# Beräkning av skalärprodukten i ON-bas, boken sid 36

$$\text{ON-bas} \Longrightarrow \quad \begin{cases} \mathbf{e}_1 \bullet \mathbf{e}_2 = \mathbf{e}_2 \bullet \mathbf{e}_3 = \mathbf{e}_1 \bullet \mathbf{e}_3 = 0 \\ \mathbf{e}_1 \bullet \mathbf{e}_1 = \mathbf{e}_2 \bullet \mathbf{e}_2 = \mathbf{e}_3 \bullet \mathbf{e}_3 = 1 \end{cases}$$

$$\mathbf{u} \bullet \mathbf{v} = \underline{\mathbf{e}} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} \bullet \underline{\mathbf{e}} \begin{pmatrix} y_1 \\ y_2 \\ y_3 \end{pmatrix}$$

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$$\mathbf{u} \bullet \mathbf{v} = \underline{\mathbf{e}} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} \bullet \underline{\mathbf{e}} \begin{pmatrix} y_1 \\ y_2 \\ y_3 \end{pmatrix} = (x_1\mathbf{e}_1 + x_2\mathbf{e}_2 + x_3\mathbf{e}_3) \bullet (y_1\mathbf{e}_1 + y_2\mathbf{e}_2 + y_3\mathbf{e}_3)$$

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$$\mathbf{u} \bullet \mathbf{v} = \underline{\mathbf{e}} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} \bullet \underline{\mathbf{e}} \begin{pmatrix} y_1 \\ y_2 \\ y_3 \end{pmatrix} = (x_1\mathbf{e}_1 + x_2\mathbf{e}_2 + x_3\mathbf{e}_3) \bullet (y_1\mathbf{e}_1 + y_2\mathbf{e}_2 + y_3\mathbf{e}_3) =$$

$$= x_1y_1(\mathbf{e}_1 \bullet \mathbf{e}_1) + x_1y_2(\mathbf{e}_1 \bullet \mathbf{e}_2) + x_1y_3(\mathbf{e}_1 \bullet \mathbf{e}_3)$$

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$$= x_1y_1(\mathbf{e}_1 \bullet \mathbf{e}_1) + x_1y_2(\mathbf{e}_1 \bullet \mathbf{e}_2) + x_1y_3(\mathbf{e}_1 \bullet \mathbf{e}_3) +$$

$$+ x_2y_1(\mathbf{e}_2 \bullet \mathbf{e}_1) + x_2y_2(\mathbf{e}_2 \bullet \mathbf{e}_2) + x_2y_3(\mathbf{e}_2 \bullet \mathbf{e}_3)$$

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$$\begin{aligned}
\mathbf{u} \bullet \mathbf{v} = \underline{\mathbf{e}} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} \bullet \underline{\mathbf{e}} \begin{pmatrix} y_1 \\ y_2 \\ y_3 \end{pmatrix} &= (x_1\mathbf{e}_1 + x_2\mathbf{e}_2 + x_3\mathbf{e}_3) \bullet (y_1\mathbf{e}_1 + y_2\mathbf{e}_2 + y_3\mathbf{e}_3) = \\
&= x_1y_1(\mathbf{e}_1 \bullet \mathbf{e}_1) + x_1y_2(\mathbf{e}_1 \bullet \mathbf{e}_2) + x_1y_3(\mathbf{e}_1 \bullet \mathbf{e}_3) + \\
&+ x_2y_1(\mathbf{e}_2 \bullet \mathbf{e}_1) + x_2y_2(\mathbf{e}_2 \bullet \mathbf{e}_2) + x_2y_3(\mathbf{e}_2 \bullet \mathbf{e}_3) + \\
&+ x_3y_1(\mathbf{e}_3 \bullet \mathbf{e}_1) + x_3y_2(\mathbf{e}_3 \bullet \mathbf{e}_2) + x_3y_3(\mathbf{e}_3 \bullet \mathbf{e}_3)
\end{aligned}$$

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$$\begin{aligned}
\mathbf{u} \bullet \mathbf{v} = \underline{\mathbf{e}} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} \bullet \underline{\mathbf{e}} \begin{pmatrix} y_1 \\ y_2 \\ y_3 \end{pmatrix} &= (x_1\mathbf{e}_1 + x_2\mathbf{e}_2 + x_3\mathbf{e}_3) \bullet (y_1\mathbf{e}_1 + y_2\mathbf{e}_2 + y_3\mathbf{e}_3) = \\
&= x_1y_1 \underbrace{(\mathbf{e}_1 \bullet \mathbf{e}_1)}_{=1} + x_1y_2 \underbrace{(\mathbf{e}_1 \bullet \mathbf{e}_2)}_{=0} + x_1y_3 \underbrace{(\mathbf{e}_1 \bullet \mathbf{e}_3)}_{=0} + \\
&+ x_2y_1 \underbrace{(\mathbf{e}_2 \bullet \mathbf{e}_1)}_{=0} + x_2y_2 \underbrace{(\mathbf{e}_2 \bullet \mathbf{e}_2)}_{=1} + x_2y_3 \underbrace{(\mathbf{e}_2 \bullet \mathbf{e}_3)}_{=0} + \\
&+ x_3y_1 \underbrace{(\mathbf{e}_3 \bullet \mathbf{e}_1)}_{=0} + x_3y_2 \underbrace{(\mathbf{e}_3 \bullet \mathbf{e}_2)}_{=0} + x_3y_3 \underbrace{(\mathbf{e}_3 \bullet \mathbf{e}_3)}_{=1}
\end{aligned}$$

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$$\mathbf{u} \bullet \mathbf{v} = \underline{\mathbf{e}} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} \bullet \underline{\mathbf{e}} \begin{pmatrix} y_1 \\ y_2 \\ y_3 \end{pmatrix} = (x_1\mathbf{e}_1 + x_2\mathbf{e}_2 + x_3\mathbf{e}_3) \bullet (y_1\mathbf{e}_1 + y_2\mathbf{e}_2 + y_3\mathbf{e}_3) =$$

$$= x_1 y_1 \underbrace{(\mathbf{e}_1 \bullet \mathbf{e}_1)}_{=1} + x_2 y_2 \underbrace{(\mathbf{e}_2 \bullet \mathbf{e}_2)}_{=1} + x_3 y_3 \underbrace{(\mathbf{e}_3 \bullet \mathbf{e}_3)}_{=1}$$

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$$\begin{aligned} \mathbf{u} \bullet \mathbf{v} = \underline{\mathbf{e}} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} \bullet \underline{\mathbf{e}} \begin{pmatrix} y_1 \\ y_2 \\ y_3 \end{pmatrix} &= (x_1\mathbf{e}_1 + x_2\mathbf{e}_2 + x_3\mathbf{e}_3) \bullet (y_1\mathbf{e}_1 + y_2\mathbf{e}_2 + y_3\mathbf{e}_3) = \\ &= x_1 y_1 \underbrace{(\mathbf{e}_1 \bullet \mathbf{e}_1)}_{=1} + \\ &\qquad x_2 y_2 \underbrace{(\mathbf{e}_2 \bullet \mathbf{e}_2)}_{=1} + \\ &\qquad\qquad x_3 y_3 \underbrace{(\mathbf{e}_3 \bullet \mathbf{e}_3)}_{=1} = \\ &= x_1 y_1 + x_2 y_2 + x_3 y_3 \end{aligned}$$