Cloud ARtificial Intelligence For pathologY

THIRD NEWSLETTER – Mar 2022

Welcome to the third newsletter!

CLARIFY has already two years old and counting! Although the project was affected by the COVID-19 pandemic, in the last months that hasn't been a big problem. To date, we have gotten great progress so we are one-step closer to the project goals. In the next pages, we will inform our public about the last outcomes of the CLARIFY project regarding dissemination actions, events, training activities, secondments, and more!

CLARIFY 2nd training school will be held next month in Granada, we are looking forward to meet all of us in person!

To know more about CLARIFY, visit our webpage: www.clarify-project.eu

CLARIFY in a nutshell


4 universities
UPV, UvA, UiS & UGR


2 companies
bY & TY


4 years duration
Nov,19 - Oct,23


3 hospitals
INCLIVA, SUH & EMC


12 Early Stage Researchers (ESR)


3 partner organizations
UV, LINKEUS & RD

Milestones achieved

- First Periodic Technical report submitted
- Monthly meetings between ESRs and their supervisors
- Monthly work package meetings
- Regular project meetings with SB
- 13 secondments concluded from September to February (only 4 online)
- External Advisory board supervision
- Monthly organ-specific cancer meetings (bladder, breast and skin)
- 5 research's paper in international conference (1) and journals (4) since the last newsletter

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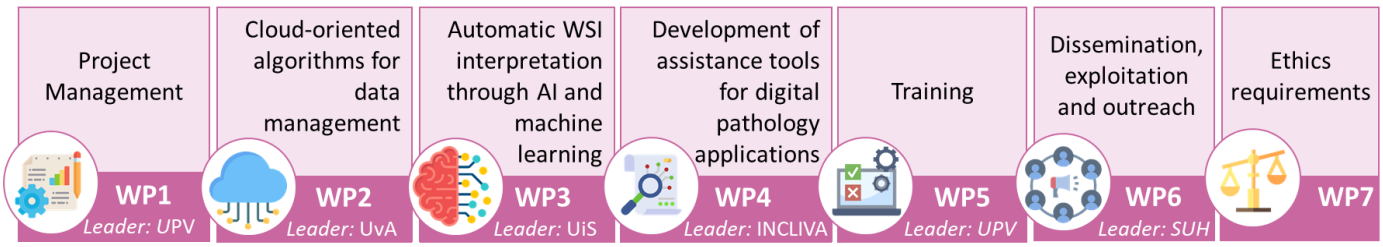
Things you din't know about the project

In spite of the fact we have already published two newsletters, in which we have included lot of information about CLARIFY project, we have never explained how we distributed the project work. To cover the whole range of aspects that need to be considered to comply with project's goals, we structured the CLARIFY's research training programme in 7 work packages (WP). Each WP is led by a partner and, in this way, the work is distributed by fields of expertise (especially WPs 2 and 3).



Work packages of CLARIFY's research programme list

ESR project updates

ESR1: Na Li, Universiteit van Amsterdam: *"Semantic interoperability of digital pathology data via common formal terminology"*

- Participated in the UPV, where she gained first-hand experiences of histopathological image analysis technique. The training was conducted on-site at the CVBLab located in UPV.
- Focused on the topic of "notebook search", which is a starting point of research asset search. A baseline method has been implemented to enable notebook search based on text descriptions.
- Literature study on techniques of code search, source code analysis, code representation to support notebook search based on code contents.

ESR2: Yuandou Wang, Universiteit van Amsterdam: "*Seamless trusted data sharing techniques*"

- Submitted a manuscript entitled "Scaling notebooks as re-configurable cloud workflows" to Data Intelligence journal that has been accepted.
- Together with ESR7, discussion about federated learning framework with workflow-oriented conceptual model.
- Secondment at UiS to gain knowledge about the WSI preprocessing, artificial intelligence applied for HR-NMIBC characterization, anonymization, and data privacy techniques.
- Together with ESR4 and ESR5, exploration of AI pipelines with workflow technologies to cope with some computational performance bottlenecks during the AI model training procedures.

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ESR3: Jiahui Geng, bitYoga AS: "*Taking computation to Data: integrating BigData and Blockchain allowing secure analysis of sensitive health data on-premise*"

- Published a paper "Towards General Deep Leakage in Federated Learning" in International Workshop on Trustable, Verifiable and Auditable Federated Learning in Conjunction with AAAI 2022(FL-AAAI-2022).
- Participated in the FL-AAAI-2022 workshop and gave an oral presentation about deep leakage in Federeted learning research.
- Participated in the PACE\LUCS workshop 2022 in Munich, and he gave a presentation on the topic "OpenlaC: Open Infraestructure as code- The Network is My Computer".

ESR4: Neel Kanwal, University of Stavanger: *"Preprocessing, segmentation and anonymization of WSI"*

- Preparing a manuscript for a review journal on WSI preprocessing with ESR8 and researchers from UGR.
- Working on deep kernel learning methods to perform artifact detection.
- Started a secondment at SUH to learn more about the biology and hallmarks of cancer.

ESR5: Saul Fuster Navarro, University of Stavanger: *"Extracting diagnostic and prognostic information from histological images of NMIBC"*

- A novel machine learning architecture for weakly supervised learning methods was implemented and tested on classical and histological image datasets, and currently, a manuscript is under review.
- Secondment at bitYoga about blockchain frameworks. Learing about the foundations of blockchain technology and how subsequent developments led to implementing the Hyperledger Fabric software technology.
- Preparation of the non-muscle invasive bladder dataset, in collaboration with ESR10 and ESR11. Weakly supervised learning methods have been developed without annotations to overcome the lack of a thoroughly annotated dataset in the meanwhile.

ESR6: Claudio Fernández - Universitat Politècnica de València: *"Significant feature extraction from WSI for diagnosis and prognosis of TNBC"*

- Secondment at SUH, where he learnt from Emiel Janssen and ESR 11 about the pathology aspects of the TNBC and about the current techniques in cancer research.
- Participated in the research meetings from the Pathology Department at SUH and the BMDLab at UiS, where he presented his work to doctors and to AI researchers.
- Training and testing a Deep Learning model for classifying patches from WSIs on whether they have or not have mitoses, using the public database TUPAC16.

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ESR7: Laëtitia Launet - Universitat Politècnica de València: *"Deep learning for spitzoid melanocytic lesion (SML) characterization"*

- Development of a DL framework enabling the use of both annotated and unannotated data samples to train the models, combining semi-supervised and weakly-supervised learning.
- Segmentation of tumorous areas, with on-the-fly patch extraction during training based on the predicted coarse annotations, at the wanted magnification level.
- Secondment at UvA to focus on cloud computing and more precisely federated learning. This method allows the collaboration of multiple institutions to train AI models, without having to share the data between collaborators.

ESR8: Arne Schmidt - Universidad de Granada: *"Probabilistic large scale crowdsourcing methods for histological image classification"*

- Paper on semi supervised and multiple instance learning for histopathological images was accepted for IEEE Access. In this successful collaboration between the UPV and UGR it was shown how to train a machine learning model for cancer classification with minimum labeling effort.
- Completed virtual secondment at the Northwestern University with a main focus on active learning and multiple instance learning with probabilistic deep learning.

ESR9: Zahra Tabatabaei - Tyris Software S.L.: *"Strategies for cloud-based histological image retrieval"*

- Attended DeepHealth Winter School 2022. Use of deep learning and computer vision in tasks related to medical imaging and other medical data.
- Secondment at UiS to develop AI models to simulate the traditional cancer diagnosis process.
- Modifying a Convolutional Auto Encoder (CAE) by using residual block and skip net to complete the Content-Based Image Retrieval (CBIR) steps.
- Feeding the whole proposed CBIR method with different data set.

ESR10: Farbod Khoraminia - Erasmus Medisch Centrum Rotterdam: *"Improving HR-NMBC diagnosis and prognosis by digital pathology"*

- Completing the WSI dataset of high risk non-muscle invasive bladder cancer (HR-NMIBC) includes 790 WSI from 652 H&E stained primary tumor samples of HR-NMIBC patients.
- Preparing the clinicopathological dataset corresponding to above mentioned 652 HR-NMIBC patients.
- Adjusting the annotation protocol, and setting up a guideline to annotate the whole slide images according to the clinicopathological dataset – 100 whole slide images have been annotated according to the adjusted annotation protocol so far.

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ESR11: Umay Kiraz - Helse Stavanger HF: *"Evaluation of TNBC for diagnostic and prognostic by digital pathology"*

- Preparation of TNBC dataset containing approximately 340 cases, including clinical variants. Quality checking. Selecting appropriate slides to count mitosis and TILs.
- Focus on detecting and segmenting mitosis from WSIs of TNBC with ESR6
- Working with ESR10 and ESR5 for NMIBC annotations.
- Obtaining knowledge about TNBC to gain a proper perspective on realizing the project. Learning how to count and perform microRNA staining at TNBC cases with two master students from SUH whose projects she is responsible for assisting.

ESR12: Andrés Mosquera-Zamudio - Instituto de Investigación Sanitaria INCLIVA: *"Analysis of the implementation of AI algorithms in the evaluation of spitzoid melanocytic tumours for diagnosis and prognosis"*

- Trip to Colombia showing objectives of my thesis in Spitz tumours part of the CLARIFY project. Two oral presentations in Keralty´s IA Health symposium about the use of Digital Pathology
- Systematic review of analysis using Artificial Intelligence of melanocytic tumors (work in progress).
- Recollection of clinical data of Spitz tumors cases (work in progress).

What's happening?

1 conference papers

4 journal papers

3 local training activities

9 Secondments

- **Scientific publications**

CONFERENCE PAPERS

AAAI-22: International Worksohp on Trustable, Verifiable and Auditable Federated Learning in Conjuction with AAAI 2022 (FL-AAAI-22) (March 2, 2022)

Jiahui Geng, Ynli Mou, Feifei Li, Qing Li, Oya Beyan, Stefan decker, Chunming Rong, 2022: Towards General Deep Leakage in Federated Learning, arXiv preprint arXiv:2110.09074.

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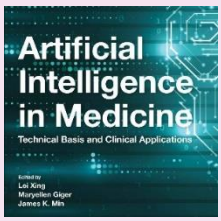
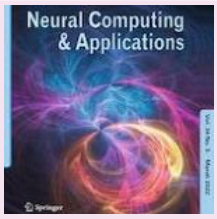
JOURNAL PAPERS



ARTIFICIAL INTELLIGENCE IN MEDICINE: An attention-based weakly supervised framework for spitzoid melanocytic lesion diagnosis in whole slide images.

Rocío del Amor, Laëtitia Launet, Adrián Colomer, Anaïs Moscardó, Andrés Mosquera-Zamudio, Carlos Monteagudo, Valery Naranjo, vol. 121, p. 102197. DOI: 10.1016/j.artmed.2021.102197



NEURAL COMPUTING AND APPLICATIONS: A Deep Embedded Refined Clustering Approach for Breast Cancer Distinction based on DNA Methylation.

Rocío del Amor, Adrián Colomer, Carlos Monteagudo, Valery Naranjo, 2021, p1-13. DOI: 10.1007/s00521-021-06357-0

IEEE ACCESS: Efficient Cancer Classification by Coupling Semi Supervised and Multiple Instance Learning

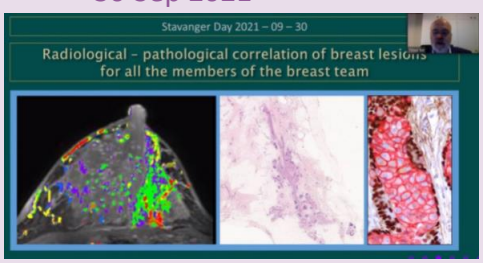
Arne Schmidt, Julio Silva, Rafael Molina, Valery Naranjo, 2022, in IEEE Access, vol. 10, pp. 9763-9773, 2022, DOI: 10.1109/ACCESS.2022.3143345

DATA INTELLIGENCE JOURNAL: Scaling notebooks as re-configurable cloud workflows.

Yuandou Wang, Spiros Koulouzis, Riccardo Bianchi, Na Li, Yifang Shi, Joris Timmermans, W. Danial Kissling, Zhiming Zhao, 2022, Canonical Workflow Frameworks for Research (CWFR), in Data intelligence journal [Accepted for publication]

- **Events and training**

30 Sep 2021



LOCAL TRAINING ACTIVITIES

ESR6 and ESR11 attended a seminar "Stavanger Day in Pathology" organised by Stavanger University Hospital (SUH). There was more of 50 attendants among members of the SUH and students of pathology.

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11 Oct 2021

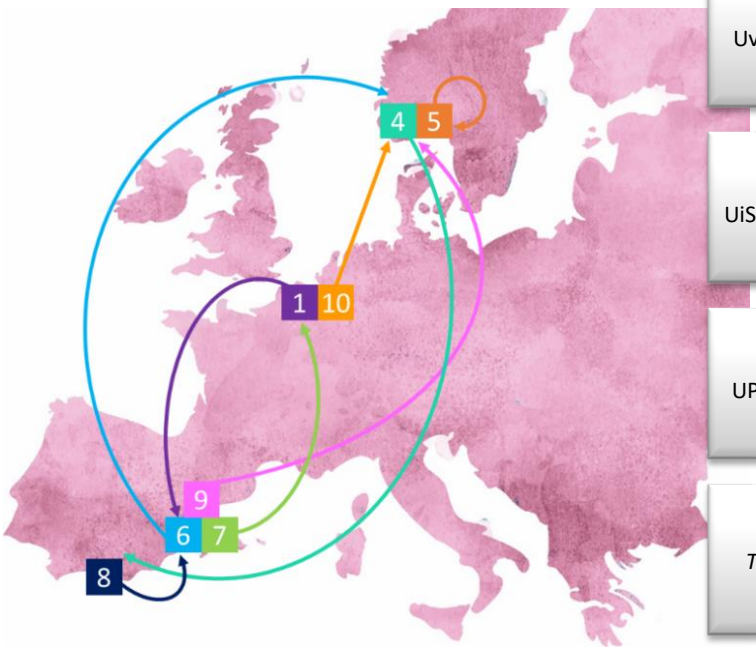
ESR4, ESR6 and ESR11 attended a Diaceutics Webinar "Digital pathology and implementation of AI scoring algorithms in clinical practice". This webinar was delivered by Dr. Bert van der Vegt, who discussed digital pathology and the implementation of artificial intelligence scoring algorithms in clinical practice from a laboratory perspective. Besides, he share some insights on the current state of digital pathology and the use of artificial intelligence scoring algorithms in various European countries.

4-5 Nov 2021

ESR5, ESR7 and ESR12 participated as speakers in an online Colombian event organized by Keralty about Artificial Intelligence and its opportunities to transform the healthcare field. ESR7 and ESR12 presented the medical vs. engineering perspectives of histological image analysis. Also, ESR12 spoke about the recent advances of AI in the digital pathology field. ESR5 talked about the challenges of the implementation of intelligent systems in the clinical practice.

- **Secondments**

Since September, **8 of our 12 ESRs** have been in a secondment, someone in more than one. In total, **9 secondments** have been carried out. The other ESRs will do their secondments in the following months.



ESR1
UvA to UPV *(Oct, 21-Dec, 21)*

ESR4
UiS to UGR *(Oct, 21-Dec, 21*
UiS to SUH *(Feb, 22)*

ESR5
UiS to bY *(Nov, 21-Jan, 22)*

ESR6
UPV to SUH *(Oct, 21-Dec, 21)*

ESR7
UPV to UvA *(Dec, 21-Feb, 22)*

ESR8
UGR to UPV *(Jan, 22-Feb, 22)*

ESR9
TY to UiS (Sep, 21-Dec,21)

ESR10
EMC to SUH (Nov, 21-Jan, 22)

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Host Entity:	*Host Supervisor:*	*Period of secondment*:	*ESR:*
Polytechnic University of Valencia	Valery Naranjo	October-December 2021	**ESR1**

The secondment was on site and, during this time, ESR1 research was mainly focused on notebook search. To understand the intentions of researchers when searching for research resources, they collected 37 natural language queries that express their resource needs within the CVBLab group at UPV. Examples are "segmentation of epidermis in histopathological images", "whole-slide images classification tensorflow code", "Deep Kernel Learning" and "mitosis detection in histological images". For her, the possibility of meeting their colleagues in person has been totally positive and enriching.

Host Entity:	*Host Supervisor:*	*Period of secondment*:	*ESR:*
University of Granada	Rafael Molina	September - November 2021	**ESR4**

During this secondment, ESR4 he had the opportunity to have a prime insight in developing end-to-end methods for detecting artifacts in the bladder cancer dataset. Also, ESR4 attended discussion sessions on implementing combined neural networks and the Gaussian process. Overall, this time at UGR provides him a deep insight into establishing an experimental setup for preprocessing perspective or the project. The developed model will help preprocess pipelines create CAD systems with better diagnostic and prognostic capabilities. This will provide a foundation for cancer mitigation with different possible technological advancements in detecting histological ESI abnormalities. Finally, ESR4 actively participated in drafting preprocessing journal with other collaborators during the stay and other publications on this work are still under progress.

Host Entity:	*Host Supervisors:*	*Period of secondment*:	*ESR:*
bitYoga	Long Cui and Chunming Rong	November 2021-January 2022	**ESR5**

In his secondment, ESR5 worked with ESR3. This time gave him the insights into blockchain networks and their applications. During the secondments, ESR5 attended technical lectures on the foundations of the blockchain and Hyperledger Fabric, the blockchain technology of choice at bitYoga. In addition, the secondment provides him the opportunity to expand his current work line. Currently, a future publication of his work is still in progress.

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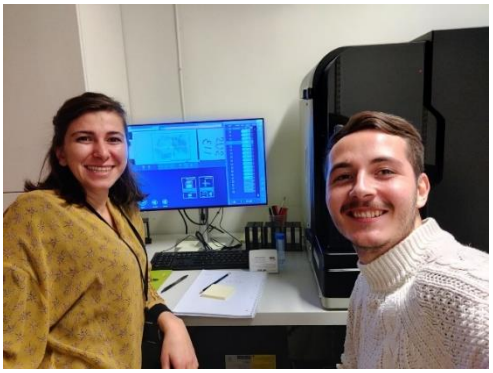
Host Entity:	*Host Supervisor:*	*Period of secondment*:	*ESR:*
Stavanger University Hospital	Emiel Janssen	October - December 2021	**ESR6**



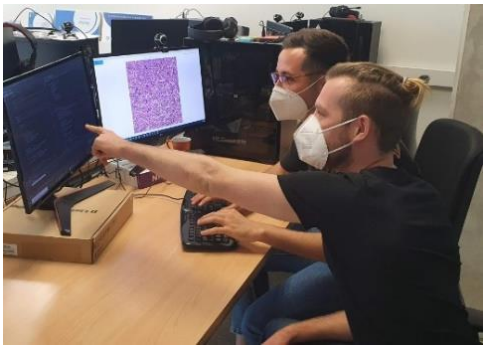
During the secondment, ESR6 worked in collaboration with ESR11, which allow him to learn from the perspective of pathologists and to know their needs and workflows. He considers his collaboration with ESR11 as a crucial point because he learnt about the mitotic cycle and how to determine whether a nucleus is mitotic or not and to obtain the Mitotic Activity Index (MAI). Besides, he has learnt to distinguish tumour cells from other nuclei and he learnt how to count and evaluate the Tumour Infiltrating Lymphocytes (TILs). In addition, he improves his knowledge about Whole-Slide Image (WSI) digitalization workflow from the extraction of the biopsy, the paraffin block creation, cutting and scanning. Finally, he also learnt about the latest technologies and techniques in cancer research, such as the Hyperion and the Nanostring geoMx together with an introduction about molecular pathology.

Host Entity:	*Host Supervisor:*	*Period of secondment*:	*ESR:*
Universeteit van Amsterdam	Zimming Zhao	December - February 2022	**ESR7**

ESR7 did an on-site secondment at the UvA in Amsterdam for 3 months, where ESR1 and ESR2 are doing their Ph.D. During this secondment, Laëtitia focused on an approach combining the expertise of UvA and UPV, working on the development of a federated learning pipeline. Once completed, that framework will allow collaborators to go from a centralized to a federated setup, thus enabling the training of more robust AI models without the need to share the data among institutions.

Host Entity:	*Host Supervisor:*	*Period of secondment*:	*ESR:*
Polytechnic University of Valencia	Valery Naranjo	January - February 2022	**ESR8**

In the first secondment of ESR8 in Valencia, he has been collaborating with ESR6 in a project about Triple Negative Breast Cancer. The goal of this is to help pathologists with Artificial Intelligence algorithms to obtain better cancer diagnoses with Whole Slide Images. Also, he had regular technical meetings with experts at the UPV, to increase his knowledge about this methodology. In collaboration with them, he has published a journal paper titled “Coupling semi-supervised and multiple instance learning for histopathological image classification.



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Host Entity:	*Host Supervisors:*	*Period of secondment:*	*ESR:*
Univertity of Stavanger	Kjersti Engan and Trygve Eftestøl	September - December 2021	**ESR9**

ES9 secondment allowed her to meet ESR3, ESR4, ESR5, ESR7, ESR10 and ESR11 in person, and discuss about a wide range of topics with them. These meetings bring her a good overview of the different part of the project and make the next steps clearer. She had a weekly meeting with her host supervisors to discuss the achieved results and the next steps to solve the problems and analysis the models. Besides, during her secondment, she has the opportunity to attend some lectures about breast cancer and learn about its clinical features from Professor Emiel Janssen.

Host Entity:	*Host Supervisors:*	*Period of secondment:*	*ESR:*
Stavanger University Hospital	Emiel Janssen	September - December 2021	**ESR10**

In this time, ESR10 has been able to meet and collaborate with other ESRs, which has been a very remarkable experience for his career development. He had different lectures and meetings by some of the best pathologists and uropathologists. This has allowed him to have a broader perspective over his project. He considers that his knowledge about digital pathology, molecular biology, and bladder cancer pathology has increased considerably.

Upcoming events

2nd training school in Granada!

The **second CLARIFY Training School** would have be held in February, 2022. Unfortunately, it had to be postponed because the COVID-19 pandemic situation. Now the situation has improved enough to organized the event onsite again, so we **will finally have the opportunity to meet in person!**

It will be on **April 5-7** at the **University of Granada.** During the first day, different workshops and seminars in transferable skills will take place, all of them of great interest to our ESRs. The second day will be the most technical day, so technical lectures and seminars regarding "Establishing the fundamentals and advanced methods in Artificial Intelligence for Medical Applications" will be done. On this day, different decision and management meetings will be also organised. Last day, some the members of the External Advisory Board (EAB) will contribute with master classes, assess the progress of the ESR's projects and provide overall advice on future trends and development requirements.

Online attendance is now open to general public. So if you are interested, you can register and find more information about this event in:

2nd Clarify Training School

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