

# Math macro command for latex support in markdown

## Number and Arrays

command	visualization	comment	
<code>a</code>	$\$a\$$	A scalar	
<code>\va</code>	$\$\va\$$	A vector, additionally $\$ \backslash vzero, \backslash vone, \backslash vmu, \backslash vnu, \backslash vtheta \$$ for <code>\vzero</code> , <code>\vone</code> , <code>\vmu</code> , <code>\vnu</code> , <code>\vtheta</code>	
<code>\mA</code>	$\$\mA\$$	A matrix	
<code>\tA</code>	$\$\tA\$$	A tensor	
<code>\mI_n</code>	$\$\mI_n\$$	Identity matrix with $\$n\$$ rows and $\$n\$$ columns	
<code>\mI</code>	$\$\mI\$$	Identity matrix with dimensionality implied by context	
<code>\ve^{(i)}</code>	$\$\ve^{(i)}\$$	Standard basis vector $\$[0,\backslash dots,0,1,0,\backslash dots,0]\$$ with a 1 at position $\$i\$$	
<code>\text{diag}(\va)</code>	$\$\text{diag}(\va)\$$	A square, diagonal matrix with diagonal entries given by $\$\va\$$	
<code>\ra</code>	$\$\ra\$$	A scalar-valued random variable	
<code>\rva</code>	$\$\rva\$$	A vector-valued random variables	
<code>\rmA</code>	$\$\rmA\$$	A matrix-valued random variabes	

## Sets and Graphs

Command	Visualization	Comment
<code>\sA</code>	$\mathcal{S}A$	A set <b>Note:</b> the command covers <code>\sA</code> to <code>\sZ</code> but don't no <code>\sE</code> since it's expectation
<code>\R</code>	$\mathbb{R}$	The set of real numbers
<code>\{0, 1\}</code>	$\{0, 1\}$	The set containing 0 and 1
<code>\{0, 1, \dots, n\}</code>	$\{0, 1, \dots, n\}$	The set of all integers between $0$ and $n$
<code>[a, b]</code>	$[a, b]$	The real interval including $a$ and $b$
<code>(a, b]</code>	$(a, b]$	The real interval excluding $a$ but including $b$
<code>\sA \backslash \sB</code>	$\mathcal{S}A \setminus \mathcal{S}B$	Set subtraction, i.e., the set containing the elements of $\mathcal{S}A$ not in $\mathcal{S}B$
<code>\gG</code>	$\mathcal{G}G$	A graph

# Indexing

Command	Visualization	Comment
<code>\eva_i</code>	$\mathcal{e}va_i$	Element $i$ of vector $\mathcal{e}va$ , with indexing starting at 1
<code>\eva_{-i}</code>	$\mathcal{e}va_{-i}$	All elements of vector $\mathcal{e}va$ except for element $i$
<code>\emA_{i,j}</code>	$\mathcal{e}mA_{i,j}$	Element $i, j$ of matrix $\mathcal{e}mA$
<code>\mA_{i, :}</code>	$\mathcal{m}A_{i, :}$	Row $i$ of matrix $\mathcal{m}A$
<code>\mA_{:, i}</code>	$\mathcal{m}A_{:, i}$	Column $i$ of matrix $\mathcal{m}A$
<code>\etA_{i, j, k}</code>	$\mathcal{e}tA_{i, j, k}$	Element $(i, j, k)$ of a 3-D tensor $\mathcal{e}tA$
<code>\tA_{:, :, i}</code>	$\mathcal{t}A_{:, :, i}$	2-D slice of a 3-D tensor
<code>\erva_i</code>	$\mathcal{e}rva_i$	Element $i$ of the random vector $\mathcal{e}rva$

# Linear Algebra Operators

Command	Visualization	Comment
<code>\mA^{\top}</code>	$\mathcal{m}A^{\top}$	Transpose of matrix $\mathcal{m}A$

Command	Visualization	Comment
<code>\mA^+</code>	$\mA^+$	Moore-Penrose pseudoinverse of $\mA$
<code>\mA \odot \mB</code>	$\mA \odot \mB$	Element-wise (Hadamard) product of $\mA$ and $\mB$
<code>\mathrm{det}(\mA)</code>	$\mathrm{det}(\mA)$	Determinant of $\mA$
<code>\sign(x)</code>	$\sign(x)$	Sign of a variable $x$
<code>\Tr \mA</code>	$\Tr(\mA)$	Trace of a matrix $A$

# Calculus

Command	Visualization	Comment
<code>\diff y / \diff x</code>	$\diff y / \diff x$	Derivative of $y$ with respect to $x$
<code>\frac{\partial y}{\partial x}</code>	$\frac{\partial y}{\partial x}$	Partial derivative of $y$ with respect to $x$
<code>\nabla_{\vx} y</code>	$\nabla_{\vx} y$	Gradient of $y$ with respect to $\vx$
<code>\nabla_{\mX} y</code>	$\nabla_{\mX} y$	Matrix derivatives of $y$ with respect to $\mX$
<code>\nabla_{\tX} y</code>	$\nabla_{\tX} y$	Tensor containing derivatives of $y$ with respect to $\tX$
<code>\frac{\partial f}{\partial \vx}</code>	$\frac{\partial f}{\partial \vx}$	Jacobian matrix $\mJ \in \mathbb{R}^{m \times n}$ of $f: \mathbb{R}^n \rightarrow \mathbb{R}^m$
<code>\nabla_{\vx}^2 f(\vx)\text{ or }\mH(f)(\vx)</code>	$\nabla_{\vx}^2 f(\vx)\text{ or }\mH(f)(\vx)$	The Hessian matrix of $f$ at input point $\vx$
<code>\int f(\vx) \, d\vx</code>	$\int f(\vx) \, d\vx$	Definite integral over the entire domain of $\vx$
<code>\int_{\sS} f(\vx) \, d\vx</code>	$\int_{\sS} f(\vx) \, d\vx$	Definite integral with respect to $\vx$ over the set $\sS$

# Probabilities

Command	Visualization	Comment
<code>\ra \bot \rb</code>	$\ra \bot \rb$	The random variables $\ra$ and $\rb$ are independent
<code>\ra \bot \rb \mid \rc</code>	$\ra \bot \rb \mid \rc$	They are conditionally independent given $\rc$

Command	Visualization	Comment
<code>P(\ra)</code>	$\$P(\ra)\$$	A probability distribution over a discrete variable
<code>p(\ra)</code>	$\$p(\ra)\$$	A probability distribution over a continuous variable, or a variable of unspecified type
<code>\ra \sim P</code>	$\$\ra \sim P\$$	Random variable $\$\ra\$$ has distribution $\$P\$$
<code>\E_{\rx \sim P} [ f(x) ] \text{ or } \E f(x)</code>	$\$\E_{\rx \sim P} [ f(x) ] \text{ or } \E f(x)\$$	Expectation of $\$f(x)\$$ with respect to $\$P(\rx)\$$
<code>\Var(f(x))</code>	$\$\Var(f(x))\$$	Variance of $\$f(x)\$$ under $\$P(\rx)\$$
<code>\Cov(f(x), g(x))</code>	$\$\Cov(f(x), g(x))\$$	Covariance of $\$f(x)\$$ and $\$g(x)\$$ under $\$P(\rx)\$$
<code>H(\rx)</code>	$\$H(\rx)\$$	Shannon entropy of the random variable $\$\rx\$$
<code>\KL(P \Vert Q)</code>	$\$\KL(P \Vert Q)\$$	Kullback-Leibler divergence of $\$P\$$ and $\$Q\$$
<code>\mathcal{N}(\vx ; \vmu , \mSigma)</code>	$\$\mathcal{N}(\vx ; \vmu , \mSigma)\$$	Gaussian distribution over $\$\vx\$$ with mean $\$\vmu\$$ and covariance $\$\mSigma\$$

# Functions

Command	Visualization	Comment
<code>f: \sA \rightarrow \sB</code>	$\$f: \sA \rightarrow \sB\$$	The function $\$f\$$ with domain $\$\sA\$$ and range $\$\sB\$$
<code>f \circ g</code>	$\$f \circ g\$$	Composition of the functions $\$f\$$ and $\$g\$$
<code>f(\vx ; \vtheta)</code>	$\$f(\vx ; \vtheta)\$$	A function of $\$\vx\$$ parametrized by $\$\vtheta\$$ . Sometimes written as $\$f(\vx)\$$ to simplify notation
<code>\log x</code>	$\$\log x\$$	Natural logarithm of $\$x\$$
<code>\sigma(x)</code>	$\$\sigma(x)\$$	Logistic sigmoid, $\displaystyle \frac{1}{1 + \exp(-x)}$
<code>\zeta(x)</code>	$\$\zeta(x)\$$	Softplus, $\$\log(1 + \exp(x))\$$
<code>\Vert \vx \Vert_p</code>	$\$\Vert \vx \Vert_p\$$	$\$L^p\$$ norm of $\$\vx\$$
<code>\Vert \vx \Vert</code>	$\$\Vert \vx \Vert\$$	$\$L^2\$$ norm of $\$\vx\$$
<code>x^+</code>	$\$x^+\$$	Positive part of $\$x\$$ , i.e., $\$\max(0,x)\$$

Command	Visualization	Comment
<code>\bm{1}_\mathrm{condition}</code>	$\bm{1}_\mathrm{condition}$	Is 1 if the condition is true, 0 otherwise

# Custom Commands special

Command	Visualization	Comment
<code>\bm{#1}</code>	$\bm{x}$	Bold symbol, e.g., $\boldsymbol{x}$
<code>\sign</code>	$\text{sign}$	<b>operator</b> , Sign , $\operatorname{sign}$
<code>\Tr</code>	$\text{Tr}$	<b>operator</b> Trace, $\operatorname{Tr}$
<code>\E</code>	$\mathbb{E}$	Expectation, $\mathbb{E}$
<code>\KL</code>	$\text{KL}$	Kullback-Leibler divergence, $D_\mathrm{KL}$
<code>\NormalDist</code>	$\text{NormalDist}$	Gaussian distribution, $\mathcal{N}$
<code>\diag</code>	$\text{diag}$	Diagonal matrix, $\mathrm{diag}$
<code>\Ls</code>	$\mathcal{L}$	Loss function, $\mathcal{L}$
<code>\R</code>	$\mathbb{R}$	Real number set, $\mathbb{R}$
<code>\emp</code>	$\tilde{p}$	Empirical distribution, $\tilde{p}$
<code>\lr</code>	$\alpha$	Learning rate, $\alpha$
<code>\reg</code>	$\lambda$	Regularization coefficient, $\lambda$
<code>\rect</code>	$\text{rectifier}$	Rectifier activation, $\mathrm{rectifier}$
<code>\softmax</code>	$\text{softmax}$	Softmax function, $\mathrm{softmax}$
<code>\sigmoid</code>	$\sigma$	Sigmoid function, $\sigma$
<code>\softplus</code>	$\zeta$	Softplus function, $\zeta$
<code>\Var</code>	$\mathrm{Var}$	Variance, $\mathrm{Var}$
<code>\standarderror</code>	$\mathrm{SE}$	Standard error, $\mathrm{SE}$
<code>\Cov</code>	$\mathrm{Cov}$	Covariance, $\mathrm{Cov}$
<code>\tran</code>	$^\top$	Transpose operator, $^\top$
<code>\inv</code>	$^{-1}$	Inverse operator, $^{-1}$
<code>\diff</code>	$\mathrm{d}$	Differential operator, $\mathrm{d}$

# Reference

- Ian Goodfellow's ML book:  
[https://github.com/goodfeli/dlbook\\_notation/blob/master/notation\\_example.pdf](https://github.com/goodfeli/dlbook_notation/blob/master/notation_example.pdf)
- MathJax: <https://docs.mathjax.org/en/latest/input/tex/macros.html>

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