Theory of automata and Formal languages

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Practice 4
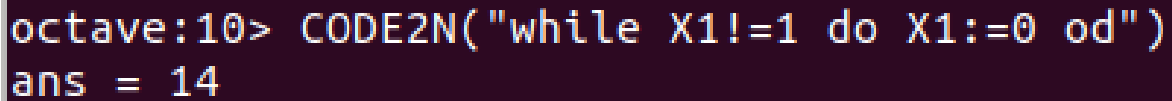
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Problem 1

Exercise 1 asks us to find a while program that diverges with the smallest possible codification. This is my contribution:

```
Diverge=(0,s)
s:
    while X1 ≠ 1 do
        X1 := 0;
    od
```

This program has the following codification:


```
octave:10> CODE2N("while X1!=1 do X1:=0 od")
ans = 14
```

Problem 2

Problem 2 asks us to code in octave a program which prints all vectors belonging to $\mathbb{N}^*$. As there are infinite vectors I tried doing a program with an infinite loop that would print in screen all the vectors one by one, this program would of course be neverending. However I don't think octave allows this as when I tried no output was shown on-screen until I interrupted the program. So instead I created a program that outputs the first n vectors.

```
for i=0:n-1
        disp([num2str(i+1), ': (' num2str(godeldecoding(i)) ')']);
        i=i+1;
        end
end
```

Here is an example of it's execution:

```
octave:20> printvector(20)
1: ()
2: (0)
3: (0   0)
4: (1)
5: (0   0   0)
6: (1   0)
7: (2)
8: (0   0   0   0)
9: (1   0   0)
10: (0   1)
11: (3)
12: (0   0   0   0   0)
13: (1   0   0   0)
14: (0   0   1)
15: (2   0)
16: (4)
17: (0   0   0   0   0   0)
18: (1   0   0   0   0)
19: (0   0   0   1)
20: (0   1   0)
```

Problem 3

Problem 3 asks us to do the same as problem 2 but in this case the output should be all possible while programs instead of vectors. Therefore:

```
for i=0:n-1
        disp([num2str(i+1), ': (' num2str(N2WHILE(i)) ')']);
        i=i+1;
        end
end
```

Here is an example of it's execution:

```
octave:21> printwhile(20)
1:  ((0, X1:=0))
2:  ((1, X1:=0))
3:  ((0, X1:=0; X1:=0))
4:  ((2, X1:=0))
5:  ((1, X1:=0; X1:=0))
6:  ((0, X1:=X1))
7:  ((3, X1:=0))
8:  ((2, X1:=0; X1:=0))
9:  ((1, X1:=X1))
10: ((0, X1:=0; X1:=0; X1:=0))
11: ((4, X1:=0))
12: ((3, X1:=0; X1:=0))
13: ((2, X1:=X1))
14: ((1, X1:=0; X1:=0; X1:=0))
15: ((0, X1:=X1; X1:=0))
16: ((5, X1:=0))
17: ((4, X1:=0; X1:=0))
18: ((3, X1:=X1))
19: ((2, X1:=0; X1:=0; X1:=0))
20: ((1, X1:=X1; X1:=0))
```