

BioNT - Network for Training

Deliverable 1.2 | Introduction to programming languages



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Project partners

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2. BIOBYTE SOLUTIONS GMBH (BIOBYTE)
3. HPC NOW CONSULTING SL (HPCNOW)
4. UNIVERSITETET I OSLO (UO)
5. UNIVERSITAT DE BARCELONA (UB)
6. INFORMATION CENTRE FOR LIFE SCIENCE (ZBMED)
7. SIMULA CONSULTING (SIMULA)
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Project overview

The BioNT consortium is dedicated to providing a comprehensive training program and fostering a community for digital skills relevant to the biotechnology industry and biomedical sector. With a curriculum tailored for both beginners and advanced professionals, BioNT aims to equip individuals with the necessary expertise in handling, processing, and visualising biological data, as well as utilising computational biology tools. Leveraging the consortium's strong background in digital literacy training and extensive network of collaborations, BioNT is poised to professionalise life sciences data management, processing, and analysis skills.

Second training workshop report in summary

BioNT delivered its second training workshop in November 2023. This document reports about this workshop regarding its organisation, the applicants and participants, as well as their feedback about it. The report also touches on the different advertising channels used to reach the project's target audience, as well as on the methods developed exclusively for creating and delivering BioNT's training workshops.

Introduction to Programming Languages

BioNT conducted its second training workshop, an introduction to the programming language Python, from the 21st to the 24th of November 2023. The workshop titled “From Hero to Zero with Python” was offered free of charge to the participants and took place fully online.

Within this practical introduction to Python 3, key concepts of programming languages were explained and put into practice. In addition, practical libraries for data analysis and methods for visualising the results were demonstrated. The material was complemented by a brief introduction to GitLab and an exploration of Jupyter Book, along with guidance on hosting a website using GitLab. The well-rounded program provided participants with skills to perform basic programming tasks, especially in the context of data analysis. It also enabled them to publicly present their work and results via a website. This way, they learned how to share their work with potential collaboration partners.

Python is considered to be an excellent programming language to start a successful programming journey. Using [The Carpentries](#) online learning materials proved to be beneficial as they are the result of a community-driven development process and have been improved and validated through extensive workshop evaluation.

Organisation of the workshop

This workshop ran for four days, from the 21st to the 24th of November 2023. The entire event was conducted virtually with no cost for participants. Each day, a 3-hour session was delivered from 18:00 to 21:00 CET. As this was the second workshop delivered in BioNT’s basic curriculum, the standard operating procedure (SOP) developed during the first workshop (a protocol document describing the steps and timeline to organise a BioNT workshop) was followed and further improved.

Webpage and registrations

The CECAM event management platform, provided by the EPFL, was used to create a dedicated webpage for the workshop, which included the workshop description, learning objectives, requirements, program (Figure 1), and any further information relevant to potential participants. The webpage is accessible at <https://www.cecarn.org/workshop-details/1265>.

Tuesday November 21st 2023 - Day 1

- 18:00 to 18:20 - Welcome + Ice-breaker
- 18:20 to 18:30 - Summary and Setup
- 18:30 to 18:50 - Running and Quitting
- 18:50 to 19:15 - Variables and Assignment
- 19:15 to 19:40 - Data Types and Type Conversion
- 19:40 to 19:55 - Break
- 19:55 to 20:25 - Built-in Functions and Help
- 20:25 to 20:50 - Libraries
- 20:50 to 21:00 - Summary + Feedback

Wednesday November 22nd 2023 - Day 2

- 18:00 to 18:10 - Welcome + Summary
- 18:10 to 18:35 - Reading Tabular Data into DataFrames
- 18:35 to 19:10 - Pandas DataFrames
- 19:10 to 19:45 - Plotting
- 19:45 to 20:10 - Lists
- 20:10 to 20:25 - Break
- 20:25 to 20:55 - For Loops
- 20:55 to 21:00 - Summary + Feedback

Thursday November 23rd 2023 - Day 3

- 18:00 to 18:10 - Welcome + Summary
- 18:10 to 18:40 - Conditionals
- 18:40 to 19:00 - Looping Over Data Sets
- 19:00 to 19:30 - Writing Functions
- 19:30 to 19:55 - Variable Scope
- 19:55 to 20:10 - Break
- 20:10 to 20:45 - Programming Style
- 20:45 to 21:00 - Summary + Feedback

Friday November 24th 2023 - Day 4

- 18:00 to 18:10 - Welcome + Summary
- 18:10 to 18:30 - Introduction
- 18:30 to 18:50 - Authoring With Markdown
- 18:51 to 19:20 - Hosting Pages on GitLab
- 19:20 to 19:35 - Break
- 19:35 to 20:05 - Work with Jupyter books locally
- 20:05 to 20:30 - Host Jupyter Books in GitLab
- 20:30 to 20:40 - Summary
- 20:40 to 20:50 - Final remarks
- 20:50 to 21:00 - Feedback survey

Figure 1 - Workshop program as displayed on the [event page](#) at the CECAM platform.

For registration, the CECAM platform was used to manage the applicant's information and communication. In parallel, the EMBL servers were used to collect pre- and post-workshop information through pseudo-anonymised surveys. The survey data was linked to the applicant's data only via a unique identifier, provided in the CECAM registration process, as well as in the EMBL-based survey. This ensured that only the workshop organisers accessed the applicants' personal data while still collecting information relevant to the workshop separately. To register, applicants had to: (i) register on the CECAM platform, (ii) complete and submit the pre-workshop survey, and finally (iii) complete the application on the CECAM platform using the unique identifier provided in the pre-workshop survey.

Applications were reviewed based on answers in the pre-workshop survey (containing no personal information). Applicants working in small and medium enterprises (SMEs) or who identified themselves as job seekers would have been prioritised if needed, but after a thorough assessment of technical and personnel capacity, all 50 applicants were accepted. The communication of the application outcome to all participants, as well as any additional communication, was performed via the CECAM platform.

Advertisement

The workshop was advertised via social media (Figure 2 A-B), several websites, mailing lists or Slack spaces of networks and communities (ELIXIR, Research Data Alliance (RDA), Bioconductor, de.NBI, NFDI4Microbiota, LifeSciTrainer and the Open Life Science (OLS)).



Panel A (LinkedIn):

BioNT 163 followers
2mo •

Calling all learners! 🌟 Join us for **#BioNT's** second workshop titled "From zero to hero with Python!" 🚀🔗

Are you eager to acquire the foundational skills of coding using the Python programming language? Join us at BioNT, for a 4-day workshop (comprising half-day sessions) designed to introduce Python3 programming to individuals with limited or no prior coding experience. By the end of this workshop, you will also gain insight into Jupyter Book and learn how to host a website on GitLab.

Don't miss out on this incredible opportunity! Visit our event webpage now to discover the program details, meet the organising team, and submit your application. Remember, participation in the workshop is completely free, but seats are limited!

<https://lnkd.in/eu9JGGhX>

#LearningOpportunity #BioinformaticsWorkshop #DigitalLifeSciences #NetworkForTraining #ComputationalLifeSciences

From zero to hero with Python
cecam.org • 3 min read
BioNT - BIO Network for Training - is an international consortium of academic entities and ..

Panel B (Twitter):

BioNT @biont_training · Sep 6

🌟 Exciting news! Join us for the second **#BioNT** workshop and unlock the power of Python! 🚀🔗🌟

💡 Don't miss out! Participation is free but seats are limited. Click below to learn more about our offer! 📌

shorturl.at/qDPW2

#LearningOpportunity #BioinformaticsWorkshop

1 reply • 2 retweets • 2 likes • 310 views

BioNT @biont_training · Sep 6

💡 Don't miss out! Participation is free but seats are limited. Click below to learn more about our offer! 📌

shorturl.at/qDPW2

#DigitalLifeSciences #NetworkForTraining #ComputationalLifeSciences

1 reply • 2 retweets • 2 likes • 23 views

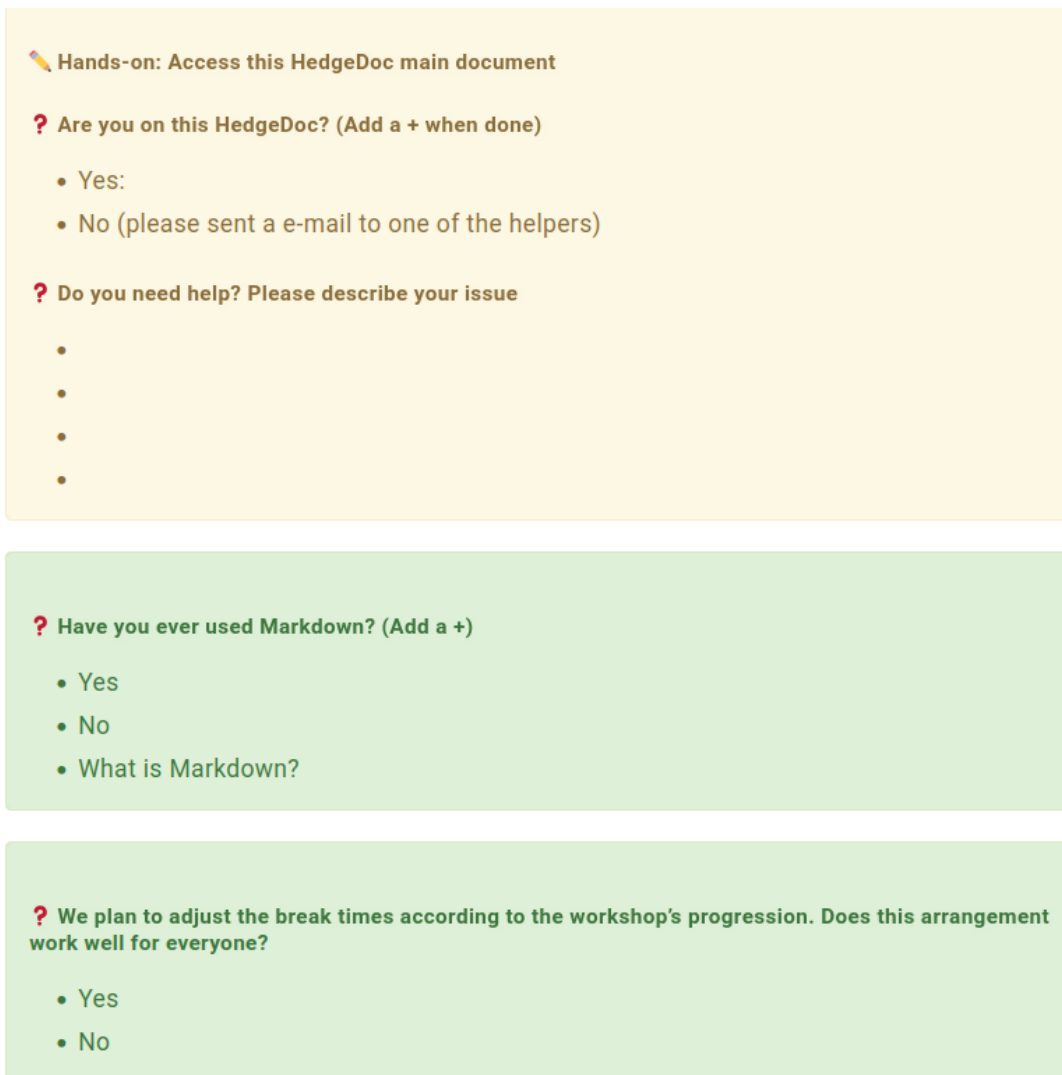
Figure 2 - Screenshots of the examples of advertisement through social media (**A** - LinkedIn, **B** - Twitter).


Infrastructure for the workshop

The workshop was delivered in a Zoom webinar format, with participants' visibility disabled to preserve their privacy. Participants were able to see and learn from the trainers but direct interactions (e.g. chat or voice) were not possible within Zoom during the sessions. All direct interaction took place in written form via a collaborative document, where anonymous

participation was possible. To serve the collaborative documents, a [HedgeDoc](#) collaborative space was set up by BIOBYTE, and was hosted on their server.

A **Main** collaborative document, set up by the instructors and organisers, was shared with the participants before the workshop. Each section of the workshop had dedicated *Hands-on* boxes to report on the task status, ask questions or raise issues. Helpers engaged and assisted participants by answering the questions and issues directly in this document. This Main document was updated live during the workshop. Separate boxes to answer questions were used to improve participant engagement and as an indirect learning assessment (Figure 3).



 **Hands-on: Access this HedgeDoc main document**

? Are you on this HedgeDoc? (Add a + when done)

- Yes:
- No (please sent a e-mail to one of the helpers)

? Do you need help? Please describe your issue

-
-
-
-

? Have you ever used Markdown? (Add a +)

- Yes
- No
- What is Markdown?

? We plan to adjust the break times according to the workshop's progression. Does this arrangement work well for everyone?

- Yes
- No

Figure 3 - Example of question and hands-on boxes in the collaborative document.

To help with the organisation, four HedgeDoc documents were used: (i) a [Template](#) with all instructions and boxes for hands-on, questions, etc; (ii) the [Main](#) document with the information for the participants during the workshop, filled with boxes related to the section covered by the instructor to help with the navigation and cleaned during each break to avoid an overcrowded document; and (iii) a [History](#) document collecting all the content from the

Main document. This document was shared with participants during the workshop, to grant them access to all prior conversations. In addition, (iv) a [document](#) for Helpers & Instructors was created providing the workshop setup, interactions and explaining tasks of the helpers and instructors.

To enhance the structure of the workshops, an improved version of the document for Helpers & Instructors was used: The roles of the Helpers were clearly defined, including step-by-step information for their tasks before, during, and after the workshops.

The training material used during this workshop (Table 1) were slides and tutorials sourced from The Carpentries, a nonprofit organisation that teaches software engineering and data science skills in order to conduct efficient, open, and reproducible research. Their volunteer instructors (4287) have run 4000+ workshops in 65 countries since 2012, with 450+ alone in 2022 (data from the annual [report](#)). All their lesson materials are freely reusable under the Creative Commons - Attribution licence and are stored on [The Carpentries website](#). Existing tutorials and exercises were used for the first three days of the workshop. However, for the final day, a customised tutorial was created exclusively for this workshop and will be shared with The Carpentries to support their distribution and widen their reach. The customised tutorial was designed on two specific use cases of SMEs and job seekers, as it teaches how to build a website and host it for free with basic programming skills. This could be useful for people with the need to share a data analysis report with colleagues and beyond, or for people that want to host their CV or group/business website online.

Day	Topic	Tutorial
Day 1	Programming environment setup	Summary and Setup 1. Running and Quitting 2. Variables and Assignment 3. Data Types and Type Conversion 4. Built-in Functions and Help 6. Libraries
Day 2	Tabular data manipulation and visualisation	7. Reading Tabular Data into DataFrames 8. Pandas DataFrames 9. Plotting 11. Lists 12. For Loops
Day 3	Advanced programming	13. Conditionals 14. Looping Over Data Sets 16. Writing Functions 17. Variable Scope 18. Programming Style
Day 4	Build a website using Jupyter Book	GitLab and JupyterBook. Website hosting in GitLab

Table 1 - Program and training material per day.

Certificates

Certificates (Figure 5) were provided to those participants who explicitly requested them and fulfilled these criteria: (i) they joined at least one session on Zoom or notified the organisers that they could not attend, (ii) they provided the Jupyter notebooks of day 2 and day 3 that they created during the workshop and (iii) they completed the post-workshop survey.

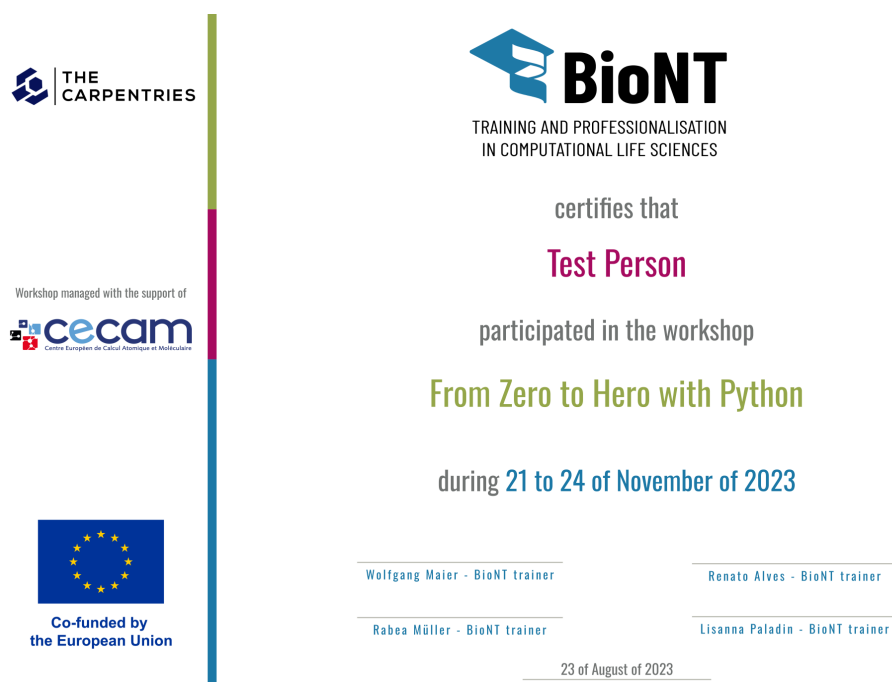


Figure 5 - Template used to generate certificates.

Outcomes of the workshop

Applications and pre-workshop survey

60 applicants completed the pre-workshop survey and 50 submitted their application form via the CECAM platform. Out of the 50 submissions, one participant was added after the deadline had passed. Unfortunately, this person did not fill in the pre-workshop survey and therefore only the answers of the other 49 participants were included in the following analysis. The pre-workshop survey comprised 10 questions covering skills, demographics, and miscellaneous topics. The majority of questions were optional for the successful completion and submission of the survey.

General information

The 49 applicants, almost at a balanced gender representation with 55% male and 43% female (2% preferred not to say), were from and were working in 28 different countries (Table 2), and described themselves as 38% White, 32% Asian, 13% Black or African American, 11% Hispanic or Latino(a), 2% Slavic and 4% preferred not to say.

Country	Nationality	Employment
Algeria	1	1
Austria		1
Belgium		1
Canada		1
Colombia	1	
Czechia	1	1
Egypt	1	
France		1
Germany	2	8
Greece	1	
India	10	6
Indonesia	1	
Iceland		1
Israel	1	
Italy	3	2
Kenya	3	3
Malaysia	1	1
Mexico	1	
Morocco	1	1
Nigeria	1	
Norway		1
Poland	2	1
Portugal	1	1
Romania	3	3
Spain	5	5
Sweden	3	3
Turkey	3	2
United States of America	2	5

Table 2 - Workshop applicants' nationality and country of employment from the pre-workshop survey.

Most applicants worked or studied in the fields of Biomedical or Health Sciences (data not shown) and were academic employees (Figure 5 - B) in the category of graduate students (31%) or research staff (18%) (Figure 5 - A).

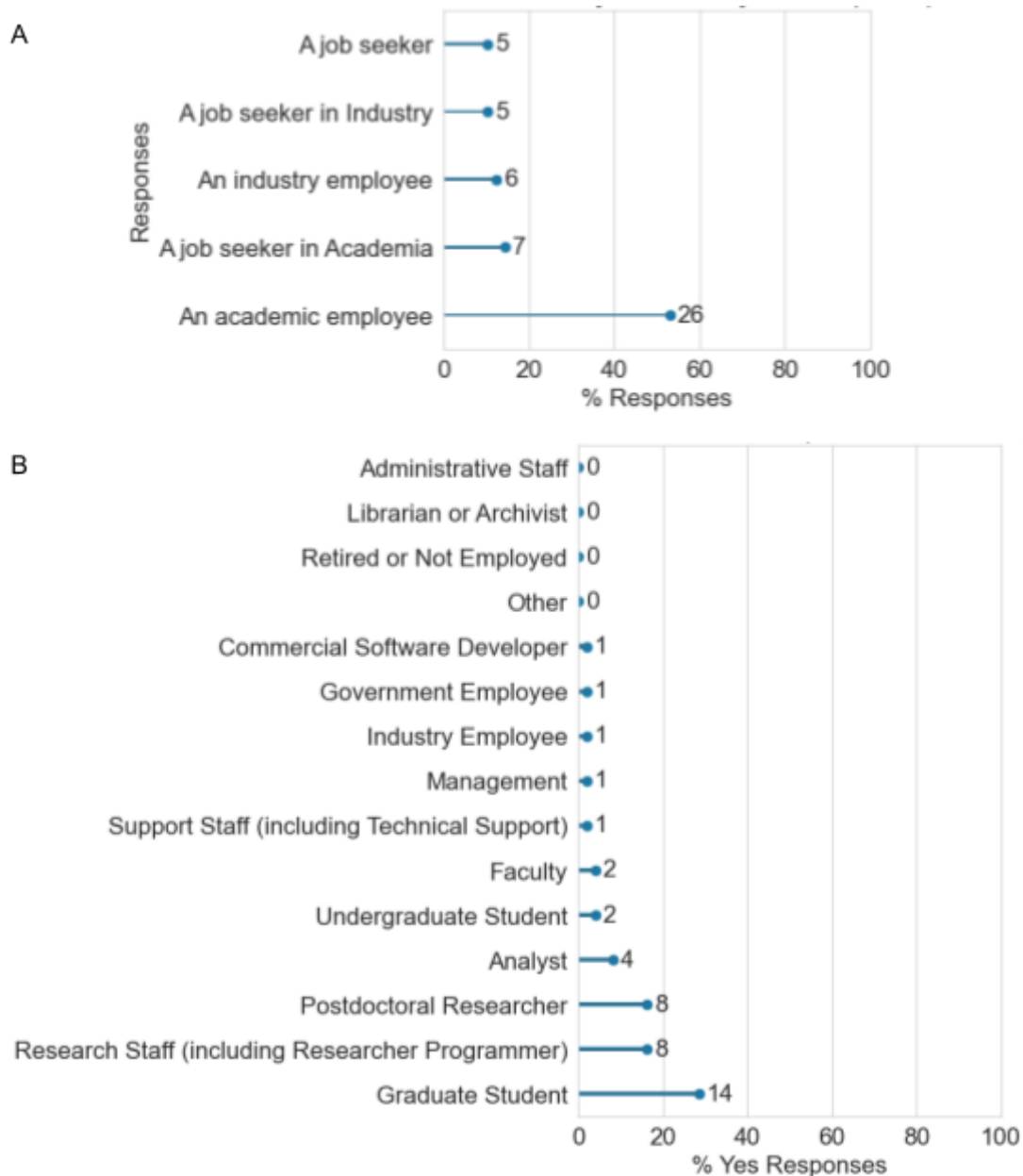


Figure 5 - The current job definition of the applicants (**A**) for n = 49, and the current occupation/career stage (**B**) for n = 45, according to the pre-workshop survey.

Additionally, 6 applicants were industry employees and 17 were job seekers (with 7 in Academia, 5 in Industry and 5 either in academia or in industry). Regarding the connections with SMEs, 9 mentioned to be working in an SME, 6 collaborating with SME(s) and 13 aiming to work in an SME.

Applicants found information about the workshop through various channels, as illustrated in Figure 6, with the majority learning about it via social media or receiving direct recommendations from friends or colleagues. Additionally, 9 applicants reported becoming aware of the workshop through conferences, meetings, or seminars.

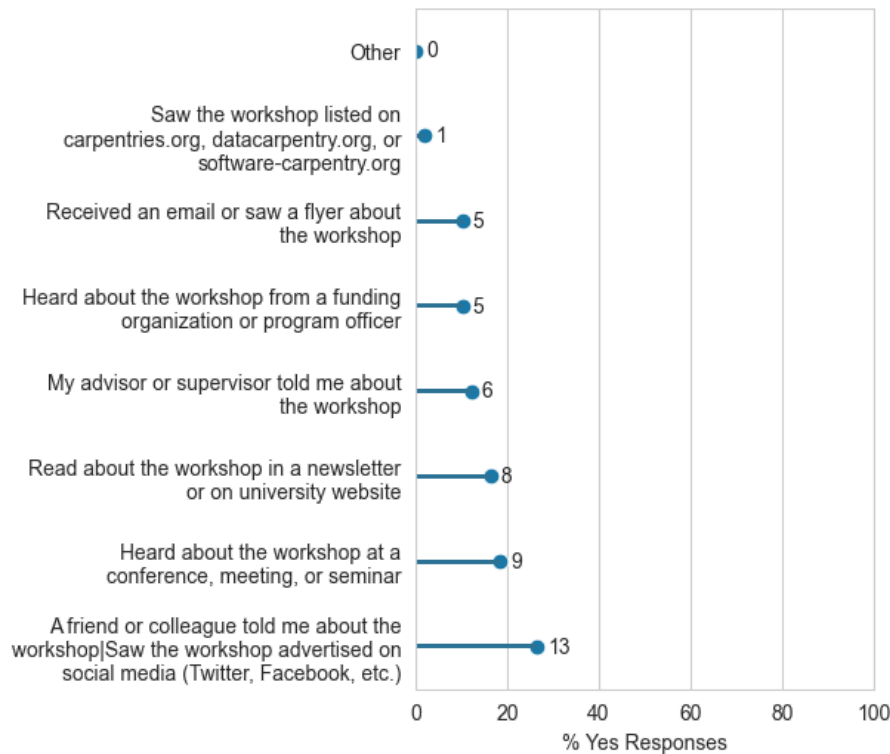


Figure 6 - Answers to the question: “How did you find out about this workshop?” (n = 42).

Out of 49 applicants, 50% planned to use Windows for the workshop, 35% macOS, 14% Linux, and 2% were unsure about the operating system they would use. Finally, two applicants had visual accessibility requirements. These two applicants were contacted in advance to understand and implement their accessibility requirements, e.g. extensive self-learning materials were provided to them in advance to decrease the total sources of information that they needed to monitor in parallel during the workshop. The same materials were provided by the organisers to all learners during the workshop

Background information

This workshop aimed to provide an introduction to the programming language Python. When asked about how often they use this programming language, 29% answered “Several times per year,” 25% answered “Never,” and 13% answered “Less than once per year” (Figure 7). This confirmed the advertising of this workshop reached the desired audience: Beginners with limited or no prior experience in programming.

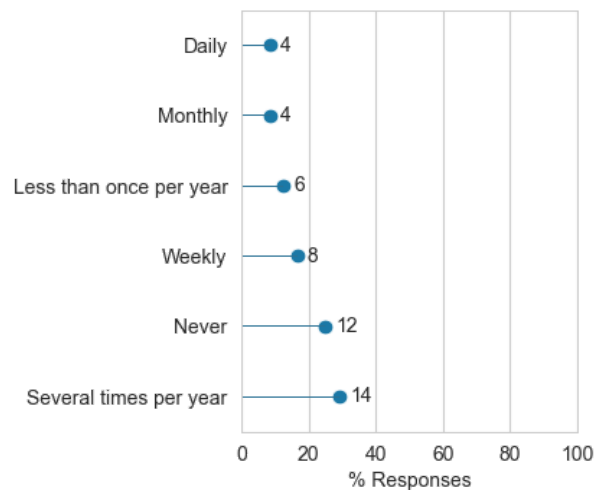


Figure 7 - Answers to the question: “How often do you currently use the Programming language: Python?” (n = 48).

Most applicants (95%) agreed with the importance of having access to the original, raw data to be able to repeat an analysis (data not shown). The majority agreed that using a programming language can make their analyses easier to reproduce (Figure 8A), and 35% of applicants were not satisfied with their current data management and analysis workflow (Figure 8B).

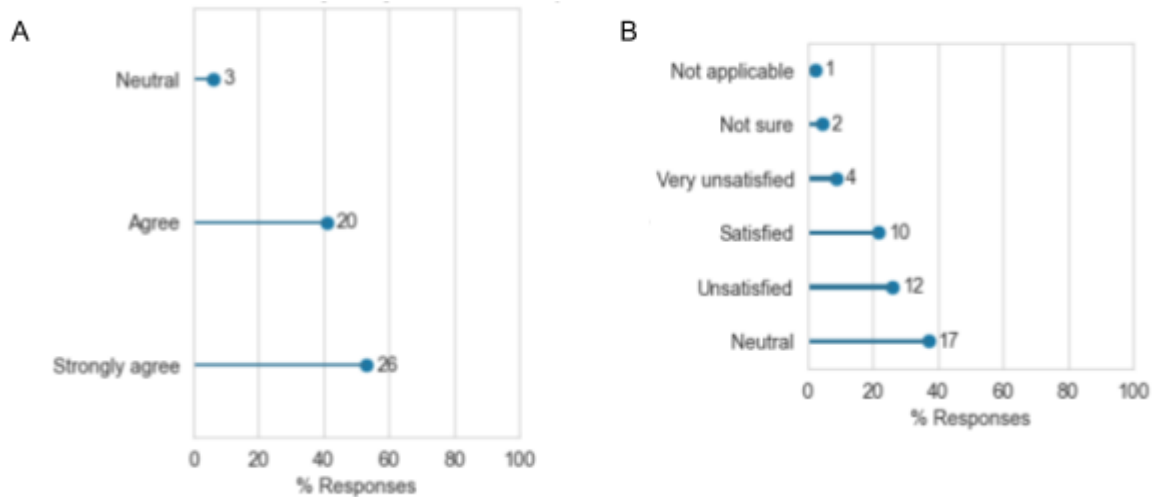


Figure 8 - Answers to the questions: A; “Using a programming language (like R or Python) can make my analysis easier to reproduce” (n=49). B; “Please rate your level of satisfaction with your current data management and analysis workflow (i.e. how you collect, organise, store and analyse your data)” (n = 46).

Expectations

The applicants' expectations for the workshop were overall uniform. Most were keen on acquiring new skills, with some specifically interested in learning those applicable to their current positions. Notably, 19 participants expressed their intention to leverage the acquired skills either to secure a promotion within their current job or to pursue new employment opportunities (Figure 9).



Figure 9 - Answers to the question: “Why are you participating in this workshop?” (n = 49).

Participation

All 50 applicants who submitted their complete application were chosen to take part in the workshop. Of these 50 applicants, a total of 32 participants attended the workshop live, although not all of them stayed for the entire duration (Table 3). All 50 received the self-learning materials for them to consult at any time.

Day	Participants	Instructors	Helpers
1	29	1	4
2	27	1	4
3	21	1	4
4	17	1	4

Table 3 - Number of participants, instructors and helpers per day. The number of participants was obtained from the participant login information captured by Zoom.

After the workshop, 17 participants requested a certificate. The certificate was provided to those participants who attended the Zoom live session at least once, completed the post-workshop survey and submitted their saved Jupyter notebook.

Daily feedback

At the end of each day, participants were asked for feedback on the following three points:

- Please share one thing that was good about today
- Please share one thing that could be improved about today
- Do you have any other comments?

The daily feedback is summarised in the following Table 4.

Day	Good about today	To improve	Any other comments?
1	<p>Having access to the resources where I can go over the exercises again (sw carpentries, know my way around there now..)</p> <p>Being shown different ways to arrive at the same desired outcome.</p> <p>I think it was a good start :) thanks for your efforts</p> <p>Good explanations and access to tutorials and possibility to practise</p> <p>Being able to go to the tutorial under the guidance of the speaker and the staff helping in the Hedge document</p> <p>It's good that we have the exercises and the materials</p>	<p>Well, we've been there, the mixing of 4-5 tabs/apps/docs was difficult</p> <p>Mentioning before, that it would be better to use two screens for the workshop</p> <p>Add examples section, in this document, where we can put our examples directly</p> <p>A bit slower start with launching the jupyterlab (especially using the command line as the data files need to be in the exactly same path as the instructors, I got lost a bit as I had it in the downloads)</p> <p>It would be nice to learn how to run it through terminal</p> <p>Communication/links to documents was hard to navigate in the beginning. But I've got the hang of it now. It would be so much easier if this was previously communicated and the links provided the day before the workshop</p> <p>It was really fast in the beginning so really difficult to follow, and also definitely need at least 2 screens</p>	<p>I would love to have a quick intro to the help site as I wrote above.. i know that these sites are essential</p> <p>Good explanations, speed was a t the beginning too fast, but time for the exercises was good enough</p> <p>Are we going to have at some point, applications for python in real life problems ?</p> <p>Will there a be a video available of today's and the rest of the days explanations for the participants</p>
2	<p>I learned new things. It was very interesting</p> <p>Awesome! I can follow it completely although I am a newbie</p> <p>Actually working with data helped me thoroughly understand what I was doing and what the commands were doing</p>	<p>Increase your screen when you share. It is so difficult to read</p> <p>orientation at the beginning with files, where to type, what is happening.. we had to get used to a new teacher (meaning: this requires a</p>	<p>I have some problems seeing the difference between "(" and "[]" with my screen.</p> <p>Suggestion: taking few 1 minute breaks at the beginning for others to catch up</p>

	<p>Very helpful</p> <p>Very interesting session. Learned a lot</p> <p>I was able to follow along, except for the plotting, will have to try recapping that with the software carpentry document myself</p> <p>Good explanations of all that we did!</p> <p>The coding part today was easier to follow , a lot of information that covers all the basics</p> <p>I was able to apply my knowledge from yesterday and could do a few things already on my own :) nice to see progress</p>	<p>little time to get used to their way of explaining where we are...)</p> <p>Maybe could have talked about other plotting tools/libraries</p> <p>The need to always switch between screen is partially annoying</p> <p>I think it would be good to show, the same thing could be made with another library. Today is good example when talking about plot</p> <p>A little bit more explanation about the code instead of going more further with difficulty</p> <p>Especially in the beginning it was really difficult to follow, maybe some important steps would be better to be repeated so everyone can follow. If you stop somewhere it's really difficult to continue after that</p> <p>more breaks/more often</p>	
3	<p>Great tho i have joined start and we were able to orient</p> <p>The pace was amazing. I loved the session today and it was easy to follow. Also the number of breaks was great</p> <p>Having two breaks</p> <p>it was always clear where we were in the hedge doc (again, we are getting used to it)</p> <p>I look forward to tomorrow</p> <p>Clear and nice explanations. Thank you a lot</p>	<p>All good (I am also getting used to python, which makes day 3 easier than day 1 and 2</p> <p>Add some examples from the bio/biomed topic (perhaps from your past real projects, but probably simplified for us</p> <p>The def function/return part was a bit faster for me</p>	

4	<p>I have never used a jupyter-book. I think it is great. Really the teacher talk very clearly</p> <p>I very much liked the whole course, the tireless help on the hedge doc .. everyone of my questions was answered and all my issues solved!! Thank you to the entire team</p> <p>Today, i loved learning yet more tools and workflows.... on day 1 I almost cried being confused about them all, today I happily installed yet another jupyter-something-something</p> <p>To see where to go next with learning coding in python</p> <p>Very interesting session. Thank you a lot!</p> <p>Thank you!! learned a lot again</p> <p>Really thanks, great team</p>	<p>Probably I would have hoped to see more python applied to bioinformatic, but of course, it is an introductory course. I am very grateful</p> <p>I also agree on our hunger for bioinformatics related tasks</p>	<p>I believe that being able to say something in zoom, and NOT being anonymous, would have been great. Day 1 and Day2 we had troubles with Hedgedoc , so when you don't have the right link you can never even write a request for help there.</p>
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Table 4 - Daily feedback collected in the HedgeDoc document.

Postworkshop survey

At the end of the workshop, participants were asked to complete the post-workshop survey consisting of 20 questions, 19 of them optional. In total, 21 participants completed this survey.

Regarding the workshop environment and the possibility of interacting with the trainer and helpers, the answers were overall positive. (Figure 11 A-B). A significant number of participants perceived the instructors as enthusiastic about the workshop and knowledgeable about the material being taught (Figure 11 C-D). With the exception of one participant, all others could get clear answers to their questions from the instructors (Figure 11 E). One-third of the participants expressed confidence in their ability to immediately apply what they learned at the workshop (Figure 11 F).

No accessibility issue was reported. However, one participant mentioned that on the last day, they were left behind since a question took longer to be answered by the helpers. Despite this, the interaction of the helper/trainer team with the shared document was perceived as very positive.

Participants mostly viewed the interaction with the HedgeDoc document and the questions answered on the fly by the helpers as positive and helpful for their learning experience. Not only the assistance of the helpers but also the support from the instructors in addressing individual issues and the repetition of exercises were positively received. The possibility to access the overall discussion within the shared document, during and after the workshop,

seemed to have improved the participant's learning experience, as indicated by their feedback.

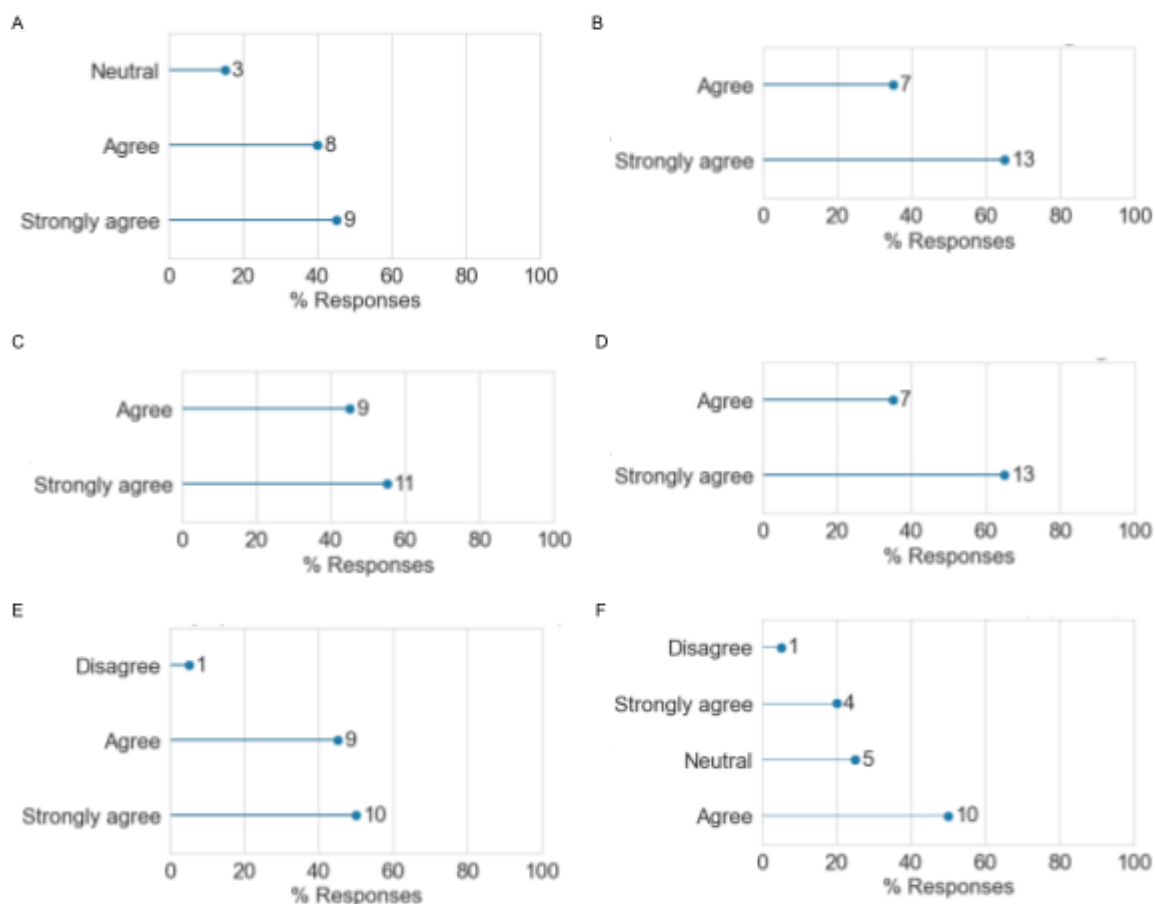


Figure 11 - Rating of participant's agreement with the following statements: **A** - I felt comfortable learning in this workshop environment; **B** - I felt comfortable interacting with the instructors; **C** - The instructors were enthusiastic about the workshop; **D** - The instructors were knowledgeable about the material being taught; **E** - I was able to get clear answers to my questions from the instructors; **F** - I can immediately apply what I learned at this workshop (n = 20).

Participants were also asked about strengths and ways to improve the workshop. All answers are reported in the following Table 5.

Major strengths of this workshop	Ways the workshop could be improved
An easy way to interact with the teachers and the ease with which questions were answered.	I don't have a large biology background but I appreciated that I was able to join. I think I'd have been a little happier to know whether I'd taken a spot that belonged to an individual that fit your target more.'
Day 2 and day 3	Last day was a bit complex to follow.

<p>Very basic and elaborate explanations. all questions were answered and the communication was very good</p>	<p>Sometimes a bit chaotic. Very important is the recommendations to maybe have two screens to be able to follow both the zoom and the programming IDE</p>
<p>Hedgedoc</p>	<p>Maybe to shorten the time.</p>
<p>Provides a good overview on the topic and can be a valuable starting point to get into programming</p>	<p>I understand that the workshop is a collaborative effort, however, in my opinion it would be better to only have 1, max. 2, instructors throughout the course</p> <p>It is a bit overwhelming to manage that many windows simultaneously while looking at the shared screen, checking the links in the chat etc. Maybe it would be good to warn people beforehand to try and set up e.g. a tablet/additional laptop to screen the zoom lecture while working on the coding exercises on a laptop</p> <p>Using the jupyter notebook to type in +/- to express something is quite annoying, maybe the reactions in the zoom lecture would be a better option</p> <p>I don't really get the reason why the code of conduct had to be recited multiple times and why the level of anonymity needs to be so high for a programming course. somehow gave me a weird feeling', like the participants were seen as a bunch of uncivilised barbarians not able to behave properly. Since there were so many instructors involved, maybe it would have been nice to have some sort of breakout room for the self-study exercises where everybody can decide for themselves if they want to make themselves visible/switch on camera/talk/be silent etc.</p>
<p>I really liked the "HedgeDoc" thing :)</p>	<p>Explain in a more detailed way how libraries work in python.</p>
<p>Jupyter-book</p>	<p>Some instructors need to be clearer and slower, especially when explaining topics that may be completely new for some. Pandas should have been explored a bit more.</p>
<p>The possibility to work in parallel with the instructors and solve problems in real time</p>	

The workshop was slow-paced and interactive which made following it easy.	I believe that instead of the last day session on Gitlab, a session on file manipulation (some of it was introduced for csv, though) such as PDB and a general introduction on ways to validate the scripts would have been beneficial.
Easy to follow tutorials <ul style="list-style-type: none"> • Start from basics Covered stuff that's mostly applied like conditional statements and loops 	Increasing workshop days
Basic understanding of python Basic understanding of tools like git Motivation to learn something new	More screens are definitely needed Sometimes got a little bit hectic until everyone is on the same side
Your team was great in the workshop.	Maybe practical time.
Knowledgeable instructors Good time keeping	<ul style="list-style-type: none"> • Pace of some instructors could be slowed down
It covered a wide range of topics and the basics were very well explained.	The last day was a bit chaotic. Also, I would have liked to use other libraries as NumPy.
Having the software carpentry website to follow along with was great because while getting questions answered, it was really easy to get behind on the flow of the course. Also, the instructors were very knowledgeable about the topics.	It may be beneficial to have the workshop last longer,' all of the days for the most part we were behind. The workshop may need to be lengthened by maybe an hour to give adequate time to cover each topic and answer questions so there isn't a rush.
The number of hours That we were exposed to different tutors which was very nice	If it was following day 3 that would have been awesome. As on day 3 we had a clear agenda explanation at the beginning of the workshop, we had frequent short breaks which was perfect and the tutor was easy to follow.

Table 5 - Strengths and possible improvements for this workshop, as suggested by participants in the post-workshop survey.

The feedback on the post-workshop survey was positive and participants were likely to recommend this workshop to a friend or colleague (Figure 12).

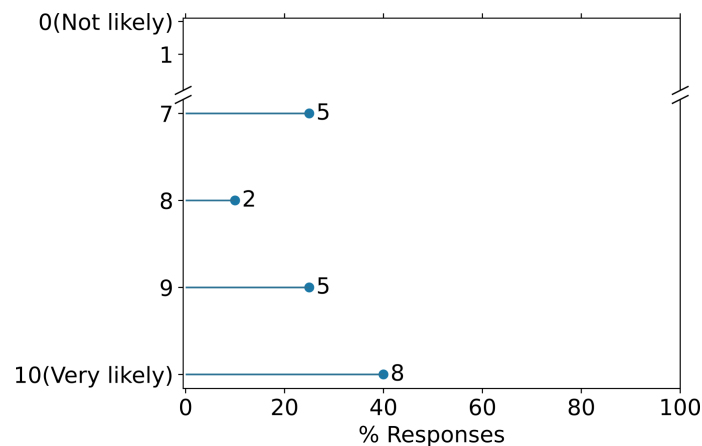


Figure 12 - Answers to the question: How likely would participants recommend this workshop to a friend or colleague?

Conclusion

The second BioNT workshop, an introduction to the programming language Python titled “From Hero to Zero with Python”, was successfully held on November 21st-24th of 2023, online and cost-free for participants.

The setup for the second workshop benefited from the experience gathered during the first BioNT workshop. The organisation of registration, survey data collection and analysis, and certificate requirements were improved compared to the first one. However, the setup for the second workshop posed some challenges, as successful participation in the training required: (a) the installation of certain packages before the course, and (b) the use of a dual-screen setup was recommended. Due to setup issues, some participants faced challenges at the beginning of the workshop. Nevertheless, addressing them and adjusting the workshop’s pace improved their experience over the course of the remaining days. The evening time slot was perceived as not the best option for the concentration of participants.

The consortium will take the improvements and the individual challenges of the second workshop into consideration to further enhance the training provided by BioNT, especially regarding the upcoming third workshop scheduled for February 2024. Overall, the BioNT consortium concludes that the workshop successfully achieved its goals.