Last lecture's unresolved problem:

May 26, 2018

Question:

Consider the following grammar with the productions

```
S → aBCDe
B → ε | b | CD
C → ε | c | DB
D → ε | BCS
```

Construct an equivalent grammar which has no ε-productions. You should describe the process by which you obtain the new grammar.

Solution:

Eliminate D → ε using our ε elimination procedure:

```
S → aBCDe | aBCe
B → ε | b | CD | C
C → ε | c | DB | B
D → BCS
```

Now eliminate B → C and C → B (which in fact means they correspond to the same variable):

```
S → aBCDe | aBCe
B → ε | b | CD | c | DB
C → ε | c | DB | b | CD
D → BCS
```

Now, we see that in the above grammar B and C generate exactly the same right-hand side. Thus, they are the *same* variable (generating the same sequence of terminals). Then replace both B and C with the new variable X.

```
S → aXXDe | aXXe
X → ε | b | XD | c | DX
D → XXS
```

Now eliminate X → ε:

```
S → aXXDe | aXXe | aXDe | aDe | aXe | ae
X → b | XD | c | DX | D
D → XXS | XS | S
```

We are done.