Physician-Centered Explainable AI

Weina Jin, MD
PhD Student
Medical Imaging Analysis Lab
School of Computing Science
Simon Fraser University
Problems during Physician-AI Collaboration

**When radiologists are using AI**
Hi AI, give me a second opinion on this patient.
I predict the diagnosis is pneumonia.
Why? I think it’s tumor.
emm……

**When surgeons are using AI**
AI, what do you think of the case?
I predict this is a grade II tumor.
Can you justify it? I’ll need to put it in the medical record and discuss with my colleagues.
well, it’s hard to tell…

**When pathologists are using AI**
I recognize this is adenocarcinoma.
How do I know whether to trust you?

**When ophthalmologists are using AI**
I suspect the diagnosis of proliferative diabetic retinopathy.
Then tell me, is microaneurysms on the image a sign of the grading?
Sorry I’m still learning…

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Problems during Physician-AI Collaboration

Explanations can facilitate physician-AI collaboration by:

- **Resolve doctors’ disagreement with AI**
  
  *When radiologists are using AI*
  
  Hi AI, give me a second opinion on this patient. I predict the diagnosis is pneumonia. Why? I think it’s tumor.
  
  *When surgeons are using AI*
  
  Al, what do you think of the case? I predict this is a grade II tumor. Can you justify it? I’ll need to put it in the medical record and discuss with my colleagues.
  
  *When pathologists are using AI*
  
  I recognize this is adenocarcinoma. How do I know whether to trust you?
  
  *When ophthalmologists are using AI*
  
  I suspect the diagnosis of proliferative diabetic retinopathy. Sorry, I’m still learning...

- **Verify AI’s suggestion**

- **Calibrate doctors’ trust**

- **Learning & Medical knowledge discovery**
Explaining AI’s decision is a necessity for clinical deployment of AI

Input MRI

AI

Al’s suggestion: Grade 4 glioblastoma
Explaining AI’s decision is a necessity for clinical deployment of AI
Engineer-Centered $\rightarrow$ Physician-Centered Explainable AI Paradigm

Evaluation

Problem formulation

Engineer-Centered AI Development Cycle

Explainable AI Design
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Engineer-Centered  →  Physician-Centered Explainable AI Paradigm
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**Engineer-Centered → Physician-Centered**

**Explainable AI Paradigm**

**Research Question**

Doctor + AI > Doctor

http://weina.me/one-map-not-fit-all

**Evaluation**

Human-Centered Design, Bring in physician perspective

**Problem formulation**

EUCA

http://weina.me/end-user-xai/

**Explainable AI Design**

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EUCA: the End-User-Centered Explainable AI Prototyping Framework.

arXiv:2107.05047

http://weina.me/end-user-xai/
Clinical Requirement-Grounded, Systematic Evaluation on Explainable AI

Evaluating Explainable AI on Multi-Modal Medical Imaging Task: Can Existing Algorithms Fulfill Clinical Requirements?

arXiv:2107.05047
http://weina.me/one-map-not-fit-all
Clinical Utility Evaluation of Explainable AI

Research Question

Doctor + AI > Doctor

Assessing the Clinical Utility of AI and its Explanation on a Brain Tumor Classification Task

http://weina.me/brain-ai
Why does AI arrive at this decision?

That makes sense! I want to use your technique on my MRI data.

Because the saliency map shows the important regions for AI's prediction.

Np. Oh, wait... how can I generate one heatmap for 4 MRI modalities?
The image you uploaded:

Your input image is recognized as:

- Pleural Effusion: Likelihood 95%
- Cardiomegaly: Likelihood 70%
- Edema: Likelihood 55%

The three most likely findings of your input image, and their percentage in the training dataset where AI learns from:

- Pleural Effusion: Likelihood 66%, Percentage of label in training data (n = 100,000): 25%
- Cardiomegaly: Likelihood 35%, Percentage of label in training data (n = 100,000): 12%
- Edema: Likelihood 12%, Percentage of label in training data (n = 100,000): 24%

Overall performance of the AI recognition tool:

- Accuracy: 92%, Error rate: 8%
- Sensitivity: 0.95
- Specificity: 0.82
- AUC: 0.89

Important features to the prediction of Pleural Effusion:

- High density of left lung base
- High density of right lung base
- Heart size

Important regions (highlighted) for AI’s recognition:

- If opacity is at lung base, and costophrenic angle is blunting. Then the CXR is recognized as Pleural effusion.
- If opacity is at upper or middle lung, and margin is regular. Then the CXR is recognized as Consolidate.

Important regions for AI’s recognition:

- Normal
- highlight distinguishable regions
- Pleural effusion
  - Normal >> progressive transition >> Pleural effusion
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