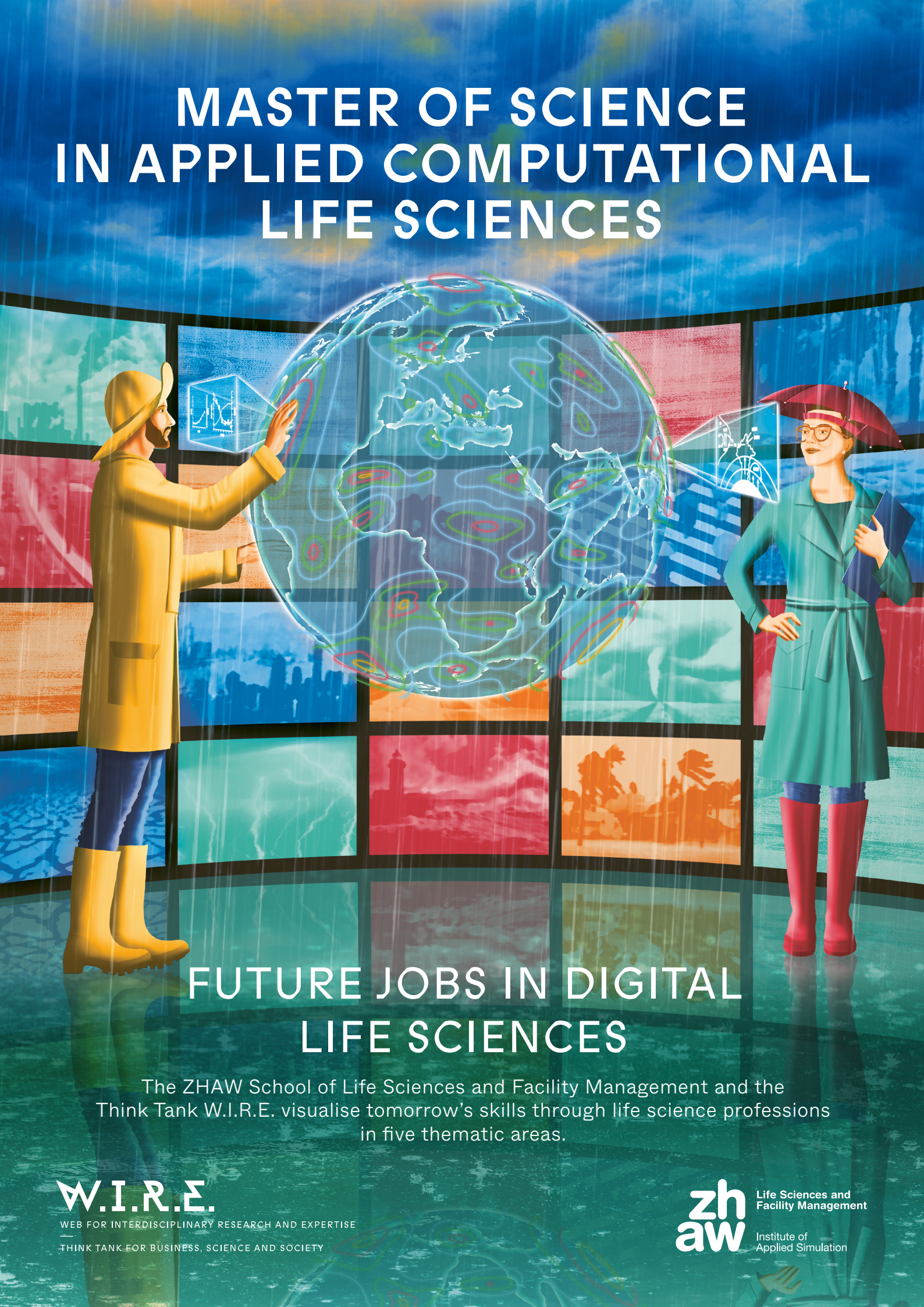
MASTER OF SCIENCE IN APPLIED COMPUTATIONAL LIFE SCIENCES



FUTURE JOBS IN DIGITAL LIFE SCIENCES

The ZHAW School of Life Sciences and Facility Management and the Think Tank W.I.R.E. visualise tomorrow's skills through life science professions in five thematic areas.

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WEB FOR INTERDISCIPLINARY RESEARCH AND EXPERTISE
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THINK TANK FOR BUSINESS, SCIENCE AND SOCIETY

zh aw
Life Sciences and Facility Management
Institute of Applied Simulation

FUTURE JOBS IN DIGITAL LIFE SCIENCES

VIRTUALISATION | AUTOMATION | DECIPHERING NATURE | MINIATURISATION | **DRIVERS OF CHANGE** | ARTIFICIAL INTELLIGENCE | ADDITIVE MANUFACTURING | SELF-ORGANISATION

HEALTH DECODER

The health decoder examines bioinformatical data to facilitate the comprehension of the molecular, physiological, behavioural and social determinants of individual health. By combining genome sequencing with behavioural and physiological data from health-monitoring devices, the health decoder provides personalised treatment and prevention measures. Machine learning methods calibrate biomarkers from sensor data to quantify physiological and behavioural functions. The health decoder functions as a diagnostic partner in close collaboration with other specialists to identify the most effective and cost-efficient diagnoses and treatments.

CLOUD MODELER

The cloud modeler develops data-driven climate models to help understand the effects of climate change on biogeochemical cycles. Using computational fluid dynamics and reaction kinetics, atmospheric chemistry can be simulated. By describing and predicting how the emission of chemicals such as carbon and nitrogen circulate through the atmosphere and interact with other environmental compartments, the cloud modeler provides insights that help us to better understand the impact of natural and human-caused emissions on air quality and the greenhouse effect.

GREENGINEER

Greengineers combine their computational modelling and data-management skills with their understanding of synthetic biology to apply precision agriculture techniques which maximise the crop yield of agricultural products. Data from parameters such as soil moisture and solar factors are collected through sensors, drones and satellite images to create yield, planting and soil fertility maps. Variable rate applications are used to calculate optimal planting prescriptions.

AUTOMATION ARCHITECT

Laboratory tools such as liquid handling robots and automated workstations make it possible to process large amounts of samples through the use of pre-programmed and customisable procedures. Test facilities are available online which allow scientists to remotely access equipment and real-time data. The automation architect operates and supervises the execution of these out-sourced experiments. Due to their programming skills and scientific understanding, automation architects are able to translate out-sourced scientific hypotheses into relevant automated tests.

DATA CHEF

Through crowdsourcing and machine learning techniques, the data chef collects and studies sensory data combined with food chemistry results to gain new insights into dietary habits. The data chef uses network analysis to identify nutritional and chemical factors that determine food selection. In this way, the data chef can suggest new ingredient combinations and support the development of innovative and healthy foods in the lab or with 3D printing.

EXPERTISE

ARTIFICIAL INTELLIGENCE
Machine Learning
Deep Learning
Advanced Analytics

MODELLING AND SIMULATION
Dynamical Systems
Multiphysics
Optimisation

MANAGING COMPLEXITY
Algorithms
Dynamic Programming
Data Engineering and Data Visualisation

INTERDISCIPLINARITY
Agile Methodologies
Intercultural Competence
Communication in Science

DIGITAL ECOSYSTEMS
Research Management
Business Models
Ethics and Legal

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zhaw Life Sciences and Facility Management
Institute of Applied Simulation
MSc Applied Computational Life Sciences
www.zhaw.ch/ias/master

CONVERGING DISCIPLINES AND NOVEL TOOLS: THE FUTURE OF LIFE SCIENCES

Advances in genetic engineering, robotics, artificial intelligence and data analytics are empowering life scientists with a growing set of tools for modelling and modifying the building blocks of life. These developments can be summarised as seven drivers of change.

MINIATURISATION

Microfluidic technologies and the development of new nanomaterials allow life scientists to work with ever-smaller volumes and sizes. By engineering microchips that contain living human cells, the functions of human organs can be replicated in vivo, facilitating the modelling of diseases and the discovery of new clinical biomarkers. Nanorobotics can be used for targeted drug delivery and disease monitoring, and even to perform nanosized surgeries. The improvement of material properties through the manipulation of nanoparticles can lead to new packaging and coating materials that increase food shelf life.

AUTOMATION

By combining artificial intelligence and innovations in robotic engineering, processes in various life science areas are being automated. Machine learning algorithms will be increasingly involved in the design and analysis of experiments, as well as the diagnosis of medical images. Autonomous monitoring instruments are being applied in agricultural and ecological contexts as well, and they can keep track of predefined parameters and automatically respond when required.

VIRTUALISATION

Advanced computational tools facilitate the simulation and visualisation of complex biophysical and environmental systems, such as neurological networks or cloud behaviour. This creates new opportunities to conduct in silico experiments, test hypotheses or develop diagnostic instruments. New computational tools also enable virtual drug discovery, whereby software can model experiments and search for new biomarkers. At the same time, virtual and augmented reality techniques enable life scientists to visualise complex systems in novel and comprehensible ways.

ADDITIVE MANUFACTURING

The combined application of 3D printing techniques and synthetic biology allow biomaterials to be used to create artificial tissue. Additive manufacturing tools assist in various life science areas, from the transplantation of human tissue to the development of biodegradable products via 4D printing. Additive manufacturing tools are also used to fabricate and increase the scale of new food products such as lab grown meat, or to synthesise chemical compounds and print new drugs.

ARTIFICIAL INTELLIGENCE

The collection of large volumes of data is used to provide predictive insights and optimise business processes. Artificial neural networks can analyse data such as cell images and thereby predict how potential drugs would interact, support the development of personalised medicine and optimise treatment plans. Additionally, real-time analysis of crop volume data is used to predict and optimise the food supply chain, whereas processing data can make the entire food production chain more transparent for consumers.

DECIPHERING NATURE

Modelling DNA changes in the genomes of living organisms over time opens a range of new opportunities in all life science disciplines. Such models are used to analyse the evolutionary dynamics of pathogens, which enables gene predictions and specific residues responsible for the pathogenicity of infectious diseases, leading to solutions for their eradication. Computational models help us to understand the functional role of DNA regions in the genomes of crops and livestock animals, which helps to improve resistance to microbial pathogens and climatological challenges. Deciphering the evolutionary history of human populations paves the way for personalised medical treatments.

SELF-ORGANISATION

While digitisation seems to foster centralised data monitoring, its real power is realised through decentralisation. Block chain technologies facilitate new ways of collaboration and distributed secure communication. In healthcare, medical decision support systems can safely utilise large amounts of medical records to improve diagnoses and treatment. Furthermore, autonomous digital agents form increasingly complex self-organising networks of decentralised decision-makers in factories, laboratories or organisations.

MASTER OF SCIENCE IN APPLIED COMPUTATIONAL LIFE SCIENCES

Science and business are undergoing profound changes as a result of the developments of the digital revolution. There is a growing need for experts who combine specific knowledge in a scientific discipline with skills in data science, modelling and computation.

Expertise in working with digital tools and large quantities of data are key supplementary skills for subject specialists. As a student of the Master of Science in Applied Computational Life Sciences, you will acquire these supplementary skills and combine them with the subject-specific experience and knowledge that you gained in your Bachelor's degree.

YOUR BACKGROUND

Do you have a Bachelor's degree in one of the following fields or in a related field?

- Agronomy
- Bioanalytics and Cell Biology
- Biology
- Biotechnology
- Chemistry
- Energy and Environmental Technology
- Engineering
- Environmental Technology
- Food Science and Management
- Food Technology
- Forest Sciences
- Medical Technology
- Natural Resources and Environment
- Pharmaceutical Technology
- System Technology

Are you fascinated by the potential of digital technology? Then come and expand your career options by becoming a data science and simulation expert in your field. If you are interested but your background differs from the above fields, please contact us.

FLEXIBLE STUDY AGREEMENT

Before your studies begin, you decide on your personal educational goals, define the topic of your Master's thesis and work with your supervisor to create your individual study plan from a selection of available modules. Your personal study program is based on your educational background, your interests and your objectives. You will be able to profit from close interaction with your supervisor, both at the beginning of and throughout your studies. The Study Agreement is a learning tool that defines the balance between independent learning, contact lessons and e-learning.

YOUR FIELD OF INTEREST

- Artificial Intelligence and Predictive Analytics
- Biomedical Simulation
- Citizen Science Technologies
- Climate Modelling
- Complex Systems
- Computational Genomics
- Data Integration and Semantic Web Technologies
- Digital Health
- Forecasting & Decision Making
- Geoinformatics
- Health Technologies
- Lab Information and Management Systems LIMS
- Process Optimisation in Food Technology
- Smart Environmental Systems
- Smart Farming

You can choose your thesis topic and your advisor based on your field of interest. You will be placed in one of our specialisation tracks, which will fully prepare you for your Master's thesis in your area of study.

HANDS-ON MASTER'S THESIS

During your Master's thesis, you will be part of a cutting-edge research group. This may be in close collaboration with our industry partners or as part of a research group in one of the life science institutes at the ZHAW. You can visit our thesis marketplace at www.zhaw.ch/ias/master, or even contact us with your own ideas!

YOUR NEW SKILLS

- processing and analysing data of various sizes and levels of complexity
- conceptual and technical skills to combine your expertise in a life sciences discipline with the potential of computational methods
- computational modelling and simulation of processes
- statistical modelling with machine learning and neural networks
- programming using modern scripting languages such as Python and R, which will enable you to understand the basic concepts of software and computer architectures
- analysis and solving of complex problems that combine scientific, social and entrepreneurial thinking
- planning, implementation, evaluation and presentation of major research and development projects

MSC APPLIED COMPUTATIONAL LIFE SCIENCES

Duration and workload:
3 semesters of full-time study; part-time also possible (90 ECTS)
Starts in: September, February
Registration deadline: 31 October and 30 April
Language: English
Entry requirements: Bachelor's degree from a university of applied sciences, university or ETH
Further information: www.zhaw.ch/ias/master
Registrar's office Master of Science in Life Sciences:
+41 (0) 58 934 59 61 / master.lsfm@zhaw.ch

WE ARE PASSIONATE ABOUT PREPARING YOU FOR EXCITING JOB PROSPECTS IN THE EMERGING FIELDS OF DIGITAL LIFE SCIENCES

THE INSTITUTE OF APPLIED SIMULATION

Computational science, with the central topics of modelling, simulation, optimisation and data analytics, is the focus of work and research at the Institute of Applied Simulation. Computational science is an interdisciplinary approach to dealing with complex problems and developing new solutions in the key areas of health, society, food and the environment. The institute thus makes an important contribution to meeting societal challenges and improving quality of life.

Working in conjunction with businesses, public agencies and associations, our institute engages in applied research and provides services for third parties. Close collaboration with external parties ensures the transfer of knowledge and technology between the academic realm and professional practice.

THE ZHAW SCHOOL OF LIFE SCIENCES AND FACILITY MANAGEMENT

The ZHAW (Zurich University of Applied Sciences) is one of the leading universities of applied sciences in Switzerland. Teaching, research, continuing education, consulting and other services are scientifically-based and practice-oriented. The ZHAW is comprised of eight schools at three locations (Wädenswil, Winterthur, Zurich). Currently, over 13,000 students are enrolled at the ZHAW.

The School of Life Sciences and Facility Management (LSFM) is located in Wädenswil on the Lake of Zurich. Teaching and research are carried out in the fields of environment, nutrition/food, health and society. The degree and continuing education programmes include five Bachelor's degree programmes, three Master's degree programmes and a wide range of continuing education courses. Around 1,500 students are currently enrolled at the LSFM in Wädenswil.