Concepts of Programming Languages, CSCI 305, Fall 2021
Exam 1, Sept. 24

The exam will have two parts, a non-programming portion and a programming portion. You may not use notes, book, etc. for the non-programming portion. You can use the text, your notes and the web, but not other people, for the programming portion.

1. The following code snippet in C contains an error (the subroutine needs two parameters).

```
void main ( ) {
        int x = 3;
        sub(5*x,  );
        return;
}
```

This error is most likely to be classified as a: (4 pts.)

a. syntax error detected by the lexical analyzer
b. syntax error detected by the parser
c. static semantic analysis error
d. dynamic semantic analysis error
e. compiler can't catch

2. In C#, an array out of bounds error is most likely to be classified as a: (4 pts.)

a. syntax error detected by the lexical analyzer
b. syntax error detected by the parser
c. static semantic analysis error
d. dynamic semantic analysis error
e. this error would not be caught

By default, C and C++ do not check for array out of bounds errors. It can be turned on however. C# does check, making the answer d.

3. The following code snippet in C contains a divide by zero error.

```
main ( ) {
        int value = 231;
        int div = 10;
        int i;
        for (i=0; i<10; i++) {
                --div;
        }
        value = value/div;
}
```

This error is most likely to be classified as a: (4 pts.)

a. syntax error detected by the lexical analyzer
b. syntax error detected by the parser
c. static semantic analysis error
d. dynamic semantic analysis error
e. this error would not be caught

4. Which of the following is NOT a task of lexical analyzer? (4 pts.)

a. Detect errors
b. Remove comments
c. Remove whitespace
d. Collect characters into logical groupings
e. These are all tasks of the lexical analyzer.

5. Which of the following is least likely to be considered a procedural language? (4 pts.)

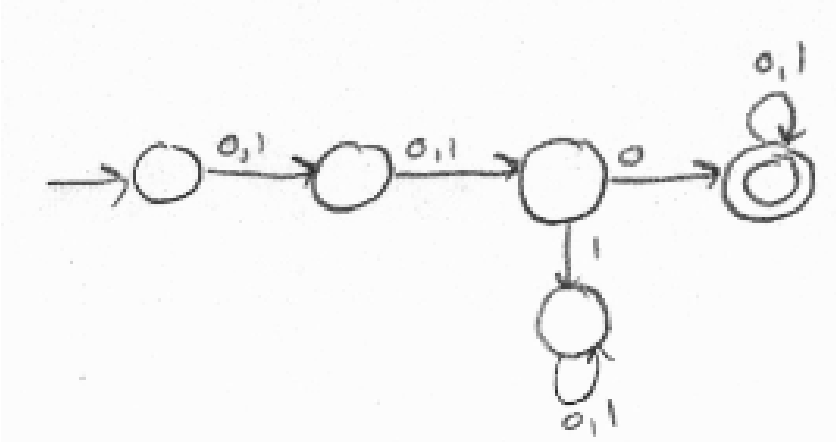
a. Java
b. C#
c. JavaScript
d. Scheme
e. Mini-C

6. Create a DFA for the language L:

L={w | w ∈ {0,1}*, it at least three characters long and its third symbol is 0 }

(5 pts.)

Answer:



7. Write one or more regular expressions to identify the first three elements of URLs.

URLs consist of an optional protocol indicator, IP address or hostname, optional port number, optional directory name, optional filename and optional query string.

- Protocol indicator, if specified, is either http:// or https://
- IP address is four numbers separated by three periods (The numbers should be between 0 and 255, but you just need to check for one to three digits.)
- Hostnames are case-insensitive but allow them to be a series of names separated by periods (.). Each name starts with an upper- or lower-case character, followed by any number of upper or lower case characters or digits.

(10 pts.)

URL → (P | ε) ∘ num . num . num . num | H

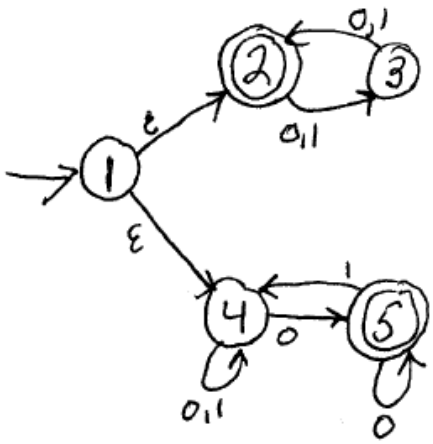
P → http:// | https://

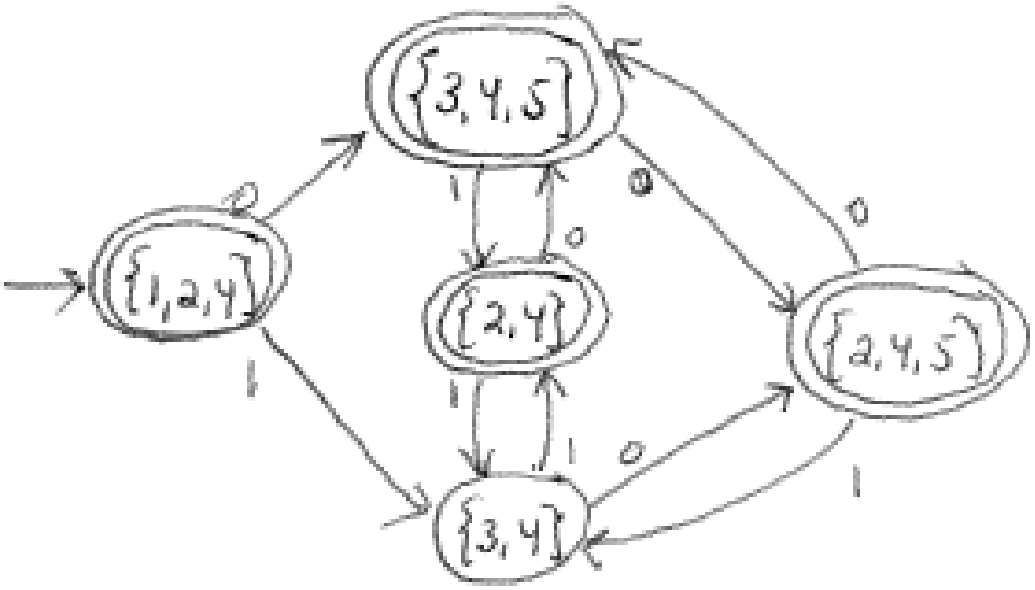
digit → 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9
alpha → a | b | … | z | A | B | … | Z

num → digit | digit digit | digit digit digit
name → alpha (alpha | digit)*

H → name (. name)*

8. Use the construction described in class and the text to convert the following nondeterministic finite automaton (NFA) to an equivalent deterministic finite automaton (DFA). (10 pts.)

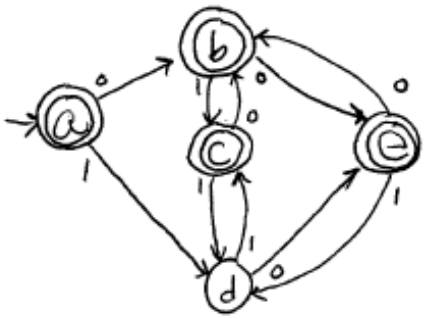




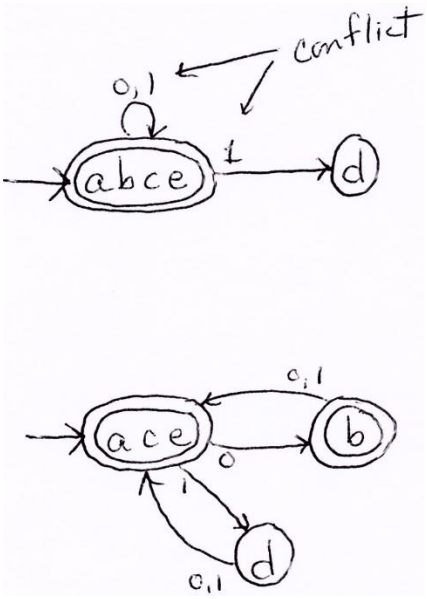
9. Describe the strings which are accepted by the previous NFA. (5 pts.)

Strings from the alphabet {0,1} which are either of even length or end with a 0.

10. Use the construction described in class and the text to convert the following DFA to a minimum DFA, if the DFA is not already a minimum DFA. (10 pts.)



Answer:



DFA with more descriptive names:

11. Let myList be defined as follows:

```
(define myList
    (((a b) w)((c d) x)((e f) y)((g h) z))
)
```

Note that

(car myList) returns ((a b) w) and
(caar myList) returns (a b)

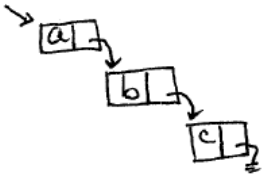
Write a statement that returns d. (10 pts.)

```
(cadaadr  myList)   returns d
```

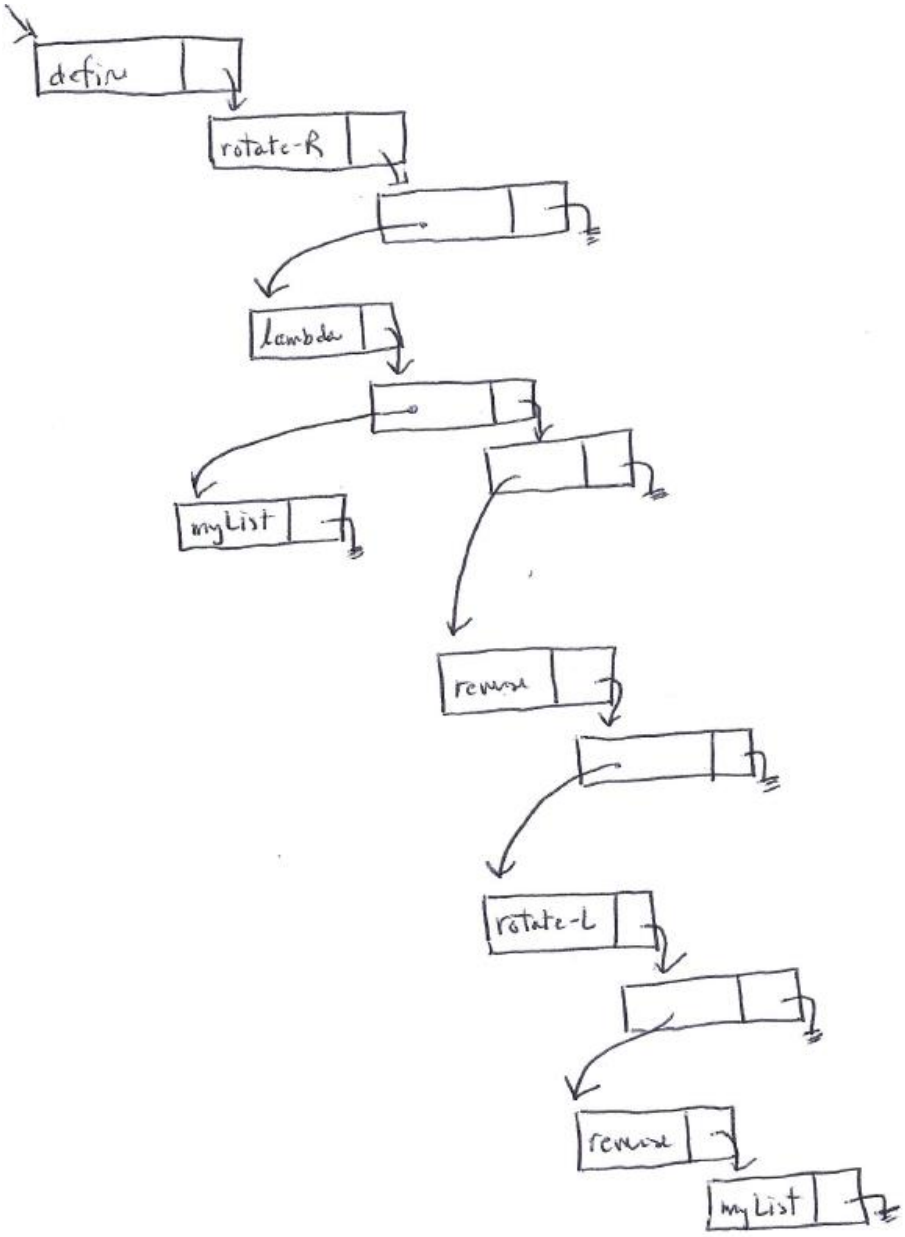
12. Show how the following would be stored in Scheme.

```
(define rotate-R
  (lambda (myList)
    (reverse (rotate-L (reverse myList) ) )
  )
)
```

For example, the list (a b c) is stored as (10 pts.)



Answer:



Extra Credit:

The programming languages Go and MATLAB were presented. One of these languages is proprietary and the other is not. Which language is proprietary? (1 pt.)

MATLAB is proprietary.

One of these languages is weakly typed, while the other is statically typed. Which language is weakly typed? (1 pt.)

MATLAB is weakly typed.

Why was Go created? (1 pt.)

Increase programmer productivity, replace high-performance server-side languages like Java and C++.

What will be outputted by the following snippet of Go code? (1 pt.)

```
func main() {
    n := 0
    if true {
        n := 1
        n++
    }
    fmt.Println(n) // 0
}
```

0 will be printed.

Consider the MATLAB snippet:

```
scores = 102 432 6 88 28 1000
x = scores(scores > 100)
```

What will be the value of x? (1 pt.)

102 432 1000

Concepts of Programming Languages, CSCI 305, Fall 2021
Exam 1, Computer Portion, Sept. 24

Turn in the first portion of the exam before beginning this portion. To complete this portion of the exam you may use your notes, any previous assignments, the text and/or the Internet. You may not communicate with anyone other than me during this exam.

When you are done, email your answers to me:

13. Define the function *myComplex?* that takes three arguments a, b and c and returns true if b^2-4ac<0 and false otherwise. (10 pts.)

```
(define myComplex?
      (lambda (a b c)
            (if (>= (* 4 (* a c)) (* b b)) #t #f)
      )
 )
```

14. Higher order functions are functions that take one or more functions as input, or output a function. The Scheme "map" function is one such function. It takes as arguments a function f and a list of elements, and as the result, returns a new list with f applied to each element from the list. For example, given the function double:

```
(define double
      (lambda (x)
            (* 2 x)
      )
)
```

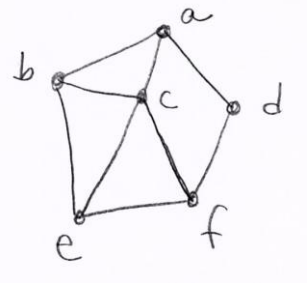
(map double '(4 5 6)) returns (8 10 12)

Write your own map function called *myMap*. The function *myMap* takes a function and a list of elements. It returns a new list with the function applied to each element of the list. For maximum points, your program must be well-designed and must not call the built-in *map* function. (5 pts.)

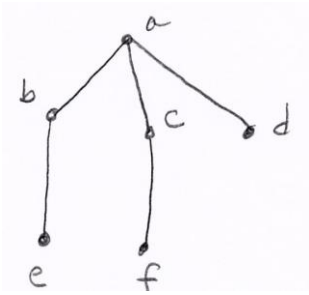
```
(define myMap
      (lambda (func  myList)
            (if  (null? myList)
          myList)
          (cons  (func (car myList)) (myMap func  (cdr myList)))
           )  ; if
      )     ; lambda
)    ; define
```

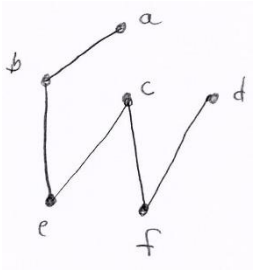
15. Jake plans to write a spanning tree function in Scheme and has decided that he needs some helper functions.

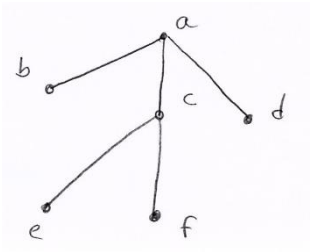
Recall that a spanning tree of a graph, is a graph which contains all of the vertices in the original graph, however, it is also a tree. For example, the following graph



has several spanning trees.







Jake decides to define a helper function called ‘edge-search’. The edge-search function takes a vertex and a graph, given as a list of edges. It returns the list of edges, beginning with the first edge which contains the given vertex.

For example:
(edge-search 'a '((d e) (f g) (b a) (x y) (b c))) returns '((b a) (x y) (b c))
(edge-search 'a '((a b) (a c) (b c))) returns '((a b) (a c) (b c))
(edge-search 'c '((a b) (a c) (b c))) returns '((a c) (b c))
(edge-search 'x '((a b) (a c) (b c))) returns '()

Write the function edge-search. (5 pts.)

```
(define edge-search
 (lambda (item myList)
  (cond
    ((null? myList) myList)
    ((or (equal? item (caar myList))
         (equal? item (cadar myList)))
          myList)
    (else (edge-search item (cdr myList))))))
```