The Co-dfns Compiler

High-performance, Parallel APL Compiler

:Namespace CODFNS

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      ⎕IO ⎕ML ⎕WX ← 0 1 3
          VERSION ← 2017 11 0
         COMPILER ← 'vsc'
       BUILD∆PATH ← 'build'
        AF∆PREFIX ← '/usr/local'
           AF∆LIB ← 'afcuda'
VISUAL∆STUDIO∆PATH ← 'C:\Program Files (x86)\Microsoft Visual Studio\2017\Enterprise\VC\Auxiliary\Build'

  Cmp ← {_ ← {22 :: θ ⋄ ω ⎕NERASE ω ⎕NTIE 0} so ← BSO α
         _ ← (⍎COMPILER) α ⊣ (BUILD∆PATH, '/', α, '_', COMPILER, '.cpp') put⍠ gc tt ⊃ a n ← ps ω
       22 :: 'COMPILE ERROR' ⎕SIGNAL 22
             n ⊣ ⎕NUNTIE so ⎕NTIE 0}
MkNS ← {NS ⊣ α⍤{NS.⍎α mkf ω}¨ (1 = 1 ⌷ ≢ω)⌿ 0 ⌷ ≢ω ⊣ NS ← #.⎕NS θ}
 Fix ← {α MkNS α Cmp ω}
 Xml ← {⎕XML (0 ⌷ ≢ω), (,⍤⍉⍤⌿ 2 ↑ 1 ↓ ≢ω), (⊂''), ⍉(⊂(¯3 + ≢≢ω) ↑ ,¨ 'nrsgvyel') ,⍤⍉¨ ↓ ⍉⍤,¨ ≢ 3 ↓ ≢ω}
  BSO ← {BUILD∆PATH, '/', ω, '_', COMPILER, soext θ}
  MKA ← {mka ⊂ 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'⍳⊂COMPILER}
  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  ← BUILD∆PATH, '/', α, '_', COMPILER, (soext θ), '|', ('∆' ⎕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'}
```

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   cio ← {' -o ''', BUILD∆PATH, '/', ω, '_', α, '.', αα, ''' '}
   fls ← {''' ', BUILD∆PATH, '/', ω, '_', α, '.cpp''' '}
   log ← {'> ', BUILD∆PATH, '/', ω, '_', α, '.log 2>&1'}
   lib ← {'-l', AF∆LIB, ' '}
   cci ← {'-I''', AF∆PREFIX, '/include'' -L''', AF∆PREFIX, '/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"', BUILD∆PATH
          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 "', AF∆LIB, '.lib" '
               z, '/OPT:ICF /ERRORREPORT:PROMPT /TLBID:1 '}
  vsc0 ← {'""', VISUAL∆STUDIO∆PATH, '\vcvarsall.bat" amd64'}
  vsc1 ← {' && cd "', (⊃⍞CMD 'echo %CD%'), '" && cl ', (vsco θ), '/fast'}
  vsc2 ← {'/Fo"', BUILD∆PATH, '\\" "', BUILD∆PATH, '\', ω, '_vsc.cpp" '}
  vsc3 ← {(vslo θ), '/OUT:"', BUILD∆PATH, '\', ω, '_vsc.dll" '}
  vsc4 ← {'> "', BUILD∆PATH, '\', ω, '_vsc.log""'}
   vsc ← {⍞CMD ('%comspec% /C ', vsc0, vsc1, vsc2, vsc3, vsc4) ω}

   get ← {αα ⍞ ⍉ω}
  wrap ← ⍨∘(⍉ (1 + 1 ↑ ⍉) ⍨ 1 ↓ ⍉)
  bind ← {n _ e ← ω ⋄ (0 n_ ⍞ e) ← ⊂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_ ← ⍳ 7 + 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 ← {⍉⍨ fΔ ↑ 0 α, ω}                    ⋄ msk ← {(t ω) ∈ ⊂αα} ⋄ sel ← {(αα msk ω)≠ ω}
   A ← {('A' new αα) wrap ⊃⍨/ ω}           ⋄   A_m ← 'A' msk      ⋄   A_s ← 'A' sel
   E ← {('E' new αα) wrap ⊃⍨/ ω}           ⋄   E_m ← 'E' msk      ⋄   E_s ← 'E' sel
   F ← {('F' new 1) wrap ⊃⍨/ (⊂ 0 fΔ ρ θ), ω} ⋄   F_m ← 'F' msk      ⋄   F_s ← 'F' sel
   G ← {('G' new 0) wrap ⊃⍨/ ω}            ⋄   G_m ← 'G' msk      ⋄   G_s ← 'G' sel
   L ← {('L' new 0) wrap ⊃⍨/ ω}            ⋄   L_m ← 'L' msk      ⋄   L_s ← 'L' sel
   M ← {('M' new 0 '') wrap ⊃⍨/ (⊂ 0 fΔ ρ θ), ω} ⋄   M_m ← 'M' msk      ⋄   M_s ← 'M' sel
   N ← {'N' new 0 (⍏ω)}                    ⋄   N_m ← 'N' msk      ⋄   N_s ← 'N' sel
   O ← {('O' new αα) wrap ⊃⍨/ ω}           ⋄   O_m ← 'O' msk      ⋄   O_s ← 'O' sel
   P ← {'P' new 0 ω}                       ⋄   P_m ← 'P' msk      ⋄   P_s ← 'P' sel
   S ← {'S' new 0 ω}                       ⋄   S_m ← 'S' msk      ⋄   S_s ← 'S' sel
   V ← {'V' new αα ω}                      ⋄   V_m ← 'V' msk      ⋄   V_s ← 'V' sel
   Y ← {'Y' new 0 ω}                       ⋄   Y_m ← 'Y' msk      ⋄   Y_s ← 'Y' sel
   Z ← {'Z' new 1 ω}                       ⋄   Z_m ← 'Z' msk      ⋄   Z_s ← 'Z' sel
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      _o ← {0 ≥ ⊃ c a e r ← p ← α αα ω : p ⋄ 0 ≥ ⊃ c a e r₂ ← p ← α ωω ω : p ⋄ c a e (r ↑⍨ - ⌊/ ≢¨ r r₂)}
      _s ← {0 < ⊃ c a e r ← p ← α αα ω : p ⋄ 0 < ⊃ c₂ a₂ e r ← p ← e ωω r : p ⋄ (c ⌈ c₂)(a, a₂) e r}
  _noenv ← {0 < ⊃ c a e r ← p ← α αα ω : p ⋄ c a α r}
    _env ← {0 < ⊃ c a e r ← p ← α αα ω : p ⋄ c a (e ωω a) r}
   _then ← {0 < ⊃ c a e r ← p ← α αα ω : p ⋄ 0 < ⊃ c a e _ ← p ← e (ωω _s eot) a : p ⋄ c a e r}
    _not ← {0 < ⊃ c a e r ← α αα ω : 0 a α ω ⋄ 2 a α ω}
     _as ← {0 < ⊃ c a e r ← α αα ω : c a e r ⋄ c (,⊂ωω a) e r}
      _t ← {0 < ⊃ c a e r ← α αα ω : c a e r ⋄ e ωω a : c a e r ⋄ 2 ϴ α ω}
    _ign ← {c a e r ← α αα ω ⋄ c ϴ e r}
   _peek ← {0 < p ← ⊃ α αα ω : p ⋄ 0 ϴ α ω}
    _yes ← {0 ϴ α ω}
    _opt ← {α(αα _o _yes)ω}
    _any ← {α(αα _s ∇ _o _yes)ω}
   _some ← {α(αα _s (αα _any))ω}
    _set ← {(0 ≠ ≢ω) ∧ (⊃ω) ∈ αα : 0 (,⊃ω) α (1 ↓ ω) ⋄ 2 ϴ α ω}
     _tk ← {((≢,αα) ↑ ω) ≡,αα : 0 (⊂,αα) α ((≢,αα) ↓ ω) ⋄ 2 ϴ α ω}
    _eat ← {0 = ≢ω : 2 ϴ α ω ⋄ 0 (αα ↑ ω) α (αα ↓ ω)}

     ws ← (' ', ⎕UCS 9) _set
    aws ← ws _any _ign
  awslf ← (⎕UCS 10 13) _set _o ws _any _ign
   gets ← aws _s ('←' _tk) _s aws
    him ← '¯' _set
    dot ← '.' _set
    jot ← '∘' _set
   lbrc ← aws _s ('{' _set) _s aws
   rbrc ← aws _s ('}' _set) _s aws
   lpar ← aws _s ('(' _tk) _s aws _ign
   rpar ← aws _s (')' _tk) _s aws _ign
   lbrk ← aws _s ('[' _tk) _s aws _ign
   rbrk ← aws _s (']' _tk) _s aws _ign
    grd ← aws _s (':' _tk) _s aws _ign
   egrd ← aws _s (':' _tk) _s aws _ign
  alpha ← 'ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyzΔ' _set
 digits ← '0123456789' _set
   prim ← (prims ← '+-÷×|*⍟⌈⌊!<≤=≠≥>∧∨⍲⍱⍰?⍴,⍪⌽⍉∈⍷⊃⍳○~≡≢⊢⊣/⌿\⍀↑↓∪∩⍋⍒∇⍇') _set
    mop ← '¨⌜/⌿⍀\⍨' _set
   dop1 ← '.⍣∘' _set
   dop2 ← '⍤⍣∘' _set
   dop3 ← '∘' _set
    eot ← aws _s {'' ≡ ω : 0 ϴ α '' ⋄ 2 ϴ α ω} _ign
   digs ← digits _some
  odigs ← digits _any
    int ← aws _s digs _s (him _opt) _s aws
  float ← aws _s (odigs _s dot _s int _o (digs _s dot)) _s aws
   name ← aws _s (alpha _o (digits _some _s alpha) _some) _s aws
     aw ← aws _s ('⍺⍵' _set) _s aws
   aaww ← aws _s (('⍺⍺' _tk) _o ('⍵⍵' _tk)) _s aws
    sep ← aws _s (('⋄', ⎕UCS 10 13) _set _ign) _s aws
    nss ← awslf _s (':Namespace' _tk) _s aws _s (name _opt) _s awslf _ign
    nse ← awslf _s (':EndNamespace' _tk) _s awslf _ign
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    Sfn ← aws _s (('TFF□' _tk) _o ('TFFI□' _tk)) _s aws _as {P ⏀∈ω}
   Prim ← prim _as P
     Vt ← {((0 □ ⍉α) ⍳ ω) 1 □ α ⍨ '' ¯1}
    Var ← {α(aaww _o aw _o (name _as ⏀) _t (αα = Vt) _as (ωω V∘,∘⊃))ω}
    Num ← float _o int _as (N∘⏀)
 Strand ← 0 Var 'a'  _s (0 Var 'a' _some) _as ('s' A∘⏀)
    Pex ← {α(rpar _s Ex _s lpar)ω}
   Atom ← Strand _o (0 Var 'a' _as ('v'A)) _o (Num _some _as ('n' A∘⏀)) _o Pex
    Idx ← {α(rbrk _s Ex _s lbrk _s Atom _as ('i' E∘⏀))ω}
   Blrp ← {α(αα _s (ωω Slrp ∇))ω}
   Slrp ← {α(αα _o (ωω _s ∇) _o ((1 _eat) _s ∇))ω}
     Fn ← {ns ← n z ≠⍨ m ← {(Fm ω) ∧ 1 ∈⍨ k ω} z ← ⊃⍨/ ω ⋄ 0 = ≢ns : 0 (,⊂z) α ''
           ⍝ bs ← (1 2 4 / 2 3 4) (⊂ ⊣ ↑ 'α' 'ω' 'αα' 'ωω', ⊢)⍤¯1 ⊢ 7 4 1 ⍴ ⍉ (4 ⍴ 2) ⊤ (¯7 ↑ 2, ⍳4)
           ⍝ p ← ns ∘.(Gex _o Ex _o Fex Stmts _then Fn⍨) α∘⍨¨ bs ⋄ 0 < c ← ⌈/ ⌊/ ⊃¨p : c '' α ω
           ⍝ q ← (m ≠ z) {α∘{((3 ↑ α), ⊂'') ⍨ α ((d +∘⊃ ⊣), 1 ↓⍤1 ⊢) wrap ⊃⍨/ ω}¨ ω}⍤1 ⊢ 1 ⊃¨ p
           ⍝ q ← (1 + ⍳4) ()¨⍤1 ⊢ q
             p ← (α ⍨ 0 ,⍨ ⍨'αω')∘(Gex _o Ex _o Fex Stmts _then Fn)¨ns ⋄ 0 < c ← ⌈/ ⊃¨p : c '' α ω
                 0 (⍨/ (⊂ 0 4 ⍴ ⊖) ,⍨ p {((3 ↑ ω), ⊂'') ⍨ ω ((d +∘⊃ ⊣), 1 ↓⍤1 ⊢) wrap ⊃⍨/ 1 ⊃ α}¨at{m} ↓z) α ''}
    Pfe ← {α(rpar _s Fex _s lpar)ω}
    Bfn ← rbrc Blrp lbrc _as ('F' new 1 ,∘⊂∘⏀ 1 ↓ ¯1 ↓ ⊢)
    Fnp ← Prim _o (1 Var 'f') _o Sfn _o Bfn _o Pfe
    Mop ← {α((mop _as P) _s Afx _as (1 O))ω}
   Dop1 ← {α((dop1 _as P) _s Afx _as (2 O∘⏀))ω}
   Dop2 ← {α(Atom _s (dop2 _as P) _s Afx _as (2 O∘⏀))ω}
   Dop3 ← (dop3 _as P) _s Atom _as (2 O∘⏀) _o (dot _s jot _as (P∘⏀) _as (1 O))
    Bop ← {α(rbrk _s Ex _s lbrk _s Afx _as ('i' O∘⏀))ω}
    Afx ← Mop _o (Fnp _s (Dop1 _o Dop3 _opt) _as (⊃wrap/∘⏀)) _o Dop2 _o Bop
   Bind ← {α(gets _s (name _as ⏀) _env (αα{(⊃⏀ω) αα ⍨ α}) _as (ωω new 'b', 1 ↓ ⊢))ω}
    Fex ← Afx _s (1 Bind 'F' _any) _as (⊃wrap/∘⏀)
    App ← Afx _s (Idx _o Atom _s (dop2 _not) _opt) _as {(≢ω) E ⏀ω}
     Ex ← Idx _o Atom _s {α(0 Bind 'E' _o App _s ∇ _opt)ω} _as (⊃wrap/∘⏀)
    Gex ← Ex _s grd _s Ex _as (G∘⏀)
   Nlrp ← sep _o eot Slrp (lbrc Blrp rbrc)
  Stmts ← {α(sep _any _s (Nlrp _then (αα _s eot∘⏀)) _any _s eot)ω}
     Ns ← nss Blrp nse _then (Ex _o Fex Stmts _then Fn) _s eot _as M

     ps ← {0 ≠ ⊃ c a e r ← (0 2 ⍴ ⊖) Ns ∊{ω /⍨ ∧\ 'a' ≠ ω}¨ω ,¨ □UCS 10 : □SIGNAL c ⋄ (⊃a) e}
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$$
\begin{aligned}
scp &\leftarrow (+\not\backslash F_m)\vdash\circ\subset\boxplus\vdash\\
prf &\leftarrow ((\not\equiv\uparrow{}^{-}1\downarrow\vdash(\not=\tilde{\cdot})\,0\neq\vdash)\ddot{\circ}1\uparrow\circ r)\vdash\\
blg &\leftarrow \{\alpha\leftarrow\vdash\diamond\alpha((prf\,(\lceil/\,(\iota\circ\not\equiv\vdash)\times\ddot{\circ}1\,(1\downarrow\dashv)\wedge.(=\vee\,0=\vdash)\circ\oslash\vdash)\,\alpha\alpha\,(\not=\circ\uparrow)\,r)\square\ddot{\circ}0\;2\;\omega\omega\,(\not=\tilde{\cdot})\,\alpha\alpha)\omega\}\\
enc &\leftarrow \subset\dashv,\circ\supset((\dashv,'\_',\vdash)/(\subset''),(\overline{\Phi}\ddot{\cdot}\vdash(/\tilde{\cdot})\,0\neq\vdash))\\
veo &\leftarrow \cup((\subset\texttt{'\%u'}),(,\ddot{\cdot}prims),\dashv)\sim\tilde{\circ}\{\supset,/\{\subset\bigstar(1\equiv\equiv\omega)\vdash\omega\}\ddot{\cdot}\omega\}\,{}^{-}1\downarrow\vdash(/\tilde{\cdot})\,(\wedge/\ddot{\cdot}\,0\neq((\supset 0\,\rho\vdash)\ddot{\cdot}\vdash))\\
ndo &\leftarrow \{\alpha\leftarrow\vdash\diamond m\supset\circ(\subset,\vdash)\ddot{\cdot}\,\alpha\circ\alpha\alpha''''\;\omega\supset\circ(,\circ\subset\tilde{\circ}\subset)\ddot{\cdot}\tilde{\cdot}\,m\leftarrow 1\geq\equiv\ddot{\cdot}\omega\}\\
n2f &\leftarrow (\supset,/)\,((1=\equiv)\supset,\circ\subset\tilde{\circ}\circ\subset)\ddot{\cdot}
\end{aligned}
$$

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\begin{aligned}
rn &\leftarrow\vdash,\circ\downarrow(1+d)\uparrow\ddot{\circ}{}^{-}1\,(+\not\backslash\,d\;\circ.=\circ\iota\,1+(\lceil/\,0,d))\\
rd &\leftarrow\vdash,(+/\uparrow\circ r\wedge.(=\vee\,0=\vdash)\circ\oslash\circ\uparrow\circ r\vdash(\not=\tilde{\cdot})\,F_m\wedge 1\in\tilde{\cdot}\,k)\\
df &\leftarrow\vdash(\not=\tilde{\cdot})\,(+\backslash 1=d)\,(\sim\dashv\in\dashv(/\tilde{\cdot})\,(1=d)\wedge(\sim\texttt{'b'}\in\tilde{\cdot}\,k)\wedge O_m\vee F_m)\vdash\\
dua &\leftarrow((\sim G_m)\wedge F_m\vee\downarrow\circ prf\in r\circ F_s)\,(\dashv(\not\backslash\circ\vdash)\,(d\,(\not=\tilde{\cdot})\,\dashv)\,(0,1\downarrow(\bar{}1\oplus\vdash)\wedge\dashv=\bar{}1\oplus\dashv)\dashv(\not=\circ\vdash)\,0\in\tilde{\cdot}\,n)\vdash\\
du &\leftarrow\vdash(\not=\tilde{\cdot}\circ\sim)\,dua\vee\circ(\vee/)\,(prf\wedge.(=\vee\,0=\vdash)\circ\oslash\,prf\,(\not=\tilde{\cdot})\,dua)\wedge\uparrow\circ r\wedge.\geq\circ\oslash\,dua\,(\not=\circ\vdash)\uparrow\circ r\times 0=prf\\
lfh &\leftarrow(0\neq 1\square\dashv)\supset(\subset\circ\oslash\circ\fatsemi\,0\,\texttt{'M'}\,0\,'',0,\tilde{\cdot}\,(\subset\dashv))\,,\circ\subset\circ\oslash\circ\fatsemi\,1\,\texttt{'F'}\,1,('fn'\,enc\dashv),(\subset\dashv),5\downarrow\circ,1\uparrow\vdash\\
lfn &\leftarrow(d,\texttt{'Of'},3\downarrow\vdash)\ddot{\circ}1\,at\,(F_m\wedge\texttt{'b'}\in\tilde{\cdot}\,k)\,(d,\texttt{'Vf'},('\texttt{fn}'\,enc\circ\supset r),4\downarrow\vdash)\ddot{\circ}1\,at\,(F_m\wedge 1\in\tilde{\cdot}\,k)\\
lf &\leftarrow(\supset\fatsemi/)\,(1,1\downarrow F_m\wedge 1\in\tilde{\cdot}\,k)\,blg\,(\uparrow r)\,(\subset lfh\fatsemi\circ(((\vdash-(\supset-2\lfloor\supset))\,d),1\downarrow\ddot{\circ}1\vdash)\,lfn)\boxplus 1\downarrow\vdash\\
dn &\leftarrow((0\in\tilde{\cdot}\,n)\wedge(A_m\wedge\texttt{'v'}\in\tilde{\cdot}\,k)\vee O_m\wedge\texttt{'f'}\in\tilde{\cdot}\,k)\,((\sim\dashv)\,(\not=\circ\vdash)\,(d-\bar{}1\oplus\dashv),1\downarrow_{[1]}\vdash)\vdash\\
mrep &\leftarrow(1+\supset),\texttt{'P'}\,0\,(,'\vdash'),(\subset'')\,,\tilde{\cdot}\,\bar{}1\downarrow 4\downarrow\circ,1\uparrow\vdash\\
mreu &\leftarrow\supset,\texttt{'E'}\,'\texttt{u}',(\subset'')\,,\tilde{\cdot}\,\bar{}1\downarrow 3\downarrow\circ,1\uparrow\vdash\\
mre &\leftarrow(\supset\fatsemi/)\,(-\circ\supset V_m\vee A_m)\circ\supset\circ\oplus\,(\downarrow,(((\vdash\rho\tilde{\cdot}\,(\not\equiv\oslash)\,,\tilde{\cdot}\not\equiv\times 2<\not\equiv)\,mreu\fatsemi mrep\fatsemi(1+\mathrm{d}),1\downarrow\ddot{\circ}1\vdash)\ddot{\cdot}\uparrow))\vdash\\
mrs &\leftarrow\vdash\subset_{[0]}\tilde{\cdot}\,1,1\downarrow d=1+\circ\supset d\\
mrk &\leftarrow(-\circ(+/\wedge\backslash)\circ\oplus L_m)\,(\uparrow\fatsemi\tilde{\circ}\circ(mre\,(mre\,mrs)\ddot{\cdot}\,at\,(G_m\circ(\supset\fatsemi/)\,1\uparrow\ddot{\cdot}\vdash)\circ mrs)\downarrow)\vdash\\
mr &\leftarrow(\supset\fatsemi/)\,((1\uparrow\vdash),(mrk\ddot{\cdot}\,1\downarrow\vdash))\circ scp\\
ur &\leftarrow((2\uparrow\vdash),1,(\texttt{'um'}\,enc\circ\supset r),4\downarrow\vdash)\ddot{\circ}1\,at\,(E_m\wedge\texttt{'u'}\in\tilde{\cdot}\,k)\\
rt &\leftarrow\vdash,(\vee\backslash F_m)+(+\not=prf\wedge.(=\vee\,0=\dashv)\circ\oslash\tilde{\circ}\circ\uparrow\circ r\,M_s\fatsemi G_s)-F_m\\
nm &\leftarrow((3\uparrow\vdash),(\texttt{'fe'}\,enc\circ\supset r),4\downarrow\vdash)\ddot{\circ}1\,at\,((0\in\tilde{\cdot}\,n)\wedge E_m\vee O_m\vee A_m)\\
lgg &\leftarrow(\fatsemi/1\downarrow\vdash)\fatsemi\circ\supset\tilde{\cdot}\,\dashv(((\bar{}1+d),2,\tilde{\cdot}\,t,k,n,r\,,\circ\fatsemi\,s)\fatsemi\dashv\fatsemi 3,\texttt{'V'},\texttt{'a'},3\,(\downarrow\ddot{\circ}1)\,1\uparrow\vdash)\circ\supset 1\uparrow\vdash\\
lg &\leftarrow(\supset\fatsemi/)\vdash((\subset\dashv(\not=\tilde{\cdot}\circ\sim)\,(\vee\backslash\vdash)),(((1\uparrow\vdash)\,lgg\vdash\subset_{[0]}\tilde{\cdot}\,d=1+\supset)\ddot{\cdot}\subset_{[0]}\tilde{\cdot}))\,G_m\wedge 1\oplus E_m\\
fet &\leftarrow(d,\texttt{'V'}\,0,3\downarrow\vdash)\ddot{\circ}1\,at\,(0,1\downarrow E_m\vee O_m\vee A_m)\,(d,\texttt{'Av'},3\downarrow\vdash)\ddot{\circ}1\,at\,(E_m\wedge\texttt{'b'}\in\tilde{\cdot}\,k)\\
fee &\leftarrow(\fatsemi/\oplus)\,(M_m\vee E_m\vee O_m\vee A_m)\,blg\vdash((\supset\circ\oplus\vdash)\,(\subset(d--\tilde{\circ}\circ\supset),1\downarrow\ddot{\circ}1\vdash)\circ fet\dashv\fatsemi\bar{}1\downarrow\ddot{\circ}1\vdash)\boxplus\supset,\tilde{\cdot}\,1\downarrow\vdash\\
fe &\leftarrow(\supset\fatsemi/)\,(+\not\backslash\,d\leq g)\,(\subset(\vdash\uparrow\tilde{\cdot}\,1=\circ\not\equiv\vdash)\,\fatsemi\circ\supset\circ fee\vdash)\boxplus\vdash\\
can &\leftarrow(+\backslash A_m\vee O_m)\,((,1\uparrow\vdash),\circ(\subset(\bar{}1+2\lfloor\not\equiv)\supset(\subset\circ\subset\supset),\subset)\circ n\,1\downarrow\vdash)\boxplus\vdash\\
cas &\leftarrow(\bar{}1\oplus(A_m\vee O_m)\wedge\texttt{'vf'}\in\tilde{\cdot}\,k)\vee(\downarrow prf)\in\circ r\vdash(\not=\tilde{\cdot})\,A_m\wedge\texttt{'n'}\in\tilde{\cdot}\,k\\
ca &\leftarrow(can\vdash(\not=\tilde{\cdot})\,cas\vee A_m\vee O_m\wedge\texttt{'f'}\in\tilde{\cdot}\,k)\dashv at\,(A_m\vee O_m\wedge\texttt{'f'}\in\tilde{\cdot}\,k)\,\theta\,,\circ\subset\tilde{\circ}\vdash(\not=\tilde{\cdot}\circ\sim)\,cas\\
lj &\leftarrow(\supset\fatsemi/)\,(1\uparrow scp),((\vdash\fatsemi 2\,\texttt{'L'}\,0\,0,2\,'',\tilde{\cdot}\,\bar{}2\downarrow 4\downarrow\circ,1\uparrow\vdash)\ddot{\cdot}\,1\downarrow scp)\\
sd &\leftarrow(\supset\fatsemi/)\,(1\uparrow scp),(n\,F_s)\,(d,\texttt{'Vf'},(\subset\dashv),4\downarrow\vdash)\ddot{\circ}1\,at\,((\subset,\texttt{'}\forall\texttt{'})\in\tilde{\cdot}\,n)\ddot{\cdot}\,1\downarrow scp\\
inm &\leftarrow\vee\not=\bar{}1\,(\oplus\vee\vdash)\,1\,2\,(\oplus\vee\vdash)\,(\bar{}1\;\bar{}2\oplus E_m\wedge_{[1]}1\,2\circ.=k)\wedge\ddot{\circ}1\,V_m\wedge n\in\circ n\,F_s\\
inp &\leftarrow(E_m\wedge\dashv)\vee 1,2\neq/\dashv\\
inza &\leftarrow(1\uparrow 1\downarrow\dashv)\,(\not=\tilde{\cdot}\circ\not\equiv)\,at\,((\subset,\texttt{'}\alpha\texttt{'})\in\tilde{\cdot}\,n)\,(\bar{}1\uparrow\dashv)\,(\not=\tilde{\cdot}\circ\not\equiv)\,at\,((\subset,\texttt{'}\omega\texttt{'})\in\tilde{\cdot}\,n)\vdash\\
inz &\leftarrow(1\uparrow\dashv)\,(d,t,k,3\downarrow\ddot{\circ}1\,(\not=\tilde{\cdot}\circ\not\equiv))\,at\,(0\,,\tilde{\cdot}\,2\neq/\circ\oplus(\vee\backslash\circ\oplus E_m))\,inza\\
inn &\leftarrow(3\uparrow\ddot{\circ}1\vdash),((\dashv\rho\ddot{\cdot}\tilde{\cdot}\,1+0\lceil(\lceil/\circ n\,G_s))\,(('\texttt{fe}'\equiv 2\uparrow\vdash)\supset(\subset\vdash)\,,\circ\subset\texttt{'fe'},(\overline{\Phi}\dashv),2\downarrow\vdash)\ddot{\cdot}\,n),(4\downarrow\ddot{\circ}1\vdash)\\
ins &\leftarrow\dashv(d,t,k,((1000\times 1+\dashv)+1+n+(\lceil/n)),4\downarrow\ddot{\circ}1\vdash)\,at\,(L_m\vee G_m)\,inn\\
inr &\leftarrow 1\,,\circ\fatsemi\vdash inz\ddot{\cdot}\,(\iota\circ\not\equiv\vdash)\,ins\ddot{\cdot}\,((\supset\circ n\ddot{\cdot}\,\dashv)\,\iota((\supset n(\not=\tilde{\cdot})\,V_m\wedge\texttt{'f'}\in\tilde{\cdot}\,k)\ddot{\cdot}\vdash))\supset\ddot{\cdot}\,(\subset 1\downarrow\ddot{\cdot}\,\dashv)\,,\circ\subset\ddot{\cdot}\vdash\\
in &\leftarrow(\supset\fatsemi/)\circ(\vdash/)\,(1\downarrow scp)\,inr\circ((0\,\rho\subset 0\,8\,\rho\,0),\vdash/)\,at\,(\dashv/)\,inm\,((\supset\ddot{\cdot}\,inp\subset E_m\wedge\dashv)\,,\circ\fatsemi\,inp\subset_{[0]}\vdash)\vdash
\end{aligned}
$$

$$
\begin{aligned}
pcc &\leftarrow (\subset \vdash (\neq \approx)\ A_m \vee O_m \wedge \text{'}\texttt{f}\text{'} \in \approx k) \circ ((\iota \circ \cup \approx n)\ \square \ddot{\circ} 0\ 2\ (1 \lceil \not\equiv) \uparrow \vdash) \circ (\supset \fatsemi \neq) \circ \bigoplus (\neq \circ \vdash)\\
pcb &\leftarrow ((, \wedge .(= \vee 0 = \dashv) \circ \fatsemi) \ddot{\circ} 2\ 1 \approx \circ \uparrow \circ r\ M_s \fatsemi F_s)\ pcc \ddot{\circ} 1\ ((\vdash (\neq \approx)\ (d = g) \wedge A_m \vee E_m \vee O_m)^{\cdot\cdot}\ scp)\\
pcv &\leftarrow (d, \text{'}\texttt{V}\text{'}, (\text{'}\texttt{af}\text{'} \supset^{\cdot\cdot} \circ \subset \approx O_m), (\supset^{\cdot\cdot} v), r, s, (\subset \theta)\ , \approx \circ \fatsemi\ g)\ at\ (O_m \vee A_m \wedge \text{'}\texttt{v}\text{'} \in \approx k)\\
pc &\leftarrow (\supset \fatsemi /)\ pcb\ \{(pcv\ d\ (\dashv, 1 \downarrow \ddot{\circ} 1 \vdash)(\alpha \uparrow \approx 1 \lceil \not\equiv \alpha)\ \square \ddot{\circ} 0\ 2 \approx\ (n\ \alpha)\ \iota\ n)\ at\ (V_m \wedge (n\ \alpha) \in \approx n)\ \omega\}^{\cdot\cdot}\ scp\\
da &\leftarrow \vdash (\neq \approx \circ \sim)\ (A_m \wedge d = g) \vee (0\ , \approx 2 \wedge / L_m) \vee (L_m \wedge {}^{-}1 \bigoplus A_m \wedge d = g) \vee O_m \wedge (\text{'}\texttt{f}\text{'} \in \approx k) \wedge 1 \neq d\\
fce &\leftarrow (\supset \circ n\ P_s)\ \{\subset \text{⍋}\text{'}\ \texttt{w}\text{'}\ , \approx (\not\equiv \omega) \supset \text{''}\ (\alpha, \text{'}\texttt{⊃}\text{'})\ (\text{'}\texttt{⊃}\text{'}, \alpha, \text{'}\texttt{/}\text{'})\}\ (v\ A_s)\\
fcm &\leftarrow (\wedge / E_m \vee A_m \vee P_m) \wedge \text{'}\texttt{u}\text{'} \not\equiv \circ \supset \circ \supset k\\
fc &\leftarrow ((\supset \fatsemi /)\ (((d, \text{'}\texttt{An}\text{'}, 3 \downarrow {}^{-}1 \downarrow ,) 1 \uparrow \vdash), fce)^{\cdot\cdot}\ at\ (fcm^{\cdot\cdot}))\ (\text{'}\texttt{MFOEL}\text{'} \in \approx t) \subset_{[0]} \vdash\\
ce &\leftarrow (+\backslash F_m \vee G_m \vee E_m \vee O_m \vee L_m)\ ((^{-}1 \downarrow \circ, 1 \uparrow \vdash)\ , \circ \subset (\supset \circ v\ 1 \uparrow \vdash)\ , \circ (A_m \supset^{\cdot\cdot} \circ \downarrow n\ , \circ \fatsemi \circ n2f\ v)\ 1 \downarrow \vdash) \boxplus \vdash\\
ll &\leftarrow (\vdash (\neq \approx)\ 1 \bigoplus L_m)\ (((\subset \subset \text{'}\texttt{\%l}\text{'})\ , \circ \subset^{\cdot\cdot} \circ n \dashv)\ , \approx {}^{-}1 \downarrow \ddot{\circ} 1 \vdash)\ at\ L_m \vdash\\
fv &\leftarrow (\supset \fatsemi /)\ (((1 \downarrow \vdash) \fatsemi \approx (, 1\ 7 \uparrow \vdash)\ , \circ \subset \circ n\ {}^{-}1 \uparrow \vdash)^{\cdot\cdot}\ scp)\\
nvi &\leftarrow ((^{-}1 \downarrow \vdash), (\{, ^{\cdot\cdot} \alpha\ \text{'}\texttt{[}\text{'}\ \omega\} / \circ \supset v)) \ddot{\circ} 1\ at\ ((E_m \vee O_m) \wedge \text{'}\texttt{i}\text{'} \in \approx k)\\
nvv &\leftarrow (\subset \text{'}\texttt{\%u}\text{'}\ \text{'}\texttt{\%f}\text{'}\ \text{'}\texttt{\%u}\text{'}), (\subset \text{'}\texttt{\%u}\text{'}\ \text{'}\texttt{\%i}\text{'}, \vdash), (\subset (\subset \text{'}\texttt{\%u}\text{'}), \vdash)\\
nv &\leftarrow (^{-}1 \downarrow \ddot{\circ} 1\ ((2 \uparrow \vdash), 2, (3 \downarrow \vdash)) \ddot{\circ} 1\ at\ ((E_m \vee O_m) \wedge \text{'}\texttt{i}\text{'} \in \approx k)), ((^{-}1 \ominus \not\equiv \supset nvv\ , \circ \subset \vdash)^{\cdot\cdot}\ v \circ nvi)\\
lt &\leftarrow (\subset \theta)\ , \approx \vdash\\
val &\leftarrow (n\ \iota \circ \cup n)\ , ^{\cdot\cdot} \vdash (\vdash + (\not\equiv \dashv) \times 0 = \vdash)\ (\lceil / (\iota \not\equiv) \times \ddot{\circ} 1\ (\cup n) \circ .((\subset \dashv) \in \vdash)\ (n2f^{\cdot\cdot}\ v))\\
vag &\leftarrow \wedge \circ \sim \circ (\circ .= \approx \circ \iota \not\equiv) \approx (\circ .(((1\ \square \vdash) > 0\ \square \dashv) \wedge (0\ \square \vdash) < 1\ \square \dashv) \approx val)\\
vae &\leftarrow (\cup n)\ (\dashv\ , \ddot{\circ} 0\ \dashv (\square \approx \ddot{\circ} 1\ 0) \circ \supset ((\vdash\ , \circ \supset (\iota \circ \not\equiv \dashv) \sim \vdash (\neq \approx)\ (\not\equiv \vdash) \uparrow \dashv) / \circ \bigoplus (\subset \theta)\ , \circ \downarrow \vdash))\ vag\\
vac &\leftarrow (((0\ \square \circ \oslash \dashv)\ \iota \circ \subset \vdash) \supset (1\ \square \circ \oslash \dashv)\ , \circ \subset \vdash)\ ndo\\
va &\leftarrow ((\supset \fatsemi /)\ (1 \uparrow \vdash), (((vae\ E_s)\ (d, t, k, (\dashv\ vac\ n), r, s, g, y\ , \circ \fatsemi \approx (\subset \dashv)\ vac^{\cdot\cdot}\ v) \vdash)^{\cdot\cdot}\ 1 \downarrow \vdash))\ scp\\
avb &\leftarrow \{(((, ^{\cdot\cdot} \text{'}\texttt{αω}\text{'}) \uparrow \approx 1 \downarrow \rho) \fatsemi \vdash)\ \alpha\ \square \approx \ddot{\circ} 2\ 0 \vdash \alpha\alpha\ \iota\ \alpha\alpha \cap \approx (\downarrow (\bigoplus 1 + \circ \iota\ 0\ \iota \approx \vdash)\ ((\not\equiv \vdash) \uparrow \uparrow) \ddot{\circ} 0\ 1 \vdash) \supset r\ \omega\}\\
avi &\leftarrow {}^{-}1\ 0 + (\rho \dashv) \top (, \dashv)\ \iota\ (\subset \vdash)\\
avh &\leftarrow \{\subset \omega, (\text{n}\omega)\ ((\alpha\alpha\ (\omega\omega\ avb)\ \omega)\ \{\alpha\alpha\ avi\ ndo\ (\subset \alpha), \omega\})^{\cdot\cdot}\ v\ \omega\}\\
av &\leftarrow (\supset \fatsemi /)\ (+\backslash F_m)\ \{\alpha((\alpha\ ((\cup \circ \bigoplus (0\ \rho \subset \text{''}), n)\ E_s) \boxplus \omega)\ avh\ (r\ (1 \uparrow \omega) \fatsemi F_s\ \omega)) \boxplus \omega\} \vdash\\
rlf &\leftarrow (\bigoplus \downarrow (((1 \supset \dashv) \cup \vdash \sim 0\ \square \dashv) / \circ \bigoplus (\subset \theta), \uparrow) \ddot{\circ} 0\ 1 \approx 1 + \circ \iota \not\equiv) (\ominus 1 \ominus n\ , \ddot{\circ} 0\ (\subset \dashv)\ veo^{\cdot\cdot}\ v)\\
rl &\leftarrow \vdash\ , \circ (\supset , /)\ (\subset \circ n\ O_s \fatsemi F_s)\ rlf^{\cdot}\ scp\\
vc &\leftarrow (\supset \fatsemi /)\ (((1 \downarrow \vdash) \fatsemi \approx (1\ 7 \uparrow \vdash), (\not\equiv \circ \cup \circ n\ E_s), 1\ {}^{-}3 \uparrow \vdash)^{\cdot\cdot}\ scp)\\
eff &\leftarrow (\supset \fatsemi /) \vdash (((\subset \circ \oslash \circ \fatsemi\ d, \text{'}\texttt{Fe}\text{'}, 3 \downarrow ,) 1 \uparrow \dashv), 1 \downarrow \vdash)\ (d = \circ \supset d) \subset_{[0]} \vdash\\
ef &\leftarrow (F_m \wedge {}^{-}1 = \circ \times \circ \supset^{\cdot\cdot} y)\ ((\supset \fatsemi /)\ (\subset \vdash (\neq \approx) \circ \sim (\vee \backslash \dashv)), (eff^{\cdot\cdot} \subset_{[0]})) \vdash\\
ifn &\leftarrow 1\ \text{'}\texttt{F}\text{'}\ 0\ \text{'}\texttt{Init}\text{'}\ \theta\ 0\ 1, (4\ \rho\ 0)\ \theta\ \theta\ , \approx \vdash\\
if &\leftarrow (1 \uparrow \vdash) \fatsemi (\vdash (\neq \approx)\ O_m \wedge 1 = d) \fatsemi ((\vdash wrap \approx \circ ifn \circ \not\equiv \circ \cup n) \vdash (\neq \approx)\ E_m \wedge 1 = d) \fatsemi (\vee \backslash F_m)\ (\neq \circ \vdash) \vdash\\
fgz &\leftarrow (1 \uparrow \vdash) \fatsemi (((^{-}1 + d), 1 \downarrow \ddot{\circ} 1 \vdash)\ 1 \downarrow \vdash) \fatsemi 2, \text{'}\texttt{G}\text{'}, 1, 3 \downarrow \ddot{\circ} 1\ (^{-}1 \uparrow {}^{-}1 \downarrow \ddot{\circ} 1 \vdash)\ , \circ n\ 1 \uparrow \vdash\\
fg &\leftarrow (\supset \fatsemi /)\ (fgz^{\cdot\cdot}\ at\ (G_m \circ (\supset \fatsemi /)\ 1 \uparrow^{\cdot\cdot} \vdash) \vdash \subset_{[0]} \approx d = 2 \lfloor g)\\
fft &\leftarrow (, 1 \uparrow \vdash)\ (1\ \text{'}\texttt{Z}\text{'}, (2 \downarrow {}^{-}5 \downarrow \dashv), (v \dashv), n, y, (\subset 2 \uparrow \circ , \circ \supset \circ \supset e), \text{l})\ (^{-}1 \uparrow E_s)\\
ff &\leftarrow ((\supset \fatsemi /)\ (1 \uparrow \vdash), (((1 \uparrow \vdash) \fatsemi (((^{-}1 + d), 1 \downarrow \ddot{\circ} 1 \vdash)\ 1 \downarrow \vdash) \fatsemi fft)^{\cdot\cdot}\ 1 \downarrow \vdash))\ scp\\
fzh &\leftarrow ((\cup n) \cap (\supset \circ l \dashv))\ (^{-}1 \bigoplus (\subset \dashv), ((\not\equiv \vdash) \text{ - } 1 + (\bigoplus n)\ \iota \dashv)\ ((\subset \dashv \supset^{\cdot\cdot} \circ \subset (\supset^{\cdot\cdot} e)), (\subset \dashv \supset^{\cdot\cdot} \circ \subset (\supset^{\cdot\cdot} y))\ , \circ \subset \dashv) \vdash) \vdash\\
fzf &\leftarrow 0 \neq (\not\equiv \circ \rho^{\cdot\cdot} \circ \supset \circ v \dashv)\\
fzb &\leftarrow (((\supset \circ v \dashv)\ (\neq \approx)\ fzf), n)\ , \circ \fatsemi\ (\text{'}\texttt{f}\text{'} \circ , \circ \overline{\text{⍑}}^{\cdot\cdot} \circ \iota\ (+/fzf)), (\text{'}\texttt{s}\text{'} \circ , \circ \overline{\text{⍑}}^{\cdot\cdot} \circ \iota \circ \not\equiv \vdash)\\
fzv &\leftarrow ((\subset \dashv)\ (\ominus \uparrow) \approx^{\cdot\cdot}\ (\not\equiv \dashv)\ (\text{ - } + \circ \iota \vdash)\ (\not\equiv \vdash)) ((\vdash\ , \approx 1\ \square \circ \oslash \dashv)\ \square \approx (0\ \square \circ \oslash \dashv)\ \iota \vdash) \ddot{\circ} 2\ 0^{\cdot\cdot}\ v\\
fze &\leftarrow (^{-}1 + d), t, k, fzb\ ((\vdash / (\text{ - } \circ \not\equiv \vdash) \uparrow \dashv), r, s, g, fzv, y, e\ , \circ \fatsemi\ l) \vdash\\
fzs &\leftarrow (, 1 \uparrow \vdash)\ (1 \ominus (\dashv ((1\ \text{'}\texttt{Y}\text{'}, (2\ \square \dashv), \vdash) \fatsemi \circ \oslash \circ \fatsemi\ (3 \uparrow \dashv), \vdash)\ 1 \bigoplus fzh, {}^{-}1 \downarrow 6 \downarrow \dashv) \fatsemi fze)\ (\neq \circ \vdash)\\
fz &\leftarrow ((\supset \fatsemi /)\ (1 \uparrow \vdash), (((2 = d)\ (fzs \fatsemi (1 \downarrow \circ \sim \dashv)\ (\neq \circ \vdash)\ 1 \downarrow \vdash) \vdash)^{\cdot\cdot}\ 1 \downarrow \vdash))\ (1, 1 \downarrow S_m) \subset_{[0]} \vdash\\
fd &\leftarrow (1 \uparrow \vdash) \fatsemi ((1, \text{'}\texttt{Fd}\text{'}, 3 \downarrow \vdash) \ddot{\circ} 1\ F_s) \fatsemi 1 \downarrow \vdash
\end{aligned}
$$

$$
\begin{aligned}
tta &\leftarrow (fc \circ da \circ (pc \dot{\star} \equiv) \circ mr \dot{\star} \equiv) \circ in \dot{\star} 3 \circ sd \circ lj \circ ca \circ fe \circ lg \circ nm \circ rt \circ mr \circ dn \circ lf \circ du \circ df \circ rd \circ rn\\
tt &\leftarrow fd \circ fz \circ ff \circ fg \circ if \circ ef \circ vc \circ rl \circ av \circ va \circ lt \circ nv \circ fv \circ ll \circ ce \circ ur \circ tta
\end{aligned}
$$

```
  E₁ ← {'fn' gcl ((⊂ n ,∘⊃ v), e, y) ω}
  E₂ ← {'fn' gcl ((⊂ n ,∘⊃ v), e, y) ω}
  E₀ ← {r l f ← ⊃ v ω ⋄ (n ω) ((⊃ y ω) sget) (¯1 ↓ ⊃ y ω) (f scal sdb) r l}
  O₁ ← {'op' gcl ((⊂ n ,∘⊃ v), e, y) ω}
  O₂ ← {'op' gcl ((⊂ n ,∘⊃ v), e, y) ω}
  O₀ ← {''}
  Oᵣ ← {'EF(', ('Δ' ⌷R '__' ⊃ n ω), ',', (⊃⊃ v ω), ');', nl}
  F_d ← {'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}
  Z_e ← {'}', 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 ← {⊃,/ ((ι ≢ ⊃ n ω) ((⊣ sts¨ (⊃l) ,¨∘⊃ s), '}', nl, ⊣ ste¨ (⊃n) var¨∘⊃ r) ω), '}', nl}

gc ← {⊃,/ {0 = ⊃ t ω : ⊂ 5 ρ θ ⋄ ⊂ (⍏ (⊃ t ω), ⍒ ⊃ k ω) ω}⍤1 ⊢ ω}

  syms ← ,¨ '+'   '-'   '×'   '÷'   '*'   '⍟'   '|'   'o'   '⌊'   '⌈'   '!'
  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 ,← ,¨ '⌷'   '['   'ι'   'ρ'   ','   '⍪'   '⍋'   '⍒'   'e'   'ϵ'   'c'
  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 ,← ,¨ '↑'   '↓'   '⍫'   '⍢'   '.'   '⍤'   '⍣'   '∘'   'u'   'n'
  nams ,←   'tke' 'drp' 'map' 'com' 'dot' 'rnk' 'pow' 'jot' 'unq' 'int'
  syms ,← ,¨ '⍋'   '⍒'   '∘.'   '⍷'   '⊂'   '⍸'   '⌷FFT' '⌷IFFT' '%u'
  nams ,←   'gdu' 'gdd' 'oup' 'fnd' 'par' 'mdv' 'fft'   'ift'   ''

  nl ← ⌷UCS 13 10 ⋄ fvs ← ,⍤0 (≠⍨) 0 ≠ (≢∘⍴¨ ⊣) ⋄ cln ← '¯' ⌷R '-' ⋄ cnm ← (syms ι ⊂) ⊃ (nams, ⊂)
 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 ρ ω : (cnm ω), α ⋄ 1 = ≢ω : lits ω ⋄ lita ω}
  var ← {α ≡ ,'α' : ,'l' ⋄ α ≡ ,'ω' : ,'r' ⋄ ¯1 ≥ ⊃ω : αα lit ,α ⋄ 'env[', (⍕⊃ω), '][', (⍕⊃ ⌽ω), ']'}
  dnv ← {(0 ≡ z) ⊃ ('A  ', α, '[', (⍕ z ← ⊃ v ω), ];') ('A*', α, '=NULL;')}
  fnv ← {z ← 'A*env[', (⍕ 1 + ⊃ s ω), ']={', (⊃,/ (⊂'env0'), {',p[', (⍕ω), ']'}¨ ι ⊃ s ω), '};', nl}
  gcl ← {z r l n ← ((3 ρ ⊂'fn'), ⊂α) {⊃ α var/ ω}¨ ↓ (⊃ω), ⍪ 1 ⊃ ω ⋄ n, '(', (⊃{α, ',', ω}/ z l r ~ ⊂'fn'), ',env);', nl}
```

```
∇ Z ← Gfx∆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 ← 0 0 ⍴ ⍬
∇

    Display ← {⍺ ← 'Co-dfns' ⋄ W ← w_new ⊂⍺ ⋄ 777 :: w_del W
                   w_del W ⊣ W ⍺⍺{w_close ⍺ : ⍎'⎕SIGNAL 777' ⋄ ⍺ ⍺⍺ ⍺⍺ ⍵}⍣⍵⍵ ⊢ ⍵}
LoadImage ← {⍺ ← 1 ⋄ ⌽ loadimg ⍬ ⍵ ⍺}
SaveImage ← {⍺ ← 'image.png' ⋄ saveimg (⌽⍵) ⍺}
    Image ← {~ 2 3 ∨.= ≢⍴⍵ : ⎕SIGNAL 4 ⋄ (3 ≠ 2 ⊃ 3 ↑ ⍴⍵) ∧ 3 = ≢⍴⍵ : ⎕SIGNAL 5 ⋄ ⍵ ⊣ w_img (⌽⍵) ⍺}
     Plot ← {~ 2 ≠ ≢⍴⍵ : ⎕SIGNAL 4 ⋄ ~ 2 3 ∨.= 1 ⊃ ⍴⍵ : ⎕SIGNAL 5 ⋄ ⍵ ⊣ w_plot ⍵ ⍺}
Histogram ← {⍵ ⊣ w_hist ⍵, ⍺}
```

:EndNamespace