Solution to Exercise 3: Hodgkin-Huxley model

(i) A function version of the code is found in `exercise_3_solution.py`

(ii) The result should look like what is shown in Figure 1. The rebound spike occurs since during the long hyperpolarization, the inactivation parameter h increases while n is reduced. When the negative input current is removed, m also increases, while h and n change only slowly, so that the product m^3h remains large for a while, and the hyperpolarizing potassium current remains small for a while. In this example the sodium current is in fact large enough to reach the threshold for spike generation.

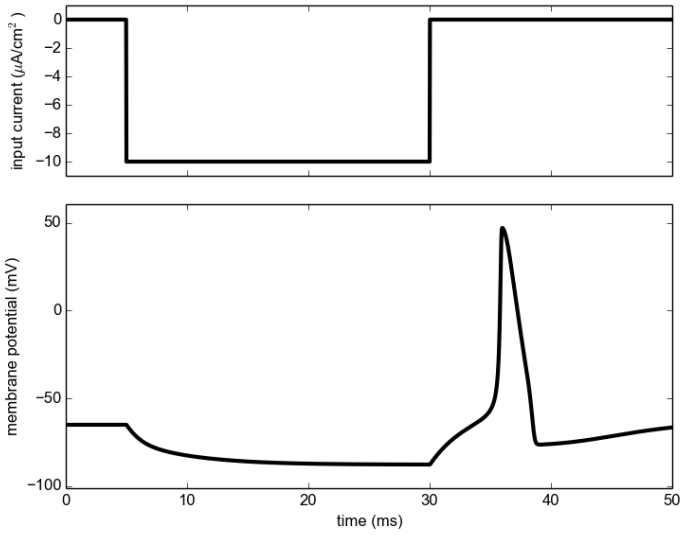

Figure 1: Result of (ii), showing a rebound spike.

(iii) By modifying the code to return the firing rate for a given input current, you can (given some patience) obtain a figure like the one in Figure 2. The threshold current is about 6.2 μA/cm^2.

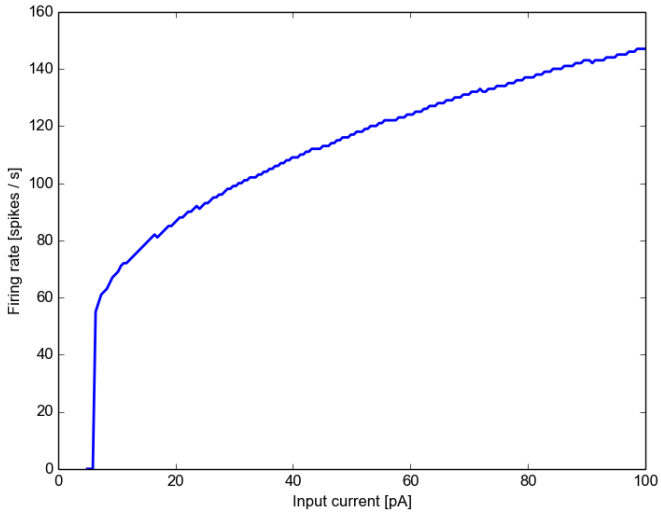

Figure 2: Result of (iii), showing the $f - I$ curve of the Hodgkin-Huxley model.