**Node**

* A node that starts with a lower case can have a Box.

(number, operator, Parenthesis.open, Parenthesis.close)

|  |  |  |
| --- | --- | --- |
| **Node’s Name** | **Node’s Child** | **Available Factor** |
| Expression | X | Anything |
| number | X | Box – key : positive, 0, negative, fractional number |
| operator | X | Box – key : **+, -, \*, /** |
| Bianry | Left | Anything |
| operator | operator |
| Right | Anything |
| Parenthesis | open | Box – key : **(** |
| Binary | Binary |
| close | Box – key : **)** |

**Tree Structure**

Nodes that starts with a lower case is a kind of pointer to point out a box and each box has a key like numbers, operators, open and close and has ability to draw itself. Therefore, we can access a key of box in the tree. For example, Parenthesis.open.key, Binary.Left.number.key, etc… So I logically use the tree to check the rules and physically use array of boxes to draw boxes.

**Rule**

* Rule1 : for basic rules.
* Rule2 : for commutative rules.
* Rule3 : for associative rules.
* Rule4 : for distributive rules.
* /\*+- means / or \* or + or - ex) 3+-4 => 3+4 or 3-4

|  |  |
| --- | --- |
| **Rule** | **Example** |
| **Rule\_R1-1** | 3/\*+-4 or +-3+-4 or /\*+-3/\*4 or /\*+-3/\*4+-  drag '3' or '4' and drop on 'operator' between '3' and '4' |
| **Rule\_W1-1-1** | 3/\*+-4 or +-3+-4 or /\*+-3/\*4 or /\*+-3/\*4+-  drag '3' or '4' and drop on 'operator' which is not between '3' and '4' |
| **Rule\_R1-2** | 3/\*4/\* or /\*+-3/\*4/\*  drag '3' and drop on 'operator' between '3' and '4' |
| **Rule\_W1-2-1** | 3/\*4/\* or /\*+-3/\*4/\*  drag '3' and drop on 'operator' which is not between '3' and '4' |
| **Rule\_R1-3** | 3+-4+- or +-3+-4+-  drag '3' and drop on 'operator' between '3' and '4' |
| **Rule\_W1-3-1** | 3+-4+- or +-3+-4+-  drag '3' and drop on 'operator' which is not between '3' and '4' |
| **Rule\_R1-4** | 3/\*4/\* or /\*+-3/\*4/\*  drag '4' and drop on 'operator' between '3' and '4' |
| **Rule\_W1-4-1** | 3/\*4/\* or /\*+-3/\*4/\*  drag '4' and drop on 'operator' which is not between '3' and '4' |
| **Rule\_R1-5** | 3+-4+- or +-3+-4+-  drag '4' and drop on 'operator' between '3' and '4' |
| **Rule\_W1-5-1** | 3+-4+- or +-3+-4+-  drag '4' and drop on 'operator' which is not between '3' and '4' |
|  |  |
| **Rule\_R2-1** | 3\*+4 or +3+4 or -3-4 or /\*+-3\*4  drag '3' and drop on '4' OR drag '4' and drop on '3' |
| **Rule\_W2-1-1** | 3\*+4 or +3+4 or -3-4 or /\*+-3\*4  drag '3' and drop on 'number' which is not '4' OR drag '4' and drop on 'number' which is not '3' |
| **Rule\_W2-1-2** | 3/-4  drag '3' and drop on '4' OR drag '4' and drop on '3' |
| **Rule\_W2-1-3** | /\*3/4 or /\*3/4+-  drag '3' and drop on '4' OR drag '4' and drop on '3' |
| **Rule\_W2-1-4** | +3-4 or -3+4  drag '3' and drop on '4' OR drag '4' and drop on '3' |
| **Rule\_W2-1-5** | +-3/4 or +-3/4+-  drag '3' and drop on '4' OR drag '4' and drop on '3' |
| **Rule\_W2-1-6** | /\*3+-4  drag '3' and drop on '4' OR drag '4' and drop on '3' |
| **Rule\_R2-2** | 3+4+- or 3\*4/\*+- or +3+4+- or -3-4+- or /\*+-3\*4/\*+-  drag '3' and drop on '4' |
| **Rule\_W2-2-1** | 3+4+- or 3\*4/\*+- or +3+4+- or -3-4+- or /\*+-3\*4/\*+-  drag '3' and drop on 'number' which is not '4' |
| **Rule\_W2-2-2** | 3/4/\* or 3-4+-  drag '3' and drop on '4' |
| **Rule\_W2-2-3** | 3/4+-  drag '3' and drop on '4' |
| **Rule\_W2-2-4** | 3+-4/\*  drag '3' and drop on '4' |
| **Rule\_W2-2-5** | /\*3+-4/\*+-  drag '3' and drop on '4' |
| **Rule\_W2-2-6** | -3+-4+- or +-3+-4/\* or /\*3/4/\*  drag '3' and drop on '4' |
| **Rule\_W2-2-7** | +-3/4/\*  drag '3' and drop on '4' |
| **Rule\_R2-3** | 3+4+- or 3\*4/\*+- or +3+4+- or -3-4+- or /\*+-3\*4/\*+-  drag '4' and drop on '3' |
| **Rule\_W2-3-1** | 3+4+- or 3\*4/\*+- or +3+4+- or -3-4+- or /\*+-3\*4/\*+-  drag '4' and drop on 'number' which is not '3' |
| **Rule\_W2-3-2** | 3/4/\*  drag '4' and drop on '3' |
| **Rule\_W2-3-3** | 3/4+-  drag '4' and drop on '3' |
| **Rule\_W2-3-4** | 3+-4/\* or +-3+-4/\*  drag '4' and drop on '3' |
| **Rule\_W2-3-5** | /\*3+-4+-  drag '4' and drop on '3' |
| **Rule\_W2-3-6** | /\*3+-4/\*  drag '4' and drop on '3' |
| **Rule\_W2-3-7** | -3+4+- or +3-4+- or /\*3/4/\* or +-3/4/\*  drag '4' and drop on '3' |
|  |  |
| **Rule\_R3-1** | (3+4)+-5 or +(3+4)+-5 or (3\*4)\*5 or /\*+-(3\*4)\*5  drag '(' and drop on '4' |
| **Rule\_W3-1-1** | (3+4)+-5 or +(3+4)+-5 or (3\*4)\*5 or /\*+-(3\*4)\*5  drag '(' and drop on 'number' which is not '4' |
| **Rule\_W3-1-2** | /\*(3/\*+-4)+-5  drag '(' and drop on '4' |
| **Rule\_W3-1-3** | -(3/\*+-4)+-5 or +(3/\*-4)-+5 or (3/\*-4)-+5  drag '(' and drop on '4' |
| **Rule\_W3-1-4** | +-(3/\*+-4)/5 or +-(3/+-4)\*5 or (3/\*+-4)/5 or (3/+-4)\*5 or +-(3/\*+-4)/5+- or +-(3/+-4)\*5+- or (3/\*+-4)/5+- or (3/+-4)\*5+-  drag '(' and drop on '4' |
| **Rule\_R3-2** | (3+4)+-5+- or +(3+4)+-5+- or (3\*4)\*5/\*+- or /\*+-(3\*4)\*5/\*+-  drag '(' and drop on '4' |
| **Rule\_W3-2-1** | (3+4)+-5+- or +(3+4)+-5+- or (3\*4)\*5/\*+- or /\*+-(3\*4)\*5/\*+-  drag '(' and drop on 'number' which is not '4' |
| **Rule\_W3-2-2** | /\*(3/\*+-4)+-5/\*+-  drag '(' and drop on '4' |
| **Rule\_W3-2-3** | -(3/\*+-4)+-5+- or +(3/\*-4)+-5+- or (3/\*-4)+-5+-  drag '(' and drop on '4' |
| **Rule\_W3-2-4** | +-(3/\*+-4)+-5/\* or (3/\*+-4)+-5/\*  drag '(' and drop on '4' |
| **Rule\_W3-2-5** | +-(3/\*+-4)/5/\* or +-(3/+-4)\*5/\* or (3/\*+-4)/5/\* or (3/+-4)\*5/\*  drag '(' and drop on '4' |
| **Rule\_R3-3** | 2+(3+-4) or +2+(3+-4) or 2\*(3\*4) or /\*+-2\*(3\*4)  drag '(' and drop on '2' |
| **Rule\_W3-3-1** | 2+(3+-4) or +2+(3+-4) or 2\*(3\*4) or /\*+-2\*(3\*4)  drag '(' and drop on 'number' which is not '2' |
| **Rule\_W3-3-2** | 2+-(3/\*4) or +-2+-(3/\*4) or 2-(3+-4) or +-2-(3+-4)  drag '(' and drop on '2' |
| **Rule\_W3-3-3** | /\*2+-(3/\*+-4)  drag '(' and drop on '2' |
| **Rule\_W3-3-4** | 2/(3/\*+-4) or +-2/(3/\*+-4) or 2\*(3/+-4) or +-2\*(3/+-4) or 2/(3/\*+-4)+- or +-2/(3/\*+-4)+- or 2\*(3/+-4)+- or +-2\*(3/+-4)+-  drag '(' and drop on '2' |
| **Rule\_R3-4** | 2+(3+-4)+- or +2+(3+-4)+- or 2\*(3\*4)/\*+- or /\*+-2\*(3\*4)/\*+-  drag '(' and drop on '2' |
| **Rule\_W3-4-1** | 2+(3+-4)+- or +2+(3+-4)+- or 2\*(3\*4)/\*+- or /\*+-2\*(3\*4)/\*+-  drag '(' and drop 'number' which is not '2' |
| **Rule\_W3-4-2** | 2+-(3/\*+-4)/\* or +-2+-(3/\*+-4)/\*  drag '(' and drop on '2' |
| **Rule\_W3-4-3** | 2+-(3/\*4)+- or +-2+-(3/\*4)+- or 2-(3+-4)+- or +-2-(3+-4)+- or -2+(3+-4)+-  drag '(' and drop on '2' |
| **Rule\_W3-4-4** | /\*2+-(3/\*+-4)/\*  drag '(' and drop on '2' |
| **Rule\_W3-4-5** | /\*2+-(3/\*+-2)+-  drag '(' and drop on '2' |
| **Rule\_W3-4-6** | /\*2/(3/\*+-4) or /\*2/(3/\*+-4)+- or /\*2\*(3/+-4) or /\*2\*(3/+-4)+-  drag '(' and drop on '2' |
| **Rule\_R3-5** | 2+(3+-4) or +2+(3+-4) or 2\*(3\*4) or /\*+-2\*(3\*4)  drag ')' and drop on '3' |
| **Rule\_W3-5-1** | 2+(3+-4) or +2+(3+-4) or 2\*(3\*4) or /\*+-2\*(3\*4)  drag ')' and drop on 'number' which is not '3' |
| **Rule\_W3-5-2** | 2+-(3/\*4) or +-2+-(3/\*4) or 2-(3+-4) or +-2-(3+-4) or -2+(3+-4)  drag ')' and drop on '3' |
| **Rule\_W3-5-3** | /\*2+-(3/\*+-4)  drag ')' and drop on '3' |
| **Rule\_W3-5-4** | 2/(3/\*+-4) or +-2/(3/\*+-4) or 2\*(3/+-4) or +-2\*(3/+-4) or 2/(3/\*+-4)+- or +-2/(3/\*+-4)+- or 2\*(3/+-4)+- or +-2\*(3/+-4)+-  drag ')' and drop on '3' |
| **Rule\_R3-6** | 2+(3+-4)+- or +2+(3+-4)+- or 2\*(3\*4)/\*+- or /\*+-2\*(3\*4)/\*+-  drag ')' and drop on '3' |
| **Rule\_W3-6-1** | 2+(3+-4)+- or +2+(3+-4)+- or 2\*(3\*4)/\*+- or /\*+-2\*(3\*4)/\*+-  drag ')' and drop on 'number' which is not '3' |
| **Rule\_W3-6-2** | 2+-(3/\*+-4)/\* or +-2+-(3/\*+-4)/\*  drag ')' and drop on '3' |
| **Rule\_W3-6-3** | 2+-(3/\*4)+- or +-2+-(3/\*4)+- or 2-(3+-4)+- or +-2-(3+-4)+- or -2+(3+-4)+-  drag ')' and drop on '3' |
| **Rule\_W3-6-4** | /\*2+-(3/\*+-4)/\*  drag ')' and drop on '3' |
| **Rule\_W3-6-5** | /\*2+-(3/\*+-2)+-  drag ')' and drop on '3' |
| **Rule\_W3-6-6** | /\*2/(3/\*+-4) or /\*2/(3/\*+-4)+- or /\*2\*(3/+-4) or /\*2\*(3/+-4)+-  drag ')' and drop on '3' |
| **Rule\_R3-7** | (3+4)+-5 or +(3+4)+-5 or (3\*4)\*5 or /\*+-(3\*4)\*5  drag ')' and drop on '5' |
| **Rule\_W3-7-1** | (3+4)+-5 or +(3+4)+-5 or (3\*4)\*5 or /\*+-(3\*4)\*5  drag ')' and drop on 'number' which is not '5' |
| **Rule\_W3-7-2** | /\*(3/\*+-4)+-5  drag ')' and drop on '5' |
| **Rule\_W3-7-3** | -(3/\*+-4)+-5 or +(3/\*-4)-+5 or (3/\*-4)-+5  drag ')' and drop on '5' |
| **Rule\_W3-7-4** | +-(3/\*+-4)/5 or +-(3/+-4)\*5 or (3/\*+-4)/5 or (3/+-4)\*5 or +-(3/\*+-4)/5+- or +-(3/+-4)\*5+- or (3/\*+-4)/5+- or (3/+-4)\*5+-  drag ')' and drop on '5' |
| **Rule\_R3-8** | (3+4)+-5+- or +(3+4)+-5+- or (3\*4)\*5/\*+- or /\*+-(3\*4)\*5/\*+-  drag ')' and drop on '5' |
| **Rule\_W3-8-1** | (3+4)+-5+- or +(3+4)+-5+- or (3\*4)\*5/\*+- or /\*+-(3\*4)\*5/\*+-  drag ')' and drop on 'number' which is not '5' |
| **Rule\_W3-8-2** | /\*(3/\*+-4)+-5/\*+-  drag ')' and drop on '5' |
| **Rule\_W3-8-3** | -(3/\*+-4)+-5+- or +(3/\*-4)+-5+- or (3/\*-4)+-5+-  drag ')' and drop on '5' |
| **Rule\_W3-8-4** | +-(3/\*+-4)+-5/\* or (3/\*+-4)+-5/\*  drag ')' and drop on '5' |
| **Rule\_W3-8-5** | +-(3/\*+-4)/5/\* or +-(3/+-4)\*5/\* or (3/\*+-4)/5/\* or (3/+-4)\*5/\*  drag ')' and drop on '5' |
|  |  |
| **Rule\_R4-1** | /\*+-2\*(3+-4)/\*+-  drag '2' and drop on 'operator' between '2' and '(3+-4)' |
| **Rule\_W4-1-1** | /\*+-2\*(3+-4)/\*+-  drag '2' and drop on 'operator' which is not between '2' and '(3+-4)' |
| **Rule\_W4-1-2** | 2/+-(3+-4) or 2/+-(3+-4)+- or +-2/+-(3+-4) or +-2/+-(3+-4)+- or /\*2/(3+-4)/\*+-  drag '2' and drop on 'operator' between '2' and '(3+-4)' |
| **Rule\_W4-1-3** | /\*2+-(3+-4) or /\*2+-(3+-4)/\*+-  drag '2' and drop on 'operator' between '2' and '(3+-4)' |
| **Rule\_R4-2** | /\*+-(3+-4)\*5/\*+-  drag '5' and drop on 'operator' between '(3+-4)' and '5' |
| **Rule\_W4-2-1** | /\*+-(3+-4)\*5/\*+-  drag '5' and drop on 'operator' which is not between '(3+-4)' and '5' |
| **Rule\_W4-2-2** | (3+-4)/+-5 or /\*+-(3+-4)/+-5 or (3+-4)/+-5/\*+- or +-(3+-4)/+-5/\*+-  drag '5' and drop on 'operator' between '(3+-4)' and '5' |
| **Rule\_R4-3** | (3\*4+-4\*5)  drag '4' and drop on '(' |
| **Rule\_W4-3-1** | (3\*4+-4\*5)+(9+10)  drag '4' and drop on '(' which is not in (3\*4+-4\*5) |
| **Rule\_W4-3-2** | (3\*4+-5\*6)  drag '4' and drop on '(' |
| **Rule\_R4-4** | (3\*4+-4\*5)  drag '4' and drop on ')' |
| **Rule\_W4-4-1** | (3\*4+-4\*5)+(9+10)  drag '4' and drop on ')' which is not in (3\*4+-4\*5) |
| **Rule\_W4-4-2** | (3\*4+-5\*6)  drag '4' and drop on ')' |

**Reference**

* <http://ariya.ofilabs.com/2011/08/math-evaluator-in-javascript-part1.html>
* <http://ariya.ofilabs.com/2011/08/math-evaluator-in-javascript-part-2.html>
* <http://ariya.ofilabs.com/2011/08/math-expression-evaluator-in-javascript-part-3.html>