



| 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 estruturas e funcionamento dos circuitos do cerebro. Para a investigación do sistema nervioso e para diseñar sistemas intelixentes baseados no funcionamento cerebral. | | | |

| Study programme competences | |
|-----------------------------|--|
| Code | Study programme competences |
| 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 | |
| - 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 | |
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| 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. Macro-circuit 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 | Espoñeráse e comentaránse 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 | Ordinary class hours | 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 | 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

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| Basic | <p>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/enviroment/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.UJAIL: 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⁺-activated K⁺ conductances regulate electrical signal propagation in an invertebrate neuron?. J. Neuroscience. 19:8319-8326. 1999.Wiener, N.: ?Cibernética?. Tusquets editores. 1985.WILSON, S.G. Digital modulation and coding, Prentice Hall, 1996.</p> |
| 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.