2023 Digital IC Design Homework 3

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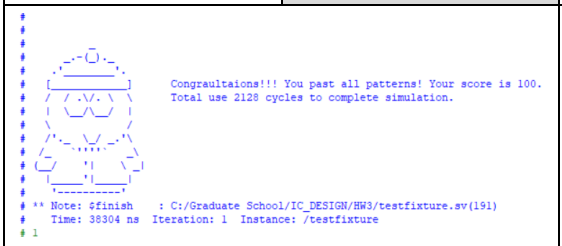
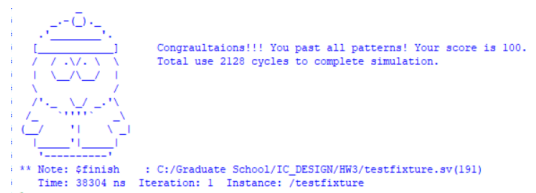
Simulation Result

Functional simulation	100	Gate-level simulation	100





Synthesis Result

Total logic elements	639
Total memory bits	0
Embedded multiplier 9-bit elements	1
Total cycle used	2128
Clock width	18

Flow Status	Successful - Sat Apr 22 21:46:11 2023
Quartus Prime Version	20.1.1 Build 720 11/11/2020 SJ Lite Edition
Revision Name	AEC
Top-level Entity Name	AEC
Family	Cyclone IV E
Device	EP4CE55F23A7
Timing Models	Final
Total logic elements	639 / 55,856 (1 %)
Total registers	278
Total pins	19 / 325 (6 %)
Total virtual pins	0
Total memory bits	0 / 2,396,160 (0 %)
Embedded Multiplier 9-bit elements	1 / 308 (< 1 %)
Total PLLs	0 / 4 (0 %)

Description of your design

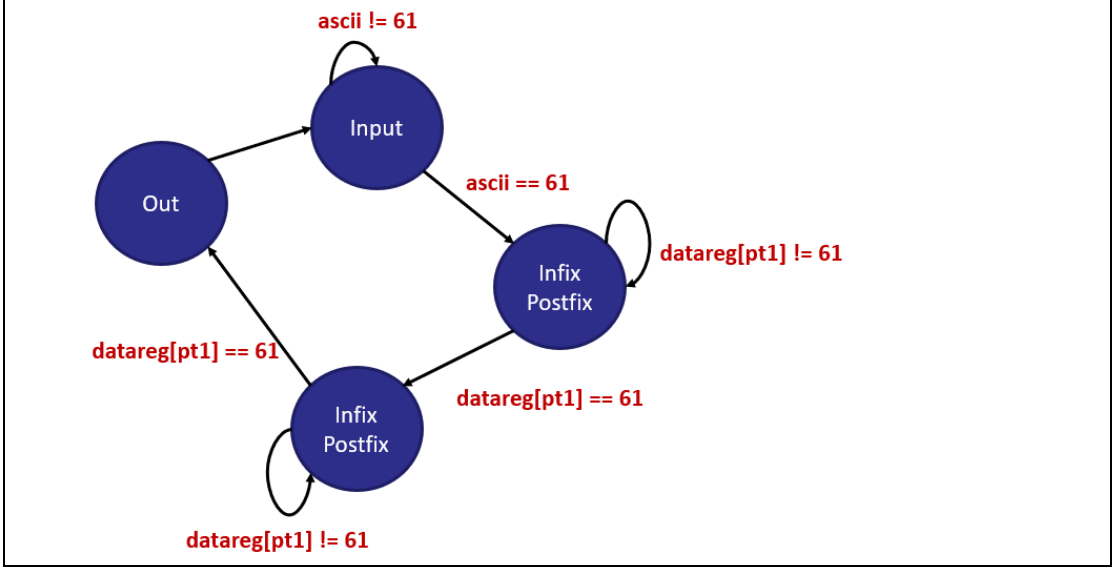
Algorithm Infix - Postfix

```
for (char c : infix) {
    if (isalpha(c) || isdigit(c)) {
        postfix += c;
    }
    else if (isOperator(c)) {
        while (!operatorStack.empty() && operatorStack.top() != '(' && precedence[c] <= precedence[operatorStack.top()]) {
            postfix += operatorStack.top();
            operatorStack.pop();
        }
        operatorStack.push(c);
    }
    else if (c == '(') {
        operatorStack.push(c);
    }
    else if (c == ')') {
        while (!operatorStack.empty() && operatorStack.top() != '(') {
            postfix += operatorStack.top();
            operatorStack.pop();
        }
        operatorStack.pop();
    }
}

while (!operatorStack.empty()) {
    postfix += operatorStack.top();
    operatorStack.pop();
}

return postfix;
```

Algorithm Postfix Valuation

```
stack<int> operands;

for (char c : expr) {
    if (isdigit(c))
        operands.push(c - '0'); // Convert character to integer and push onto stack
    else {
        int op2 = operands.top();
        operands.pop();
        int op1 = operands.top();
        operands.pop();
        switch (c) {
        case '+':
            operands.push(op1 + op2);
            break;
        case '-':
            operands.push(op1 - op2);
            break;
        case '*':
            operands.push(op1 * op2);
            break;
        case '/':
            operands.push(op1 / op2);
            break;
        default:
            throw runtime_error("Invalid operator");
        }
    }
}
return operands.top();
```

Finite state Machine



*Scoring = Area cost * Timing cost = 640 * 38304 = 24514560*

*Area cost = Total logic elements (639) + Total memory bits (0) + 9*Embedded multipliers 9-bit elements (1) = 640*

*Timing cost = Total cycle used (2128) * Clock width (18ns) = 38304ns*

*** Total logic elements must not exceed 1500.**