Models of Spiking Neurons and Differential Equations

July 8, 2022

Chapter 1

An Introduction to Differential Equations

Why are Differential Equations an important technique for computational modelling in psychology and neuroscience?

The Action Potential

- 10 minutes to brush up on what an action potential is

- Then be able to draw one and explain,

- What are the axes?

- What ion causes the upward deflection?

- What causes the repolarization?

- Who discovered the action potential?

- Who won the Nobel Prize for characterizing the ionic events of the action potential experimentally and building a mathematical model?

Did you draw this?

Notation Concise summaries of things that would take too long to write out in detail. Mathematical notation is just a technical emoji. You probably know the "math" they represent; you just don't know the abbreviation that is being used.

Why is the action potential relevant for a discussion of DE's in modelling?

$$\sum_{i=0}^{n} x_i^3$$

$$\sum_{\forall x \in \{1,2,3\}} x \ = \ 6$$

3

1.1   Multiple Ways to Say the Same Thing

$\frac{dx}{dt}$

$\dot{x}$

x'

$f'(x)$

Chapter 2

Derivatives are Slopes

- What is a slope?

- When in doubt return to definition.

- Deriving the definition of a derivative.

- What is the definition of a derivative?

Digression: Use your computer as a tool for exploration

Example:

```
> (begin
    (define xs (list 1 2 3 4 5))
    (define ys (list 2 4 6 8 10))
    (plot (lines (map vector xs ys))))
```

5