دانشگاه علوم پزشکی و خدمات بهداشتی، درمانی ایران

Artificial Intelligence in Internal Medicine

دکتر نسیبه رادی راز

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بسم الله الرحمن الرحیم

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عنوان دوره آنلاین:

هوش مصنوعی در پزشکی با رویکرد بالینی

Online Course: Artificial Intelligence in Medicine with Clinical Approach

Course Topics	عناوین بیست و چهار جلسه	تاریخ جلسات
Artificial Intelligence (AI) in medicine	معرفی هوش مصنوعی در پزشکی	۲۸ بهمن ۱۴۰۲
AI and Fuzzy systems and its applications in medicine	هوش مصنوعی و سیستم های فازی در پزشکی	۵ اسفند ۱۴۰۲
Machine Learning and its applications in medicine	یادگیری ماشین و کاربردهای آن در پزشکی	۱۲اسفند۱۴۰۲
Evolutionary systems and its applications in medicine	الگوریتم های بهینه سازی تکاملی و کاربردهای آن در پزشکی	۱۹اسفند ۱۴۰۲
Neural networks and deep neural networks in medicine	شبکه های عصبی و شبکه های عصبی عمیق در پزشکی	۲۵فروردین ۱۴۰۳
Application of AI in Early Detection of Disease	کاربرد هوش مصنوعی در تشخیص زودهنگام بیماری ها	۱ اردیبهشت ۱۴۰۳
Swarm Intelligence and multi-agent/swarm in medicine	هوش ازدحامی، سیستم های چند عامله/ازدحامی در پزشکی	۸اردیبهشت ۱۴۰۳
Application of AI in Cancer	کاربردهای هوش مصنوعی در سرطان	۲۲اردیبهشت ۱۴۰۳
Application of AI in surgery	کاربردهای هوش مصنوعی در جراحی	۲۹ اردیبهشت ۱۴۰۳
Applications of AI in Neurology	کاربردهای هوش مصنوعی در مغز و اعصاب	۵ خرداد ۱۴۰۳
Application of AI in Internal Medicine	کاربردهای هوش مصنوعی در پزشکی داخلی	۱۲ خرداد ۱۴۰۳
Applications of AI in cardiovascular	کاربردهای هوش مصنوعی در قلب و عروق	۱۹ خرداد ۱۴۰۳
Applications of AI in Breast Disease	کاربردهای هوش مصنوعی در بیماری های پستان	۲۶ خرداد ۱۴۰۳
Application of AI in Ophthalmology	کاربردهای هوش مصنوعی در چشم پزشکی	۲ تیر ۱۴۰۳
Application of AI in Nephrology	کاربردهای هوش مصنوعی در نفرولوژی	۹ تیر ۱۴۰۳
Application of AI in Otorhinolaryngology	کاربردهای هوش مصنوعی در گوش و حلق و بینی	۱۶ تیر ۱۴۰۳
Application of AI in Gynecology and obstetrics	کاربردهای هوش مصنوعی در زنان و مامایی	۲۳ تیر ۱۴۰۳
Application of AI in pediatric medicine	کاربردهای هوش مصنوعی در پزشکی اطفال	۳۰ تیر ۱۴۰۳
Application of AI in anesthesia	کاربردهای هوش مصنوعی در بیهوشی	۶ مرداد ۱۴۰۳
Application of AI in emergency medicine	کاربردهای هوش مصنوعی در پزشکی اورژانس	۱۳ مرداد ۱۴۰۳
Applications of artificial intelligence in orthopedics	کاربردهای هوش مصنوعی در ارتوپدی	۲۰ مرداد ۱۴۰۳
Application of AI in pain management	کاربردهای هوش مصنوعی در مدیریت درد	۲۷ مرداد ۱۴۰۳
Application of AI in pharmacology	کاربردهای هوش مصنوعی در داروسازی	۳ شهریور ۱۴۰۳
Application of AI in dentistry	کاربردهای هوش مصنوعی در دندان پزشکی	۱۰ شهریور ۱۴۰۳

Internal Medicine

internal medicine doctors focused on the “inner”” diseases instead of the external manifestations of those diseases.

AI Tools

Machine Learning
Deep Neural Network
Generative AI
Optimization
Fuzzy system and control
Swarm Intelligence
Distributed Artificial Intelligence
Image Processing
Data-driven models
Decision-making
pattern recognition
Signal Processing
Speech Processing
Natural Language Processing

Diabetes

Nature Medicine **volume 30**, pages584–594 (2024)

Diabetes Managment

International Journal of Obesity **volume 47**, pages1179–1199 (2023)

Angiology

Radiomics
Deep learning-based coronary tree extraction
Clinical or patient data
A-line classification
OCT
Precision phenotyping
Multimodal learning
Longitudinal representation
Automated grading of stenosis severity
Plaque detection and component segmentation
Automated prediction of myocardial infarction
Automated plaque segmentation in OCT
CT
Non-invasive plaque quantification
Invasive plaque quantification
Calcified plaque assessment in non-contrast CT
Risk stratification
Invasive plaque quantification
Coronary calcium scoring
Automated CAD-RADS categorization
CAD-RAD 0
CAD-RAD 1
CAD-RAD 2
CAD-RAD 3
CAD-RAD 4
CAD-RAD
PET or CT plaque assessment
Automated plaque segmentation in IVUS
PET or CT
IVUS

Cardiology

Adopting Artificial Intelligence in Cardiovascular Medicine: A Scoping Review

High cholesterol

Performance and clinical utility of supervised machine-learning approaches in detecting familial hypercholesterolaemia in primary care

npj Digital Medicine **volume 3**, Article number: 142 (2020)

High blood pressure

Future possibilities for artificial intelligence in the practical management of hypertension
Hypertension Research **volume 43**, pages1327–1337 (2020)

Sinus infections

npj Digital Medicine **volume 5**, Article number: 115 (2022)

Allergies

Many gaps remain to be addressed for adoption of AI
Diagnosis and Phenotyping
Asthma, Atopic dermatitis
Predicting Health Trajectories
Atopic disease development, Outgrowth of disease
Assessment of Tolerance
Antibiotic or Food allergen tolerance
Drug Discovery and Vaccinology
Drug target identification, Immune response tracking
Practice Management
Operations
Laborious tasks
Population and Environmental Health
Safety monitoring, Exposure and allergen tracking
Remote Monitoring
Wearables, Smart inhalers
Research and Clinical Trials
Decentralized trials, Digital twins
Applications of AI to Allergy Immunology

Endocrinology

Machine intelligence in non-invasive endocrine cancer diagnostics
Nature Reviews Endocrinology **volume 18**, pages81–95 (2022)

Neurology

has PD, and assesses the severity

Nature Medicine **volume 28**, pages2207–2215 (2022

Nephrology

Novel specific end points for clinical trials

Assessment of drug kinetics for optimized dosing and delivery

Companion diagnostic approach to improve patient stratification and therapy management

Patient outcome prediction, and monitoring of treatment responses and disease progression for improved patient care

Hematology

Communications Medicine **volume 2**, Article number: 45 (2022)

Hepatology

Integration of multimodal data

Hospital Medicine

Oncology

Tumor diagnosis
Microscope-based research
Image-based research
Tumor screening and early detection
Tumor prognosis
Survival
Time
AI
Tumor staging and grading
Tumor clinical decision
New therapeutic targets
Drug design
Ub
Tumor therapy

Neonatology

Journal of Perinatology **volume 42**, pages1561–1575 (2022)

Pediatrics

The potential for AI in Medicine
VIEWS OF CHILDREN AND YOUNG PEOPLE WITH LIVED EXPERIENCES OF HEALTHCARE
D R I V E
Findings from a one-hour design workshop attended by 21 members of the Young Persons Advisory Group at Great Ormond Street Hospital for Children
a
What matters to Children and Young people?
Fair access
Safety
Intent
Reliability
Ethics
Governance
Jobs market
Human centredness
Emotions
Compassion
Control
Education
Trust
b
What do Children and Young People want to know more about?
"What safety measures are in place?"
"Will AI make the decision or be the advisor to the doctor?"
"Will doctors need to be less qualified if the use of AI is normalised?"
"What happens if the robot makes a mistake?"
"Is a chatbot actually more beneficial to patients?"
"What will stop people abusing the system?"
"How will bad news be broken to patients?"
"How do you teach AI to be empathetic and understand pain?"
c
How comfortable do Children and Young People feel about potential AI-driven scenarios?
Not Comfortable
Comfortable
Virtual reality visits
Cleaning robots
Talking robots
Robot surgery
Chatbot diagnoses
Self driving vehicles
AI powered nurses
3D printed hearts
Sensor technology to reduce overcrowding
d
How can healthcare staff communicate effectively about the potential for AI?
"Examples in everyday life"
"Show positive benefits"
"Set up workshops to bond trust"
"Address common worries"
"Helping humanity (with AI)"
"Be transparent when it is already being used"

Pulmonology

Rheumatology

Bone density screenings

Echocardiograms

Gastroenterology

Liver Diseases *⇒Section 10*
- Detection by ultrasonography, CT, MRI
  HCC, hemangioma, metastasis, cyst, FNH
- Risk analysis and outcome prediction
  NAFLD, viral hepatitis, PSC, liver transplantation

Pancreas Diseases *⇒Section 11*
- Detection by CT and/or EUS
  Pancreatic cancer
- Diagnosis by EUS
  IPMN, AIP
- Risk analysis
  Pancreatic cancer

Colon Cancer and Polyp *⇒Section 7*
- Detection/diagnosis by endoscopy
  Colon cancer and adenoma
- Detection by VCE
  Colon polyp

IBS *⇒Section 9*
- Data analysis
  Trigger foods, gut microbiota

Pharyngeal Cancer *⇒Section 3*
- Detection by endoscopy with white-light image and NBI

Upper GI Diseases *⇒Section 4*
- Detection by endoscopy
  Esophageal cancer
  Gastric cancer
  H. pylori atrophic gastritis
  Quality control
- Risk analysis
  Upper GI bleeding

GIST *⇒Section 5*
- Diagnosis by EUS

Duodenal and Small Intestinal Lesions *⇒Section 6*
- Detection by endoscopy or VCE
  Adenoma, bleeding, blood content, vascular lesion, erosion, ulcer, etc.

IBD *⇒Section 8*
- Detection by endoscopy
- Severity scoring by endoscopy
- Prognosis prediction by data analysis

Infectious diseases

Sports Medicine

Injury Prevention

- **Predicting the risk of injury durng the training phase**:
  - Skazalski et al. 2018 - Prediction of physical injury
  - Chen et al. 2018 - Heat-stroke detection
  - Lewis 2018 - Fatigue and injury risk in basketball
  - Karnuta et al. 2020 - injury prediction base on age, performance and injury history

Pre-performance Optimisation

- **Identifying patterns in athletic performance:**
  - Novatchkov et al. 2013- monitor force, displacement and velocity during resistance training
  - Ghasemzadeh et al. 2009 - analysis of hand-wrist movements in golf
  - Claudino et al. 2019 - risk assessment

Matchday Optimisation

- **Optimising matchway performance:**
  - Lui 2020 - AI in basketball games
  - Li and Zu 2021 - AI in basketball
  - Ghazemzadeh et al. 2011 - Analysis of baseball swings

Post-Injury Diagnosis

- **Monitoring for major aberration indicating injury/disease:**
  - Panindre et al. 2020 - monitoring for Atrial Fibrillation
  - Jahfari et al. 2022 - assessment of cardiovascular outcomes
  - Galloway et al. 2018 - monitoring for hyperkalaemia
  - Choi et al. 2017 - detection of heart failure onset
  - Coutts et al. 2020 - general and mental health
  - Karlsson et al. 2012 - assessment of cardiac rhythm

Rehabilitation

- **Improving patient experience:**
  - Bloomfield et al. 2019 - analysis of data post-total knee arthoplasty
  - Nwachukwu et al. 2020 - impact of mood disorders and preoperative outcome scores on perioperative rehabilitation

Intensive care Medicine

a)

b)

Geriatrics

Cloud data center
Fog nodes
Edge nodes
Patient monitoring with IoT devices
Environment
Action
A_t
Reward
S_{t+1} R_t
R_{t+1}
State
S_t
Agent
Reinforcement learning
Machine learning
Local model 1
Local model 2
Local model 3
Global model
Federated learning
Predict vital signs
Classify physical activities

Monitoring

Headbands
Earrings
Skin patches
Belts
Body sensors
Socks
Glasses
Necklaces
Rings
Bracelets
Clothing fabric
Shoes
Shoe insoles

Stress test

Daily activities
embedded with stressors
Wearable
sensors
Interactive stressor
evaluation
Smart personal
assistant
Continuous stress
marker monitoring
with wearables
MONDAY
TUESDAY
Personalized
archive

Challenges and Ethical Considerations

data privacy,

potential biases in datasets

interpretability of algorithms,

Note that!!

- AI may not replace human doctors.
- Since doctors are trained to not only diagnose and treat diseases but also to provide emotional support to patients.
- AI cannot replace the empathy and compassion that doctors bring to their work.

8-AI Medical Application

Prevention	Screening
Early Detection	Diagnosis
Recurrence Prediction	Critical Decision Making
Treatment Selection and Analysis	Mortality and Morbidity Prediction
Triage	…

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Research Interest:

Artificial Intelligence, Artificial Intelligence in Medicine, Complex Systems, Biomimicry, Cognitive Science, Swarm Intelligence, Nanomedicine, Targeted Drug Delivery, Early Detection of Disease, Swarm Nano Robotics, Cancer Research, Fuzzy Logic and Control, Soft Computing, Neural Networks, Machine Learning, Multi-agent Systems, Distributed Decision Making, Biomarkers, Biophysics, Nature Inspired Algorithms, Computational Cellular/Molecular Biology, Protein Folding

Artificial Intelligence for Good (AI for Good)