EE341 Fall 2019 HW 2
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github.com/LewisCollum/microelectronics

Problem 4.35

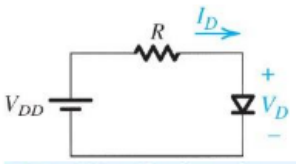

Fig. 10

4.35 Use the iterative-analysis procedure to determine the diode current and voltage in the circuit of Fig. 4.10 for $V_{DD} = 1$ V, $R = 1$ kΩ, and a diode having $I_S = 10^{-15}$ A.

Given:

```
import numpy
import pint
unit = pint.UnitRegistry()

R = 1 * unit.kohm
v = {'DD': 1 * unit.V}
i = {'S': 10e-15 * unit.A, 'D': []}
```

Algebraically solve for I_D:

$$V_{DD} = I_D R + V_D$$
$$\text{So, } I_D = \frac{V_{DD} - V_D}{R} \text{ (by KVL).}$$
$$\text{And, } I_D = I_S \cdot e^{V_D/V_T} \text{ (by diode characteristics)}$$

Solve for V_D
From above,

$$\frac{V_{DD} - V_D}{R} = I_S \cdot e^{V_D/V_T}$$
$$a = 2$$

```
v['D'] = 0.7 * unit.V
v['T'] = 25 * unit.mV
i['D'].append(i['S']*numpy.exp(v['D']/v['T'])) #((v['DD'] - v['D'])/R).to('mA')
print("\\begin{center}", f"\(I_D = {i['D'][0]:.2~Lx}\)", "\\end{center}")
```

$$I_D = 0.014\,\text{A}$$

Iterative solution for V_D and I_D:
Assume $V_T = 25\text{mV}$ (Thermal voltage at room temperature).

$$V_1 - V_0 = V_T \ln \frac{I_1}{I_0}$$

```
.title dual rc ladder
R1 int in 5k
V1 in 0 dc 0 ac 1 PULSE (0 10 1u 1u 1u 1 1)
R2 out int 1k
C1 int 0 10u
C2 out 0 100n
.control
ac dec 10 1 100k
set gnuplot_terminal=png/quit
gnuplot $file v(out)
.endc
.end
```