WILDDRONE

D4.3 – Curriculum of e-learning

WP4, T4.1 Organise and implement outlined training

Version 1.0 – 24/01/2024

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Technical References

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Executive Summary

WildDrone Doctoral Candidates (DCs) join from diverse backgrounds, creating a multidisciplinary network with great potential but specific training and support needs.

Knowledge- and skill-based needs are addressed in part through a series of e-learning modules, permitting participants to self-direct and self-pace as required. These are supplemented by monitoring and intervention from the Training Coordinator and wider network.

This deliverable details the e-learning components of DC training, including curriculum, assessment, and evaluation approaches. As courses are currently underway, initial participant feedback is presented, indicating confidence in the approach and resources and additionally highlighting items for proactive support. Formal evaluation is to follow in later deliverables.

Keywords: training, education, ecology, conservation, intelligent robotics, machine learning

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1. Introduction

1.1. Purpose, scope, and target group

This deliverable summarises the combined curriculum of the e-learning training activities delivered to WildDrone doctoral candidates (DCs) in the 2023-2024 academic year.

This deliverable reports Work Package 4 (WP4) progress to project partners and funders and is also intended for reference by future projects as a training approach upon which to build.

1.2. Contributing partners

Table 1-1: Contribution of partners

Partner	Contribution
Syddansk Universitet (SDU)	S4&5 Multidisciplinary Computer Science e-learning
Westfaelische Wilhelms-Universitaet de Muenster (WWU)	S4&5 Multidisciplinary Computer Science e-learning
Wageningen University (WU)	S3 Multidisciplinary Ecology e-learning

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1.3. Relation to other activities in the project

Table 1-2: Relation to other activities in the project

Task	Description
4.1 Organize and implement the outlined training	This set of activities is part of the wider doctoral candidate training programme and lays the foundation for later development activities.
4.2 Personal Career Development Plans	All doctoral candidates will prepare personal development plans, for which core WildDrone training activities will form a part.
Tasks in WP 1,2,3,5	These training activities form a foundation to enable high-quality doctoral candidate contribution to project-wide activities.

1.4. Delays and obstacles

Due to recruitment and reallocation of a new WP4 lead this deliverable's submission deadline was extended.

1.5. Potential for dissemination, exploitation, and communication activities

This summary and associated training materials, where permitted, will be distributed to partners and disseminated via the WildDrone training repository (Figure 1-1). The repository is a Docusaurus[1] instance hosted at https://wilddrone.github.io/training/, and compiled remotely as a static site via a custom GitHub Action script[2]. It will remain online beyond the end of the WildDrone project, to be used as a resource for future projects and wider interested parties.

[1] https://docusaurus.io
[2] https://github.com/WildDrone/training/blob/main/.github/workflows/docusaurus-gh-pages.yml

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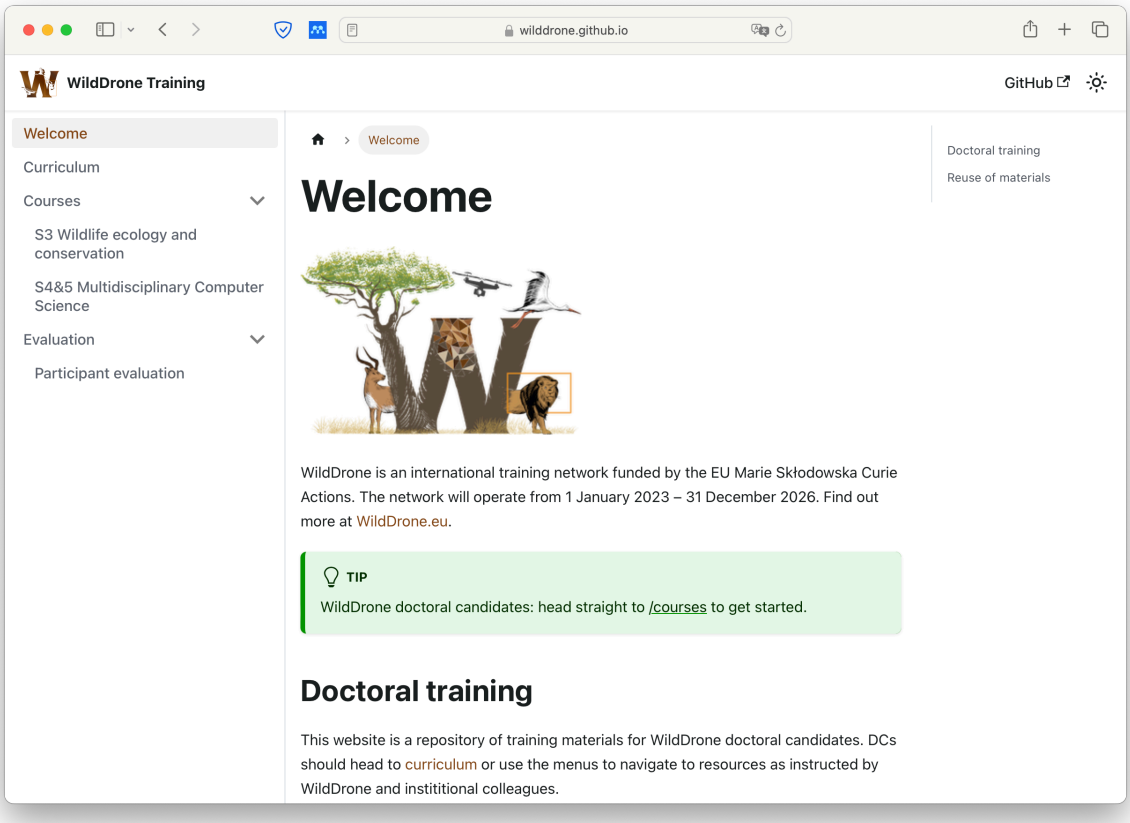

Figure 1-1: WildDrone training repository at http://wilddrone.github.io/training/

1.6. Ethical and security considerations

No direct ethical or security issues were encountered in the activities detailed in this deliverable.

Based on participant evaluations detailed in deliverable *D4.2*, additional support has been implemented to assist participants in developing their Data Management Plans (DMPs), in particular the tensions between open data and the considered and ethical use of data sets and machine learning tools.

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2. Summary of e-learning

Given the diverse backgrounds of WildDrone DCs, spanning disciplines across biological sciences, engineering, and computer science, a series of self-directed and self-paced courses have been developed to provide a common base for collaboration. DCs will self-select courses based on their specific training and development needs. ECTS can be awarded by SDU on submission of related assignments depending on local awarding requirements.

The doctoral training curriculum is divided into:

- Research Skills (R),
- Scientific and Technical Skills (S), and
- Transferrable Skills (T).

Most Research and Transferrable Skills courses are delivered in-person due to their collaborative nature. The two Scientific and Technical Skills courses detailed in this deliverable have their content delivered asynchronously, with peer and academic support facilitated through the WildDrone collaborative online space via messaging and live drop-ins where desirable.

2.1. Context

The e-learning courses are part of a wider doctoral training programme extending throughout the 48-month project period, intended to achieve the interdisciplinary goals of WildDrone, and at the same time provide the best possible context for each DC to complete their individual PhD projects. Elements are delivered in-person and online.

Elements summarised in this deliverable are listed in Table 2-1, and the wider programme can be found in the WildDrone Description of Action (DoA) Table 1.3b.[3] Many elements are awarded ECTS credits and elements can be tailored and scaled, permitting DCs to meet the requirements of their home institution.

2.2. Schedule

Courses S4 and S5 were initially separate in the WildDrone proposal and DoA, as 'programming & data science basics' and 'applied machine learning for computer vision', respectively. These have been combined to take advantage of the overlap between the topics. The present structure is detailed in Table 2-1.

Table 2-1: List of e-learning courses

	Course	ECTS
S3	Multidisciplinary Ecology e-learning	3
S4&5	Multidisciplinary Computer Science e-learning	3

[3] https://doi.org/10.3030/101071224

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2.3. Assessment

The e-learning courses deliver a foundation upon which DCs will build throughout their projects, developing and demonstrate their abilities to meet learning outcomes through their wider PhD work.

As such, no summative assessment has yet been submitted, but deadlines for submissions span the remainder of their programme. DCs' assessment and attainment will be documented in later deliverables, and ECTS will be awarded by SDU based on submissions from individual DCs.

2.4. Evaluation approach

As of submission of this report, DCs' progression through the e-learning courses is currently underway. A number of DCs have responded confidently to requests for initial anecdotal feedback, this has been used to clarify structure and expectations, and this will continue throughout the project's timeline.

DCs have also been asked to self-rate their confidence in areas covered by the *S4&5 Multidisciplinary Computer Science e-learning* course, and this is summarised in section 2.5.

Formal evaluation will be undertaken later in the project, in a similar manner to that employed for *D4.2 - Curriculum of M9 training events*, and will be included in deliverable *D4.10 - Joint curriculum including lessons learned*. Interim evaluations may be conducted ad-hoc and will be published on the WildDrone training repository website[4].

2.5. Initial feedback

DCs were asked to self-rate their own confidence and the local support that they were aware of, in order to identify individuals who might require additional resource to access the e-learning materials. Three questions were asked via email, with a solicitation for as much or as little detail as participants wished, and responses were categorised by the Training Coordinator into low/medium/high capacity, and summarised in Table 2-2.

Questions:

1. How confident are you with Python/coding in general?
2. How much support do you have in your local institution?
3. Have you already set up your own Python environment locally?

It should be noted that a 'low' support score may not indicate poor institutional support availability, just that the DC is not aware of support that is available. A correlation can be identified between indicated confidence and level of support, which supports this.

Question three was intended to be a 'yes/no' answer to gauge whether further support (dependent on need) should be offered, but DCs gave detail indicating more or less confidence and sophistication, so responses were also categorised low/medium/high.

[4] https://wilddrone.github.io/training/category/evaluation

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Table 2-2: DC self-reported Python confidence, perceived level of local support, and programming environment set-up status

Python level	Local support	Set up env
M	M	M
H	H	H
L	L	L
H	H	H
H	H	H
H	H	H
M	H	M
M	H	M
M	M	M
H	M	H
L	M	L
H	H	H

(DC ordering randomised)

For DCs reporting low confidence and low or medium perceived support, the Training Coordinator will meet with candidates to identify needs, requirements, and appropriate interventions in order to develop skills and cement confidence in institutional and WildDrone support.

2.6. Actions

The actions detailed in Table 2-3 will be undertaken as follow-up to the initial anecdotal e-learning evaluation.

Table 2-3: Actions to be taken

	Course	Action	By	Due
1	All	Disseminate initial feedback to course leads.	SB	Done
2	S4&5	Plan and schedule Jan/Feb 2024 online drop-ins for general troubleshooting and advice.	SB/EP	Done
3	S4&5	Plan and schedule Jan/Feb 2024 1:1s, prioritising DCs with lower confidence and less local support.	SB/EP	Done
4	All	Undertake formal evaluation of S3, S4&5 courses once DCs have worked through them. To be published in D4.10.	SB	End 2024

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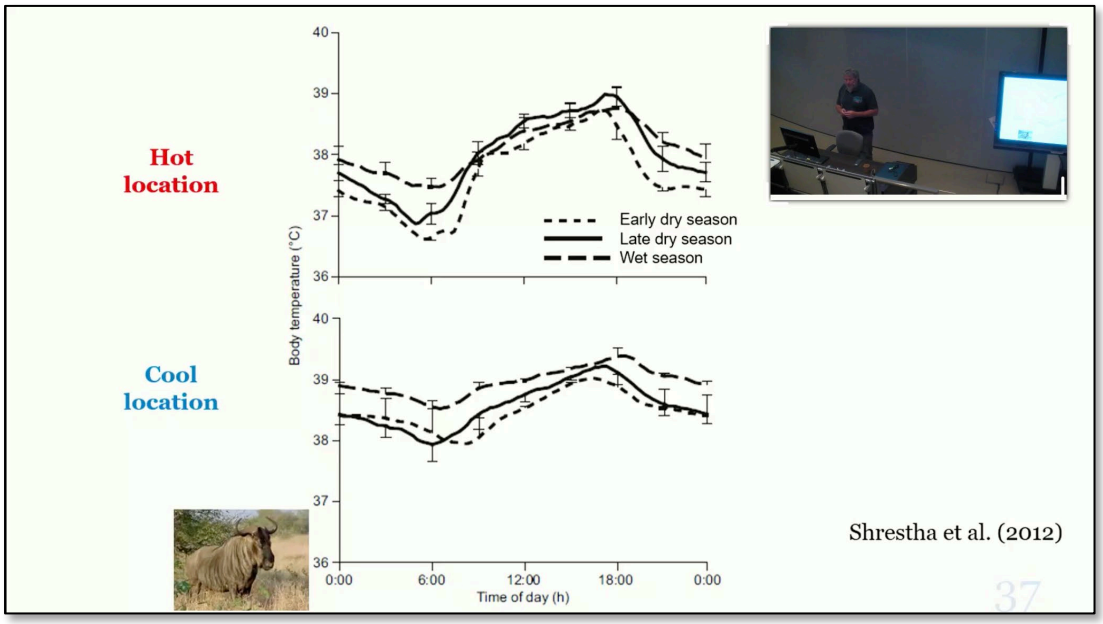
3. Training Curriculum

This section details each e-learning course in a common format.

3.1. S3 Multidisciplinary Ecology e-learning



Course title	Multidisciplinary Ecology e-learning		
Course code	S3	**Lead institution**	MPG, WU
ECTS	3	**Location**	e-learning
Intended Learning Outcomes			
Students will be able to: 1. understand basic concepts in ecology and biodiversity conservation, with a focus on wildlife ecology and conservation. 2. explain the societal importance of biodiversity and wildlife species. 3. evaluate threats to biodiversity and wildlife species and suggest wildlife management and conservation strategies.			
Assessment			
• Written account. • Consider how the topics covered impact your particular research aims. Write a critical summary describing how you will use concepts from at least three of the lectures to support your doctoral project. This should read well on its own but your writing could eventually end up as part of a paper or thesis.			

This course has been developed from existing teaching at Wageningen University, based on content delivered by their Wildlife Ecology & Conservation Group[5] in their WEC30306 Animal Ecology and WEC32806 Wildlife Ecology and Conservation modules.

[5] https://www.wur.nl/en/research-results/chair-groups/environmental-sciences/wildlife-ecology-and-conservation-group/education.htm

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DCs review a series of video lectures and incorporate concepts from these into their main research. Assessment of learning for this course is based on participant reflection about how this material has informed their research.

3.1.1. Curriculum

Animal Ecology

- Body size and food webs
- Competition, facilitation, and predation
- Activity patterns, and adaptation to stress
- Space use, sociality and group living
- Species diversity, migration, and movement

Wildlife Ecology & Conservation

- Threats to biodiversity
- Landscape modification, habitat loss and fragmentation
- Species protection
- Area protection
- Population Viability Analysis
- Understanding species distribution models
- The human context part I
- Limitations to distribution ranges
- Landscape planning
- Ecological restoration
- The human context part II
- Technology, conservation, and rewilding

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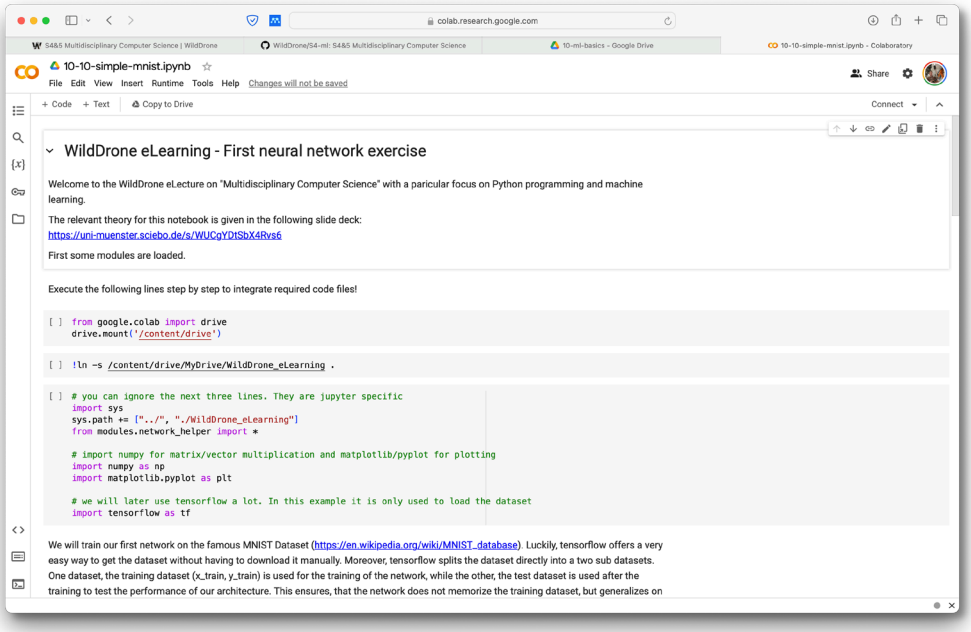
3.2. S4&5 Multidisciplinary Computer Science e-learning



Course title	Multidisciplinary Computer Science e-learning		
Course code	S4&5	**Lead institution**	WWU
ECTS	3	**Location**	e-learning
Intended Learning Outcomes			
Students will be able to: 1. Set up and use a Python programming environment, either online or locally. 2. Use scientific computing packages such as NumPy and SciPy. 3. Use deep learning approaches for computer vision applications based on TensorFlow and/or PyTorch.			
Assessment			
• Jupyter Notebook, graded pass/fail.			

DCs joined WildDrone with widely varying skillsets in computer science and machine learning, which will form a core part of the network's research. A flexible self-paced course has been developed, building on well-regarded open-sourced basic primers from institutions such as Stanford[6], and moving on to bespoke materials covering image processing and machine learning concepts for ecology.

Python is the most popular language for machine learning, and a solid first language for learning to code, and is therefore what this course focuses on.

DCs are supported, where needed, in getting started in their coding, and the Training Coordinator ensures that any further needs not met by local institutions can be addressed via the network.

[6] https://cs231n.github.io/python-numpy-tutorial/

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DCs are provided with slides containing theoretical concepts, and a series of Jupyter notebooks which combine code and explanatory text and figures, permitting highly interactive learning. DCs can run these in the Google Colab online environment, and then progress to downloading the files and running them in their local development environment.

3.2.1. Curriculum

- Tutorials
  - Introductory Python tutorial
- Imaging
  - Image formation
  - Colour-based segmentation
  - Colour representation
- Machine Learning basics
  - Simple neural network exercise with MNIST
- Tensorflow basics
  - Regression
  - Classification
  - MNIST revisited
- Further techniques
  - Support Vector Machines
  - Decision trees
- Convolutional Neural Networks
  - MNIST again
  - CIFAR-10
- Data loading and exploration
  - Reading data with NumPy
  - Reading and exploring data with Pandas
- Tensorflow with data
  - Simple example
  - Complex list files
  - Complex from slices
  - Complex generator
- Recurrent Neural Networks
  - Forecasting univariate data
  - Forecasting multivariate data
- Autoencoders
  - MNIST again
  - Credit card data
- Overfitting
  - CIFAR-10

Assessment is via submission of a Jupyter notebook evidencing ways in which DCs have used their programming skills to meet their research goals.

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4. Conclusions

The e-learning components of WildDrone doctoral candidates' development are underway, with participants reporting that they are comfortable accessing the learning materials and are finding them helpful to their research.

The curriculum presented here is flexible and permits DCs to tailor their learning to their prior experience and their research needs. Network-provided and local institutional support is ongoing and will be continually monitored.

Actions as detailed in Table 2-3 are underway to ensure responsiveness to DC needs and effective follow-up.

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