CMPSC 461 Spring 2020
Homework 1 Solution. Gang Tan. Please do not upload the document to an online site such as coursehero.com.

1. (a)

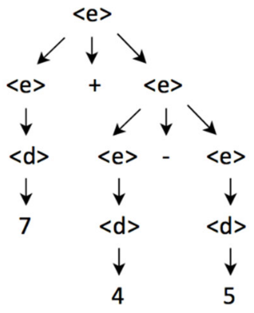
<e> **->** <e> + <e> **->** <d> + <e> **->** 7 + <e> **->** 7 + <e> - <e> **->** 7 + <d> - <e> **->**
7 + 4 - <e> **->** 7 + 4 - <d> **->** 7 + 4 - 5

1. (b)

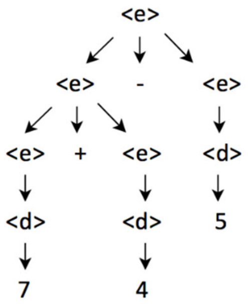
<e> **->** <e> - <e> **->** <e> - <d> **->** <e> - 5 **->** <e> + <e> - 5 **->** <e> + <d> - 5 **->**
<e> + 4 - 5 **->** <d> + 4 - 5 **->** 7 + 4 - 5

1. (c)

For (a):



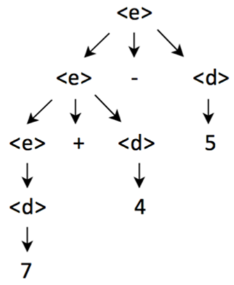
For (b):



1. (d)

<e> -> <d> | <e>+<d> | <e>-<d>
<d> -> 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9

The parse tree for “7 + 4 – 5” based on the new grammar:

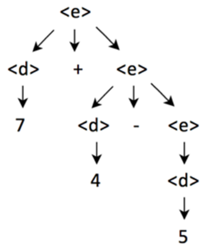


There are two choices to begin parsing 7+4-5:
(1) <e> -> <e>+<d> or (2) <e> -> <e>-<d>
For option (1), it is impossible to get the expression 7+4-5 from <e> -> <e>+<d> -> <e>+5.
For option (2), it is shown above. Hence, (2) is the only choice.

1. (e)

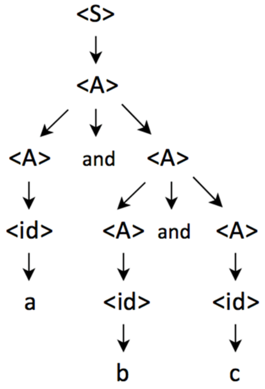
<e> -> <d> | <d>+<e> | <d>-<e>
<d> -> 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9

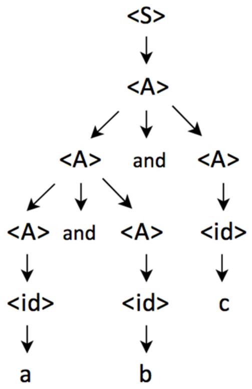
The parse tree for “7 + 4 – 5” based on the new grammar:



2. Example input: a and b and c

Corresponding parse tree 1: parse tree 2:





An equivalent unambiguous grammar:

<S> -> <A>
<A> -> <A> and <id> | <id>
<id> -> a | b | c

3. <S> -> a b b | a <S> b b

4.

<assign> -> <id> = <expr>
<id> -> x | y | z
<expr> -> <expr> + <term> | <term>
<term> -> <expon> ** <term> | <expon>
<expon> -> <expon> * <factor> | <factor>
<factor> -> (<expr>) | <id>

5.

<email> -> <account> @ <subDomains> . <topDomain>
<account> -> <letter> | <account><letter> | <account><digit>
<subDomains> -> <letterDigitSeq> | <letterDigitSeq> . <subDomains>
<letterDigitSeq> -> <letter> | <digit>
| <letter><letterDigitSeq>
| <digit><letterDigitSeq>
<topDomain> -> edu | org | com
<letter> -> a | b | c | … | z | A | B | C | … | Z
<digit> -> 0 | 1 | 2 | … | 9

6. BNF grammar:

```
<s-exp> -> <atomic-sym> | ( <s-exp>. <s-exp>) | ( ) | ( <s-exp-list> )
<s-exp-list> -> <s-exp> | <s-exp><s-exp-list>
<atomic-sym> -> <letter> | <atomic-sym><letter> | <atomic-sym><number>
<letter> -> a | b| … | z
<number> -> 0 | 1 | … | 9
```