Hodgkin-Huxley Model

$$C_m \frac{dV}{dt} = - g_{Na}\, m^3\, h\, (V - E_{Na}) - g_K\, n^4\, (V - E_K) - g_L\, (V - E_L) + I_{app}$$

$$\frac{dm}{dt} = \alpha_m(V)\,(1 - m) - \beta_m(V)\, m$$

$$\frac{dh}{dt} = \alpha_h(V)\,(1 - h) - \beta_h(V)\, h$$

$$\frac{dn}{dt} = \alpha_n(V)\,(1 - n) - \beta_n(V)\, n$$

Activation and inactivation gating functions:

$$\alpha_m(V) = \frac{0.1\,(V + 40)}{1 - \exp(-(V + 40)/10)}$$

$$\beta_m(V) = 4 \exp(-(V + 65)/18)$$

$$\alpha_h(V) = 0.07 \exp(-(V + 65)/20)$$

$$\beta_h(V) = \frac{1}{1 + \exp(-(V + 35)/10)}$$

$$\alpha_n(V) = \frac{0.01\,(V + 55)}{1 - \exp(-(V + 55)/10)}$$

$$\beta_n(V) = 0.125 \exp(-(V + 65)/80)$$

Parameter values:

$C_m = 1\ \mu F/cm^2$, $g_{Na} = 120$ mS/ cm^2, $g_K = 36$ mS/ cm^2, $g_L = 0.3$ mS/ cm^2,
$E_{Na} = 50$ mV, $E_K = -77$ mV, $E_L = -54.4$ mV

Units: Membrane voltage in mV, time in msec, current in μA/ cm^2.