

Opis raziskovalnega dela (*Research work description*)

1. Članica UL (*UL member*):

Fakulteta za računalništvo in informatiko

2. Ime, priimek in elektronski naslov mentorja/ice (*Mentor's name, surname and email*):

Zoran Bosnić, zoran.bosnic@fri.uni-lj.si

3. Raziskovalno področje (*Research field*):

računalništvo in informatika, inteligentni sistemi

4. Opis raziskovalnega dela (*Research work description*):

Vključuje morebitne dodatne pogoje, ki jih mora izpolnjevati kandidat/ka za mladega raziskovalca/ko, ki niso navedeni v razpisu za mlade raziskovalce (*It includes any additional conditions that the candidate for a young researcher must meet, which are not listed in the call to tender for young researchers.*).

Slov.:

Trajnostno upravljanje vodnih virov predstavlja enega ključnih znanstvenih in družbenih izzivov. Podnebne spremembe, raba prostora, urbanizacija ter naraščajoči pritiski na vodne ekosisteme povzročajo variabilnost vodnih režimov, pogostejše ekstremne dogodke (suše, poplave) ter poslabšanje kakovosti voda. Hkrati so sodobni sistemi upravljanja z vodami izrazito podatkovno intenzivni: vključujejo hidrometeorološke meritve, satelitske posnetke, modele rabe tal, podatke o porabi vode, hidrološke in hidrogeološke simulacije ter kazalnike kakovosti vode in stanja ekosistemov. Klasični fizikalno zasnovani modeli pogosto težko zajamejo kompleksne, nelinearne interakcije med podnebjem, površinskim in podzemnim tokom, rabo prostora ter človeškimi vplivi.

Metode strojnega učenja in umetne inteligence (UI) ponujajo možnost izgradnje podatkovno vodenih, hibridnih in prilagodljivih modelov, ki lahko dopolnjujejo obstoječe hidrološke pristope, izboljšajo napovedno točnost ter omogočijo boljšo podporo odločanju pri razporejanju vodnih virov, upravljanju akumulacij in načrtovanju prilagoditvenih ukrepov. Raziskovalno delo mladega raziskovalca bo usmerjeno v razvoj naprednih metod strojnega učenja za podporo hidrološkemu modeliranju in upravljanju vodnih virov v pogojih podnebne in družbene negotovosti. Prvi ključni cilj usposabljanja bo razvoj hibridnih, fizikalno-informiranih modelov strojnega učenja, ki bodo združevali hidrološke modele z globokim strojnimi učenjem ter omogočali izboljšano napoved vodne razpoložljivosti, ekstremnih dogodkov in dinamike kakovosti vode ob ohranjanju interpretabilnosti modelov. Drugi cilj bo metodološki okvir za vrednotenje robustnosti, varnosti in razložljivosti modelov umetne inteligence v vodnem sektorju, vključno z analizo občutljivosti na negotovosti, nepopolne podatke in potencialne napade na integriteto modelov. S tem bo raziskava prispevala k znanstvenemu razvoju zanesljivih in transparentnih orodij umetne inteligence ter k boljšemu razumevanju njihove vloge pri trajnostnem in pravičnem upravljanju vodnih virov.

Eng.:

Sustainable water resources management represents one of the key scientific and societal challenges of our time. Climate change, land-use change, urbanization, and increasing pressures on aquatic ecosystems lead to greater variability of hydrological regimes, more frequent extreme events (droughts and floods), and deterioration of water quality. At the same time, modern water management systems are highly data-intensive, relying on hydrometeorological measurements, satellite observations, land-use models, water consumption data,

hydrological and hydrogeological simulations, as well as indicators of water quality and ecosystem status. Classical physically based models often struggle to capture the complex, nonlinear interactions among climate dynamics, surface and groundwater flows, land use, and anthropogenic influences.

Machine learning and artificial intelligence (AI) methods offer the possibility of developing data-driven, hybrid, and adaptive models that complement existing hydrological approaches, improve predictive accuracy, and provide enhanced decision support for water allocation, reservoir management, and climate adaptation planning. The research work of the young researcher will focus on the development of advanced machine learning methods to support hydrological modeling and water resources management under conditions of climatic and societal uncertainty. The first key objective of the training will be the development of hybrid, physics-informed machine learning models that integrate hydrological models with deep learning techniques, enabling improved prediction of water availability, extreme events, and water quality dynamics while preserving model interpretability. The second objective will be to establish a methodological framework for evaluating the robustness, security, and explainability of AI models in the water sector, including sensitivity analysis to uncertainties, incomplete data, and potential attacks on model integrity. Through these contributions, the research will advance the scientific development of reliable and transparent AI tools and enhance the understanding of their role in sustainable and equitable water resources management.

5. Priloge, ki jih je treba priložiti ob prijavi (*Documents required to be submitted with the application*):

potrdilo o doseženi izobrazbi (*proof of completed education*)

- kandidat z zaključenim magistrskim študijskim programom (2. bolonjska stopnja) (*candidate who has completed a Master's degree (2nd Bologna level)*):
 - diplomska listina / potrdilo o zaključku študijskega programa (*diploma certificate / certificate of completion of the study programme*)
 - priloga k diplomi / potrdilo o opravljenih obveznostih (*diploma supplement / official transcript of records containing all grades obtained in the study programme*)
- kandidat, ki še ni zaključil študija na 2. stopnji (*candidate who has not yet completed a Master's degree*):
 - potrdilo o do sedaj opravljenih obveznostih z ocenami magistrskega študijskega programa, s katerim se bo kandidat prijavil na doktorski študij (*official transcript of records listing all courses and grades obtained so far in the Master's degree programme on the basis of which the candidate will apply for enrollment in a doctoral degree programme.*)

nagrade – univerzitetna Prešernova nagrada ali Prešernova nagrada članice Univerze v Ljubljani oz. druga enakovredna nagrada (*awards, e.g. Prešeren Prize of the University of Ljubljana, Prešeren Prize of a University of Ljubljana member and/or another equivalent award*)

bibliografija (*bibliography*)

življenjepis (*CV*)

motivacijsko pismo (*motivation letter*)

opis dosedanjega sodelovanja pri raziskovalnem delu (*description of the candidate's research work*)

osnutek idejne zasnove raziskovalnega dela (*preliminary research proposal*)

priporočilno pismo (*letter of recommendation*)

druge priloge (*other attachments*):

Opis raziskovalnega dela (Research work description)

1. Članica UL (UL member):

Fakulteta za računalništvo in informatiko/Faculty of Computer and Information Science

2. Ime, priimek in elektronski naslov mentorja/ice (Mentor's name, surname and email):

Petar Kochovski, petar.kochovski@fri.uni-lj.si

3. Raziskovalno področje (Research field):

računalniški kontinuum od oblaka do stvari; Zaupanja vredna in zasebnost ohranjajoča umetna inteligenca, razločljiva umetna inteligenca, tehnologiji razpršenih evidenc (DLT), stohastično odločanje
Things-to-Cloud continuum; explainable AI, Trustworthy and privacy preserving AI, Distributed Ledger Technologies (DLT), Stochastic decision making under uncertainty

4. Opis raziskovalnega dela (Research work description):

Vključuje morebitne dodatne pogoje, ki jih mora izpolnjevati kandidat/ka za mladega raziskovalca/ko, ki niso navedeni v razpisu za mlade raziskovalce (It includes any additional conditions that the candidate for a young researcher must meet, which are not listed in the call to tender for young researchers.).

Slov.:

Mladi raziskovalec bo deloval na presečišču računalniškega kontinuuma od oblaka do stvari, tehnologij razpršenih evidenc in umetne inteligence. To raziskovalno področje je strateško izjemno pomembno zaradi pospešene digitalne preobrazbe industrije in javnih storitev, razširjene uporabe infrastrukture interneta stvari ter naraščajoče potrebe po čezmejnih in federiranih rešitvah umetne inteligence, ki delujejo prek heterogenih računalniških okolij. Sodobni primeri uporabe na področjih pametne infrastrukture, mobilnosti, energetike in digitalnih javnih storitev so zaznamovani z negotovostjo, dinamično razpoložljivostjo virov, spreminjajočimi se regulativnimi okviri ter delno opaznimi sistemskimi stanji. Takšne razmere zahtevajo robustne in prilagodljive arhitekture, ki lahko zanesljivo delujejo vzdolž računalniškega kontinuuma ob hkratnem zagotavljanju zaupanja, odgovornosti, varstva zasebnosti in skladnosti z regulativo. Raziskovalno področje je zato usmerjeno v razvoj zaupanja vrednih in razširljivih arhitektur umetne inteligence, ki podpirajo decentralizirano odločanje in upravljanje v kompleksnih večdeležniških ekosistemih.

Raziskovalni cilj bo razvoj rešitev, ki presegajo klasične pristope federiranega učenja ter omogočajo razširljivo obdelavo podatkov umetne inteligence prek heterogenih infrastruktur in jurisdikcij. Raziskava bo obravnavala usklajen razvoj, uvajanje in obratovanje delovnih tokov umetne inteligence prek roba, oblaka in visoko zmogljivega računalništva, s poudarkom na interoperabilnosti, zmogljivosti, varstvu zasebnosti in zaupanju. Zaradi inherentne negotovosti porazdeljenih okolij in realnih primerov uporabe bo raziskava vključevala stohastične metode za odločanje in napovedovanje, vključno s probabilističnim sklepanjem, kvantifikacijo negotovosti ter prilagodljivimi strategijami dodeljevanja virov. Vzporedno bodo razvite nove metode za izboljšanje razpoložljivosti, kakovosti in konsistentnosti podatkov v decentraliziranih sistemih umetne inteligence, vključno z obvladovanjem neuravnoteženosti podatkovnih zbirk, optimizacijo prenosa podatkov ter robustnimi mehanizmi porazdeljenega upravljanja podatkov.

Od raziskovalca se pričakuje visoka analitična sposobnost in zmožnost samostojnega reševanja kompleksnih raziskovalnih izzivov na področju porazdeljenih sistemov in umetne inteligence.

Kandidat mora izpolnjevati naslednje pogoje:

- magisterij s področja računalništva, elektrotehnike ali sorodne tehnične discipline,
- dobre programerske spretnosti in izkušnje z uporabo sodobnih razvojnih orodij,
- sposobnost strokovne komunikacije in timskega dela,
- dobro znanje angleškega jezika.

Eng.: The young researcher will work at the intersection of Things-to-Cloud computing, Distributed Ledger Technologies, and Artificial Intelligence. This research field is of high strategic relevance due to the accelerated digital transformation of industry and public services, the widespread deployment of Internet of Things infrastructures, and the growing demand for cross border and federated AI solutions operating across heterogeneous computing environments. Contemporary use cases in domains such as smart infrastructure, mobility, energy systems, and digital public services are characterised by uncertainty, dynamic resource availability, evolving regulatory frameworks, and partially observable system states. These conditions necessitate robust and adaptive architectures capable of operating reliably across the compute continuum while ensuring trust, accountability, privacy, and regulatory compliance. The research domain therefore focuses on the design of trustworthy and scalable AI architectures that support decentralised decision making and governance in complex multi stakeholder ecosystems.

The primary research goal will be the development of solutions that extend beyond conventional federated learning and enable scalable AI data processing across heterogeneous infrastructures and jurisdictions. The work will address the coordinated development, deployment, and operation of AI workflows across edge, cloud, and high performance computing environments, with explicit attention to interoperability, performance, privacy, and trustworthiness. Given the inherent uncertainty in distributed environments and real world use cases, the research will incorporate stochastic methods for decision making and prediction, including probabilistic reasoning, uncertainty quantification, and adaptive resource allocation strategies. In parallel, the research will develop novel approaches to enhance data availability, quality, and consistency in decentralised AI systems, including mitigation of dataset imbalance, optimisation of data transfer volumes, and robust distributed data management mechanisms.

The researcher is expected to demonstrate strong analytical capability and the ability to independently address complex research challenges in distributed systems and artificial intelligence.

The candidate is required to fulfil the following criteria:

- *Master's degree in computer science, electrical engineering, or a related discipline,*
- *strong programming skills and experience with modern software development tools,*
- *good ability for professional communication and teamwork,*
- *good proficiency in the English language.*

5. Priloge, ki jih je treba priložiti ob prijavi (*Documents required to be submitted with the application*):

potrdilo o doseženi izobrazbi (*proof of completed education*)

- kandidat z zaključenim magistrskim študijskim programom (2. bolonjska stopnja) (*candidate who has completed a Master's degree (2nd Bologna level)*):
 - *diplomska listina / potrdilo o zaključku študijskega programa (diploma certificate / certificate of completion of the study programme)*
 - *priloga k diplomi / potrdilo o opravljenih obveznostih (diploma supplement / official transcript of records containing all grades obtained in the study programme)*

– kandidat, ki še ni zaključil študija na 2. stopnji
(*candidate who has not yet completed a Master's degree*):

- potrdilo o do sedaj opravljenih obveznostih z ocenami magistrskega študijskega programa, s katerim se bo kandidat prijavil na doktorski študij
(*official transcript of records listing all courses and grades obtained so far in the Master's degree programme on the basis of which the candidate will apply for enrollment in a doctoral degree programme.*)

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bibliografija (*bibliography*)

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osnutek idejne zasnove raziskovalnega dela (*preliminary research proposal*)

priporočilno pismo (*letter of recommendation*)

druge priloge (*other attachments*):

Opis raziskovalnega dela (Research work description)

1. Članica UL (UL member):

FRI

2. Ime, priimek in elektronski naslov mentorja/ice (Mentor's name, surname and email):

Peter Peer, peter.peer@fri.uni-lj.si

3. Raziskovalno področje (Research field):

Računalništvo in informatika, umetna inteligenca, računalniški vid, slikovna biometrija /
Computer and information science, artificial intelligence, computer vision, image-based biometrics

4. Opis raziskovalnega dela (Research work description):

Vključuje morebitne dodatne pogoje, ki jih mora izpolnjevati kandidat/ka za mladega raziskovalca/ko, ki niso navedeni v razpisu za mlade raziskovalce (It includes any additional conditions that the candidate for a young researcher must meet, which are not listed in the call to tender for young researchers.).

Slov.:

Mladi raziskovalec bo delal v okviru programske skupine Računalniški vid v Laboratoriju za računalniški vid na Fakulteti za računalništvo in informatiko Univerze v Ljubljani. Raziskave v laboratoriju vključujejo razvoj metod za biometrično prepoznavanje iz različnih modalnosti, kot so uho, beločnica, obraz, prstna sled, ter izboljševanje kakovosti in robustnosti teh sistemov. Vzporedno razvijamo tudi tehnologije za zaščito zasebnosti, kot so deidentifikacija obrazov, metode za ohranjanje zasebnosti pri obdelavi obraznih podatkov ter generiranje sintetičnih biometričnih slik za učenje modelov. Med novejšimi raziskovalnimi smermi so tudi odkrivanje globokih ponaredkov, virtualno pomerjanje oblakov, lahki odločitveni modeli, detekcija morfov in napadov na biometrične sisteme, razločljivost odločitev. Skupaj te raziskave združujejo globoko učenje, razpoznavalne in generativne modele ter biometrično analizo z namenom razvoja zanesljivih, varnih in zasebnosti prijaznih sistemov vizualnega prepoznavanja. Raziskovalno delo mladega raziskovalca bo tako potekalo na področju računalniškega vida z aplikativnostjo na področju slikovne biometrije, vključevalo bo globoko učenje, razpoznavalne, generativne pristope.

V okviru svojega dela bo mladi raziskovalec poročal o svojih rezultatih na mednarodnih znanstvenih konferencah in v revijah s faktorjem vpliva. Zaradi dobre vpetosti raziskovalne skupine v mednarodno okolje, se predvidevajo tudi obiski mladega raziskovalca na tujih inštitucijah. Pravtako bo mladi raziskovalec vključen tudi v napore za potencialno komercializacijo uporabe metod.

Od mladega raziskovalca se pričakuje dobro poznavanje temeljev računalniške stroke, programiranja, umetne inteligence, znanje angleščine, samoiniciativnost, kritično razmišljanje, zmožnost dela v skupini.

Nekaj ključnih referenc s faktorjem vpliva raziskovalne skupine iz zadnjih dveh let, ki tudi dodatno osvetlijo raziskovalno področje:

M. Ivanovska, L. Todorov, P. Peer, V. Štruc, SelfMAD++: Self-supervised foundation model with local feature enhancement for generalized morphing attack detection, *Information Fusion*, 2026.

P. Rot, R. Jutreša, P. Peer, V. Štruc, W. Scheirer, K. Grm, FaceMINT: A library for gaining insights into biometric face recognition via mechanistic interpretability, *Image and Vision Computing*, 2026.

B. Batagelj, A. Kronovšek, V. Štruc, P. Peer, Robust cross-dataset deepfake detection with multitask self-supervised learning, *ICT Express*, 2025.

M. Vitek, V. Štruc, P. Peer, *GazeNet: a lightweight multitask sclera feature extractor*, *Alexandria Engineering Journal*, 2025.

D. Tomašević, F. Boutros, N. Damer, P. Peer, V. Štruc, *Generating bimodal privacy-preserving data for face recognition*, *Engineering Applications of Artificial Intelligence*, 2024.

Eng.:

The young researcher will work within the Computer Vision research programme at the Computer Vision Laboratory, Faculty of Computer and Information Science, University of Ljubljana. Research in the laboratory includes the development of methods for biometric recognition from different modalities, such as ear, sclera, face, and fingermarks, as well as improving the quality and robustness of such systems. In parallel, we also develop privacy-enhancing technologies, such as face deidentification, privacy-preserving methods for processing facial data, and the generation of synthetic biometric images for training machine-learning models. More recent research directions include deepfake detection, virtual garment try-on, lightweight decision models, detection of morphing attacks and presentation attacks on biometric systems, and explainability of model decisions. These research activities combine deep learning, recognition and generative models, and biometric analysis with the aim of developing reliable, secure and privacy-preserving visual recognition systems. The research work of the young researcher will therefore take place in the field of computer vision with applications in image-based biometrics, involving deep learning, recognition and generative approaches.

The young researcher will present research results at international scientific conferences and publish them in journals with an impact factor. Due to the strong international collaborations of the research group, research visits to foreign institutions are also expected. The young researcher will also participate in efforts related to the potential commercialization of developed methods.

The candidate is expected to have a solid background in computer science fundamentals, programming, and artificial intelligence, good English language skills, be self-initiative, capable of critical thinking, and the ability to work in a team.

Some key impact-factor publications from the research group in the last two years, which further illustrate the research area, are listed below:

M. Ivanovska, L. Todorov, P. Peer, V. Štruc, *SelfMAD++: Self-supervised foundation model with local feature enhancement for generalized morphing attack detection*, *Information Fusion*, 2026.

P. Roč, R. Jutraša, P. Peer, V. Štruc, W. Scheirer, K. Grm, *FaceMINT: A library for gaining insights into biometric face recognition via mechanistic interpretability*, *Image and Vision Computing*, 2026.

B. Batagelj, A. Kronovšek, V. Štruc, P. Peer, *Robust cross-dataset deepfake detection with multitask self-supervised learning*, *ICT Express*, 2025.

M. Vitek, V. Štruc, P. Peer, *GazeNet: a lightweight multitask sclera feature extractor*, *Alexandria Engineering Journal*, 2025.

D. Tomašević, F. Boutros, N. Damer, P. Peer, V. Štruc, *Generating bimodal privacy-preserving data for face recognition*, *Engineering Applications of Artificial Intelligence*, 2024.

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– kandidat z zaključenim magistrskim študijskim programom (2. bolonjska stopnja)
(*candidate who has completed a Master's degree (2nd Bologna level)*):

- diplomska listina / potrdilo o zaključku študijskega programa
(*diploma certificate / certificate of completion of the study programme*)
- priloga k diplomu / potrdilo o opravljenih obveznostih

(diploma supplement / official transcript of records containing all grades obtained in the study programme)

- kandidat, ki še ni zaključil študija na 2. stopnji
(candidate who has not yet completed a Master's degree):
 - o potrdilo o do sedaj opravljenih obveznostih z ocenami magistrskega študijskega programa, s katerim se bo kandidat prijavil na doktorski študij
(official transcript of records listing all courses and grades obtained so far in the Master's degree programme on the basis of which the candidate will apply for enrollment in a doctoral degree programme.)

nagrade – univerzitetna Prešernova nagrada ali Prešernova nagrada članice Univerze v Ljubljani oz. druga enakovredna nagrada (*awards, e.g. Prešeren Prize of the University of Ljubljana, Prešeren Prize of a University of Ljubljana member and/or another equivalent award*)

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opis dosedanjega sodelovanja pri raziskovalnem delu (*description of the candidate's research work*)

osnutek idejne zasnove raziskovalnega dela (*preliminary research proposal*)

priporočilno pismo (*letter of recommendation*) - Only for students coming outside of FRI UL.

druge priloge (*other attachments*):

Opis raziskovalnega dela (Research work description)

1. Članica UL (UL member):

UL FRI

2. Ime, priimek in elektronski naslov mentorja/ice (Mentor's name, surname and email):

Matevž Pesek, matevz.pesek@fri.uni-lj.si

3. Raziskovalno področje (Research field):

Računalništvo in informatika

4. Opis raziskovalnega dela (Research work description):

Vključuje morebitne dodatne pogoje, ki jih mora izpolnjevati kandidat/ka za mladega raziskovalca/ko, ki niso navedeni v razpisu za mlade raziskovalce (It includes any additional conditions that the candidate for a young researcher must meet, which are not listed in the call to tender for young researchers.).

Slov.: Mladi raziskovalec bo vključen v delo interdisciplinarnega raziskovalnega programa s področja digitalne humanistike, katerega cilj je preseči trenutno fragmentiranost in tehnološko neenotnost digitaliziranih raziskovalnih virov v Sloveniji. Njegovo delo bo usmerjeno v razvoj novih modelov, metod in orodij, ki bodo presegali trenutne rezultate obstoječih, za slovenski jezik in področje neprilagojenih modelov in metod. Raziskovalec s svojim delom doprinesel k interoperabilni, področju prilagojeni obdelavi slovenske in širše snovne in nesnovne kulturne dediščine ter s tem okreplil raziskovalno področje na področju računalništva in digitalne humanistike.

Raziskovalno delo bo zajemalo razvoj naprednih modelov za obdelavo multimodalnih digitaliziranih gradiv, sodelovanje z drugimi deležniki pri ustvarjanju digitalnih virov ter vzpostavljanju standardiziranih pristopov k označevanju slednjih. Raziskovalec bo razvijal modele, podprti s pristopi strojnega učenja in umetne inteligence, namenjene obdelavi in ekstrakciji podatkov iz večjih digitaliziranih virov, ki bodo presegali trenutne najsodobnejše (angl. state-of-the-art) metode modernih sorodnih del. Širše bo raziskovalec preizkušal in prilagajal razvite modele za več različnih opravil (klasifikacija, interoperabilno bogatenje podatkov, pridobivanje podatkov iz virov), jezikov (narečja, sorodni jeziki in jeziki, govorjeni ali uporabljeni na slovenskem področju) in modalnosti (besedilo, fotografije dokumentov)

V okviru programa bo sodeloval v celotnem raziskovalnem ciklu razvoja moderne digitalne humanistike: od svetovanja pri zajemu in digitalizaciji gradiva, razvoja metod in modelov za klasifikacijo, pridobivanje in obogatitev podatkov, ter njihove analize in interpretacije. Rezultati njegovega dela bodo prispevali k večji mednarodni primerljivosti slovenskih raziskovalnih virov ter k metodološkemu razvoju digitalne humanistike v širšem evropskem prostoru.

Eng.: The researcher will be involved in an interdisciplinary research programme in the field of digital humanities, whose aim is to overcome the current fragmentation and technological heterogeneity of digitised research resources in Slovenia. Their work will focus on the development of new models, methods, and tools that go beyond the current results of existing approaches, particularly with respect to the Slovenian language and the domain of non-adapted models and methods. Through their research, the researcher will contribute to interoperable, domain-

adapted processing of Slovenian and broader cultural heritage, thereby strengthening research at the intersection of computer science and digital humanities.

The research activities will include the development of advanced models for processing multimodal digitised materials, collaboration with other stakeholders in the creation of digital resources, and the establishment of standardised approaches to their annotation. The researcher will develop models based on machine learning and artificial intelligence approaches for the processing and extraction of data from large-scale digitised resources, exceeding current state-of-the-art methods in related fields. More broadly, the researcher will test and adapt the developed models across multiple tasks (classification, interoperable data enrichment, data extraction from sources), languages (dialects, related languages, and languages spoken or used in the Slovenian context), and modalities (text, document images).

Within the programme, the researcher will participate in the entire research cycle of modern digital humanities development: from advising on the acquisition and digitisation of materials, to the development of methods and models for data classification, extraction, and enrichment, as well as their analysis and interpretation. The results of their work will contribute to greater international comparability of Slovenian research resources and to the methodological advancement of digital humanities in the wider European context.

5. Priloge, ki jih je treba priložiti ob prijavi (*Documents required to be submitted with the application*):

potrdilo o doseženi izobrazbi (proof of completed education)

- kandidat z zaključenim magistrskim študijskim programom (2. bolonjska stopnja) (*candidate who has completed a Master's degree (2nd Bologna level)*):
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- kandidat, ki še ni zaključil študija na 2. stopnji (*candidate who has not yet completed a Master's degree*):
 - potrdilo o do sedaj opravljenih obveznostih z ocenami magistrskega študijskega programa, s katerim se bo kandidat prijavil na doktorski študij (*official transcript of records listing all courses and grades obtained so far in the Master's degree programme on the basis of which the candidate will apply for enrollment in a doctoral degree programme.*)

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motivacijsko pismo (*motivation letter*)

opis dosedanjega sodelovanja pri raziskovalnem delu (*description of the candidate's research work*)

osnutek idejne zasnove raziskovalnega dela (*preliminary research proposal*)

priporočilno pismo (*letter of recommendation*)

druge priloge (*other attachments*):

Opis raziskovalnega dela (*Research work description*)

1. Članica UL (*UL member*):

Fakulteta za računalništvo in informatiko

2. Ime, priimek in elektronski naslov mentorja/ice (*Mentor's name, surname and email*):

Danijel Skočaj, danijel.skocaj@fri.uni-lj.si

3. Raziskovalno področje (*Research field*):

Računalništvo in informatika

4. Opis raziskovalnega dela (*Research work description*):

Vključuje morebitne dodatne pogoje, ki jih mora izpolnjevati kandidat/ka za mladega raziskovalca/ko, ki niso navedeni v razpisu za mlade raziskovalce (*It includes any additional conditions that the candidate for a young researcher must meet, which are not listed in the call to tender for young researchers.*).

Slov.:

Detekcija vizualnih anomalij je v zadnjem obdobju postala zelo aktivno raziskovalno področje z velikim aplikativnim potencialom. Raziskave potekajo v več smereh, od uporabe različnih podatkovnih modalnosti za detekcijo anomalij do razvoja različnih pristopov učenja modelov za ta namen.

Mladi raziskovalec bo svoje delo gradil na bogatih izkušnjah laboratorija na tem področju ter razvijal nove metode za bolj učinkovito, prenosljivo in uporabniku prijazno detekcijo anomalij. Pri tem bo obravnaval več raziskovalnih izzivov. Detekcija anomalij bo najprej temeljila na opisu problema z množico slik, pri čemer pridejo v poštev različni pristopi učenja, od nenadzorovanega do popolnoma nadzorovanega, oz. učenja brez ali z malo učnimi primeri. Tak način opisa problema bo nadgrajen z besedilnimi opisi potencialnih napak oz. normalnosti izgleda, kar omogoča, da se pri učenju poleg slikovne informacije upošteva tudi besedilna modalnost. Raziskoval bo načine, kako ti dve modalnosti čim bolj učinkovito povezati, zlasti v kontekstu interaktivnega učenja, oziroma nadgradnje modelov potencialnih anomalij in normalnega videza površin na čim bolj naraven in učinkovit način. Primarni cilj raziskav bo razvoj metod za čim bolj uspešno detekcijo in segmentacijo anomalij, ob hkratnem prizadevanju za čim bolj splošen in enostaven način podajanja informacij o problemu. Gre za še razmeroma neraziskano področje, ki pa ima velik potencial za praktično uporabo.

Od kandidata se pričakuje izrazita motivacija in sposobnost za raziskovalno delo ter odgovoren in sodelovalen pristop k delu v raziskovalni skupini. Pričakuje se dobro poznavanje računalniškega vida in globokega učenja. Zahteva se tudi odlično znanje angleškega jezika v pisni in govorni obliki.

Eng.:

Visual anomaly detection has recently become a very active research area with significant application potential. Research in this field is developing in several directions, ranging from the use of different data modalities for anomaly detection to the development of various learning approaches for this task.

The doctoral student will build upon the laboratory's extensive expertise in this field and develop new methods for more efficient, portable, and user-friendly anomaly detection. Several research challenges will be addressed.

Initially, anomaly detection will be based on describing the problem using sets of images, where different learning paradigms can be applied, ranging from unsupervised to fully supervised learning, as well as zero-shot and few-shot learning. This way of describing the problem will be further extended with textual descriptions of potential defects or normal appearance, enabling the learning process to incorporate textual information in addition to visual data. The research will investigate how these two modalities can be most effectively integrated, particularly in the context of interactive learning, i.e., through the iterative refinement of models of potential anomalies and normal surface appearance in a natural and efficient manner. The primary goal of the research will be the development of methods for accurate anomaly detection and segmentation, while at the same time striving for a general and simple way of specifying information about the problem. This is still a relatively underexplored research area, yet it holds significant potential for practical applications.

The candidate is expected to demonstrate strong motivation and aptitude for research, as well as a responsible and collaborative approach to working within a research team. A strong background in computer vision and deep learning is expected. Excellent proficiency in English is required.

5. Priloge, ki jih je treba priložiti ob prijavi (*Documents required to be submitted with the application*):

potrdilo o doseženi izobrazbi (*proof of completed education*)

- kandidat z zaključenim magistrskim študijskim programom (2. bolonjska stopnja) (*candidate who has completed a Master's degree (2nd Bologna level)*):
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druge priloge (*other attachments*):

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1. Članica UL (*UL member*):

Fakulteta za računalništvo in informatiko

2. Ime, priimek in elektronski naslov mentorja/ice (*Mentor's name, surname and email*):

Erik Štrumbelj, erik.strumbelj@fri.uni-lj.si

3. Raziskovalno področje (*Research field*):

Računalništvo in informatika

4. Opis raziskovalnega dela (*Research work description*):

Vključuje morebitne dodatne pogoje, ki jih mora izpolnjevati kandidat/ka za mladega raziskovalca/ko, ki niso navedeni v razpisu za mlade raziskovalce (*It includes any additional conditions that the candidate for a young researcher must meet, which are not listed in the call to tender for young researchers.*).

Slov.:

Raziskovali bomo učinke pogovornih sistemov umetne inteligence na človeško učenje, razmišljanje in akademsko delo. Medtem ko pretekle raziskave o zgodnejših digitalnih tehnologijah nakazujejo, da lahko kognitivno razbremenjevanje vpliva na spomin, strategije reševanja problemov in metakognitivno uravnavanje, sistematičnih empiričnih dokazov o sodobnih sistemih umetne inteligence še vedno primanjkuje.

Obravnavali bomo naslednja raziskovalna vprašanja:

- Kako uporaba pogovornih orodij umetne inteligence vpliva na kognicijo?
- Kateri kognitivni mehanizmi so v ozadju morebitnih negativnih učinkov?
- In pod katerimi pogoji lahko takšna orodja kognicijo podpirajo namesto da bi jo ovirala?

Raziskava bo združevala:

- sistematično sintezo literature s področja kognitivnega razbremenjevanja in kognitivne obremenitve,
- kontrolirane eksperimentalne študije v izobraževalnih in akademskih kontekstih,
- kvantitativno analizo vedenjskih podatkov in podatkov o uspešnosti ter
- načrtovanje in evalvacijo razširitev vmesnikov umetne inteligence, namenjenih zmanjšanju negativnih kognitivnih učinkov.

Kandidat/ka mora imeti izobrazbo na področju računalništva, psihologije, kognitivne znanosti, podatkovne znanosti, uporabne statistike ali sorodnega področja. Zahtevano je osnovno znanje računalniškega programiranja. Kandidat/ka mora izkazati trdne temelje vsaj na enem od naslednjih področij: kognitivna psihologija, interakcija človek–računalnik, strojno učenje ali kvantitativne raziskovalne metode. Interdisciplinarno ozadje, ki povezuje računalniške in vedenjske znanosti, je zelo zaželeno.

Eng.:

We will investigate the cognitive effects of AI conversational systems on human learning, reasoning, and

academic work. While prior research on earlier digital technologies suggests that cognitive offloading can alter memory, problem-solving strategies, and metacognitive regulation, systematic empirical evidence regarding contemporary AI systems remains limited.

We will address the following research questions:

- How does the use of AI conversational tools affect cognition?
- What are the cognitive mechanisms underlying potential negative effects?
- And under what conditions can such tools support rather than impair cognition?

The research will combine:

- systematic literature synthesis of cognitive offloading and cognitive load research,
- controlled experimental user studies in educational and academic contexts,
- quantitative analysis of behavioral and performance data, and
- design and evaluation of AI interface extensions aimed at mitigating negative cognitive effects.

Candidates should hold a degree in computer science, psychology, cognitive science, data science, applied statistics, or a related field. Basic computer programming knowledge is required. The candidate must demonstrate solid foundations in at least one of the following: cognitive psychology, human-computer interaction, machine learning, or quantitative research methods. Interdisciplinary background combining computational and behavioral sciences is highly desirable.

5. Priloge, ki jih je treba priložiti ob prijavi (*Documents required to be submitted with the application*):

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- kandidat z zaključenim magistrskim študijskim programom (2. bolonjska stopnja) (*candidate who has completed a Master's degree (2nd Bologna level)*):
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priporočilno pismo (*letter of recommendation*)

druge priloge (*other attachments*):

Opis raziskovalnega dela (Research work description)

1. Članica UL (UL member):

Univerza v Ljubljani, Fakulteta za računalništvo in informatiko (University of Ljubljana, Faculty of Computer and Information Science)

2. Ime, priimek in elektronski naslov mentorja/ice (Mentor's name, surname and email):

Slavko Žitnik, slavko.zitnik@fri.uni-lj.si

3. Raziskovalno področje (Research field):

2.07 Računalništvo in informatika
2.07.07 Inteligentni sistemi - programska oprema

4. Opis raziskovalnega dela (Research work description):

Vključuje morebitne dodatne pogoje, ki jih mora izpolnjevati kandidat/ka za mladega raziskovalca/ko, ki niso navedeni v razpisu za mlade raziskovalce (It includes any additional conditions that the candidate for a young researcher must meet, which are not listed in the call to tender for young researchers.).

Slov.:

Od kandidata se pričakuje znanje angleškega jezika, poznavanje metod strojnega učenja (predvsem novejših pristopov z uporabo globokih nevronskih mrež), sposobnost samostojnega organiziranja dela ter natančnost in doslednost.

Podatkovna ekonomija postaja čedalje bolj pomembna tudi izzven področja računalništva in informatike. Uvajajo se agentni sistemi, EU implementira področne podatkovne prostore, pomembni postajajo vidiki varnosti, etike in upravljanja. Povezano s tem se vzpostavljajo Evropske tovarne umetne inteligence, ki bodo združene v Evropsko gigatovarno umetne inteligence, kompetenčni centri skrbijo za povezovanje posameznih akterjev. Glavne tematike, s katerimi se bo ukvarjala mlada raziskovalka ali mladi raziskovalec bodo **avtomatizacija in upravljanje znanja**, predvsem pa **tehnologije naprednejših jezikovnih modelov, agentni sistemi, semantični splet, neuro-simbolna umetna inteligenca**.

Kandidat bo najprej spoznal širše področje obdelave naravnega jezika, pregledal trenutne izzive na področju in se seznanil z najboljšimi dosežki za specifične probleme. Na podlagi tega se bo identificirala specifična tematika raziskovalnega dela. Kot izvorna tematika za raziskovanje bo kandidatu predlagana avtomatska gradnja, vzdrževanje, posodabljanje, preverjanje pravilnosti in uporaba baz znanja, pridobljenih iz besedil (v kombinaciji s strukturiranimi viri). Baze znanja namreč s pomočjo poenotenja in integracije podatkov nudijo uporabo naprednega konteksta in uporabe pomenov (semantike). Pri tem se izpostavljajo izzivi ne samo pri izgradnji takšnih baz, vendar tudi pri njihovi uporabi med različnimi domenami in sklepanju. Poleg širšega področja obdelave naravnega jezika se pričakuje, da se bo kandidat ukvarjal tudi s tesno povezanimi področji informacijskega poizvedovanja, semantičnim spletom in podatkovnimi bazami.

Eng.:

A candidate is expected to communicate in English, to have some knowledge related to machine learning (especially related to newer approaches of deep neural networks), is able to automatically organize his work and is accurate and consistent.

The data economy is becoming increasingly important, also beyond the fields of computer science and informatics. Agent-based systems are being introduced, the EU is implementing sectorial data spaces, and issues of security, ethics, and governance are gaining importance. In this context, European AI Factories are being established and will be integrated into a European AI Gigafactory, while competence centers are ensuring coordination and collaboration among individual stakeholders. The main topics to be addressed by the young researcher will include **automation and knowledge management**, with a particular focus on **advanced language model technologies, agent-based systems, the Semantic Web, and neuro-symbolic artificial intelligence**.

The candidate will first be acquainted with a broader field of natural language processing. Then he will review current challenges in the field and get to know state-of-the-art achievements for specific problems. Based on this work, the specific topic for his research will be identified. Initial research ideas, proposed to the candidate, will focus on automatic construction, maintenance, updating, validation and use of knowledge bases derived from textual sources (in combination with structured sources). Knowledge bases offer advanced contexts and meaning representation (semantics) using unification and integration of data. The main challenges are not only in construction of such data bases but also in their usage among different domains and inferencing. In addition to the broader field of natural language processing, the candidate will work also on closely related research fields of information retrieval, semantic Web and data bases.

5. Priloge, ki jih je treba priložiti ob prijavi (*Documents required to be submitted with the application*):

potrdilo o doseženi izobrazbi (*proof of completed education*)

- kandidat z zaključenim magistrskim študijskim programom (2. bolonjska stopnja) (*candidate who has completed a Master's degree (2nd Bologna level)*):
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osnutek idejne zasnove raziskovalnega dela (*preliminary research proposal*)

priporočilno pismo (*letter of recommendation*)

druge priloge (*other attachments*):