Basic mathematical symbols and structures

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Contents

1 Standard mathematical symbols **1**

2 Standard mathematical structures **7**

2.1 Testing line breaking 12

2.2 Testing new commands 13

List of Figures

List of Tables

1 Standard mathematical symbols

We will use the robust single dollar environment for these

Math versions of text symbols: $\$\_\ddagger\{\P \ldots\}\S\dagger£©$

Keyboard symbols: $+- =<> /:!' |[]()$

But for longer tests we will use the equation environment so that we don't overrun the line if we increase the font size. We'll do a basic macro test in section 2.2.

Greek:

$$\alpha\beta\gamma\delta\epsilon\varepsilon\zeta\eta\theta\vartheta\iota\kappa\lambda\mu\nu\xi o\pi\varpi\rho\varrho\sigma\varsigma\tau\upsilon\phi\varphi\chi\psi\omega \tag{1}$$

Upper case Greek:

$$\Gamma\Delta\Theta\Lambda\Xi\Pi\Sigma\Upsilon\Phi\Psi\Omega \tag{2}$$

Normal, lower case:

$$abcdefghijklmnopqrstuvwxyz \tag{3}$$

Normal, upper case:

$$ABCDEFGHIJKLMNOPQRSTUVWXYZ \quad (4)$$

Bold using boldmath, lower case:

$$\boldsymbol{abcdefghijklmnopqrstuvwxyz} \quad (5)$$

Bold using boldmath, upper case:

$$\boldsymbol{ABCDEFGHIJKLMNOPQRSTUVWXYZ} \quad (6)$$

Italic, lower case:

$$a\ b\ c\ d\ e\ f\ g\ h\ i\ j\ k\ l\ m\ n\ o\ p\ q\ r\ s\ t\ u\ v\ w\ x\ y\ z \quad (7)$$

Italic, upper case:

$$A\ B\ C\ D\ E\ F\ G\ H\ I\ J\ K\ L\ M\ N\ O\ P\ Q\ R\ S\ T\ U\ V\ W\ X\ Y\ Z \quad (8)$$

Roman, lower case:

$$\mathrm{abcdefghijklmnopqrstuvwxyz} \quad (9)$$

Roman, upper case:

$$\mathrm{ABCDEFGHIJKLMNOPQRSTUVWXYZ} \tag{10}$$

Bold using bf, lower case:

$$\mathbf{abcdefghijklmnopqrstuvwxyz} \tag{11}$$

Bold using bf, upper case:

$$\mathbf{ABCDEFGHIJKLMNOPQRSTUVWXYZ} \tag{12}$$

Calligraphic (upper case only):

$$\mathcal{ABCDEFGHIJKLMNOPQRSTUVWXYZ} \tag{13}$$

Binary operators:

$$\pm\mp\times\div\cdot*\star\dagger\ddagger\amalg\cap\cup\uplus\sqcap\sqcup\vee\wedge\oplus\ominus\otimes\circ\bullet\diamond\oslash\odot\bigcirc\triangle\bigtriangledown\triangleleft\triangleright\setminus\wr \tag{14}$$

Relations:

$$\leq\subseteq\ll\subset\sqsubseteq\sqsubset\in\vdash\models\geq\supseteq\gg\supset\sqsupseteq\ni\dashv\perp\neq \tag{15}$$

$$\doteq\approx\cong\equiv\propto\prec\preceq\|\ \|\sim\simeq\asymp\smile\frown\bowtie\succ\succeq|$$

Negated which do not stop conversion but may not be displayed in Word:

$$\not<\not\leq\not\subset\not\subseteq\not\sqsubseteq\not\in\not\ni\not\mid\not\parallel\not>\not\geq\not\supset\not\supseteq\not\sqsupseteq\not\exists\neq\not\approx\not\cong\not\equiv\not\asymp\not\sim\not\simeq\not\asymp\not\prec \tag{16}$$

Arrows:

$$\leftarrow\gets\Leftarrow\rightarrow\to\Rightarrow\leftrightarrow\Leftrightarrow\mapsto\hookleftarrow\leftharpoonup\leftharpoondown\rightleftharpoons\longleftarrow\Longleftarrow\longrightarrow\Longrightarrow \tag{17}$$

$$\longleftrightarrow\Longleftrightarrow\mapsto\longrightarrow\hookrightarrow\rightharpoonup\rightharpoondown\uparrow\Uparrow\downarrow\Downarrow\updownarrow\Updownarrow\nearrow\searrow\swarrow\nwarrow \tag{18}$$

Other:

$$\aleph\hbar\imath\jmath\ell\wp\Re\Im\eth\emptyset\nabla\surd\partial\top\bot\vdash\dashv\forall\exists\neq\flat\natural\sharp\|\angle\backslash\triangle\clubsuit\diamondsuit\heartsuit\spadesuit\infty \tag{19}$$

Symbols with two sizes:

$$\sum\int\oint\prod\coprod\bigcap\bigcup\bigsqcup\bigvee\bigwedge\bigodot\bigotimes\bigoplus\biguplus$$

$$\sum\int\oint\prod\coprod\bigcap\bigcup\bigsqcup\bigvee\bigwedge\bigodot\bigotimes\bigoplus\biguplus \tag{20}$$

Function names:

$$\arccos \arcsin \arctan \arg \cos \cosh \cot \coth \csc \deg \det \tag{21}$$

$$\dim \exp \gcd \hom \inf \ker \lg \lim \liminf \limsup \ln \log \tag{22}$$

$$\max \min \Pr \sec \sin \sinh \sup \tan \tanh \tag{23}$$

Those with under-subscript available:

$$\det_a \gcd_a \inf_a \lim_a \liminf_a \limsup_a \max_a \min_a \Pr_a \sup_a \tag{24}$$

Modulus:

$$a \bmod b \qquad a \pmod b \tag{25}$$

Accents and under/over:

$$\hat{a}\check{a}\dot{a}\breve{a}\acute{a}\ddot{a}\grave{a}\tilde{a}\mathring{a}\bar{a}\vec{a}\widehat{aaa}\widetilde{aaa}\overline{aaa}\underline{aaa}\overbrace{aaa}\underbrace{aaa} \tag{26}$$

Symbols left and right can be applied to:

$$\left(\frac{1}{2}\right) \left[\frac{1}{2}\right] \left\{\frac{1}{2}\right\} \left|\frac{1}{2}\right| \left/\frac{1}{2}\right\backslash \left\lfloor\frac{1}{2}\right\rfloor \left\lceil\frac{1}{2}\right\rceil \left\langle\frac{1}{2}\right\rangle \tag{27}$$

Manual sizing:

$$() [] \{\} \lfloor\rfloor \lceil\rceil \langle\rangle / \backslash \| \uparrow \Uparrow \downarrow \Downarrow \updownarrow \Updownarrow \tag{28}$$

$$\left() \left[] \left\{\right\} \left\lfloor\right\rfloor \left\lceil\right\rceil \left\langle\right\rangle / \backslash \left\| \right\uparrow \left\Uparrow \right\downarrow \left\Downarrow \right\updownarrow \left\Updownarrow \right. \tag{29}$$

$$\left() \left[] \left\{\right\} \left\lfloor\right\rfloor \left\lceil\right\rceil \left\langle\right\rangle / \backslash \left\| \right\uparrow \left\Uparrow \right\downarrow \left\Downarrow \right\updownarrow \left\Updownarrow \right. \tag{30}$$

$$\left() \left[] \left\{\right\} \left\lfloor\right\rfloor \left\lceil\right\rceil \left\langle\right\rangle / \backslash \left\| \right\uparrow \left\Uparrow \right\downarrow \left\Downarrow \right\updownarrow \left\Updownarrow \right. \tag{31}$$

Dots:

$$a \ldots a \quad a \vdots a \quad a \cdots a \quad a \ddots a \tag{32}$$

Horizontal spacing:

$$| \, | \, | \, | \quad | \qquad | \tag{33}$$

2 Standard mathematical structures

Three different ways to inline $A^{2^n}_{i,j,k}$ $A^{2^n}_{i,j,k}$ $A^{2^n}_{i,j,k}$

Four different ways to displaymath.

$$\sum_{i=1}^{15} x_i^2 = x_1^2 + x_2^2 + x_3^2 + x_4^2 + x_5^2 + x_6^2 + x_7^2 + x_8^2 \tag{100}$$

$$+ x_9^2 + x_{10}^2 + x_{11}^2 + x_{12}^2 + x_{13}^2 + x_{14}^2 + x_{15}^2$$

$$x_1^2 = x_2^2 = x_3^2 = x_4^2 = x_5^2 = x_6^2 = x_7^2 = x_8^2 = x_9^2$$

$$= x_{10}^2 = x_{11}^2 = x_{12}^2 = x_{13}^2 = x_{14}^2 = x_{15}^2$$

$$\prod_{i=1}^{15} x_i^2 = x_1^2 \ x_2^2 \ x_3^2 \ x_4^2 \ x_5^2 \ x_6^2 \ x_7^2 \ x_8^2 \ x_9^2 \ x_{10}^2 \ x_{11}^2 \ x_{12}^2 \ x_{13}^2 \ x_{14}^2 \ x_{15}^2$$

$$\prod_{i=1}^{15} x_i^2 = x_1^2 \cdot x_2^2 \cdot x_3^2 \cdot x_4^2 \cdot x_5^2 \cdot x_6^2 \cdot x_7^2 \cdot x_8^2 \cdot x_9^2 \cdot x_{10}^2 \cdot x_{11}^2 \cdot x_{12}^2 \cdot x_{13}^2 \cdot x_{14}^2 \cdot x_{15}^2$$

One of the forms is numbered equation 100.

$$\sqrt{\sum_{i=1}^{13} x_i^2}$$

$$= \sqrt{x_1^2 + x_2^2 + x_3^2 + x_4^2 + x_5^2 + x_6^2 + x_7^2 + x_8^2 + x_9^2 + x_{10}^2 + x_{11}^2 + x_{12}^2 + x_{13}^2}$$

$$\sqrt{\sum_{i=1}^{13} x_i^2} = \big(x_1^2 + x_2^2 + x_3^2 + x_4^2 + x_5^2 + x_6^2 + x_7^2 + x_8^2 + x_9^2 + x_{10}^2 + x_{11}^2 + x_{12}^2 + x_{13}^2\big)^{\frac{1}{2}}$$

Now for an equation array:

$$\begin{aligned}\sum_{i=1}^{13} 2^i &= 2^1+2^2+2^3+2^4+2^5+2^6+2^7+2^8+2^9+2^{10}+2^{11}+2^{12}+2^{13} \\ &= 2+4+8+16+32+64+128+256 \\ &\quad +512+1024+2048+4096+8192 \\ &= 16382 \end{aligned} \tag{101}$$

$$\sum_{i=1}^{13} 2^i = 2^1+2^2+2^3+2^4+2^5+2^6+2^7+2^8+2^9+2^{10}+2^{11}+2^{12}+2^{13}$$

$$= 2 + 4 + 8 + 16 + 32 + 64 + 128 + 256$$

$$+ 512 + 1024 + 2048 + 4096 + 8192$$

$$= 16382$$ here is some text in the formula to fill up the line at 1

$$\begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}$$

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

$$\begin{vmatrix} 1 & 2 \\ 3 & 4 \end{vmatrix} = (1 \times 4) - (2 \times 3)$$

$$= 4 - 6 = -2$$

$$\sqrt{a + \sqrt{\frac{b + c + d}{e}} + f}$$

$$\overline{\underline{a}+\overline{b+\underline{c}+d}+\overline{\overline{e}}}$$

$$\underbrace{a+\overbrace{b+c}^{=0}+d}_{\text{text}}$$

$$\xrightarrow{a}$$

$$\binom{a}{b}$$

$$a+\cfrac{1}{b+\cfrac{1}{c+\cfrac{1}{d+\cfrac{1}{e+\cfrac{1}{f+\cfrac{1}{g+\frac{1}{h}}}}}}} \qquad a+\cfrac{1}{b+\cfrac{1}{c+\cfrac{1}{d+\cfrac{1}{e+\cfrac{1}{f+\cfrac{1}{g+\cfrac{1}{h}}}}}}}$$

2.1 Testing line breaking

$$a = b = c = d = e = f = g = h = i = j = k$$

$$= l = m = n = o = p = q = r = s = t$$

$$a < b < c < d < e < f < g < h < i < j < k$$

$$< l < m < n < o < p < q < r < s < t$$

$$a > b > c > d > e > f > g > h > i > j > k$$

$$> l > m > n > o > p > q > r > s > t$$

$$a \leq b \leq c \leq d \leq e \leq f \leq g \leq h \leq i \leq j \leq k$$

$$\leq l \leq m \leq n \leq o \leq p \leq q \leq r \leq s \leq t$$

$$a \geq b \geq c \geq d \geq e \geq f \geq g \geq h \geq i \geq j \geq k$$

$$\geq l \geq m \geq n \geq o \geq p \geq q \geq r \geq s \geq t$$

$$a + b + c + d + e + f + g + h + i + j + k$$

$$+ l + m + n + o + p + q + r + s + t + u$$

$$a - b - c - d - e - f - g - h - i - j - k$$

$$- l - m - n - o - p - q - r - s - t - u$$

$$a \times b \times c \times d \times e \times f \times g \times h \times i \times j \times k$$

$$\times l \times m \times n \times o \times p \times q \times r \times s \times t \times u$$

$$a * b * c * d * e * f * g * h * i * j * k * l * m$$

$$* n * o * p * q * r * s * t * u * v * w * x * y$$

$$a \cdot b \cdot c \cdot d \cdot e \cdot f \cdot g \cdot h \cdot i \cdot j \cdot k \cdot l \cdot m \cdot n \cdot o$$

$$\cdot p \cdot q \cdot r \cdot s \cdot t \cdot u \cdot v \cdot w \cdot x \cdot y \cdot z \cdot a \cdot b \cdot c$$

$$a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x, y, z, a, b, c, d, e, f, g$$

2.2 Testing new commands

$$x_1 x^2 x_2$$