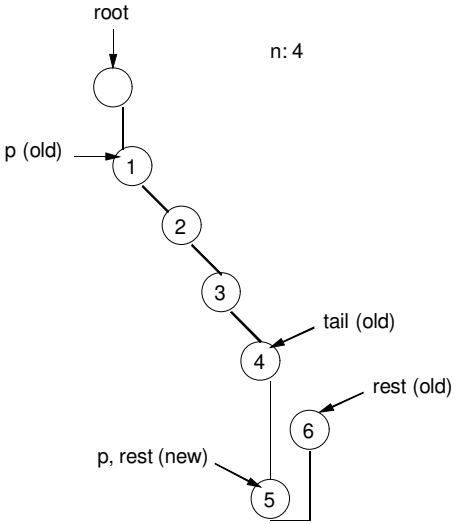

root
n: 2
p (old)
tail (old)
rest (old)
rest (new)
p (new)
1
2
4
3
6
5

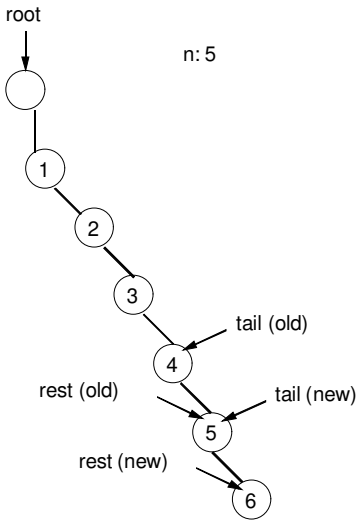

root
n: 3
p (old)
tail (old)
rest (old)
tail (new)
rest (new)
1
2
3
4
6
5

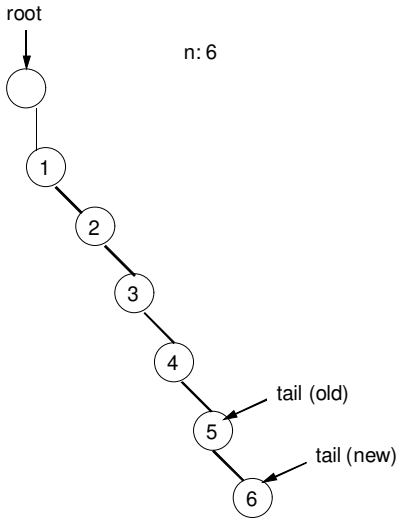

root
n: 4
p (old)
tail (old)
rest (old)
tail (new)
rest (new)
1
2
3
4
6
5


root
n: 3
p (old)
tail (old)
rest (old)
tail (new)
rest (new)
1
2
3
4
6
5


root
n: 4
p (old)
tail (old)
rest (old)
tail (new)
rest (new)
1
2
3
4
6
5


root
n: 4
p (old)
1
2
3
tail (old)
4
rest (old)
6
p, rest (new)
5


root
n: 5
1
2
3
tail (old)
4
rest (old)
tail (new)
5
rest (new)
6


root
n: 6
1
2
3
4
tail (old)
5
tail (new)
6