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## Tartalomjegyzék

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### Problem 1: New Tree Methods

- Write an `is_path(self)` method for the class `Tree` which returns `True` if the tree is a long path without a junction. `False` otherwise. The tree is a path if all of the nodes **except the root** have at most one branches.
- Write a `path(self)` method for the class `Tree` which returns all paths from the leaves to the root of a given binary tree.

### Problem 2: Proper Calculator

Write modify the calculator in the exercise to handle parantheses such that it calculates the input based on the parantheses.

Example:

```
2 + (7 * 3) --> 23
(2 + 7) * 3 --> 27
```

### Problem 3: Calculator Function

You have to improve the calculator's `Node` class even further. You have to treat the functions:

- `sin`, `cos`

Example:

```
cos(0) * sin(5 + 6 * 3)
```

- `factorial`: `!`

example:

```
(2 * 3) !
```

You can treat these functions as unary operations and the operator is the name of the function. This means that in the expression tree you can have `"http://wiki.math.bme.husin"http://wiki.math.bme.hu`, `"http://wiki.math.bme.hucos"http://wiki.math.bme.hu` or `"http://wiki.math.bme.hu!"http://wiki.math.bme.hu` in a node an they have only one outgoing edge (child) in the tree, that is their operands.

The nodes `"http://wiki.math.bme.husin"http://wiki.math.bme.hu` and `"http://wiki.math.bme.hucos"http://wiki.math.bme.hu` should have a right member, which is expression what

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is inside the function. This is because the argument of the sin (or cos) is on the right-hand-side of the symbol itself.

Example "http://wiki.math.bme.hu1+cos(5-3)"http://wiki.math.bme.hu:

```
"http://wiki.math.bme.hu"+"http://wiki.math.bme.hu
/ \
1  "http://wiki.math.bme.hucos"http://wiki.math.bme.hu
    \
    "http://wiki.math.bme.hu-"http://wiki.math.bme.hu
    / \
    5   3
```

The "http://wiki.math.bme.hu!"http://wiki.math.bme.hu node should have a left member, which is the argument of the factorial. This is because the argument is on the left-hand-side of the factorial symbol.

Example "http://wiki.math.bme.hu1/(2\*3)!"http://wiki.math.bme.hu:

```
"http://wiki.math.bme.hu/"http://wiki.math.bme.hu
/ \
1  "http://wiki.math.bme.hu!"http://wiki.math.bme.hu
    /
    "http://wiki.math.bme.hu*"http://wiki.math.bme.hu
    / \
    2   3
```

The trigonometric functions should have a higher precedence, than any other operations. Example:

$\cos(1)^2 = (\cos(1))^2$

The factorial should have a higher precedence than the binary operations, but lower than the trigonometric functions. Example:

$1 + 2! = 1 + (2!)$

and

$\cos(0)! = (\cos(0))!$

Help:

- The rfind method can search for a sub-string in a string.
- Use the math library's mathematical functions.

Remark:

- The argument of the factorial will be a non-negative integer, but there is a continuous generalizations of the factorial, called gamma function. "http://wiki.math.bme.hu

## Note

- Problem 1: 2 points
- Problem 2: 2 points
- Problem 3: 3 points