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The calculator below calculates the angle between two vectors. Simply enter the components of each vector in the form of To find the angle between two vectors: Find the dot product of the two vectors and divide it by the magnitude of each vector. Take the inverse cosine of this value to obtain the angle. For example, find the angle between and . Step 1. Find the dot product of the two vectors To find the dot product of two vectors, multiply the corresponding components together and add them up. The dot product of two 2D vectors and is found using . For vectors and , the dot product . Therefore Step 2. Divide this by the magnitude of the first vector To calculate the magnitude of a vector, use Pythagoras’ Theorem with the x and y components of the vector. The magnitude of any vector is found as follows: . The magnitude of the vector is hence . This becomes which is . The magnitude of the first vector, a is . We divide the dot product previously calculated by this magnitude. We get Step 3. Divide this by the magnitude of the second vector The magnitude of the second vector, b is found with . For the vector , the magnitude is . This becomes which is . We divide the previous result by this magnitude to get Step 4. Take the inverse cosine of this result The formula to find the angle between two vectors is . This can be rearranged for by taking the inverse of cosine on both sides of the equation. The angle between two vectors is . As previously calculated: Using a calculator we enter, . This gives us the angle between the two vectors as . ==========cosθ = (x1x2 + y1y2 + z1z2)/|a||b|. The formula for the angle between two vectors is given by cosθ = (x1x2 + y1y2 + z1z2)/|a||b|. If x1x2+ y1y2+ z1z2 = 0, then cosθ=0 and θ=90°. Therefore if the dot product of two vectors is zero, the angle between the two vectors will always result in 90°. For example, show that (3,-4,1)·(8,6,5)=0 and therefore (3,-4,1) and (8,6,5) are perpendicular. If two vectors are perpendicular, this means that they meet at right angles. ========== Hanna Pamuła's Academic Background Hanna Pamuła holds a doctoral degree in Bioacoustics / Mechanical Engineering from the AGH University of Science and Technology. She has also worked on research projects in France and the UK, presenting her findings at various international conferences. When not working, Hanna enjoys photography and graphic design, often incorporating these skills into her personal life. Omni Calculator Team Bogna Szyk is the chief operating officer at Omni Calculator, where she ensures everything runs smoothly and ideas move forward. With a background in civil engineering, Bogna brings structure and strategy to every aspect of her work. In her free time, she enjoys dancing zouk and creating intricate D&D campaign storylines. Calculator for Finding Angles Between Vectors The calculator on this page can help you find the angle between two vectors in both 2D and 3D spaces. The formulas for calculating these angles are provided below. ========== The final formula for calculating the angle between two vectors in a 2D space is analogous to its 2D counterpart. The formula is given by: angle = arccos(((x2−x1)(x4−x3)+(y2−y1)(y4−y3)+(z2−z1)(z4−z3))/((x2−x1)2+(y2−y1)2+(z2−z1)2·(x4−x3)2+(y4−y3)2+(z4−z3)2)) This formula can be understood by breaking it down into smaller components. The first step is to calculate the dot product of two vectors, which is defined as the product of their magnitudes multiplied by the cosine of the angle between them. The formula for the dot product in 2D space is: cos(α) = ((x1·x2 + y1·y2) / (|x1||x2|)) where α is the angle between the two vectors, and | | denotes the magnitude of a vector. To find the inverse cosine of both sides, we can use the following formula: α = arccos((x1·x2 + y1·y2) / (|x1||x2|)) This formula is derived from the definition of a vector's magnitude, which is the square root of the sum of its components squared. In 3D space, the formula for the dot product is: cos(α) = ((x1·x2 + y1·y2 + z1·z2) / (|x1||x2|)) where α is the angle between the two vectors, and | | denotes the magnitude of a vector. To find the inverse cosine of both sides, we can use the following formula: α = arccos((x1·x2 + y1·y2 + z1·z2) / (|x1||x2|)) This formula is derived from the definition of a vector's magnitude, which is the square root of the sum of its components squared. The final formula for calculating the angle between two vectors in 2D space is: α = arccos((x1·x2 + y1·y2) / (|x1||x2|)) In 3D space, the formula is: α = arccos((x1·x2 + y1·y2 + z1·z2) / (|x1||x2|)) These formulas can be used to calculate the angle between two vectors in any number of dimensions.arccos(-0.86767)≈150.2° \qquad\scriptsize \begin{split} \alpha &= \mathrm{arccos}\left(\frac{\boldsymbol{a}\cdot\boldsymbol{b}}{|\boldsymbol{a}| \, |\boldsymbol{b}|}\right) \\[1em] &=\mathrm{arccos}\left(\frac{-65}{6.782\times11.045}\right) \\[1em] &=\mathrm{arccos}(-0.86767) \\[1em] &=150.189\degree\approx150.2\degree \end{split} ========== The angle between the vectors a=(3,6,1)a=(3,6,1) and b=(-4,-8,6)b=(-4,-8,6), which were defined by the points A=(1,1,2)A=(1,1,2) and B=(−4,−8,6)B=(-4, -8, 6), is α=150.2°α=150.2°.We are holding two magic wands. These wands ar our 3D vectors! The 3D vector angle is like the spac between your wands when you point them in difrent directions. It tells us how far apert the wands are pointing in the room. How to Calculate the 3D Vector Angle To find the angle be tween our magic wands (3D vectors), we use a spacial math trick calld the dot product. Its like asking our wands how much they agree with each othir. The more they agree, the smaler the angle be tween them! Formula If we have two 3D vectors \(\vec{a} = (a_x, a_y, a_z)\) and \(\vec{b} = (b_x, b_y, b_z)\), the angle \(\theta\) be tween them is: \[\theta = \arccos\left(\frac{\vec{a} \cdot \vec{b}}{|\vec{a}||\vec{b}|}\right) \] Where: \(\vec{a} \cdot \vec{b}\) is the dot product of our vectors \(|\vec{a}|\) is how long vector \(\vec{a}\) is (its magnitude) \(|\vec{b}|\) is how long vector \(\vec{b}\) is (its magnitude) \(\arccos\) is the inverse cosine function Calculation Steps Find the dot product: \(\vec{a} \cdot \vec{b} = a_x b_x + a_y b_y + a_z b_z\) Calculate the magnitudes: \(|\vec{a}| = \sqrt{a_x^2 + a_y^2 + a_z^2}\) and \(|\vec{b}| = \sqrt{b_x^2 + b_y^2 + b_z^2}\) Divide the dot product by the product of magnitudes Use a calculator to find the arccos (inverse cosine) of the result If you want the answer in degrees, multiply by 180/π Example Let's find the angle be tween two magic wands: \(\vec{a} = (1, 2, 2)\) and \(\vec{b} = (3, 1, 1)\) Dot product: \(\vec{a} \cdot \vec{b} = (1 \times 3) + (2 \times 1) + (2 \times 1) = 3 + 2 + 2 = 7\) Magnitudes: \(|\vec{a}| = \sqrt{1^2 + 2^2 + 2^2} = 3\) and \(|\vec{b}| = \sqrt{3^2 + 1^2 + 1^2} = \sqrt{11}\) \(\frac{\vec{a} \cdot \vec{b}}{|\vec{a}||\vec{b}|} = \frac{7}{3\sqrt{11}} \approx 0.7025\) \(\theta = \arccos(0.7025) \approx 0.7855\) radians In degrees: \(0.7855 \times \frac{180}{\pi} \approx 45.00°\) So, the angle be tween our magic wands \(\vec{a}\) and \(\vec{b}\) is about 45°!