

⌕ The Co-DFS 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 11 0
⌕ COMPILER ← 'vsc'
⌕ BUILDΔPATH ← 'build'
⌕ AFΔPREFIX ← '/usr/local'
⌕ AFΔLIB ← 'afcuda'
VISUALΔSTUDIOΔPATH ← 'C:\Program Files (x86)\Microsoft Visual Studio\2017\Enterprise\VC\Auxiliary\Build'

Cmp ← { _ ← { 22 :: θ ⋄ ω ⌕ NERASE ω ⌕ N TIE 0 } so ← BSO α
      _ ← (⌕ COMPILER) α ⌕ (BUILDΔPATH, '/', α, '_', COMPILER, '.cpp') put~ gc tt ⋄ a n ← ps ω
      22 :: 'COMPILE ERROR' ⌕ SIGNAL 22
      n ⌕ NUNTIE so ⌕ N TIE 0 }

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

soext ← { '.dll' '.so' '.dylib' ⋄ ~ 'vsc' 'gcc' 'clang' ⌕ C COMPILER }
tie ← { 0 :: ⌕ SIGNAL ⌕ EN ⋄ 22 :: ω ⌕ NCREATE 0 ⋄ 0 ⌕ NRESIZE ω ⌕ N TIE 0 }
put ← { s ← (~128 + 256 | 128 + 'UTF-8' ⌕ UCS α) ⌕ NAPPEND (t ← tie ω) 83 ⋄ 1 : r ← s ⌕ NUNTIE t }
mkf ← { fn ← BUILDΔPATH, '/', α, '_', COMPILER, (soext θ), '|', (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, ' _ ', α, ' . ', αα, ' ' ' }
fls ← { ' ' , BUILDΔPATH, '/', ω, ' _ ', α, ' .cpp ' ' ' }
log ← { '> ' , BUILDΔPATH, '/', ω, ' _ ', α, ' .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), COMPILER (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 ← { " " , VISUALΔSTUDIOΔPATH, '\vcvarsall.bat' amd64 }
vsc1 ← { && cd " , (⊃ □CMD 'echo %CD%'), " && cl ' , (vsco θ), '/fast ' }
vsc2 ← { /Fo" , BUILDΔPATH, '\\" " , BUILDΔPATH, '\', ω, ' _vsc.cpp " ' }
vsc3 ← { (vslo θ), '/OUT:" , BUILDΔPATH, '\', ω, ' _vsc.dll " ' }
vsc4 ← { '> " , BUILDΔPATH, '\', ω, ' _vsc.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) ← C n ◊ e }
at ← { α ← ⊢ ◊ A ⊢ ((B) ⊢ (r A) 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 1) wrap ⊃ ∓ / (⊂ 0 fΔ ρ θ), ω }
G ← { ('G' new 0) wrap ⊃ ∓ / ω }
L ← { ('L' new 0) wrap ⊃ ∓ / ω }
M ← { ('M' new 0 ") wrap ⊃ ∓ / (⊂ 0 fΔ ρ θ), ω }
N ← { ('N' new 0 (⊕ω) }
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]

$Sfn \leftarrow aws_s (('TFF\Box_tk) _o ('TFFI\Box_tk)) _s aws_as \{P \Phi \in \omega\}$
 $Prim \leftarrow prim_as P$
 $Vt \leftarrow \{((0 \Box \Box \alpha) \downarrow \omega) 1 \Box \alpha \vdash \neg 1\}$
 $Var \leftarrow \{\alpha (aaww_o aw_o (name_as \Phi)) _t (\alpha \alpha = Vt) _as (\omega \omega V_o, o \supset)) \omega\}$
 $Num \leftarrow float_o int_as (N_o \Phi)$
 $Strand \leftarrow 0 \ Var \ 'a' _s (0 \ Var \ 'a' _some) _as ('s' A_o \Phi)$
 $Pex \leftarrow \{\alpha (rpar_s Ex_s lpar) \omega\}$
 $Atom \leftarrow Strand_o (0 \ Var \ 'a' _as ('v' A)) _o (Num_some_as ('n' A_o \Phi)) _o Pex$
 $Idx \leftarrow \{\alpha (rbrk_s Ex_s lbrk_s Atom_as ('i' E_o \Phi)) \omega\}$
 $Blrp \leftarrow \{\alpha (\alpha _s (\omega \omega Slrp \nabla)) \omega\}$
 $Slrp \leftarrow \{\alpha (\alpha _o (\omega \omega _s \nabla)) _o ((1_eat) _s \nabla)) \omega\}$
 $Fn \leftarrow ns \leftarrow n \ z \neq m \leftarrow \{(Fm \ \omega) \wedge 1 \in \approx k \ \omega\} \ z \leftarrow \supset \neg / \ \omega \diamond 0 = \neq ns : 0 (_Cz) \alpha "$
 $\quad \mathcal{Q} \ bs \leftarrow (1 \ 2 \ 4 / 2 \ 3 \ 4) (_C \neg \uparrow ' \alpha ' ' \omega ' ' \alpha \alpha ' ' \omega \omega ', \vdash) \ddot{o} \neg 1 \vdash 7 \ 4 \ 1 \ \rho \ \mathcal{Q} (4 \ \rho \ 2) \top (\neg 7 \uparrow 2, \imath 4)$
 $\quad \mathcal{Q} \ p \leftarrow ns \circ (Gex_o Ex_o Fex \ Stmts_then \ Fn \approx) \alpha \circ \neg \neg \ bs \diamond 0 < c \leftarrow [/ _ / _ \supset \neg \neg p : c " \alpha \ \omega$
 $\quad \mathcal{Q} \ q \leftarrow (m \neq z) \{\alpha \circ \{((3 \uparrow \alpha), _C ") \vdash \alpha ((d \ + o \supset \neg), 1 \downarrow \ddot{o} 1 \vdash) \ wrap \supset \neg / \ \omega\} \neg \neg \ddot{o} 1 \vdash 1 \supset \neg \neg p$
 $\quad \mathcal{Q} \ q \leftarrow (1 + \imath 4) () \neg \neg \ddot{o} 1 \vdash q$
 $\quad p \leftarrow (\alpha \vdash 0, \approx \neg \neg \alpha \omega) \circ (Gex_o Ex_o Fex \ Stmts_then \ Fn) \neg \neg ns \diamond 0 < c \leftarrow [/ _ \supset \neg \neg p : c " \alpha \ \omega$
 $\quad 0 (\neg \neg / (_C \ 0 \ 4 \ \rho \ \theta), \approx \neg \neg p \{((3 \uparrow \omega), _C ") \vdash \omega ((d \ + o \supset \neg), 1 \downarrow \ddot{o} 1 \vdash) \ wrap \supset \neg \neg / \ 1 \supset \alpha \} \neg \neg at \{m\} \downarrow z) \alpha "$
 $Pfe \leftarrow \{\alpha (rpar_s Fex_s lpar) \omega\}$
 $Bfn \leftarrow rbrc \ Blrp \ lbrc _as ('F' new \ 1, o _C o \Phi \ 1 \downarrow \neg 1 \downarrow \vdash)$
 $Fnp \leftarrow Prim_o (1 \ Var \ 'f') _o Sfn_o Bfn_o Pfe$
 $Mop \leftarrow \{\alpha ((mop_as P) _s Afx_as (1 \ O)) \omega\}$
 $Dop1 \leftarrow \{\alpha ((dop1_as P) _s Afx_as (2 \ O_o \Phi)) \omega\}$
 $Dop2 \leftarrow \{\alpha (Atom_s (dop2_as P) _s Afx_as (2 \ O_o \Phi)) \omega\}$
 $Dop3 \leftarrow (dop3_as P) _s Atom_as (2 \ O_o \Phi) _o (dot_s jot_as (P_o \Phi) _as (1 \ O))$
 $Bop \leftarrow \{\alpha (rbrk_s Ex_s lbrk_s Afx_as ('i' O_o \Phi)) \omega\}$
 $Afx \leftarrow Mop_o (Fnp_s (Dop1_o Dop3_opt) _as (\supset wrap / o \Phi)) _o Dop2_o Bop$
 $Bind \leftarrow \{\alpha (gets_s (name_as \Phi) _env (\alpha \alpha \{(\supset \Phi \omega) \alpha \alpha \vdash \alpha\}) _as (\omega \omega new \ 'b', 1 \downarrow \vdash)) \omega\}$
 $Fex \leftarrow Afx_s (1 \ Bind \ 'F' _any) _as (\supset wrap / o \Phi)$
 $App \leftarrow Afx_s (Idx_o Atom_s (dop2_not) _opt) _as \{(\neq \omega) E \ \Phi \omega\}$
 $Ex \leftarrow Idx_o Atom_s \{\alpha (0 \ Bind \ 'E' _o App_s \nabla _opt) \omega\} _as (\supset wrap / o \Phi)$
 $Gex \leftarrow Ex_s grd_s Ex_as (G_o \Phi)$
 $Nlrp \leftarrow sep_o eot \ Slrp (lbrc \ Blrp \ rbrc)$
 $Stmts \leftarrow \{\alpha (sep_any_s (Nlrp_then (\alpha \alpha _s eot_o \Phi)) _any_s eot) \omega\}$
 $Ns \leftarrow nss \ Blrp \ nse _then (Ex_o Fex \ Stmts_then \ Fn) _s eot _as M$

 $ps \leftarrow \{0 \neq \supset c \ a \ e \ r \leftarrow (0 \ 2 \ \rho \ \theta) \ Ns \in \{\omega / \approx \wedge \setminus ' \mathfrak{A} ' \neq \omega\} \neg \neg \omega, \neg \neg \Box UCS \ 10 : \Box SIGNAL \ c \diamond (\supset \alpha) \ e\}$

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

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

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

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

```

E1 ← { 'fn' gcl ((C n, o ⊃ v), e, y) ω }
E2 ← { 'fn' gcl ((C n, o ⊃ v), e, y) ω }
E0 ← { r l f ← ⊃ v ω ◊ (n ω) ((⊃ y ω) sget) (¬ 1 ↓ ⊃ y ω) (fscal sdb) r l }
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), ', ', (⊃ ⊃ v ω), ')'; ', nl }
Fd ← { 'FP' (', (⊃ n ω), ')'; ', nl }
F0 ← { 'DF' (', (⊃ n ω), '_f') { ', nl, 'A*env[]={tenv}'; ', nl }
F1 ← { 'DF' (', (⊃ n ω), '_f') { ', nl, ('env0' dnv ω), (fnv ω) }
G0 ← { v ← (⊃ ⊃ v ω) ("var) 1 ⊃ ⊃ e ω
      'if (1!=cnt('v, ')) err(5); if('v, 'v.as(s32).scalar<I>()) { ', nl }
G1 ← { 'z=', ((⊃ n ω) ("var) ⊃ ⊃ e ω), '; goto L, (⊃ ⊃ l ω), '; }', nl }
L0 ← { 'z=', a, '; L, (⊃ ⊃ 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 ≡ ⊃ ω) ⊃ 'tenv' 'NULL'), '}', nl, nl }
S0 ← { (('{'rk0, srk, 'DO(i, prk) cnt*=sp[i]'; ', spp, sfv, slp) ω) }
Y0 ← { ⊃, / ((1 ≠ ⊃ n ω) ((¬ sts'' ⊃ l), '° ⊃ s), '}', nl, ¬ ste'' (⊃ n) var'' ⊃ r) ω), '}', nl }

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

syms ← , ' + ' - ' x ' ÷ ' * ' @ ' | ' o ' l ' f ' ! '
nams ← 'add' 'sub' 'mul' 'div' 'exp' 'log' 'res' 'cir' 'min' 'max' 'fac'
syms ← , ' < ' ≤ ' = ' ≥ ' > ' ≠ ' ~ ' ^ ' v ' ^ ' v '
nams ← 'lth' 'lte' 'eql' 'gte' 'gth' 'neq' 'not' 'and' 'lor' 'nan' 'nor'
syms ← , ' [] ' [ ' l ' p ' , ' , ' ϕ ' Ø ' ø ' € ' ÷ '
nams ← 'sqd' 'brk' 'iot' 'rho' 'cat' 'ctf' 'rot' 'trn' 'rtf' 'mem' 'dis'
syms ← , ' ≡ ' ≠ ' h ' h ' T ' L ' / ' ≠ ' \ ' x ' ? '
nams ← 'eqv' 'nqv' 'rgt' 'lft' 'enc' 'dec' 'red' 'rdf' 'scn' 'scf' 'rol'
syms ← , ' ↑ ' ↓ ' ... ' ... ' . ' ° ' * ' o ' u ' n '
nams ← 'tke' 'drp' 'map' 'com' 'dot' 'rnk' 'pow' 'jot' 'unq' 'int'
syms ← , ' Φ ' Ψ ' ° ' ε ' c ' ⊞ ' □ FFT ' □ IFFT ' % u '
nams ← 'gdu' 'gdd' 'oup' 'fnd' 'par' 'mdv' 'fft' 'ift' "

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

$Z \leftarrow 00\rho\theta$

∇

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

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

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

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

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

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

:EndNamespace