

BE 526 – Neuromorphing: Building Brains in Silicon

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Towne 315, Tue and Thur – 3:00-4:20pm

Wk	Date	Topics	Reading & Assignments
1	Tue 1/11	Overview of VLSI and Neural Systems	<i>Weiss I: 86-90,454-61,474-77,528-33</i> Ana1: Electrodiffusion
	Thur 1/13	Ion-Channel: Electrodiffusion in Liquids	
2	Tue 1/18	PN-Junction: Electrodiffusion in Solids	<i>Mead: 11-33</i> <i>Mead: 319-22</i> Lab1: PN Junction
	Thur 1/20	MOS Transistor: Controlling Electrodiffusion	
3	Tue 1/25	MOS Transistor: Channel-Current Equation	<i>Mead: 33-41</i> <i>Weiss II: 406-16</i> Lab2: MOS Transistor
	Thur 1/27	Voltage-Gated Channel: Rate Kinetics	
4	Tue 2/1	Voltage-Gated Channel: Diode-Capacitor Dynamics	<i>Liu: 256-61</i> <i>Frey: IEE Proc-G,140:6,406-16,'93</i> Ana2: Rate Kinetics
	Thur 2/3	Ligand-Gated Channel: Log-Domain Filter	
5	Tue 2/8	Dendritic Integration: Excitation and Inhibition	<i>Nicholls:156-75</i> <i>Weiss II:187-206</i> Lab3: Synapse
	Thur 2/10	Spike Generation: Simplifying Hodgkin-Huxley	
6	Tue 2/15	Spike Generation: Frequency–Current Relationship	— — Lab4: Axon-Hillock
	Thur 2/17	Potassium Channels: Spike-Rate Adaptation	
7	Tue 2/22	Potassium Channels: Slew-Rate Adaptation	<i>Hynna: Neur. Net. 14:6-7,645-56,'01</i> <i>Nicholls: 340-46,366-72</i> Lab5: Spike Timing
	Thur 2/24	The Cochlea	
8	Tue 3/1	Cochlea: Basilar Membrane Model	<i>Mead: 279-301</i> <i>Watts: PhD Thesis,80-113,'93</i>
	Thur 3/3	Cochlea: Fluid Model	
9	Tue 3/8	Spring Break	
	Thur 3/10	Spring Break	
10	Tue 3/15	Cochlea: Traveling Waves	<i>Watts: PhD Thesis,31-45,'93</i> <i>Wen: EMBS 2013-16,'03</i> Sim1: Cochlea
	Thur 3/17	Cochlea: Amplification and Gain Control	
11	Tue 3/22	The Retina	<i>Nicholls: 380-404</i> <i>Boahen: PhD Thesis,122-48,'97</i> Lab6: Diffusers
	Thur 3/24	Cell-Syncytium Model	
12	Tue 3/29	Morphing the Outer Retina	<i>Boahen: PhD Thesis,56-64,'97</i> <i>Boahen: PhD Thesis,64-85,'97</i> Sim2: Outer Retina
	Thur 3/31	Spatiotemporal Filtering and Luminance Adaptation	
13	Tue 4/5	Spiking Neuron Arrays: Address-Events	<i>Boahen: TCAS II,47:5 416-34,'00</i> <i>Tuinhout: JSSC,39:1,157-68</i> Lab7: Neuron Array
	Thur 4/7	Variability in Neuron Arrays	
14	Tue 4/12	Synchrony in Inhibitory Recurrent Networks	<i>Arthur: IJCNN,1699-704,'04</i> <i>Merolla: NIPS-16,995-1002,'04</i> Lab8: Synchrony
	Thur 4/14	Multistability in Excitatory Recurrent Networks	
15	Tue 4/19	Anatomical Plasticity via Address Translation	<i>Taba: NIPS-15,1163-70,'03</i> Lab9: Neurotropin
	Thur 4/21	Learning feed-forward mappings	

Mead: Analog VLSI and Neural Systems, Carver Mead, Addison-Wesley, 1989
Nicholls: From Neuron to Brain, Kuffler, Nicholls et al., Sinauer, 4th Edition, 2001
Weiss I,II: Cellular Biophysics I & II, Thomas Weiss, MIT Press, 1996
Liu: Analog VLSI: Circuits and Principles, Liu, Kramer, et al., MIT Press 2002
Remaining citations are published papers or PhD dissertations (as stated).

Revised 1/10/05