

Digital, Robotics & Enabling Technology

Jean Chaoui, EMBA, PhD



Tech capabilities and foundational infrastructure



Robotics



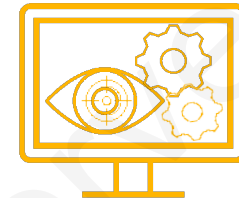
Guidance



Sensors



AR/VR



Computer vision



EHR integration



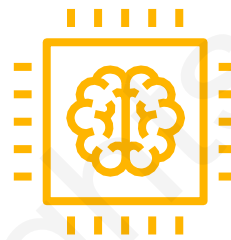
Cloud/
Connectivity



Product security
and privacy



Agile and
DevSecOps



AI/ML



Data
intelligence



UI/UX



Digital
IP

From Value in Product to Value in Ecosystem

Product
(Value creation)

Value in « Game changing tech »
Innovative products



This block illustrates the 'Product' stage, featuring various orthopedic components such as screws, plates, and a knee joint, along with a power drill and a knee brace.

Service
(Value co-creation)

Value in the « Use Concept »
Surgeons create part of the value



This block illustrates the 'Service' stage, showing a hand on a screen, a robotic arm, a hand model, and a Mako robotic system.

Platform
(Value connector)

Value in Community:
We provide an infrastructure that connects surgeons, patients, stakeholders,...



This block illustrates the 'Platform' stage, featuring a 5G signal icon, a hand model, a knee joint model, a robotic arm, and a Mako robotic system.

Ecosystem
(Value interoperability)

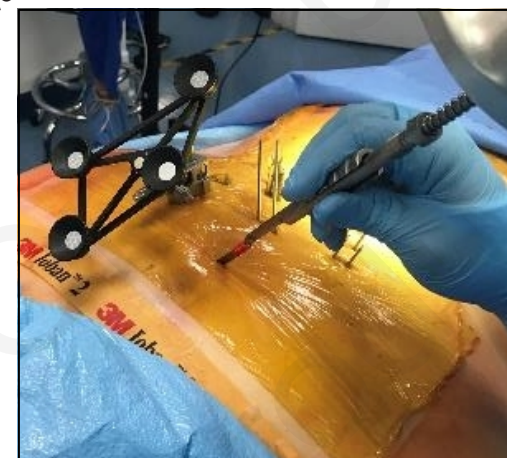
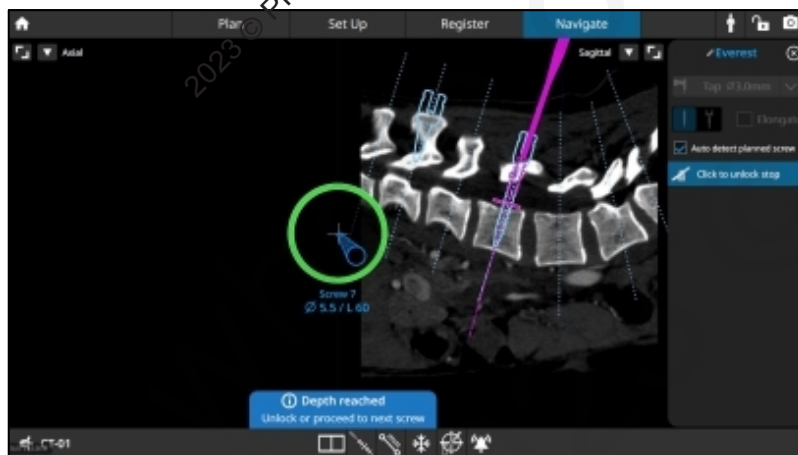
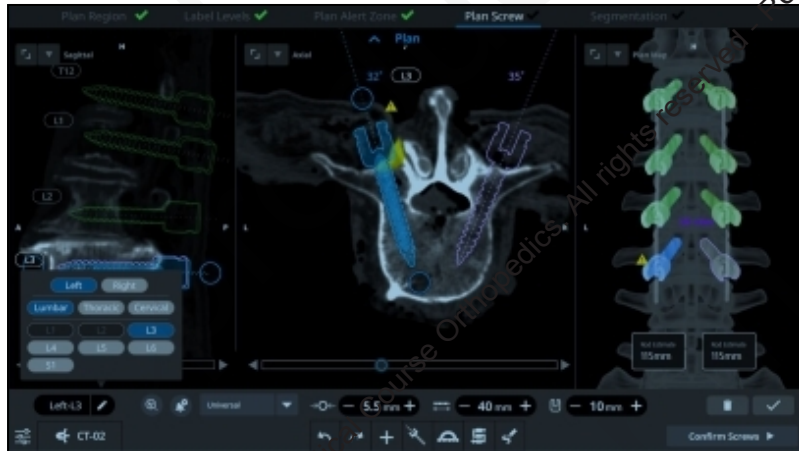
Value in Ecosystem:
APIs to connect portfolio solutions together and to external solutions



This block illustrates the 'Ecosystem' stage, showing a human figure surrounded by various medical devices and a large medical device.

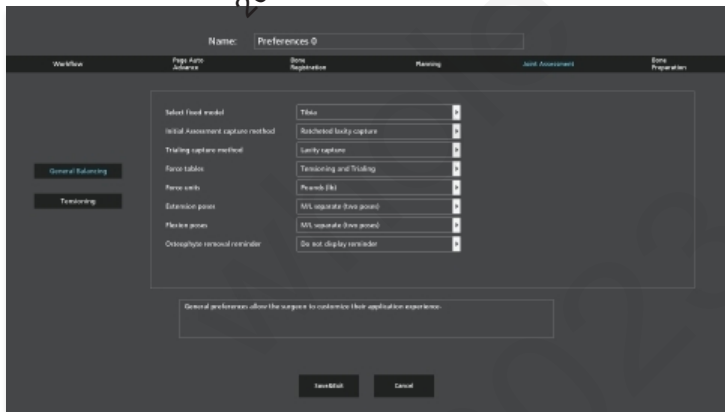
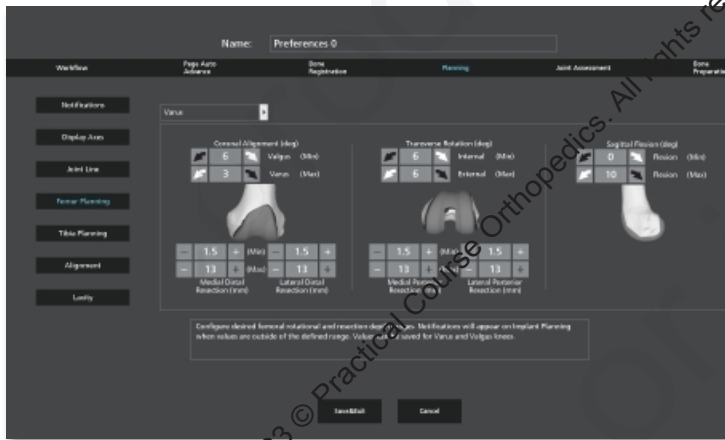
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One Robot Multiple Applications

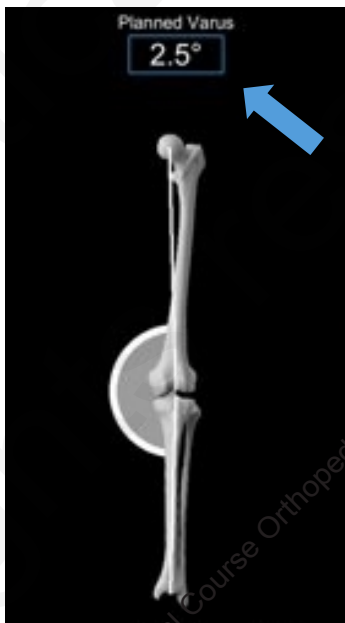
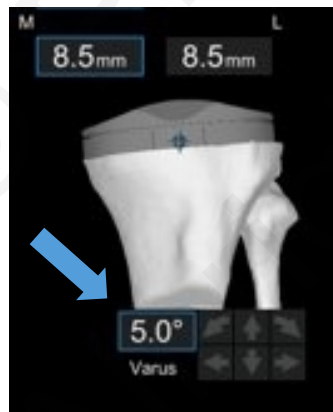
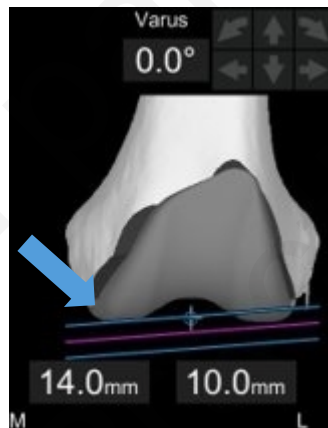


Next Generation Software | Robotics 2.0

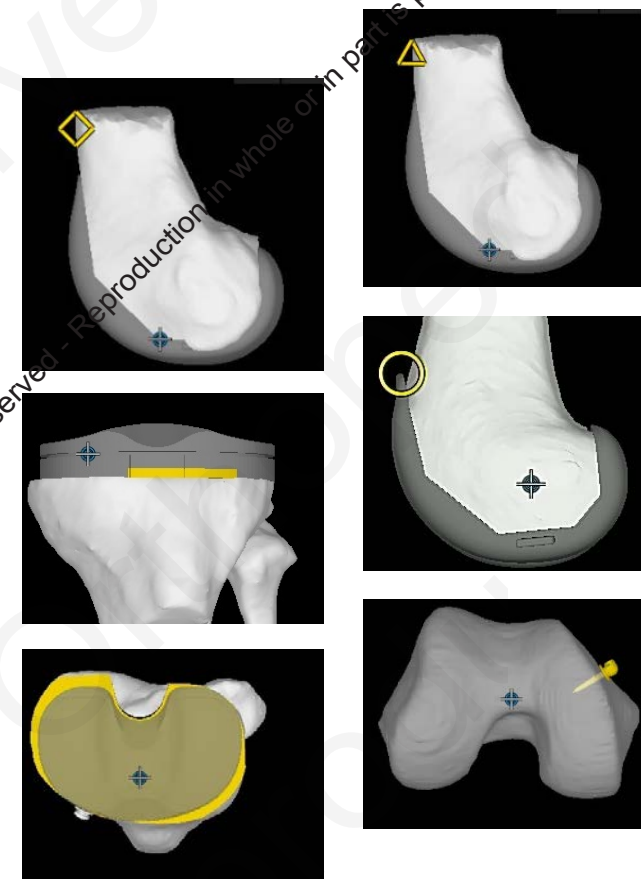
Preferences



AI-Based Notifications

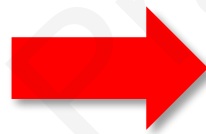


AI-Based Warnings



AI in Decision Making

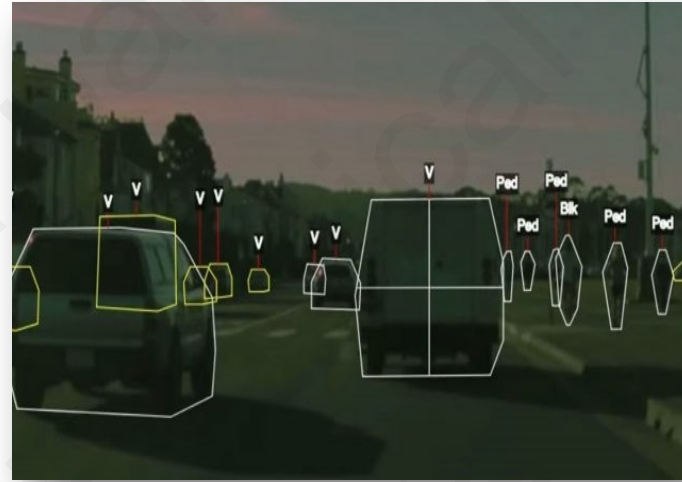
AI Machines **Have Beaten** Moore's Law Over The Last Decade*



*According to Stanford University's AI Index report

Clinical Intelligence

Radiomics



From
Pixel/Frame



To
Road Feature

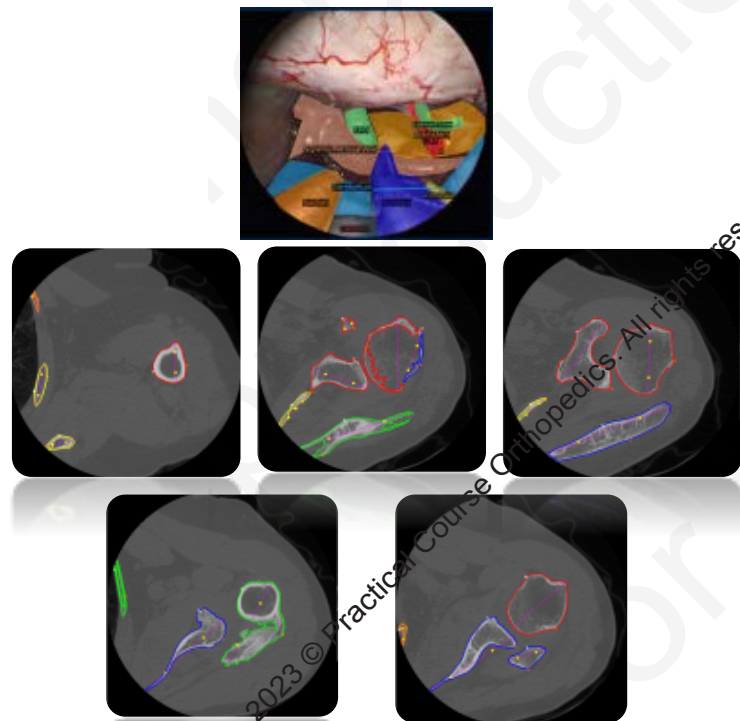


To
Auto Pilot

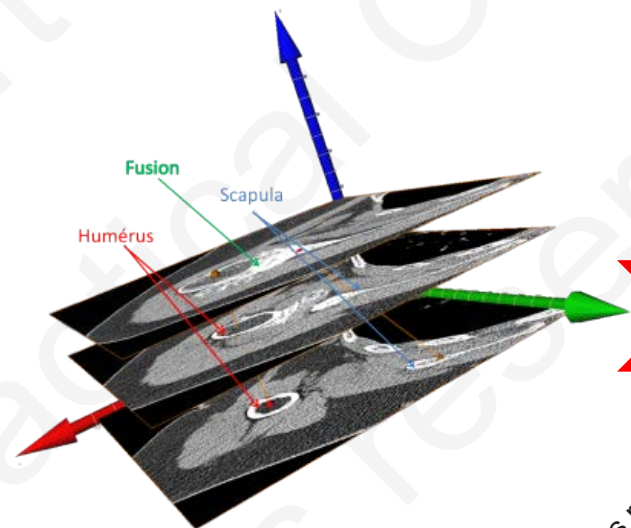
We help our customers **rebuild lives.**TM

Clinical Intelligence

Radiomics



**From
Pixel/Voxel**



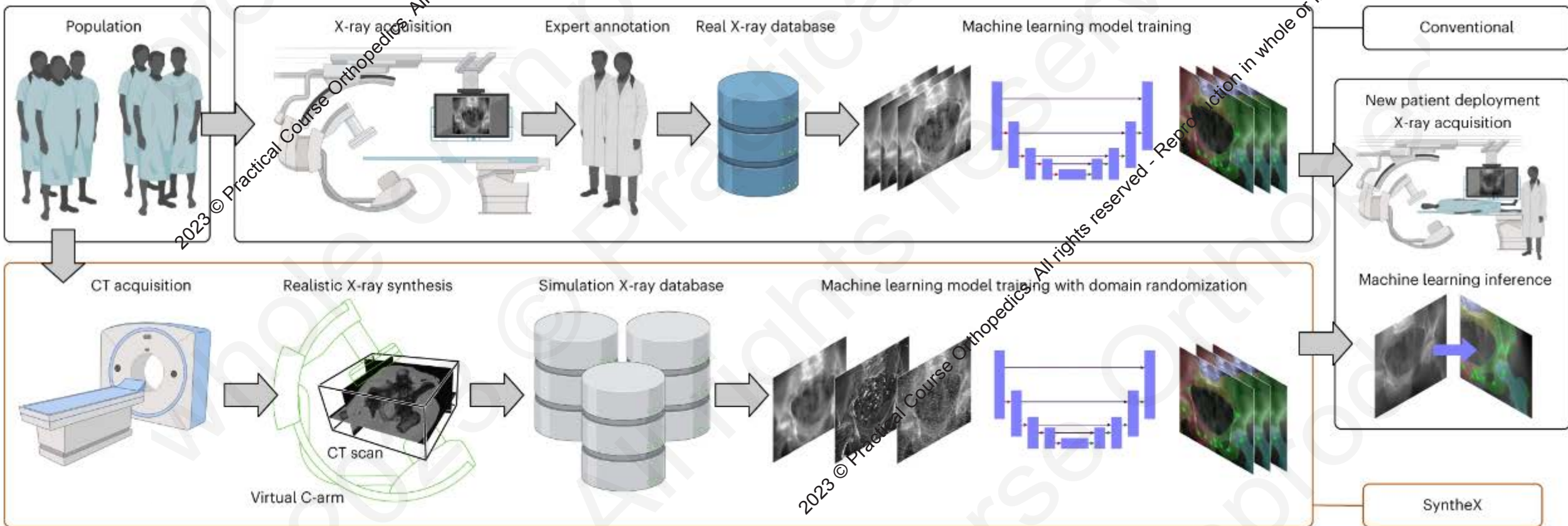
**To
Clinical Feature**



**To
Smart Planning
and Guidance**

AI in Decision Making

- During the training phase an AI system is fed thousands of labeled features of various cases learning to classify them.
- The prediction output would be surgical strategy, Implant type/size/placement.



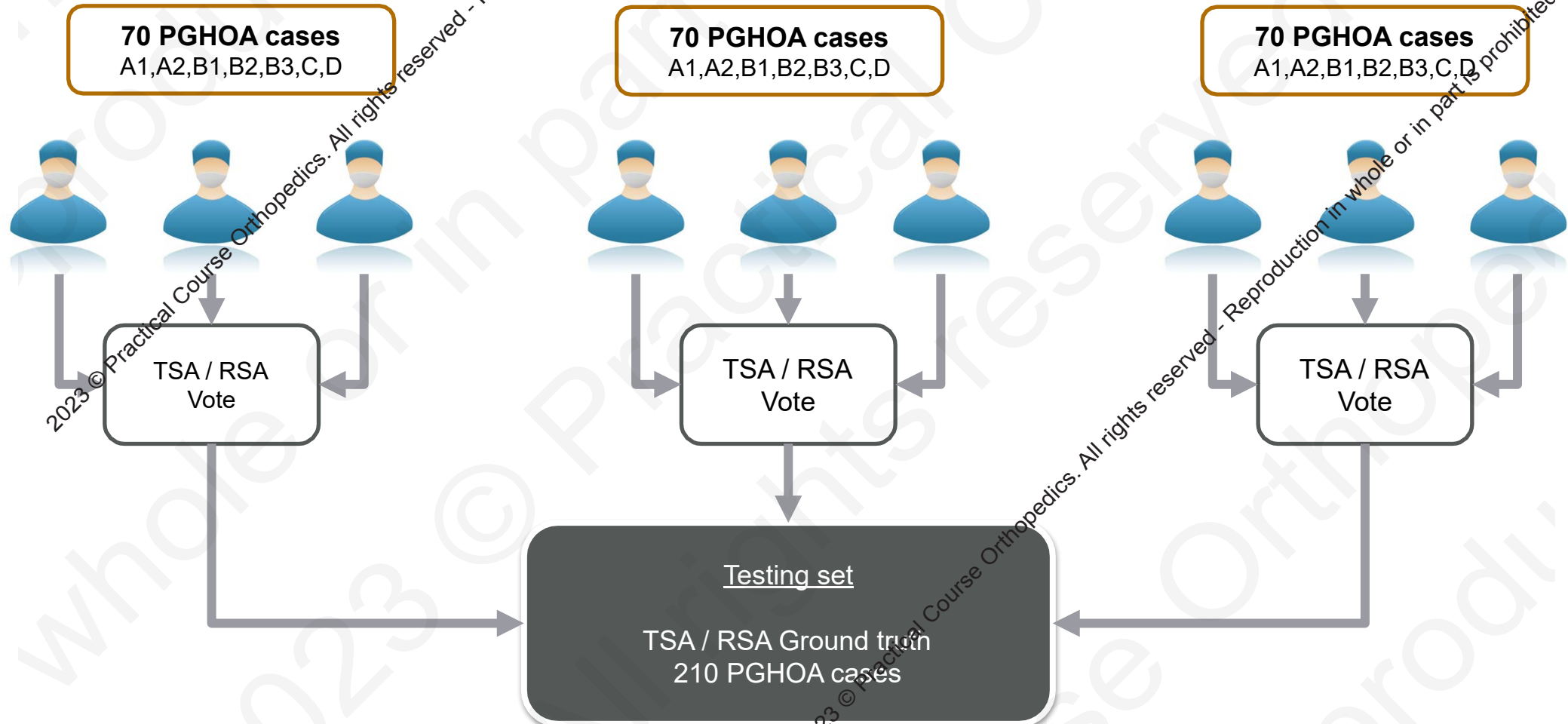
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ARTIFICIAL INTELLIGENCE

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AI Validation/Testing Framework

Testing set – 210 PGHOA cases



The average surgeon-to-surgeon Kappa was **K = 0.54** (moderate agreement).

The AI algorithm offered significantly higher agreement compared to any expert-to-expert agreement in cases of full and strong agreement votes, with Kappa of **0.78** and **0.70** respectively.

FULL LENGTH ARTICLE | ARTICLES IN PRESS

Can we predict the humerus stem component size required to achieve rotational stability in metaphyseal stability concept?

Manuel Urvoy, MEng & Will Blakeney, MD • Patric Raiss, MD • George S. Athwal, MD •

Thais Dutra Vieira, MD • Gilles Walch, MD


Open Access • Published: August 11, 2022 • DOI: <https://doi.org/10.1016/j.jseint.2022.07.011>

SHOULDER SHOULDER ARTHROPLASTY | VOLUME 5, ISSUE 6, P1008-1013, NOVEMBER 01, 2021

Development and assessment of 3-dimensional computed tomography measures of proximal humeral bone density: a comparison to established 2-dimensional measures and intraoperative findings in patients undergoing shoulder arthroplasty

William G. Blakeney, MBBS, MS, MSc, FRACS & Manuel Urvoy, MEng • Jean Chaoui, EMBA, PhD • Patric Raiss, MD • George S. Athwal, MD, FRCSC • Gilles Walch, MD

Open Access • Published: September 15, 2021 • DOI: <https://doi.org/10.1016/j.jseint.2021.07.015>

 Check for updates

Can we predict a stem size to achieve rotational stability in metaphyseal fixation concept?

Bone Density Assessment

Cohort & Data

Cohort

Period

- 2014 to 2019

Gender

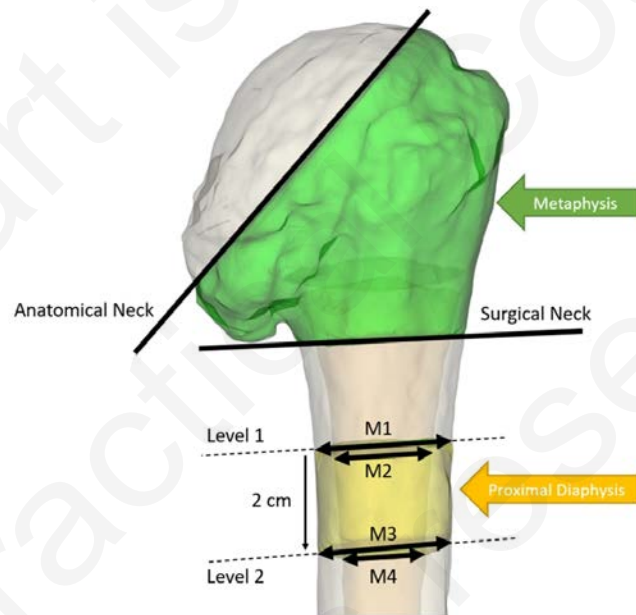
- 181 female patients (62%)
- 109 male (38%)

Age

- mean age at the time of the arthroplasty of 72 years (range, 34-99 years)

Diagnosis

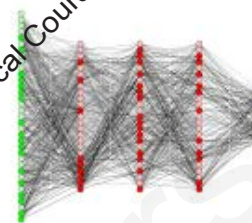
- Primary glenohumeral osteoarthritis (66%, N=192)
- Massive rotator cuff tear (17%, N=48)
- Cuff tear arthropathy (17%, N=50)



6 shape characteristics

8 Bone density measures

Patient Age

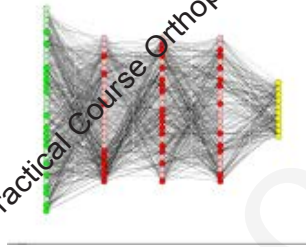


Surgery Stem Size

Results

Training on 80% of the cohort (248 cases)

Testing on 20% of the cohort (42 cases)

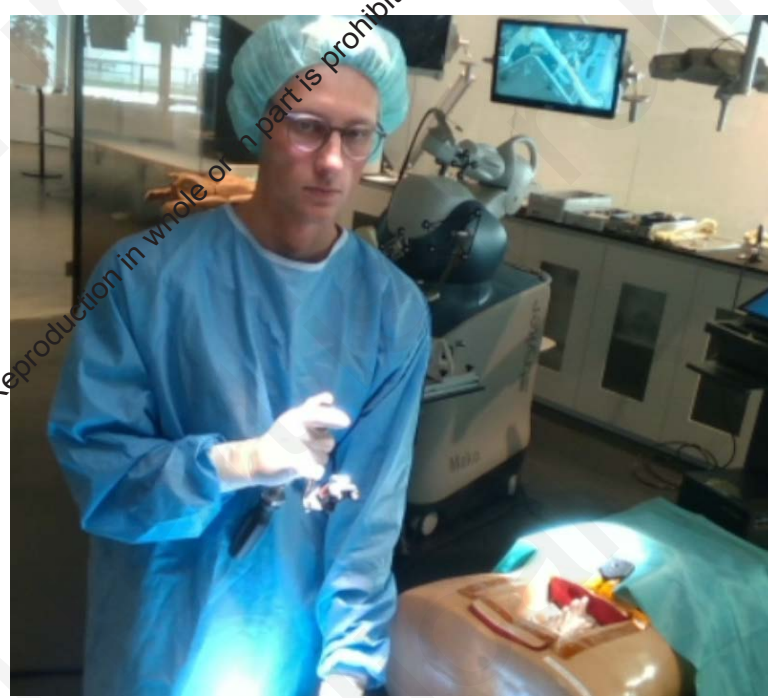
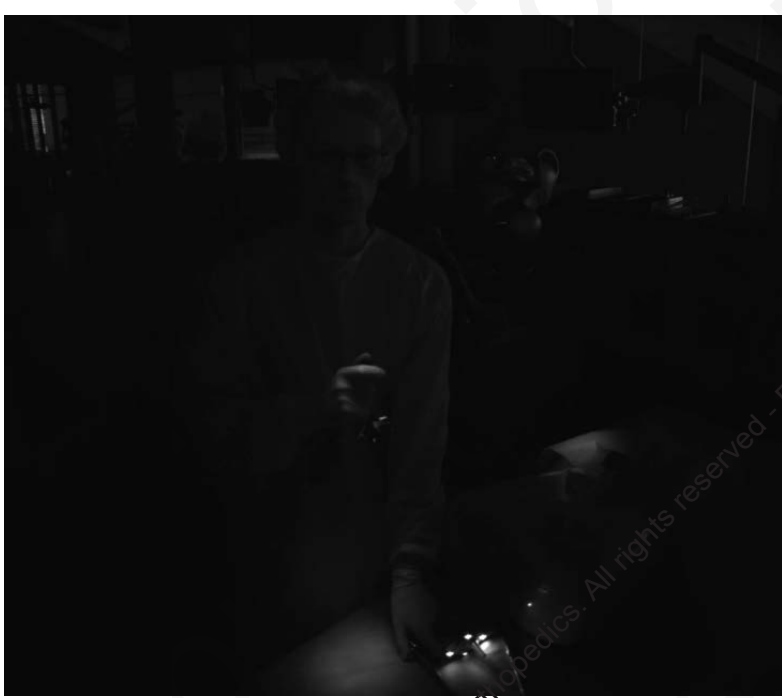


$R^2 = 0.63$

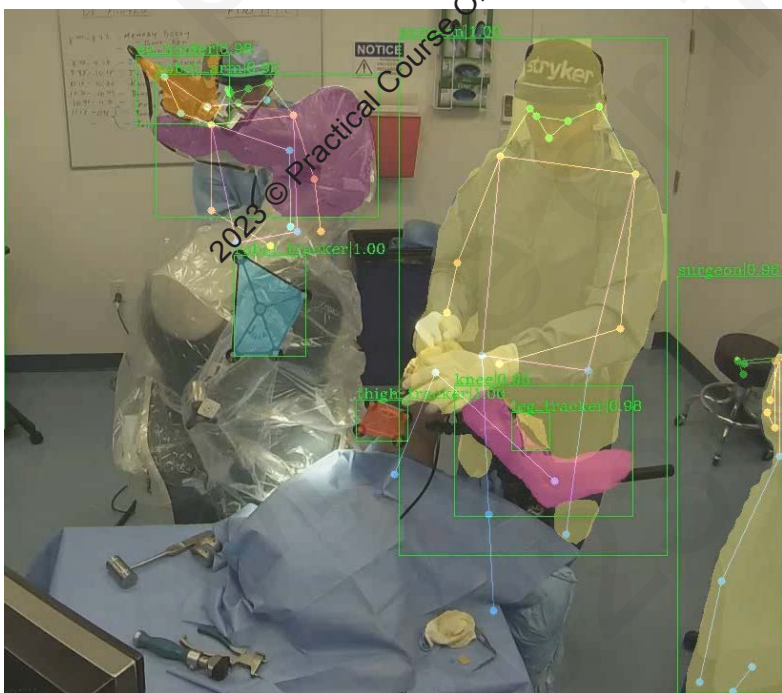
Surgery Stem Size

The stem sizes obtained by the model were correct within **one size** variation for 40 cases (95%).

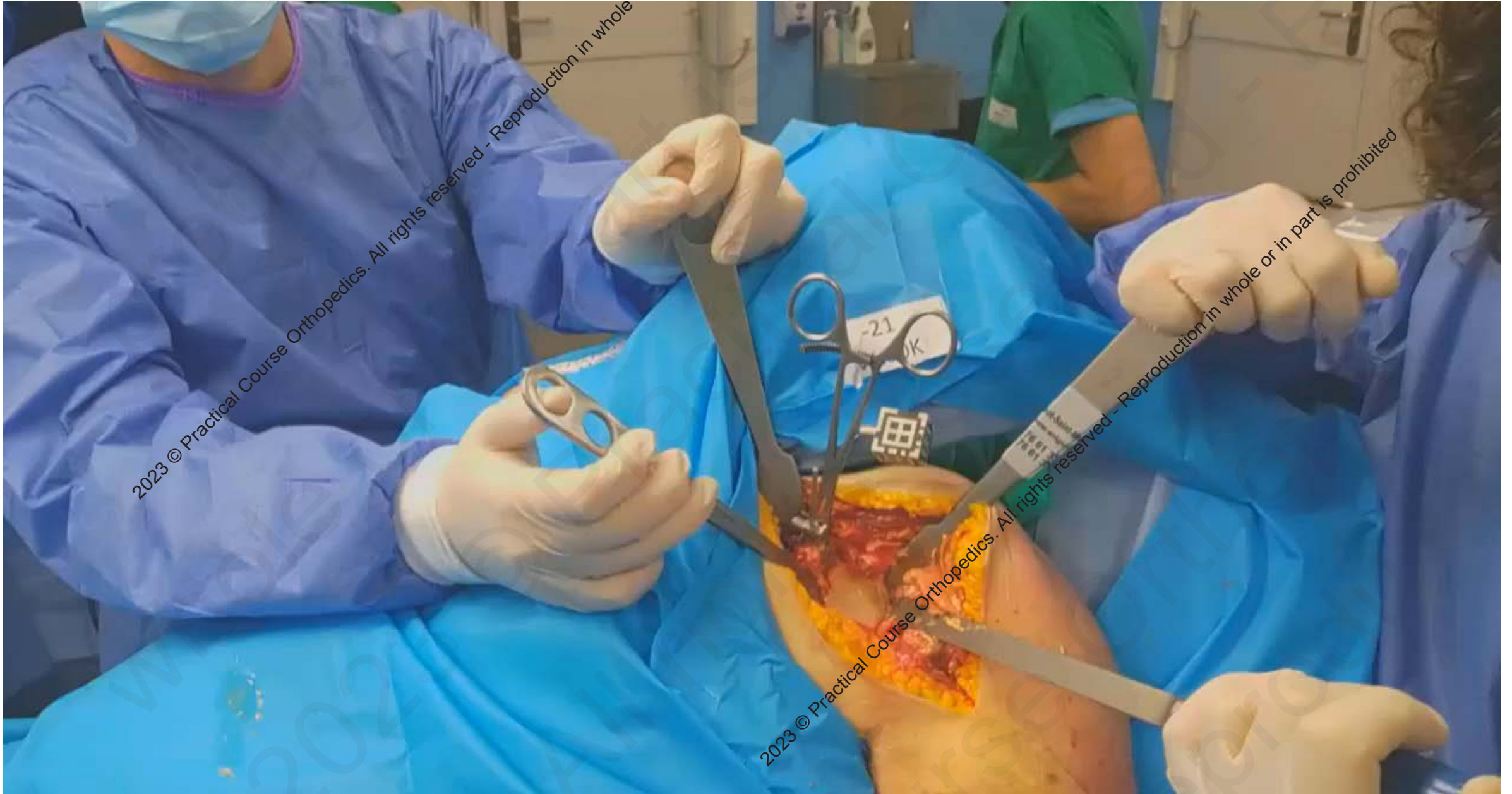
Measure	Average	SD	Significant contribution to the Stem Size Prediction	Corresponding p-value
Patient Age	72 y	10 y	No	> 0.1
M1	24.1 mm	3.1 mm	No	> 0.1
M2	18.0 mm	3.1 mm	No	> 0.1
M3	21.5 mm	2.8 mm	No	> 0.1
M4	15.0 mm	2.7 mm	Yes	< 0.0001
Humerus Proximal Diaphysis Cortical Thickness	3.2 mm	0.6 mm	No	> 0.1
HSSM_{λ1}	-0.552	0.8990	Yes	< 0.0001
HSSM _{λ2}	0.00710	0.8166	No	> 0.1
HSSM_{λ3}	-0.0940	0.6671	Yes	0.0027
HSSM_{λ4}	0.376	0.8557	Yes	< 0.0001
HSSM_{λ5}	-0.200	0.7902	Yes	< 0.0001
HSSM _{λ6}	-1.017	1.0608	No	> 0.1
Humerus Metaphysis Cancellous Bone Density	22 HU	29 HU	Yes	< 0.0001
Humerus Metaphysis Cortical Bone Density	537 HU	93 HU	Yes	0.0022
Humerus Proximal Diaphysis Cortical Bone Density	1025 HU	134 HU	No	> 0.1



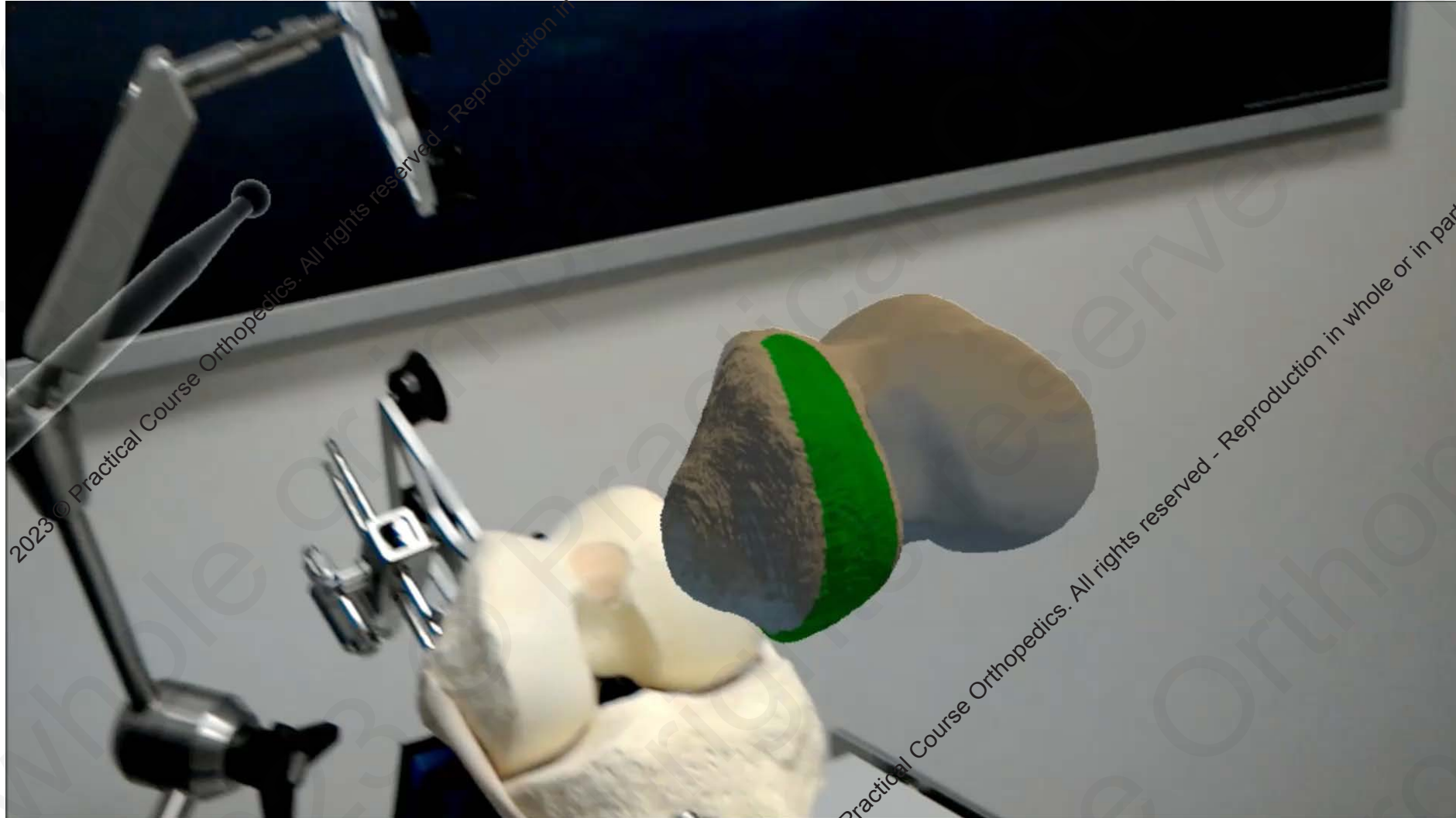
Machine Vision



Spatial Computing & Mixed Reality



Robotics and Mixed Reality (XR)



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Downward cameras

IR illuminators

Side cameras

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Generative AI



 OpenAI  Microsoft

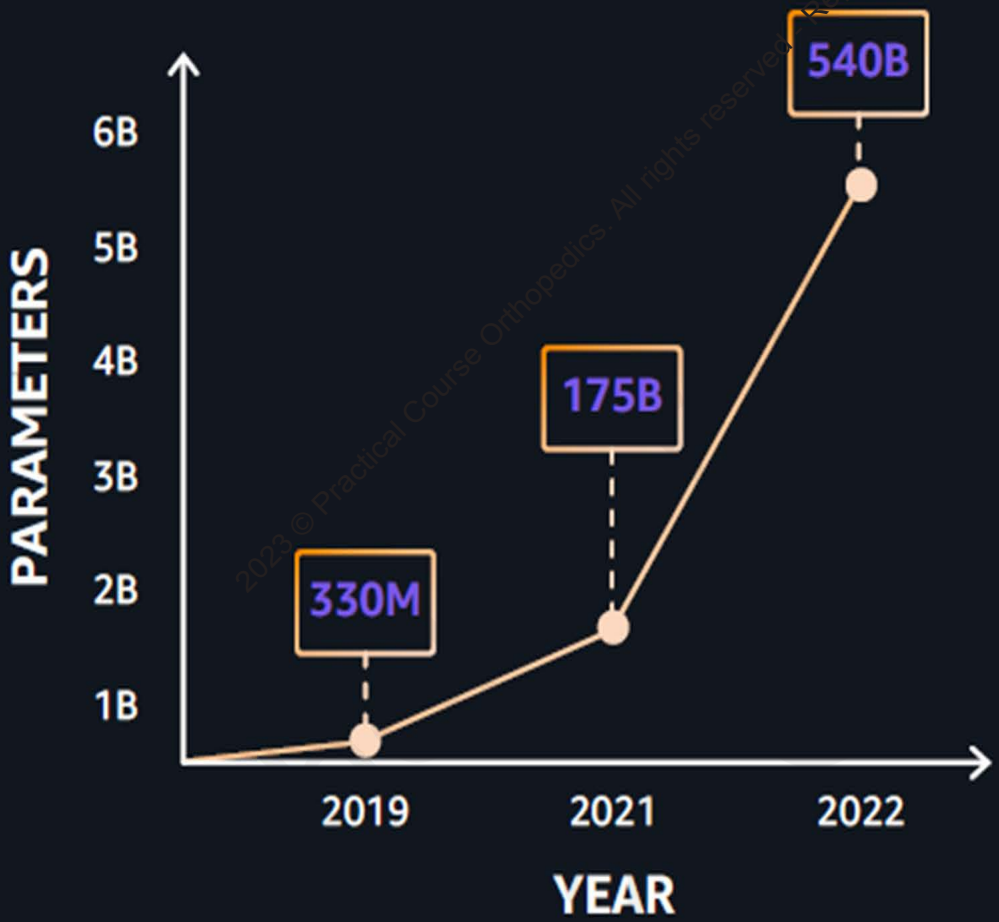
INTRODUCING



GPT 4



The Rise of Foundational Models



2019–2022

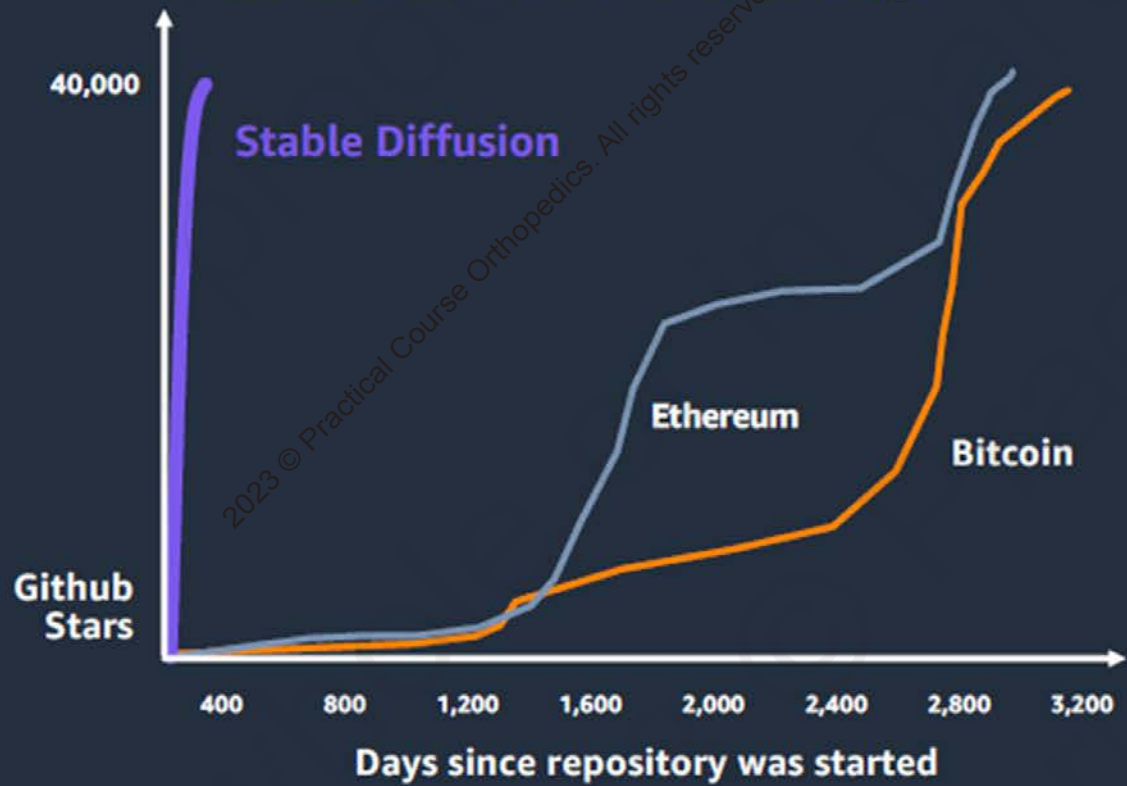
1,600x

increase in size of model
as measured by number
of parameters

Generative AI is the fastest growing trend in AI

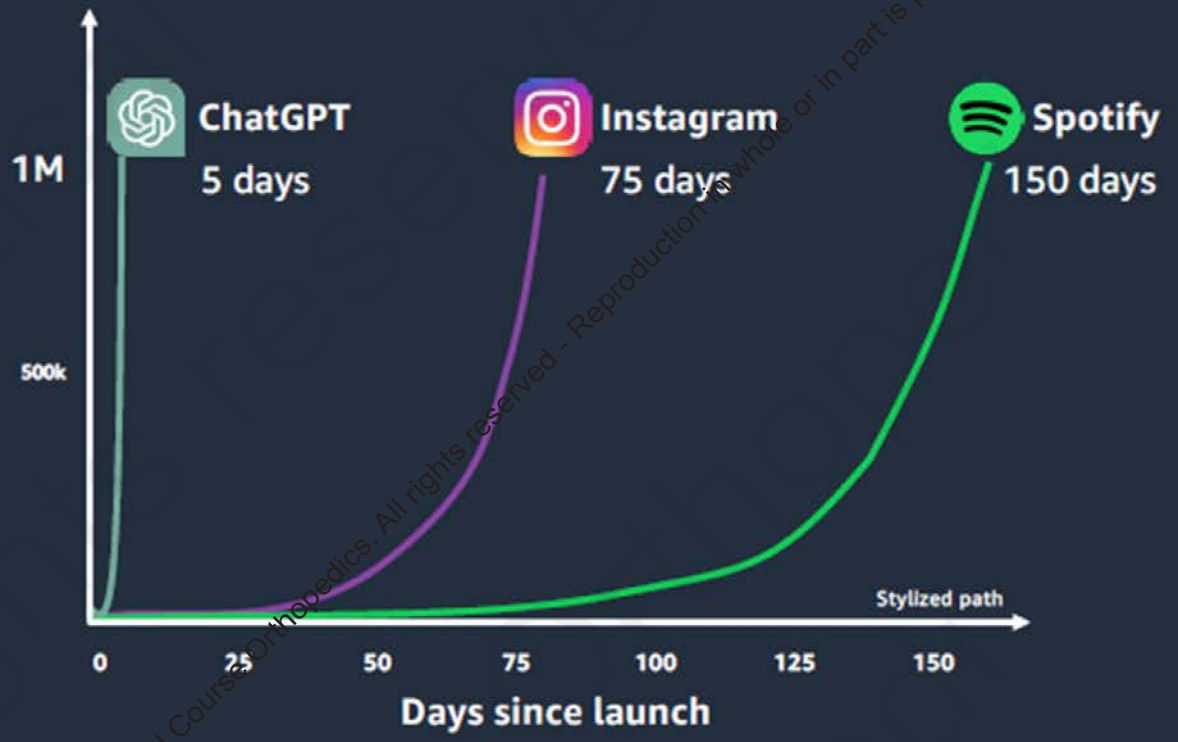
Developer adoption

Stable Diffusion accumulated 40k stars on GitHub in its first 90 days



Consumer adoption

ChatGPT reached the 1 million users mark in just 5 days



Q&A

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Publicly available

stability.ai



Models

Text2Image
Upscaling

Tasks

Generate photo-realistic images from text input
Improve quality of generated images

Features

Fine-tuning on SD 2.1 model

Models

AlexaTM 203

Tasks

Machine translation
Question answering
Summarization
Annotation
Data generation

Models

Flan T-5 models (8 variants)
DistilGPT2, GPT2
Bloom models (3 variants)

Tasks

Machine translation
Question answering
Summarization
Annotation
Data generation

Proprietary models

co:here

Light

AI21labs

Models

Cohere
generate-med

Tasks

Text generation
Information extraction
Question answering
Summarization

Models

Lyra-Fr 10B

Tasks

Text generation
Keyword extraction
Information extraction
Question answering
Summarization
Sentiment analysis
Classification

Models

Jurassic-1 Grande 17B

Tasks

Text generation
Long-form generation
Summarization
Paraphrasing
Chat
Information extraction
Question answering
Classification