Computer Vision Algorithms And Applications

Computer Vision Algorithms And Applications Computer Vision Algorithms and Applications A Deep Dive into the Future of Sight Meta Explore the fascinating world of computer vision algorithms their diverse applications and the future of this rapidly evolving field Discover realworld examples expert insights and actionable advice for leveraging this powerful technology Computer vision algorithms applications image processing object detection image recognition deep learning machine learning artificial intelligence convolutional neural networks CNNs realworld examples future trends FAQs Computer vision a field of artificial intelligence AI that enables computers to see and interpret images and videos like humans is rapidly transforming industries worldwide This transformative technology relies on sophisticated algorithms to analyze visual data extracting meaningful information and enabling machines to understand and interact with the visual world From selfdriving cars to medical diagnoses the applications of computer vision are vast and continue to expand at an astonishing rate The Power of Algorithms The Engine of Computer Vision At the heart of computer vision lies a complex interplay of algorithms These algorithms often built upon machine learning ML and deep learning DL techniques perform various tasks including Image Classification Categorizing images into predefined classes eg cat dog car Object Detection Identifying and locating specific objects within an image or video often drawing bounding boxes around them Image Segmentation Partitioning an image into multiple segments based on object boundaries or characteristics Image Recognition Identifying and understanding the content of an image going beyond simple classification to comprehend context and relationships Optical Character Recognition OCR Extracting text from images Deep Learnings Dominance Convolutional Neural Networks CNNs Convolutional Neural Networks CNNs have emerged as the dominant architecture for many computer vision tasks CNNs are particularly adept at processing visual data due to their 2 ability to learn hierarchical features progressively extracting increasingly complex patterns from raw pixel data Their success is evidenced by their use in groundbreaking applications like ImageNet where deep learning models achieved superhuman accuracy in image classification According to a report by MarketsandMarkets the global computer vision market is projected to reach USD 486 billion by 2028 growing at a CAGR of 135 This dramatic growth highlights the increasing adoption of computer vision across various sectors RealWorld Applications Transforming Industries The

impact of computer vision is felt across a diverse range of industries Autonomous Vehicles Selfdriving cars rely heavily on computer vision for object detection lane recognition and navigation Companies like Tesla and Waymo are at the forefront of this technology investing heavily in the development of robust and reliable computer vision systems Healthcare Computer vision aids in medical image analysis enabling faster and more accurate diagnoses of diseases like cancer AIpowered systems can detect subtle anomalies in Xrays MRIs and CT scans that might be missed by human eyes Retail Computer vision is revolutionizing retail through applications like automated checkout inventory management and personalized shopping experiences Amazon Go stores exemplify this trend using computer vision to track customer purchases without traditional checkout counters Security and Surveillance Facial recognition object tracking and anomaly detection are employed in security systems to enhance safety and prevent crime Manufacturing Computer vision plays a crucial role in quality control defect detection and robotic automation in manufacturing processes Agriculture Precision agriculture utilizes computer vision for crop monitoring yield prediction and automated harvesting Expert Opinion The advancements in deep learning particularly the development of more efficient and robust CNN architectures have been crucial in driving the progress of computer vision says Dr Anya Petrova a leading researcher in computer vision at MIT However challenges remain in addressing issues like data bias adversarial attacks and the need for more explainable AI Actionable Advice 3 For businesses looking to leverage computer vision consider these key steps 1 Identify a clear business problem Determine how computer vision can solve a specific challenge and generate a positive return on investment 2 Gather and prepare data Highquality labeled data is essential for training effective computer vision models 3 Choose the right algorithms and tools Select algorithms tailored to your specific needs and leverage cloudbased platforms or pretrained models to accelerate development 4 Evaluate and iterate Continuously monitor model performance and refine your approach based on realworld feedback 5 Address ethical considerations Ensure fairness transparency and accountability in your computer vision applications mitigating potential biases and risks Computer vision algorithms are transforming the way we interact with the world enabling machines to perceive and understand visual information with remarkable accuracy Driven by advancements in deep learning particularly CNNs this powerful technology is rapidly finding its way into a diverse range of industries promising to revolutionize everything from healthcare to autonomous driving By carefully considering the ethical implications and leveraging the right tools and expertise businesses can harness the immense potential of computer vision to gain a competitive edge and drive innovation Frequently

Asked Questions FAQs 1 What is the difference between computer vision and image processing While closely related computer vision and image processing differ in their goals Image processing focuses on manipulating and enhancing images improving their quality or extracting specific features Computer vision on the other hand aims to interpret the meaning and content of images enabling machines to understand what they see Image processing often serves as a preprocessing step for computer vision tasks 2 How can I get started with computer vision Begin by learning the fundamentals of image processing and machine learning Online courses tutorials and opensource libraries like OpenCV and TensorFlow provide excellent resources Start with simple projects like image classification or object detection using pre trained models gradually progressing to more complex tasks 3 What are the limitations of current computer vision technology Current computer vision systems can struggle with complex scenes variations in lighting 4 conditions and adversarial attacks deliberate attempts to fool the system Explainability remains a challenge making it difficult to understand why a model makes a particular decision Data bias can also lead to unfair or inaccurate outcomes 4 What are the future trends in computer vision Future trends include advancements in 3D computer vision realtime processing capabilities improved robustness to noise and variations and the development of more explainable and ethical AI systems The integration of computer vision with other AI technologies such as natural language processing will also create exciting new possibilities 5 What are the ethical considerations in using computer vision Ethical considerations include potential biases in training data leading to unfair outcomes privacy concerns associated with facial recognition and the misuse of computer vision for surveillance or manipulation Its crucial to develop and deploy computer vision systems responsibly ensuring fairness transparency and accountability

Computer VisionMachine Vision Algorithms and ApplicationsHands-On Algorithms for Computer VisionMachine VisionMachine Vision Algorithms and ApplicationsSpecial Issue on Advances in Vision Algorithms and Systems Beyond the Visible SpectrumArchitectures for Computer VisionDeep Learning for 3D Vision: Algorithms and ApplicationsVision Algorithms: Theory and PracticeMachine VisionHandbook of Computer Vision Algorithms in Image AlgebraVision Algorithms and PsychophysicsVision Algorithms and PsychophysicsMachine Vision Algorithms in JavaAn Introduction to 3D Computer Vision Techniques and AlgorithmsAugmented Vision Perception in InfraredRobust Computer VisionVision Algorithms: Theory and PracticeBuilding Computer Vision Projects with OpenCV 4 and C++Towards Solving Computer Vision Problems Richard Szeliski Carsten Steger Amin Ahmadi Tazehkandi Herbert Freeman Carsten Steger Riad I. Hammoud Hong Jeong Xiaoli Li Bill Triggs E. R. Davies Gerhard X. Ritter W. A. Richards

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Computer Vision Machine Vision Algorithms and Applications Hands-On Algorithms for Computer Vision Machine Vision Machine Vision Algorithms and Applications Special Issue on Advances in Vision Algorithms and Systems Beyond the Visible Spectrum Architectures for Computer Vision Deep Learning for 3D Vision: Algorithms and Applications Vision Algorithms: Theory and Practice Machine Vision Handbook of Computer Vision Algorithms in Image Algebra Vision Algorithms and Psychophysics Vision Algorithms and Psychophysics Machine Vision Algorithms in Java An Introduction to 3D Computer Vision Techniques and Algorithms Augmented Vision Perception in Infrared Robust Computer Vision Vision Algorithms: Theory and Practice Building Computer Vision Projects with OpenCV 4 and C++ Towards Solving Computer Vision Problems *Richard Szeliski Carsten Steger Amin Ahmadi Tazehkandi Herbert Freeman Carsten Steger Riad I. Hammoud Hong Jeong Xiaoli Li Bill Triggs E. R. Davies Gerhard X. Ritter W. A. Richards Paul F. Whelan Boguslaw Cyganek Riad I. Hammoud Wolfgang Förstner Bill Triggs David Mill n Escriv Iljung Samuel Kwak*

computer vision algorithms and applications explores the variety of techniques commonly used to analyze and interpret images it also describes challenging real world applications where vision is being successfully used both for specialized applications such as medical imaging and for fun consumer level tasks such as image editing and stitching which students can apply to their own personal photos and videos more than just a source of recipes this exceptionally authoritative and comprehensive textbook reference also takes a scientific approach to basic vision problems formulating physical models of the imaging process before inverting them to produce descriptions of a scene these problems are also analyzed using statistical models and solved using rigorous engineering techniques topics and features structured to support active curricula and project oriented courses with tips in the introduction for using the book in a variety of customized courses presents exercises at the end of each chapter with a heavy emphasis on testing algorithms and containing numerous suggestions for small mid term projects provides additional material and more detailed mathematical topics in the appendices which cover linear algebra numerical techniques and bayesian estimation theory suggests additional reading at the end of each chapter including the latest research in each sub field in addition to a full bibliography at the end of the book supplies supplementary course material for students at the associated website szeliski org book suitable for an upper level undergraduate or graduate level course in computer science or engineering this textbook focuses on basic techniques that work under real

world conditions and encourages students to push their creative boundaries its design and exposition also make it eminently suitable as a unique reference to the fundamental techniques and current research literature in computer vision

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create powerful accurate and real time computer vision applications using a perfect blend of algorithms and filters also learn about object tracking and foreground extractions with a variety of new filters and algorithms key features filter transform and manipulate images using mat class and opencv framework explore motion detection and object tracking with filters and algorithms build object detectors using deep learning and machine learning algorithms book description an arena that has been positively impacted by the advancements in processing power and performance is the field of computer vision it s only natural that over time more and more algorithms are introduced to perform computer vision tasks more efficiently hands on algorithms for computer vision is a starting point for anyone who is interested in the field of computer vision and wants to explore the most practical algorithms used by professional computer vision developers the book starts with the basics and builds up over the course of the chapters with hands on examples for each algorithm right from the start you will learn about the required tools for computer vision development and how to install and configure them you ll explore the opencv framework and its powerful collection of libraries and functions starting from the most simple image modifications filtering and transformations you will gradually build up your knowledge of various algorithms until you are able to perform much more sophisticated tasks such as real time object detection using deep learning algorithms what you will learn get to grips with machine learning and artificial intelligence algorithms read write and process images and videos perform mathematical matrix and other types of image data operations create and use histograms from back projection images detect motion extract foregrounds and track objects extract key points with a collection of feature detector algorithms develop cascade classifiers and use them and

train and test classifiers employ tensorflow object detection to detect multiple objects who this book is for hands on algorithms for computer vision helps those who want to learn algorithms in computer vision to create and customize their applications this book will also help existing computer vision developers customize their applications a basic understanding of computer vision and programming experience is needed

machine vision algorithms architectures and systems contains the proceedings of the workshop machine vision where are we and where are we going sponsored by the center for computer aids for industrial productivity caip at rutgers university and held in april 1987 in new brunswick new jersey the papers review the state of the art of machine vision and sets directions for future research topics covered include smart sensing in machine vision computer architectures for machine vision and range image segmentation comprised of 14 chapters this book opens with an overview of smart sensing strategies in machine vision and illustrates how smart sensing may fit into a general purpose vision system by implementing a flexible modular system called pipeline pyramid machine the discussion then turns to a hierarchy of local autonomy for processor arrays focusing on the progression from pure simd to complete mimd as well as the hardware penalties that arise when autonomy is increased the following chapters explore schemes for integrating vision modules on fine grained machines computer architectures for real time machine vision systems the application of machine vision to industrial inspection and characteristics of technologies and social processes that are inhibiting the development and or evolution of machine vision machine vision research at general motors is also considered the final chapter assesses future prospects for machine vision and highlights directions for research this monograph will be a useful resource for practitioners in the fields of computer science and applied mathematics

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this book provides comprehensive coverage of 3d vision systems from vision models and state of the art algorithms to their hardware architectures for implementation on dsps fpga and asic chips and gpus it aims to fill the gaps between computer vision algorithms and real time digital circuit implementations especially with verilog hdl design the organization of this book is vision and hardware module directed based on verilog vision modules 3d vision modules parallel vision architectures and verilog designs for the stereo matching system with various parallel architectures provides verilog vision simulators tailored to the design and testing of general vision chips bridges the differences between c c and hdl to encompass both software realization and chip implementation includes numerous examples that realize vision algorithms and general vision processing in hdl unique in providing an organized and complete overview of how a real time 3d vision system on chip can be designed focuses on the digital vlsi aspects and implementation of digital signal processing tasks on hardware platforms such as asics and fpgas for 3d vision systems which have not been comprehensively covered in one single book provides a timely view of the pervasive use of vision systems and the challenges of fusing information from different vision modules accompanying website includes software and hdl code packages to enhance further learning and develop advanced systems a solution set and lecture slides are provided on the book s companion website the book is aimed at graduate students and researchers in computer vision and embedded systems as well as chip and fpga designers senior undergraduate students specializing in vlsi design or computer vision will also find the book to be helpful in understanding advanced applications

3d deep learning is a rapidly evolving field that has the potential to transform various industries this book provides a comprehensive overview of the current state of the art in 3d deep learning covering a wide range of research topics and applications it collates the most recent research advances in 3d deep learning including algorithms and applications with a focus on efficient methods to tackle the key technical challenges in current 3d deep learning research and adoption therefore making 3d deep learning more practical and feasible for real world applications this book is organized into five sections each of which addresses different aspects of 3d deep learning section i sample efficient 3d deep learning focuses on developing efficient algorithms to build accurate 3d models with limited annotated samples section ii representation efficient 3d deep learning deals with the challenge of developing efficient representations for dynamic 3d scenes and multiple 3d modalities section iii robust 3d deep learning presents methods for improving the robustness and reliability of deep learning models in real world applications section iv resource efficient 3d deep learning explores ways to reduce the

computation cost of 3d models and improve their efficiency in resource limited environments section v emerging 3d deep learning applications showcases how 3d deep learning is transforming industries and enabling new applications for healthcare and manufacturing this collection is a valuable resource for researchers and practitioners interested in exploring the potential of 3d deep learning

this book constitutes the thoroughly refereed post workshop proceedings of the international workshop on vision algorithms held in corfu greece in september 1999 in conjunction with iccv 99 the 15 revised full papers presented were carefully reviewed and selected from 65 submissions each paper is complemented by a brief transcription of the discussion that followed its presentation also included are two invited contributions and two expert reviews as well as a panel discussion the volume spans the whole range of algorithms for geometric vision the authors and volume editors succeeded in providing added value beyond a mere collection of papers and made the volume a state of the art survey of their field

machine vision theory algorithms practicalities covers the limitations constraints and tradeoffs of vision algorithms this book is organized into four parts encompassing 21 chapters that tackle general topics such as noise suppression edge detection principles of illumination feature recognition bayes theory and hough transforms part 1 provides research ideas on imaging and image filtering operations thresholding techniques edge detection and binary shape and boundary pattern analyses part 2 deals with the area of intermediate level vision the nature of the hough transform shape detection and corner location part 3 demonstrates some of the practical applications of the basic work previously covered in the book this part also discusses some of the principles underlying implementation including on lighting and hardware systems part 4 highlights the limitations and constraints of vision algorithms and their corresponding solutions this book will prove useful to students with undergraduate course on vision for electronic engineering or computer science

image algebra is a comprehensive unifying theory of image transformations image analysis and image understanding in 1996 the bestselling first edition of the handbook of computer vision algorithms in image algebra introduced engineers scientists and students to this powerful tool its basic concepts and its use in the concise representation of computer vision algorithms updated to reflect recent developments and advances the second edition continues to provide an outstanding introduction to image algebra it describes more than 80 fundamental computer vision

techniques and introduces the portable iac library which supports image algebra programming in the c language revisions to the first edition include a new chapter on geometric manipulation and spatial transformation several additional algorithms and the addition of exercises to each chapter the authors both instrumental in the groundbreaking development of image algebra introduce each technique with a brief discussion of its purpose and methodology then provide its precise mathematical formulation in addition to furnishing the simple yet powerful utility of image algebra the handbook of computer vision algorithms in image algebra supplies the core of knowledge all computer vision practitioners need it offers a more practical less esoteric presentation than those found in research publications that will soon earn it a prime location on your reference shelf

vision by man or machine is the useful symbolic descriptions form images of the world studies of human visual system provide valuable insights into the kinds of descriptions that will be the most useful but little insight into the computational problems involved in deriving and manipulating theses descriptions this research examines several computational problems associated with aspects of two and three dimensional vision the solution to these problems includes the design and implementation of particular algorithms their efficiency and flexibility is compared with that of the human visual processor keywords include image understanding visual pattern recognition visual algorithms human vision biological information processing

representing shapes in a manner suitable for recognition has been a challenge for machine vision here we approach this problem by combining studies of representations used by the human visual system with computational studies of how such representations can be derived and manipulated by machine both axial based and contour based descriptors were investigated with emphasis on the role of curvature which was found to be an important primitive underlying both types of representations related but unreported studies include color and motion which often serve as the glue that allows one to form appropriate groupings of broken image contours or tokens this research has yielded over fifty publications with only the major thrust summarized here keywords image understanding shape recognition visual pattern recognition visual psychophysics vision algorithms

machine vision algorithms in java provides a comprehensive introduction to the algorithms and techniques associated with machine vision systems the java programming language is also introduced with particular reference to its imaging capabilities the book contains explanations of key machine vision techniques and algorithms along with the associated java source code

special features include a complete self contained treatment of the topics and techniques essential to the understanding and implementation of machine vision an introduction to object oriented programming and to the java programming language with particular reference to its imaging capabilities java source code for a wide range of practical image processing and analysis functions readers will be given the opportunity to download a fully functional java based visual programming environment for machine vision available via the www this contains over 200 image processing manipulation and analysis functions and will enable users to implement many of the ideas covered in this book details relating to the design of a java based visual programming environment for machine vision an introduction to the java 2d imaging and java advanced imaging jai apis a wide range of illustrative examples practical treatment of the subject matter this book is aimed at senior undergraduate and postgraduate students in engineering and computer science as well as practitioners in machine vision who may wish to update or expand their knowledge of the subject the techniques and algorithms of machine vision are expounded in a way that will be understood not only by specialists but also by those who are less familiar with the topic

computer vision encompasses the construction of integrated vision systems and the application of vision to problems of real world importance the process of creating 3d models is still rather difficult requiring mechanical measurement of the camera positions or manual alignment of partial 3d views of a scene however using algorithms it is possible to take a collection of stereo pair images of a scene and then automatically produce a photo realistic geometrically accurate digital 3d model this book provides a comprehensive introduction to the methods theories and algorithms of 3d computer vision almost every theoretical issue is underpinned with practical implementation or a working algorithm using pseudo code and complete code written in c and matlab there is the additional clarification of an accompanying website with downloadable software case studies and exercises organised in three parts cyganek and siebert give a brief history of vision research and subsequently present basic low level image processing operations for image matching including a separate chapter on image matching algorithms explain scale space vision as well as space reconstruction and multiview integration demonstrate a variety of practical applications for 3d surface imaging and analysis provide concise appendices on topics such as the basics of projective geometry and tensor calculus for image processing distortion and noise in images plus image warping procedures an introduction to 3d computer vision algorithms and techniques is a valuable reference for practitioners and programmers working in 3d computer vision image processing and analysis as well as computer visualisation it would

also be of interest to advanced students and researchers in the fields of engineering computer science clinical photography robotics graphics and mathematics

throughout much of machine vision s early years the infrared imagery has suffered from return on investment despite its advantages over visual counterparts recently the scal momentum has switched in favor of both manufacturers and practitioners of infrared technology as a result of today s rising security and safety challenges and advances in thermographic sensors and their continuous drop in costs this yielded a great impetus in achieving ever better performance in remote surveillance object recognition guidance noncontact medical measurements and more the purpose of this book is to draw attention to recent successful efforts made on merging computer vision applications nonmilitary only and nonvisual imagery as well as to ll in the need in the literature for an up to date convenient reference on machine vision and infrared technologies augmented perception in infrared provides a comprehensive review of recent deployment of infrared sensors in modern applications of computer vision along with in depth description of the world s best machine vision algorithms and intel gent analytics its topics encompass many disciplines of machine vision including remote sensing automatic target detection and recognition background modeling and image segmentation object tracking face and facial expression recognition variant shape characterization disparate sensors fusion noncontact physiological measurements night vision and target classi cation its application scope includes homeland security public transportation surveillance medical and military mo over this book emphasizes the merging of the aforementioned machine perception applications and nonvisual imaging in intensi ed near infrared thermal infrared laser polarimetric and hyperspectral bands

this book constitutes the thoroughly refereed post workshop proceedings of the international workshop on vision algorithms held in corfu greece in september 1999 in conjunction with iccv 99 the 15 revised full papers presented were carefully reviewed and selected from 65 submissions each paper is complemented by a brief transcription of the discussion that followed its presentation also included are two invited contributions and two expert reviews as well as a panel discussion the volume spans the whole range of algorithms for geometric vision the authors and volume editors succeeded in providing added value beyond a mere collection of papers and made the volume a state of the art survey of their field

delve into practical computer vision and image processing projects and get up to speed with

advanced object detection techniques and machine learning algorithms key featuresdiscover best practices for engineering and maintaining opencv projectsexplore important deep learning tools for image classificationunderstand basic image matrix formats and filtersbook description opencv is one of the best open source libraries available and can help you focus on constructing complete projects on image processing motion detection and image segmentation this learning path is your guide to understanding opencv concepts and algorithms through real world examples and activities through various projects you ll also discover how to use complex computer vision and machine learning algorithms and face detection to extract the maximum amount of information from images and videos in later chapters you ll learn to enhance your videos and images with optical flow analysis and background subtraction sections in the learning path will help you get to grips with text segmentation and recognition in addition to guiding you through the basics of the new and improved deep learning modules by the end of this learning path you will have mastered commonly used computer vision techniques to build opencv projects from scratch this learning path includes content from the following packt books mastering opencv 4 third edition by roy shilkrot and david mill n escriv learn opencv 4 by building projects second edition by david mill n escriv vin cius g mendon-a and prateek joshiwhat you will learnstay up to date with algorithmic design approaches for complex computer vision taskswork with opencv s most up to date api through various projectsunderstand 3d scene reconstruction and structure from motion sfm study camera calibration and overlay augmented reality ar using the aruco modulecreate cmake scripts to compile your c applicationexplore segmentation and feature extraction techniquesremove backgrounds from static scenes to identify moving objects for surveillancework with new opencv functions to detect and recognize text with tesseractwho this book is for if you are a software developer with a basic understanding of computer vision and image processing and want to develop interesting computer vision applications with opencv this learning path is for you prior knowledge of c and familiarity with mathematical concepts will help you better understand the concepts in this learning path

the solution to a supervised computer vision problem consists of an application algorithm input data and a set of human generated labels solving these kinds of tasks involves collecting large quantities of data collecting appropriate labels and developing machine vision algorithms tailored to the application progress on these problems has often benefited from large scale datasets with high fidelity labels successful algorithms display a synergy between application goals and the size and quality of the dataset this thesis presents work highlighting the importance of each component of a supervised vision task first the problem of automatically classifying groups of

people into social categories is introduced this problem is called urban tribe classification to tackle this problem each individual and the entire group of individuals are modeled since this was a newly introduced computer vision problem a dataset for this task was created on this dataset the combined representation of group and individuals outperforms using only the person representations this model showed promising results for automatic subculture classification second the problem of creating perceptual embeddings based on human similarity judgements is tackled this work focuses on triplet similarity comparisons of the form is object i more similar to j or k which have been useful for computer vision and machine learning applications unfortunately triplet similarity comparisons like many human labeling efforts can be prohibitively expensive this work proposes two techniques for dealing with this obstacle first an alternative display for collecting triplets is designed this display shows a probe image and a grid of query images allowing the user to collect multiple triplets simultaneously the display is shown to reduce the cost and time of triplet collection in addition higher quality embeddings are created with the improved triplet collection ui a 10 000 food item dataset of human taste similarity was created using this ui second snack a low dimensional perceptual embedding algorithm that combines human expertise with automatic machine kernels is introduced both parts are complementary human insight can capture relationships that are not apparent from the object s visual similarity and the machine can help relieve the human from having to exhaustively specify many constraints finally the precise localization of key frames of an action is explored this work focuses on detecting the exact starting frame of a behavior an important task for neuroscience research to address this problem a loss designed to penalize extra and missed action start detections over small misalignments recurrent neural networks rnn are trained to optimize this loss the model is shown to reduce the number of false positives an important criteria defined by the neuroscientist the performance of the model is evaluated on a new dataset the mouse reach dataset a large annotated video dataset of mice performing a sequence of actions the dataset was created for neuroscience research on this dataset the proposed model outperforms related approaches and baseline methods using an unstructured loss

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