CSPB 2820 - Truong - Linear Algebra with Computer Science Applications

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Started on	Wednesday, 13 September 2023, 3:08 PM
State	Finished
Completed on	Wednesday, 13 September 2023, 4:14 PM
Time taken	1 hour 6 mins
Grade	Not yet graded

Question **1**

Correct

Mark 1.00 out of 1.00

Let $\mathbf{a} = (6, 4)$. Find a vector $\mathbf{b} \neq \mathbf{0}$ such that it is perpendicular to $\mathbf{a}$.

$\mathbf{b} = \left(\boxed{2} , \boxed{-3} \right)$

Your last answer was interpreted as follows: 2

Your last answer was interpreted as follows: -3

Your answers are correct!Vastauksesi on oikein!
Marks for this submission: 1.00/1.00.

Worked solution:
Two vectors are said to be perpendicular to each other when their dot product is zero. If $\mathbf{a} = (6, 4)$ then for example the vector $\mathbf{b} = (4, -6)$ is perpendicular to $\mathbf{a}$: $\mathbf{a} \cdot \mathbf{b} = 6 \cdot 4 + 4 \cdot (-6) = 0$.

Vector $\mathbf{0}$ is said to be perpendicular to all other vectors

Question **2**

Correct

Mark 1.00 out of 1.00

Let $\mathbf{u} = (3,6)$, $\mathbf{v} = (6,5)$. Denote the angle between the vectors as θ. Now calculate the exact value of the dot product of $\mathbf{u}$ and $\mathbf{v}$ as well as the angle θ. Input the angle as radians rounded to 3 decimal places. In python with numpy, you can use numpy.arccos.

$\mathbf{u} \cdot \mathbf{v} =$ | 48 | Your last answer was interpreted as follows: 48

$\theta =$ | 0.412 | Your last answer was interpreted as follows: 0.412

> Your answers are correct!
>
> Your answers are correct!
> Marks for this submission: 0.50/0.50.
>
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> Marks for this submission: 0.50/0.50.
>
>
> **Worked solution:**
> The dot product of two vectors $\mathbf{u} = (u_1, u_2)$ and $\mathbf{v} = (v_1, v_2)$ is $\mathbf{u} \cdot \mathbf{v} = u_1 v_1 + u_2 v_2$ so the dot product between the given vectors $\mathbf{u} = (3,6)$ and $\mathbf{v} = (6,5)$ can be calculated as $\mathbf{u} \cdot \mathbf{v} = 3 \cdot 6 + 6 \cdot 5 = 48$. If we denote the angle between the vectors as θ we may write $\mathbf{u} \cdot \mathbf{v} = |\mathbf{u}| \, |\mathbf{v}| \cos\theta$ and solve for the angle: $\theta = \cos^{-1}\frac{\mathbf{u}\cdot\mathbf{v}}{|\mathbf{u}|\,|\mathbf{v}|}$. Now $|\mathbf{u}| = \sqrt{3^2 + 6^2} = 3 \cdot \sqrt{5}$, and $|\mathbf{v}| = \sqrt{6^2 + 5^2} = \sqrt{61}$, so $\theta = \cos^{-1}\frac{48}{3\cdot\sqrt{5}\cdot\sqrt{61}} \approx 0.412$ (rad).
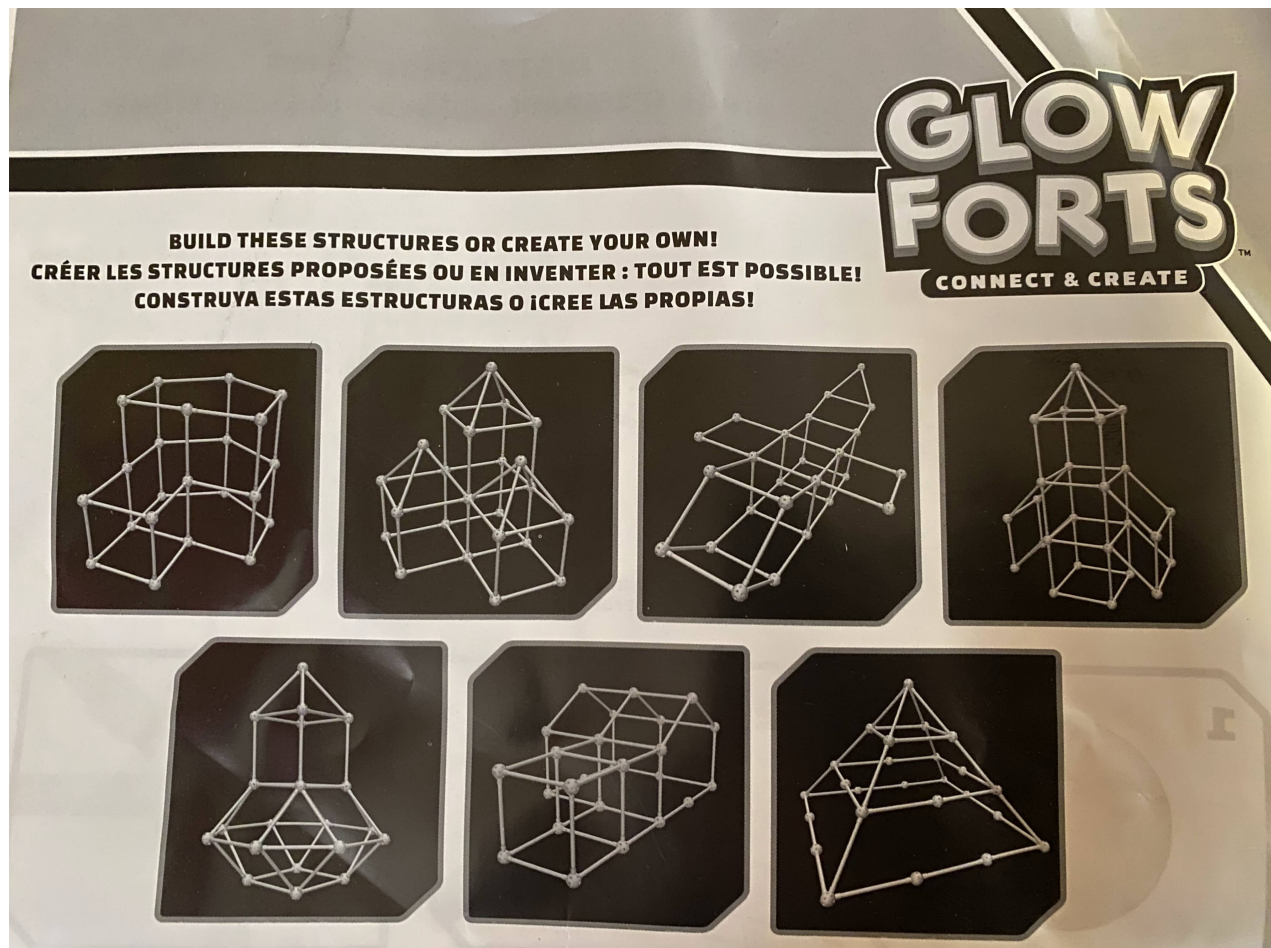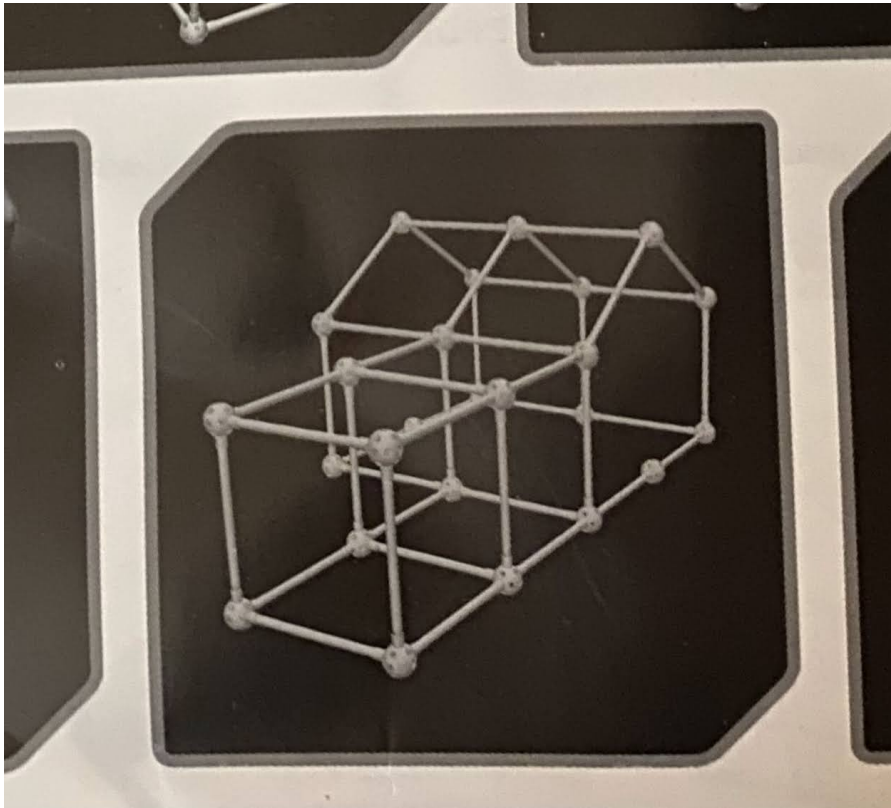
Question **3**

Complete

Marked out of 1.00

The triangle inequality has practical implications.

Consider this child toy, **all of the lengths of this building toy are identical**. Use the triangle inequality informally to identify which fort cannot actually be made.

Explain.

The triangle inequality essentially states that the sum of any two lengths of the sides of the triangle must be greater than or equal to that of the remaining side's length.

In order for a for to not be able to be constructed, the sum of the lengths of two sides of a given triangle must be less than that of the remaining sides length.

Using the above logic, any fort that encompasses an equilateral triangle is fort that can be constructed using the triangle inequality. The for that cannot be constructed is one that has a triangle in the fort that invalidates the triangle inequality. From observing the forts, the one that invalidates the triangle inequality is the for that is in the one that can be found in the image below all of the forts.

This is because when checking for if all combinations of the sides of the triangle, there is a combination of sides that will invalidate the triangle inequality.

The highlight "House" shape cannot be built.

The roof bar are at an angle and can form a triangle (imagine a line across) - with the base the length of the "floor" piece which is made of 2 bars.

Since all of the pieces are same length, no roof can be formed since the shorter sides added together are equal to the base which is 2 bars long. By the triangle inequality this cannot be made.

We see the same issue in the top left image.

Question **4**

Complete

Marked out of 1.00

Review the Python Companion - Chapter 3 try out one or more of the code functions.

Make a **simple** activity with a related multiple choice question related to one of the functions in the 3 that could be added as a quiz question.

Add your activity and multiple choice question in the essay section below.

Be sure to include some wrong answers.

(If you have an idea for a more complex or involved activity or project, please email me. For this question, please keep it simple)

Question:

You are given two two dimensional vectors (assume all necessary modules have been loaded in this file) in the following Python file:

a = np.array[1,2]

b = np.array[3,4]

Defining 'ang' as the function that will calculate the angle between these vectors, what syntax for this function is correct?

Answers:

(a) - ang = lambda x,y : np.arccos(x @ y / (np.linalg.norm(x)*np.linalg.norm(y))

(b) - ang = x,y : np.arccos(x @ y / (np.linalg.norm(x)*np.linalg.norm(y))

(c) - ang = lambda x,y : arccos(x @ y / (linalg.norm(x)*linalg.norm(y))

(d) - ang = lambda x,y : arccos(x[1] * y[1] / (linalg.norm(x)*linalg.norm(y))

(e) - None of the above