Basic mathematical symbols and structures

Emma Cliffe

Contents

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:

$$ABCDEFGHIJKLMNOPQRSTUVWXYZ \tag{4}$$

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:

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

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:

$$\leq\ \geq\ \ll\ \subset\ \subseteq\ \sqsubseteq\ \in\ \vdash\ \models\ \geq\ \geq\ \gg\ \supset\ \supseteq\ \sqsupseteq\ \ni\ \dashv\ \perp\ \neq\ \doteq\ \approx\ \cong\ \equiv\ \propto\ \prec\ \preceq\ \|\ \|\ \sim\ \simeq\ \asymp\ \smile\ \frown\ \bowtie\ \succ\ \succeq\ | \tag{15}$$

Negated:

$$\not<\ \not\leq\ \not\leq\ \not\ll\ \not\subset\ \not\subseteq\ \not\sqsubseteq\ \not\in\ \not\vdash\ \not\models\ \not>\ \not\geq\ \not\geq\ \not\gg\ \not\supset\ \not\supseteq\ \not\sqsupseteq\ \not\ni\ \not\dashv\ \not=\ \not=\ \not\approx\ \not\cong\ \not\equiv\ \not\propto\ \not\prec\ \not\preceq\ \not\sim\ \not\simeq\ \not\asymp\ \not\smile\ \not\frown\ \not\bowtie\ \not\succ\ \not\succeq \tag{16}$$

Arrows:

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

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

Other:

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

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:

$$\det_{a}\ \gcd_{a}\ \inf_{a}\ \lim_{a}\ \lim_{a}\ \liminf_{a}\ \lim_{a}\ \limsup_{a}\ \max_{a}\ \min_{a}\ \Pr_{a}\ \sup_{a} \tag{24}$$

Modulus:

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

Accents and under/over:

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

Symbols left and right can be applied to:

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

Manual sizing:

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

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

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

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

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 $A_{i,j,k}^{2^n}$ $A_{i,j,k}^{2^n}$ $A_{i,j,k}^{2^n}$

Four different ways to displaymath.

$$\sum_{i=1}^{15} x_i^2 = x_1^2+x_2^2+x_3^2+x_4^2+x_5^2+x_6^2+x_7^2+x_8^2+x_9^2+x_{10}^2+x_{11}^2+x_{12}^2+x_{13}^2+x_{14}^2+x_{15}^2 \tag{100}$$

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

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

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

One of the forms is numbered equation 100.

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

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

Now for an equation array:

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

$$\begin{aligned} \sum_{i=1}^{13} 2^i &= 2^1 + 2^2 + 2^3 + 2^4 + 2^5 + 2^6 + 2^7 + 2^8 + 2^9 + 2^{10} + 2^{11} + 2^{12} + 2^{13} \\ &= 2 + 4 + 8 + 16 + 32 + 64 + 128 + 256 + 512 + 1024 + 2048 + 4096 + 8192 \\ &= 16382 \qquad \text{here is some text in the formula to fill up the line at 12pt font} \end{aligned}$$

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

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

$$\begin{vmatrix} 1 & 2 \\ 3 & 4 \end{vmatrix} = (1 \times 4) - (2 \times 3)$$
$$= 4 - 6 = -2$$

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

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

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

$$\xrightarrow{a}$$

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

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

2.1 Testing line breaking

$a = b = c = d = e = f = g = h = i = j = k = l = m = n = o = p = q = r = s = t$
$a < b < c < d < e < f < g < h < i < j < k < l < m < n < o < p < q < r < s < t$
$a > b > c > d > e > f > g > h > i > j > k > l > m > n > o > p > q > r > s > t$
$a \leq b \leq c \leq d \leq e \leq f \leq g \leq h \leq i \leq j \leq k \leq l \leq m \leq n \leq o \leq p \leq q \leq r \leq s \leq t$
$a \geq b \geq c \geq d \geq e \geq f \geq g \geq h \geq i \geq j \geq k \geq l \geq m \geq n \geq o \geq p \geq q \geq r \geq s \geq t$

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

2.2 Testing new commands

$$x_1x^2x_2$$