

# BIOINFORMATIKA – INDIVIDUALNO RAZISKOVALNI PREDMETI

## UČNI NAČRT PREDMETA/COURSE SYLLABUS

|                                   |                            |
|-----------------------------------|----------------------------|
| <b>Predmet:</b>                   | Bioinformacijski algoritmi |
| <b>Course title:</b>              | Bioinformatics Algorithms  |
| <b>Članica nosilka/UL Member:</b> | UL FRI                     |

| Študijski programi in stopnja          | Študijska smer                  | Letnik | Semestri  |
|--|---------------------------------|--------|-----------|
| Bioznanosti, tretja stopnja, doktorski | Ni členitve (študijski program) |        | Celoletni |

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| <b>Univerzitetna koda predmeta/University course code:</b> | 0037263 |
| <b>Koda učne enote na članici/UL Member course code:</b>   | 3765    |

| Predavanja | Seminar | Vaje | Klinične vaje | Druge oblike študija | Samostojno delo | ECTS |
|------------|---------|------|---------------|----------------------|-----------------|------|
| 10         | 0       | 20   | 0             | 0                    | 95              | 5    |

**Nosilec predmeta/Lecturer:** Tomaž Curk

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| <b>Izvajalci predavanj:</b>                 |            |
| <b>Izvajalci seminarjev:</b>                | Tomaž Curk |
| <b>Izvajalci vaj:</b>                       |            |
| <b>Izvajalci kliničnih vaj:</b>             |            |
| <b>Izvajalci drugih oblik:</b>              |            |
| <b>Izvajalci praktičnega usposabljanja:</b> |            |

**Vrsta predmeta/Course type:** individualno raziskovalni/individual research course

|                          |                             |                         |
|--------------------------|-----------------------------|-------------------------|
| <b>Jeziki/Languages:</b> | <b>Predavanja/Lectures:</b> | Angleščina, Slovenščina |
|                          | <b>Vaje/Tutorial:</b>       | Angleščina, Slovenščina |

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| <b>Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:</b> | <b>Prerequisites:</b>  |
| Osnovna znanja programiranja, verjetnosti in statistike.                     | Basics of computer programming in any language, basic knowledge of probability and statistics. |

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| <b>Vsebina:</b>   | <b>Content (Syllabus outline):</b>  |
| <ul style="list-style-type: none"><li>- Algoritmi za analizo zaporedij, iskanje podzaporedij, iskanje motivov.</li><li>- Določanje zaporedja genomov, algoritmi na grafih.</li><li>- Primerjava zaporedij, dinamično programiranje.</li><li>- Algoritmi za filogenetsko analizo.</li><li>- Skriti markovski modeli, analiza strukture genoma.</li><li>- Analiza genskih izrazov, razvrščanje v skupine, klasifikacija, analiza obogatenosti genskih skupin.</li></ul> | <ul style="list-style-type: none"><li>- Sequence analysis, search for subsequences, motif search.</li><li>- Genome assembly, graph algorithms.</li><li>- Comparison of biological sequences, dynamic programming.</li><li>- Phylogeny algorithms.</li><li>- Hidden Markov Models and gene prediction.</li></ul> |

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| - Rekonstrukcija in analiza genskih mrež.<br>- Vizualizacija podatkov. | - Gene expression analysis, clustering and supervised data mining, enrichment analysis.<br>- Gene network reconstruction and analysis.<br>- Data vizualization. |
|--|---|

**Temeljna literatura in viri/Readings:**

- Durbin R, Eddy SR, Krogh A, Mitchison G (1998) Biological sequence analysis: probabilistic models of proteins and nucleic acids, Cambridge University Press.  
- Jones NC, Pevzner PA (2004) An introduction to bioinformatics algorithms, The MIT Press.  
- Pavel A. Pevzner, Phillip Compeau (2018) Bioinformatics Algorithms: An Active Learning Approach , Active Learning Publishers.  
Ostalo: revijalni članki s področja, tekoča periodika in druga učna gradiva.

**Cilji in kompetence:**

Študentje se bodo pri predmetu naučili implementirati vrsto algoritmov, ki jih lahko uporabimo na področju bioinformatike in systemske biologije. Znali bodo razbrati, na kater tip biološki vprašanj lahko odgovorimo z razvojem in uporabo računskih pristopov.

**Objectives and competences:**

Students completing the course should be able to implement a variety of bioinformatics and systems biology algorithms, and learn which type of biological questions can be answered by means of computational approaches.

**Predvideni študijski rezultati:**

Študentje se bodo seznanili z glavnimi razredi algoritmov, ki so uporabljajo na področju bioinformatike in lahko z njimi analiziramo zaporedja, grafe in podatke o meritvah iz molekularne biologije. Na praktičnih primerih analize velike množice podatkov bodo spoznali probleme pri razvoju teh algoritmov, ki so vezani na hitrost izvajanja in uporabo spomina. Izpopolnili bodo svoje predznanje programiranja in v praksi uporabili predznanja s področja verjetnosti in statistike.

**Intended learning outcomes:**

Students will become familiar with main classes of computational approaches and algorithms in bioinformatics. The algorithms that they will design in a class are those from sequence and graph analysis and analysis of data coming from experimental measurements in molecular biology. In practical cases of analysis of large data sets they will need to cope with problems of computational efficiency and limited data storage (computer memory). They will advance their knowledge of programming, and use their previously developed skills in probability and statistics in practical problems from systems biology.

**Metode poučevanja in učenja:**

Praktične vaje, domače naloge, seminar, konzultacije. Reševanje problemov na učnih spletnih straneh <http://rosalind.info> in <http://stepic.org>.

**Learning and teaching methods:**

Workshops, homeworks, consultations, seminar. Solving problems on learning portals such as <http://rosalind.info> and <http://stepic.org>.

**Načini ocenjevanja:**

Domače naloge  
seminar

**Delež/Weight**

20,00 %  
80,00 %

**Assessment:**

Homeworks  
seminar

**Reference nosilca/Lecturer's references:**

**Tomaž Curk:**

- GOMIŠČEK, Rok, CURK, Tomaž. Relation chaining in binary positive-only recommender systems. Expert systems with applications, ISSN 0957-4174. 2020, vol. 150, str. 1-8, doi: 10.1016/j.eswa.2020.113296. [COBISS.SI-ID 1538542531]

2. JAKOMIN, Martin, BOSNIĆ, Zoran, CURK, Tomaž. Simultaneous incremental matrix factorization for streaming recommender systems. *Expert systems with applications*, ISSN 0957-4174. [Print ed.], Dec. 2020, vol. 160, str. 1-10, doi: 10.1016/j.eswa.2020.113685. [COBISS.SI-ID 23113219]
3. VODOPIVEC, Maja, LAH, Ljerka, NARAT, Mojca, CURK, Tomaž. Metabolomic profiling of CHO fed-batch growth phases at 10, 100, and 1,000 L. *Biotechnology and bioengineering*, ISSN 0006-3592, 2019, vol. 116, no. 10, str. 2720-2729, doi: 10.1002/bit.27087. [COBISS.SI-ID 4260232]
4. HABERMAN, Nejc, HUPPERTZ, Ina, ATTIG, Jan, KÖNIG, Julian, WANG, Zhen, HAUER, Christian, HENTZE, Matthias W., KULOZIK, Andreas E., LE HIR, Hervé, CURK, Tomaž, SIBLEY, Christopher R., ZARNACK, Kathi, ULE, Jernej. Insights into the design and interpretation of iCLIP experiments. *Genome biology*, ISSN 1474-760X. [Online ed.], Jan. 2017, vol. 18, str. 1-21, doi: 10.1186/s13059-016-1130-x. [COBISS.SI-ID 1537665731]
5. DIAZ-MUÑOZ, Manuel D., KISELEV, Vladimir Yu., LE NOVÈRE, Nicolas, CURK, Tomaž, ULE, Jernej, TURNER, Martin. Tia1 dependent regulation of mRNA subcellular location and translation controls p53 expression in B cells. *Nature communications*, ISSN 2041-1723, Sep. 2017, vol. 8, str. 1-16, doi: 10.1038/s41467-017-00454-2. [COBISS.SI-ID 1537665987]
6. CASTELLO, Alfredo, FRESE, Christian K., FISCHER, Bernd, JÄRVELIN, Aino I., HOROS, Rastislav, ALLEAUME, Anne-Marie, FOEHR, Sophia, CURK, Tomaž, KRIJGSVELD, Jeroen, HENTZE, Matthias W. Identification of RNA-binding domains of RNA-binding proteins in cultured cells on a system-wide scale with RBDmap. *Nature protocols*, ISSN 1754-2189, Dec. 2017, vol. 12, no. 12, str. 2447-2464, [COBISS.SI-ID 1537666243]

## UČNI NAČRT PREDMETA/COURSE SYLLABUS

|                                   |                                      |
|-----------------------------------|--------------------------------------|
| <b>Predmet:</b>                   | Biološke teme za nebiologe           |
| <b>Course title:</b>              | Topics in Biology for Non-Biologists |
| <b>Članica nosilka/UL Member:</b> | UL BF                                |

| Študijski programi in stopnja          | Študijska smer                  | Letnik | Semestri  |
|--|---------------------------------|--------|-----------|
| Bioznanosti, tretja stopnja, doktorski | Ni členitve (študijski program) |        | Celoletni |

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| <b>Univerzitetna koda predmeta/University course code:</b> | 0037264 |
| <b>Koda učne enote na članici/UL Member course code:</b>   | 3766    |

| Predavanja | Seminar | Vaje | Klinične vaje | Druge oblike študija | Samostojno delo | ECTS |
|------------|---------|------|---------------|----------------------|-----------------|------|
| 0          | 25      | 0    | 0             | 0                    | 100             | 5    |

**Nosilec predmeta/Lecturer:** Marina Dermastia

**Izvajalci predavanj:** Marina Dermastia, Tom Turk  
**Izvajalci seminarjev:**  
**Izvajalci vaj:**  
**Izvajalci kliničnih vaj:**  
**Izvajalci drugih oblik:**  
**Izvajalci praktičnega usposabljanja:**

**Vrsta predmeta/Course type:** individualno raziskovalni /individual research course

|                          |                      |                         |
|--------------------------|----------------------|-------------------------|
| <b>Jeziki/Languages:</b> | Predavanja/Lectures: | Angleščina, Slovenščina |
|                          | Vaje/Tutorial:       | Angleščina, Slovenščina |

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| <b>Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:</b> | <b>Prerequisites:</b>                                 |
| Splošni pogoji za vpis na doktorski študij.                                  | General conditions for enrolment in doctoral studies. |

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| <b>Vsebina:</b>  | <b>Content (Syllabus outline):</b>  |
| Predmet je namenjen študentom s srednješolskim znanjem biologije. Njegova vsebina je posebej prilagojena vsakemu študentu. Poučevanje je zelo neformalno in omogoča dovolj časa za razpravo ter vprašanja, s ciljem navdušiti študente, tako da jim da nekaj osnov biologije. Študentje bodo spoznali osnovne gradnike življenja od molekul do celic, razumeli mehanizme za replikacijo, transkripcijo in translacijo DNA ter kako se celice organizirajo v prostoru in času. Razumeli bodo osnovno molekularno biologijo gena in temeljne celične | The course is designed for students with high school knowledge of biology and the content is specifically tailored to the individual student. The class is very informal and allows ample time for discussion and questions. The goal is to get students excited about basic biology. Students learn about the basic building blocks of life, from molecules to cells, and understand the mechanisms and machinery of DNA replication, transcription, and translation, as well as the organization of cells in space and time. The organization of plant and animal growth is |

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| procese, povezane z energijo. Prikazana bo organizacija rasti rastlin in živali s poudarkom na evolucijski razvojni biologiji, ki temelji na izražanju genov in genski regulaciji. | demonstrated, with emphasis on evolutionary developmental biology based on gene expression and gene regulation. |
|--|---|

**Temeljna literatura in viri/Readings:**

Spellman F. R. Biology for Nonbiologists, Government Institutes; 1 edition (2007), 292 pages, ISBN-10: 0865874212  
 Dermastia M. Pogled v rastline, Nacionalni inštitut za biologijo (2010), 237 strani, ISBN 978-961-92543-4-9  
 Molecular Biology of the Cell Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, Peter Walter Sixth Edition, editors. (2014) Garland Science: New York and Abingdon, UK. 1464 pages. ISBN: 9780815344643  
 Brown T. A. Genomes 4; 4 edition(2017) 544 pages, ISBN 9780815345084.

**Cilji in kompetence:**

Predmet je namenjen študentom, ki so končali drugostopenjske magistrske programe orientirane v fiziko, kemijo, matematiko, računalništvo ipd., z izraženim interesom, da povežejo svoje znanje z biološkimi disciplinami. Izobraževalni cilj predmeta je, da študenti razumejo koncepte biologije. Z usvojenim znanjem se bodo bolj zavedali pomena in motivov njim manj znanega biološkega področja.

**Objectives and competences:**

The course is designed for students who've a second-level master's degree in physics, chemistry, or mathematics and are explicitly interested in linking their knowledge to biological disciplines. The goal of the course is to understand the main concepts of biology. The knowledge acquired will increase their awareness of the area of biology with which they're less familiar.

**Predvideni študijski rezultati:**

Znanje in razumevanje:  
 Študenti se bodo s pridobljenim znanjem lahko enakopravno vključevali v znanstvene razprave s študenti z biološkim predznanjem v času študija in skupaj z njimi kasneje oblikovali interaktivno mrežo področnih sodelovanj.

**Intended learning outcomes:**

Knowledge and understanding:  
 With the knowledge acquired, students will be able to participate equally in scientific discussions with students with prior biology education and to form interactive networks of collaboration between disciplines together with them.

**Metode poučevanja in učenja:**

Vodeno samoučenje; razprave o specifičnih temah zbranih iz temeljnih študijskih virov ali dodatnih virov z aktualnimi tematikami in konzultacije pri pripravi in predstavitvi seminarske naloge iz izbranih preglednih vsebin v znanstveni literaturi.

**Learning and teaching methods:**

Guided self-learning; discussions on specific selected themes; and consultation for preparation and presentation of seminar tasks from selected review contents in the scientific literature.

**Načini ocenjevanja:**

- Izdelava in predstavitev seminarja

**Delež/Weight**

100,00 %

**Assessment:**

- Preparation and presentation of a seminar

**Reference nosilca/Lecturer's references:**

**Prof. dr. Marina Dermastia**

- DERMASTIA, Marina. Plant hormones in phytoplasma infected plants. *Frontiers in plant science*. 2019, vol. 10, str. 1-15. ISSN 1664-462X. DOI: [10.3389/fpls.2019.00477](https://doi.org/10.3389/fpls.2019.00477). [COBISS.SI-ID [5050959](https://www.cobiss.si/id/5050959)]
- DERMASTIA, Marina, ŠKRLJ, Blaž, STRAH, Rebeka, ANŽIČ, Barbara, TOMAŽ, Špela, KRIŽNIK, Maja, SCHÖNHUBER, Christina, RIEDLE-BAUER, Monika, RAMŠAK, Živa, PETEK, Marko, Kladnik, Aleš, Lavrač, Nada, GRUDEN, Kristina, ROITSCH, Thomas, BRADER, Günter, POMPE NOVAK, Maruša. *Differential*

response of grapevine to Infection with 'Candidatus Phytoplasma solani' in early and late growing season through complex regulation of mRNA and small RNA transcriptomes. International journal of molecular sciences. 1 Apr. 2021, vol. 22, no. 7, str. 3531-1-3531-28. ISSN 1661-6596.

<https://www.mdpi.com/1422-0067/22/7/3531>. [COBISS.SI-ID 58895619]

- MEHLE, Nataša, JAKOŠ, Nejc, MEŠL, Miro, MIKLAVC, Jože, MATKO, Boštjan, ROT, Mojca, FERLEŽ RUS, Alenka, BRUS, Robert, DERMASTIA, Marina. Phytoplasmas associated with declining of hazelnut (*Corylus avellana*) in Slovenia. European journal of plant pathology. 2019, vol. 155, iss. 4, str. 1117-1132. ISSN 0929-1873. DOI: [10.1007/s10658-019-01839-3](https://doi.org/10.1007/s10658-019-01839-3). [COBISS.SI-ID 5156175]
- ROTTER, Ana, NIKOLIĆ, Petra, TURNŠEK, Neža, KOGOVSŠEK, Polona, BLEJEC, Andrej, GRUDEN, Kristina, DERMASTIA, Marina. Statistical modeling of long-term grapevine response to "Candidatus Phytoplasma solani" infection in the field. European journal of plant pathology. 2018, vol. 150, iss.3, str. 653-668. ISSN 0929-1873. <http://dx.doi.org/10.1007/s10658-017-1310-x>, DOI: [10.1007/s10658-017-1310-x](https://doi.org/10.1007/s10658-017-1310-x). [COBISS.SI-ID 4396623]
- CHERSICOLA, Marko, KLADNIK, Aleš, TUŠEK-ŽNIDARIČ, Magda, MRAK, Tanja, GRUDEN, Kristina, DERMASTIA, Marina. 1-aminocyclopropane-1-carboxylate oxidase induction in tomato flower pedicel phloem and abscission related processes are differentially sensitive to ethylene. Frontiers in plant science. 2017, vol. 8, str. 1-14. ISSN 1664-462X. DOI: [10.3389/fpls.2017.00464](https://doi.org/10.3389/fpls.2017.00464). [COBISS.SI-ID 4268879]
- MILJKOVIĆ, Dragana, STARE, Tjaša, MOZETIČ, Igor, PODPEČAN, Vid, PETEK, Marko, WITEK, Kamil, DERMASTIA, Marina, LAVRAČ, Nada, GRUDEN, Kristina. Signalling network construction for modelling plant defence response. PloS one, ISSN 1932-6203, 2012, vol. 7, no. 12, str. e51822-1e51822-18. <http://ponta.ijs.si/mozetic/papers/Miljetal-signet-PlosONE-12.pdf>, doi: [10.1371/journal.pone.0051822](https://doi.org/10.1371/journal.pone.0051822). [COBISS.SI-ID 26363431]

**Prof. dr. Tom Turk**

- MOODIE, Lindon W. K., SEPČIĆ, Kristina, TURK, Tom, FRANGEŽ, Robert, SVENSON, Johan. Natural cholinesterase inhibitors from marine organisms. Natural product reports. [Print ed.]. 2019, vol. , iss. , 40 str., ISSN 0265-0568. DOI: [10.1039/c9np00010k](https://doi.org/10.1039/c9np00010k). [COBISS.SI-ID 5024335]
- BERNE, Sabina, ČEMAŽAR, Maja, FRANGEŽ, Robert, JUNTES, Polona, KRANJC BREZAR, Simona, GRANDIČ, Marjana, SAVARIN, Monika, TURK, Tom. APS8 delays tumor growth in mice by inducing apoptosis of lung adenocarcinoma cells expressing high number of [alfa]7 nicotinic receptors. Marine drugs. 2018, vol. 16, no. 10, št. članka 367, 1-17. ISSN 1660-3397. <https://www.mdpi.com/1660-3397/16/10/367>. [COBISS.SI-ID 4683642]
- BERNE, Sabina, KALAUZ, Martina, LAPAT, Marko, SAVIN, Lora, JANUSSEN, Dorte, KERSKEN, Daniel, AMBROŽIČ, Jerneja, ZEMLIČ JOKHADAR, Špela, JAKLIČ, Domen, GUNDE-CIMERMAN, Nina, LUNDER, Mojca, ROŠKAR, Irena, ELERŠEK, Tina, TURK, Tom, SEPČIĆ, Kristina. Screening of the Antarctic marine sponges (Porifera) as a source of bioactive compounds. Polar biology. 2016, vol. 39, str. 947-959. ISSN 0722-4060. DOI: [10.1007/s00300-015-1835-4](https://doi.org/10.1007/s00300-015-1835-4). [COBISS.SI-ID 3662671]
- KOSS, David J., ROBINSON, Lianne, MIETELSKA-POROWSKA, Anna, GASIOROWSKA, Anna, SEPČIĆ, Kristina, TURK, Tom, JASPARS, Marcel, NIEWIADOMSKA, Grazyna, SCOTT, Roderick H., PLATT, Bettina, RIEDEL, Gernot. Polymeric alkylpyridinium salts permit intracellular delivery of human Tau in rat hippocampal neurons : requirement of Tau phosphorylation for functional deficits. Cellular and molecular life sciences. 2015, vol. 72, iss. 23, str. 4613-4632. ISSN 1420-682X. DOI: [10.1007/s00018-015-1949-4](https://doi.org/10.1007/s00018-015-1949-4). [COBISS.SI-ID 3498831]
- BUTALA, Matej, ŠEGA, Daniel, TOMC ZIDAR, Blaž, PODLESEK, Zdravko, KEM, William R., KÜPPER, Frithjof C., TURK, Tom. Recombinant expression and predicted structure of parborlysin, a cytolytic protein from the Antarctic heteronemertine Parborlasia corrugatus. Toxicon. [Print ed.]. 2015, vol. 108, str. 32-37. ISSN 0041-0101. DOI: [10.1016/j.toxicon.2015.09.044](https://doi.org/10.1016/j.toxicon.2015.09.044). [COBISS.SI-ID 3618127]

## UČNI NAČRT PREDMETA/COURSE SYLLABUS

|                                   |                       |
|-----------------------------------|-----------------------|
| <b>Predmet:</b>                   | Računska biologija    |
| <b>Course title:</b>              | Computational Biology |
| <b>Članica nosilka/UL Member:</b> | UL FRI                |

| Študijski programi in stopnja          | Študijska smer                  | Letnik | Semestri  |
|--|---------------------------------|--------|-----------|
| Bioznanosti, tretja stopnja, doktorski | Ni členitve (študijski program) |        | Celoletni |

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| <b>Univerzitetna koda predmeta/University course code:</b> | 0037265 |
| <b>Koda učne enote na članici/UL Member course code:</b>   | 3767    |

| Predavanja | Seminar | Vaje | Klinične vaje | Druge oblike študija | Samostojno delo | ECTS |
|------------|---------|------|---------------|----------------------|-----------------|------|
| 0          | 5       | 5    | 0             | 15                   | 100             | 5    |

**Nosilec predmeta/Lecturer:** Miha Mraz

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|---|------------------------------------|
| <b>Izvajalci predavanj:</b>                 |                                    |
| <b>Izvajalci seminarjev:</b>                | Aleš Belič, Miha Moškon, Miha Mraz |
| <b>Izvajalci vaj:</b>                       |                                    |
| <b>Izvajalci kliničnih vaj:</b>             |                                    |
| <b>Izvajalci drugih oblik:</b>              |                                    |
| <b>Izvajalci praktičnega usposabljanja:</b> |                                    |

**Vrsta predmeta/Course type:** individualno raziskovalni/individual research course

|                          |                      |                         |
|--------------------------|----------------------|-------------------------|
| <b>Jeziki/Languages:</b> | Predavanja/Lectures: | Angleščina, Slovenščina |
|                          | Vaje/Tutorial:       | Angleščina, Slovenščina |

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| <b>Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:</b>                 | <b>Prerequisites:</b>   |
| <ul style="list-style-type: none"> <li>Splošni pogoji za vpis na doktorski študij</li> </ul> | General prerequisites for the enrolment in the doctoral programme |

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| <b>Vsebina:</b>  | <b>Content (Syllabus outline):</b>   |
| <ul style="list-style-type: none"> <li>Biološka omrežja: gensko-regulatorna omrežja, signalna omrežja, metabolna omrežja.</li> <li>Procesiranje informacij v bioloških sistemih.</li> <li>Pristopi za računsko modeliranje bioloških sistemov: deterministično in stohastično modeliranje, agentno modeliranje, logično modeliranje, modeliranje na podlagi omejitev, modeliranje na nivoju genoma.</li> <li>Simulacija dinamike bioloških sistemov.</li> <li>Pristopi za računsko analizo bioloških sistemov: kvalitativna in kvantitativna analiza,</li> </ul> | <ul style="list-style-type: none"> <li>Biological networks: gene-regulatory networks, signalling networks, metabolic networks.</li> <li>Biological information processing.</li> <li>Computational approaches for modelling of biological systems: deterministic and stochastic modelling, agent-based modelling, logic modelling, constraint-based modelling, genome-scale modelling.</li> <li>Dynamical simulations of biological systems.</li> <li>Computational analysis of biological systems: qualitative and quantitative analysis,</li> </ul> |

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| <p>preiskovanje prostora dopustnih vrednosti kinetičnih parametrov.</p> <ul style="list-style-type: none"> <li>• Hevristike za analizo in načrtovanje bioloških sistemov.</li> <li>• Kontekstno-specifično modeliranje in prilagajanje računskih modelov specifičnemu kontekstu.</li> <li>• Modeliranje populacij bioloških entitet z agentnimi modeli.</li> <li>• Dopolnjevanje eksperimentalnega dela z računalniškimi modeliranjem in uporaba eksperimentalno pridobljenih podatkov pri postavitvi, dopolnjevanju in prilagajanju računskih modelov.</li> <li>• Uporaba računskih modelov pri interpretaciji eksperimentalnih podatkov.</li> <li>• Uporaba računskih modelov za generiranje novih podatkov in testiranje postavljenih hipotez.</li> </ul> | <p>investigation of feasible values of kinetic parameters.</p> <ul style="list-style-type: none"> <li>• Heuristics for analysis and design of biological systems.</li> <li>• Context-specific modelling and adaptation of computational models to a specific context.</li> <li>• Population-based modelling of biological entities using agent-based models.</li> <li>• Complementing experimental work with computational modelling. Application of experimental data to the establishment, enhancement, and adaptation of computational models.</li> <li>• Interpretation of experimental data using computational models.</li> <li>• Application of computational models to the generation of new data and hypothesis testing.</li> </ul> |
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#### Temeljna literatura in viri/Readings:

- Alon, Uri. (2006) *An introduction to systems biology: design principles of biological circuits*. Chapman and Hall/CRC.
- Bø, P. (2015) *Systems Biology: Constraint-Based Reconstruction and Analysis*. Cambridge University Press; 1st edition.
- Ingalls, B. P. (2013). *Mathematical modeling in systems biology: an introduction*. MIT press.
- Sneppen, K. (2014). *Models of life*. Cambridge University Press.
- Klipp, E., Liebermeister, W., Wierling, C., & Kowald, A. (2016). *Systems biology: a textbook*. John Wiley & Sons.

Ostalo: revijski članki s področja, tekoča periodika in druga učna gradiva.

#### Cilji in kompetence:

Poznavanje računskih pristopov za modeliranje, simulacijo, analizo in načrtovanje bioloških sistemov. Sposobnost gradnje in prilagajanja računskih modelov pri reševanju specifičnih problemov. Uporaba računskih modelov v kombinaciji z eksperimentalnim delom za interpretacijo eksperimentalno-pridobljenih podatkov, generiranje novih podatkov in testiranje postavljenih hipotez.

#### Objectives and competences:

To get an overview on the computational modelling, simulation, analysis, and design approaches in the biological systems domain. To be able to construct and adapt a computational model in the context of the student's research work. To be able to use computational models in a combination with experimental work for data interpretation, generation of new data, and testing of hypotheses.

#### Predvideni študijski rezultati:

Znanje in razumevanje računskega modeliranja, analize in načrtovanja bioloških sistemov.

#### Intended learning outcomes:

Knowledge and understanding of computational modelling, analysis, and design of biological systems.

#### Metode poučevanja in učenja:

Seminarji, vaje, individualne konzultacije

#### Learning and teaching methods:

Seminars, hands-on tutorials, individual consultations

#### Načini ocenjevanja:

Domače naloge  
Seminarsko delo

#### Delež/Weight

0,00 %  
100,00 %

#### Assessment:

Homework assignments  
Project work



#### Reference nosilca/Lecturer's references:

##### Miha Mraz

- WALAKIRA, Andrew, ROZMAN, Damjana, REŽEN, Tadeja, MRAZ, Miha, MOŠKON, Miha. Guided extraction of genome-scale metabolic models for the integration and analysis of omics data. *Computational and Structural Biotechnology Journal*. 2021, vol. 19, str. 3521-3530, graf. prikazi. ISSN 2001-0370. <https://www.sciencedirect.com/science/article/pii/S2001037021002476>, DOI: 10.1016/j.csbj.2021.06.009. [COBISS.SI-ID 66227971]
- MOŠKON, Miha, PUŠNIK, Žiga, ZIMIC, Nikolaj, MRAZ, Miha. Field-programmable biological circuits and configurable (bio)logic blocks for distributed biological computing. *Computers in Biology and Medicine*. [Print ed.]. Jan. 2021, vol. 128, str. 1-9, ilustr. ISSN 0010-4825. <https://www.sciencedirect.com/science/article/abs/pii/S0010482520304406>, DOI: 10.1016/j.compbimed.2020.104109. [COBISS.SI-ID 37003267]
- MOŠKON, Miha, KOMAC, Roman, ZIMIC, Nikolaj, MRAZ, Miha. Distributed biological computation : from oscillators, logic gates and switches to a multicellular processor and neural computing applications. *Neural computing & applications*. Aug. 2021, vol. 33, no. 15, str. 8923-8938, ilustr. ISSN 0941-0643. <https://link.springer.com/article/10.1007/s00521-021-05711-6>, DOI: 10.1007/s00521-021-05711-6. [COBISS.SI-ID 48415747]
- BLAGOTINŠEK COKAN, Kaja, URLEP, Žiga, MOŠKON, Miha, MRAZ, Miha, KONG, Xiang Y., ESKILD, Winnie, ROZMAN, Damjana, JUVAN, Peter, REŽEN, Tadeja. Common transcriptional program of liver fibrosis in mouse genetic models and humans. *International journal of molecular sciences*. 2021, vol. 22, iss. 2, str. 1-21, ilustr. ISSN 1422-0067. <https://www.mdpi.com/1422-0067/22/2/832>, DOI: 10.3390/ijms22020832. [COBISS.SI-ID 47324419]
- PUŠNIK, Žiga, MRAZ, Miha, ZIMIC, Nikolaj, MOŠKON, Miha. Computational analysis of viable parameter regions in models of synthetic biological systems. *Journal of biological engineering*. Sep. 2019, vol. 13, str. 1-21, graf. prikazi. ISSN 1754-1611. <https://jbioleng.biomedcentral.com/articles/10.1186/s13036-019-0205-0>, DOI: 10.1186/s13036-019-0205-0. [COBISS.SI-ID 1538345411]
- MAGDEVSKA, Lidija, MRAZ, Miha, ZIMIC, Nikolaj, MOŠKON, Miha. Initial state perturbations as a validation method for data-driven fuzzy models of cellular networks. *BMC bioinformatics*. Sep. 2018, vol. 19, str. 1-7, graf. prikazi. ISSN 1471-2105. <https://bmcbioinformatics.biomedcentral.com/articles/10.1186/s12859-018-2366-0>, DOI: 10.1186/s12859-018-2366-0. [COBISS.SI-ID 1537917379]

##### Aleš Belič

- KISS, Ádám, BELIČ, Aleš, et al. Phenoconversion of CYP2D6 by inhibitors modifies aripiprazole exposure. *European archives of psychiatry and clinical neuroscience*. 2020, vol. 270, str. 71-82. ISSN 0940-1334. DOI: 10.1007/s00406-018-0975-2. [COBISS.SI-ID 30244611]
- BRINC, Matjaž, BELIČ, Aleš. Optimization of process conditions for mammalian fed-batch cell culture in automated micro-bioreactor system using genetic algorithm. *Journal of biotechnology*. [Print ed.]. 2019, vol. 300, str. 40-47. ISSN 0168-1656. DOI: 10.1016/j.jbiotec.2019.05.001. [COBISS.SI-ID 30237187]
- TÓTH, Katalin, BELIČ, Aleš, et al. Potential role of patients' CYP3A-status in clozapine pharmacokinetics. *The international journal of neuropsychopharmacology*. 2017, vol. 20, issue 7, str. 529-537. ISSN 1461-1457. DOI: 10.1093/ijnp/pyx019. [COBISS.SI-ID 1358686]
- KANDUŠER, Maša, BELIČ, Aleš, ČROVIĆ, Selma, ŠKRJANC, Igor. Modular Serial Flow Through device for pulsed electric field treatment of the liquid samples. *Scientific reports*. 2017, 7, art. no. 8115, str. 1-12, ilustr. ISSN 2045-2322. <https://www.nature.com/articles/s41598-017-08620-8>, DOI: 10.1038/s41598-017-08620-8. [COBISS.SI-ID 11793492]

##### Miha Moškon

- WALAKIRA, Andrew, ROZMAN, Damjana, REŽEN, Tadeja, MRAZ, Miha, MOŠKON, Miha. Guided extraction of genome-scale metabolic models for the integration and analysis of omics data. *Computational and Structural Biotechnology Journal*. 2021, vol. 19, str. 3521-3530, graf. prikazi. ISSN 2001-0370. <https://www.sciencedirect.com/science/article/pii/S2001037021002476>, DOI: 10.1016/j.csbj.2021.06.009. [COBISS.SI-ID 66227971]
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<https://www.sciencedirect.com/science/article/abs/pii/S0010482520304406>, DOI: 10.1016/j.compbio.2020.104109. [COBISS.SI-ID 37003267]

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- KOVAČ, Urša, ŽUŽEK, Zala, RASPOR DALL'OLIO, Lucija, POHAR, Katka, IHAN, Alojz, MOŠKON, Miha, ROZMAN, Damjana, STARČIČ ERJAVEC, Marjanca. *Escherichia coli* affects expression of circadian clock genes in human hepatoma cells. *Microorganisms*. 2021, vol. 9, iss. 4, str. 1-14. ISSN 2076-2607. <https://www.mdpi.com/2076-2607/9/4/869>, DOI: 10.3390/microorganisms9040869. [COBISS.SI-ID 61091843]
- MOŠKON, Miha. CosinorPy : a Python package for cosinor-based rhythmometry. *BMC bioinformatics*. Oct. 2020, vol. 21, str. 1-12, graf. prikazi. ISSN 1471-2105. <https://bmcbioinformatics.biomedcentral.com/articles/10.1186/s12859-020-03830-w>, DOI: 10.1186/s12859-020-03830-w. [COBISS.SI-ID 34886403]