DeepMind and Beyond:

Using Machine Learning to teach an Artificial Intelligence anatomy for medical education

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1. Introduction

In the COVID-19 era of distance learning, Artificial Intelligence (AI) agents conversing through dialogue systems offer a way to capture an important pedagogy; the **individual student-teacher discussion**. In order to achieve this, the first step is training the AI on the subject matter to be discussed.

Customising open-source AI tools from Google's DeepMind, we attempted to answer the **research question** - *"Can we train an AI to discuss human anatomy via Machine Learning?"*

2. Methods

- To develop our Artificial Intelligence Support System (AISS) Anatomy Bot, we created **a web application** and used multiple different modules to relay prompts and responses in order to build a controlled yet smart chatbot. Models used in the AISS bot includes BERT with a question-answering head pre-trained with SQUAD2.0 dataset, an open source tool.
- We constructed a **customised training database** of anatomical information linked to the UK Anatomy Syllabus for Medical Graduates (Smith et al 2016) and trained our AI agent using Machine Learning in Microsoft's Azure ML environment.
- A subset of the research team **including students** independently formulated questioned to pose to the AI and typed them via a dialogue interface in our app.
- The AI gave an answer with an associated confidence value, and these were reviewed by a **separate panel of experienced anatomy teachers**.

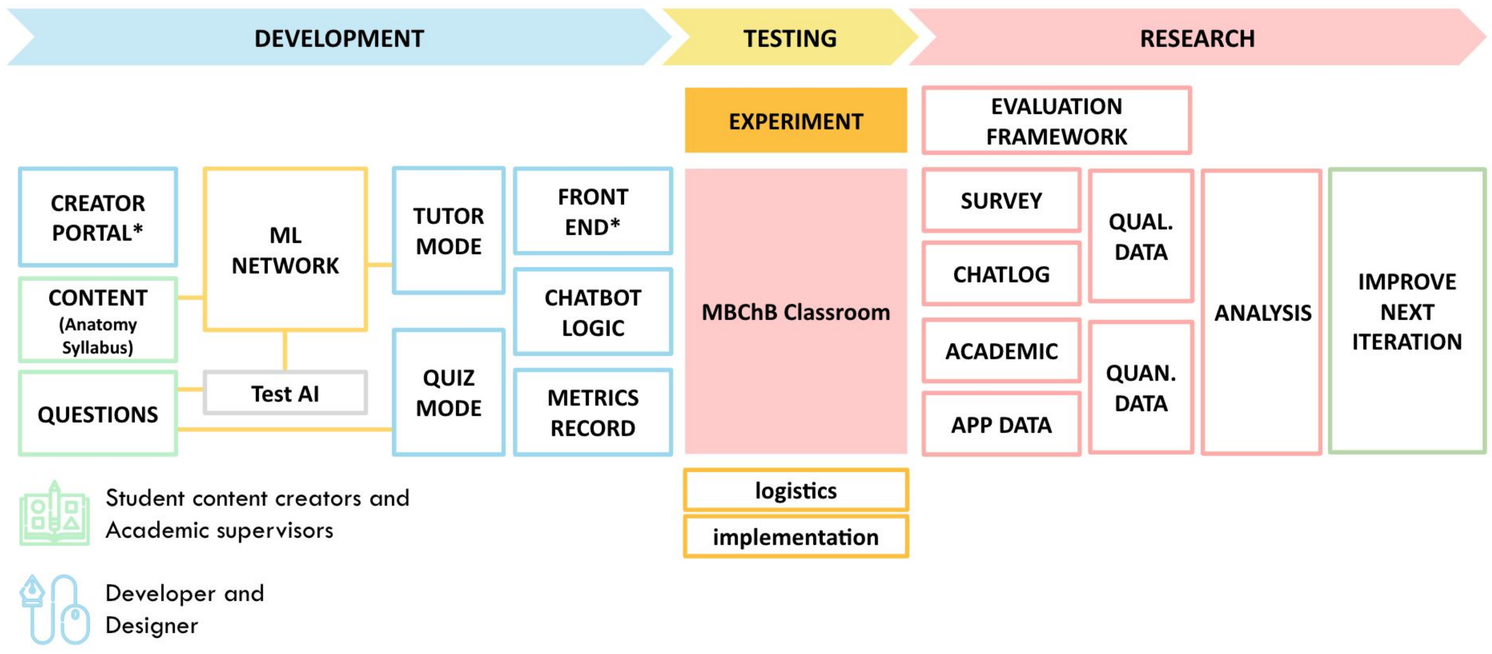

Fig 1: The research and development pipeline of AISS Bot development and evaluation

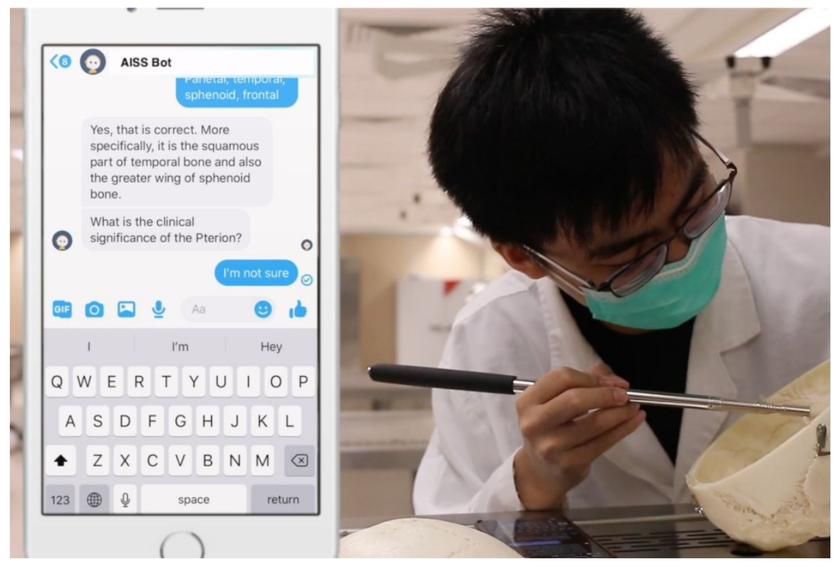

Fig 2.. Snapshot of the AISS Bot user interface

3. Results

The confidence values ranged from 0.56 to 0.70, indicating the degree to which the algorithm thinks its answer is correct. All of the questions were assessed to have been answered correctly by the anatomy teaching panel (N=15/15, 100%), **despite no explicit programming of questions or answers**.

<u>Example Q&A Dialogue:</u>

Student: What is epigastric vessel lateral to?
AISS BOT:: The deep ring of the inguinal canal.
Student: What's the use of the mid-point of the inguinal ligament?
AISS BOT:: It identifies the opening of the inguinal canal.
Student: What is the clinical significance of the inguinal canal then?
AISS BOT:: It can form potential weakness in abdominal wall and act as hernia sites.

4. Discussion & Conclusion

- For any digital learning application to be successful, it must **accurately understand the questions** posed to it by students.
- Mobile-based applications, courseware or learning games can be effective but are **limited** by the ability of the designers to **predict dialogue** or **give a limited pool of options** for students to select.
- **Truly intelligent AI agents** like ours have the potential to change this completely. This pilot study has demonstrated the ability to train a conversational agent which was able to handle questions of the type seen everyday teaching.
- **Unexpected questions**, simple spelling and grammatical errors posed no issue for the AI, as they do in non-intelligent systems.
- There are limitations to this study which is a work in progress, including the training of the AI against a limited amount of information and a relatively small subset of questions.
- Ongoing work is aimed at broadening of the scope of anatomy database upon which the AI has been trained, and **engaging real students in using the AI for learning**.

AISS
Artificial Intelligence Support System

This work is kindly supported by a
Teaching Development and Language Enhancement Grant

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香港中文大學醫學院
Faculty of Medicine
The Chinese University of Hong Kong