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HW1

Problem 1

1. Successor Function

Rule 1: $| -> |a
Rule 2: a| -> |a
Rule 3: a# -> |

Example:
$|||#
|a||# By Rule 1
||a|# By Rule 2
|||a# By Rule 2
|||| By Rule 3

2. Double Function

Rule 1: $| -> |a
Rule 2: a| -> ||a
Rule 3: a# -> |

Example:
$|||#
|a||# By Rule 1
|||a|# By Rule 2
|||||a# By Rule 2
|||||| By Rule 3

3. Addition Function

Rule 1: $| -> |a
Rule 2: a| -> |a
Rule 3: a&| -> |a
Rule 4: |a# -> |

Example
$||&|||#
|a|&|||# By Rule 1
||a&|||# By Rule 2
|||a||# By Rule 3
||||a|# By Rule 2
|||||a# By Rule 2
||||| By Rule 4

Problem 2

1. Rewrite system

Rule 1: 0+0 -> 0
Rule 2: 0+1 -> 1
Rule 3: 1+0 -> 1
Rule 4: 0+2 -> 2
Rule 5: 2+0 -> 2
Rule 6: 1+1 -> 2
Rule 7: 1+2 -> 0
Rule 8: 2+1 -> 0
Rule 9: 2+2 -> 1
Rule 10: (0) -> 0
Rule 11: (1) -> 1
Rule 12: (2) -> 2

2. Examples

Input: ((1+2)+0)
((1+2)+0) = ((0)+0) By rule 7
((0)+0) = (0+0) By rule 10
(0+0) = (0) By rule 1
(0)= 0 By rule 10
Output: 0

Input: (1+(2+2))
(1+(2+2)) = (1+(1)) By rule 9
(1+(1)) = (1+1) By rule 11
(1+1) = (2) By rule 6
(2)= 2 By rule 12
Output: 2

3. Yes it's unique.

Problem 3

1.
$r^+ = rr^*$

2.
$r^* = \varepsilon|r|rr|rrr|\ldots$
$r^+ = r|rr|rrr|\ldots$

Problem 4

Digit = 0|1|2|3|4|5|6|7|8|9
Sign = +|-

Regular expression
(ε|Sign)(Digit)$^+$.(Digit)$^+$(ε|((E)(ε|Sign)(Digit)$^+$(ε|(.(Digit)$^+$))))

Problem 5
1. All strings of “a”s and “b”s
2. Binary numbers starting with 1 and ending with 001 or 011

Problem 6
1. (a*(bc)*d*)*
2. (a*(ε|b)(ε|c|cc|ccc|cccc))*