

[Nnunet Tutorial](#)

nnUNet Tutorial: A Comprehensive Guide to Medical Image Segmentation

Introduction:

Are you a medical imaging professional, a data scientist, or a researcher fascinated by the power of deep learning in medical image analysis? If so, you've likely heard of nnUNet, a powerful and versatile framework for automated medical image segmentation. This comprehensive nnUNet tutorial will guide you through the entire process, from installation and data preparation to training and evaluating your own models. We'll cover everything you need to know to get started, regardless of your prior experience with deep learning. This isn't just another superficial overview; we'll delve into the intricacies of nnUNet, providing practical examples and troubleshooting tips along the way. Get ready to unlock the potential of nnUNet and revolutionize your workflow!

What this Tutorial Covers:

This nnUNet tutorial will equip you with the knowledge and skills to effectively utilize this powerful framework. We will cover the following key areas:

Understanding nnUNet's Architecture and Strengths: We'll explore the underlying architecture of nnUNet, highlighting its key features and advantages over other segmentation methods.

Setting up the Environment: A step-by-step guide to installing all necessary dependencies and configuring your system for nnUNet.

Data Preparation: The Key to Success: Learn how to properly format and preprocess your medical image data for optimal nnUNet performance. This includes handling different modalities and addressing common challenges.

Training Your First nnUNet Model: A practical walkthrough of the training process, including parameter tuning and monitoring performance.

Evaluating Model Performance: Understand various evaluation metrics and how to interpret the results of your trained model.

Advanced Techniques: Explore advanced topics such as hyperparameter optimization, model ensembling, and deploying your trained model.

Troubleshooting Common Issues: Practical advice on resolving common problems encountered during the nnUNet workflow.

Real-World Applications: Explore real-world examples of nnUNet's application in various medical imaging domains.

Future Directions: Discussing the ongoing development and future potential of nnUNet.

nnUNet Tutorial Outline:

Title: Mastering nnUNet: A Deep Dive into Medical Image Segmentation

Contents:

Introduction: What is nnUNet? Why use it? Overview of the tutorial.

Chapter 1: Setting up Your Environment: Installing required software (Python, CUDA, relevant libraries). Detailed installation instructions for different operating systems (Windows, Linux, macOS). Verification steps.

Chapter 2: Data Preparation and Preprocessing: Understanding nnUNet's data format requirements. Data conversion tools and scripts. Handling different image modalities (MRI, CT, etc.). Data augmentation techniques. Dealing with class imbalance.

Chapter 3: Training your nnUNet Model: Choosing the appropriate network architecture. Understanding hyperparameters and their impact. Monitoring training progress. Saving checkpoints and managing model versions.

Chapter 4: Model Evaluation and Validation: Understanding relevant metrics (Dice score, IoU, sensitivity, specificity). Cross-validation techniques. Analyzing performance results and identifying areas for improvement.

Chapter 5: Advanced nnUNet Techniques: Hyperparameter optimization using techniques like Bayesian optimization. Model ensembling for improved performance. Deploying your trained model for real-world applications.

Chapter 6: Troubleshooting and Best Practices: Addressing common errors and issues. Tips for optimizing performance and resource usage. Best practices for data handling and model training.

Chapter 7: Real-World Applications and Case Studies: Examples of successful nnUNet implementations in different medical imaging tasks. Discussion of relevant publications and research.

Conclusion: Recap of key concepts and future directions for nnUNet research and development.

(Now, let's expand on each chapter of the outline):

Chapter 1: Setting up Your Environment:

This chapter will provide a detailed, step-by-step guide to setting up the necessary software and hardware for running nnUNet. This includes installing Python (ideally version 3.8 or higher), verifying CUDA installation (if using a GPU), and installing all required Python packages (e.g., PyTorch, SimpleITK, nibabel) using pip or conda. We will provide platform-specific instructions for Windows, macOS, and Linux, addressing potential compatibility issues. The chapter will conclude with verification steps to ensure everything is correctly installed and configured.

Chapter 2: Data Preparation and Preprocessing:

This chapter is crucial. We'll explain nnUNet's specific data format requirements, focusing on the organization of images and corresponding segmentation masks. We'll provide practical examples of how to convert data from common medical imaging formats (DICOM, NIfTI) into the required format using readily available tools and scripts. We'll discuss strategies for handling multi-modal data (e.g., combining T1-weighted and T2-weighted MRI images) and address the challenges of data heterogeneity (variations in image acquisition parameters). The importance of data augmentation (random rotations, flips, intensity changes) to improve model robustness and generalization will also be highlighted, with clear examples of how to implement them. Finally, we'll explain how to handle class imbalance, a common problem in medical image segmentation.

Chapter 3: Training your nnUNet Model:

This chapter guides you through the training process. We'll explain how to choose the appropriate network architecture based on your dataset and task. The importance of hyperparameter tuning will be emphasized, with practical advice on how to adjust parameters like learning rate, batch size, and number of epochs. We'll demonstrate how to monitor the training progress using tools provided by nnUNet and interpret training curves to identify potential problems (e.g., overfitting, underfitting). We will also cover techniques for saving checkpoints at regular intervals, allowing you to resume training from a previous point and manage multiple model versions.

Chapter 4: Model Evaluation and Validation:

This chapter focuses on evaluating the performance of your trained model. We'll cover key evaluation metrics such as Dice similarity coefficient (DSC), Intersection over Union (IoU), sensitivity, and specificity, explaining their significance and interpretation. The importance of using cross-validation techniques to obtain reliable performance estimates will be discussed. We'll show how to analyze the results and identify areas where the model performs well and where it struggles. This analysis can provide valuable insights for improving the model's accuracy and generalizability.

Chapter 5: Advanced nnUNet Techniques:

This chapter explores advanced techniques to enhance your workflow. We'll cover hyperparameter optimization using methods like Bayesian Optimization or grid search to automatically find optimal parameter settings. Model ensembling, combining predictions from multiple models to improve accuracy and robustness, will be explained. Finally, we'll discuss deploying your trained model for practical use, considering factors such as computational resources and integration with existing medical imaging workflows.

Chapter 6: Troubleshooting and Best Practices:

This chapter addresses common errors and issues encountered during nnUNet use, providing practical solutions. We'll cover topics such as memory management, dealing with GPU errors, and resolving problems related to data loading and processing. We'll offer advice on optimizing performance, using resources efficiently, and adhering to best practices in data handling and model training.

Chapter 7: Real-World Applications and Case Studies:

This chapter provides examples of successful nnUNet applications in various medical imaging tasks. We'll showcase case studies highlighting the framework's effectiveness in different clinical settings and discuss relevant research publications that have utilized nnUNet.

Conclusion:

The conclusion summarizes the key concepts covered in the tutorial, reinforcing the practical skills gained. It will also discuss the ongoing development of nnUNet and future potential applications, encouraging further exploration and research in this exciting field.

FAQs:

1. What is the minimum hardware requirement for running nnUNet? A reasonable CPU and sufficient RAM; a GPU is highly recommended for efficient training.
2. What programming languages are needed? Primarily Python.
3. Can nnUNet handle different image modalities? Yes, it is designed to handle various modalities.
4. How do I choose the right network architecture for my dataset? nnUNet automatically selects an appropriate architecture based on dataset characteristics.
5. What are the common evaluation metrics used with nnUNet? Dice similarity coefficient, IoU, sensitivity, specificity.
6. How can I improve the performance of my nnUNet model? Data augmentation, hyperparameter tuning, and model ensembling.
7. Where can I find pre-trained nnUNet models? The nnUNet repository provides access to models trained on various datasets.
8. What are some common issues encountered during nnUNet training? Out-of-memory errors, slow training speed, poor generalization.
9. Is there a community or forum for support? Yes, the nnUNet developers maintain online resources and a community forum.

Related Articles:

1. Introduction to Medical Image Segmentation: A beginner's guide to the concepts and techniques of medical image segmentation.
2. Deep Learning for Medical Image Analysis: An overview of deep learning applications in medical imaging.
3. Understanding Dice Similarity Coefficient: A detailed explanation of this key evaluation metric.
4. Data Augmentation Techniques in Medical Imaging: Exploring various methods for improving model robustness.
5. Hyperparameter Optimization in Deep Learning: A guide to finding optimal parameter settings for deep learning models.
6. Model Ensembling for Improved Accuracy: Exploring techniques for combining multiple models for improved performance.
7. Deploying Deep Learning Models in Healthcare: Addressing the challenges and considerations of deploying models in clinical settings.
8. Ethical Considerations in Medical Image AI: A discussion of responsible AI development and deployment in healthcare.
9. The Future of AI in Medical Imaging: Exploring future trends and advancements in medical image analysis using AI.

nnunet tutorial: Machine Learning in Medical Imaging Xiaohuan Cao, Xuanang Xu, Islem Rekik, Zhiming Cui, Xi Ouyang, 2023-10-14 The two-volume set LNCS 14348 and 14139 constitutes the proceedings of the 14th International Workshop on Machine Learning in Medical Imaging, MLMI 2023, held in conjunction with MICCAI 2023, in Vancouver, Canada, in October 2023. The 93 full papers presented in the proceedings were carefully reviewed and selected from 139 submissions. They focus on major trends and challenges in artificial intelligence and machine learning in the medical imaging field, translating medical imaging research into clinical practice. Topics of interests included deep learning, generative adversarial learning, ensemble learning, transfer learning, multi-task learning, manifold learning, reinforcement learning, along with their applications to medical image analysis, computer-aided diagnosis, multi-modality fusion, image reconstruction,

image retrieval, cellular image analysis, molecular imaging, digital pathology, etc.

nnunet tutorial: *Fast, Low-resource, and Accurate Organ and Pan-cancer Segmentation in Abdomen CT* Jun Ma,

nnunet tutorial: *Semi-supervised Tooth Segmentation* Yaqi Wang,

nnunet tutorial: *Medical Image Computing and Computer Assisted Intervention - MICCAI 2022* Linwei Wang, Qi Dou, P. Thomas Fletcher, Stefanie Speidel, Shuo Li, 2022-09-15 The eight-volume set LNCS 13431, 13432, 13433, 13434, 13435, 13436, 13437, and 13438 constitutes the refereed proceedings of the 25th International Conference on Medical Image Computing and Computer-Assisted Intervention, MICCAI 2022, which was held in Singapore in September 2022. The 574 revised full papers presented were carefully reviewed and selected from 1831 submissions in a double-blind review process. The papers are organized in the following topical sections: Part I: Brain development and atlases; DWI and tractography; functional brain networks; neuroimaging; heart and lung imaging; dermatology; Part II: Computational (integrative) pathology; computational anatomy and physiology; ophthalmology; fetal imaging; Part III: Breast imaging; colonoscopy; computer aided diagnosis; Part IV: Microscopic image analysis; positron emission tomography; ultrasound imaging; video data analysis; image segmentation I; Part V: Image segmentation II; integration of imaging with non-imaging biomarkers; Part VI: Image registration; image reconstruction; Part VII: Image-Guided interventions and surgery; outcome and disease prediction; surgical data science; surgical planning and simulation; machine learning - domain adaptation and generalization; Part VIII: Machine learning - weakly-supervised learning; machine learning - model interpretation; machine learning - uncertainty; machine learning theory and methodologies.

nnunet tutorial: *Machine Learning in Medical Imaging* Chunfeng Lian, Xiaohuan Cao, Islem Rekik, Xuanang Xu, Pingkun Yan, 2021-09-25 This book constitutes the proceedings of the 12th International Workshop on Machine Learning in Medical Imaging, MLMI 2021, held in conjunction with MICCAI 2021, in Strasbourg, France, in September 2021.* The 71 papers presented in this volume were carefully reviewed and selected from 92 submissions. They focus on major trends and challenges in the above-mentioned area, aiming to identify new-cutting-edge techniques and their uses in medical imaging. Topics dealt with are: deep learning, generative adversarial learning, ensemble learning, sparse learning, multi-task learning, multi-view learning, manifold learning, and reinforcement learning, with their applications to medical image analysis, computer-aided detection and diagnosis, multi-modality fusion, image reconstruction, image retrieval, cellular image analysis, molecular imaging, digital pathology, etc. *The workshop was held virtually.

nnunet tutorial: *Clinical Image-Based Procedures* Klaus Drechsler,

nnunet tutorial: *Statistical Atlases and Computational Models of the Heart. Multi-Disease, Multi-View, and Multi-Center Right Ventricular Segmentation in Cardiac MRI Challenge* Esther Puyol Antón, Mihaela Pop, Carlos Martín-Isla, Maxime Sermesant, Avan Suinesiaputra, Oscar Camara, Karim Lekadir, Alistair Young, 2022-01-14 This book constitutes the proceedings of the 12th International Workshop on Statistical Atlases and Computational Models of the Heart, STACOM 2021, as well as the M&Ms-2 Challenge: Multi-Disease, Multi-View and Multi-Center Right Ventricular Segmentation in Cardiac MRI Challenge. The 25 regular workshop papers included in this volume were carefully reviewed and selected after being revised. They deal with cardiac imaging and image processing, machine learning applied to cardiac imaging and image analysis, atlas construction, artificial intelligence, statistical modelling of cardiac function across different patient populations, cardiac computational physiology, model customization, atlas based functional analysis, ontological schemata for data and results, integrated functional and structural analyses, as well as the pre-clinical and clinical applicability of these methods. In addition, 15 papers from the M&MS-2 challenge are included in this volume. The Multi-Disease, Multi-View & Multi-Center Right Ventricular Segmentation in Cardiac MRI Challenge (M&Ms-2) is focusing on the development of generalizable deep learning models for the Right Ventricle that can maintain good segmentation accuracy on different centers, pathologies and cardiac MRI views. There was a total of 48 submissions to the workshop.

nnunet tutorial: Uncertainty for Safe Utilization of Machine Learning in Medical Imaging Carole H. Sudre, Christian F. Baumgartner, Adrian Dalca, Chen Qin, Ryutaro Tanno, Koen Van Leemput, William M. Wells III, 2022-09-17 This book constitutes the refereed proceedings of the Fourth Workshop on Uncertainty for Safe Utilization of Machine Learning in Medical Imaging, UNSURE 2022, held in conjunction with MICCAI 2022. The conference was hybrid event held from Singapore. For this workshop, 13 papers from 22 submissions were accepted for publication. They focus on developing awareness and encouraging research in the field of uncertainty modelling to enable safe implementation of machine learning tools in the clinical world.

nnunet tutorial: Clinical Image-Based Procedures, Distributed and Collaborative Learning, Artificial Intelligence for Combating COVID-19 and Secure and Privacy-Preserving Machine Learning Cristina Oyarzun Laura, M. Jorge Cardoso, Michal Rosen-Zvi, Georgios Kaissis, Marius George Linguraru, Raj Shekhar, Stefan Wesarg, Marius Erdt, Klaus Drechsler, Yufei Chen, Shadi Albarqouni, Spyridon Bakas, Bennett Landman, Nicola Rieke, Holger Roth, Xiaoxiao Li, Daguang Xu, Maria Gabrani, Ender Konukoglu, Michal Guindy, Daniel Rueckert, Alexander Ziller, Dmitrii Usynin, Jonathan Passerat-Palmbach, 2021-11-13 This book constitutes the refereed proceedings of the 10th International Workshop on Clinical Image-Based Procedures, CLIP 2021, Second MICCAI Workshop on Distributed and Collaborative Learning, DCL 2021, First MICCAI Workshop, LL-COVID19, First Secure and Privacy-Preserving Machine Learning for Medical Imaging Workshop and Tutorial, PPML 2021, held in conjunction with MICCAI 2021, in October 2021. The workshops were planned to take place in Strasbourg, France, but were held virtually due to the COVID-19 pandemic. CLIP 2021 accepted 9 papers from the 13 submissions received. It focuses on holistic patient models for personalized healthcare with the goal to bring basic research methods closer to the clinical practice. For DCL 2021, 4 papers from 7 submissions were accepted for publication. They deal with machine learning applied to problems where data cannot be stored in centralized databases and information privacy is a priority. LL-COVID19 2021 accepted 2 papers out of 3 submissions dealing with the use of AI models in clinical practice. And for PPML 2021, 2 papers were accepted from a total of 6 submissions, exploring the use of privacy techniques in the medical imaging community.

nnunet tutorial: Medical Image Computing and Computer Assisted Intervention - MICCAI 2023 Hayit Greenspan, Anant Madabhushi, Parvin Mousavi, Septimiu Salcudean, James Duncan, Tanveer Syeda-Mahmood, Russell Taylor, 2023-09-30 The ten-volume set LNCS 14220, 14221, 14222, 14223, 14224, 14225, 14226, 14227, 14228, and 14229 constitutes the refereed proceedings of the 26th International Conference on Medical Image Computing and Computer-Assisted Intervention, MICCAI 2023, which was held in Vancouver, Canada, in October 2023. The 730 revised full papers presented were carefully reviewed and selected from a total of 2250 submissions. The papers are organized in the following topical sections: Part I: Machine learning with limited supervision and machine learning - transfer learning; Part II: Machine learning - learning strategies; machine learning - explainability, bias, and uncertainty; Part III: Machine learning - explainability, bias and uncertainty; image segmentation; Part IV: Image segmentation; Part V: Computer-aided diagnosis; Part VI: Computer-aided diagnosis; computational pathology; Part VII: Clinical applications - abdomen; clinical applications - breast; clinical applications - cardiac; clinical applications - dermatology; clinical applications - fetal imaging; clinical applications - lung; clinical applications - musculoskeletal; clinical applications - oncology; clinical applications - ophthalmology; clinical applications - vascular; Part VIII: Clinical applications - neuroimaging; microscopy; Part IX: Image-guided intervention, surgical planning, and data science; Part X: Image reconstruction and image registration.

nnunet tutorial: Fast and Low-Resource Semi-supervised Abdominal Organ Segmentation Jun Ma, Bo Wang, 2023-01-20 This book constitutes the proceedings of the MICCAI 2022 Challenge, FLARE 2022, held in Conjunction with MICCAI 2022, in Singapore, on September 22, 2022. The 28 full papers presented in this book were carefully reviewed and selected from 48 submissions. The papers present research and results for abdominal organ segmentation which has

many important clinical applications, such as organ quantification, surgical planning, and disease diagnosis.

nnunet tutorial: Medical Image Computing and Computer Assisted Intervention - MICCAI 2020 Anne L. Martel, Purang Abolmaesumi, Danail Stoyanov, Diana Mateus, Maria A. Zuluaga, S. Kevin Zhou, Daniel Racoceanu, Leo Joskowicz, 2020-10-02 The seven-volume set LNCS 12261, 12262, 12263, 12264, 12265, 12266, and 12267 constitutes the refereed proceedings of the 23rd International Conference on Medical Image Computing and Computer-Assisted Intervention, MICCAI 2020, held in Lima, Peru, in October 2020. The conference was held virtually due to the COVID-19 pandemic. The 542 revised full papers presented were carefully reviewed and selected from 1809 submissions in a double-blind review process. The papers are organized in the following topical sections: Part I: machine learning methodologies Part II: image reconstruction; prediction and diagnosis; cross-domain methods and reconstruction; domain adaptation; machine learning applications; generative adversarial networks Part III: CAI applications; image registration; instrumentation and surgical phase detection; navigation and visualization; ultrasound imaging; video image analysis Part IV: segmentation; shape models and landmark detection Part V: biological, optical, microscopic imaging; cell segmentation and stain normalization; histopathology image analysis; ophthalmology Part VI: angiography and vessel analysis; breast imaging; colonoscopy; dermatology; fetal imaging; heart and lung imaging; musculoskeletal imaging Part VI: brain development and atlases; DWI and tractography; functional brain networks; neuroimaging; positron emission tomography

nnunet tutorial: Computer and Information Science Roger Lee, 2022-11-22 This book presents scientific results of the 22nd IEEE/ACIS International Conference on Computer and Information Science (ICIS 2022) held on June 26-28, 2022 in Zhuhai China. The aim of this conference was to bring together researchers and scientists, businessmen and entrepreneurs, teachers, engineers, computer users, and students to discuss the numerous fields of computer science and to share their experiences and exchange new ideas and information in a meaningful way. Research results about all aspects (theory, applications, and tools) of computer and information science and to discuss the practical challenges encountered along the way and the solutions adopted to solve them. The conference organizers selected the best papers from those papers accepted for presentation at the conference. The papers were chosen based on review scores submitted by members of the program committee and underwent further rigorous rounds of review. From this second round of review, 14 of the conference's most promising papers are then published in this Springer (SCI) book and not the conference proceedings. We impatiently await the important contributions that we know these authors will bring to the field of computer and information science.

nnunet tutorial: Medical Image Computing and Computer Assisted Intervention - MICCAI 2021 Marleen de Bruijne, Philippe C. Cattin, Stéphane Cotin, Nicolas Padoy, Stefanie Speidel, Yefeng Zheng, Caroline Essert, 2021-09-23 The eight-volume set LNCS 12901, 12902, 12903, 12904, 12905, 12906, 12907, and 12908 constitutes the refereed proceedings of the 24th International Conference on Medical Image Computing and Computer-Assisted Intervention, MICCAI 2021, held in Strasbourg, France, in September/October 2021.* The 531 revised full papers presented were carefully reviewed and selected from 1630 submissions in a double-blind review process. The papers are organized in the following topical sections: Part I: image segmentation Part II: machine learning - self-supervised learning; machine learning - semi-supervised learning; and machine learning - weakly supervised learning Part III: machine learning - advances in machine learning theory; machine learning - attention models; machine learning - domain adaptation; machine learning - federated learning; machine learning - interpretability / explainability; and machine learning - uncertainty Part IV: image registration; image-guided interventions and surgery; surgical data science; surgical planning and simulation; surgical skill and work flow analysis; and surgical visualization and mixed, augmented and virtual reality Part V: computer aided diagnosis; integration of imaging with non-imaging biomarkers; and outcome/disease prediction Part VI: image reconstruction; clinical applications - cardiac; and clinical applications - vascular Part VII: clinical

applications - abdomen; clinical applications - breast; clinical applications - dermatology; clinical applications - fetal imaging; clinical applications - lung; clinical applications - neuroimaging - brain development; clinical applications - neuroimaging - DWI and tractography; clinical applications - neuroimaging - functional brain networks; clinical applications - neuroimaging - others; and clinical applications - oncology Part VIII: clinical applications - ophthalmology; computational (integrative) pathology; modalities - microscopy; modalities - histopathology; and modalities - ultrasound *The conference was held virtually.

nnunet tutorial: Medical Image Understanding and Analysis Bartłomiej W. Papież, Ana I. L. Namburete, Mohammad Yaqub, J. Alison Noble, 2020-07-08 This book constitutes the refereed proceedings of the 24th Conference on Medical Image Understanding and Analysis, MIUA 2020, held in July 2020. Due to COVID-19 pandemic the conference was held virtually. The 29 full papers and 5 short papers presented were carefully reviewed and selected from 70 submissions. They were organized according to following topical sections: image segmentation; image registration, reconstruction and enhancement; radiomics, predictive models, and quantitative imaging biomarkers; ocular imaging analysis; biomedical simulation and modelling.

nnunet tutorial: Pattern Recognition and Computer Vision Qingshan Liu, Hanzi Wang, Zhanyu Ma, Weishi Zheng, Hongbin Zha, Xilin Chen, Liang Wang, Rongrong Ji, 2024-01-26 The 13-volume set LNCS 14425-14437 constitutes the refereed proceedings of the 6th Chinese Conference on Pattern Recognition and Computer Vision, PRCV 2023, held in Xiamen, China, during October 13-15, 2023. The 532 full papers presented in these volumes were selected from 1420 submissions. The papers have been organized in the following topical sections: Action Recognition, Multi-Modal Information Processing, 3D Vision and Reconstruction, Character Recognition, Fundamental Theory of Computer Vision, Machine Learning, Vision Problems in Robotics, Autonomous Driving, Pattern Classification and Cluster Analysis, Performance Evaluation and Benchmarks, Remote Sensing Image Interpretation, Biometric Recognition, Face Recognition and Pose Recognition, Structural Pattern Recognition, Computational Photography, Sensing and Display Technology, Video Analysis and Understanding, Vision Applications and Systems, Document Analysis and Recognition, Feature Extraction and Feature Selection, Multimedia Analysis and Reasoning, Optimization and Learning methods, Neural Network and Deep Learning, Low-Level Vision and Image Processing, Object Detection, Tracking and Identification, Medical Image Processing and Analysis.

nnunet tutorial: Medical Image Understanding and Analysis Moi Hoon Yap, Connah Kendrick, Ardhendu Behera, Timothy Cootes, Reyer Zwiggelaar, 2024 Zusammenfassung: This two-volume set LNCS 14859-14860 constitutes the proceedings of the 28th Annual Conference on Medical Image Understanding and Analysis, MIUA 2024, held in Manchester, UK, during July 24-26, 2024. The 59 full papers included in this book were carefully reviewed and selected from 93 submissions. They were organized in topical sections as follows: Part I : Advancement in Brain Imaging; Medical Images and Computational Models; and Digital Pathology, Histology and Microscopic Imaging. Part II : Dental and Bone Imaging; Enhancing Low-Quality Medical Images; Domain Adaptation and Generalisation; and Dermatology, Cardiac Imaging and Other Medical Imaging

nnunet tutorial: Pattern Recognition and Computer Vision Zhouchen Lin,

nnunet tutorial: Brainlesion: Glioma, Multiple Sclerosis, Stroke and Traumatic Brain Injuries Alessandro Crimi, Spyridon Bakas, 2021-03-26 This two-volume set LNCS 12658 and 12659 constitutes the thoroughly refereed proceedings of the 6th International MICCAI Brainlesion Workshop, BrainLes 2020, the International Multimodal Brain Tumor Segmentation (BraTS) challenge, and the Computational Precision Medicine: Radiology-Pathology Challenge on Brain Tumor Classification (CPM-RadPath) challenge. These were held jointly at the 23rd Medical Image Computing for Computer Assisted Intervention Conference, MICCAI 2020, in Lima, Peru, in October 2020.* The revised selected papers presented in these volumes were organized in the following topical sections: brain lesion image analysis (16 selected papers from 21 submissions); brain tumor

image segmentation (69 selected papers from 75 submissions); and computational precision medicine: radiology-pathology challenge on brain tumor classification (6 selected papers from 6 submissions). *The workshop and challenges were held virtually.

nnunet tutorial: *Segmentation, Classification, and Registration of Multi-modality Medical Imaging Data* Nadya Shusharina, Mattias P. Heinrich, Ruobing Huang, 2021-03-12 This book constitutes three challenges that were held in conjunction with the 23rd International Conference on Medical Image Computing and Computer-Assisted Intervention, MICCAI 2020, in Lima, Peru, in October 2020*: the Anatomical Brain Barriers to Cancer Spread: Segmentation from CT and MR Images Challenge, the Learn2Reg Challenge, and the Thyroid Nodule Segmentation and Classification in Ultrasound Images Challenge. The 19 papers presented in this volume were carefully reviewed and selected from numerous submissions. The ABCs challenge aims to identify the best methods of segmenting brain structures that serve as barriers to the spread of brain cancers and structures to be spared from irradiation, for use in computer assisted target definition for glioma and radiotherapy plan optimization. The papers of the L2R challenge cover a wide spectrum of conventional and learning-based registration methods and often describe novel contributions. The main goal of the TN-SCUI challenge is to find automatic algorithms to accurately segment and classify the thyroid nodules in ultrasound images. *The challenges took place virtually due to the COVID-19 pandemic.

nnunet tutorial: *Statistical Atlases and Computational Models of the Heart. Regular and CMRxMotion Challenge Papers* Oscar Camara, Esther Puyol-Antón, Chen Qin, Maxime Sermesant, Avan Suinesiaputra, Shuo Wang, Alistair Young, 2023-01-27 This book constitutes the proceedings of the 13th International Workshop on Statistical Atlases and Computational Models of the Heart, STACOM 2022, held in conjunction with the 25th MICCAI conference. The 34 regular workshop papers included in this volume were carefully reviewed and selected after being revised and deal with topics such as: common cardiac segmentation and modelling problems to more advanced generative modelling for ageing hearts, learning cardiac motion using biomechanical networks, physics-informed neural networks for left atrial appendage occlusion, biventricular mechanics for Tetralogy of Fallot, ventricular arrhythmia prediction by using graph convolutional network, and deeper analysis of racial and sex biases from machine learning-based cardiac segmentation. In addition, 14 papers from the CMRxMotion challenge are included in the proceedings which aim to assess the effects of respiratory motion on cardiac MRI (CMR) imaging quality and examine the robustness of segmentation models in face of respiratory motion artefacts. A total of 48 submissions to the workshop was received.

nnunet tutorial: *Deep Generative Models* Anirban Mukhopadhyay,

nnunet tutorial: *Applied Intelligence* De-Shuang Huang,

nnunet tutorial: *Database and Expert Systems Applications - DEXA 2022 Workshops* Gabriele Kotsis, A Min Tjoa, Ismail Khalil, Bernhard Moser, Alfred Taudes, Atif Mashkoor, Johannes Sametinger, Jorge Martinez-Gil, Florian Sobieczky, Lukas Fischer, Rudolf Ramler, Maqbool Khan, Gerald Czech, 2022-08-15 This volume constitutes the refereed proceedings of the workshops held at the 33rd International Conference on Database and Expert Systems Applications, DEXA 2022, held in Vienna, Austria, in August 2022: The 6th International Workshop on Cyber-Security and Functional Safety in Cyber-Physical Systems (IWCFS 2022); 4th International Workshop on Machine Learning and Knowledge Graphs (MLKgraphs 2022); 2nd International Workshop on Time Ordered Data (ProTime2022); 2nd International Workshop on AI System Engineering: Math, Modelling and Software (AISys2022); 1st International Workshop on Distributed Ledgers and Related Technologies (DLRT2022); 1st International Workshop on Applied Research, Technology Transfer and Knowledge Exchange in Software and Data Science (ARTE2022). The 40 papers were thoroughly reviewed and selected from 62 submissions, and discuss a range of topics including: knowledge discovery, biological data, cyber security, cyber-physical system, machine learning, knowledge graphs, information retriever, data base, and artificial intelligence.

nnunet tutorial: *Advances in Deep Generative Models for Medical Artificial Intelligence* Hazrat

Ali, Mubashir Husain Rehmani, Zubair Shah, 2023-12-16 Generative Artificial Intelligence is rapidly advancing with many state-of-the-art performances on computer vision, speech processing, and natural language processing tasks. Generative adversarial networks and neural diffusion models can generate high-quality synthetic images of human faces, artworks, and coherent essays on different topics. Generative models are also transforming Medical Artificial Intelligence, given their potential to learn complex features from medical imaging and healthcare data. Hence, computer-aided diagnosis and healthcare are benefiting from Medical Artificial Intelligence and Generative Artificial Intelligence. This book presents the recent advances in generative models for Medical Artificial Intelligence. It covers many applications of generative models for medical image data, including volumetric medical image segmentation, data augmentation, MRI reconstruction, and modeling of spatiotemporal medical data. This book highlights the recent advancements in Generative Artificial Intelligence for medical and healthcare applications, using medical imaging and clinical and electronic health records data. Furthermore, the book comprehensively presents the concepts and applications of deep learning-based artificial intelligence methods, such as generative adversarial networks, convolutional neural networks, and vision transformers. It also presents a quantitative and qualitative analysis of data augmentation and synthesis performances of Generative Artificial Intelligence models. This book is the result of the collaborative efforts and hard work of many minds who contributed to it and illuminated the vast landscape of Medical Artificial Intelligence. The book is suitable for reading by computer science researchers, medical professionals, healthcare informatics, and medical imaging researchers interested in understanding the potential of artificial intelligence in healthcare. It serves as a compass for navigating the artificial intelligence-driven healthcare landscape.

nnunet tutorial: Machine learning in radiation oncology Wei Zhao, Ye Zhang, Jia Wu, Xiaomeng Li, Yuming Jiang, 2023-04-05

nnunet tutorial: Computational Neurosurgery Antonio Di Ieva,

nnunet tutorial: Computational Intelligence for Oncology and Neurological Disorders Mrutyunjaya Panda, Ajith Abraham, Biju Gopi, Reuel Ajith, 2024-07-15 With the advent of computational intelligence-based approaches, such as bio-inspired techniques, and the availability of clinical data from various complex experiments, medical consultants, researchers, neurologists, and oncologists, there is huge scope for CI-based applications in medical oncology and neurological disorders. This book focuses on interdisciplinary research in this field, bringing together medical practitioners dealing with neurological disorders and medical oncology along with CI investigators. The book collects high-quality original contributions, containing the latest developments or applications of practical use and value, presenting interdisciplinary research and review articles in the field of intelligent systems for computational oncology and neurological disorders. Drawing from work across computer science, physics, mathematics, medical science, psychology, cognitive science, oncology, and neurobiology among others, it combines theoretical, applied, computational, experimental, and clinical research. It will be of great interest to any neurology or oncology researchers focused on computational approaches.

nnunet tutorial: AI in Clinical Medicine Michael F. Byrne, Nasim Parsa, Alexandra T. Greenhill, Daljeet Chahal, Omer Ahmad, Ulas Bagci, 2023-03-01 AI IN CLINICAL MEDICINE An essential overview of the application of artificial intelligence in clinical medicine AI in Clinical Medicine: A Practical Guide for Healthcare Professionals is the definitive reference book for the emerging and exciting use of AI throughout clinical medicine. AI in Clinical Medicine: A Practical Guide for Healthcare Professionals is divided into four sections. Section 1 provides readers with the basic vocabulary that they require, a framework for AI, and highlights the importance of robust AI training for physicians. Section 2 reviews foundational ideas and concepts, including the history of AI. Section 3 explores how AI is applied to specific disciplines. Section 4 describes emerging trends, and applications of AI in medicine in the future. Readers will find that this book: Describes where AI is currently being used to change practice, and provides successful cases of AI approaches in specific medical domains. Dives into the actual implementation of AI in the healthcare setting, and addresses

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