Basic mathematical symbols and structures

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1   Standard mathematical symbols

We will use the robust single dollar environment for these

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

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:

$$ABCDEFGHIJKLMNOPQRSTUVWXYZ \tag{4}$$

Bold using boldmath, lower case:

$$\boldsymbol{abcdefghijklmnopqrstuvwxyz} \tag{5}$$

Bold using boldmath, upper case:

$$\boldsymbol{ABCDEFGHIJKLMNOPQRSTUVWXYZ} \tag{6}$$

Italic, lower case:

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

Italic, upper case:

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

Roman, lower case:

$$\mathrm{abcdefghijklmnopqrstuvwxyz} \tag{9}$$

Roman, upper case:

$$ABCDEFGHIJKLMNOPQRSTUVWXYZ \tag{10}$$

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:

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

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

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

$$\not< \not\le \not\subset \not\subseteq \not\sqsubseteq \not\vdash \not\models \not> \not\ge \not\supset \not\supseteq \not\sqsupseteq \ne \not\approx \not\equiv \not\prec \not\preceq \not\succ \not\succeq \tag{16}$$

Arrows:

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

$$\longleftrightarrow \Longleftrightarrow \Longleftrightarrow \longmapsto \hookrightarrow \rightharpoonup \uparrow \Uparrow \downarrow \Downarrow \updownarrow \nearrow \searrow \swarrow \nwarrow \tag{18}$$

Other:

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

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:

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

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

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

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:

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

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:

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

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

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

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

Dots:

$$a\ldots a \quad a\mathbin{:}a \quad a\cdots a \quad a\ddots a \tag{32}$$

Horizontal spacing:

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

2   Standard mathematical structures

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

Four different ways to displaymath.

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

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

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

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

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

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

One of the forms is numbered equation 100.

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

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

$$\sqrt{\sum_{i=1}^{13} x_i^2} = \left(x_1^2 + x_2^2 + x_3^2 + x_4^2 + x_5^2 + x_6^2 + x_7^2 + x_8^2 + x_9^2 + x_{10}^2 \right.$$

$$\left. + x_{11}^2 + x_{12}^2 + x_{13}^2\right)^{\frac{1}{2}}$$

Now for an equation array:

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

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

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

$$= 16382 \tag{101}$$

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

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

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

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

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

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

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

$$= 4 - 6 = -2$$

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

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

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

$$\xrightarrow{a}$$

$$\begin{pmatrix} a \\ b \end{pmatrix}$$

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

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

$$x_1 x^2 x_2$$