CS 315-01 Quizzes

1. **Date:** Feb. 7, 2022
   Question: Given the following grammar, drive the string "`a = 5; b = 2; print a+b;`", using the rightmost derivation to show that it is in the language.

   ```
   <program> → <stmt_list>
   <stmt_list> → <stmt> | <stmt> <stmt_list>
   <stmt> → <var> = <expression> ;
          | print <expression> ;
   <expression> → <var>
          | <int_const>
          | <var> <arith_op> <var>
   <var> → a | b | c | d
   <int_const> → 0 | 1 | 2 | 3 | 4
   <arith_op> → + | - | * | /
   ```

   Answer:

   The rightmost derivation:

   ```
   <program> ⇒ <stmt_list>
             ⇒ <stmt> <stmt_list>
             ⇒ <stmt> <stmt> <stmt_list>
             ⇒ <stmt> <stmt> <stmt>
             ⇒ <stmt> <stmt> print <expression> ;
             ⇒ <stmt> <stmt> print <var> <arith_op> <var> ;
             ⇒ <stmt> <stmt> print <var> <arith_op> b ;
             ⇒ <stmt> <stmt> print <var> + b ;
             ⇒ <stmt> <stmt> print a + b ;
             ⇒ <stmt> <var> = <expression> ; print a + b ;
             ⇒ <stmt> <var> = <int_const> ; print a + b ;
             ⇒ <stmt> <var> = 2 ; print a + b ;
             ⇒ <stmt> b = 2 ; print a + b ;
             ⇒ <var> = <expression> ; b = 2 ; print a + b ;
             ⇒ <var> = <int_const> ; b = 2 ; print a + b ;
             ⇒ <var> = 5 ; b = 2 ; print a + b ;
             ⇒ a = 5 ; b = 2 ; print a + b ;
   ```

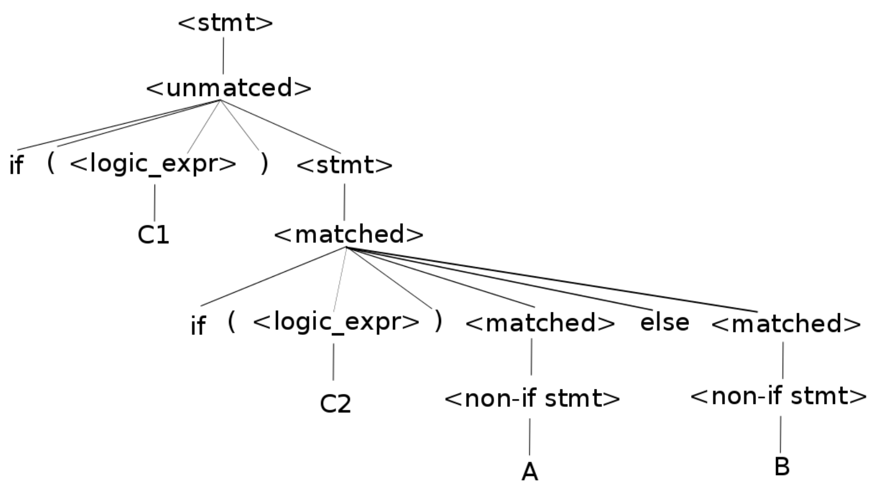
   17 sententail forms.

2. **Date:** Feb. 10, 2022
   Question: What is the parse tree of the string `if (C1) if (C2) A else B` in the following grammar?

   ```
   <stmt> -> <matched> | <unmatched>
   <matched> -> if (<logic_expr>) <matched> else <matched>
             | a non-if statement
   <unmatched> -> if (<logic_expr>) <stmt>
               | if (<logic_expr>) <matched> else <unmatched>
   ```

   Here, C1 and C2 are logical expressions and A an B are non-if statements.

   Answer:



3. **Date:** Feb. 17, 2022
Question: Write a lex specification file for all valid letter grades in Bilkent grading system. If the input matches exactlya letter grade followed by a new line, it should print "Letter Grade", otherwise, it should print "Unknown".
Answer:

```
%option main
%%
A[+--]?\n  printf("Letter Grade\n");
B[+--]?\n  printf("Letter Grade\n");
C[+--]?\n  printf("Letter Grade\n");
D[I+]?\n   printf("Letter Grade\n");
F[X|Z]?\n  printf("Letter Grade\n");
[WSUI]\n   printf("Letter Grade\n");
.*\n       printf("Unknown\n");
```

4. **Date:** Feb. 28, 2022
Question: Given the following yacc specification file,
   a) What is the language accepted by the grammar?
   b) Is the grammar ambiguous or not?
      If your answer is "yes", give an example string with two or more parse trees.
   c) Does the grammar contains conflict?
      If your answer is "yes", what is the type of the conflict?
      What token causes the conflict?

```
%token A B
%%
start: A | f A | g;
g: B A;
f: B ;
```

Answer:

   a) L = {A, BA}
   b) Ambiguous. The sentence BA has two parse trees.

```
     start              start
        / \                 |
       f   A                g
       |                   / \
       B                  B    A
```

   c) This grammar has shift/reduce conflict on A.

5. **Date:** Mar. 17, 2022

Question: What is the output of the following Perl program?

```
sub A {
    $a = 1;
    my $b = 2;
    local $c = 3;
    print "In A: $a : $b : $c\n";
    B();
}

sub B {
    $a = 4;
    print "In B: $a : $b : $c\n";
    $b = 5;
}

A();
print "After A: $a : $b : $c\n";
```

Answer:

```
In A: 1 : 2 : 3
In B: 4 :  : 3
After A: 4 : 5 :
```

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6. **Date:** Mar. 17, 2022

Question: What are the results of the following expressions in Python?

```
>>> [ i**3 for i in range(3,10,2) ]
>>> False or 0 or 2 or 'two'
>>> 7 and ''
>>> x = 7
>>> --x
>>> "one" and "True" and 0
>>> 17 and 0 and "abc"
>>> a,b = 5,10
>>> a,b = b+2,a+2
>>> a
```

Answer:

```
>>> [ i**3 for i in range(3,10,2) ]
[27, 125, 343, 729]
>>> False or 0 or 2 or 'two'
2
>>> 7 and ''
''
>>> x = 7
>>> --x
7
>>> "one" and "True" and 0
0
>>> 17 and 0 or "abc"
"abc"
>>> a,b = 5,10
>>> a,b = b+2,a+2
>>> a
12
>>>
```

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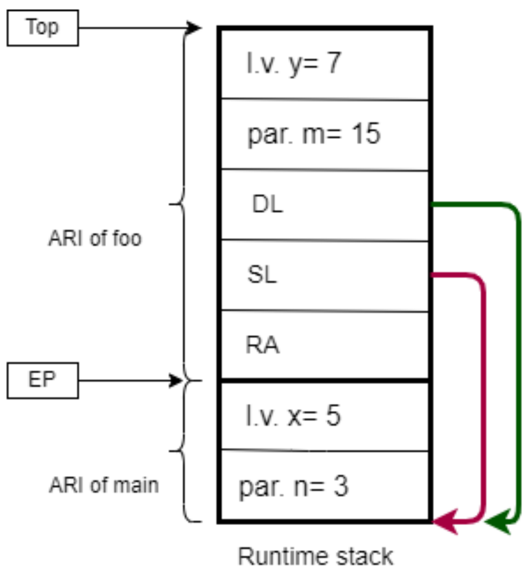
7. **Date:** Apr. 21, 2022

Question: Given the following program written in javascript language, draw the contents of the run-time stack just before the console.log function is called, marked as point 1.
What is written to console logs?

```
<script>
function main(n) {
  var x = 5;
  function foo (m) {
     var y = 7;
     // point 1
     console.log("m="+m+" n="+n+" x="+x+" y="+y);
  } // foo
  foo(x+10);
}
</script>
<button type="button" onclick="main(3)">
call main(3) </button>
```

Answer:



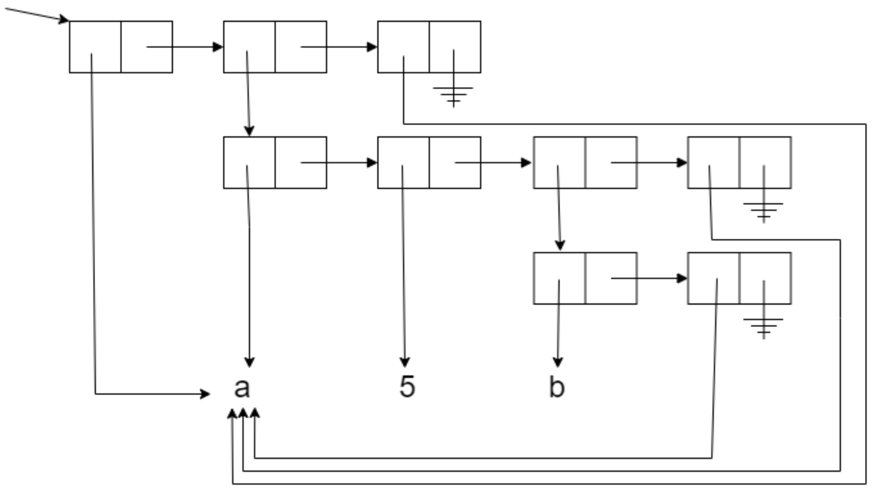
Output: `m=15 n=3 x=5 y=7`

8. **Date:** Apr. 25, 2022
Question:

a) Draw the internal representation of the list (a (a 5 (b a) a) a).

b) write a function, called `foo`, using the lambda notation, that takes two arguments, a and b, returns a * 3 + b.
Answer:

a)



b) `(define foo (lambda (a b) (+ (* a 3) b)))`

9. **Date:** Apr. 28, 2022
Question: Assume the following functions are evaluated.

```
> (define r 5)
> (define x '(a b r))
> (define y '(r 2))
```

What are the values of the following function calls?

```
> (cons 'x y)
> (list x y r)
> (append x '(a b))
> (let ((a 7) (b 9))
        (* a (+ b r)))
> (eq? r (+ 2 5))
> (equal? x '(a b r))
> (null? (cdddr x))
```

Answer:

```
> (cons 'x y)
(x r 2)
> (list x y r)
((a b r) (r 2) 5)
> (append x '(a b))
(a b r a b)
> (let ((a 7) (b 9))
        (* a (+ b r)))
98
> (eq? r (+ 2 5))
#f
> (equal? x '(a b r))
#t
> (null? (cdddr x))
#t
```

10. **Date:** May. 5, 2022
Question: Given the defifinition of the `length` function that takes a list of atoms as

```
(define (length lst)
  (cond ((null? lst) 0)
        (#t (+ 1 (length (cdr lst))))))
```

a) Is it tail recursive?
b) If not, reimplement it as tail recursive.

Answer:
a) It is not tail recursive, as the result of the recursive call is used as an argument to the + function.
b) The tail recursive version:

```
(define (length lst)
  (length-helper lst 0))

(define (length-helper lst curr-length)
  (cond ((null? lst) curr-length)
        (#t (length-helper (cdr lst) (+ 1 curr-length)))))
```

11. **Date:** May. 9, 2022
Question:
a) Define, in Prolog, a list of courses that you are taking this semester.
b) Given the definition of `member` as

```
member(Element, [Element | _]).
member(Element, [_ | List]) :-
       member(Element, List).
```

Write a query to check if cs315 is in the lest.
c) What would be the result of this query?

Answer:
a) `courses([cs299, cs315, cs319, eng401, math240, econ107]).`
b) `courses(C), member(cs315, C).`
c) `C = [cs299, cs315, cs319, eng401, math240, econ107].`