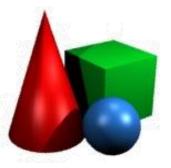
# **Computer Graphics**

Mathematical background Part 0

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#### **Vectors & matrices**

$$\mathbf{x} = \begin{pmatrix} x_1 \\ x_2 \\ \vdots \\ x_m \end{pmatrix} \qquad \mathbf{A} = \begin{pmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{m1} & \cdots & a_{mn} \end{pmatrix}$$



### **Vectors & matrices**

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• Transpose:

- $oldsymbol{x}^T$  ,  $oldsymbol{A}^T$
- Multiplication: Ax,  $w^Tx$
- Multiplication by a number:  $\alpha x$
- Addition:

$$A + B$$
,  $x + y$ 



$$\bullet \begin{pmatrix} 2 & 3 & 4 \\ 1 & 1 & 2 \end{pmatrix}^T =$$



$$2 \cdot {3 \choose 4} + {1 \choose -1} =$$



• 
$$(1 \ 2) \binom{3}{4} =$$



$$\bullet \begin{pmatrix} 1 & 2 \\ 2 & 3 \end{pmatrix} \begin{pmatrix} 3 \\ 4 \end{pmatrix} =$$





• 
$$\binom{3}{4}(1 \quad 2) =$$



$$\bullet \binom{3}{4} \binom{1}{2} =$$



• A vector is a matrix: True or False?



• 3-dimensional computer graphics primarily operates with 3-dimensional vectors: True or false?



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• Given **x** and **y**, locate:

- 2*x*
- x + y
- -0.5x + 0.5y
- -0.9x + 0.1y
- 1.1x 0.1y



#### **Convex combination**

A convex combination of vectors  $v_1, v_2, v_3, ..., v_n$  is a vector

$$\lambda_1 \boldsymbol{v}_1 + \lambda_2 \boldsymbol{v}_2 + \dots + \lambda_n \boldsymbol{v}_n$$

where

$$\lambda_1 + \lambda_2 + \dots + \lambda_n = 1,$$
 $\lambda_i \ge 0$ 



• Provide a mathematical expression, describing the set of points, lying on a line which passes through *p* and *q*.



 Provide a mathematical expression, describing the set of points, lying within a triangle (p, q, r).



#### So far:

- Vectors, matrices
- Transposition
- Matrix addition & multiplication
- Convex combinations

• To be continued...

