

# Asymptote Reference Card

## Program structure/functions

```

import "filename"          import module
import "filename" as name  import filename as module name
include "filename"         include verbatim text from file
type f(type,...);         optional function declaration
type name;                variable declaration
type f(type arg,...) {    function definition
    statements
    return value;
}

```

## Data types/declarations

boolean (true or false)	bool
tri-state boolean (true, default, or false)	bool3
integer	int
float (double precision)	real
ordered pair (complex number)	pair
character string	string
fixed piecewise cubic Bezier spline	path
unresolved piecewise cubic Bezier spline	guide
color, line type/width/cap, font, fill rule	pen
label with position, alignment, pen attributes	Label
drawing canvas	picture
affine transform	transform
constant (unchanging) value	const
allocate in higher scope	static
no value	void
inhibit implicit argument casting	explicit
structure	struct
create name by data type	typedef <i>type name</i>

## 3D data types (import three;)

ordered triple	triple
3D path	path3
3D guide	guide3
3D affine transform	transform3

## Constants

exponential form	6.02e23
TeX string constant	"abc...de"
TeX strings: special characters	\\, \"
C strings: constant	'abc...de'
C strings: special characters	\\, \" \' \?
C strings: newline, cr, tab, backspace	\n \r \t \b
C strings: octal, hexadecimal bytes	\0-\377 \x0-\xFF

## Operators

arithmetic operations  
 modulus (remainder)  
 comparisons  
 not  
 and or (conditional evaluation of RHS)  
 and or xor  
 cast expression to type  
 increment decrement prefix operators  
 assignment operators  
 conditional expression  
 structure member operator  
 expression evaluation separator

```

+ - * /
%
== != > >= < <=
!
&& ||
& | ^
(type) expr
++ --
+= -= *= /= %=
expr1 ? expr2 : expr3
name.member
,

```

## Flow control

statement terminator  
 block delimiters  
 comment delimiters  
 comment to end of line delimiter  
 exit from while/do/for  
 next iteration of while/do/for  
 return value from function  
 terminate execution  
 abort execution with error message  
**Flow constructions (if/while/for/do)**

```

;
{ }
/* */
//
break;
continue;
return expr;
exit();
abort(string);

```

```

if(expr) statement
else if(expr) statement
else statement
-----
while(expr)
    statement
-----
for(expr1; expr2; expr3)
    statement
-----
for(type var : array)
    statement
-----
do statement
    while(expr);

```

## Arrays

array  
array element *i*  
array indexed by elements of int array *A*  
anonymous array  
array containing *n* deep copies of *x*  
length  
cyclic flag  
pop element *x*  
push element *x*  
append array *a*  
insert rest arguments at index *i*  
delete element at index *i*  
delete elements with indices in  $[i,j]$   
delete all elements  
test whether element *n* is initialized  
array of indices of initialized elements  
complement of int array in  $\{0,\dots,n-1\}$   
deep copy of array *a*  
array  $\{0,1,\dots,n-1\}$   
array  $\{n,n+1,\dots,m\}$   
array  $\{n-1,n-2,\dots,0\}$   
array  $\{f(0),f(1),\dots,f(n-1)\}$   
array obtained by applying *f* to array *a*  
uniform partition of  $[a,b]$  into *n* intervals  
concat specified 1D arrays  
return sorted array  
return array sorted using ordering *less*  
search sorted array *a* for key  
index of first true value of bool array *a*  
index of *n*th true value of bool array *a*

## Initialization

initialize variable  
initialize array

## path connectors

straight segment  
Beziér segment with implicit control points  
Beziér segment with explicit control points  
concatenate  
lift pen  
..tension atleast 1..  
..tension atleast infinity..

## Labels

implicit cast of string *s* to Label  
Label *s* with relative position and alignment  
Label *s* with absolute position and alignment  
Label *s* with specified pen

## draw commands

draw path with current pen  
draw path with pen  
draw labeled path  
draw arrow with pen  
draw path on picture  
draw visible portion of line through two pairs

```
type [] name;  
name [i]  
name [A]  
new type [dim]  
array (n,x)  
name.length  
name.cyclic  
name.pop()  
name.push(x)  
name.append(a)  
name.insert(i,...)  
name.delete(i)  
name.delete(i,j)  
name.delete()  
name.initialized(n)  
name.keys  
complement(a,n)  
copy(a)  
sequence(n)  
sequence(n,m)  
reverse(n)  
sequence(f,n)  
map(f,a)  
uniform(a,b,n)  
concat(a,b,...)  
sort(a)  
sort(a,less)  
search(a,key)  
find(a)  
find(a,n)
```

```
type name=value;  
type [] name={...};
```

```
--  
..  
..controls c0 and c1.  
&  
^^  
::  
---
```

```
s  
Label(s,real,pair)  
Label(s,pair,pair)  
Label(s,pen)
```

```
draw(path)  
draw(path,pen)  
draw(Label,path)  
draw(path,pen,Arrow)  
draw(picture,path)  
drawline(pair,pair)
```

## fill commands

fill path with current pen  
fill path with pen  
fill path on picture

## label commands

label a pair with optional alignment *z*  
label a path with optional alignment *z*  
add label to picture

## clip commands

clip to path  
clip to path with fill rule  
clip picture to path

## pens

Grayscale pen from value in  $[0,1]$   
RGB pen from values in  $[0,1]$   
CMYK pen from values in  $[0,1]$   
RGB pen from hexadecimal string]  
heximdecimal string from rgb pen]  
hsv pen from values in  $[0,1]$   
invisible pen  
default pen  
current pen  
solid pen  
dotted pen  
wide dotted current pen  
wide dotted pen  
dashed pen  
long dashed pen  
dash dotted pen  
long dash dotted pen  
PostScript butt line cap  
PostScript round line cap  
PostScript projecting square line cap  
miter join  
round join  
bevel join  
.pen with miter limit  
zero-winding fill rule  
even-odd fill rule  
align to character bounding box (default)  
align to T<sub>E</sub>X baseline  
pen with font size (pt)  
LaTeX pen from encoding,family,series,shape  
T<sub>E</sub>X pen  
scaled T<sub>E</sub>X pen  
PostScript font from strings  
pen with opacity in  $[0,1]$   
construct pen nib from polygonal path  
pen mixing operator

```
fill(path)  
fill(path,pen)  
fill(picture,path)
```

```
label(Label,pair,z)  
label(Label,path,z)  
label(picture,Label)
```

```
clip(path)  
clip(path,pen)  
clip(picture,path)
```

```
gray(g)  
rgb(r,g,b)  
cmyk(r,g,b)  
rgb(string)  
hex(pen)  
hsv(h,s,v)  
invisible  
defaultpen  
currentpen  
solid  
dotted  
Dotted  
Dotted(pen)  
dashed  
longdashed  
dashdotted  
longdashdotted  
squarecap  
roundcap  
extendcap  
miterjoin  
roundjoin  
beveljoin  
miterlimit(real)  
zerowinding  
evenodd  
nobasealign  
basealign  
fontsize(real)  
font(strings)  
font(string)  
font(string,real)  
Courier(series,shape)  
opacity(real)  
makepen(path)  
+
```

## path operations

number of segments in path **p**  
number of nodes in path **p**  
is path **p** cyclic?  
is segment **i** of path **p** straight?  
is path **p** straight?  
coordinates of path **p** at time **t**  
direction of path **p** at time **t**  
direction of path **p** at **length(p)**  
**unit(dir(p)+dir(q))**  
acceleration of path **p** at time **t**  
radius of curvature of path **p** at time **t**  
precontrol point of path **p** at time **t**  
postcontrol point of path **p** at time **t**  
**arclength** of path **p**  
time at which **arclength(p)=L**  
point on path **p** at **arclength L**  
first value **t** at which **dir(p,t)=z**  
time **t** at relative fraction **l** of **arclength(p)**  
point at relative fraction **l** of **arclength(p)**  
point midway along **arclength** of **p**  
path running backwards along **p**  
subpath of **p** between times **a** and **b**  
times for one intersection of paths **p** and **q**  
times at which **p** reaches minimal extents  
times at which **p** reaches maximal extents  
intersection times of paths **p** and **q**  
intersection times of path **p** with ‘--a--b--’  
intersection times of path **p** crossing  $x=x$   
intersection times of path **p** crossing  $y=z.y$   
intersection point of paths **p** and **q**  
intersection points of **p** and **q**  
intersection of extension of **P--Q** and **p--q**  
lower left point of bounding box of path **p**  
upper right point of bounding box of path **p**  
subpaths of **p** split by **nth** cut of **knife**  
winding number of path **p** about pair **z**  
pair **z** lies within path **p**?  
pair **z** lies within or on path **p**?  
path surrounding region bounded by paths  
path filled by **draw(g,p)**  
unit square with lower-left vertex at origin  
unit circle centered at origin  
circle of radius **r** about **c**  
arc of radius **r** about **c** from angle **a** to **b**  
unit **n**-sided polygon  
unit **n**-point cyclic cross

## pictures

add picture **pic** to currentpicture  
add picture **pic** about pair **z**

**length(p)**  
**size(p)**  
**cyclic(p)**  
**straight(p,i)**  
**piecewisestraight(p)**  
**point(p,t)**  
**dir(p,t)**  
**dir(p)**  
**dir(p,q)**  
**accel(p,t)**  
**radius(p,t)**  
**precontrol(p,t)**  
**postcontrol(p,t)**  
**arclength(p)**  
**arctime(p,L)**  
**arcpoint(p,L)**  
**dirtime(p,z)**  
**reltime(p,l)**  
**relpoint(p,l)**  
**midpoint(p)**  
**reverse(p)**  
**subpath(p,a,b)**  
**intersect(p,q)**  
**mintimes(p)**  
**maxtimes(p)**  
**intersections(p,q)**  
**intersections(p,a,b)**  
**times(p,x)**  
**times(p,z)**  
**intersectionpoint(p,q)**  
**intersectionpoints(p,q)**  
**extension(P,Q,p,q)**  
**min(p)**  
**max(p)**  
**cut(p,knife,n)**  
**windingnumber(p,z)**  
**interior(p,z)**  
**inside(p,z)**  
**buildcycle(...)**  
**strokepath(g,p)**  
**unitsquare**  
**unitcircle**  
**circle(c,r)**  
**arc(c,r,a,b)**  
**polygon(n)**  
**cross(n)**

**add(pic)**  
**add(pic,z)**

## affine transforms

identity transform  
shift by values  
shift by pair  
scale by **x** in the **x** direction  
scale by **y** in the **y** direction  
scale by **x** in both directions  
scale by real values **x** and **y**  
map  $(x,y) \rightarrow (x+sy,y)$   
rotate by real **angle** in degrees about pair **z**  
reflect about line from **P--Q**

## string operations

concatenate operator  
string length  
position  $\geq$  **pos** of first occurrence of **t** in **s**  
position  $\leq$  **pos** of last occurrence of **t** in **s**  
string with **t** inserted in **s** at **pos**  
string **s** with **n** characters at **pos** erased  
substring of string **s** of length **n** at **pos**  
string **s** reversed  
string **s** with **before** changed to **after**  
string **s** translated via  $\{\{\text{before,after}\},\dots\}$   
format **x** using C-style format string **s**  
casts hexadecimal string to an integer  
casts **x** to string using precision **digits**  
current time formatted by **format**  
time in seconds of string **t** using **format**  
string corresponding to **seconds** using **format**  
split **s** into strings separated by **delimiter**

**identity()**  
**shift(real,real)**  
**shift(pair)**  
**xscale(x)**  
**yscale(y)**  
**scale(x)**  
**scale(x,y)**  
**slant(s)**  
**rotate(angle,z=(0,0))**  
**reflect(P,Q)**  
  
**+**  
**length(string)**  
**find(s,t,pos=0)**  
**rfind(s,t,pos=-1)**  
**insert(s,pos,t)**  
**erase(s,pos,n)**  
**substr(s,pos,n)**  
**reverse(s)**  
**replace(s,before,after)**  
**replace(s,string [] [] table)**  
**format(s,x)**  
**hex(s)**  
**string(x,digits=realDigits)**  
**time(format="%a %b %d %T %Z %Y")**  
**seconds(t,format)**  
**time(seconds,format)**  
**split(s,delimiter="")**

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