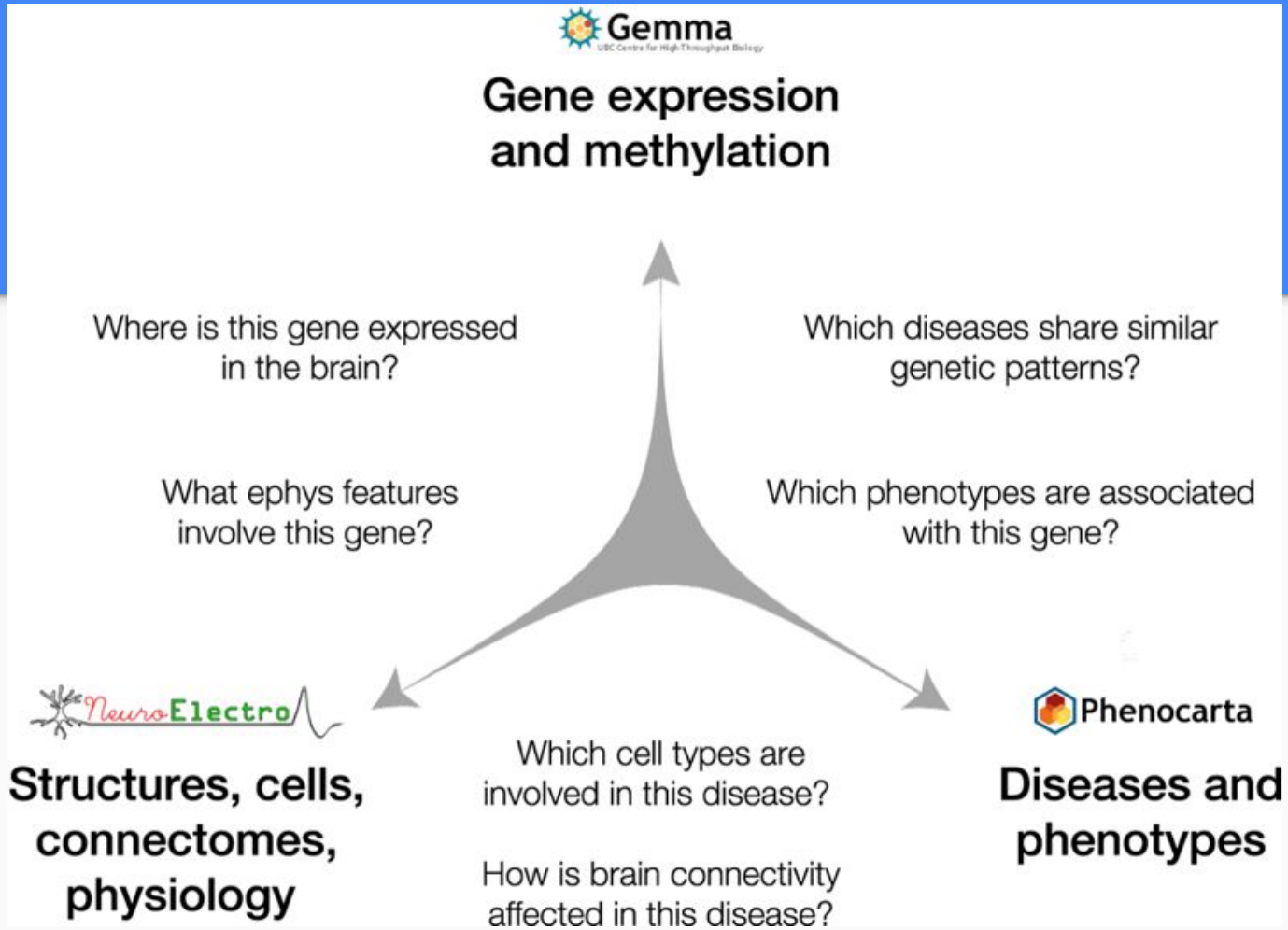
NeD’s Vis: NeuroElectro Data’s Visualization

Presented by: Dmitry, Emily and Mike

CPSC547


Gemma
UBC Centre for High-Throughput Biology
Gene expression and methylation
Where is this gene expressed in the brain?
What ephys features involve this gene?
Which diseases share similar genetic patterns?
Which phenotypes are associated with this gene?
NeuroElectro
Structures, cells, connectomes, physiology
Which cell types are involved in this disease?
How is brain connectivity affected in this disease?
Phenocarta
Diseases and phenotypes

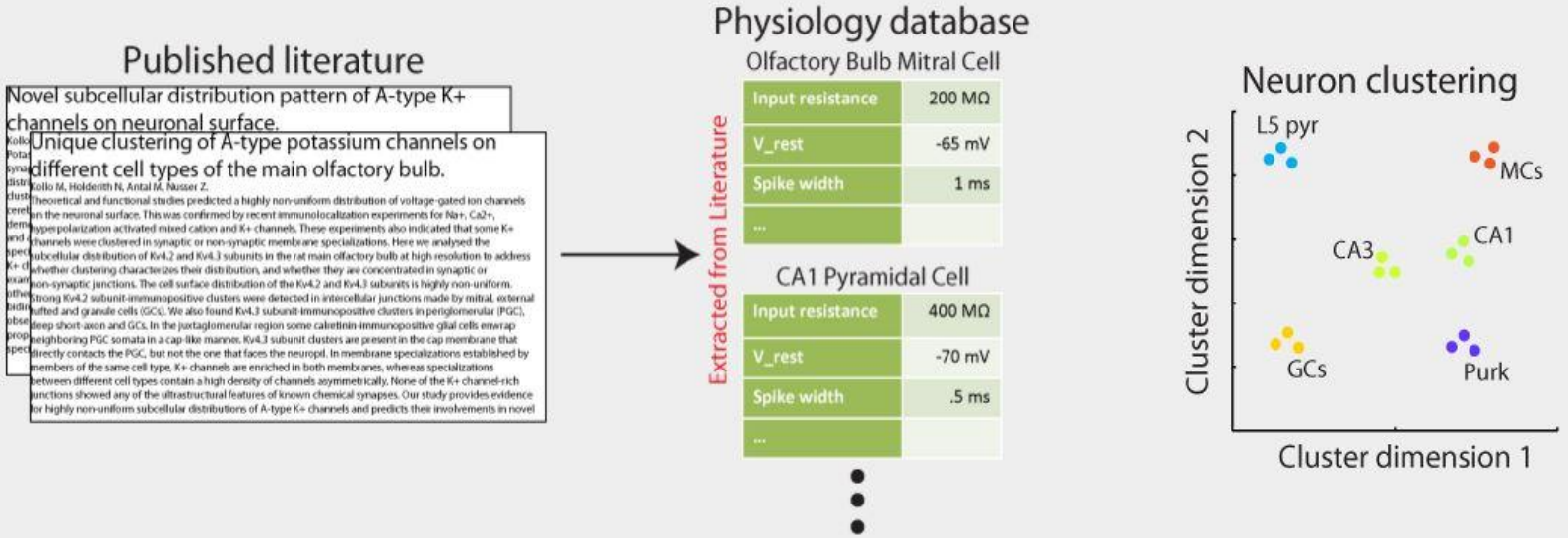
NeuroElectro

NeuroElectro Publications

About | Neuron Types | Electrophysiology Properties | Articles | FAQs | Data/API | Contribute

NeuroElectro: *organizing information on cellular neurophysiology.*

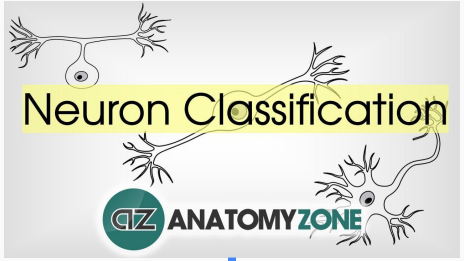
The goal of the NeuroElectro Project is to extract information about the electrophysiological properties (e.g. resting membrane potentials and membrane time constants) of diverse neuron types from the existing literature and place it into a centralized database.



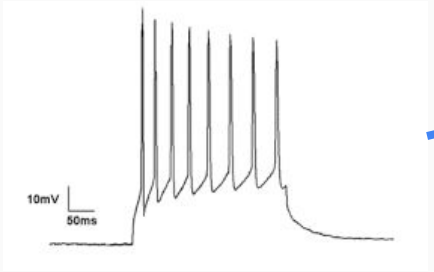
Our goal is to facilitate the discovery of neuron-to-neuron relationships and better understand the role of functional diversity across neuron types.

Data overview: What?

Brain Region

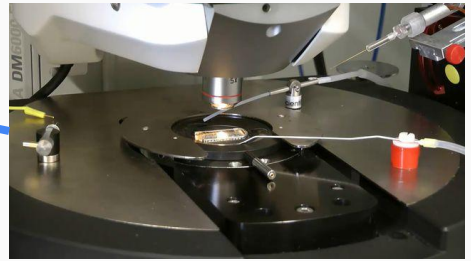


Electrophysiology



NeuroElectro

Metadata



Visualization project motivation

1) Ability to explore the NeuroElectro database

2) Promote integration of NeuroElectro into the scientific community

3) Previous visualization very rudimentary

Current State

Listing of articles with extracted electrophysiology properties

Article title links out to pubmed abstract

Show 10 entries

Search:

Article Title	Authors	Journal	Year	Electrophys values	Neuron types
Are all spinal segments equal: intrinsic membrane properties of superficial dorsal horn neurons in the developing and mature mouse spinal cord. (NeuroElectro data) (PubMed)	Tadros MA; Harris BM; Anderson WB; Brichta AM; Graham BA; Callister RJ	J. Physiol. (Lond.)	2012	90	1
Morphological and electrophysiological properties of pyramidal-like neurons in the stratum oriens of Cornu ammonis 1 and Cornu ammonis 2 area of Proechimys. (NeuroElectro data) (PubMed)	Scorza CA; Araujo BH; Leite LA; Torres LB; Otalora LF; Oliveira MS; Garrido-Sanabria ER; Cavalheiro EA	Neuroscience	2011	88	3
Target-specific output patterns are predicted by the distribution of regular-spiking and bursting pyramidal neurons in the subiculum. (NeuroElectro data) (PubMed)	Kim Y; Spruston N	Hippocampus	2012	88	2
Hyperexcitability of axotomized and neighboring unaxotomized sensory neurons is reduced days after perineural clonidine at the site of injury. (NeuroElectro data) (PubMed)	Liu B; Eisenach JC	J. Neurophysiol.	2005	78	1
The largest group of superficial neocortical GABAergic interneurons expresses ionotropic serotonin receptors. (NeuroElectro data) (PubMed)	Lee S; Hjerling-Leffler J; Zagha E; Fishell G; Rudy B	J. Neurosci.	2010	69	2
Lateral hypothalamic GAD65 neurons are spontaneously firing and distinct from orexin- and melanin-concentrating hormone neurons. (NeuroElectro data) (PubMed)	Karnani MM; Szabó G; Erdélyi F; Burdakov D	J. Physiol. (Lond.)	2013	56	1
5-HT(3A) receptor-bearing white matter interstitial GABAergic interneurons are functionally integrated into cortical and subcortical networks. (NeuroElectro data) (PubMed)	von Engelhardt J; Khrulev S; Eliava M; Wahlster S; Monyer H	J. Neurosci.	2011	55	1
Cellular neuroanatomy of rat presubiculum. (NeuroElectro data) (PubMed)	Simonnet J; Eugène E; Cohen I; Miles R; Fricker D	Eur. J. Neurosci.	2013	52	1
Inter- and intralaminar subcircuits of excitatory and inhibitory neurons in layer 6a of the rat barrel cortex. (NeuroElectro data) (PubMed)	Kumar P; Ohana O	J. Neurophysiol.	2008	50	2
Synaptic interactions between pyramidal cells and interneurone subtypes during seizure-like activity in the rat hippocampus. (NeuroElectro data) (PubMed)	Fujiwara-Tsukamoto Y; Isomura Y; Kaneda K; Takada M	J. Physiol. (Lond.)	2004	49	5

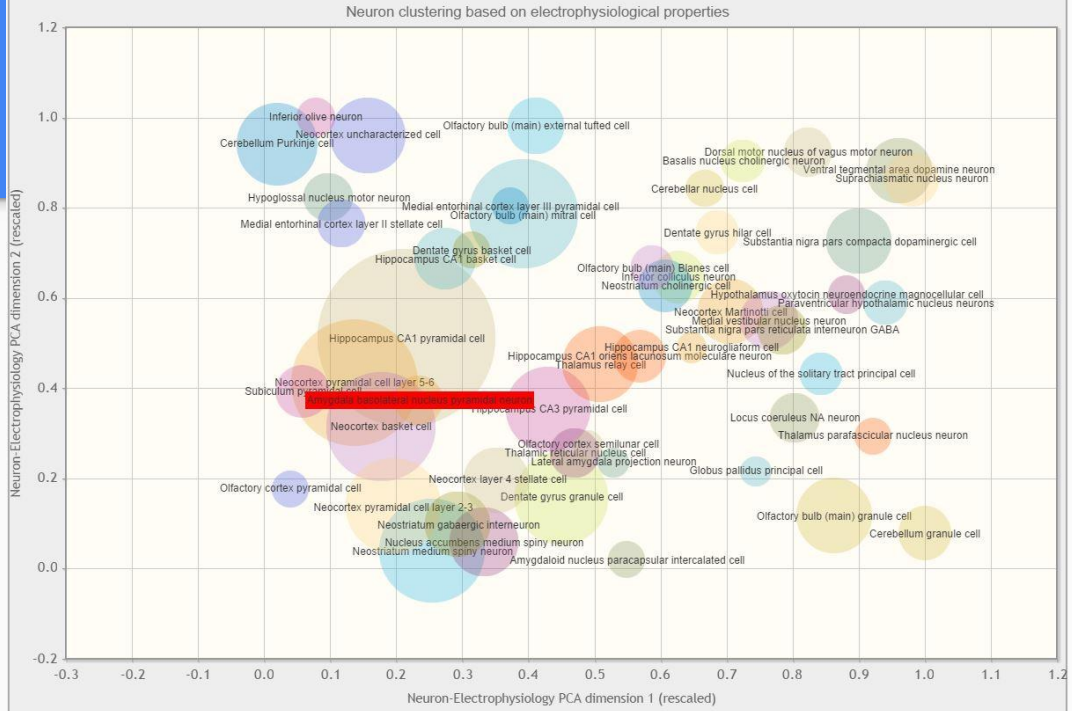
Clustering of neuron types based on similarities in electrophysiological values:

Description:

- Projection of NeuroElectro neuron types onto space defined by the first 2 electrophysiology principal components which collectively represent ~70% of variance. Neuron types are indicated by circles and circle size is proportional to number of corresponding articles indexed in NeuroElectro database.

Interactivity:

- Click on neuron types to go to corresponding neuron page.
- Zoom in on a section of plot by dragging cursor. Zoom out by double clicking on plot.



Show neuron names
Don't show neuron names

Display a specific neuron(s):

None selected
Amygdala basolateral nucle
Amygdaloid nucleus paraca
Basalis nucleus cholinergic
Cerebellar nucleus cell
Cerebellum granule cell

Listing of neuron types in the database

Electrophysiology values across neuron types obtained are obtained from semi-automated literature text-mining.
(neuron types are mostly from NeuroLex.org)

Show 10 entries

Search:

Neuron type	Number extracted electrophysiology values	Number articles
Other	1119	70
Hippocampus CA1 pyramidal cell	505	66
Dorsal root ganglion cell	353	23
Neocortex pyramidal cell layer 5-6	281	33
Neocortex basket cell	185	25
Neostriatum medium spiny neuron	163	23
Neocortex pyramidal cell layer 2-3	144	19
Neocortex uncharacterized cell	143	12
Dentate gyrus granule cell	107	18
Medial vestibular nucleus neuron	102	7

Showing 1 to 10 of 235 entries

Electrophysiological properties of *Amygdala basolateral nucleus pyramidal neurons* from literature:

Legend:

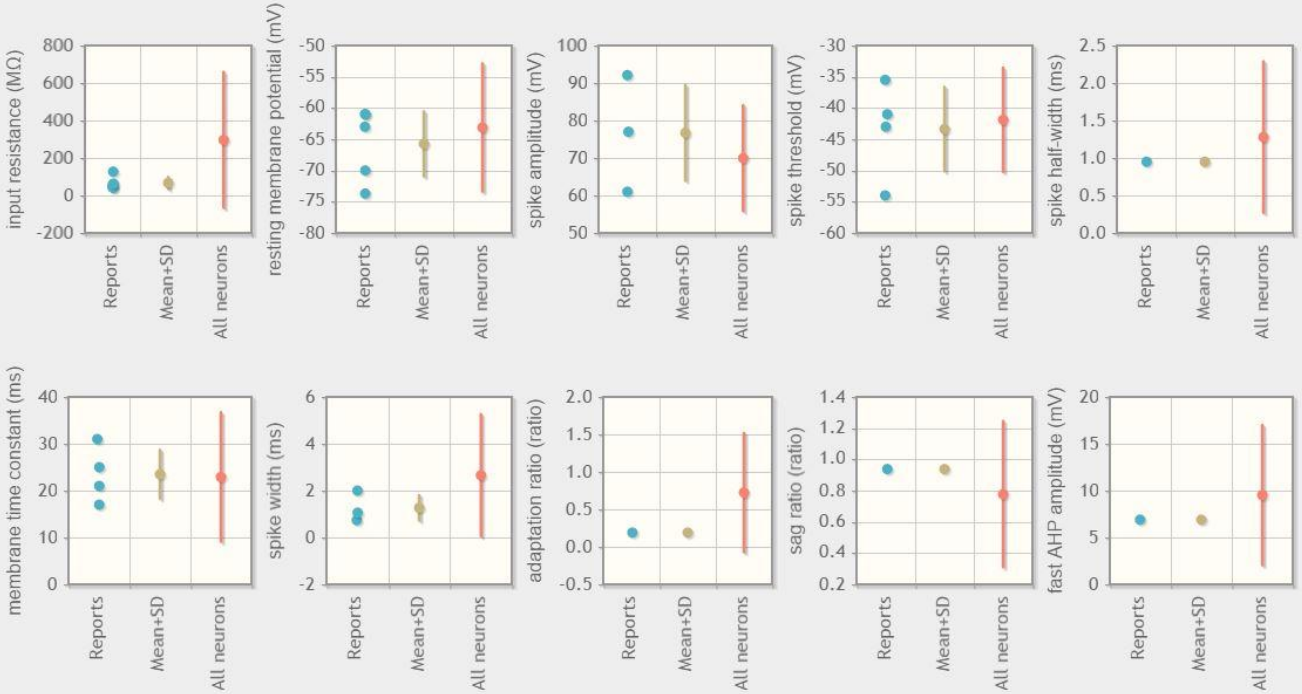
- Reports: Blue dots indicate human-curated values; Orange dots indicate non-human curated values
- Mean+SD: mean and standard deviation of human-curated neuron measurements
- All neurons: mean and standard deviation computed over all neurons in database

Interactivity:

- Mouse over neuron report data points and click to view corresponding publication
- Mouse over y- axis labels to view definition or click to view values across neuron types
- Zoom in on a section of plot by dragging cursor. Zoom out by double clicking on plot.
- Legend: Blue dots = text-mined values human curated; Orange dots = text-mined values not human curated

View data in table form

Report miscurated data



View data in table form

input resistance

Common definition: Input resistance measured at steady-state voltage response to current injection

Electrophysiological values of *input resistance* across neuron types from literature:

Standardization criteria:

- Values corrected for differences in units, but are otherwise unchanged. Refer to individual articles for specific definitions and calculation methodologies.

Legend:

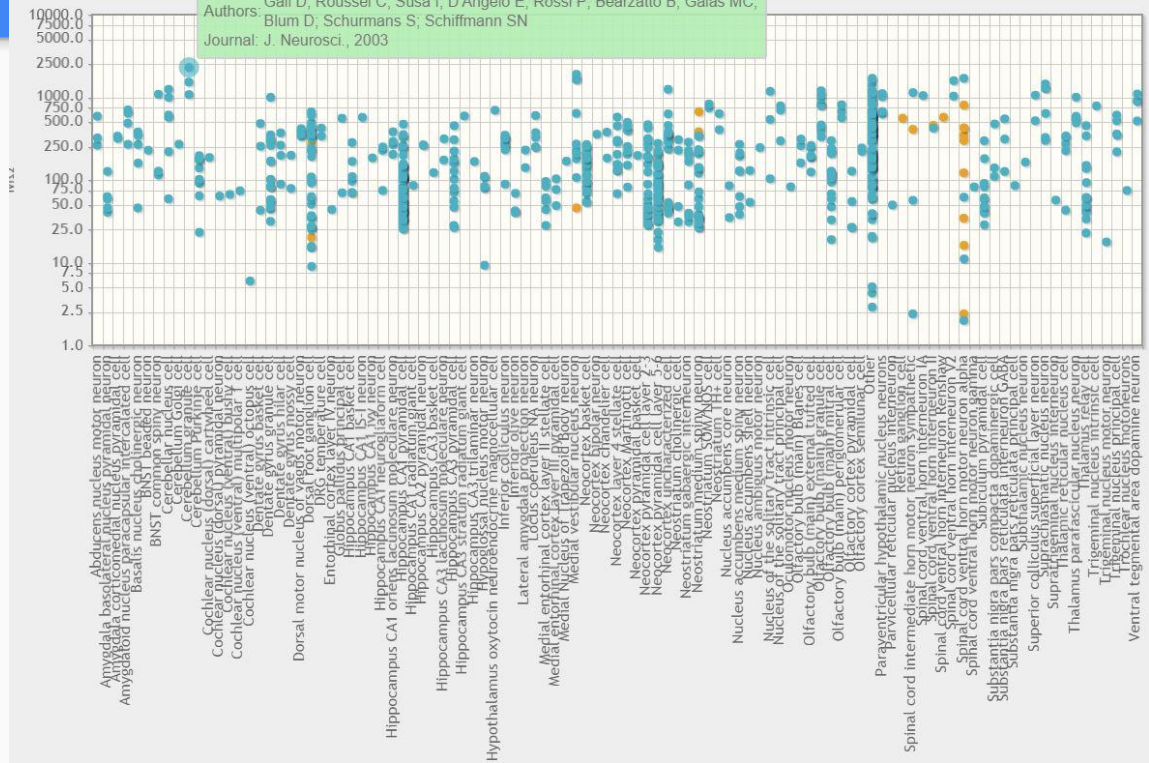
- Blue dots = text-mined values human curated; Orange dots = text-mined values not human curated

Interactivity:

- Mouse over neuron n
- Click on neuron nam
- Zoom in on a section

View data in table form

Report miscurated data



Requirements Gathering: Why?

1. What are the ephys characteristics of different neuron types?
2. How do different neuron types compare in terms of ephys properties?
3. How do experimental conditions relate to ephys measurements?
4. How much data exists to support specific discoveries?

Task Abstraction: Why?

1. *Explore* relationships between neuron types, ephys properties, and experimental conditions.
    a. *Browse* attributes available for analysis.
    b. *Identify distributions* of quantitative attribute values for a particular categorical attribute values
    c. *Compare distributions* of quantitative attribute values for different categorical attribute values
    d. *Identify correlations* between quantitative attributes
2. *Reduce* how many data points are included via filtering
3. *Identify* how many data points exist for different combinations of neuron types, ephys properties, and experimental conditions.
4. *Identify* how many data points support a specific analysis.
5. *Summarize* the data in the current analysis scope.
6. *Lookup* details for individual data points (items).

Demo Time: How

This will work!

Critique

- Filters in conjunction with null values -> misleading behavior
- Information overload on Overview page
  - Number of connections in hive plot
  - Inclusion of numbers on matrix
- Colour not backed by empirical data
- Tooltips and interactive features can get stuck, be slow or not function correctly
  - Technical debt has piled up, serious refactoring needed
- Usability/style issues:
  - Axis label format and length
  - Scale of slider bars
  - Highlight on click