CS 460

Programming Languages

Fall 2023

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Course Administration

- Exercise 2 Questions
- Project 1 Preliminary Exercise

Exercise 2 Questions

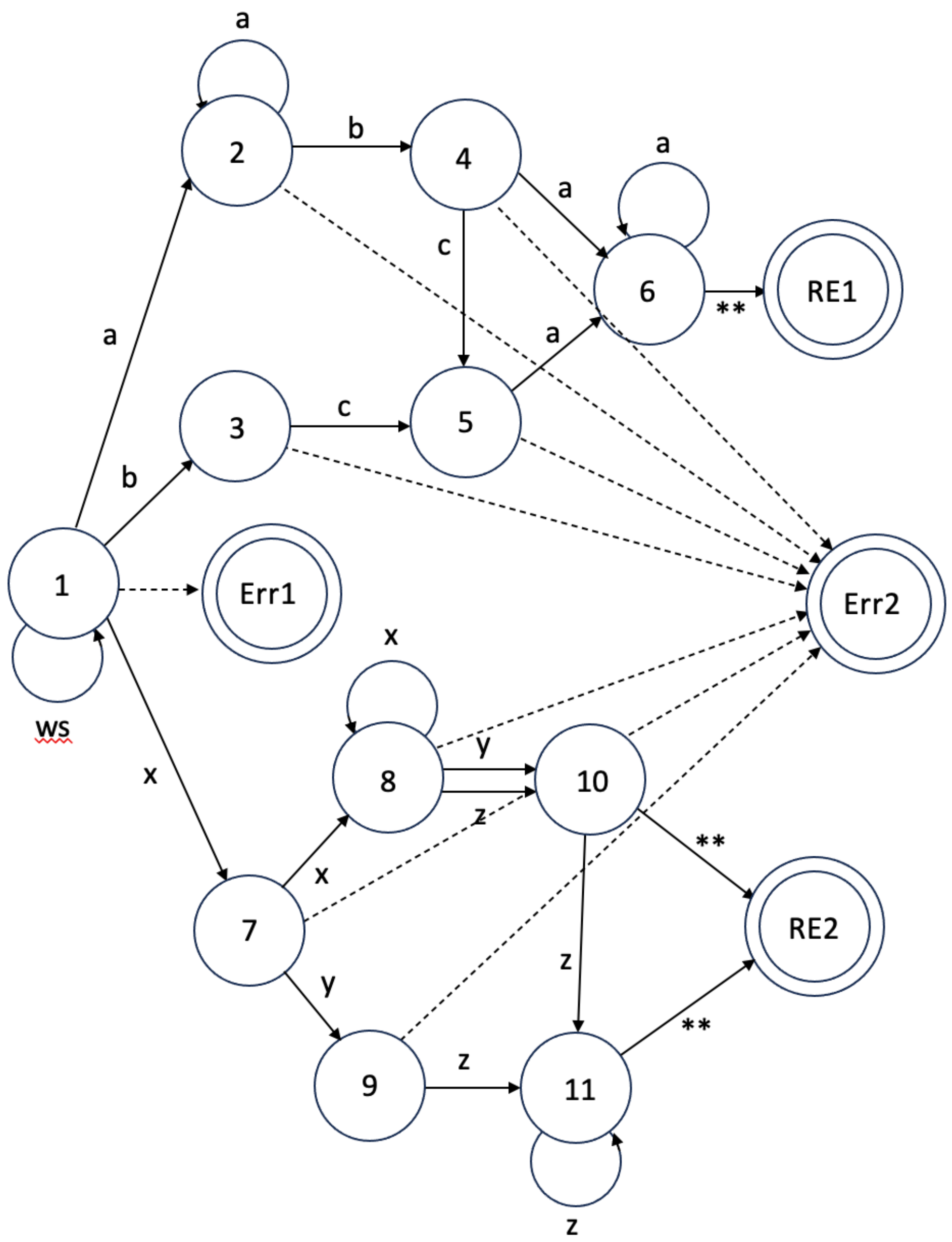
- (1a)I would like some clarification on our currency dynamic array.
- I understand, (correct me if I'm wrong), that if our dynamic array contains [101] it means we have 1 penny, 0 nickels, and 1 dime (assuming we are going in ascending order). So if we wanted to produce our currency array for $100 it would look something like this? [0,0,0,0,0,0,0,0,0,0,1]

- (1b) I am also a little confused as to how exactly our currency is going to be updated.
- How exactly should we update our currency array? For example, if we initialized an object that contained $6.97, where would our calculations, (to find how many and what kind of denominations are needed), go? I understand we could initially do the calculations in that constructor, however, if we were to add to that same object we would need to update our currency array. **Would we be able to have a helper function that aids in doing that?** I see we have a set currency function that is supposed to set our currency array. Can we assume that that calculation is done apart from the class and that the vector passed already contains the updated/optimized denominations count?

DFAs as scanners (aka tokenizers)

- Alphabet = {a, b, c, x, y, z, ␣}
- Regular expression 1 (RE1)
  - a* (ab | bc) a+
- Regular expression 2 (RE2)
  - x+ (xy | yz | xz) z*
- Combined
  - (a* (ab | bc) a+) | (x+ (xy | yz | xz) z*)

(a* (ab | bc) a+) | (x+ (xy | yz | xz) z*)



Programming a DFA

- Table

	ws	a	b	c	x	y	z	other
1	1	2	3	Err1	7	Err1	Err1	Err1
2	Err2	2	4	Err2	Err2	Err2	Err2	Err2
3	Err2	Err2	Err2	5	Err2	Err2	Err2	Err2
4	Err2	6	Err2	5	Err2	Err2	Err2	Err2
5	Err2	6	Err2	Err2	Err2	Err2	Err2	Err2
6	RE1	6	RE1	RE1	RE1	RE1	RE1	RE1
7	Err2	Err2	Err2	Err2	8	9	Err2	Err2
8	Err2	Err2	Err2	Err2	8	10	10	Err2
9	Err2	Err2	Err2	Err2	Err2	Err2	11	Err2
10	RE2	RE2	RE2	RE2	RE2	RE2	11	RE2
11	RE2	RE2	RE2	RE2	RE2	RE2	11	RE2

Example.cpp

```cpp
#include <iostream>
#include "Lex.h"

using namespace std;

int main ()
{
        string input;
        getline (cin, input);
        cout << "Input:\t" << input << endl;
        Lex tokenizer (input);
        token t = NONE;
        while (t != EOLN)
        {
                t = tokenizer.getNext ();
                cout << tokenizer.getTokenName (t) << '\t’;
                cout << tokenizer.getLexeme () << '\n’;
        }
        return 0;
}
```

Lex.h

```
#ifndef LEX_H
#define LEX_H

#include <iostream>
using namespace std;

enum token {Err2 = -4, Err1, RE2, RE1, NONE, EOLN};

class Lex
{
    public:
         Lex(const string & S);
         token getNext ();
         string getLexeme ();
         string getTokenName (token t);
    private:
         string line;
         int pos;
         string lexeme;
};

#endif
```

Lex.cpp (1)

```
#include "Lex.h"

#define DEBUG 0
#define debug if (DEBUG) cout

Lex::Lex(const string & S)
{
          line = S;
          pos = 0;
}
string Lex::getLexeme ()
{
          return lexeme;
}

string Lex::getTokenName (token t)
{
          switch (t)
          {
                    case RE1: return "RE1";
                    case RE2: return "RE2";
                    case Err1: return "Err1";
                    case Err2: return "Err2";
                    case EOLN: return "EOLN";
          }
          return "NONE";
}
```

Lex.cpp (2)

```
token Lex::getNext ()
{
          lexeme = "";
          while (pos < line.length() && isspace (line[pos]))
                    pos++;
          if (pos >= line.length())
                    return EOLN;
          char oneChar;
          int col;
          int state = 1;
          debug << pos << “ : “ << line << endl;
          while (state > 0)
          {
                    oneChar = line[pos++];
                    col = getColumn (oneChar);
                    lexeme += oneChar;
                    debug << "state = " << state << "; position = " << pos <<
                              "; lexeme = " << lexeme << endl;
                    state = table[state][col];
          }
          if (state != Err1)
          {
                    lexeme.pop_back();
                    pos--;
          }
          return token (state);
}
```

Lex.cpp (3)

```
static int table [12][8] =
       { {0, 0, 0, 0, 0, 0, 0, 0},
         {1, 2, 3, Err1, 7, Err1, Err1, Err1},
         {Err2, 2, 4, Err2, Err2, Err2, Err2, Err2},
         {Err2, Err2, Err2, 5, Err2, Err2, Err2, Err2},
         {Err2, 6, Err2, 5, Err2, Err2, Err2, Err2},
         {Err2, 6, Err2, Err2, Err2, Err2, Err2, Err2},
         {RE1, 6, RE1, RE1, RE1, RE1, RE1, RE1},
         {Err2, Err2, Err2, Err2, 8, 9, Err2, Err2},
         {Err2, Err2, Err2, Err2, 8, 10, 10, Err2},
         {Err2, Err2, Err2, Err2, Err2, Err2, 11, Err2},
         {RE2, RE2, RE2, RE2, RE2, RE2, 11, RE2},
         {RE2, RE2, RE2, RE2, RE2, RE2, 11, RE2} };
```

Inputs and Execution

- input1
  ```
  abca xyz
  ```
- input2
  ```
  abcaxyz
  ```
- input3
  ```
  abcaabxyz
  ```
- input4
  ```
  abcaxyzzzzaaabbcaaabcaxxyzzzc
  ```

Project 1

- Project1Framework

```
LexicalAnalyzer.h       LexicalAnalyzer.cpp
SyntacticalAnalyzer.h   SyntacticalAnalyzer.cpp
Project1.cpp  makefile  README
```

- Test Files

```
P1-1.pl460    P1-1.lst    P1-1.p1
P1-2.pl460    P1-2.lst    P1-2.p1
```

- In course pickup directory