# BNF Grammar Writing Exercise #1: QN (Quaternary Numbers)

Consider language QN to be the set of all unsigned quaternary numbers (numbers composed of the symbols 0, 1, 2 and 3) with no leading zeros (that is, no zeros at the start of the number, except for the number 0). Examples:

1. 0
2. 1001
3. 123000
4. 1020302010

## Your tasks ...

1. Write a BNF grammar for this language.
2. Draw a parse tree for the following sentence: 0
3. Draw a parse tree for the following sentence: 30201

## The BNF Grammar

```
<qn>   ::= 0 | <nzqd> <qds>
<nzqd> ::= 1 | 2 | 3
<qds>  ::= <empty> | <qd> <qds>
<qd>   ::= 0 | 1 | 2 | 3
```

## First parse tree

<qn>

|
↓

0

```
                          <qn>

        <nzqd>                     <qds>

          3         <qd>                  <qds>

                     0          <qd>              <qds>

                                 2        <qd>            <qds>

                                           0        <qd>           <qds>

                                                     1          <empty>
```