CV-Dr Nelson Ndugu

Job & contact details	**Nelson Ndugu** Lecturer College of Natural Sciences, Makerere University P.O. Box 7062, Kampala, Uganda. Tel: +256 -775177759; E-mail: ndugu.nelson89@gmail.com
Qualifications	● **PhD (Computational Astrophysics)**, Mbarara University of Science and Technology, Uganda | Heidelberg University, Germany, **2021** ● **Professional certification in Data Science** **2021** ● **Professional certification in Artificial Intelligence Engineering** **2020** ● **M.Sc. Computational Physics**, Mbarara University of Science and Technology, Uganda | Lund University, Sweden **2017** ● **B.Sc. Educ(Physics)**, Mbarara University of Science and Technology, Mbarara, Uganda **2014**
Work Experience	● **Data Engineer and Technical Team Lead, Aeronautics and Space Weather Program:** I build climate foundation models, design and construct system architectures, develop backends, and lead software development projects. I also mentor postgraduate students, following my product-based learning philosophy. My expertise extends to creating both mobile and desktop applications, ensuring scalable solutions in the climate data domain. **(May-2024–present)** ● **Product Engineer, HailNumbers Foundations:** **- Leveraging on open source LLAMA,** I built a specific LLM prototype for teaching and learning. The focus here was to keep in check the reasoning of the LLM and to hint to the teacher whether the LLM is hallucinating and diverting from the intended promise. This prototype was then used to reduce the negative sentiments the teaching community had against Large Language Models like ChatGPT. - I also built a simple tool that shows in real time where investors interested in EV charging business to place charging stations and potential profit they will get after a given number of periods. - I led a team that built a smart IoT tool for precision farming. The device is code-named *HailSight-7*. *HailSight-7* measures in real time soil parameters 50 m in radius and allows remote access to the soil parameter on mobile phones and predict crop suitability in real-time. **(August 2023-present)** ● **The Data Science and AI Educators' Fellow,** The Alan Turing Institute, London, UK. I trained on innovating effective and structural methods for teaching my very own product-based learning philosophy. This philosophy has the potential of enhancing learning in STEM and sparking entrepreneurship for socioeconomic development. I also trained AI and ethics and how it should implemented in higher institutions **(May 2023 –August 2023)** ● **KaggleX BIPOC grantee,** I worked on: Financial Inclusion prediction, Social-media User engagement prediction, Customers' emotions prediction using sentiment Analysis for African dialect perspective and MLOps (Machine Learning

	Operations). One peer review manuscript has been prepared out of this. **(December 2022 –March 2023)** ● **Lecturer,** College of Natural Sciences, Makerere University, Teaching computational sciences for both undergraduate and postgraduate classes in physical and biological sciences **(October 2022 –)** ● **Lecturer,** Department of Physics, Muni University Arua. Teaching both undergraduate and postgraduate classes. Also serving in the development of short courses **(March 2021 –October 2022)** ● **AI Development Facilitator**, Muni University **(2021–2022)** ● **Postdoctoral Fellow, North-West University, South Africa (2021– 2022)** ● **Asst. Lecturer**, Dept. of Physics and Dept. of Biomedical Engineering, Mbarara University of Science and Technology, Uganda **(2019 – 2020)** ● **Computational Engineer**, Dept. of Biomedical Engineering and Sciences, Mbarara University of Science and Technology, Uganda **(2018– 2020)** ● **Research Assistant**, Dept. of Environmental Sciences and Livelihoods, Mbarara University of Science and Technology, Uganda **(2018– 2020)** ● **Junior Research Fellow**, University of Nice, France **(14/02/2017– 14/06/2017)**
Courses Taught	**Postgraduate** 2023- Social Computing 2019- Advanced Quantum Mechanics 2019– Computational Physics and Data analytics 2017– Exoplanet and Remote Sensing course **Evaluation: Through my project-based teaching method,the interests and the enrollment increment of 15 % was realized. In addition, the project completion rates of the postgraduate students increased by around 50 %.** **Undergraduate** 2022- Electronics 2022-Signal Processing 2022-Fluid Dynamics 2019- Computational Physics 2019-2020 Statics and Dynamics for Electrical engineering 2019- Biostatistics for Biomedical engineering 2018- Applied Physics for Biomedical and Petroleum engineering 2016- 2018 Environmental Physics **Evaluation: Because of the product-based way of teaching, over 25 % of learners showed interest in venturing into several aspects of techno-entrepreneurship. There was an increase in the attendance rates by 39 % and the performance of the learners increased by a staggering 35 %.**

Project management experience	1. **Co-applicant and Technical Team Member of project "EMPowering Ugandan REfugee–host COmmunities in becoming climate resilient (EMPURECO)"** supported under VLIRUOS, 2024-2029. 2. **Technical Team Member of project "Space Weather and Early Warning Tool (SWET)"** supported under STI—Uganda through Busitema University, 2024-2025. **3. Principal Investigator of projects that developed:** 1. Financial inclusion prediction algorithm 2. Social media user engagement prediction 3.Emotion prediction from custom reviews using sentiment Analysis: an African language context. 4. Carbon emission prediction algorithm. 4. **Team Member of project "Natural Resource Management in the Northern Albertine Rift Landscape, Western Uganda: Agent–based Modelling of Household Land Utilisation for Conflict Reduction"** Supported under US Agency for International Development (USAID) Agreement AID-OAA-A-13-00003; SUB AWARD #06-S170624, through The Center on Conflict and Development Texas A & M University's Emco program. 5. **Team Member of project":'A sustainable MRI system to diagnose hydrocephalus in Uganda'"** Supported under NWO-WOTRO (Grants No. W 07.303.101)
Postgraduate Supervision to Completion	**1. PhD supervision** **Dr. Andama Goeffrey** **PhD Thesis Title:** Multi-species Pebble Accretion paradigm **Description:** I had the privilege of supervising Dr. Geoffrey Andama in his groundbreaking work on a new paradigm in planetary sciences, leveraging cloud computing and high-performance computing (HPC). Under my guidance, Geoffrey developed a highly cited model of dust coagulation leading to the formation of planetary cores with several Earth masses. His research has been recognized with multiple publications in the prestigious Monthly Notices of the Royal Astronomical Society. 2. **Masters Supervision** **Mr. Andama Geoffrey** **Masters Dissertation Title:** Planet population synthesis: Probing the physical performance of planet formation models **Description:** The study deployed machine learning models (i.e, Gaussian Mixture Model) on data synthesized from known planet formation models with a goal of scoring the performance of the existing planet formation models. **Mr. Iceta Emmanuel** **Masters Dissertation Title:** Planet population synthesis in discs with dead zones **Description:** The study modeled viscosity as a proxy for turbulence and dead zone regions in discs and calculated what impact dead zones have on planet population.
Publications	1. **Ndugu N**, Bitsch B, Jurua E. Planet population synthesis driven by pebble accretion in cluster environments. Monthly Notices of the Royal Astronomical Society. 2018 Feb;474(1):886-97.

	2. **Ndugu N**, Bitsch B, Jurua E. Are the observed gaps in protoplanetary discs caused by growing planets?. Monthly Notices of the Royal Astronomical Society. 2019 Sep;488(3):3625- 33. 3. **Ndugu N**, Bitsch B, Morbidelli A, Crida A, Jurua E. Probing the impact of varied migration and gas accretion rates for the formation of giant planets in the pebble accretion scenario. Monthly Notices of the Royal Astronomical Society. 2021 Feb;501(2):2017-28. 4. Andama G, **Ndugu N**, Anguma SK, Jurua E. Planetary core formation via multispecies pebble accretion. Monthly Notices of the Royal Astronomical Society. 2022 Feb;510(1):1298- 314. 5. **Ndugu N**, Abedigamba OP, Andama G. Planet population synthesis: the role of stellar encounters. Monthly Notices of the Royal Astronomical Society. 2022 May;512(1):861-73. 6. Andama G, **Ndugu N**, Anguma SK, Jurua E. The role of density perturbation on planet formation by pebble accretion. Monthly Notices of the Royal Astronomical Society. 2022 Jun;512(4):5278-5297 7. G Andama, **N Ndugu**, S K Anguma, E Jurua. The role of density perturbation on planet formation by pebble accretion. Monthly Notices of the Royal Astronomical Society. 2022 Jun; 512(4):5278–5297 8. Twongyirwe R, Fisher E, Karungi C, **Ndugu N**. Projected land use change in an oil-rich landscape in Uganda: A participatory modelling approach. The Extractive Industries and Society. 2022 June 1;10:101071. 9. Margani R, **Ndugu N**. From Local to Global: Navigating Linguistic Diversity in the African Context. arXiv preprint arXiv:2305.01427. 2023 May 2. 10. **Ndugu N.**, Bitsch B., Lienert J. L., 2024, A&A, 691, A32 11.**Ndugu, N.**, et al. **(Accepted 2025).** Chapter title. **Book:** Sustainability and Artificial Intelligence (Springer, forthcoming)**. Expected publication: [2025]**

Conference Talk	1. Invited talk on the theme "ML Solutions in Africa" by Eleventh International Conference on Learning Representations (ICLR) in Kigali, Rwanda **(2023)** **Talk title: From Local to Global: Navigating Linguistic Diversity in the African Context** 2. Invited talk on the theme "Role of Artificial Intelligence for sustainable development" by Muni University, Uganda **(2021)** **Talk title: How to retool from other disciplines to AI discipline** 3. Invited talk on the theme "The threat from the surrounding" by the European Space Observatory **(2020)** **Talk title: Planet formation in clusters** 4. Contributed talk at the European Week Of Astronomy and Space Science Conference **(2019) Talk title: Are the observed gaps in protoplanetary discs caused by growing planets?**
Hackaton Organized	1. **Carbon emission prediction Challenge (2023)** **Details:** Students were asked to; hunt for open source data that points to carbon emission within the geographical scopes of Africa, then students were probed to develop machine learning models. The machine learning models were then screened and scored. The winning student teams were then awarded with prizes 2. **EV Hackaton Challenge (2024: To be concluded)** **Details:** Competing teams were challenged to extract meaningful demand data for ev mobility in Uganda. They were then asked to come up with a consumer profile and come up with attractive incentives that have the potential of increasing the adoption of Evs in Kampala.
Awards	1. IBM Professional certification in Data Science **(2020)** 2. Professional certification in Artificial Intelligence Engineering **(2020)** 3. Certificate of completion of the course Modeling and simulation of natural 4. processes by University of Geneva **(2020)** 5. Certificate of completion of the course Energy transition towards a low carbon-future by IFP school of engineering **(2020)** 6. Certificate of Teachers Registration **(2019)** 7. Certificate of completion of the course GIS and spatial modeling by 8. University of Leuven and Mbarara University of Science and Technology **(2019)** 9. National Mathematics Contest Winner at University level **(2014)**

Community Services	**1. Perform energy demand survey and energy need analysis for refugees in Bididi Refugees Camp (2022):** Guided by the settlement patterns, I performed a detailed energy demand analysis. I mapped the suitable positions for installations of solar energy plants for powering the refugees resettlement patterns. Using computer simulations, I also suggested an efficient technique for enhancing the performance of a soap factory and larvae

	incubator (hatches larvae for feeding fish in the fishpond) that is installed and purely run by the raw expertise from the refugee communities. The soap factory and the fishpond are purely transacted within the refugee communities at subsidized rates. **2. School visits within West Nile Region (2021-2022);** I particularly showed students how to use sciences (even at an early stage as secondary school level) to shape their financial trajectories through product-based learning techniques.
Skills	Proficient in AI development, LLM, Prompt engineering, software deployment, and GIS. Skilled in Fluid Mechanics, Climate Change Modelling, Epidemiological modelling, Agent Based Modeling, Role Play Game, backend programming with Python, Linux, Fortran, C, C++, and more.
Referees	1. **Dr. Bertram Bitsch.** Associate professor Department of Planets and Stars formation University College Cork, College Rd, Cork T12 K8AF, Ireland Phone: +490-6221-528-427; E-mail: bbitsch@ucc.ie **2. Dr. Oyirwoth Patrick Abedigamba** Head of Department, Physics, Kyambogo University E-mail: oyigamba @ gmail.com **3. Dr. Alessandro Morbidelli** Director of Research CNRS, Laboratoire Joseph-Louis Lagrange; E-mail: Alessandro.Morbidelli@oca.eu **4. Dr. Patrick Vudriko.** Lecturer & Founding Manager RTC laboratory-COVAB, Makerere University; E-mail: vpato2011@gmail.com **5**. **Dr. Okello Denis** Head of Department, Physics, School of Physical Sciences Makerere University, E-mail: denis.okello@mak.ac.ug