UNIVERSITAS GADJAH MADA
FACULTY OF DENTISTRY
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Yogyakarta, August 31, 2022

NOTIFICATION LETTER

Dear Dr. Ahmad Badruddin
IIUM-Malaysia

Greetings from Faculty of Dentistry Universitas Gadjah Mada.

Thank you for your confirmation to be one of the panelists in this event. You have been scheduled to deliver your lecture on Thursday, September 1 2022. The panel will start at 4.00 PM (GMT +7). Each speaker has 30 minutes to give a lecture. Here we send you the meeting link for the event.

Meeting link: http://ugm.id/ioc2022
Meeting ID: 977 3993 6130
Passcode: IOC_2022

With do all respect, please kindly use our virtual background which can be downloaded from ugm.id/IOC2022VB. In the attachment, you kindly find the terms of reference of the event.

Thank you and see you in International Online Course 2022.

Best regards,

Suryono, DDS., Law B.A., M.M., Ph.D
Dean
Faculty of Dentistry
Universitas Gadjah Mada
Yogyakarta-Indonesia

UNIVERSITAS GADJAH MADA
FAKULTAS KEDOKTERAN GIGI

INTERNATIONAL
ONLINE COURSE

PROGRAM BOOK

DIGITAL HEALTH TRANSFORMATION

for Better Education and Clinical Practice

August 31 - September 10, 2022

In collaboration with:

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
Garden of Knowledge and Virtue

UNIVERSITI SAINS MALAYSIA

Interim University Council
University of Dental Medicine
Yangon & Mandalay
Myanmar

1907
CENTRO ESCOLAR
UNIVERSITY · MAKATI
CIENCIA Y VIRTUD

THAMMASAT UNIVERSITY

PROGRAM BOOK

International Online Course 2022

DIGITAL HEALTH TRANSFORMATION

for Better Education and Clinical Practice

Faculty of Dentistry
Universitas Gadjah Mada, Yogyakarta, Indonesia

In collaboration with:

Welcoming Remarks

Suryono, DDS., Law B.A., M.M., PhD

Dean of Faculty of Dentistry
Universitas Gadjah Mada

Good morning / afternoon / evening everyone,
I am delighted to welcome our distinguished guest lecturers, and our beloved students, both international and national. In the upcoming week, we will explore together the "Digital Health Transformation for Better Education and Clinical Practice" through this year's 2nd International Online Course, held on August 31st to September 10th.

Now more than ever, digitalization has taken over and advanced almost every aspect of our lives. The field of dentistry should not fall behind. We need to find new ways to adapt and learn, to bring both healthcare education and clinical practice into a new, transformative era. This is what our course this year is all about.

The 2022 International Online Course was formulated to address the importance of digital health transformation, in order to keep up with the fast paced world we live in today. Healthcare education and clinical practice should be accessible for everyone, from anywhere, and at anytime. The advancement and development of digital health can help us achieve that goal, as we move towards a healthier future, a healthier Indonesia, and a healthier world.

I encourage you to interact with as many people as possible during this course. Broaden your horizons, enrich your skills and build an international network. Takeaway as much knowledge as you possibly can from this course. Enjoy learning, and have a good experience.

Trianna Wahyu Utami, DDS., M.D.Sc., PhD

Vice Dean for Research, Community Service,
Collaboration, and Alumnae,
Faculty of Dentistry
Universitas Gadjah Mada

Warm regards from Universitas Gadjah Mada,
It is our great pleasure to welcome you to the second International Online Course for ASEAN dental undergraduate students. This course is a platform that brings together dental students from various ASEAN countries for the exchange of knowledge and memories.

To follow the success of the first International Online Course, this year we would like your opinion on the “Digital Health Transformation for Better Education and Clinical Practice”. Students are encouraged to share and discuss their ideas and understanding on this topic, and take in valuable insights and experiences from our panel of expert lecturers.

As a world class university, we aim to take our part to produce well-rounded global dentists. With an international network and adequate knowledge in technological advancements, the field of dentistry can move forward, grow and develop into a new era. May this course prepare you to be the catalyst for such an essential transformation in our field, as the leaders of tomorrow.

Putting together the International Online Course 2022 was a team effort. I would like to express my sincerest grattitude to every member of the hardworking committee.

To all partners, Faculty of Dentistry University Sains Malaysia, Kulliyyah of Dentistry International Islamic University Malaysia, Faculty of Dentistry Thammasat University Thailand, University of Dental Medicine Yangoon and Mandalay Myanmar, Centro Escolar University Makati Philippines, Institute Health of Sciences University Brunei Darussalam, your contributions are most appreciated. Thank you for collaborating with us to organize this international online course. I strongly hope that we could continue this fruitful friendship and partnership in the future.

Osa Amila H, DDS., M.D.Sc., M.Clin.Dent(Perio)

Chairperson
Faculty of Dentistry
Universitas Gadjah Mada

Warm greetings from Yogyakarta!

On behalf of all committees, I would like to deliver our gratitude to all participants and lecturers to our 2nd International Online Course 2022. The course consists of 10 days of lectures, from August 31, 2022, to September 10, 2022, including synchronous and asynchronous activities. This course is conducted under collaboration from Faculty of Dentistry, Universitas Gadjah Mada with other Dental Faculties from International Islamic University Malaysia, University of Dental Medicine Yangon & Mandalay, Centro Escolar University Makati, Universiti Brunei Darussalam, Thammasat University, and Universiti Sains Malaysia.

Through this course, we hope students will learn more about digital health transformation and its application in education and clinical settings. We also encourage students to have ideas regarding application of digital simulators, digital-assisted dental practices, or the ethical aspects of digitalization in health practices in general. To achieve those goals, we strongly recommend all students to actively engage themselves in lectures and discussions during the course.

Aside from all goals we set, we also look forward to new friendships and networking that built through this course. We hope all elements of this course will have great experience through all activities of IOC 2022.

Once again, thank you for joining us in IOC 2022. Please enjoy and share your great experience with your friends.

Introduction

The use of Virtual Reality (VR)/ Augmented Reality (AR), Artificial Intelligence, even Robotics could enhance the quality of education process and clinical aspects in dentistry. As the application of virtual reality has become increasingly extensive as this technology has developed, the need to improve the educational experience is also increasing.

Digital transformation is inevitable in all sectors of the world because of the accelerating development of technology, including health education and clinical work. The pandemic is stimulating to improve technology, particularly in the health study and treatment that gives great benefit to humans. Thus, lectures within this sub-topic aim to present the knowledge to the students about the application of digital transformation in the health education field that can be implemented to the students for studying or training skills. Furthermore, advanced technology can be demonstrated to students in clinical settings as a new experience.

This is an online summer course that will mainly discuss digital transformation in dentistry. Through this course, students will learn the state of the art and what is the future perspective of digital transformation. At the end of the course students will have the opportunity to pour their creative ideas on what digital transformation they need and want to be applied on clinical related psychomotor skills.

Program Overview

- **Lecture**
  1. Main Lecture and Panel Lecture
  2. Topics :
     a. Digital Transformation in Education and Clinical Settings
     b. Digital Transformation for Patient's Health Education
     c. Artificial Intelligence Assisted Clinical Practice
     d. The Prospects of Digital Stimulators in Medical and Dental Education
     e. Ethitical Issue in Digital Transformation

- **Pitching Contest**
  1. Learning outcomes:
     a. Identification of cases/topics that found in the community, education or clinical settings
     b. Identification of a simple system approach related with lessons learned and future direction that can be applied in the community, education or clinical settings
     c. The participants are expected to be able to offer possible solution by designing a project regarding implementation of future direction in the digital health transformation
  2. Each group discussion will be guided by the Tutor
  3. The objective of the group discussion is to deliver proposed examples, along with explanations on why you proposed the technology
  4. Each group will have maximum of 5 minutes presentation, it is recommended not using more than 6 PPT slides.
  5. After each group presentation, there will be a-5 minutes Q&A session.
  6. The presentation format is as follows:
     i. State of the art
     ii. How the current situation (in the status quo) is.
     iii. Explain what the urgency to shift the paradigm from what we have in the current situation is.
     iv. Discussion
     v. Proposed Solution

     Keep it concise but catchy!

Rundown

Date : August 31 – September 10, 2022

Meeting Link : http://ugm.id/ioc2022
Meeting ID: 977 3993 6130
Passcode: IOC_2022

Day 1
Wednesday (31st August 2022)

Time (WIB)	Event	Speaker	Notes
15.30 - 16.00	Preparation		Join to zoom
16.00 - 16.35	Opening Ceremony	Representative of Collaborators	Live and Video
16.35 - 16.50	Program Overview	Representative of IOC Committee	
16.50 - 17.00	Profile Video	Faculty of Dentistry, UGM	
17.00 - 18.00	Main Lecture 1: *Clinical Artificial Intelligence in Digital Dentistry*	James Kit-Hon Tsoi, B.Sc, Ph.D, MRSC, MBCS, FHEA	Moderator: Silviana Farah Diba, DDS, M.Clin.Dent(Dental Radiology)

Day 2

Thursday (1st September 2022)

Time (WIB)	Event	Speaker	Notes
15.30 - 16.00	Preparation		Join to zoom
16.00 - 16.30	Panel Lecture 1: *Artificial Intelligence in Dentistry*	Dr. Ahmad Badruddin (IIUM)	Moderator: Anggun Dwi Andini, DDS
16.30 - 16.35	Faculty Visit		Video Profile IIUM
16.35 - 17.05	Panel Lecture 2: *The Scope of Artificial Intelligence in Oral Radiology*	Isti Rahayu Suryani, DDS, M.Biotech, M.Clin.Dent(Dental Radiology)	Moderator: Anggun Dwi Andini, DDS
17.05 - 17.35	Panel Discussion		Moderator: Anggun Dwi Andini, DDS
17.35 - 17.45	Games		MC
17. 45 - 17.50	Closing		MC

Day 3

Friday (2nd September 2022)

Time (WIB)	Event	Speaker	Notes
15.30 - 16.00	Preparation		Join to zoom
16.00 - 16.30	Panel Lecture 1: *The Digital Health Revolution in Artificial Intelligence in Its Applications in Dentistry*	Dr. Ghulam Muhammad Paracha (CMH Lahore Medical College)	Moderator: Dyah Anindya W, DDS, M.DSc
16.30 - 16.35	Faculty Visit		Video Profile USM
16.35 - 17.00	Panel Lecture 2: *Digital Health Transformation for Better Education and Clinical Practice*	Ariani APP, S.Kep., Ns., NAB., DNP (UGM)	Moderator: Dyah Anindya W, DDS, M.DSc
17.00 - 17.20	Panel Discussion		Moderator: Dyah Anindya W, DDS, M.DSc
17.20 - 18.00	Forum Group Discussion	Lead by Tutors	

Day 4

Saturday (3rd September 2022)

Time (WIB)	Event	Speaker	Notes
09.00 - 09.30	Preparation		Join to zoom
09.30 - 10.30	Main Lecture: *Digital Dentistry Based on Research*	Prof. Tetsuo Ichikawa, DDS, Ph.D (Tokushima University)	Moderator: Mohammad Fadyl Yunizar, DDS, MPH, Ph.D
10.30 - 11.30	Main Lecture: *Forthcoming digital transformation in dentistry*	Prof. Young-seok Park, DDS, MSD, Ph.D (Seoul National University)	Moderator: Iffah Mardhiyah, DDS, M.Biomed

Day 5

Monday (5th September 2022)

Time (WIB)	Event	Speaker	Notes
15.30 - 16.00	Preparation		Join to zoom
16.00 - 16.30	Panel Lecture 1: *Digital Applications in Endodontic Therapy*	Dr. Nyein Pyae Sone Aung (University of Dental Medicine Yangon and Mandalay)	Moderator: Andina Widyastuti, DDS, M.Clin.Dent(Endodontics)
16.30 - 16.35	Faculty Visit		Video Profile UDMYM
16.35 - 17.05	Panel Lecture 2: Artificial Intelligence for Oral Cancer Screening	Kritsasit Warin, DDS, FRCDT (Thammasat University)	Moderator: Andina Widyastuti, DDS, M.Clin.Dent(Endodontics)
17.05 - 17.35	Panel Discussion		Moderator: Andina Widyastuti, DDS, M.Clin.Dent(Endodontics)
17.35 - 17.45	Games		MC
17.45 - 17.50	Closing		MC

Day 6

Tuesday (6th September 2022)

Time (WIB)	Event	Speaker	Notes
15.30 - 16.00	Preparation		Join to zoom
16.00 - 16.30	Panel Lecture 1: *3D Printing in Dentistry*	Asst. Prof. Dr. Chu Seng Boon (IIUM)	Moderator: Aulia Ayub, DDS
16.30 - 16.35	Faculty Visit		Video Profile University of Thammasat
16.35 - 17.05	Panel Lecture 2: *Digitalization in Dentistry to Support Successful Oral and Maxillofacial Surgical Treatments*	Pingky Krisna Arindra, DDS., M.Clin.Dent (Oral Surgery) (UGM)	Moderator: Aulia Ayub, DDS
17.05 - 17.35	Panel Discussion		Moderator: Aulia Ayub, DDS
17.35 - 17.45	Exhibition		MC
17.45 - 17.50	Closing		MC

Day 7

Wednesday (7th September 2022)

Time (WIB)	Event	Speaker	Notes
15.30 - 16.00	Preparation		Join to zoom
16.00 - 16.30	Panel Lecture 1: *GamaComet: A Deep Learning-Based Tool for the Detection and Classification of DNA Damage from Buccal*	Ryna Dwi Yanuaryska, DDS, Ph.D and Afiahayati, S.Kom., M.Cs., Ph.D (UGM)	Moderator: Rellyca Sola Gracea, DDS, M.Clin.Dent(Dental Radiology)
16.30 - 16.35	Faculty Visit		Video Profile University of Makati
16.35 - 17.05	Panel Lecture 2: Digital Dentistry in Oral Surgery	Angelique Marih F. De Ocampo, DMD, MSc.-OMS (Centro Escolar-University of Makati)	Moderator: Rellyca Sola Gracea, DDS, M.Clin.Dent(Dental Radiology)
17.05 - 17.35	Panel Discussion		Moderator: Rellyca Sola Gracea, DDS, M.Clin.Dent(Dental Radiology)
17.35 - 17.45	Ice Breaking		MC
17.45 - 17.50	Closing		MC

Day 8

Thursday (8th September 2022)

Time (WIB)	Event	Speaker	Notes
15.30 - 16.00	Preparation		Join to zoom
16.00 - 16.30	Panel Lecture 1: *Ethics Challenges in Dental Practice*	Rosa Amalia, DDS, MPH, Ph.D (UGM)	Moderator: Muhammad Fahmi Alfian, DDS, MPH
16.30 - 16.35	Faculty Visit		Video Profile UBD
16.35 - 17.05	Panel Lecture 2: *Ethics in Digital Dentistry*	Dr. Mohd. Fadhli Khamis (USM)	Moderator: Muhammad Fahmi Alfian, DDS, MPH
17.05 - 17.35	Panel Discussion		Moderator: Muhammad Fahmi Alfian, DDS, MPH
17.35 - 17.45	Exhibition		MC
17.45 - 17.50	Closing		MC

Day 9

Friday (9th September 2022)

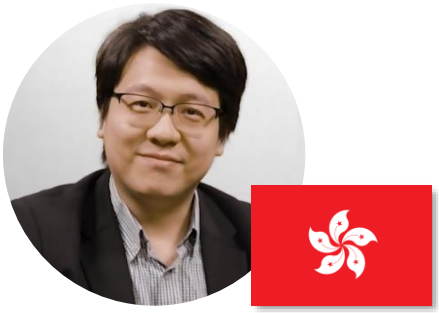
Time (WIB)	Event	Speaker	Notes
15.30 - 16.00	Preparation		Join to zoom
16.00 - 16.05	Opening		MC
16.05 - 17.30	Pitching Contest	Judges: PIC Collaborators	
17.30 - 17.35	Closing		MC

Day 10

Saturday (10th September 2022)

Time (WIB)	Event	Speaker	Notes
07.30 - 08.00	Preparation		Join to zoom
08.00 - 08.45	Main Lecture: *CAD/CAM Technology in Dentistry*	Cortino Sukotjo, DDS, Ph.D, MMSc (University of Illinois Chicago)	Moderator: Osa Amila Hafiyyah, DDS, M.DSc, M.Clin.Dent(Perio)
08.45 - 09.15	Panel Lecture 1: *Virtual Reality and Augmented Reality*	Markus Santoso, Ph.D	Moderator: Nur Rahman Ahmad Seno Aji, DDS, M.DSc, M.Clin.Dent(Perio)
09.15 - 09.25	Live Demo	Markus Santoso, Ph.D (University of Florida)	
09.25 - 09.45	Panel Lecture 2: *Virtual Reality in Dentistry*	Cortino Sukotjo, DDS, Ph.D, MMSc (University of Illinois Chicago)	Moderator: Nur Rahman Ahmad Seno Aji, DDS, M.DSc, M.Clin.Dent(Perio)
09.45 - 10.00	Panel Discussion		Moderator: Nur Rahman Ahmad Seno Aji, DDS, M.DSc, M.Clin.Dent(Perio)
10.00 - 10.30	Winner Prizes: Pitching Contest		MC
10.30 - 10.35	Photo Session		MC
10.35 - 10.45	Closing Remark	Trianna Wahyu Utami, DDS, M.DSc, Ph.D	

Main Lecture Speaker



Dr. James Kit Hon Tsoi, BSc, PhD, MRSC, MBCS, FHEA
Hong kong University
HONG KONG

Prof. Tetsuo Ichikawa, DDS, PhD
Tokushima University
JAPAN

Prof. Young-seok Park, DDS, MSD, PhD
Seoul National University
REPUBLIC OF KOREA

Cortino Sukotjo, DDS, Ph.D, MMSc
University of Illinois Chicago
USA

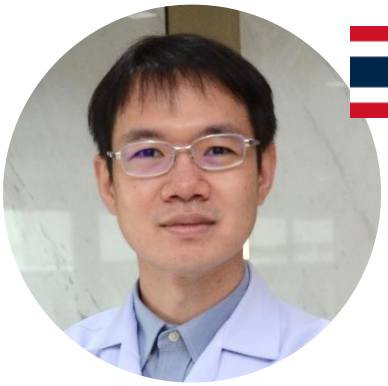
Markus Santoso, PhD
University of Florida
USA

Panel Lecture Speaker

Assist. Prof. Dr. Ahmad Badruddin
International Islamic University Malaysia

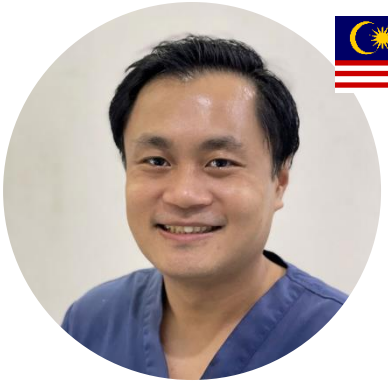
Dr. Nyein Pyae Sone Aung
University of Dental Medicine Yangon and Mandalay

Isti Rahayu Suryani, DDS, M.Biotech, M.Clin.Dent(Dental Radiology)
Universitas Gadjah Mada



Dr. Kritsasit Warin, DDS, FRCDT
Thammasat University

Ariani APP, S.Kep., Ns., NAB., DNP
Universitas Gadjah Mada



Assist. Prof. Dr. Chu Seng Boon
International Islamic University Malaysia

Panel Lecture Speaker

Dr. Ghulam Muhammad Paracha
CMH Lahore Medical College

Dr. Angelique De Ocampo
Centro Escolar University Makati

Pingky Krisna Arindra, DDS., M.Clin.Dent (Oral Surgery)
Universitas Gadjah Mada

Rosa Amalia, DDS, MPH, Ph.D
Universitas Gadjah Mada

Ryna Dwi Yanuaryska, DDS, Ph.D and Afiahayati, S.Kom., M.Cs., Ph.D
Universitas Gadjah Mada

Assoc. Prof. Dr. Mohd. Fadhli Khamis
Universiti Sains Malaysia

Abstracts

Artificial Intelligence in Dentistry

Dr Ahmad Badruddin Bin Ghazali. BDS (IIUM), MSc OMFR (Mahidol)
Oral Radiology Unit, Department of Oral Maxillofacial Surgery and Oral Diagnosis, Kulliyyah of Dentistry, International Islamic University Malaysia.

Artificial intelligence can be defined as the capability of a machine to imitate human behavior in performing several tasks like object and word recognition, outcome prediction, and solving a problem.

In dentistry, artificial intelligence can be applied to detect cephalometric landmark, detection and classification of dental diseases like caries, cyst and tumors, identification of the inferior alveolar nerve, diagnosis of temporomandibular disorders, segmentation of maxilla, mandible and dentition from radiographs and many more.

This lecture will start by looking a case study of a high impact AI project, explain about artificial intelligence, machine learning and deep learning in brief, explore the current progress of artificial intelligence in dentistry, any available products based on artificial intelligence in dentistry, limitation of the artificial intelligence and future prospects of this technology in our field.

The Scope of Artificial Intelligence in Oral Radiology

Isti Rahayu Suryani, DDS, M.Biotech, M.Clin.Dent(Dental Radiology)
Department of Dental Radiology, Faculty of Dentistry, Universitas Gadjah Mada, Indonesia

Methods based on artificial intelligence (AI) may indeed be utilised to aid dentists with image interpretation. Thus, automated methods may expedite the identification and classification of data and remove human fatigue-related errors. In dentomaxillofacial radiology, deep learning algorithms have been studied for the detection, classification, or diagnosis of diseases or anatomical structures, such as classification of teeth and mandibular morphology; differentiation of jaw tumours; and detection of root fractures, Sjogren's syndrome, maxillary sinusitis, calcified carotid atherosclerosis, caries, and periodontal diseases.

Automation may aid in saving time and improving procedures. Despite the fact that AI cannot replace dentists or oral radiologists, the precise and rapid analysis of radiographic images by artificial neural networks offers intriguing diagnostic possibilities for the future and would undoubtedly be an integral element of oral radiology. Previous AI research has yielded incredibly promising findings, but the current experiments are still in their infancy.

The Digital Health Revolution in AI & its applications in Dentistry

Dr. Ghulam Muhammad Paracha
CMH Lahore Medical College

Digital health, or digital healthcare, is a broad, multidisciplinary concept that includes concepts from an intersection between technology and healthcare. Digital health applies digital transformation to the healthcare field, incorporating software, hardware and services.

The application of information and communications technology to provide digital health interventions to prevent disease and improve quality of life isn't a new concept. However, in the face of global concerns -- related to aging, child illness and mortality, epidemics and pandemics, high costs, and the effects of poverty and racial discrimination on access to healthcare -- digital health platforms, health systems and related technology continue to grow in importance and to evolve.

According to Deloitte Insights, digital health employs more than just technologies and tools; it also views "radically interoperable data, artificial intelligence (AI), and open, secure platforms as central to the promise of more consumer-focused, prevention-oriented care."

Advances in AI, big data, robotics and machine learning continue to bring about major changes in digital healthcare. Also, alterations in the digital healthcare landscape continue developments in ingestible sensors, robotic caregivers, and devices and apps to monitor patients remotely.

These innovations can meld medicine and the internet of things, medicine and augmented reality (AR), and blockchain and EMRs. In our lecture we will talk mostly about AI and its applications in Dentistry.

Using AI in healthcare applications can augment human decision-making by automating and speeding up previously labour-intensive tasks. In medical imaging, the use of AI can reduce the number of clicks needed to perform a task and determine the next steps based on context.

Digital health transformation for better education and clinical practice

Ariani Arista Putri Pertiwi, S.Kep., Ns., MAN., DNP
Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada, Indonesia

A strong health system is needed by any countries including the Republic of Indonesia, especially after being hit by the COVID-19 pandemic in order to rise up and build a better health system. A strong health system requires competent and capable human resources, advanced technology, solid health financing, and adequate infrastructure. Various innovations in the development of digital technology in patient care have been widely introduced, including the use of electronic health records (EHR), artificial intelligence (AI) for decision making, telemedicine, robotic surgery, mobile health, etc. These various digital technologies certainly raise the need for health workers to get used to using these technologies. Not only the capability in using the technologies, there are other competencies should be mastered by the current and future healthcare providers to face the challenges of health system in a disruptive era. Adaptive and creative ways of thinking, strategies and skills become important provision for students who become the future healthcare professionals. This presentation will present the importance of digital transformation to help teachers and educators of healthcare education institutions to prepare qualified healthcare professionals to be part of building a strong health system. This presentation will also present the importance of digital health transformation to create better clinical practice.

Digital Application in Endodontic Therapy

Nyein Pyae Sone Aung, *BDS, MDSc, PhD*
University of Dental Medicine Yangon and Mandalay

Endodontics is the only dental specialty where we cannot see what we are doing. However, with the turn of the century, the advancements brought about by digital technologies have also been seen in endodontics as a result of the increased digitization taking place in many sectors. The extensive development of technologies allowed dentists to see what we could not see before. The ultimate result in the digital transformation of endodontics has unquestionably improved the daily clinical practice of practitioners. This lecture will give a general overview of how digital technologies are used in various clinical stages of endodontic therapy, emphasizing their benefits that could improve routine endodontic practice.

Artificial Intelligence in Oral Cancer Screening

Kritsasith Warin, DDS, FRCDT (Oral and Maxillofacial Surgery)
Faculty of Dentistry, Thammasat University

Artificial intelligence (AI) applications in oncology have been developed rapidly with reported successes in recent years. Novel AI technologies can help clinicians reduce human errors and increase the accurate decision-making. AI applications in head and neck cancer diagnosis have been developed rapidly with reported successes in the initial interpretation of medical images. Oral cancer is a deadly disease and a highly relevant global public health problem. The advance stage of oral cancer often involves more invasive treatment which increases morbidity, cost of treatment and significantly impacts the individual's quality of life. The prognosis of oral cancer worsens in the advanced stages of cancer. Oral cancer screening is an important part of an oral examination, the goal of which is to identify changes and the development of oral cancer. Therefore, the early detection of oral cancer, especially oral potentially malignant disorders (OPMDs) or early-stage oral cancer, with appropriate referral to specialists is crucial to control the disease and improve the survival rate and quality of life of patients. Screening of oral cancer is largely based on visual examination. Advances in computer vision and AI technology that improve visual detection can expected be used to assist visual examination combined with clinical data as a novel diagnostic tool in the oral cancer screening system.

3D Printing in Dentistry

Dr Chu Seng Boon
IIUM

Over the past decade, 3D printing has become a mainstream technique used across various fields, including dentistry. The rise of 3D printing in dentistry is parallel with CAD advancements and enhanced imaging techniques such as cone beam computed tomography (CBCT) to plan and print dental and maxillofacial prostheses. With the proliferation of more 3D printers in the market, the cost of owning one and the footprint has been lowered while keeping the quality of printed work high.

Applying digital workflow and incorporating 3D printing in routine dental procedures can sometimes be a daunting task for dental practitioners and new clinic owners. The choices of commercially available 3D printers and compatible resins are vast and requires basic understanding of the machine handling and post-processing of the printed appliances.

Therefore, this lecture aims to provide the basic knowledge and principles of the additive technology and simple tips to start and enjoy your 3D printing journey.

Digitalization in Dentistry to Support Successful Oral and Maxillofacial Surgical Treatments

Pingky Krisna Arindra, DDS., M.Clin.Dent (Oral Surgery)
Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Universitas Gadjah Mada, Indonesia

Technology in dentistry has developed rapidly. Technology makes it easier for clinicians to treat patients as needed. The field of oral and maxillofacial surgery requires such digital technology. Surgical planning requires digital radiology, such as CT scans or CBCT. The results of these examinations will be processed through special software to make a surgical plan.

Dental implants, orthognathic surgery, and reconstructive surgery after tumour resection require guidance or templates to support success and improve the aesthetics of surgical results. Surgical guidance in dental implant surgery is done by arranging the number, width, direction and depth of dental implants. Orthognathic surgery also requires precision planning in maxillary and mandibular osteotomy to get results according to the expected functional and aesthetic conditions. This plan will produce waffles to guide occlusion in the maxillary and mandibular bone arrangement. Meanwhile, tumour reconstruction surgery also requires stereolithography technology from a 3D Head CT Scan. The stereolithography is used as a guide for oral surgery to plan jaw cutting and placement of reconstruction plates so that results are close to the patient's function and aesthetics.

The digital world in dentistry will continue to grow and make it easier for clinicians. This technology is needed in planning and when performing the procedure so that the results will restore stomatognathic and aesthetic functions as expected by the patient.

Keywords: Digitalization, surgical planning, CBCT

GamaComet: A Deep Learning-Based Tool for the Detection and Classification of DNA Damage from Buccal Mucosa Comet Assay Images

Ryna Dwi Yanuaryska, DDS, Ph.D and Afiahayati, S.Kom., M.Cs., Ph.D
Universitas Gadjah Mada

Comet assay is a simple and precise method to analyze DNA damage. Nowadays, many research studies have demonstrated the effectiveness of buccal mucosa cells usage in comet assays. However, several software tools do not perform well for detecting and classifying comets from a comet assay image of buccal mucosa cells because the cell has a lot more noise. Therefore, a specific software tool is required for fully automated comet detection and classification from buccal mucosa cell swabs. This research proposes a deep learning-based fully automated framework using Faster R-CNN to detect and classify comets in a comet assay image taken from buccal mucosa swab. To train the Faster R-CNN model, buccal mucosa samples were collected from 24 patients in Indonesia. We acquired 275 comet assay images containing 519 comets. Furthermore, two strategies were used to overcome the lack of dataset problems during the model training, namely transfer learning and data augmentation. We implemented the proposed Faster R-CNN model as a web-based tool, GamaComet, that can be accessed freely for academic purposes. To test the GamaComet, buccal mucosa samples were collected from seven patients in Indonesia. We acquired 43 comet assay images containing 73 comets. GamaComet can give an accuracy of 81.34% for the detection task and an accuracy of 66.67% for the classification task. Furthermore, we also compared the performance of GamaComet with an existing free software tool for comet detection, OpenComet. The experiment results showed that GamaComet performed significantly better than OpenComet that could only give an accuracy of 11.5% for the comet detection task. Downstream analysis can be well conducted based on the detection and classification results from GamaComet. The analysis showed that patients owning comet assay images containing comets with class 3 and class 4 had a smoking habit, meaning they had more cells with a high level of DNA damage. Although GamaComet had a good performance, the performance for the classification task could still be improved. Therefore, it will be one of the future works for the research development of GamaComet.

Keywords: comet assay image; buccal mucosa; Faster R-CNN; detection and classification; DNA damage

Digital Dentistry in Oral Surgery

Anjelique Marih F. De Ocampo, DMD, MSc.-OMS
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Digital Dentistry has been a growing practice in the last decade and its application and digital workflow is continuously being developed in the field of oral surgery. Common to this field is the surgical planning using the three- dimensional (3D) modeling, also known as medical rapid prototyping (MRP). Three-dimensional models are reproduced with the aid of computer-aided design and manufacturing (CAD/CAM), and are mainly utilized for planning of complex oral and maxillofacial procedures to better appreciate the anatomical structure and deformity. Recent literatures also high lights the growing advantages of digital applications for pre-surgical planning; direct visualization of defect, anticipation of anatomic complications and intraoperative guidance. This lecture aims to present the current applications of the technology in the field of oral surgery.

Ethics in Digital Dentistry

Assoc Prof Dr Mohd Fadhli Bin Khamis
Universiti Sains Malaysia

Digital technologies have been part of dental practices for dental diagnostics, therapeutics, and education. This lecture would discuss the issues of ethics related to digital technology in dentistry based on four principles *i.e*. autonomy, beneficence, non-maleficence, justice. The scope of potential ethical issues in the clinical procedures assisted by CAD/CAM and 3D printing, digital radiography, digital photography, digital patient record management, patient education tools, and digital communication would be discussed with elaboration on the data security and manipulation during storage, transfer, sharing between professionals, patient-dentist relationship/communication, patients' privacy and anonymity, and literacy equality.

MAIN LECTURE

CAD/CAM dentistry curriculum at the UIC-COD

Cortino Sukotjo, DDS, Ph.D, MMSc
University of Illinois Chicago

The prevalence of CAD/CAM and intraoral scanning systems has grown substantially in recent years due to technological advances, resulting in improved accuracy/precision and efficiency while reducing user barriers such as high ownership costs and steep learning curves. The aims of this presentation are to: (1) describe the background of CAD/CAM technology and (2) describe the implementation of the CAD/CAM dentistry curriculum at the UIC-COD.

Virtual Reality and Augmented Reality

Markus Santoso, Ph.D
University of Florida

Immersive Technologies including Virtual Reality (VR), Augmented Reality (AR) and Metaverse, are an emerging technology that potentially offer benefits for other fields. One of the directions is the application of VR, AR and Metaverse for dentistry field. In this presentation, presenter will explain the definition of each immersive technology, benefits of employing immersive technologies in dentistry direction and couple past research projects related with VR/AR/Metaverse and dentistry field.

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Artificial Intelligence in Dentistry IOC2022

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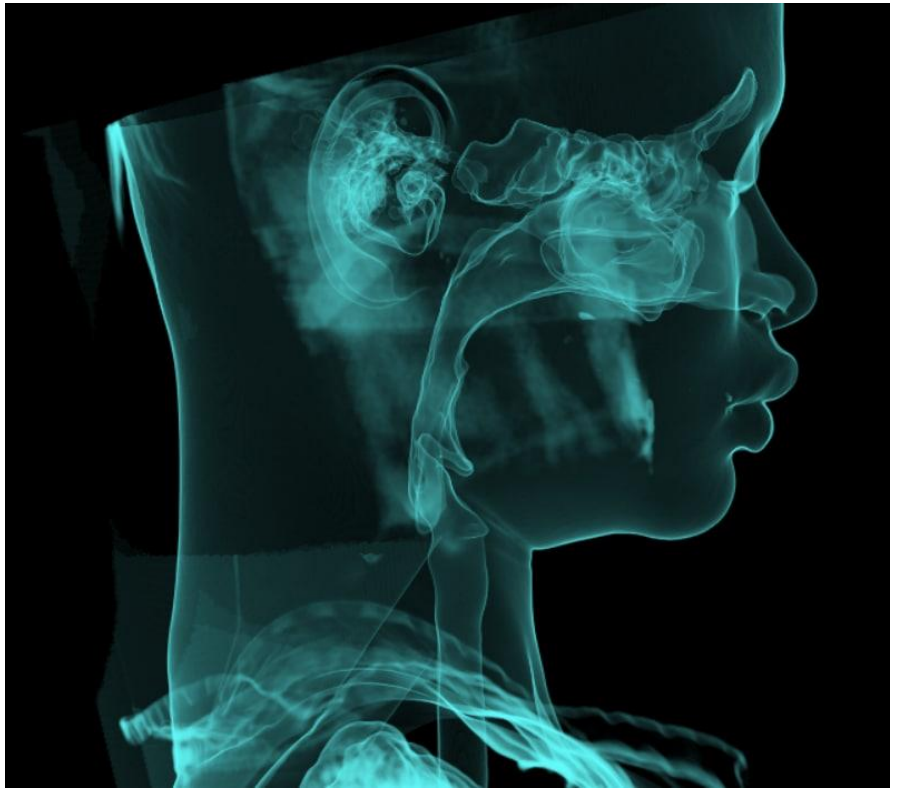

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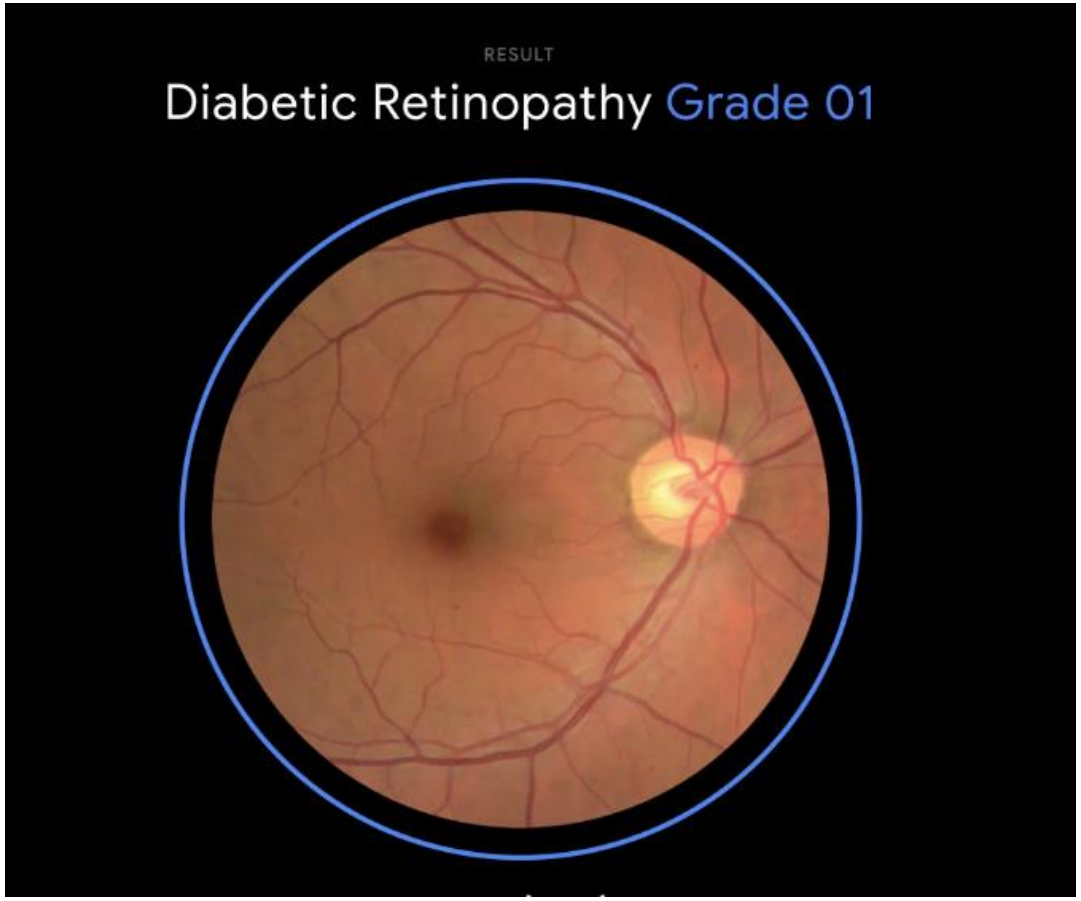
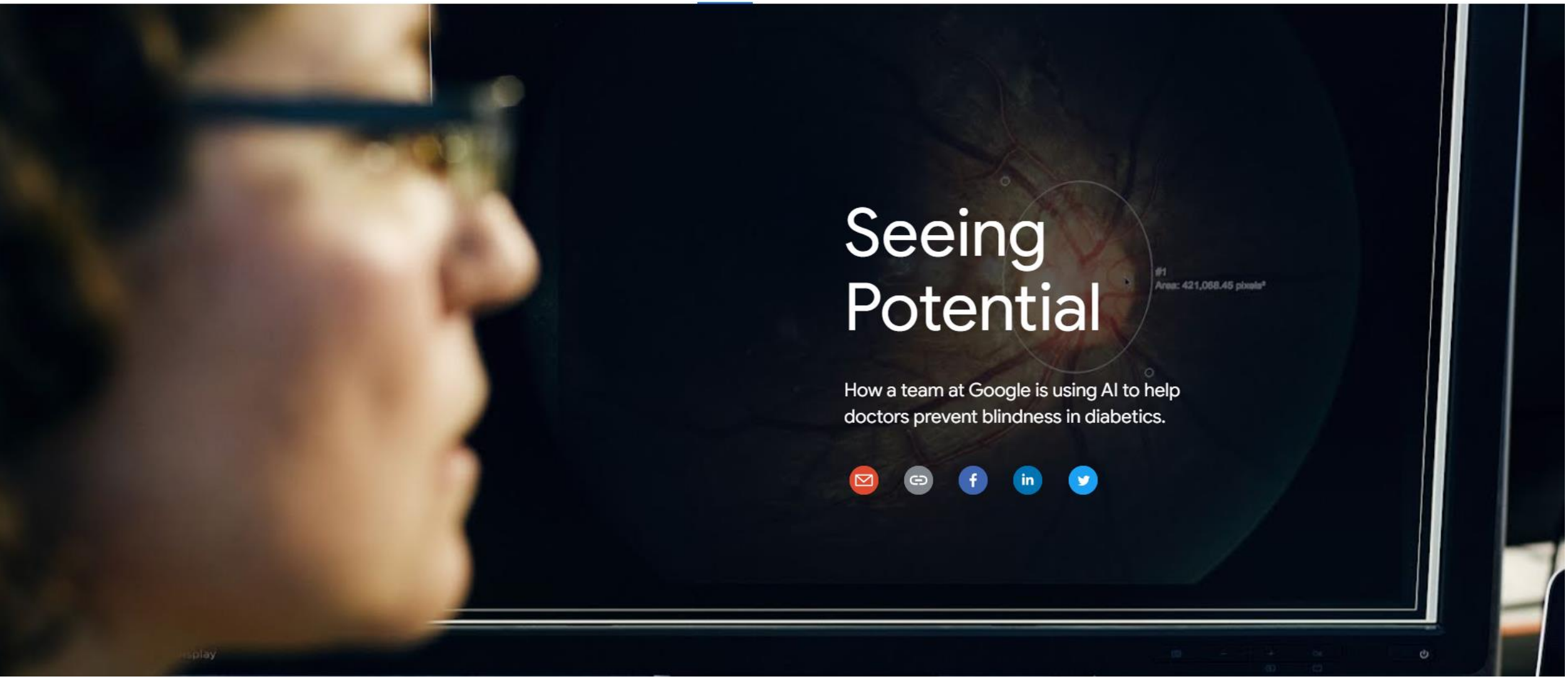
Greetings from KOD, IIUM Kuantan, Pahang

The Google-diabetic retinopathy story

- https://about.google/intl/ALL_us/stories/seeingpotential/




Seeing
Potential
How a team at Google is using AI to help
doctors prevent blindness in diabetics.

The idea

- Google research scientist Varun Gulshan was looking for a project that would meet a few criteria.
- The project would utilize Gulshan's background developing artificial intelligence (AI) algorithms and stimulate his interest in science and medicine. And ideally, the project would help people in Gulshan's home country of India.

The team

To date, close to 100 ophthalmologists have rendered more than 1 million grades for the AI model.

Peter Wubbels
Engineer, Verily

Florence Thng
Product Manager, Verily

Kasumi Widner
Program Manager, Google Brain Team

Naama Hammel
Ophthalmologist, Google Brain Team

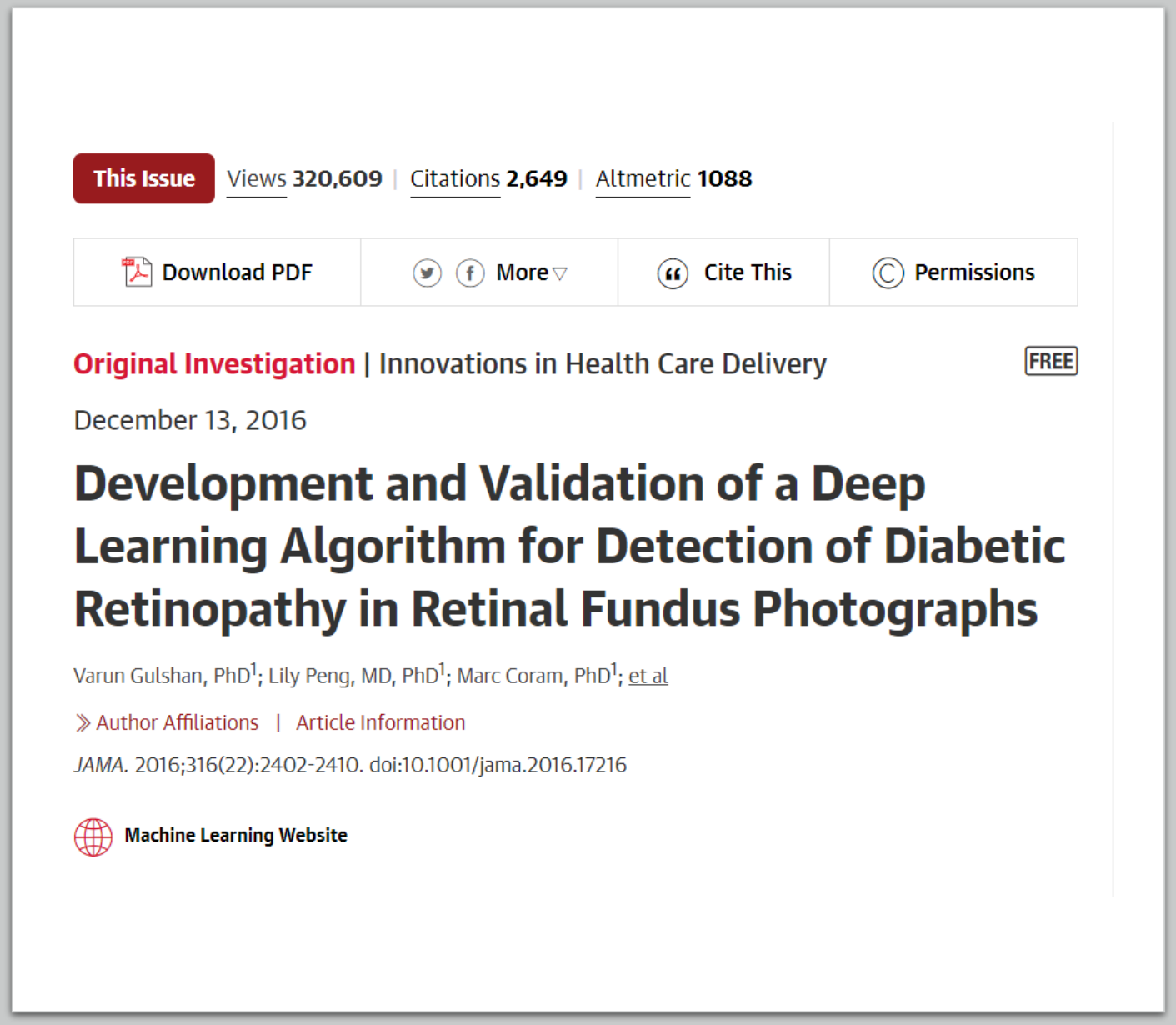
Philip Nelson
Director, Google Accelerated Sciences

Dale Webster
Engineer, Google Brain Team

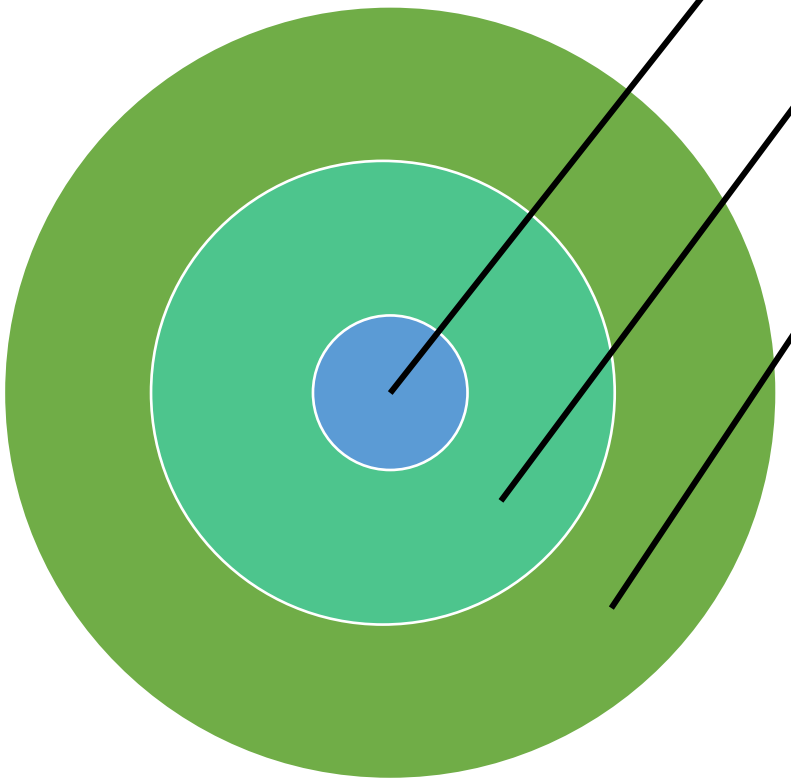
Lily Peng
Product Manager, Google Brain Team

The results

- https://jamanetwork.com/journals/jama/fullarticle/2588763



AI-ML-DL



Deep learning: artificial neural networks, collection of trainable mathematical units, in layers, working together to complete a task

Machine learning: machine that learns to be smarter

Artificial intelligence: grand project to build non-human intelligence

Deep learning

- Trains algorithm very accurately when given enough data
- Can do this without feature engineering, without writing explicit rules.
- So most of the time used not writing the rules, but for data preparation, numerical optimization and model architecture.

Where AI can be most beneficial?

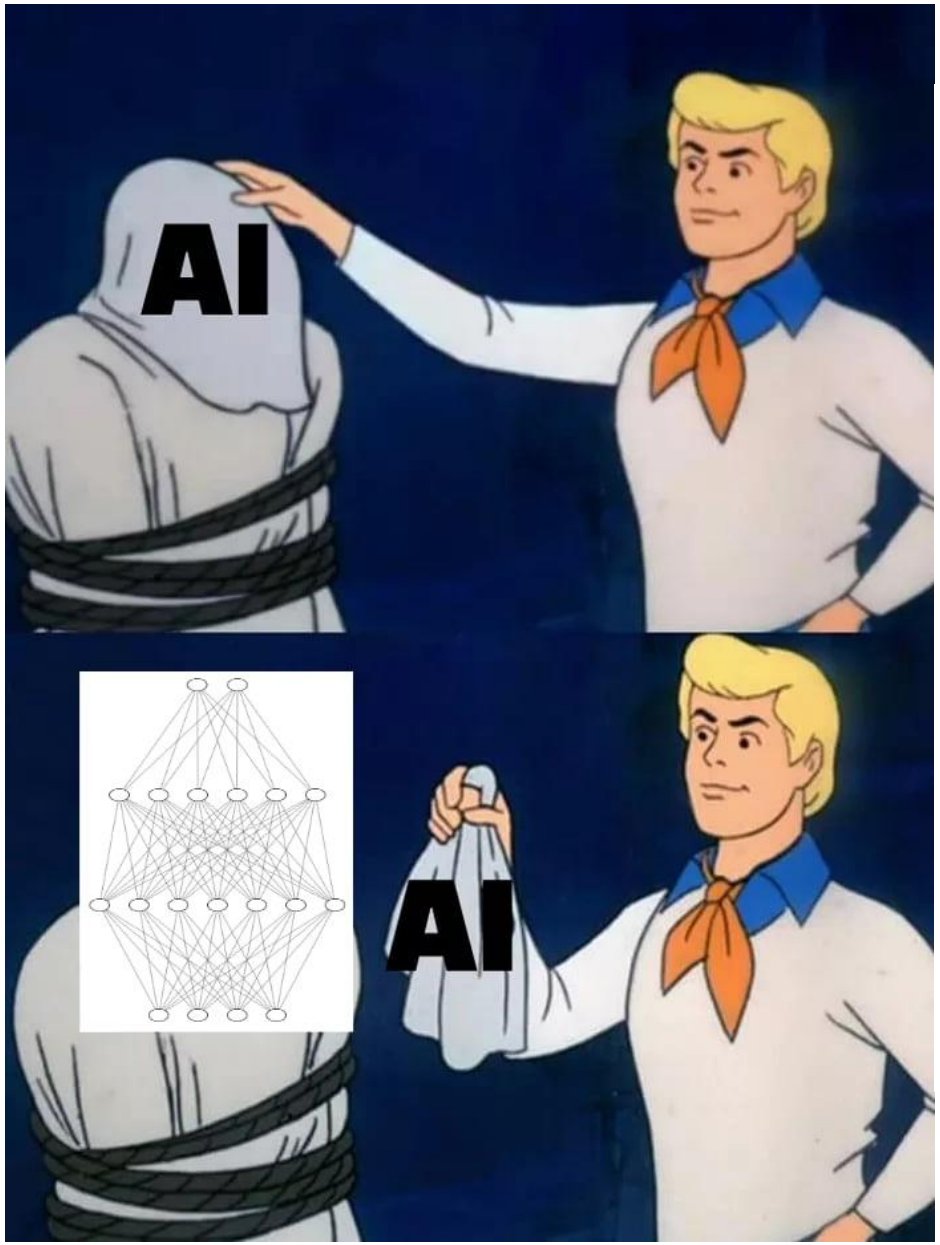
- **Where you have lots of data to look through**

  -especially true for screening process

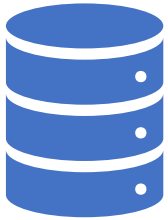
- **When the expertise is limited**

  -shortage of radiologist, pathologist, etc.

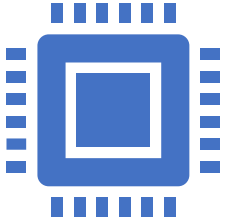
  -the algorithm can scale and enhance the expertise for diagnostic purpose


AI
AI

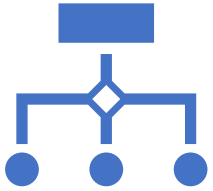

People with no idea about AI, telling me my AI will destroy the world
Me wondering why my neural network is classifying a cat as a dog..
Dog



Big data: digital data, storage, large dataset

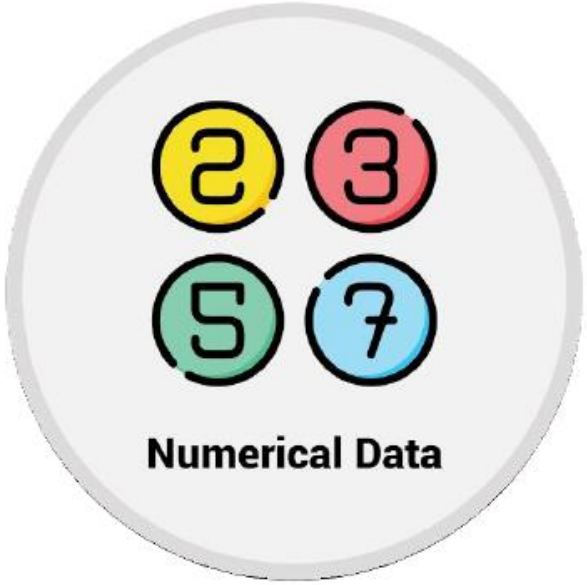


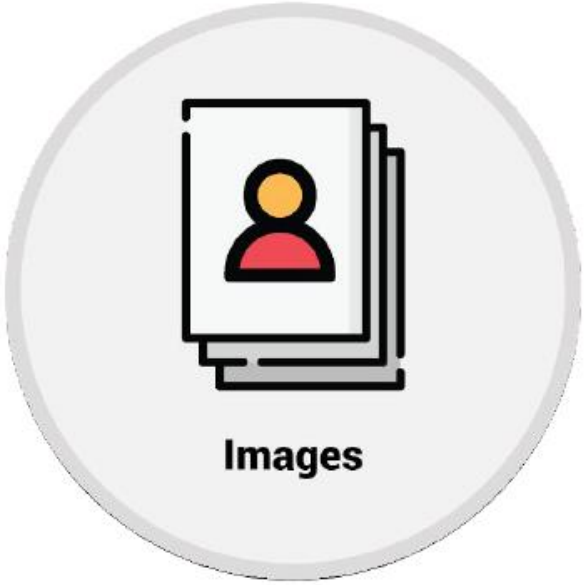
Hardware: GPU, CPU

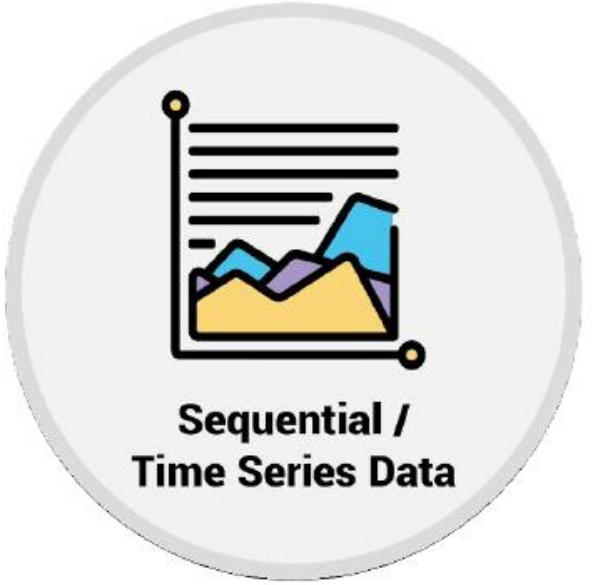


Software: improved techniques, new models, open-source software

Types of data







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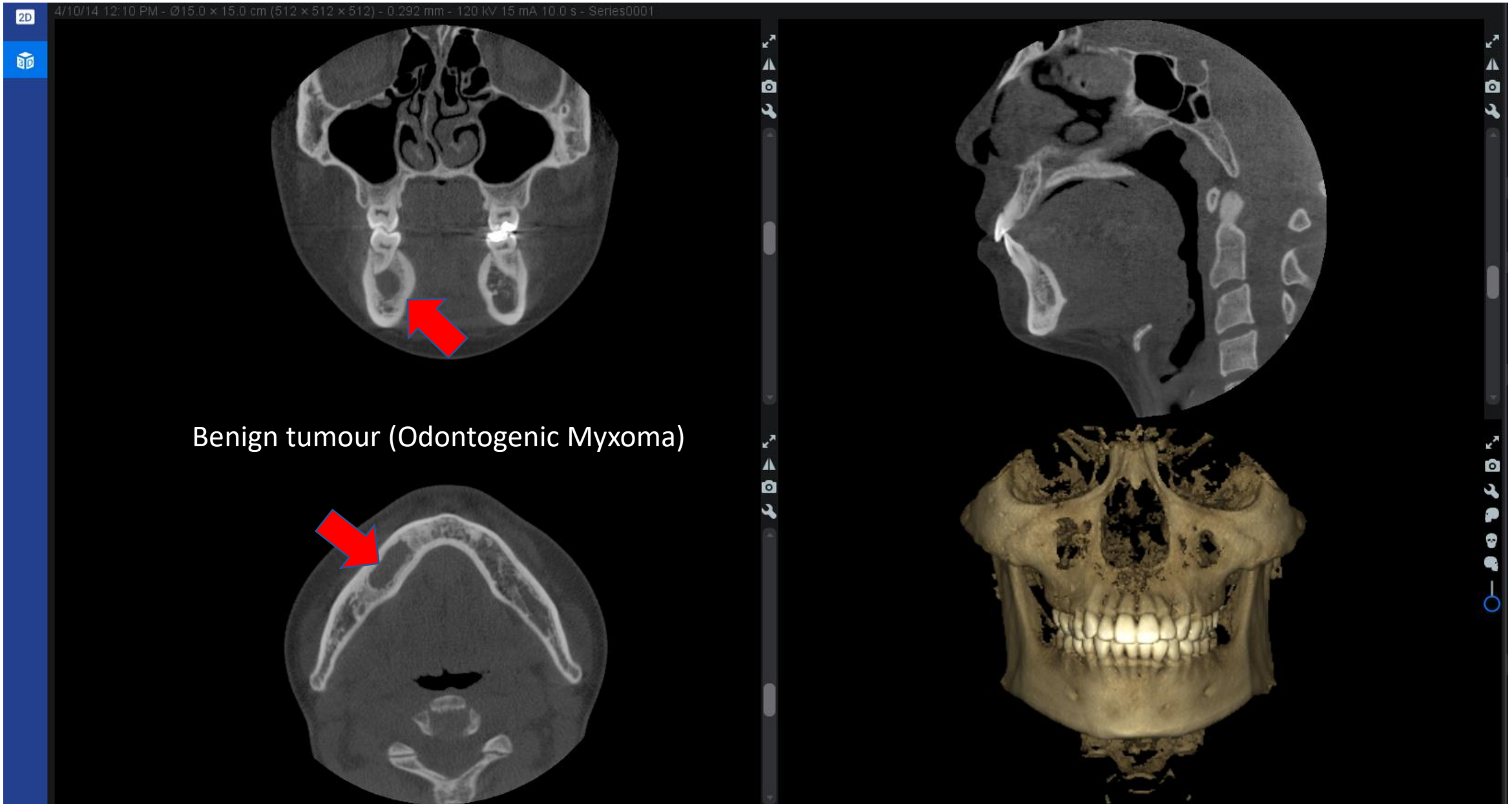
Imaging in dentistry



Benign tumour (Odontogenic Myxoma)

Images

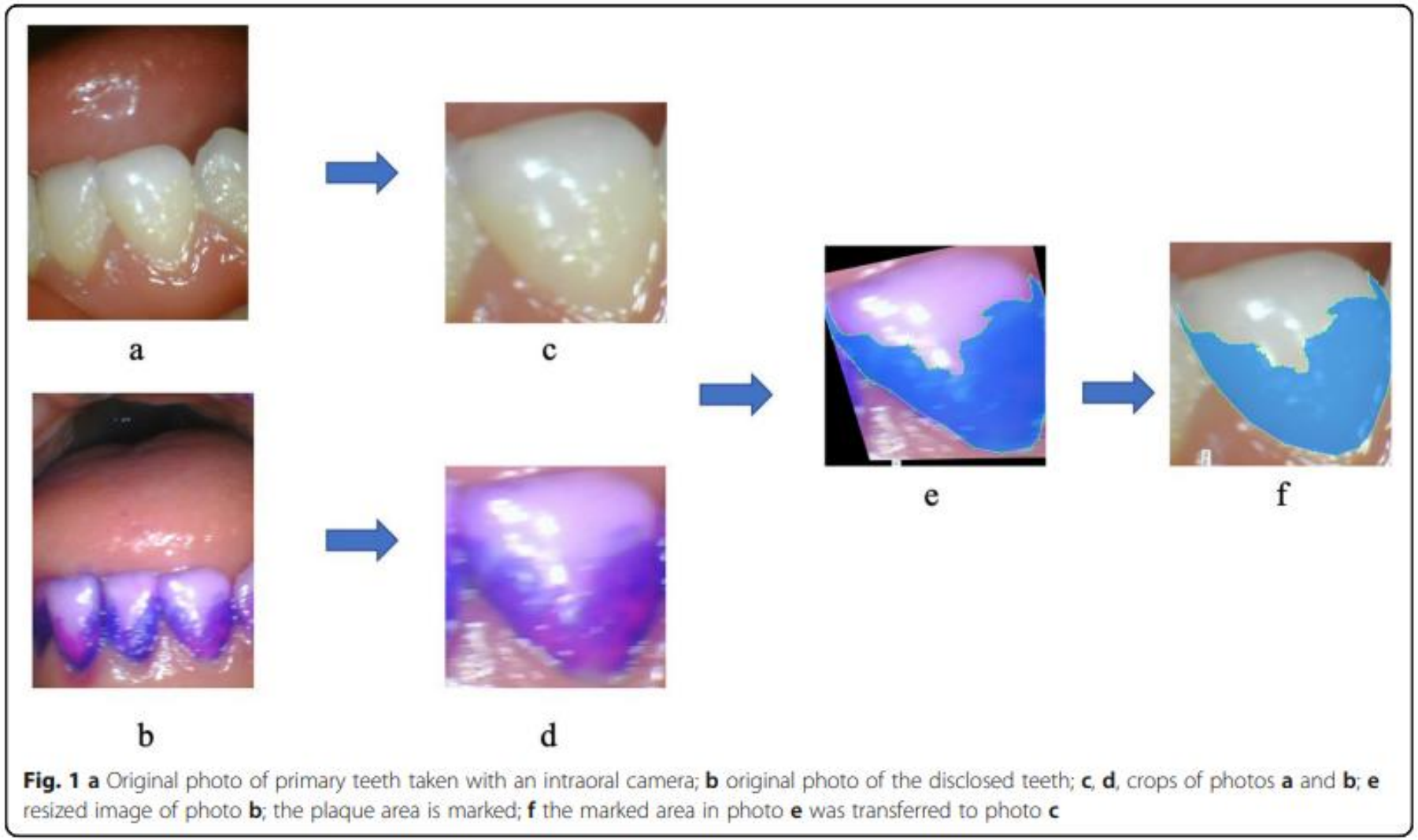
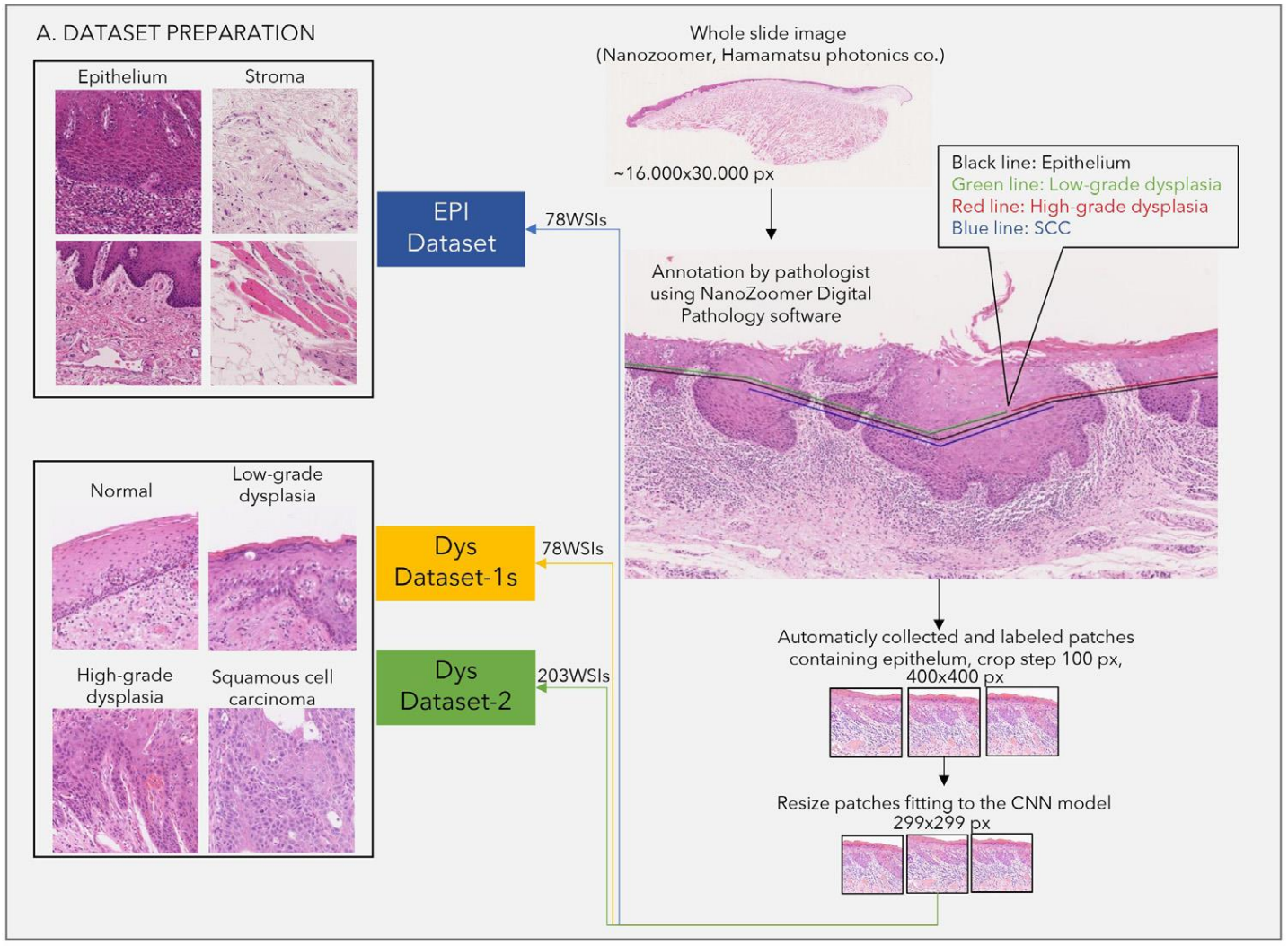


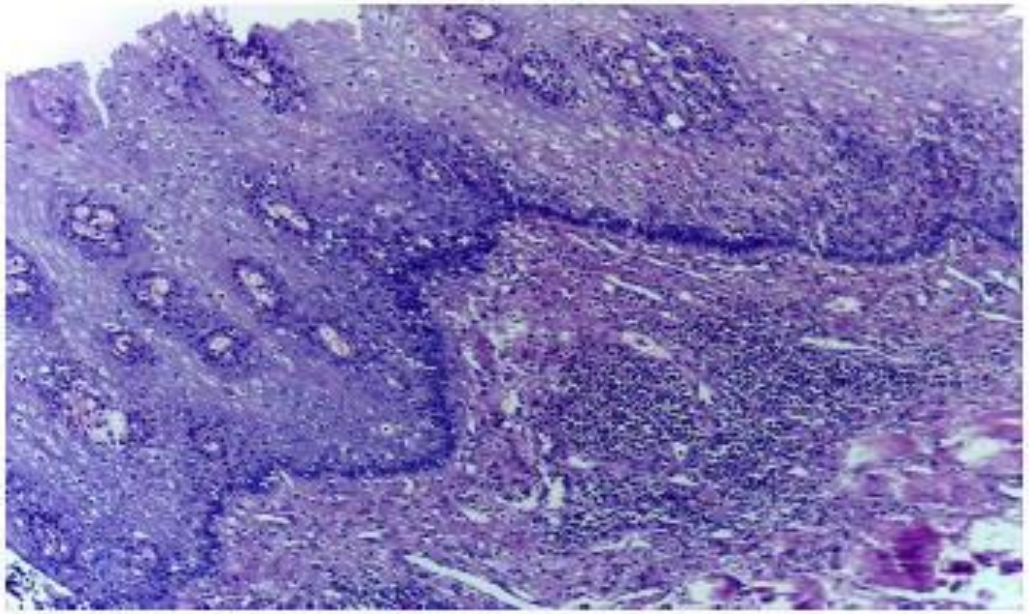
Fig. 1 **a** Original photo of primary teeth taken with an intraoral camera; **b** original photo of the disclosed teeth; **c**, **d**, crops of photos **a** and **b**; **e** resized image of photo **b**; the plaque area is marked; **f** the marked area in photo **e** was transferred to photo **c**

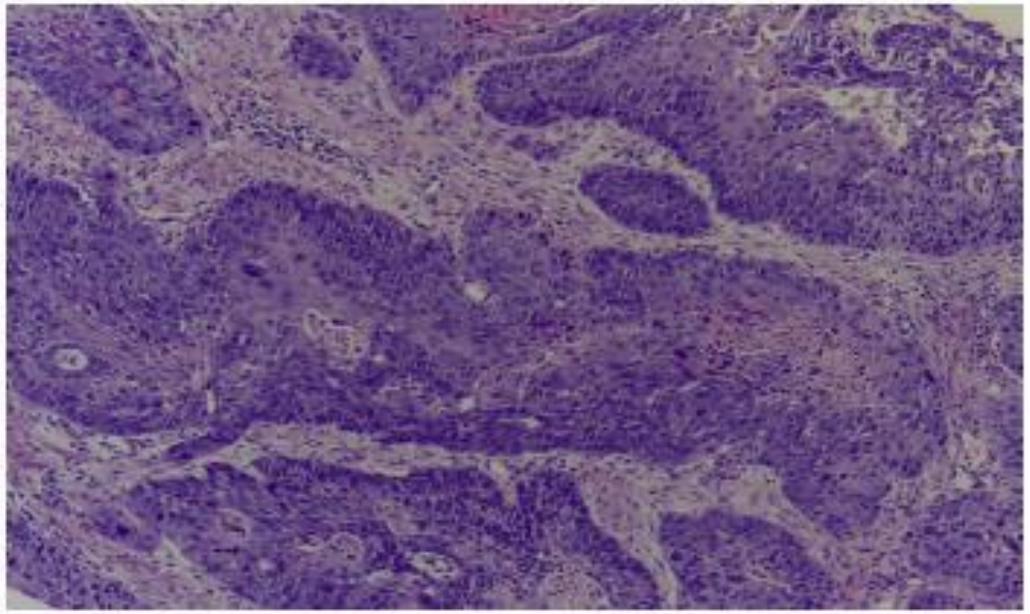
- You 2020

Histopathology



- Nguyen 2022



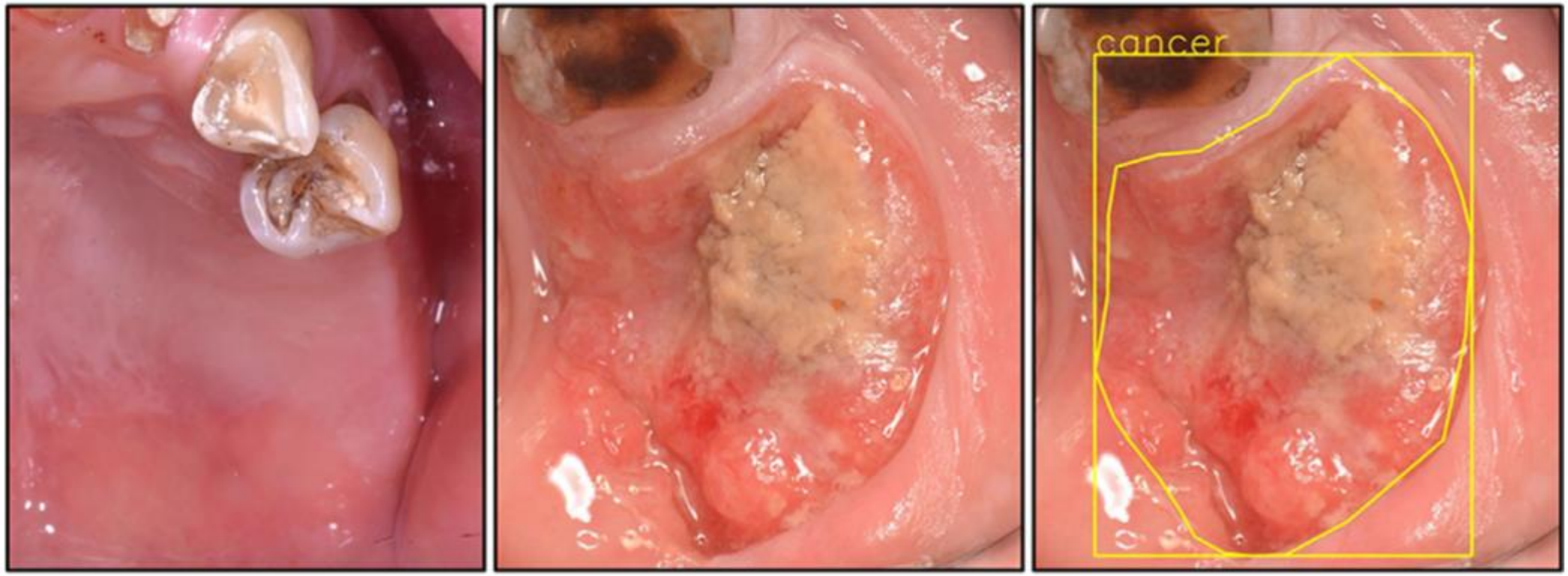


- Normal vs OSCC cells

average of 91% classification accuracy was obtained from the test and validation dataset from the Inception V3-RF pipeline

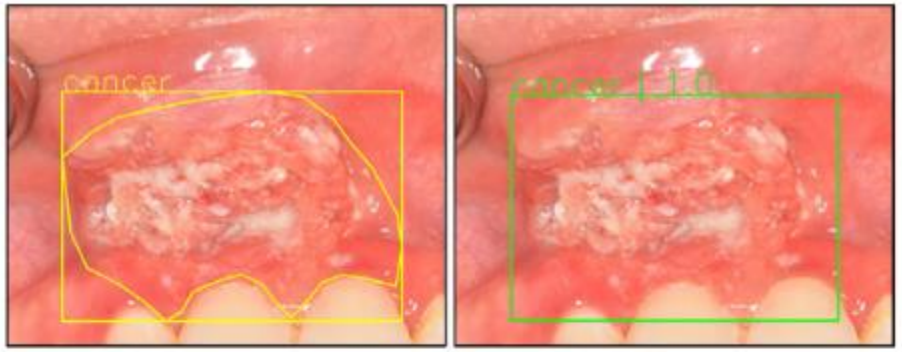
(Abdul Rauf 2022)

Detection of oral cancer from photos

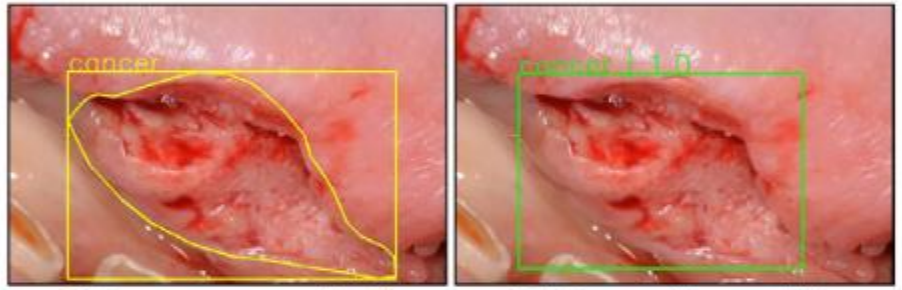


(A) Non-cancer image (B) Cancerous image (C) Annotation of the lesion

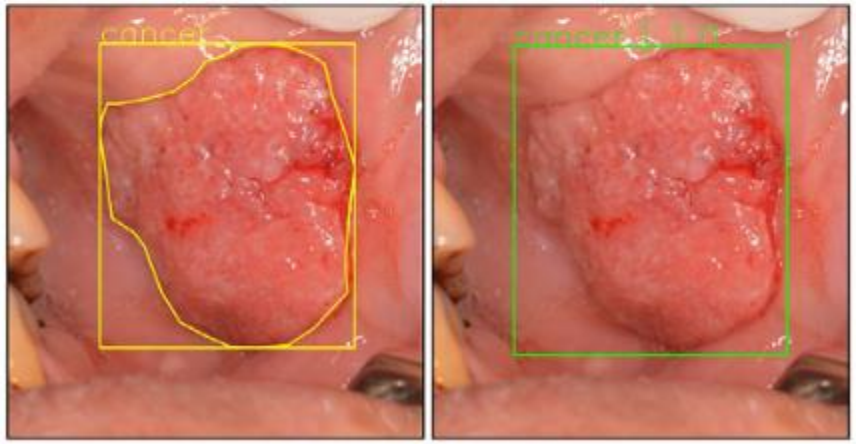
(Warin, 2021)



(A) Cancerous ground truth **(B)** True positive prediction (IoU 0.94)



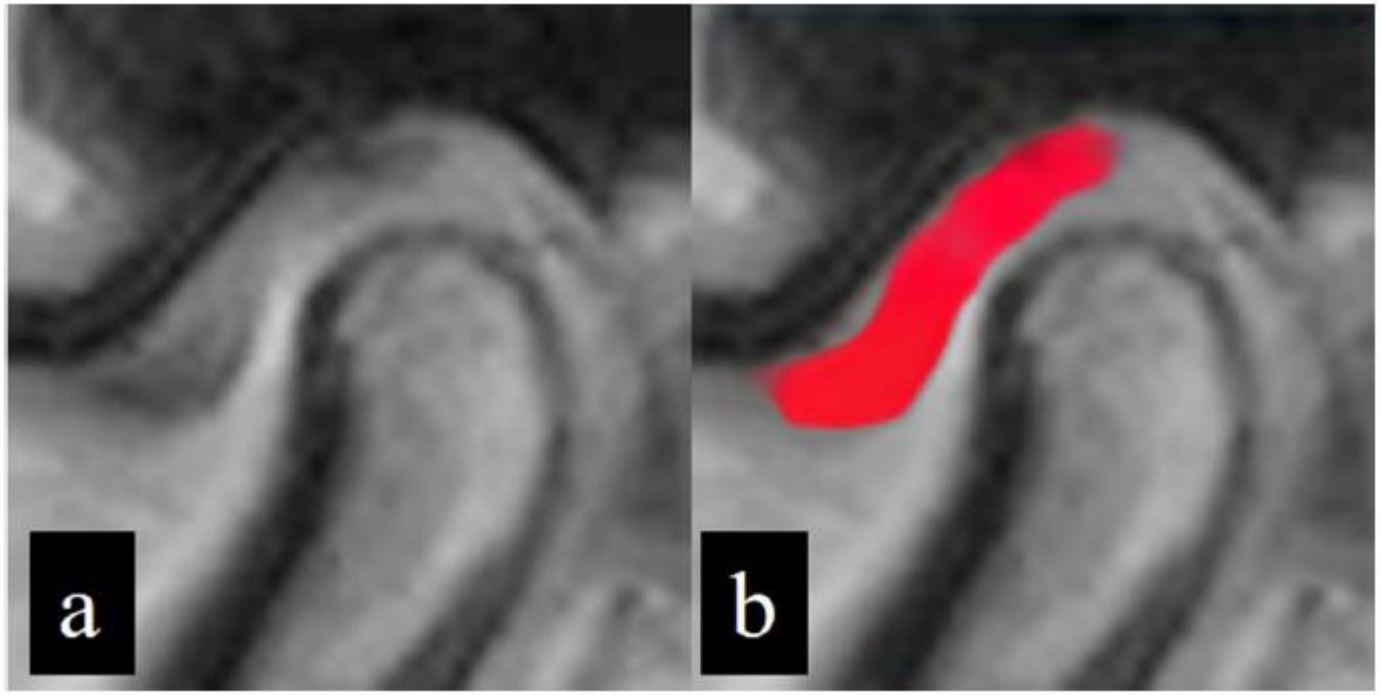
(C) Cancerous ground truth **(D)** True positive prediction (IoU 0.81)



(E) Cancerous ground truth **(F)** True positive prediction (IoU 0.91)

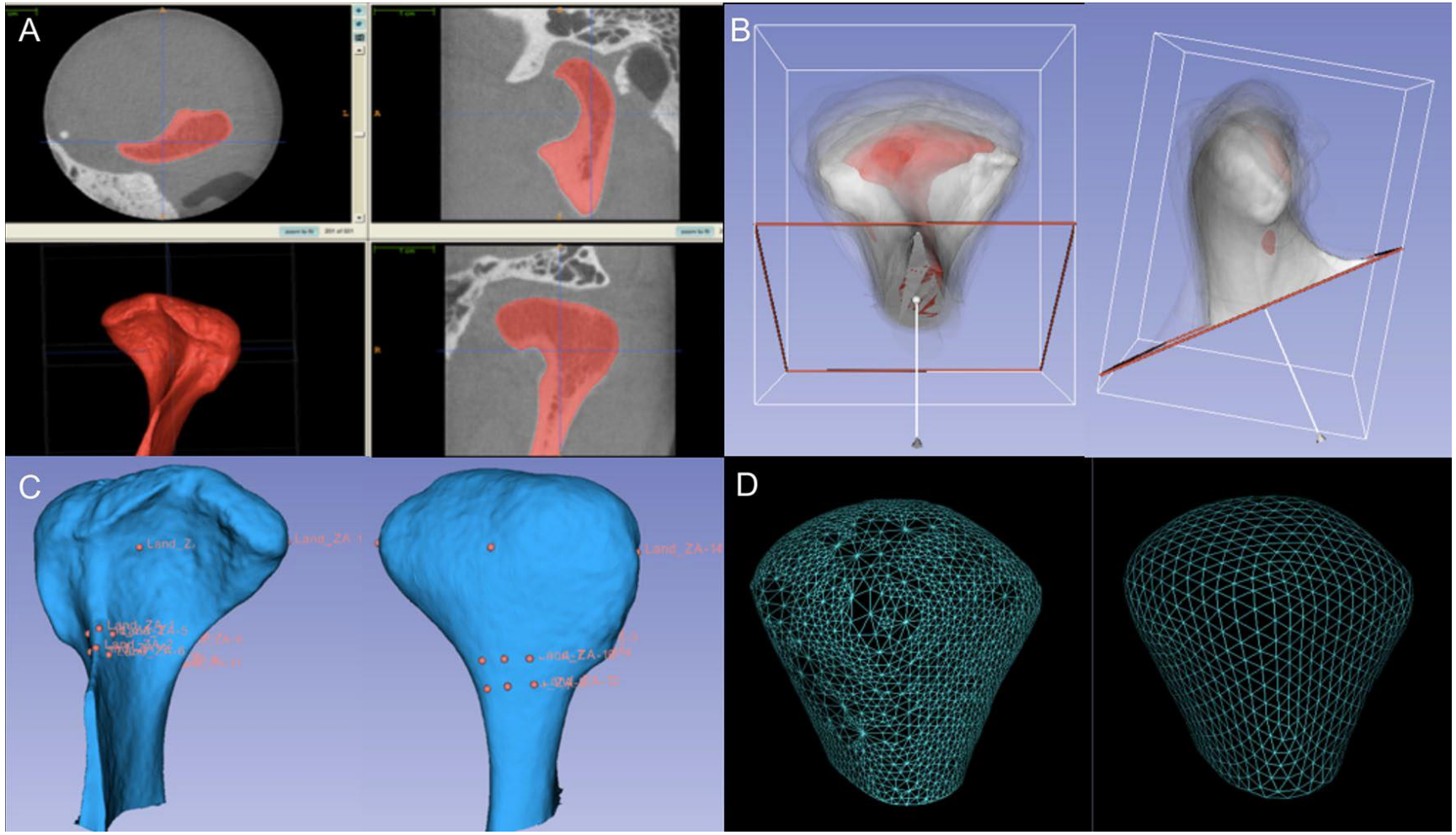
- (Warin, 2021)

TMJ-disc MRI



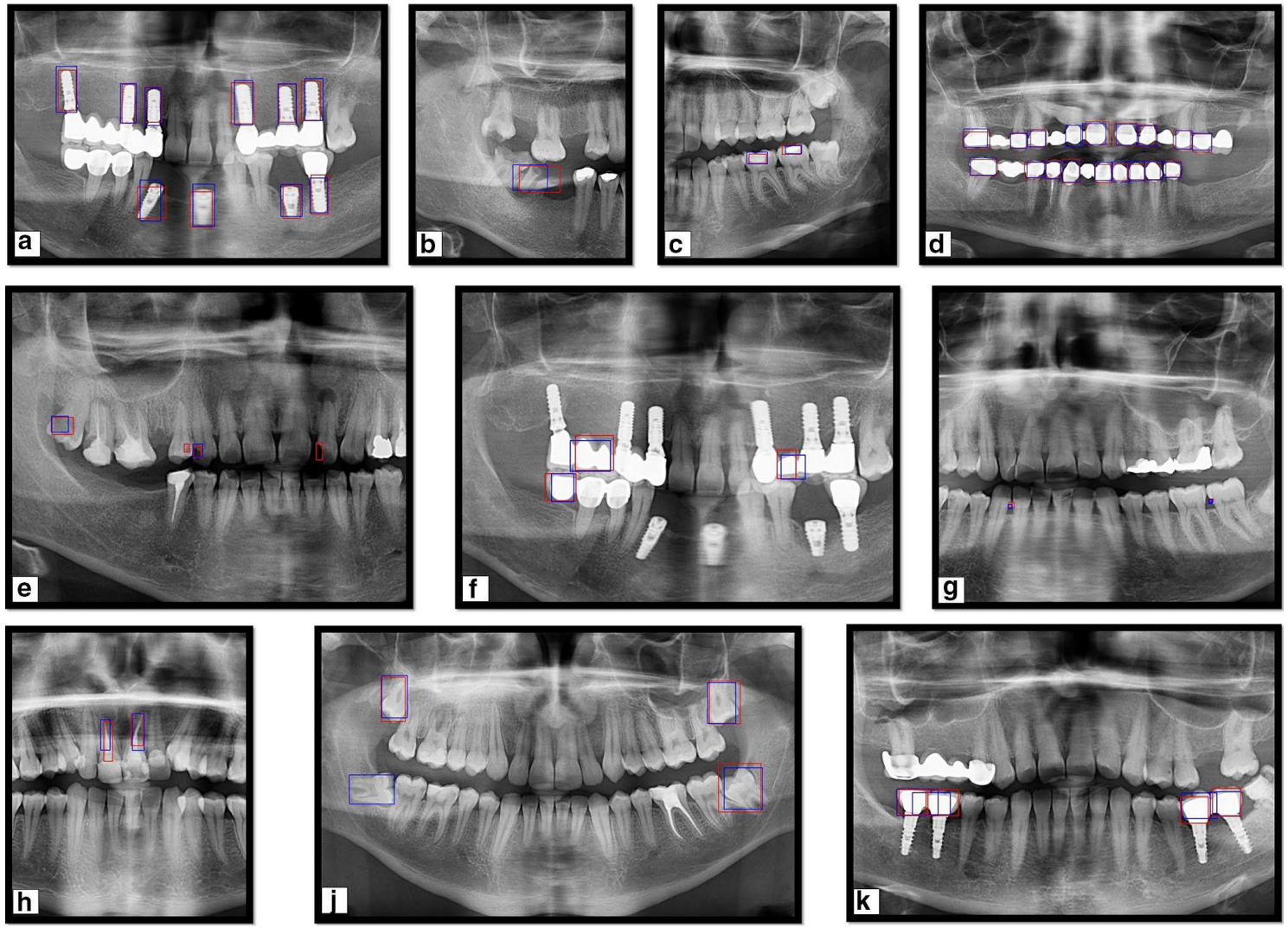
- Nozawa, 2022

TMJ-osteoarthritis from CBCT



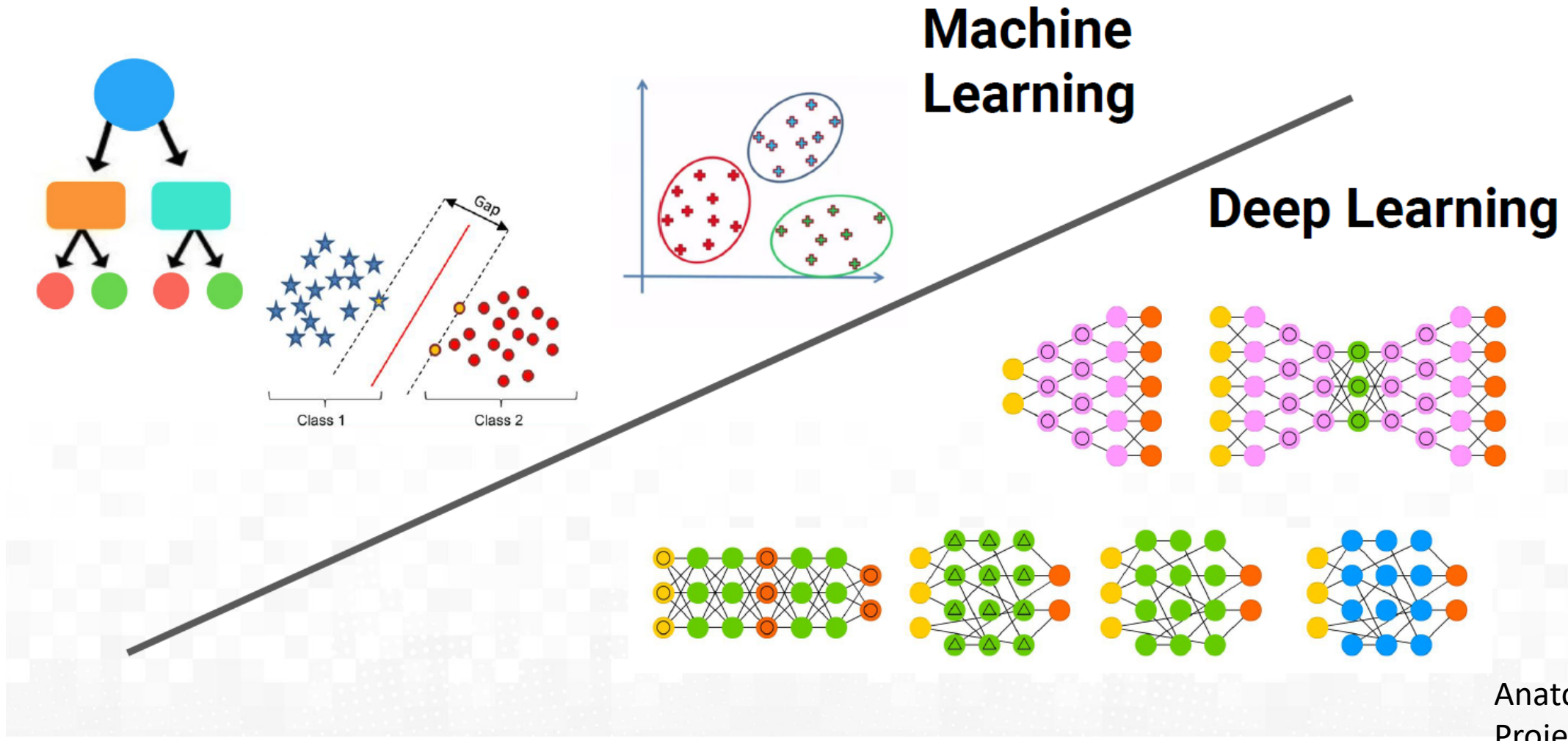
- Shoukri, 2019

Diagnostic charting with CranioCatch software



- Classifications of dental charting from panoramic radiograph
- Basaran 2021

ML/DL



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Types of learning

SUPERVISED LEARNING

Learning from labeled data

A machine is trained on 1000 images of apples and oranges to identify type of fruit in new images.

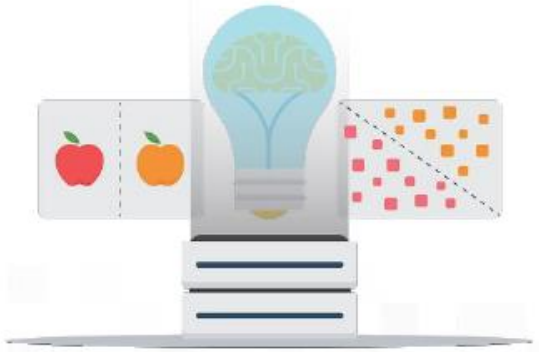
UNSUPERVISED LEARNING

Learning from unlabeled data

A machine groups objects based on the distribution of data.

SEMI-SUPERVISED LEARNING

Learning from a mix of labeled and unlabeled data



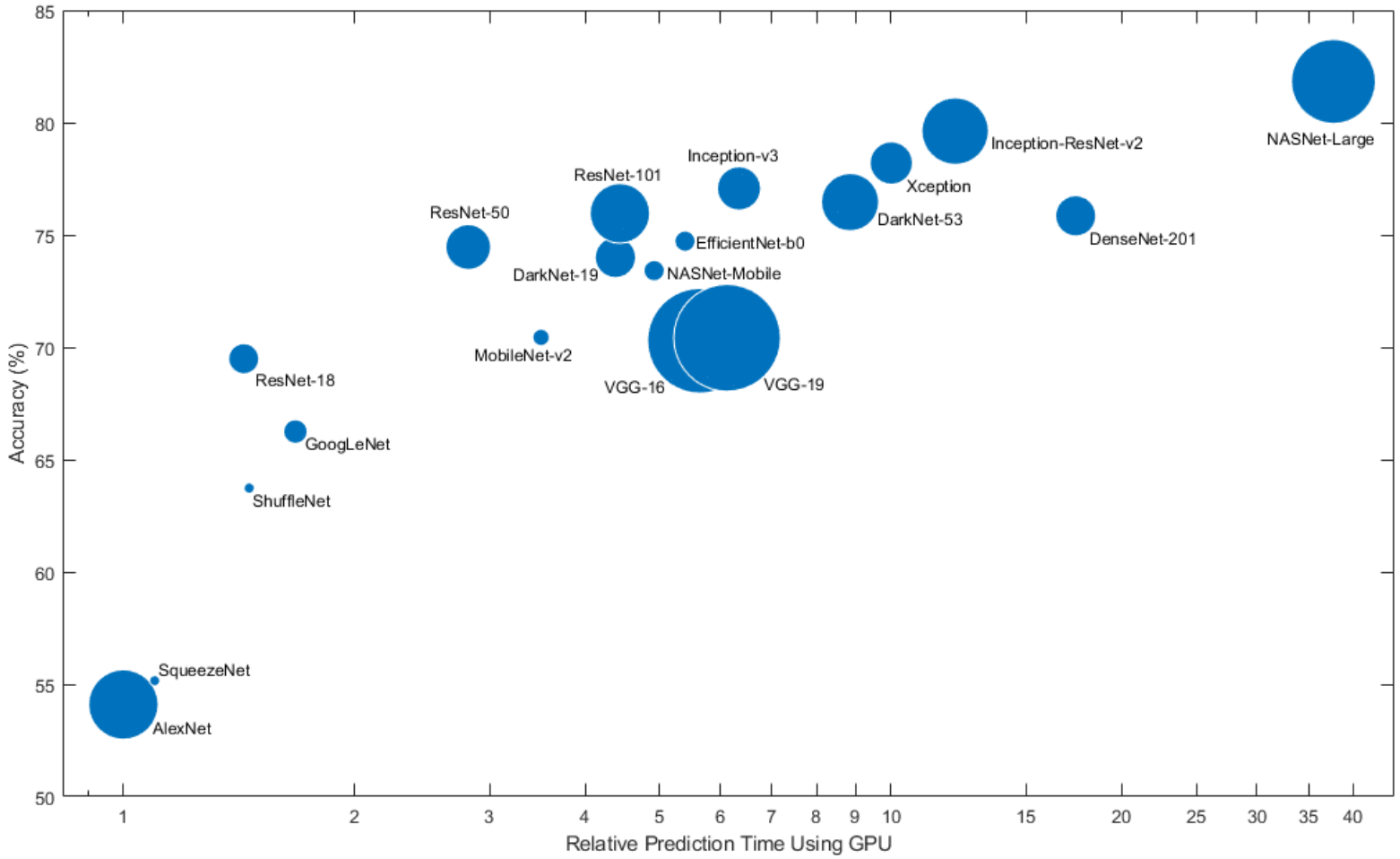
Use labeled data to split partitions. Unlabeled data will be labeled according to the partitions.

REINFORCEMENT LEARNING

Software agents take actions to maximise cumulate award

A machine is rewarded when it lands a ball into the basket, otherwise it is penalised.

Pretrained deep learning models



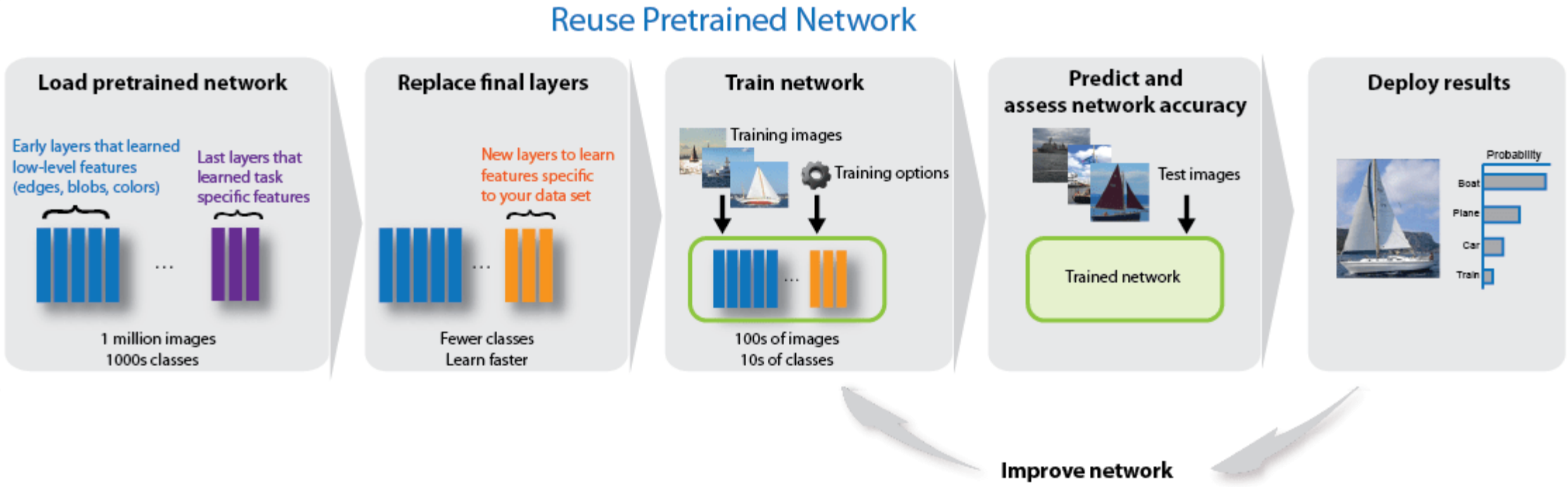
- https://www.mathworks.com/help/deeplearning/ug/pretrained-convolutional-neural-networks.html

Transfer learning

- Use of an already pre-trained DL models
- No need to build your own model/algorithm from scratch
- Example: AlexNet already trained with more than a million images from the ImageNet database.
- The network is eight layers deep and can classify images into 1000 object categories.
- As a result, the network has learned rich feature representations for a wide range of images.

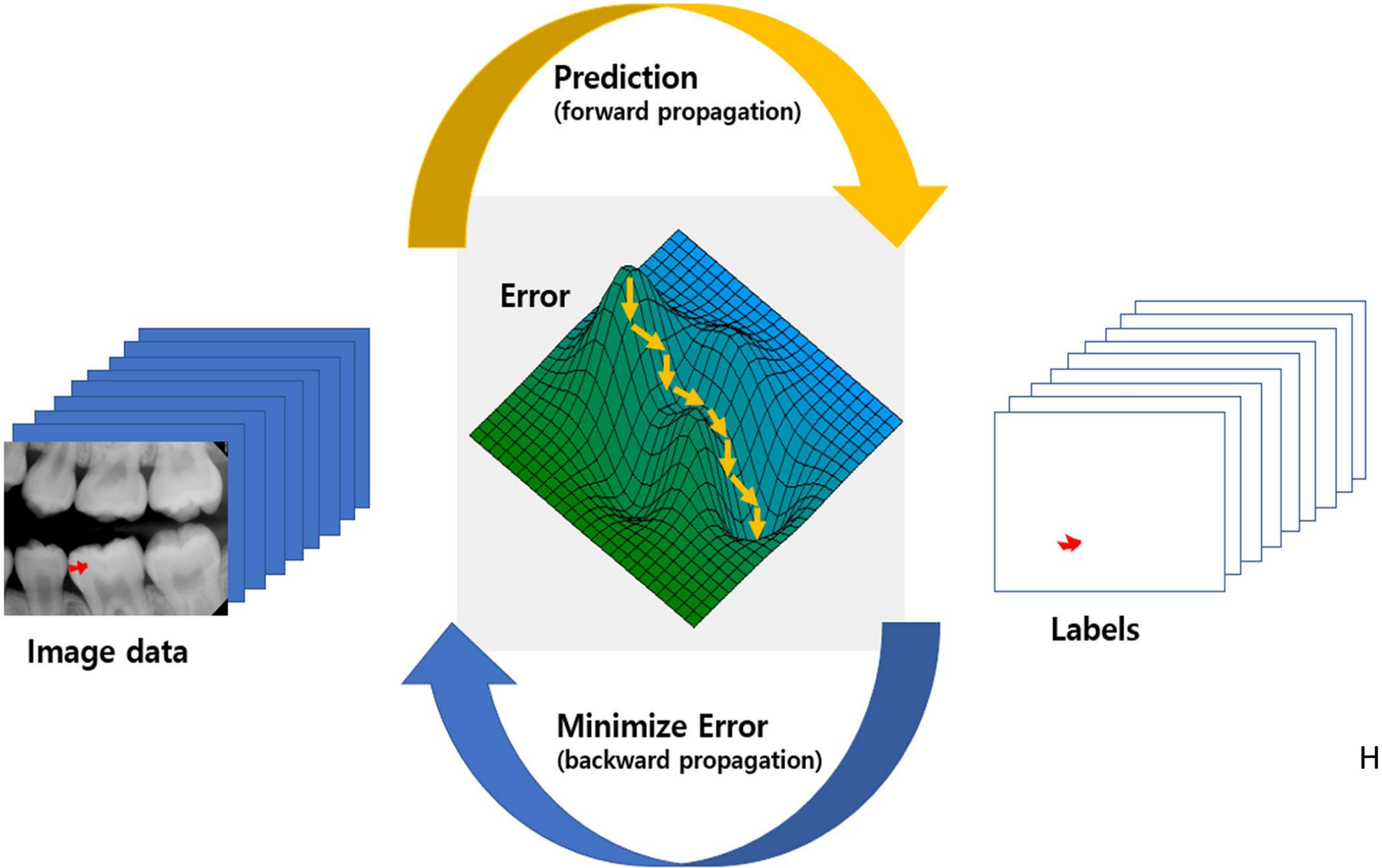
(Mohammad 2021)

Using the pretrained models in our projects



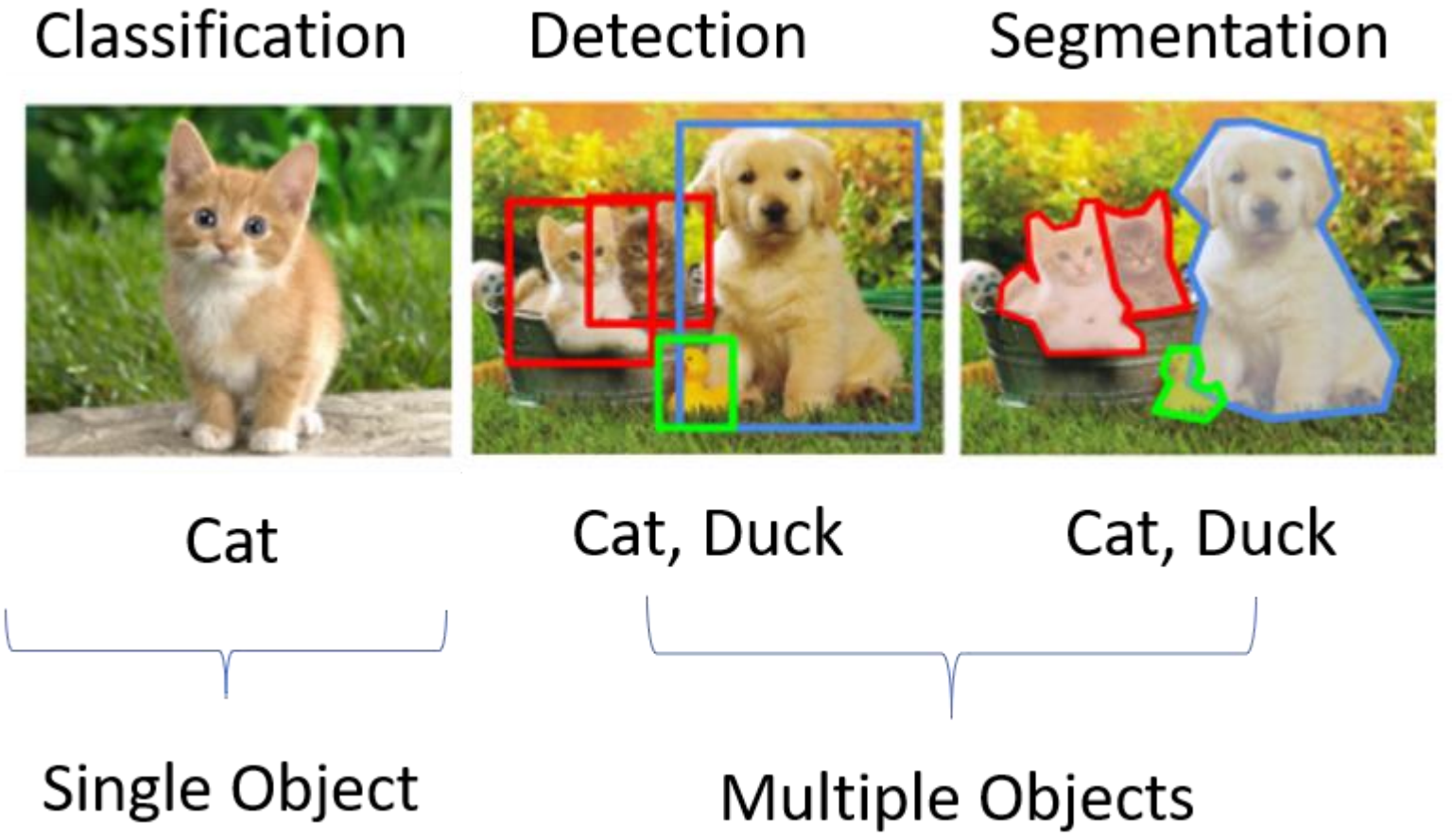
- https://www.mathworks.com/help/deeplearning/ug/pretrained-convolutional-neural-networks.html

Learning



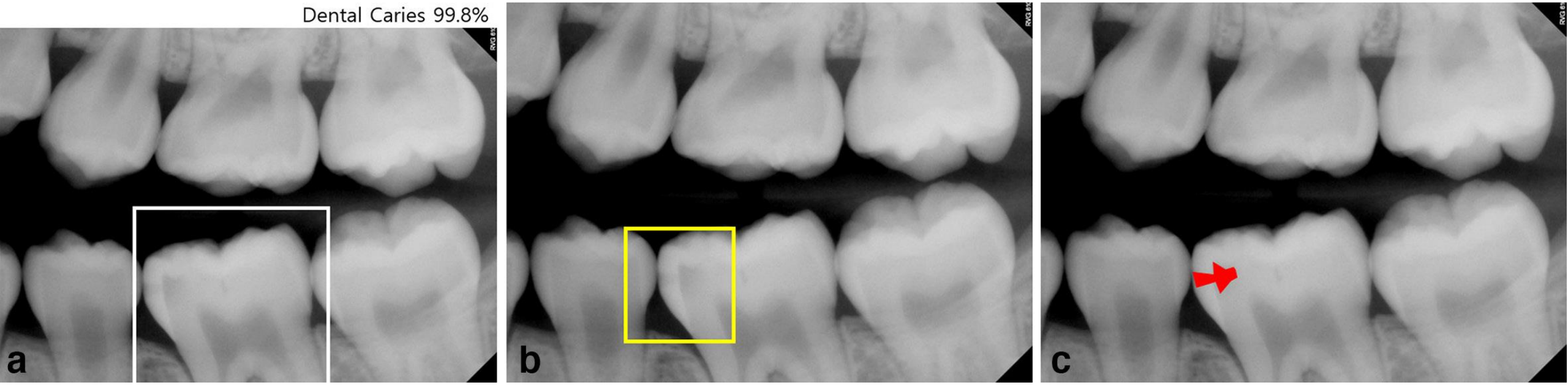
Heo 2021

Output



https://medium.com/@kolungade.s/object-detection-image-classification-and-semantic-segmentation-using-aws-sagemaker-e1f768c8f57d

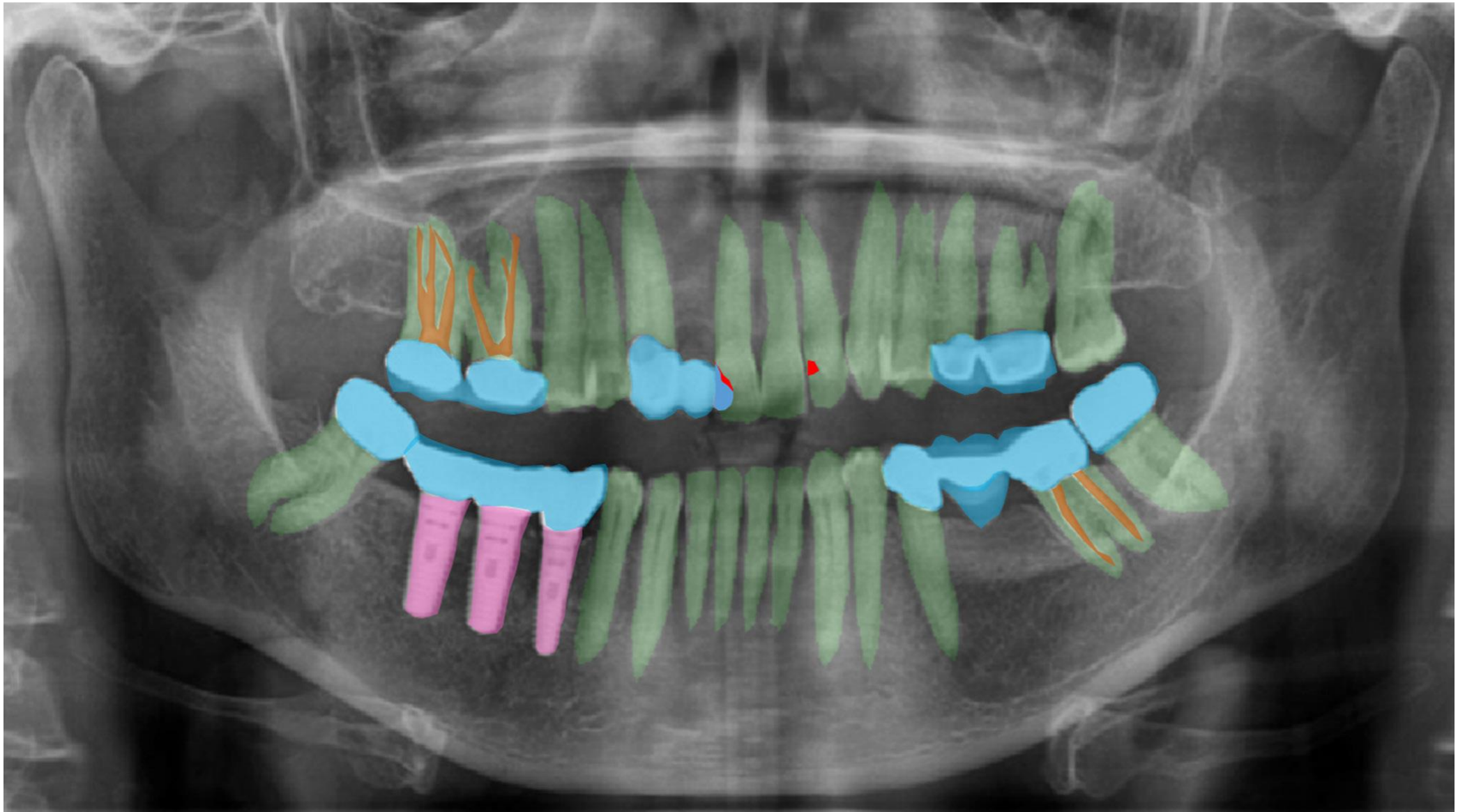
Classification, segmentation example



- Caries classification, detection, segmentation

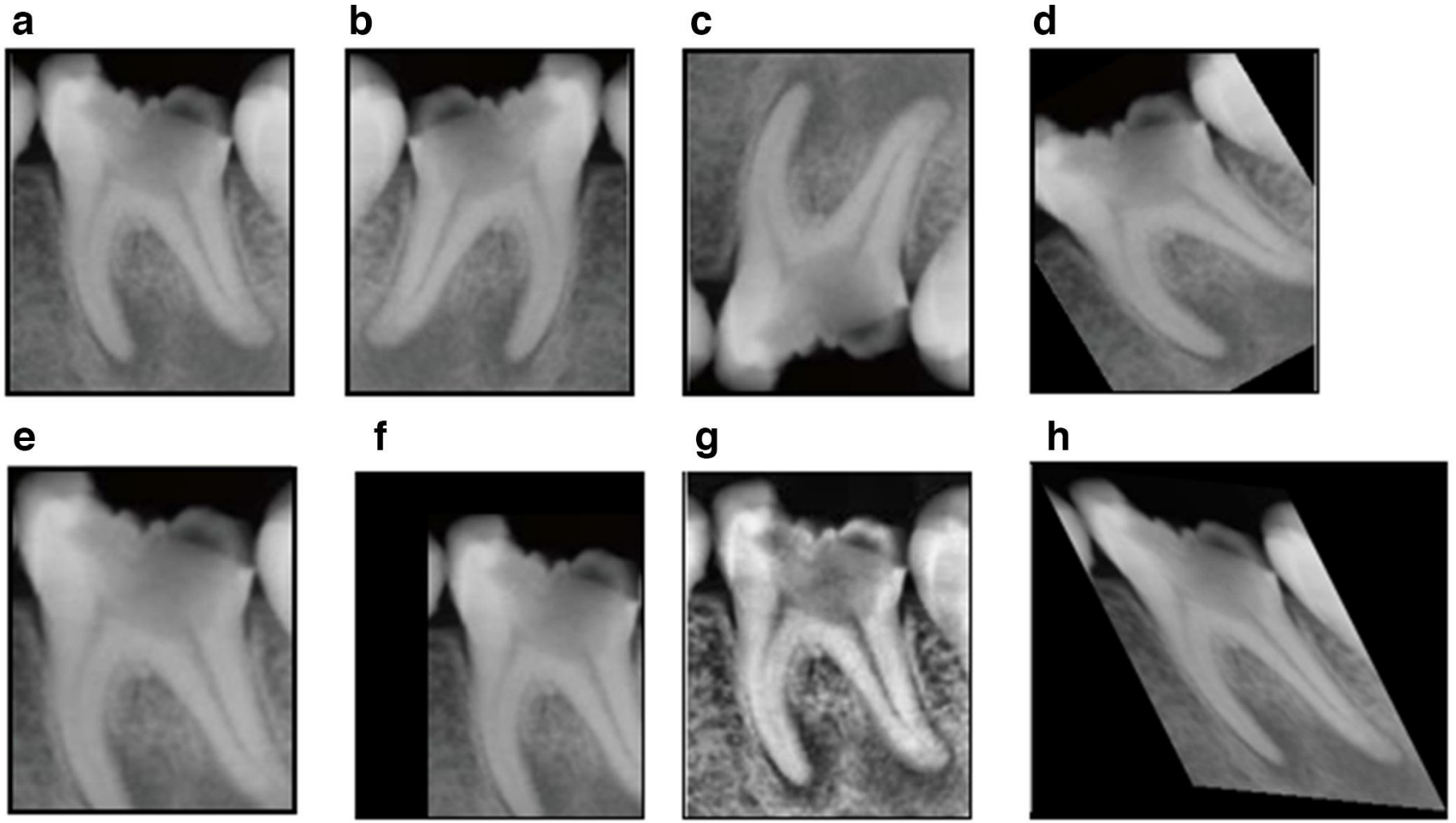
Heo 2021

Output example

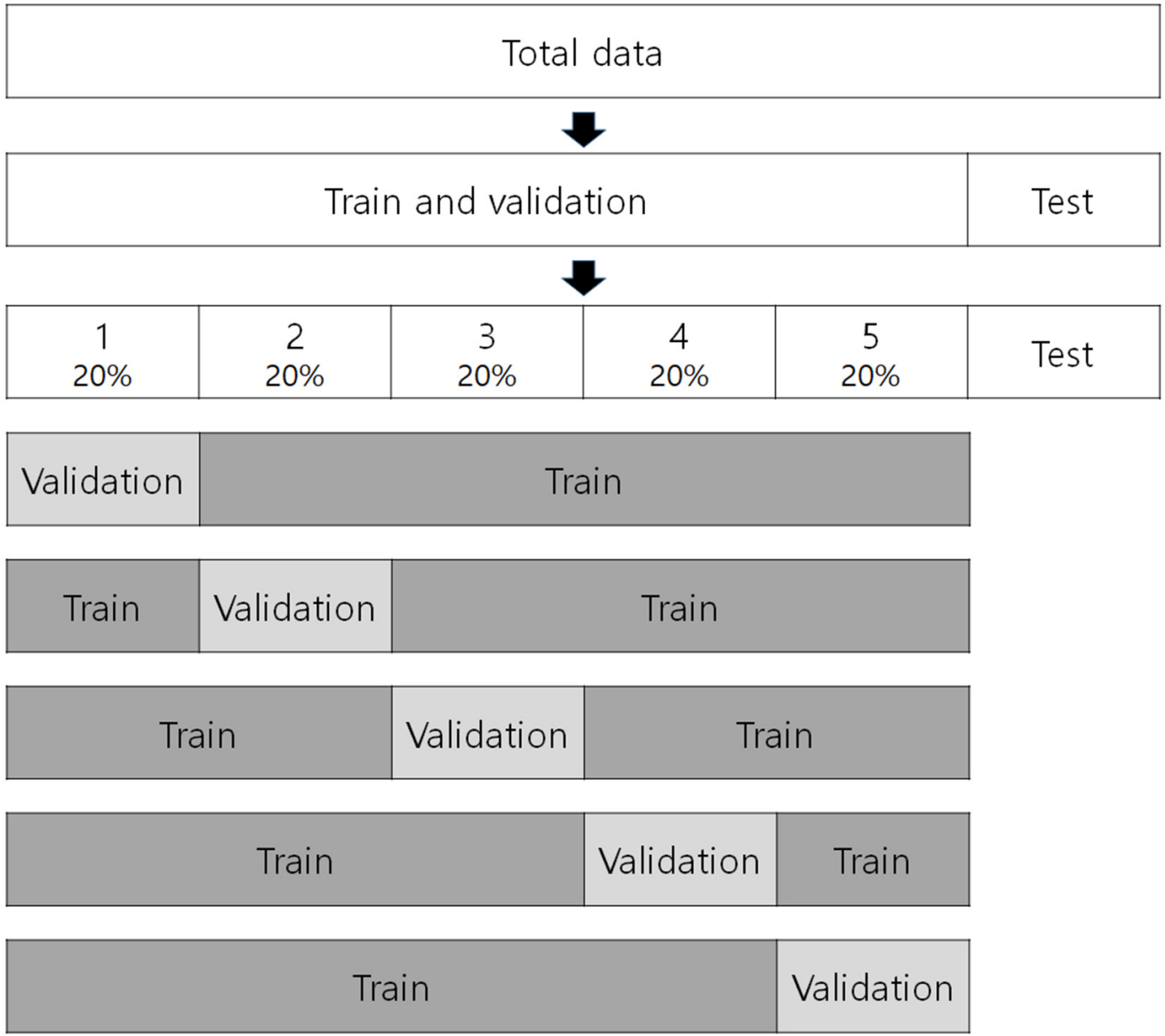


Heo 2021

Data augmentation



Heo 2021



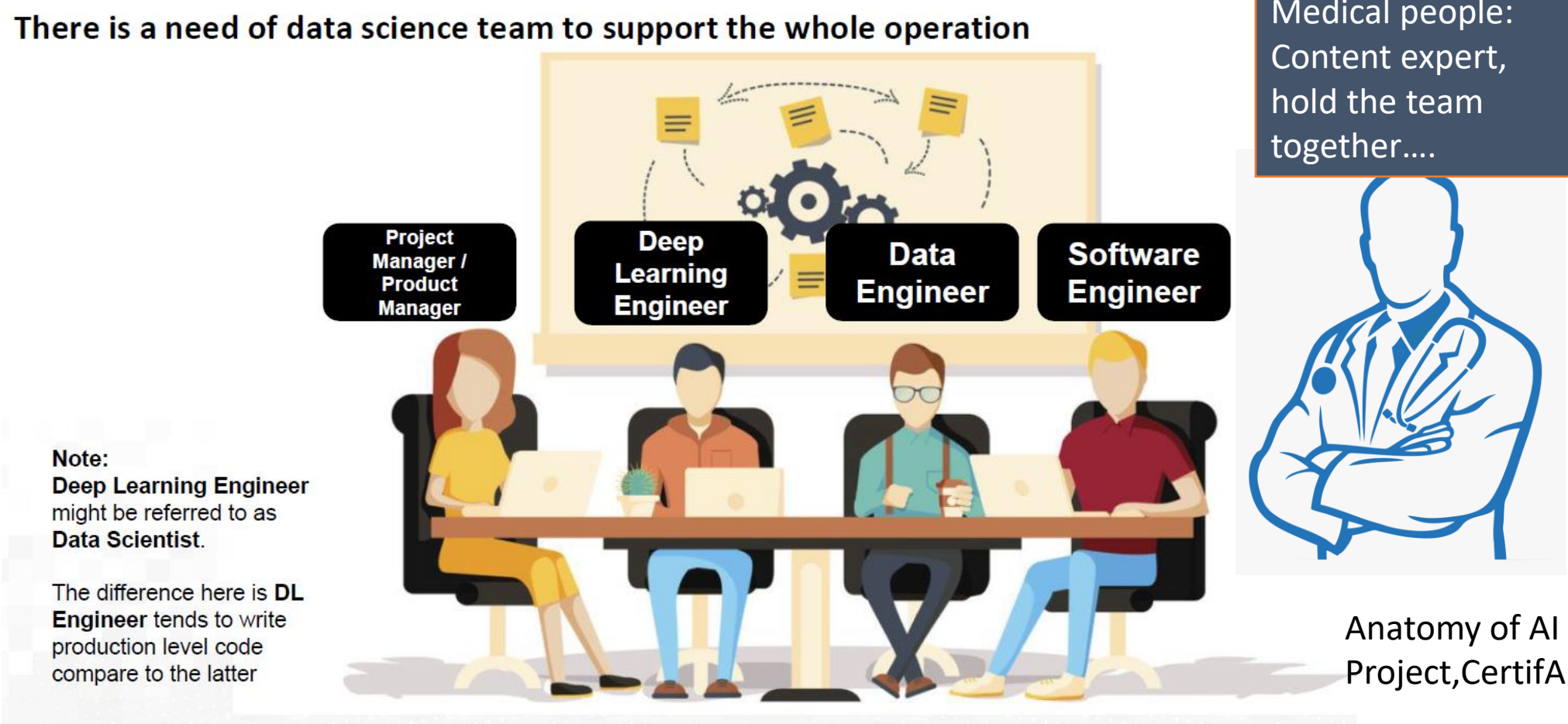
Training and validation

- Separation between training and validation/test from whole dataset

Heo 2021

What we need?

- Multidisciplinary team: Clinician with raw and labeled data and AI team



Medical people: Content expert, hold the team together….

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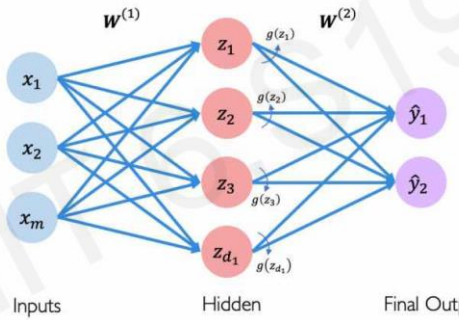
AI team?

Single Layer Neural Network



$$z_i = w_{0,i}^{(1)} + \sum_{j=1}^{m} x_j w_{j,i}^{(1)} \qquad \hat{y}_i = g\left(w_{0,i}^{(2)} + \sum_{j=1}^{d_1} g(z_j)\, w_{j,i}^{(2)}\right)$$

Loss Optimization

We want to find the network weights that ***achieve the lowest loss***

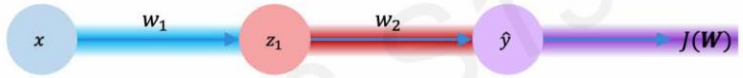
$$\boldsymbol{W}^* = \underset{\boldsymbol{W}}{\operatorname{argmin}} \frac{1}{n} \sum_{i=1}^{n} \mathcal{L}\left(f\left(x^{(i)}; \boldsymbol{W}\right), y^{(i)}\right)$$

$$\boldsymbol{W}^* = \underset{\boldsymbol{W}}{\operatorname{argmin}} J(\boldsymbol{W})$$

Remember:

$$\boldsymbol{W} = \{\boldsymbol{W}^{(0)}, \boldsymbol{W}^{(1)}, \dots\}$$

Computing Gradients: Backpropagation

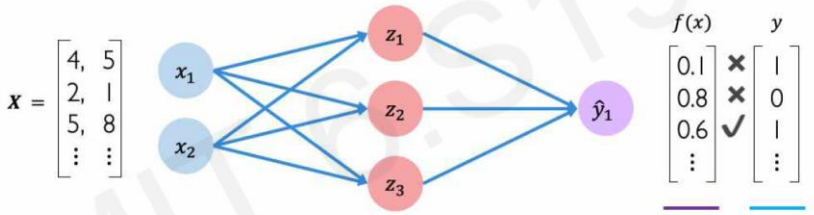


$$\frac{\partial J(\boldsymbol{W})}{\partial w_1} = \frac{\partial J(\boldsymbol{W})}{\partial \hat{y}} * \frac{\partial \hat{y}}{\partial z_1} * \frac{\partial z_1}{\partial w_1}$$

Repeat this for ***every weight in the network*** *using gradients from later layers*

Binary Cross Entropy Loss

Cross entropy loss *can be used with models that output a probability between 0 and 1*



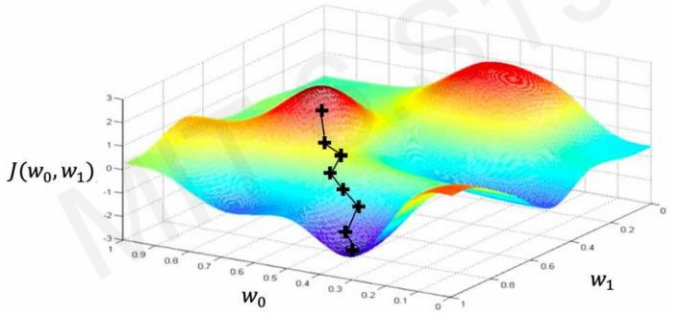
$$J(\boldsymbol{W}) = -\frac{1}{n} \sum_{i=1}^{n} y^{(i)} \log\left(f\left(x^{(i)}; \boldsymbol{W}\right)\right) + \left(1 - y^{(i)}\right) \log\left(1 - f\left(x^{(i)}; \boldsymbol{W}\right)\right)$$

Actual Predicted Actual Predicted

```
loss = tf.reduce_mean( tf.nn.softmax_cross_entropy_with_logits(y, predicted) )
```

Gradient Descent

Repeat until convergence



Core Foundation Review

The Perceptron

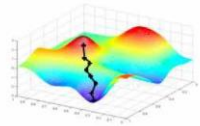
- Structural building blocks
- Nonlinear activation functions

Neural Networks

- Stacking Perceptrons to form neural networks
- Optimization through backpropagation

Training in Practice

- Adaptive learning
- Batching
- Regularization



Kulliyyah of Engineering project

How to proceed?

Remember the Google-Diabetic Retinopathy project in India?

- Continued the project in Thailand:
- Got some hurdles: ungradable, low quality images when tried out
- https://www.thelancet.com/journals/landig/article/PIIS2589-7500(22)00017-6/fulltext

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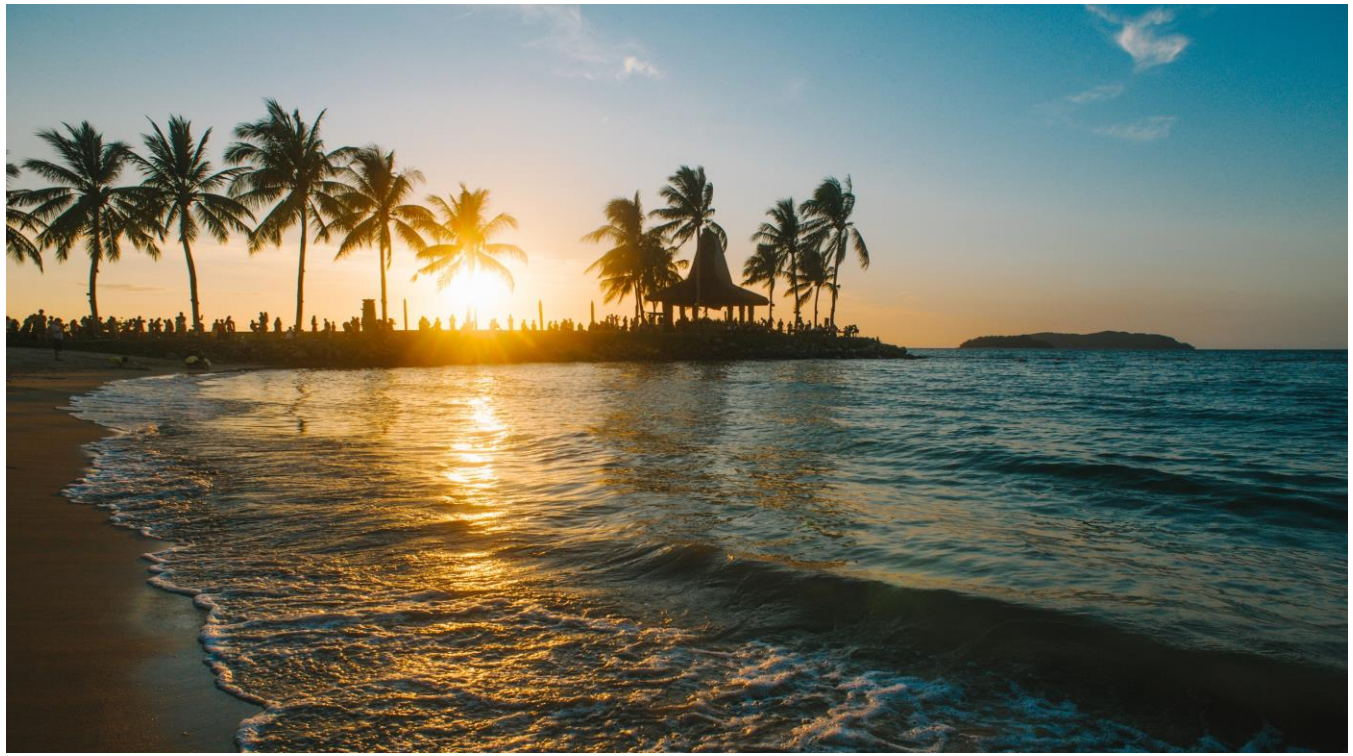
- © Alexander Amini and Ava Soleimany MIT 6.S191: Introduction to Deep Learning IntroToDeepLearning.com



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Thank you!