Teaching Guide				
Identifying Data				2018/19
Subject (*)	Computational neuroscience		Code	610490016
Study programme	Mestrado Universitario en Neurociencia (Plan 2011)			
Descriptors				
Cycle	Period	Year	Type	Credits
Official Master's Degree	2nd four-month period	First	Optional	3
Language	Spanish			
Teaching method	Face-to-face			
Prerequisites				
Department	Computación			
Coordinador	Porto Pazos, Ana Belen	E-mail	ana.portop@udc.es	
Lecturers	Porto Pazos, Ana Belen	E-mail	ana.portop@udc.es	
Web	http://www.usc.es/gl/titulacions/masters_oficiais/neurosci//			
General description	Coñecer as formas de reproducir nas computadoras as estructuras e funcionamento dos circuitos do cerebro. Para a investigación do sistema nervioso e para diseñar sistemas intelixentes baseados no funcionamento cerebral.			

Study programme competences / results	
Code	Study programme competences / results
A4	Explicar o funcionamento das neuronas dende o nivel molecular ao celular.
A5	Describir a relación entre as canles iónicas e o comportamento neuronal.
B4	Saiban ler e obter información relevante de publicacións científicas.
B5	Saiban aplicar os coñecementos adquiridos e a súa capacidade de resolución de problemas en ámbitos novos ou pouco coñecidos dentro de contextos máis amplos (ou multidisciplinares) relacionados coa neurociencia.
B7	Teñan competencia na presentación oral e escrita de resultados científicos a públicos especializados e non especializados dun modo claro e sen ambigüidades.
B8	Saiban traballar en grupos de carácter multidisciplinar
B9	Posúan capacidade de reflexión sobre as responsabilidades éticas e sociais da aplicación da investigación.
C3	Utilizar as ferramentas básicas das tecnoloxías da información e as comunicacións (TIC) necesarias para o exercicio da súa profesión e para a aprendizaxe ao longo da súa vida.
C4	Desenvolverse para o exercicio dunha cidadanía aberta, culta, crítica, comprometida, democrática e solidaria, capaz de analizar a realidade, diagnosticar problemas, formular e implantar solucións baseadas no coñecemento e orientadas ao ben común.
C6	Valorar criticamente o coñecemento, a tecnoloxía e a información dispoñible para resolver os problemas cos que deben enfrontarse.
C7	Asumir como profesional e cidadán a importancia da aprendizaxe ao longo da vida.
C8	Valorar a importancia que ten a investigación, a innovación e o desenvolvemento tecnolóxico no avance socioeconómico e cultural da sociedade.

Learning outcomes			
Learning outcomes	Study programme competences / results		
- Capacidade de abstracción e formalización do fenómeno ou sistema real a modelizar.	AR5	BR4 BR5 BR8	CR3 CR6 CR7 CR8
- Ser capaz de relacionarse e traballar en equipo con científicos de diferentes ámbitos.		BR8 BR9	CR4 CR6 CR8
- Capacidade para comprender e expoñer os resultados das modelizacións e establecer relacións co coñecemento existente ata o momento do sistema biolóxico.	AR4 AR5	BR4 BR7	CR6

Contents	
Topic	Sub-topic
1. Introduction to Computational Neuroscience 2. Models at the molecular level 3. Membrane-level models: from Boltzmann to Hodgkin-Huxley 4. Models at the neuron level: cable theory and model Compartmental of Rall 5. Synapse level models 6. Microcircuit models 7. Macrocircuit models 8. Coding in sensory receptors 9. Types of neural activity 10. Transmission of information in the brain 11. Spatial and temporal coding 12. Encoding by populations of neurons	Espoñerase e comentaranse cos alumnos as diapositivas relacionadas con cada tema.
PRACTICUM	Understand how modeling is done. Practices with neurosimulators. Report on the Application of the modeling process Exposure after analysis and criticism.

Planning				
Methodologies / tests	Competencies / Results	Teaching hours (in-person & virtual)	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A4 A5 B4 C3 C8	20	25	45
Seminar	B5 B7 B8 B9 C4 C6 C7	9	18	27
Personalized attention		3	0	3
(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.				

Methodologies	
Methodologies	Description
Guest lecture / keynote speech	Conduct a master class and use of multimedia teaching materials, taking advantage of the advantages of new technologies and encouraging the participation of students in each subject. This activity will be supported by the rest of the methodologies.
Seminar	It consists of the representation of a phenomenon of electrophysiological nature, which allows a more sinxel analysis, which if carried out on the orixinal or in reality. He puts his money in the presence of hypothetical conditions in the limes, and his behavior is tested against concrete situations. It is, therefore, based on the configuration of situations similar to those that occur in a real context, for the purpose of using them as learning experiences.

Personalized attention	
Methodologies	Description
Seminar	Resolution of doubts that arise both in the master classes and in the realization of two jobs. Attendanse students through tutorials in person, as well as through virtual tutorials through e-mail.

Assessment			
Methodologies	Competencies / Results	Description	Qualification

Guest lecture / keynote speech	A4 A5 B4 C3 C8	Attendance and participation in classes of practices and lectures will account for 40% of the final grade.	40
Seminar	B5 B7 B8 B9 C4 C6 C7	The quality of the works, as well as their exposure, is 60% of the final mark.	60

Assessment comments
Casos excepcionais: no caso de que o estudante, por razóns debidamente xustificadas, non puidera realizar todas as probas de avaliación continua, o alumno contactará coa profesora para establecer datas de defensa dos traballos.

Sources of information	
Basic	Bartol, T. : ?MCell Software?: http://www.mcell.cnl.salk.edu/Bower J. M. y Koch C. ?Experimentalists and modelers: can we all just get along??. Trends in Neuroscience. 15(11): 458-461.1992.Bower, J.M., and Beeman: ?The Book of GENESIS: Exploring Realistic Neural Models with the GEneral NEural SImulation System?. Second edition. New York: Springer-Verlag. 1998Carnevale, N.T. & Hines, M.L.: "The NEURON simulation enviroment". Neural Computation 9:1179-1209. 1997. http://neuron.duke.edu/environ/COUCH, L.W. Sistemas de comunicación digitales y analógicos. Prentice Hall, 1998.DIMITRIEV, V.I. Teoría de información aplicada. Ed. MIR, Moscú, 1991.DRURY, G., MARKARIAN, G y PICKAVANCE, K. Coding and modulation for digital television. Kluwer, 2001.Hines, M.: ?NEURON?A program for simulation of nerve equations?. In: Neural Systems: Analysis and Modeling, edited by F. Eeckman. Norwell, MA: Kluwer, p. 127-136. 1993.Hines, M.: ?The NEURON simulation program?. In: Neural Network Simulation Environments, edited by J. Skrzypek. Norwell, MA: Kluwer, p. 147-163. 1994.Koch, C. Biophysics of Computation: Information Processing in Single Neurons. Oxford University Press, 1999.LeRay, D., Fernández, D., Porto, A. & Buño, W. ?Metaplastic regulation of synaptic efficacy between convergent Schaffer collaterals in rat hippocampal CA1 neurons.? Soc. Neurosci. Abstr., Vol. 29. 2003.LeRay, D., Fernández, D., Porto, A., Fuenzalida, M. & Buño, W. ?Heterosynaptic Metaplastic Regulation of Synaptic Efficacy in CA1 Pyramidal Neurons of Rat Hippocampus?. Hippocampus. 2004.MacKay, DJC. Information Theory, Inference, and Learning Algorithms. Cambridge University Press, 2003.NEURON Programming Tutorial. http://www.cs.unc.edu/-martin/PROAKIS, J.G. Digital communications, McGraw Hill, 1995Sah P., Bekkers J.M.: ?Apical dendritic location of slow afterhyperpolarization current in hippocampal pyramidal neurons: implications for the integration of long-term potentiation?. J. Neuroscience. 16:4537-4542. 1996.F Rieke, D Warland, R de Ruyter van Steveninck & W Bialek. Spikes: Exploring the Neural Code. MIT Press, Cambridge, 1997.Schwartz, Eric L. ?Computational Neuroscience?. MIT Press. 1990.Storm J. F.: ?Potassium currents in hippocampal pyramidal cells?. Prog. Brain Res. 83, 161-187. 1990.STREMLER, F.G. Introducción a los sistemas de comunicación. Addison-Wesley, 1993.UEIL: An User Extendable Interactive Language. http://www.neuron.yale.edu/neuron/refman/hoc.htmlUSRM. NEURON User Manual. http://neuron.duke.edu/userman/Wessel R., Kristan Jr. W.B., Kleinfeld D.: ?Dendritic Ca2+-acticvated K+ conductances regulate electrical signal propagation in an invertebrate neuron?. J. Neuroscience. 19:8319-8326. 1999.Wiener, N.: ?Cibernética?. Tusqets editores. 1985.WILSON, S.G. Digital modulation and coding, Prentice Hall, 1996.
Complementary	

Recommendations
Subjects that it is recommended to have taken before
Subjects that are recommended to be taken simultaneously
Sistemas adaptativos complexos/610411231 Bioinformática aplicada á neurociencia/610411204
Subjects that continue the syllabus
Fisioloxía do sistema nervioso/610411105

Other comments

(*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.