Algorithmics
Correction Midterm #2 (C2)

UNDERGRADUATE 1^{st} YEAR S2 – EPITA

4 March 2019 - 9 : 00

***Solution 1* (A little coursework... – *4 points*)**

1. Measures:
   (a) The size of the tree `B` is: `11`
   (b) The height of the tree `B` is: `4`
   (c) The path length of the tree `B` is: `27`
   (d) The external average depth of the tree `B` is: `15/4 = 3.75`
2. Using the hierarchical numbering, the nodes of the tree `B` are :
   1, 2, 3, 5, 7, 10, 11, 14, 21, 28, 29

***Solution 2* (Maximum Gap – *4 points*)**

Specifications:
The function `maxgap(`M`)` returns the maximum gap of lines of the not empty matrix M.

```python
def gaplist(L):
    """
    returns the gap of the list L (not empty)
    """
    valMin = L[0]
    valMax = L[0]
    for i in range(1, len(L)):
        valMin = min(valMin, L[i])
        valMax = max(valMax, L[i])
    return valMax - valMin

def maxgap(M):
    mgap = gaplist(M[0])
    for i in range(1, len(M)):
        mgap = max(mgap, gaplist(M[i]))
    return mgap
```

In one function (gaplist inlined) :

```python
            def maxgap2(M):
                mgap = 0
                (l, c) = (len(M), len(M[0]))
                for i in range(l):
                    valMin = M[i][0]
                    valMax = M[i][0]
                    for j in range(1, c):
                        valMin = min(valMin, M[i][j])
                        valMax = max(valMax, M[i][j])
                    mgap = max(mgap, valMax - valMin)
                return mgap
```

Solution 3 **(Recherche – *4 points*)**

Specifications:

The function `searchMatrix(M, x)` returns the position (i, j) of the first value `x` found in the non empty matrix `M`. If `x` is not present, the function returns $(-1, -1)$.

```
                    def searchMatrix(M, x):

                        (i, lin, col) = (0, len(M), len(M[0]))
                        found = -1

                        while i < lin and found == -1:
                            j = 0
                            while j < col and M[i][j] != x:
                                j += 1
                            if j != col:
                                found = j
                            i += 1

                        if found != -1:
                            return (i-1, found)
                        else:
                            return (-1, -1)
```

Solution 4 **(Tests – *4 points*)**

Specifications: The function `equal(`$B1$`,` $B2$`)` tests whether the trees $B1$ and $B2$ are identical.

```
        def equal(B1, B2):
           if B1 == None:
              return B2 == None
           elif B2 == None:
              return False
           elif B1.key == B2.key:
              return equal(B1.left, B2.left) and equal(B1.right, B2.right)
           else:
              return False

#-------------------------------------------------------------

      def equal2(B1, B2):
          if B1 == None or B2 == None:
              return B1 == B2
          else:
              return (B1.key == B2.key) \
                     and equal2(B1.left, B2.left) \
                     and equal2(B1.right, B2.right)
```

Solution 5 **(Leaves – *2 points*)**

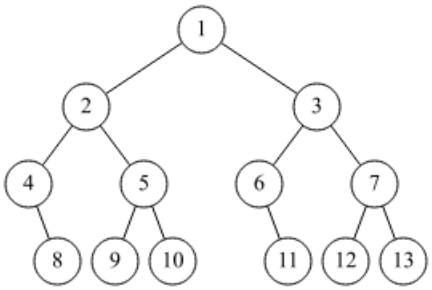
Specifications:

The function `leaves(`B`)` computes the number of leaves in the binary tree B.

```
1       def leaves(B):
2           if B == None:
3               return 0
4           else:
5               if B.left == B.right:    # B.left == None and B.right == None
6                   return 1
7               else:
8                   return leaves(B.left) + leaves(B.right)
```

Solution 6 **(Mystery – *3 points*)**

1. Arbre binaire résultat de l'application `mystery([4, 8, 2, 9, 5, 10, 1, 6, 11, 3, 12, 7, 13])` :



2. (a) *The tree is a BST if the list is* sorted in increasing order.

   (b) *The tree is perfect if the list is* of length $2^h - 1$ with h a natural