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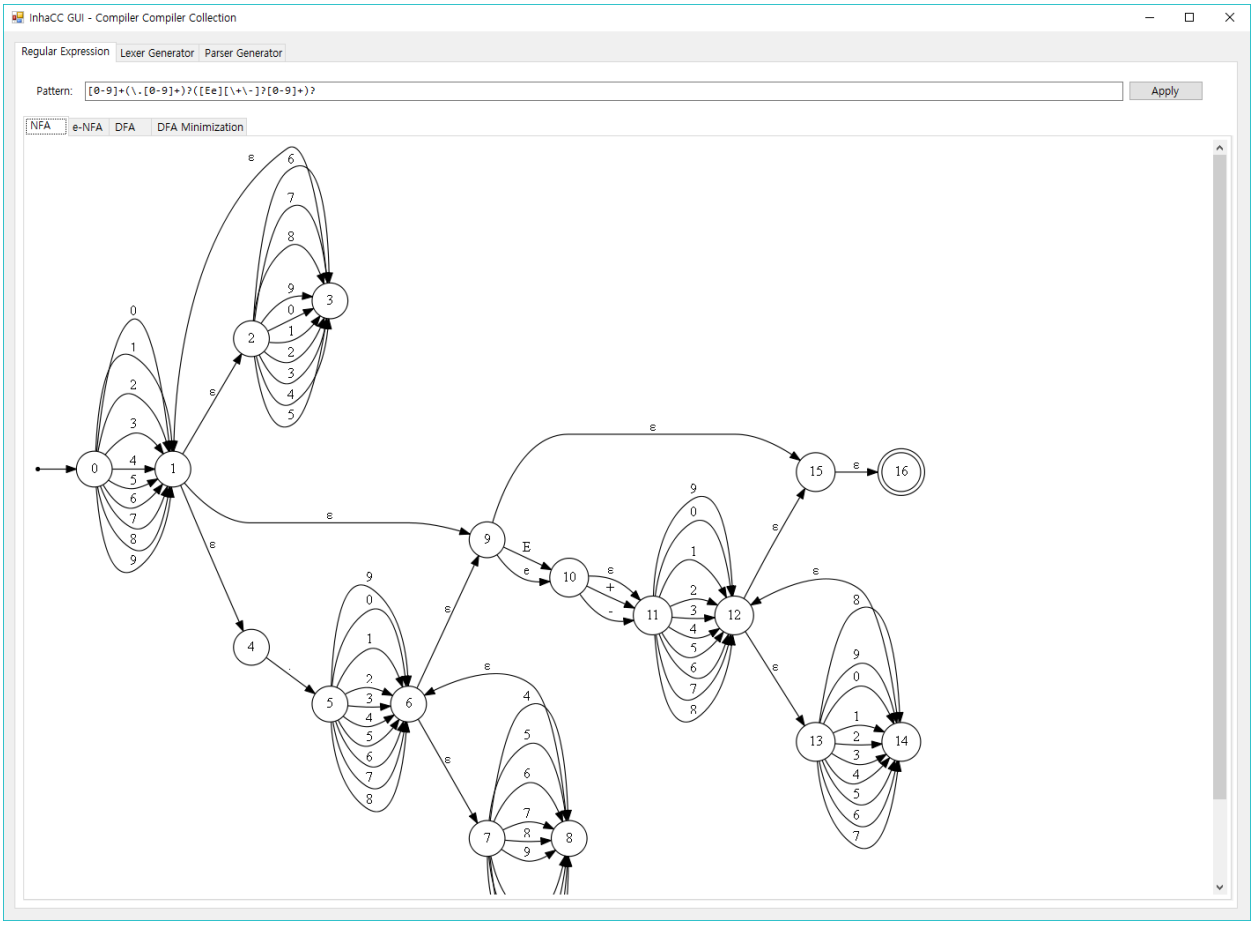
FA20-BCS-040

Q2: TWO FUNCTIONALITIES ALONG WITH SCREENSHOTS

1. Regular Expression (Regex)



Code:

```
/// Try simple-regular-expression to NFA.
    /// </summary>
    /// <param name="pattern"></param>
    /// <returns></returns>
    private diagram make_nfa(string pattern)
    {
       var first_valid_stack = new Stack<transition_node>();
```

```
        var second_valid_stack = new Stack<transition_node>();
        var first_valid_stack_stack = new List<Stack<transition_node>>();
        var second_valid_stack_stack = new List<Stack<transition_node>>();
        var tail_nodes = new Stack<List<transition_node>>();
        var opstack = new Stack<char>();
        var diagram = new diagram();

        var index_count = 0;
        var cur = new transition_node();
        var nodes = new List<transition_node>();

        var depth = 0;

        cur.index = index_count++;
        cur.transition = new List<Tuple<char, transition_node>>();
        diagram.start_node = cur;
        first_valid_stack.Push(cur);
        nodes.Add(cur);

        for (int i = 0; i < pattern.Length; i++)
        {
           switch (pattern[i])
           {
              case '(':
                 opstack.Push('(');
                 depth++;

                 // Copy stack and push to stack stack
                 first_valid_stack_stack.Add(new Stack<transition_node>(new
Stack<transition_node>(first_valid_stack)));
                 second_valid_stack_stack.Add(new Stack<transition_node>(new
Stack<transition_node>(second_valid_stack)));
                 second_valid_stack.Push(first_valid_stack.Peek());
                 first_valid_stack.Push(cur);
                 tail_nodes.Push(new List<transition_node>());
                 break;

              case ')':
                 if (opstack.Count == 0 || opstack.Peek() != '(')
                 {
                    build_errors.Add($"[regex] {i} no opener!");
```

```
                    return null;
                }
                tail_nodes.Peek().Add(cur);
                var ends_point = new transition_node { index = index_count++, transition =
new List<Tuple<char, transition_node>>() };
                cur = ends_point;
                nodes.Add(cur);

                // Connect tail nodes
                foreach (var tail_node in tail_nodes.Peek())
                    tail_node.transition.Add(new Tuple<char, transition_node>(e_closure,
cur));
                tail_nodes.Pop();

                // Pop from stack stack
                first_valid_stack = first_valid_stack_stack.Last();
                first_valid_stack_stack.RemoveAt(first_valid_stack_stack.Count - 1);
                second_valid_stack = second_valid_stack_stack.Last();
                second_valid_stack_stack.RemoveAt(second_valid_stack_stack.Count - 1);
                second_valid_stack.Push(first_valid_stack.Peek());
                first_valid_stack.Push(cur);

                depth--;
                break;

            case '|':
                tail_nodes.Peek().Add(cur);
                cur = first_valid_stack_stack[first_valid_stack_stack.Count - 1].Peek();
                break;

            case '?':
                second_valid_stack.Peek().transition.Add(new Tuple<char,
transition_node>(e_closure, cur));
                break;

            case '+':
                var ttc = copy_nodes(ref nodes, second_valid_stack.Peek().index,
cur.index);
                cur.transition.Add(new Tuple<char, transition_node>(e_closure, ttc.Item1));
                ttc.Item2.transition.Add(new Tuple<char, transition_node>(e_closure,
cur));
```

```
                index_count += ttc.Item3;
                break;

            case '*':
                second_valid_stack.Peek().transition.Add(new Tuple<char,
transition_node>(e_closure, cur));
                cur.transition.Add(new Tuple<char, transition_node>(e_closure,
second_valid_stack.Peek()));
                break;

            case '[':
                var ch_list = new List<char>();
                i++;
                bool inverse = false;
                if (i < pattern.Length && pattern[i] == '^')
                {
                    inverse = true;
                    i++;
                }
                for (; i < pattern.Length && pattern[i] != ']'; i++)
                {
                    if (pattern[i] == '\\' && i + 1 < pattern.Length)
                    {
                        if (@"+-?*|()[].=<>/\".Contains(pattern[i + 1]))
                            ch_list.Add(pattern[++i]);
                        else
                        {
                            switch (pattern[++i])
                            {
                                case 'n':
                                    ch_list.Add('\n');
                                    break;
                                case 't':
                                    ch_list.Add('\t');
                                    break;
                                case 'r':
                                    ch_list.Add('\r');
                                    break;
                                case 'x':
                                    char ch2;
```

```
                            ch2 = (char)(pattern[i + 1] >= 'A' ? (pattern[i + 1] - 'A' + 10) :
pattern[i + 1] - '0');
                            ch2 <<= 4;
                            ch2 |= (char)(pattern[i + 2] >= 'A' ? (pattern[i + 2] - 'A' + 10) :
pattern[i + 2] - '0');
                            i += 2;
                            ch_list.Add(ch2);
                            break;

                        default:
                            build_errors.Add($"{pattern[i]} escape character not found!");
                            ch_list.Add(pattern[i]);
                            break;
                    }
                }
            }
            else if (i + 2 < pattern.Length && pattern[i + 1] == '-')
            {
                for (int j = pattern[i]; j <= pattern[i + 2]; j++)
                    ch_list.Add((char)j);
                i += 2;
            }
            else
                ch_list.Add(pattern[i]);
        }
        var ends_point2 = new transition_node { index = index_count++, transition
= new List<Tuple<char, transition_node>>() };
        if (inverse)
        {
            var set = new bool[byte_size];
            var nch_list = new List<char>();
            foreach (var ch2 in ch_list)
                set[ch2] = true;
            for (int j = 0; j < byte_size; j++)
                if (!set[j])
                    nch_list.Add((char)j);
            ch_list.Clear();
            ch_list = nch_list;
        }
        foreach (var ch2 in ch_list)
        {
```

```
                    cur.transition.Add(new Tuple<char, transition_node>(ch2, ends_point2));
                }
                cur = ends_point2;
                nodes.Add(cur);
                if (first_valid_stack.Count != 0)
                {
                    second_valid_stack.Push(first_valid_stack.Peek());
                }
                first_valid_stack.Push(cur);
                break;

            case '.':
                var ends_point3 = new transition_node { index = index_count++, transition
= new List<Tuple<char, transition_node>>() };
                for( int i2 = 0; i2 < byte_size; i2++)
                {
                    cur.transition.Add(new Tuple<char, transition_node>((char)i2,
ends_point3));
                }
                cur = ends_point3;
                nodes.Add(cur);
                if (first_valid_stack.Count != 0)
                {
                    second_valid_stack.Push(first_valid_stack.Peek());
                }
                first_valid_stack.Push(cur);
                break;

            case '\\':
            default:
                char ch = pattern[i];
                if (pattern[i] == '\\')
                {
                    i++;
                    if (@"+-?*|()[].=<>/".Contains(pattern[i]))
                        ch = pattern[i];
                    else
                    {
                        switch (pattern[i])
                        {
                            case 'n':
```

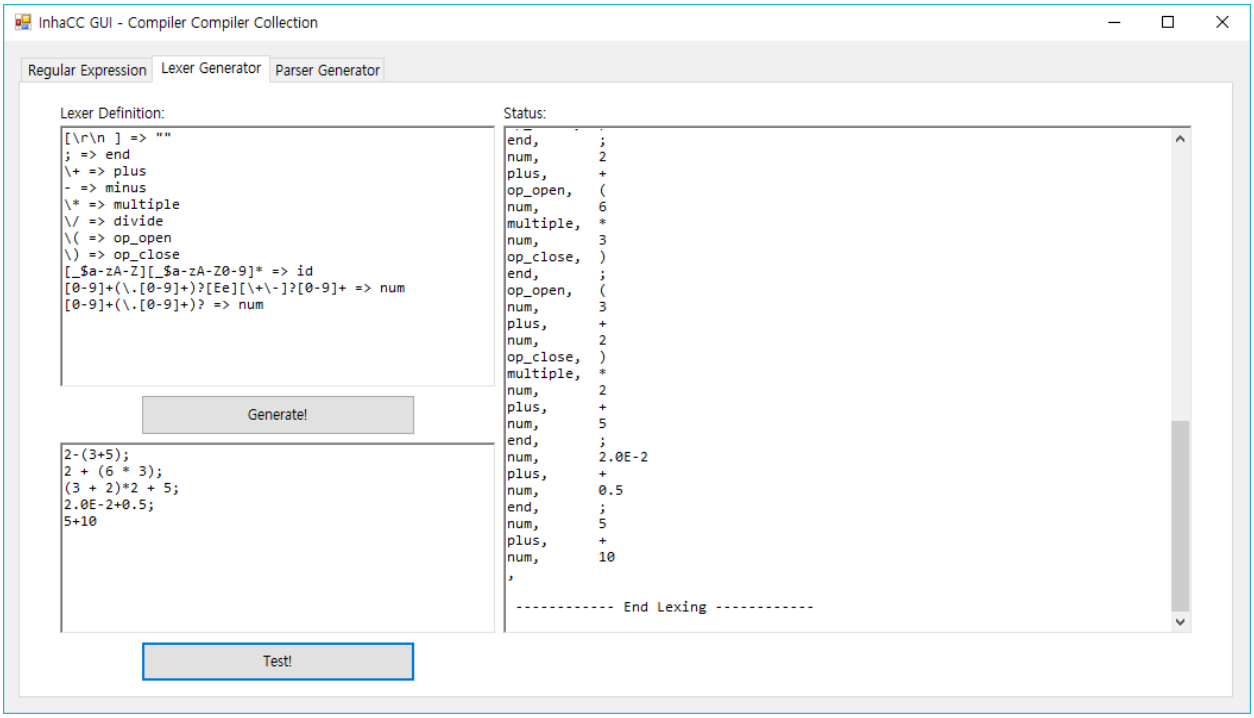
```
                        ch = '\n';
                        break;
                    case 't':
                        ch = '\t';
                        break;
                    case 'r':
                        ch = '\r';
                        break;
                    case 'x':
                        ch = (char)(pattern[i + 1] >= 'A' ? (pattern[i + 1] - 'A' + 10) :
pattern[i + 1] - '0');
                        ch <<= 4;
                        ch |= (char)(pattern[i + 2] >= 'A' ? (pattern[i + 2] - 'A' + 10) :
pattern[i + 2] - '0');
                        i += 2;
                        break;

                    default:
                        build_errors.Add($"{pattern[i]} escape character not found!");
                        ch = pattern[i];
                        break;
                }

            }
        }
        var etn = new transition_node { index = index_count++, transition = new
List<Tuple<char, transition_node>>() };
        cur.transition.Add(new Tuple<char, transition_node>(e_closure, etn));
        cur = etn;
        nodes.Add(cur);
        if (first_valid_stack.Count != 0)
        {
            second_valid_stack.Push(first_valid_stack.Peek());
        }
        first_valid_stack.Push(cur);
        var tn = new transition_node { index = index_count++, transition = new
List<Tuple<char, transition_node>>() };
        cur.transition.Add(new Tuple<char, transition_node>(ch, tn));
        cur = tn;
        nodes.Add(cur);
        if (first_valid_stack.Count != 0)
```

```
                {
                    second_valid_stack.Push(first_valid_stack.Peek());
                }
                first_valid_stack.Push(cur);
                break;
            }
        }
        diagram.count_of_vertex = index_count;
        diagram.nodes = nodes;
        nodes.Where(x => x.transition.Count == 0).ToList().ForEach(y => y.is_acceptable =
true);
        return diagram;
    }
```

2. Scanner Generator / Lexical Analyzer Generator



CODE:

```
/// Lexical Analyzer Generator
    /// </summary>
    public class ScannerGenerator
    {
```

```
    bool freeze = false;
    List<Tuple<string, SimpleRegex.diagram>> tokens = new List<Tuple<string,
SimpleRegex.diagram>>();
    SimpleRegex.diagram diagram;

    public string PrintDiagram()
    {
      if (!freeze) throw new Exception("Retry after generate!");
      return SimpleRegex.PrintDiagram(diagram);
    }

    public void PushRule(string token_name, string rule)
    {
      if (freeze) throw new Exception("You cannot push rule after generate! Please
create new scanner-generator instance.");
       var sd = new SimpleRegex(rule);
       foreach (var node in sd.Diagram.nodes)
          if (node.is_acceptable)
             node.accept_token_name = token_name;
       tokens.Add(new Tuple<string, SimpleRegex.diagram>(token_name,
sd.Diagram));
    }

    /// <summary>
    /// Generate merged DFA using stack.
    /// </summary>
    public void Generate()
    {
      freeze = true;

      //                * Warning *
      //
      // The merged_diagram index order is in the order of  DFA's
      // pattern mapping. Consider the PushRule function with this.

      var merged_diagram = get_merged_diagram();

      // Generated transition nodes for DFA based patttern matching.
      var diagram = new SimpleRegex.diagram();
      var nodes = new List<SimpleRegex.transition_node>();
      var states = new Dictionary<string, SimpleRegex.transition_node>();
      var index = new Dictionary<int, string>();
```

```
        var states_count = 0;

        // (diagram_indexes)
        var q = new Queue<List<int>>();
        q.Enqueue(populate(merged_diagram, new List<int> { 0 },
SimpleRegex.e_closure));

        var t = new SimpleRegex.transition_node { index = states_count++, transition =
new List<Tuple<char, SimpleRegex.transition_node>>() };
        states.Add(string.Join(",", q.Peek()), t);
        index.Add(t.index, string.Join(",", q.Peek()));
        nodes.Add(t);

        while (q.Count != 0)
        {
            var list = q.Dequeue();
            var list2str = string.Join(",", list);

            var tn = states[list2str];

            // Append accept tokens.
            foreach (var ix in list)
                if (merged_diagram.nodes[ix].is_acceptable)
                {
                    tn.is_acceptable = true;
                    if (tn.accept_token_names == null)
                        tn.accept_token_names = new List<string>();

tn.accept_token_names.Add(merged_diagram.nodes[ix].accept_token_name);
                }

            var available = available_matches(merged_diagram, list);

            foreach (var pair in available)
            {
                var populate = pair.Value.ToList();
                var l2s = string.Join(",", populate);

                if (!states.ContainsKey(l2s))
                {
                    var tnt = new SimpleRegex.transition_node { index = states_count++,
transition = new List<Tuple<char, SimpleRegex.transition_node>>() };
                    states.Add(l2s, tnt);
```

```
                index.Add(tnt.index, l2s);
                nodes.Add(tnt);
                q.Enqueue(populate);
            }

            var state = states[l2s];
            tn.transition.Add(new Tuple<char, SimpleRegex.transition_node>(pair.Key,
state));
        }
    }

    diagram.nodes = nodes;
    diagram.start_node = nodes[0];
    diagram.count_of_vertex = nodes.Count;

    this.diagram = diagram;
}
```