

⌈ The Co-dfns Compiler

⌈ High-performance, Parallel APL Compiler

⌈ Copyright © 2011-2017 Aaron W. Hsu arcfide@sacrideo.us

⌈

⌈ This program is free software: you can redistribute it and/or modify it under the terms of the GNU Affero

⌈ General Public License as published by the Free Software Foundation, either version 3 of the License, or (at your option) any later version.

⌈

⌈ This program is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the

⌈ implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU Affero

⌈ General Public License for more details.

⌈

⌈ You should have received a copy of the GNU Affero General Public License along with this program.

⌈ If not, see <http://www.gnu.org/licenses/>

⌈ Namespace CODFNS

```
⌈IO ⌈ML ⌈WX ← 0 1 3
VERSION ← 2017 12 0
BUILDΔPATH ← 'build'
AFΔPREFIX ← '/usr/local'
AFΔLIB ← 'afcuda'
VSΔPS ← '\2017\o, "Enterprise' Professional' Community', " C\VC\Auxiliary\Build'
VSΔPS ,← C' 14.0\VC'
VSΔPS , "← C\Program Files (x86)\Microsoft Visual Studio'
VSΔPS , "← C\vcvarsall.bat'

Cmp ← { _ ← 1 ⌈NDELETE so ← BSO α
      _ ← (BUILDΔPATH, '/', α, '.cpp') put " gc tt ⊃ a n ← ps ω
      _ ← ⌈NEXISTS so ⊃ (⌈ 'vsc' 'gcc' 'clang' ⊃ " Win' Lin' Mac' ⊃ 3 ↑ ⊃ '. ' ⌈WG 'APLVersion') α
      _ : n
      'COMPILE ERROR' ⌈SIGNAL 22}

MkNS ← {NS ⊃ α {NS.⌈α mkfω} (1 = 1 ⌈ Qω) ≠ 0 ⌈ Qω ⊃ NS ← #.⌈NS θ}
Fix ← {α MkNS α Cmp ω}
Xml ← {⌈XML (0 ⌈ Qω), (⌈Φ ≠ 2 ↑ 1 ↓ Qω), (C"), " (C(3 + ≠Qω) ↑, " nrsgvyel'), ⌈, " ↓ Φ, " Q 3 ↓ Qω}
BSO ← {BUILDΔPATH, '/', ω, soext θ}
MKA ← {mka ⊃ ω ⊃ 'mka' ⌈NA 'P ', (BSO α), '|mkarray <PP'}
EXA ← {exa ⊃ ω ⊃ 'exa' ⌈NA (BSO α), '|exarray >PP P'}
FREA ← {frea ω ⊃ 'frea' ⌈NA (BSO α), '|frea P'}

soext ← {'.dll' '.so' '.dylib' ⊃ " Win' Lin' Mac' ⊃ 3 ↑ ⊃ '. ' ⌈WG 'APLVersion'}
tie ← {0 :: ⌈SIGNAL ⌈EN ⊃ 22 :: ω ⌈NCREATE 0 ⊃ 0 ⌈NRESIZE ω ⌈NTIE 0}
put ← {s ← (~128 + 256 | 128 + 'UTF-8' ⌈UCS α) ⌈NAPPEND (t ← tie ω) 83 ⊃ 1 : r ← s ⊃ ⌈NUNTIE t}
mkf ← {fn ← (BSO α), '|', (⌈Δ' ⌈R' ___ ⊃ ω), '_dwa '
      f ← ω, " { _ ← 'dya' ⌈NA ' ', fn, ">PP <PP <PP ' ' ⊃ '
      f, " ← 'mon' ⌈NA ' ', fn, ">PP P <PP ' ' ⊃ '
      f, '0=⌈NC' 'α' :mon 0 0 ω ⊃ dya 0 α ω} ⊃ 0 }
```

```

cio ← { ' -o ' ', BUILDΔPATH, '/', ω, '.', αα, ' ' }
fls ← { ' ', BUILDΔPATH, '/', ω, '.cpp' }
log ← { '> ', BUILDΔPATH, '/', ω, '.log 2>&1' }
lib ← { '-l', AFΔLIB, ' ' }
cci ← { '-I', AFΔPREFIX, '/include' -L'', AFΔPREFIX, '/lib' }
cco ← '-std=c++11 -Ofast -g -Wall -fPIC -shared'
ucc ← { □SH αα, ' ', cco, (cci θ), (ωω cio, fls, lib, log) ω }
gcc ← 'g++' ucc 'so'
clang ← 'clang++' ucc 'dylib'
vsco ← { z ← '/W3 /wd4102 /wd4275 /Gm- /O2 /Zc:inline /Zi /Fd"', BUILDΔPATH
        z, ← '\vc.pdb' /errorReport:prompt /WX- /MD /EHsc /nologo '
        z, '/I"%AF_PATH%\include" /D "NOMINMAX" /D "AF_DEBUG" }
vslo ← { z ← '/link /DLL /OPT:REF /INCREMENTAL:NO /SUBSYSTEM:WINDOWS '
        z, ← '/LIBPATH:"%AF_PATH%\lib" /DYNAMICBASE "', AFΔLIB, '.lib' '
        z, '/OPT:ICF /ERRORREPORT:PROMPT /TLBID:1 }
vsc0 ← { ~v ≠ b ← □NEXISTS`VSΔPS: 'VS NOT FOUND' □SIGNAL 99 ◊ '""', ' amd64', ~ ⊃ b ≠ VSΔPS }
vsc1 ← { '&& cd "', (⊃ □CMD 'echo %CD%'), ' "&& cl ', (vsco θ), '/fast' }
vsc2 ← { '/Fo"', BUILDΔPATH, '\\ " ', BUILDΔPATH, '\', ω, '.cpp' }
vsc3 ← { (vslo θ), '/OUT: "', BUILDΔPATH, '\', ω, '.dll' }
vsc4 ← { '> "', BUILDΔPATH, '\', ω, '.log' "" }
vsc ← { □CMD ('%comspec% /C ', vsc0, vsc1, vsc2, vsc3, vsc4) ω }

get ← { αα □ Qω }
wrap ← ∓o(Q (1 + 1 ↑ Q) ∓ 1 ↓ Q)
bind ← { n_e ← ω ◊ (0 n_ □ e) ← Cn ◊ e }
at ← { α ← ⊢ ◊ A ⊢ ((B) ≠ (rA) ρ A) ← α αα (B) ≠ ((r ← (≠ ρ B ← ωω ω) ((×/ ↑), ↓) ρ) A) ρ (A ← ω) }

d_t_k_n_r_s_g_v_y_e_l ← 17 + fΔ ← 4
d ← d_get ◊ t ← t_get ◊ k ← k_get ◊ n ← n_get ◊ r ← r_get ◊ s ← s_get
g ← g_get ◊ v ← v_get ◊ y ← y_get ◊ e ← e_get ◊ l ← l_get

new ← { Q ∓ fΔ ↑ 0 α, ω }
A ← { ('A' new αα) wrap ⊃ ∓ / ω }
E ← { ('E' new αα) wrap ⊃ ∓ / ω }
F ← { ('F' new αα) wrap ⊃ ∓ / (C 0 fΔ ρ θ), ω }
G ← { ('G' new 0) wrap ⊃ ∓ / ω }
L ← { ('L' new 0) wrap ⊃ ∓ / ω }
M ← { ('M' new 0 ") wrap ⊃ ∓ / (C 0 fΔ ρ θ), ω }
N ← { ('N' new 0 (Φω) }
O ← { ('O' new αα) wrap ⊃ ∓ / ω }
P ← { ('P' new 0 ω }
S ← { ('S' new 0 ω }
V ← { ('V' new αα ω }
Y ← { ('Y' new 0 ω }
Z ← { ('Z' new 1 ω }

◊ msk ← { (t ω) ∈ Cαα } ◊ sel ← { (αα msk ω) ≠ ω }
Am ← 'A' msk ◊ As ← 'A' sel
Em ← 'E' msk ◊ Es ← 'E' sel
Fm ← 'F' msk ◊ Fs ← 'F' sel
Gm ← 'G' msk ◊ Gs ← 'G' sel
Lm ← 'L' msk ◊ Ls ← 'L' sel
Mm ← 'M' msk ◊ Ms ← 'M' sel
Nm ← 'N' msk ◊ Ns ← 'N' sel
Om ← 'O' msk ◊ Os ← 'O' sel
Pm ← 'P' msk ◊ Ps ← 'P' sel
Sm ← 'S' msk ◊ Ss ← 'S' sel
Vm ← 'V' msk ◊ Vs ← 'V' sel
Ym ← 'Y' msk ◊ Ys ← 'Y' sel
Zm ← 'Z' msk ◊ Zs ← 'Z' sel

```

[illegible]

$Sfn \leftarrow aws_s (('TFF\Box_tk) _o ('TFFI\Box_tk)) _s aws_as \{P \Phi \in \omega\}$
 $Prim \leftarrow prim_as P$
 $Vt \leftarrow \{((0 \Box \Box \alpha) \wr \omega) 1 \Box \alpha \bar{\cdot} \bar{\cdot} 1\}$
 $Var \leftarrow \{\alpha (aaww_o aw_o (name_as \Phi) _t (\alpha \alpha = Vt) _as (\omega \omega V \circ, \circ \rhd)) \omega\}$
 $Num \leftarrow float_o int_as (N \circ \Phi)$
 $Strand \leftarrow 0 Var 'a' _s (0 Var 'a' _some) _as ('s' A \circ \Phi)$
 $Pex \leftarrow \{\alpha (rpar_s Ex_s lpar) \omega\}$
 $Atom \leftarrow Strand_o (0 Var 'a' _as ('v' A)) _o (Num_some_as ('n' A \circ \Phi)) _o Pex$
 $Brk \leftarrow rbrk_s \{\alpha (Ex_opt_s (semi_s (Ex_opt) _any)) \omega\} _s lbrk_as ('i' E \circ \Phi)$
 $Idx \leftarrow Brk_s (_yes_as \{P, '[]'\} _s Atom_as (2 E \circ \Phi))$
 $Blrp \leftarrow \{\alpha (\alpha \alpha _s (\omega \omega Slrp \nabla)) \omega\}$
 $Slrp \leftarrow \{\alpha (\alpha \alpha _o (\omega \omega _s \nabla) _o ((1 _eat) _s \nabla)) \omega\}$
 $Fa \leftarrow \{$
 $\quad e \leftarrow (' \omega \omega ' \alpha \alpha', ' \alpha \omega'), \circ \bar{\cdot} \bar{\cdot} 1 \Box \bar{\cdot} 1 + 3 \ 3 \ 2 \ 2 \top (6 \ 4 \ 4 \neq 1 \ 5 \ 9) + 2 \times \wr 14$
 $\quad a \leftarrow e (\alpha \{\omega Gex_o Ex_o Fex Stmts_then Fn \bar{\cdot} \alpha \alpha \bar{\cdot} \alpha\} \bar{\cdot} 2 \ 1 \vdash \omega$
 $\quad m \leftarrow (0 = 0 \Box \Box \alpha) \wedge \wedge \neq (\vee \lambda \circ, = \bar{\cdot} \wr 14) \vee \circ, \neq \bar{\cdot} 1 \Box \Box \alpha$
 $\quad \sim \vee \neq m : (\wr \neq 0 \Box \Box \alpha) \theta \alpha \omega$
 $\quad (1 = + \neq m) \wedge 2 > m \wr 1 : 0 (\wr ('F' new 1) wrap \rhd \rhd m \neq 1 \Box \Box \alpha) \alpha \omega$
 $\quad z \leftarrow ('F' new 'a') wrap \rhd (m \neq 'F' new \bar{\cdot} 1 + \wr 14) \bar{\cdot} (wrap \circ \rhd) m \neq 1 \Box \Box \alpha$
 $\quad 0 (\wr, \wr z) \alpha \omega\}$
 $Fn \leftarrow \{$
 $\quad ns \leftarrow n \ z \neq \bar{\cdot} m \leftarrow \{(F_m \omega) \wedge \bar{\cdot} 1 \in \bar{\cdot} k \omega\} z \leftarrow \rhd \bar{\cdot} / \omega \diamond 0 = \neq ns : 0 (\wr, \wr z) \alpha "$
 $\quad p \leftarrow \alpha \circ Fa \bar{\cdot} ns \diamond 0 < c \leftarrow \wr / \rhd \bar{\cdot} p : c \theta \alpha \omega$
 $\quad 0 (\bar{\cdot} / (\wr 0 \ 4 \rho \theta), \bar{\cdot} p \{\omega ((d + \circ \rhd \bar{\cdot}), 1 \downarrow \bar{\cdot} 1 \vdash) \rhd \bar{\cdot} / 1 \rhd \alpha\} \bar{\cdot} at\{m\} \downarrow z) \alpha "$
 $Pfe \leftarrow \{\alpha (rpar_s Fex_s lpar) \omega\}$
 $Bfn \leftarrow rbrk Blrp lbrk_as ('F' new \bar{\cdot} 1, \circ \wr \circ \Phi 1 \downarrow \bar{\cdot} 1 \downarrow \vdash)$
 $Fnp \leftarrow Prim_o (1 Var 'f') _o Sfn_o Bfn_o Pfe$
 $Mop \leftarrow \{\alpha ((mop_as P) _s Afx_as (1 O)) \omega\}$
 $Dop_1 \leftarrow \{\alpha ((dop_1_as P) _s Afx_as (2 O \circ \Phi)) \omega\}$
 $Dop_2 \leftarrow \{\alpha (Atom_s (dop_2_as P) _s Afx_as (2 O \circ \Phi)) \omega\}$
 $Dop_3 \leftarrow (dop_3_as P) _s Atom_as (2 O \circ \Phi) _o (dot_s jot_as (P \circ \Phi) _as (1 O))$
 $Bop \leftarrow \{\alpha (rbrk_s Ex_s lbrk_s (_yes_as \{P, '[]'\} _s Afx_as (2 O \circ \Phi)) \omega\}$
 $Afx \leftarrow Mop_o (Fnp_s (Dop_1_o Dop_3_opt) _as (\rhd wrap / \circ \Phi)) _o Dop_2_o Bop$
 $Trn \leftarrow \{\alpha (Afx_s ((Afx_o Idx_o Atom) _s (\nabla _opt) _opt)) \omega\} _as ('t' F \circ \Phi)$
 $Bind \leftarrow \{\alpha (gets_s (name_as \Phi) _env (\alpha \alpha \{\rhd \Phi \omega\} \alpha \alpha \bar{\cdot} \alpha)) _as (\omega \omega new 'b', \vdash)) \omega\}$
 $Asgn \leftarrow gets_s Brk_s (name_as \Phi _t (0 = Vt) _as ('a' V \circ, \circ \rhd)) _as ('a' E \circ \Phi)$
 $Fex \leftarrow Afx_s (Trn_opt) _s (1 Bind 'F' _any) _as (\rhd wrap / \circ \Phi)$
 $App \leftarrow Afx_s (Idx_o Atom_s (dop2_not) _opt) _as \{(\neq \omega) E \Phi \omega\}$
 $Ex \leftarrow Idx_o Atom_s \{\alpha (0 Bind 'E' _o Asgn_o App_s \nabla _opt) \omega\} _as (\rhd wrap / \circ \Phi)$
 $Gex \leftarrow Ex_s grd_s Ex_as (G \circ \Phi)$
 $Nlrp \leftarrow sep_o eot Slrp (lbrk Blrp rbrk)$
 $Stmts \leftarrow \{\alpha (sep_any_s (Nlrp_then (\alpha \alpha _s eot \circ \Phi)) _any_s eot) \omega\}$
 $Ns \leftarrow nss Blrp nse_then (Ex_o Fex Stmts_then Fn) _s eot_as M$
 $ps \leftarrow \{0 \neq \rhd c a e r \leftarrow (0 \ 2 \rho \theta) Ns \in \{\omega / \bar{\cdot} \wedge \setminus 'a' \neq \omega\} \bar{\cdot} \omega, \bar{\cdot} \Box UCS \ 10 : \Box SIGNAL \ c \diamond (\rhd \alpha) e\}$

$scp \leftarrow (+\backslash F_m) \vdash \circ \sqsubset \vdash$
 $prf \leftarrow ((\neq \uparrow \neg 1 \downarrow \vdash (\neq) 0 \neq \vdash) \circ 1 \uparrow or) \vdash$
 $blg \leftarrow \{\alpha \leftarrow \vdash \diamond \alpha((prf(\uparrow / (1 \neq \vdash) \times \circ 1 (1 \downarrow \vdash) \wedge (= \vee 0 = \vdash) \circ \mathbb{Q} \vdash) \alpha \alpha (\neq \uparrow) r) \sqsubset \circ 2 \omega \omega (\neq) \alpha \alpha) \omega\}$
 $enc \leftarrow \subset \neg, \circ \supset ((\neg, \neg, \vdash) / (C''), (\Phi \vdash (\neq) 0 \neq \vdash))$
 $veo \leftarrow \cup ((C' \% u'), (\text{"prims"}, \neg) \sim \circ \{ \supset, / \{ C \star (1 \equiv \equiv \omega) \vdash \omega \}'' \omega \} \neg 1 \downarrow \vdash (\neq) (\wedge /'' 0 \neq ((\supset 0 \rho \vdash)'' \vdash))$
 $ndo \leftarrow \{\alpha \leftarrow \vdash \diamond m \supset \circ (C, \vdash)'' \alpha \circ \alpha'''' \omega \supset \circ (\circ \sim C)'' \sim m \leftarrow 1 \geq \equiv'' \omega\}$
 $n2f \leftarrow (\supset, /) ((1 = \equiv) \supset, \circ \sim \circ C)''$

 $rn \leftarrow \vdash, \circ \downarrow (1 + d) \uparrow \circ \neg 1 (+\backslash d \circ, = \circ 1 + (\uparrow / 0, d))$
 $rd \leftarrow \vdash, (+ / \uparrow or \wedge (= \vee 0 = \vdash) \circ \mathbb{Q} \circ \uparrow or \vdash (\neq) F_m \wedge 1 \in \sim k)$
 $df \leftarrow \vdash (\neq) (+\backslash 1 = d) (\sim \neg \in \neg (\neq) (1 = d) \wedge (\sim 'b' \in \sim k) \wedge O_m \vee F_m) \vdash$
 $dua \leftarrow ((\sim G_m) \wedge F_m \vee \downarrow \circ prf \in r o F_s) (\neg (\neg \circ \vdash) (d (\neq) \neg) (0, 1 \downarrow (\neg \Phi \vdash) \wedge \neg = \neg 1 \Phi \neg) \neg (\neq \circ \vdash) 0 \in \sim n) \vdash$
 $du \leftarrow \vdash (\neq \circ \sim) dua \vee \circ (\vee /) (prf \wedge (= \vee 0 = \vdash) \circ \mathbb{Q} prf (\neq) dua) \wedge \uparrow or \wedge \geq \circ \mathbb{Q} dua (\neq \circ \vdash) \uparrow or \times 0 = prf$
 $lfh \leftarrow (0 \neq 1 \sqsubset \neg) \supset (C \circ \mathbb{Q} \circ \circ \circ M' 0'', 0, \sim (C \neg)), \circ C \circ \mathbb{Q} \circ \circ 1 'F' 1, (fn' enc \neg), (C \neg), 5 \downarrow \circ, 1 \uparrow \vdash$
 $lfn \leftarrow (d, 'Of', 3 \downarrow \vdash) \circ 1 at (F_m \wedge 'b' \in \sim k) (d, 'Vf', ('fn' enc \circ \supset r), 4 \downarrow \vdash) \circ 1 at (F_m \wedge 1 \in \sim k)$
 $lf \leftarrow (\supset /) (1, 1 \downarrow F_m \wedge 1 \in \sim k) blg (\uparrow r) (C lfh \circ ((\vdash - (\supset - 2 \downarrow \supset)) d), 1 \downarrow \circ 1 \vdash) lfn) \sqsubset 1 \downarrow \vdash$
 $dn \leftarrow ((0 \in \sim n) \wedge (A_m \wedge 'v' \in \sim k) \vee O_m \wedge 'f' \in \sim k) ((\sim \neg) (\neq \circ \vdash) (d - \neg 1 \Phi \neg), 1 \downarrow_{[1]} \vdash) \vdash$
 $mrep \leftarrow (1 + \supset), 'P' 0 (' \vdash), (C''), \sim \neg 1 \downarrow 4 \downarrow \circ, 1 \uparrow \vdash$
 $mreu \leftarrow \supset, 'E' 'u', (C''), \sim \neg 1 \downarrow 3 \downarrow \circ, 1 \uparrow \vdash$
 $mre \leftarrow (\supset /) (\neg \supset V_m \vee A_m) \circ \supset \circ \Phi (\downarrow, (((\vdash \rho \sim (\neq \mathbb{Q}), \sim \neq \times 2 < \neq) mreu \circ mrep \circ (1 + d), 1 \downarrow \circ 1 \vdash)'' \uparrow)) \vdash$
 $mrs \leftarrow \vdash \subset_{[0]} \sim 1, 1 \downarrow d = 1 + \circ \supset d$
 $mrk \leftarrow (\neg \circ (+ / \wedge) \circ \Phi L_m) (\uparrow \sim \circ (mre (mre mrs)'' at (G_m \circ (\supset /) 1 \uparrow \vdash) \circ mrs) \downarrow) \vdash$
 $mr \leftarrow (\supset /) ((1 \uparrow \vdash), (mrk'' 1 \downarrow \vdash)) \circ scp$
 $ur \leftarrow ((2 \uparrow \vdash), 1, ('um' enc \circ \supset r), 4 \downarrow \vdash) \circ 1 at (E_m \wedge 'u' \in \sim k)$
 $rt \leftarrow \vdash, (\vee \backslash F_m) + (+ \neq prf \wedge (= \vee 0 = \neg) \circ \mathbb{Q} \sim \circ \uparrow or M_s \circ G_s) - F_m$
 $nm \leftarrow ((3 \uparrow \vdash), ('fe' enc \circ \supset r), 4 \downarrow \vdash) \circ 1 at ((0 \in \sim n) \wedge E_m \vee O_m \vee A_m)$
 $lgg \leftarrow (\circ / 1 \downarrow \vdash) \circ \supset \sim \neg (((\neg 1 + d), 2, \sim t, k, n, r, \circ s) \circ \neg \circ 3, 'V', 'a', 3 (\downarrow \circ 1) 1 \uparrow \vdash) \circ \supset 1 \uparrow \vdash$
 $lg \leftarrow (\supset /) \vdash ((C \neg (\neq \circ \sim) (\vee \backslash \vdash)), (((1 \uparrow \vdash) lgg \vdash \subset_{[0]} \sim d = 1 + \supset)'' \subset_{[0]} \sim)) G_m \wedge 1 \Phi E_m$
 $fet \leftarrow (d, 'V' 0, 3 \downarrow \vdash) \circ 1 at (0, 1 \downarrow E_m \vee O_m \vee A_m) (d, 'Av', 3 \downarrow \vdash) \circ 1 at (E_m \wedge 'b' \in \sim k)$
 $fee \leftarrow (\circ / \Phi) (M_m \vee E_m \vee O_m \vee A_m) blg \vdash ((\supset \circ \Phi \vdash) (C (d - \sim \circ \supset), 1 \downarrow \circ 1 \vdash) \circ fet \neg \circ \neg 1 \downarrow \circ 1 \vdash) \sqsubset \supset, \sim 1 \downarrow \vdash$
 $fe \leftarrow (\supset /) (+\backslash d \leq g) (C (\vdash \uparrow \sim 1 = \circ \neq \vdash) \circ \supset \circ fee \vdash) \sqsubset \vdash$
 $can \leftarrow (+\backslash A_m \vee O_m) ((1 \uparrow \vdash), \circ (C (\neg 1 + 2 \downarrow \neq) \supset (C \circ C \supset), C) \circ n 1 \downarrow \vdash) \sqsubset \vdash$
 $cas \leftarrow (\neg 1 \Phi (A_m \vee O_m) \wedge 'vf' \in \sim k) \vee (\downarrow prf) \in or \vdash (\neq) A_m \wedge 'n' \in \sim k$
 $ca \leftarrow (can \vdash (\neq) cas \vee A_m \vee O_m \wedge 'f' \in \sim k) \neg at (A_m \vee O_m \wedge 'f' \in \sim k) \theta, \circ C \sim \vdash (\neq \circ \sim) cas$
 $lj \leftarrow (\supset /) (1 \uparrow scp), ((\vdash \circ 2 'L' 0 0, 2'', \sim \neg 2 \downarrow 4 \downarrow \circ, 1 \uparrow \vdash)'' 1 \downarrow scp)$
 $sd \leftarrow (\supset /) (1 \uparrow scp), (n F_s) (d, 'Vf', (C \neg), 4 \downarrow \vdash) \circ 1 at ((C, 'V') \in \sim n)'' 1 \downarrow scp$
 $inm \leftarrow \vee \neq \neg 1 (\Phi \vee \vdash) 1 2 (\Phi \vee \vdash) (\neg 1 \neg 2 \Phi E_m \wedge_{[1]} 1 2 \circ, = k) \wedge \circ 1 V_m \wedge n \in \circ n F_s$
 $inp \leftarrow (E_m \wedge \neg) \vee 1, 2 \neq \neg$
 $inza \leftarrow (1 \uparrow 1 \downarrow \neg) (\neq \circ \neq) at ((C, 'a') \in \sim n) (\neg 1 \uparrow \neg) (\neq \circ \neq) at ((C, 'w') \in \sim n) \vdash$
 $inz \leftarrow (1 \uparrow \neg) (d, t, k, 3 \downarrow \circ 1 (\neq \circ \neq)) at (0, \sim 2 \neq \circ \Phi (\vee \circ \Phi E_m)) inza$
 $inn \leftarrow (3 \uparrow \circ 1 \vdash), ((\neg \rho \sim 1 + 0 \uparrow (\uparrow / \circ n G_s)) (('fe' \equiv 2 \uparrow \vdash) \supset (C \neg), \circ C 'fe', (\Phi \neg), 2 \downarrow \vdash)'' n), (4 \downarrow \circ 1 \vdash)$
 $ins \leftarrow \neg (d, t, k, ((1000 \times 1 + \neg) + 1 + n + (\uparrow / n)), 4 \downarrow \circ 1 \vdash) at (L_m \vee G_m) inn$
 $inr \leftarrow 1, \circ \vdash \vdash inz'' (\circ \neq \vdash) ins'' ((\supset \circ n'' \neg) \circ ((\supset n (\neq) V_m \wedge 'f' \in \sim k)'' \vdash)) \supset'' (C 1 \downarrow'' \neg), \circ C'' \vdash$
 $in \leftarrow (\supset /) \circ (\vdash /) (1 \downarrow scp) inr \circ ((0 \rho \subset 0 8 \rho 0), \vdash /) at (\neg /) inm ((\supset'' inp \subset E_m \wedge \neg), \circ \vdash inp \subset_{[0]} \vdash) \vdash$

$pcc \leftarrow (C \vdash (\neq) A_m \vee O_m \wedge 'f' \in \sim k) \circ ((1 \cup \sim n) \sqcap \emptyset 2 (1 \upharpoonright \neq) \uparrow \vdash) \circ (\supset \neg) \circ \Phi (\neg \vdash)$
 $pcb \leftarrow ((\wedge, (= \vee 0 = \neg) \circ \neg) \emptyset 2 1 \sim \circ \uparrow \text{or } M_s \neg F_s) pcc \emptyset 1 ((\vdash (\neq) (d = g) \wedge A_m \vee E_m \vee O_m) \neg scp)$
 $pcv \leftarrow (d, 'V', ('a f' \supset \neg \circ \neg O_m), (\supset \neg), r, s, (C \theta), \sim \circ \neg g) \text{at } (O_m \vee A_m \wedge 'v' \in \sim k)$
 $pc \leftarrow (\supset \neg /) pcb \{ (pcv d (\neg, 1 \downarrow \emptyset 1 \vdash) (\alpha \uparrow \sim 1 \upharpoonright \neq \alpha) \sqcap \emptyset 2 \sim (n \alpha) \wr n) \text{at } (V_m \wedge (n \alpha) \in \sim n) \omega \} \neg scp$
 $da \leftarrow \vdash (\neg \sim \circ \sim) (A_m \wedge d = g) \vee (0, \sim 2 \wedge / L_m) \vee (L_m \wedge \neg 1 \Phi A_m \wedge d = g) \vee O_m \wedge ('f' \in \sim k) \wedge 1 \neq d$
 $fce \leftarrow (\supset \text{on } P_s) \{ C \Phi ' \omega', \sim (\neq \omega) \supset ' (\alpha, ' \supset') (' \supset', \alpha, ' /') \} (\vee A_s)$
 $fcm \leftarrow (\wedge / E_m \vee A_m \vee P_m) \wedge \sim 'u i' \in \sim \circ \supset \circ \supset k$
 $fc \leftarrow ((\supset \neg /) (((d, 'An', 3 \downarrow \neg 1 \downarrow), 1 \uparrow \vdash), fce) \neg \text{at } (fcm)) ('MFOEL' \in \sim t) \subset_{[0]} \vdash$
 $ce \leftarrow (+ \setminus F_m \vee G_m \vee E_m \vee O_m \vee L_m) ((\neg 1 \downarrow \circ, 1 \uparrow \vdash), \circ C (\supset \text{ov } 1 \uparrow \vdash), \circ (A_m \supset \neg \circ \downarrow n, \circ \neg \text{on } 2 f v) 1 \downarrow \vdash) \sqcup \vdash$
 $ll \leftarrow (\vdash (\neq) 1 \Phi L_m) (((C C \% l'), \circ C \neg \text{on } \neg), \sim \neg 1 \downarrow \emptyset 1 \vdash) \text{at } L_m \vdash$
 $fv \leftarrow (\supset \neg /) (((1 \downarrow \vdash) \neg \sim (, 1 \uparrow \vdash), \circ C \text{on } \neg 1 \uparrow \vdash) \neg scp)$
 $nv \leftarrow (\neg 1 \downarrow \emptyset 1 \vdash), (\neg 1 \ominus \neq \supset \vdash, \circ C \sim (C \% u' \% f' \% u'), (C \% u' \% i', \vdash), (C (C \% u'), \vdash)) \neg \text{ov}$
 $lt \leftarrow (C \theta), \sim \vdash$
 $val \leftarrow (n \wr \cup n), \neg \vdash (\vdash + (\neq \neg) \times 0 = \vdash) ((/ (1 \neq) \times \emptyset 1 (\cup n) \circ ((C \neg) \in \vdash) (n 2 f' v))$
 $vag \leftarrow \wedge \sim \circ (\circ, = \sim \circ 1 \neq) \sim (\circ, (((1 \sqcap \vdash) > 0 \sqcap \neg) \wedge (0 \sqcap \vdash) < 1 \sqcap \neg) \sim val)$
 $vae \leftarrow (\cup n) (\neg, \emptyset 0 \neg (\sqcap \sim \emptyset 1 0) \circ \supset ((\vdash, \circ \supset (1 \circ \neq \neg) \sim \vdash (\neq) (\neq \vdash) \uparrow \neg) / \circ \Phi (C \theta), \circ \downarrow \vdash)) vag$
 $vac \leftarrow (((0 \sqcap \circ \neg) \neg) \wr \circ C \vdash) \supset (1 \sqcap \circ \neg) \neg, \circ C \vdash) \text{ndo}$
 $va \leftarrow ((\supset \neg /) (1 \uparrow \vdash), (((vae E_s) (d, t, k, (\neg vac n), r, s, g, y, \circ \neg \sim (C \neg) vac \neg v) \vdash) \neg 1 \downarrow \vdash)) scp$
 $avb \leftarrow \{ ((((' \alpha \omega') \uparrow \sim 1 \downarrow \rho) \neg \vdash) \alpha \sqcap \sim \emptyset 2 0 \vdash \alpha \alpha \wr \alpha \alpha \neg \sim (\downarrow (\Phi 1 + \circ 1 0 \wr \vdash) ((\neq \vdash) \uparrow \uparrow) \emptyset 0 1 \vdash) \supset r \omega \}$
 $avi \leftarrow \neg 1 0 + (\rho \neg) \top (\neg, \neg) \wr (C \vdash)$
 $avh \leftarrow \{ C \omega, (n \omega) ((\alpha \alpha (\omega \omega avb) \omega) \{ \alpha \alpha avi \text{ndo } (C \alpha), \omega \} \neg v \omega \}$
 $av \leftarrow (\supset \neg /) (+ \setminus F_m) \{ \alpha ((\alpha ((\cup \circ \Phi (0 \rho C \neg), n) E_s) \sqcup \omega) avh (r (1 \uparrow \omega) \neg F_s \omega)) \sqcup \omega \} \vdash$
 $rlf \leftarrow (\Phi \downarrow (((1 \supset \neg) \cup \vdash \sim 0 \sqcap \neg) / \circ \Phi (C \theta), \uparrow) \emptyset 0 1 \sim 1 + \circ 1 \neq) (\ominus 1 \ominus n, \emptyset 0 (C \neg) \text{veo} \neg v)$
 $rl \leftarrow \vdash, \circ (\supset, /) (C \text{on } O_s \neg F_s) rlf \neg scp$
 $vc \leftarrow (\supset \neg /) (((1 \downarrow \vdash) \neg \sim (1 \uparrow \vdash), (\neq \cup \text{on } E_s), 1 \neg 3 \uparrow \vdash) \neg scp)$
 $eff \leftarrow (\supset \neg /) \vdash (((C \circ \neg \circ \neg d, 'Fe', 3 \downarrow), 1 \uparrow \neg), 1 \downarrow \vdash) (d = \circ \supset d) \subset_{[0]} \vdash$
 $ef \leftarrow (F_m \wedge \neg 1 = \circ \times \circ \supset \neg y) ((\supset \neg /) (C \vdash (\neq) \circ \sim (\vee \neg)), (eff \neg \subset_{[0]}) \vdash$
 $ifn \leftarrow 1 'F' 0 'Init' \theta 0 1, (4 \rho 0) \theta \theta, \sim \vdash$
 $if \leftarrow (1 \uparrow \vdash) \neg (\vdash (\neq) O_m \wedge 1 = d) \neg ((\vdash \text{wrap} \sim \circ ifn \neq \cup n) \vdash (\neq) E_m \wedge 1 = d) \neg (\vee \setminus F_m) (\neg \vdash) \vdash$
 $fgz \leftarrow (1 \uparrow \vdash) \neg (((\neg 1 + d), 1 \downarrow \emptyset 1 \vdash) 1 \downarrow \vdash) \neg 2, 'G', 1, 3 \downarrow \emptyset 1 (\neg 1 \uparrow \neg 1 \downarrow \emptyset 1 \vdash), \text{on } 1 \uparrow \vdash$
 $fg \leftarrow (\supset \neg /) (fgz \neg \text{at } (G_m \circ (\supset \neg /) 1 \uparrow \neg) \vdash \subset_{[0]} \sim d = 2 \wr g)$
 $fft \leftarrow (, 1 \uparrow \vdash) (1 'Z', (2 \downarrow \neg 5 \downarrow \neg), (v \neg), n, y, (C 2 \uparrow \circ, \circ \supset \circ \supset e), l) (\neg 1 \uparrow E_s)$
 $ff \leftarrow ((\supset \neg /) (1 \uparrow \vdash), (((1 \uparrow \vdash) \neg (((\neg 1 + d), 1 \downarrow \emptyset 1 \vdash) 1 \downarrow \vdash) \neg fft) \neg 1 \downarrow \vdash)) scp$
 $fzh \leftarrow ((\cup n) \cap (\supset \text{ol } \neg)) (\neg 1 \Phi (C \neg), ((\neq \vdash) - 1 + (\Phi n) \wr \neg) ((C \neg \vdash \neg \circ C (\supset \neg e)), (C \neg \vdash \neg \circ C (\supset \neg y)), \circ C \neg) \vdash) \vdash$
 $fzf \leftarrow 0 \neq (\neq \rho \neg \circ \supset \text{ov } \neg)$
 $fzb \leftarrow (((\supset \text{ov } \neg) (\neq) fzf), n), \circ \neg ('f' \circ, \circ \Phi \neg \circ 1 (+ / fzf)), ('s' \circ, \circ \Phi \neg \circ 1 \neq \vdash)$
 $fzv \leftarrow ((C \neg) (\ominus \uparrow) \sim \neg (\neq \neg) (- + \circ 1 \vdash) (\neq \vdash)) ((\vdash, \sim 1 \sqcap \circ \neg) \sqcap \sim (0 \sqcap \circ \neg) \wr \vdash) \emptyset 2 0 \neg v$
 $fze \leftarrow (\neg 1 + d), t, k, fzb ((\vdash / (- \neq \vdash) \uparrow \neg), r, s, g, fzv, y, e, \circ \neg l) \vdash$
 $fzs \leftarrow (, 1 \uparrow \vdash) (1 \ominus (\neg ((1 'Y', (2 \sqcap \neg), \vdash) \neg \circ \neg \circ \neg (3 \uparrow \neg), \vdash) 1 \Phi fzh, \neg 1 \downarrow 6 \downarrow \neg) \neg fze) (\neg \vdash) \vdash$
 $fz \leftarrow ((\supset \neg /) (1 \uparrow \vdash), (((2 = d) (fzs \neg (1 \downarrow \circ \sim \neg) (\neg \vdash) 1 \downarrow \vdash) \vdash) \neg 1 \downarrow \vdash)) (1, 1 \downarrow S_m) \subset_{[0]} \vdash$
 $fd \leftarrow (1 \uparrow \vdash) \neg ((1, 'F d', 3 \downarrow \vdash) \emptyset 1 F) \neg 1 \downarrow \vdash$

$tta \leftarrow (f \circ da \circ (pc \star \equiv) \circ mr \star \equiv) \circ in \star 3 \circ sd \circ l j \circ ca \circ f e \circ l g \circ n m \circ r t \circ m r \circ d n \circ l f \circ d u \circ d f \circ r d \circ r n$
 $tt \leftarrow f d \circ f z \circ f f \circ f g \circ i f \circ e f \circ v c \circ r l \circ a v \circ v a \circ l t \circ n \circ v \circ f \circ v o l l \circ c e \circ u \circ r \circ t \circ t \circ a$

```

E1 ← { 'fn' gcl ((C n, o ⊃ v), e, y) ω }
E2 ← { 'fn' gcl ((C n, o ⊃ v), e, y) ω }
Ei ← { r l f ← ⊃ v ω ◊ ((C n ω) ('fn' var) ⊃ ⊃ e ω), '=' , ((C n ω) ('fn' var) 1 ⊃ ⊃ e ω), ';' , nl }
O1 ← { 'op' gcl ((C n, o ⊃ v), e, y) ω }
O2 ← { 'op' gcl ((C n, o ⊃ v), e, y) ω }
O0 ← { }
Of ← { 'EF' (, ('Δ' □R' ___' ⊃ n ω), ', ', (C n ω), ', ') ; ', nl }
Fd ← { 'FP' (, (C n ω), ', ') ; ', nl }
F0 ← { 'DF' (, (C n ω), ' _f ) { ', nl, 'A*env[]={tenv}' ; ', nl }
F1 ← { 'DF' (, (C n ω), ' _f ) { ', nl, ('env0' dnv ω), (fnv ω) }
G0 ← { v ← (C n ω) (" var) 1 ⊃ ⊃ e ω
      'if (1!=cnt('v, '))err(5); if('v, 'v.as(s32).scalar<I>()) { ', nl }
G1 ← { 'z=' , ((C n ω) (" var) ⊃ ⊃ e ω), '; goto L, (Φ ⊃ l ω), ';' ; ', nl }
L0 ← { 'z=' , a, ';' ; L, (Φ ⊃ n ω), ':' , (a ← (1 ⊃ ⊃ v ω) (" var) 1 ⊃ ⊃ e ω), '=z;' ; ', nl }
Z0 ← { }', nl, nl }
Z1 ← { }', nl, nl }
Ze ← { }', nl, nl }
M0 ← { rth, ('tenv' dnv ω), nl, 'A*env[]={', ((0 ≡ C n ω) ⊃ 'tenv' 'NULL'), ', ' ; ', nl, nl }
S0 ← { ( ('{', rk0, srk, 'DO(i, prk) cnt*=sp[i] ; ', spp, sfv, slp) ω ) }
Y0 ← { C, / ((1 ≠ C n ω) ((¬ sts'' (C l), '° ⊃ s), '}', nl, ¬ ste'' (C n) var'' ⊃ r) ω), '}', nl }

gc ← { C, / { 0 = ⊃ t ω : C 5 p θ ◊ C (Φ ⊃ t ω), Φ ⊃ k ω) ω } ÷ 1 ⊢ ω }

syms ← , " '+' '-' 'x' '÷' '*' '⊗' '|' 'o' 'L' 'f' '!'
nams ← 'add' 'sub' 'mul' 'div' 'exp' 'log' 'res' 'cir' 'min' 'max' 'fac'
syms ← , "<" "≤" "=" "≥" ">" "≠" "¬" "∧" "∨" "∧'" "∨'"
nams ← 'lth' 'lte' 'eql' 'gte' 'gth' 'neq' 'not' 'and' 'lor' 'nan' 'nor'
syms ← , "[]" '[' ']' 'p' ',' '⋮' 'φ' '⊗' '⊙' 'ε' '⊃'
nams ← 'sqd' 'brk' 'iot' 'rho' 'cat' 'ctf' 'rot' 'trn' 'rtf' 'mem' 'dis'
syms ← , "≡" "≠" "⊥" "⊥'" "⊥'" "⊥'" "⊥'" "⊥'" "⊥'" "⊥'"
nams ← 'eqv' 'nqv' 'rgt' 'lft' 'enc' 'dec' 'red' 'rdf' 'scn' 'scf' 'rol'
syms ← , "↑" "↓" "⋮" "⋮'" "⋮'" "⋮'" "⋮'" "⋮'" "⋮'" "⋮'"
nams ← 'tke' 'drp' 'map' 'com' 'dot' 'rnk' 'pow' 'jot' 'unq' 'int'
syms ← , "⊕" "⊖" "⊙" "⊙'" "⊙'" "⊙'" "⊙'" "⊙'" "⊙'" "⊙'"
nams ← 'gdu' 'gdd' 'oup' 'fnd' 'par' 'mdv' 'fft' 'ift' ""

nl ← □ UCS 13 10 ◊ fvs ← , ÷ 0 (÷) 0 ≠ (≠ op'' ⊢) ◊ cln ← '-' □R '-' ◊ cnm ← (syms 1 C) ⊃ (nams, C)
lits ← { 'A(0, eshp, constant(' , (cln Φ ω), ', eshp, ', ('f64' 's32' ⊃ ÷ ω = |ω), ', )) }
litv ← { 'std::vector<', ('DI' ⊃ ÷ ∧/ ω = |ω), '>{' , (cln ⊃ {α, ', ', ω}/ Φ'' ω), '}' .data() }
lita ← { 'A(1, dim4(' , (Φ ≠ ω), ', ), array(' , (Φ ≠ ω), ', ', (litv ω), ', )) }
lit ← { ' '= ⊃ 0 p ω : (cnm ω), α ◊ 1 = ≠ ω : lits ω ◊ lita ω }
var ← { α ≡, 'α' : , 'l' ◊ α ≡, 'ω' : , 'r' ◊ 1 ≥ C n ω : α α lit, α ◊ 'env[' , (Φ ⊃ ω), ']' [', (Φ ⊃ Φ ω), ']' }
dnv ← { (0 ≡ z) ⊃ ('A' , α, '[' , (Φ z ← C n ω), ']' ; ') ('A*' , α, '=NULL ; ') }
fnv ← { z ← 'A*env[' , (Φ 1 + C s ω), ']' = {', (C, / (C'env0'), {', p[' , (Φ ω), ']' }'' 1 ⊃ s ω), '}' ; ', nl }
gcl ← { z r l n ← ((3 p C'fn'), C α) { C α var/ ω }'' ⊃ (C ω), 1 ⊃ ω ◊ n, '(' , (C {α, ', ', ω}/ z l r ~ C'fn'), ', env) ; ', nl }

```

$\nabla Z \leftarrow Gfx\Delta Init S$

```
'w_new'   □NA 'P ', (BSO S), '|w_new <C[]'  
'w_close' □NA 'I ', (BSO S), '|w_close P'  
'w_del'   □NA (BSO S), '|w_del P'  
'w_img'   □NA (BSO S), '|w_img <PP P'  
'w_plot'  □NA (BSO S), '|w_plot <PP P'  
'w_hist'  □NA (BSO S), '|w_hist <PP F8 F8 P'  
'loadimg' □NA (BSO S), '|loadimg >PP <C[] I'  
'saveimg' □NA (BSO S), '|saveimg <PP <C[]'
```

$Z \leftarrow 00\rho\theta$

∇

$Display \leftarrow \{\alpha \leftarrow 'Co-dfns' \diamond W \leftarrow w_new \sqsubset \alpha \diamond 777 :: w_del W$
 $w_del W \dashv W \alpha \alpha \{w_close \alpha : \perp \square SIGNAL \ 777' \diamond \alpha \alpha \omega\} \star \omega \omega \vdash \omega\}$

$LoadImage \leftarrow \{\alpha \leftarrow 1 \diamond \mathbb{Q} loadimg \theta \omega \alpha\}$

$SaveImage \leftarrow \{\alpha \leftarrow 'image.png' \diamond saveimg (\mathbb{Q}\omega) \alpha\}$

$Image \leftarrow \{\sim 2 \ 3 \vee. = \neq \rho \omega : \square SIGNAL \ 4 \diamond (3 \neq 2 \supset 3 \uparrow \rho \omega) \wedge 3 = \neq \rho \omega : \square SIGNAL \ 5 \diamond \omega \dashv w_img (\mathbb{Q}\omega) \alpha\}$

$Plot \leftarrow \{\sim 2 \neq \neq \rho \omega : \square SIGNAL \ 4 \diamond \sim 2 \ 3 \vee. = 1 \supset \rho \omega : \square SIGNAL \ 5 \diamond \omega \dashv w_plot \omega \alpha\}$

$Histogram \leftarrow \{\omega \dashv w_hist \omega, \alpha\}$

:EndNamespace