BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Dragutin Petkovic

eRA COMMONS USER NAME (credential, e.g., agency login): SFSUPETK

POSITION TITLE: Associate Chair, Prof. CS Department, SFSU; Director, SFSU Center for Computing for Life Sciences

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
University of Belgrade, Serbia	BS EE	1976	Electrical Engineering
University of Belgrade, Serbia	MS	1978	Biomedical signal proc.
University of California, Irvine	Ph. D.	06/1983	Biomedical image processing

A. Personal Statement

My scientific and technical focus is in four key areas: applications of machine learning (ML); improving and promoting explainability of ML; producing systems (ML or others) that are easy to use, and investigation and application of novel teaching methods in SW engineering education. My focus and contributions are based on combination of applied ML with strong emphasis on the user needs (thus "explainable ML and easy to use systems) and on my industry experience (both in R&D and in SW product management). My specific goals are several: a) develop and promote ML systems and solutions that are accurate, solve real problems especially in health sciences, are easy to use by non-experts, b) develop and promote ML systems that are not only accurate but also explainable, ethical and free of bias; c) educate students in modern SW engineering and improve assessment of SW engineering education using ML; d) contribute and promote ease of use in scientific SW.

B. Positions and Honors

<u>Positions:</u>
Professor, CS Department, San Francisco State University, 2020 – present
Co-lead: SFSU Graduate Certificate in AI Ethics
Professor, Associate Chair, CS Department, San Francisco State University 2015 - 2020
Chair, CS Department, San Francisco State University 2003 – 2015
Director, SFSU Center for Computing for Life Sciences 2005 – present
VMware, Senior Director, Applications 2001 – 2002
Dotcast, Palo Alto, Sr. Director/VP of SW

IBM Almaden Research center, San Jose, Senior Manager
IBM Almaden Research center, San Jose, Researcher

Honors:
IEEE LIFE Fellow since 2018
IEEE Fellow since 1998 (for leadership in content based retrieval area and IBM's QBIC project)
Blue Chip Award from Lou Gerstner, IBM CEO
IBM Research Awards for technical work

C. Contributions to Science (selected works)

Querying Images by Content
After my Ph. D studies, while at IBM I applied image processing and machine learning to the problem of querying by image content. Our QBIC project (query by image content) work is considered one of the pioneering works in this area and produced first results showing this problme is feasible to accomplish. I was manager of the team as well as technical contributor and initiator of the project. For this work I was awarded IEEE Fellowship in 1998

- M. Flickner et al.: "Query by Image and Video Content: The QBIC System", IEEE Computer, Special Issue on Content Based Retrieval, September 1995, pp. 23-32**. (over 5500 as of 2018)**
- C. Niblack, R. Barber, W. Equitz, M. Flickner, E. Glasman, D. Petkovic, P. Yanker, C. Faloutsos, G. TaubinQBIC project: querying images by content, using color, texture, and shape", SPIE, 1993, San Jose (over 2800 citations as of 2018)

Improving explainability of machine learning
Being a practitioner of applied ML and working on much application, I realized that current ML techniques need much better explainability. This was in part motivated by my sensitivity to non-expert user needs (who are often key adopters of ML). Selected works are below.

- Petkovic D., Alavi A., Cai D., Wong M. (2021) Random Forest Model and Sample Explainer for Non-experts in Machine Learning – Two Case Studies. In: Del Bimbo A. et al. (eds) Pattern Recognition. ICPR International Workshops and Challenges. ICPR 2021. Lecture Notes in Computer Science, vol 12663. Springer, Cham. https://doi.org/10.1007/978-3-030-68796-0_5
- D. Petkovic, R. Altman, M. Wong, A. Vigil: "Improving the explainability of Random Forest classifier – user centered approach", Pacific Symposium on Biocomputing PSB 2018, Hawaii

Workshops devoted to AI Ethics and Explainability (leadership role)
- Workshop on Explainable DL/AI, at ICPR 2020, helps on line January 2021; https://edl-ai-icpr.labri.fr/
- Petkovic D, Kobzik L, Ganaghan R, Workshop on "AI Ethics and Values in Biomedicine – Technical Challenges and Solutions", Pacific Symposium on Biocomputing, PSB 2020, Hawaii January 3-7, 2020
- D. Petkovic (Chair), L. Kobzik, C. Re: Workshop on "Machine learning and deep analytics for biocomputing: call for better explainability", Pacific Symposium on Biocomputing PSB 2018, Hawaii

One of the founder of SFSU Graduate Certificate in Ethical AI, between SFSU Computer Science, Business and Philosophy departments; also covered by WSJ On-line (https://cob.sfsu.edu/management/certificate/ai-ethics)

Applications of ML to various biomedical problems
In our collaboration with Stanford we have applied machine learning to problems of functional site detection on 3D molecular models, where we applied and evaluated variety of ML technologies (Naïve Bayesian, Random Forest, SVM). We showed that ML performs well and can predict functional sites with acceptable false alarm rate. We have also built a WWW site allowing users to visualize results. Work was supported by NIH grant.

- L. Buturovic, M. Wong, G. Tang, R. Altman, D. Petkovic: "High precision prediction of functional sites in protein structures", PLoS ONE 9(3): e91240. doi:10.1371/journal.pone.0091240
- Okada K, Flores L, Wong M, Petkovic D, "Microenvironment-Based Protein Function Analysis by Random Forest", Proc. ICPR - International Conference on Pattern Recognition, Stockholm, 2014

Investigation and application of novel teaching methods for SW engineering education

In my academic career, as a teacher and researcher, I combined by industry expertise in SW engineering with my research in ML to investigate how we can better assess and predict student learning of teamwork by using ML. Our focus was on using objective and quantitative measures of student team behavior to predict student teams bound to fail. This work has been applied in ongoing teaching of SE classes at SFSU jointly with Fulda University in Germany and before with FAU in Florida and received NSF TUES funding.

- D. Petkovic, S. Barlaskar, J. Yang, R. Todtenhoefer: "From Explaining How Random Forest Classifier Predicts Learning of Software Engineering Teamwork to Guidance for Educators" Frontiers of Education FIE 2018, October 2018, San Jose CA
- D. Petkovic, M. Sosnick-Pérez, K. Okada, R. Todtenhoefer, S. Huang, N. Miglani, A. Vigil: "Using the Random Forest Classifier to Assess and Predict Student Learning of Software Engineering Teamwork" Frontoiers in Education FIE 2016, Erie, PA, 2016
- D. Petkovic: "Using Learning Analytics to Assess Capstone Project Teams", IEEE Computer, Issue No.01 - Jan. (2016 vol.49). (invited)
- Dragutin Petkovic, Marc Sosnick-Pérez, Shihong Huang, Rainer Todtenhoefer, Kazunori Okada, Swati Arora, Ramasubramanian Sreenivasen, Lorenzo Flores, Sonal Dubey: "SETAP: Software Engineering Teamwork Assessment and Prediction Using Machine Learning", Proc. FIE2014, Madrid, Spain 2014

D. Additional Information: Research Support and/or Scholastic Performance

SFSU PI of NIH sub-grant 2R01LM005652-19A1 (collaboration with PI Prof. R. Altman, Stanford University) "Text Mining for High-fidelity Curation and Discovery of Gene-drug-phenotype Relationships ". This grant includes several sub-projects. Role includes project management, SW Engineering, usability and UI design and evaluation, mentoring SFSU graduate students involved in the project.

SFSU PI of NIH sub-grant U54EB020405 "Mobility Data Integration to Insight", (collaboration with Stanford PI Prof. S. Delp), Role includes project management, SW engineering, usability and UI design and evaluation, mentoring SFSU graduate students involved in the project. Completed 2018

SFSU PI of NIH sub-grant (collaboration with PI Prof. Russ Altman, Stanford University NIH U54 GM072970) on Physics Based Simulation of Biological Structures Simbios. Role included project management, mentoring SFSU graduate students involved in the project, completed 2013 .

PI of collaborative NSF TUES grant 1140172 " Transforming the Understanding, Assessment and Prediction of Teamwork Effectiveness in Software Engineering Education using Machine Learning". Role included: main PI, data collection in joint SW Engineering class with Fulda Germany and FAU, Florida, application of machine learning for assessment of student success, mentoring of graduate students. Completed 2016

SFSU PI of NIH sub-grant (collaboration with PI Prof. Russ Altman, Stanford University NIH R01 LM005652) on "Annotating Functional Sites in 3-D Biological Structures". Role includes project management, SW Engineering, applications of machine learning, usability and UI design and evaluation, mentoring SFSU graduate students involved in the project. Completed 2016.