Out[1]: (Show / Hide code)

Notation Summary

CSE 4303 / CSE 5365 Computer Graphics

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Notation

Notation is used to make explanations *precise* and *concise*. *Consistent* notation helps to make explanations *clear*. Unfortunately, there is a wide variety of *differing* notation in use even across standard references, so while we will use the following in this class, you may encounter differences when consulting other references. Get in the habit of quickly reviewing a reference's notation summary before diving in to avoid confusion.

Sets

$\mathbb{N}$, the set of *natural* or *counting* numbers; the integers $1, 2, 3, 4, \ldots$. (Be careful, some definitions include 0 in the *natural* numbers. We don't, at least not in *this* class.)

$\mathbb{Z}$, the set of all integers; negative, zero, positive. (Why $\mathbb{Z}$ for *integers* and not, say, $\mathbb{I}$? Well, $\mathbb{I}$ means something else. $\mathbb{Z}$ is from the German word *Zahlen*, meaning *numbers*.)

$\mathbb{Q}$, the set of *rational* numbers; all numbers of the form $\frac{a}{b}$, $a, b \in \mathbb{Z}$. (Why $\mathbb{Q}$ for *rationals* and not, say, $\mathbb{R}$? Well, $\mathbb{R}$ means something else. $\mathbb{Q}$ is from the Italian word *Quoziente*, meaning *quotient*.)

$\mathbb{R}$ (or $\mathfrak{R}$, if you like German blackletter script from the Middle Ages :), the set of *real* numbers; differentiated from the integers in that they are *continuous*, not *discrete*.)

The superscripts $+$ and $-$ may be used to indicated *positive* and *negative* subsets. E.g., $\mathfrak{R}^+$ means the *positive* real numbers, $\mathbb{Q}^-$ means the *negative* rational numbers.

We denote membership in a set with $\in$, meaning *element of*, and $\notin$ meaning *not an element of*.

So we say $-1 \in \mathbb{Z}$ but $-1 \notin \mathbb{N}$.

Names

Item	Notation	Examples
angle	lowercase Greek	$\alpha, \beta_i, \gamma, \rho_0, \phi_{23}, \theta$
scalar	lowercase italic	$a, b, c_i, u_{ij}, m_{0,1}$
vector or ***point***	lowercase bold	$\mathbf{u}, \mathbf{v}_i, \mathbf{w}_x$
matrix	capital bold	$\mathbf{A}, \mathbf{B}, \mathbf{M}$

Note that *points* and *vectors*, though written the same way, are *different* kinds of objects. The reason for distinguishing points from vectors will become clearer once we go deeper into their uses.

Occasionally, we will emphasize that a particular object is a vector by placing an arrow on top, as $\vec{\mathbf{v}}$.

Occasionally, we will emphasize that a particular object is a matrix by enclosing it in brackets, as $[\mathbf{M}]$.

Bracketing Characters

> **bracket** — *noun* 1. each of a pair of marks used to enclose words or figures so as to separate them from the context.

The bracketing characters come in pairs and have specific names. They also have sloppy names. :)

Notation	Name	Sloppy Name
$(\quad)$	Parentheses	Round Brackets
$\{\quad\}$	Braces	Curly Brackets
$[\quad]$	Brackets	Square Brackets
$\langle\quad\rangle$	Chevrons	Angle Brackets

We use *left* and *right* with the singular to speak of one or the other sides. So, e.g.,

$)$	— right parenthesis	$\{$	— left brace
$\langle$	— left chevron	$]$	— right bracket

(Hard to believe that these comments on bracketing characters have to be included, huh? Still, I get *multiple* questions about this aspect of notation each semester. Ha!)

Symbols

Symbology evolved to reduce the amount of writing necessary to communicate a particular thought.

Notation	Name	Example
$\forall$	*for all ...*	$\forall n \in \mathbb{N}, n > 0.$
$\therefore$	*... therefore ...*	All humans are mortal. Socrates is a human. $\therefore$ Socrates is mortal.
$\because$	*... because ...*	11 is prime $\because$ it has no factors other than itself and one.
$\rightarrow$ $\Longrightarrow$	*... implies ...*	$x = 6 \rightarrow x^2 = 36$
$\nrightarrow$	*... does **not** imply ...*	$x^2 = 36 \nrightarrow x = 6 \because x$ could $= -6$
$\leftrightarrow$ $\Longleftrightarrow$	*... if and only if ...*	$\mathbf{u} \cdot \mathbf{v} = 0 \leftrightarrow \mathbf{u} \perp \mathbf{v}$
$\perp$	*... is perpendicular to ...*	$\mathbf{u} \perp \mathbf{v} \leftrightarrow \mathbf{u} \cdot \mathbf{v} = 0$
$\parallel$	*... is parallel to ...*	$\mathbf{u} \parallel \mathbf{v} \leftrightarrow \lVert\mathbf{u} + \mathbf{v}\rVert = \lVert\mathbf{u}\rVert + \lVert\mathbf{v}\rVert$

Notation	Name	Example
$\equiv$	*... is defined to be ...*	$x^2 \equiv x \cdot x$
$\blacksquare$	*... QED*	

A longer list may be found at Wikipedia's list of mathematical symbols (whence some of the examples above were derived).

> http://en.wikipedia.org/wiki/List_of_mathematical_symbols