NHERI
Natural Hazards Engineering Research Infrastructure

Dot Product
2023 NHERI REU Design Safe at UT Austin

Summary – Explain dot product and relate it to a real-life example of ChatGPT.

Engineering Connection – Dot product is a mathematical operation that is relevant in many physics and engineering courses. Dot product is related to AI models such as ChatGPT.

Audience – High school (grades 9-12)

Lesson Objectives – Students will learn what a dot product is and how to dot product two vectors and finally understand how one part of ChatGPT works.

Educational Standards – "fluency with algebra and trigonometry and extends their ability to make connections and apply concepts and procedures at higher levels." 111.42 Texas Essential Knowledge and Skills for Mathematics

Material List – Projector, Khan Academy/ trustworthy online learning resource, example problems/ worksheet

Introduction – How does ChatGPT work? When you ask it a question, how does it return you with an answer? Well, in one part of the process, ChatGPT can use dot product to find an answer. What is a dot product? Dot product is an operation that takes two vectors and finds the similarity between those two vectors. Dot product is not just used in ChatGPT but in many engineering applications when we want to figure out how much tow vectors line up.

Procedure – Instruct students to learn dot product using Khan Academy with videos and example problems.

- **Background knowledge**: Basic trigonometry, vectors, recognition of what ChatGPT is.
- **Before the activity**: Have students play around with ChatGPT.
- **During the activity**: Have students watch dot product videos on Khan Academy. Explain how information and data trained on ChatGPT turns into a vector while a user's question turns into another vector and how ChatGPT algorithm performs a dot product to find the most relevant/ similar data to answer.
- **After the activity**: Check for understanding after watching the video and open room for questions and discussions.

Assessment – Students should be able to find the dot product between two vectors and explain how it is used in ChatGPT.

Wrap up – Use ChatGPT to explain dot product and ask it for example problems to practice more of the technical calculations to wrap everything up. This interactive activity will increase retention.