Software Development with Antelope

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Outline

- Antelope Software Development
  - Simple example
- Languages: A comparison
- References
- Hints for tcl, perl, and c
- Mini-applications
- Extending Antelope
- Less well known interfaces (C)
- Predict example

Antelope S/W Development

follows Unix example: simple tools, which can be combined in a complex fashion.

- framework
- collection of subroutines in libraries

Development Framework

- Where are binaries installed?

  $ANTELOPE/{bin,lib}

- Where can you find data files?

  $ANTELOPE/{data}/

- How do you make and install programs?

  make(1), $ANTELOPEMAKE

- How do you configure programs?

  command line => parameter files

- How do you handle errors?

  elog routines (rt logging, sys errors)

- How do you write documentation?

  man pages

Starting an application in C

1. Make a directory to work in.
2. **`template dbsimple.c > my.c`**
3. edit my.c
4. **`lint my.c`**
5. repeat 3, 4
6. **`make my.o`**
7. **`ldlibs my.o`** => $(DBLIBS)
8. Makefile:

```
BIN=my
ldlibs=$(DBLIBS)
include $(ANTELOPEMAKE)
```

9. parameter file, PF=my.pf
10. **manpage - > my.1**, MAN1=my.1

Final Makefile:

```
BIN=my
MAN1=my.1
PF=my.pf
ldlibs=$(DBLIBS)
include $(ANTELOPEMAKE)
```

Don't want to install into $ANTELOPE?

- **SUBDIR=/local**
- **DEST=/home/you/development**

before

```
include $(ANTELOPEMAKE)
```

Antelope Interfaces

database manipulation

parameter files

epoch time calculations

path manipulation

waveform access

orb access/packet unstuffing

Languages

There are 6 possible languages from which to choose:

- sh
- Tcl/Tk
- Perl
- Matlab
- C
- Fortran

Shell

easy

quick

limited by existing applications

limited strings

limited calculations

limited variables

use /bin/sh, not /bin/tcsh or /bin/csh

Tcl/Tk

- hands down easiest for making GUI
- easy to extend with your c functions
- simple language with confusing quoting rules (think c-shell)
- actually interactive
- future cloudy: seems to have a smaller group of users; BRTT will continue to support it indefinitely, because various fundamental programs are in tcl/tk.

Tcl Programs in Antelope

dbe

dbevents

dbhelp

dbloc2 GUI

dbnoise

ecrontab

orbmonrtd

q330mon, k2mon

rtm

Perl

faster

more complete, better designed language

best tool for string manipulation

widespread throughout Unix, Mac and PC world, especially system administration and web cgi scripts.

looks at first like someone was typing on wrong row of keyboard.

Antelope programs in Perl

antelope_update	cronrun	dbloc2
dbmerge	deposit	getid
grepsrc	pktmon	rtbackup
rtdbclean	rtdemo	rtexec
rtincident	rtinit	rtmail
rtreport	rtrun	truncate_log

Matlab

numerical work, especially prototypes

not for real time operations

very little string manipulation

not meant for scripts

C

- when nothing else will do
- require speed
- used a lot
- need interfaces not available in other languages

Other interfaces available from C

associative arrays and lists

waveforms

response functions

niceplot graphics

travel time calculations

vogle (3d) graphics

map transformations

waveform displays

square earth tiling

Fortran

the one you know

compatibility with existing routines

fast numerical operations

complex arithmetic

incomplete, not used as much.

in many cases, you can create a fortran interface to c routine

References

Software Development tutorial (new here)

http://www.brtt.com/workshop.tar.gz

Antelope Toolbox for Matlab, Kent Lindquist

Datascope tutorial (on cd)

Reference Booklets:

User, Programmer, Scripting

Man pages; look at the html version

file:/opt/antelope/4.4/antelope.html

FAQ ***http://www.brtt.com/faq***

Antelope-users mailing list

antelope-users@brtt.com

Antelope User's Group web site

http://www.indiana.edu/~aug

Tcl hints

package require Tclx ; cmdtrace on

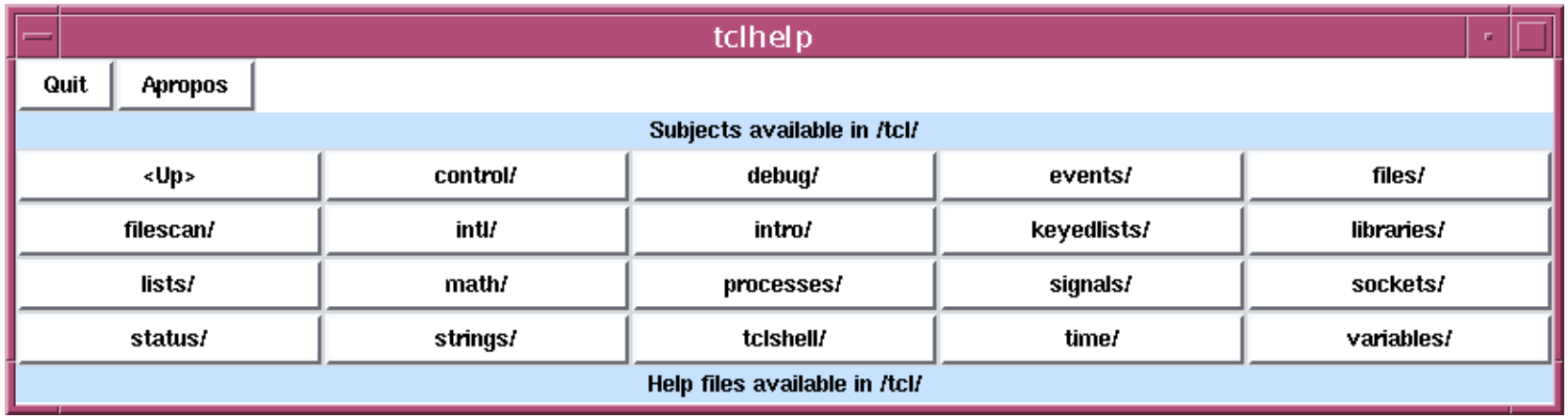
(like set -x or set -v in shell script)

http://www.tcl.tk

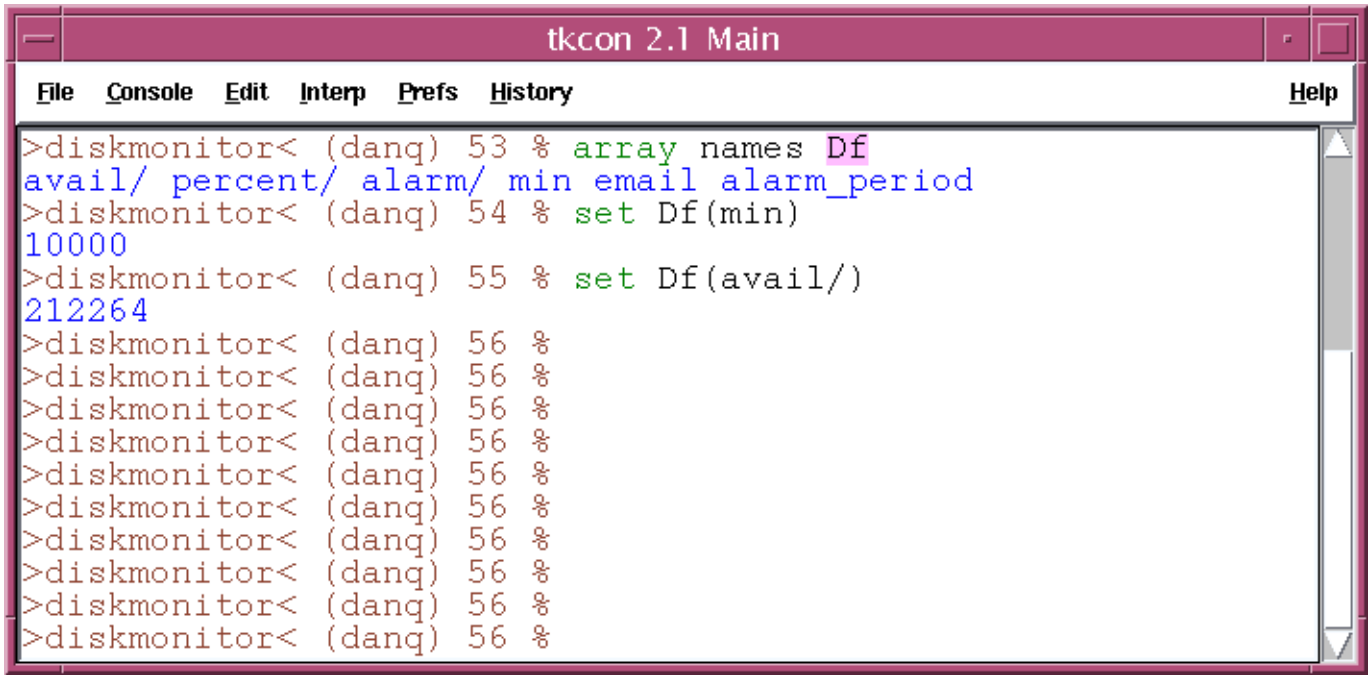
Tcl/Tk Pocket reference O'Reilly

tcltk-widget

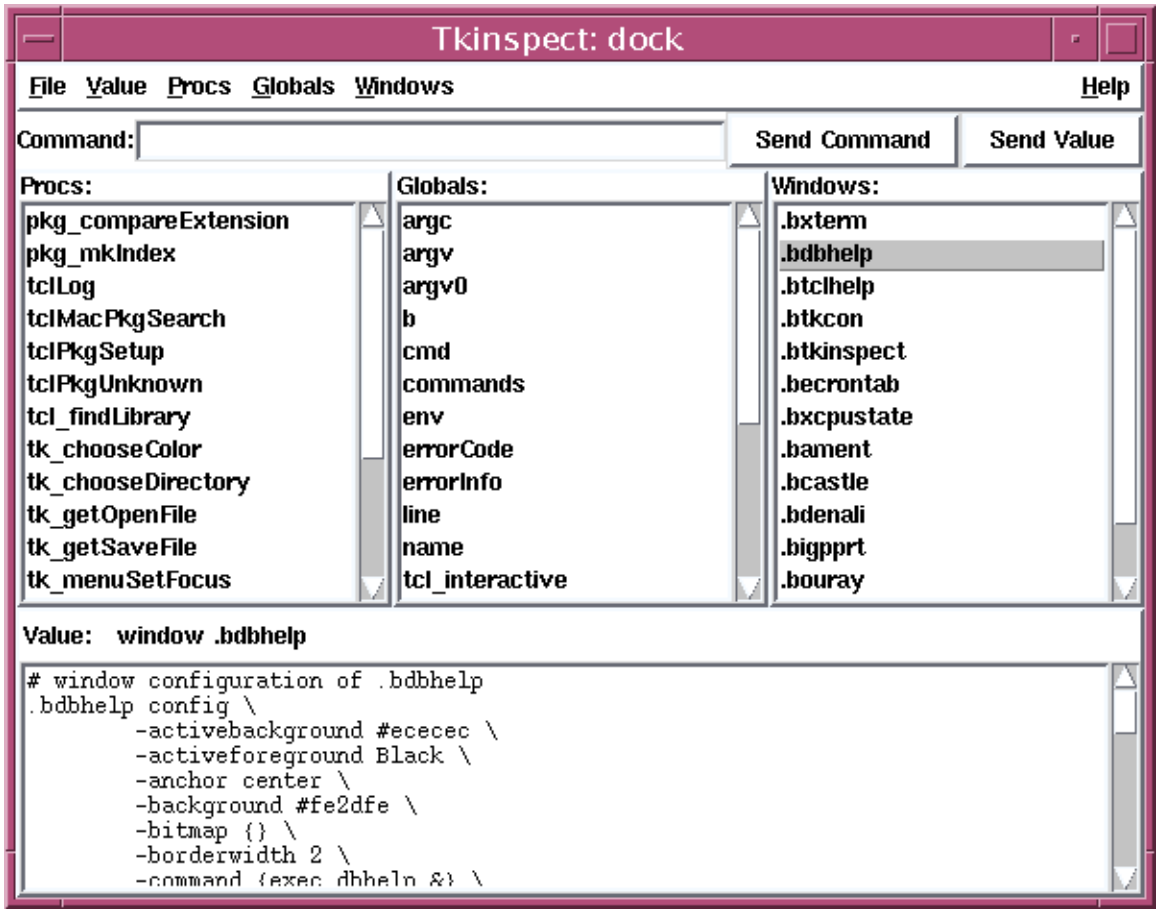
tclhelp: lookup tcl functions



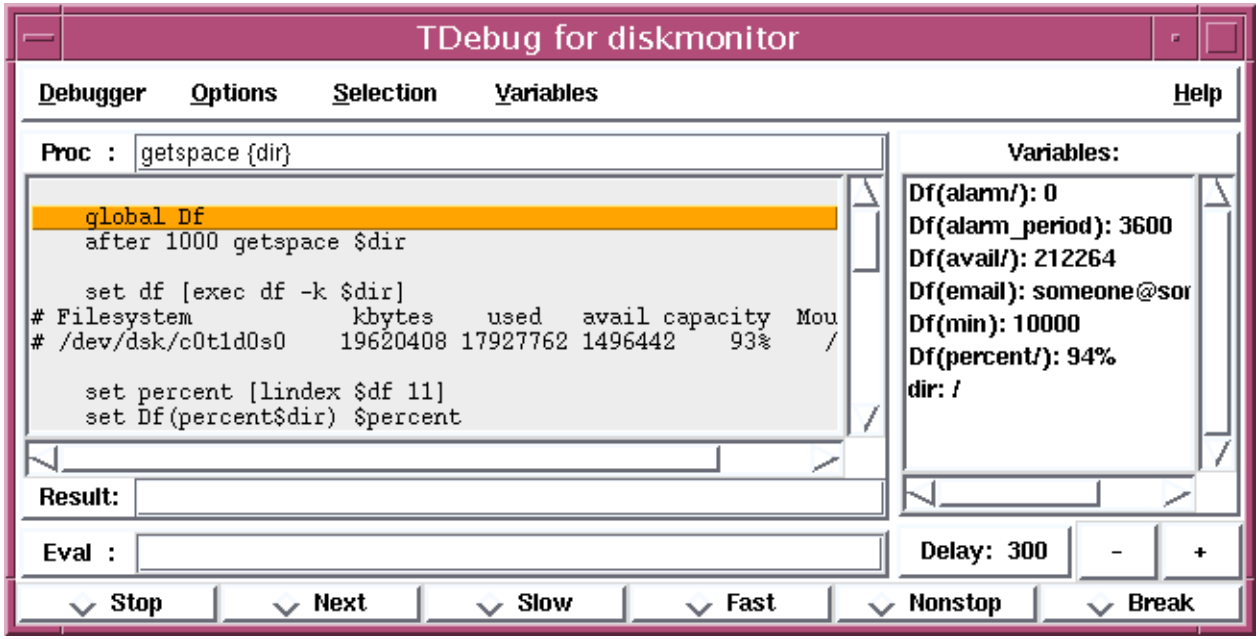
tkcon: talk to other tk applications



tkinspect: configure tk apps



tdb: graphical debugger



Global variables

One problem in tcl is local static variables. A routine does not have variables which preserve their value from one call to the next. Instead, you must save such values into global variables, much like Fortran common.

Suggestion: Choose a few (one) global variables, make them arrays and index into the array with the appropriate name.

E.g., for a program example, you might have an array Example, with elements like:

Example(gain)

Example(t0)

If you need further qualification, try putting two names together as the index:

Example(w0.t0)

Example(w1.t0)

Fewer global statements, easier to find and organize all the various global variables.

Perl Hints

perldoc -f stat

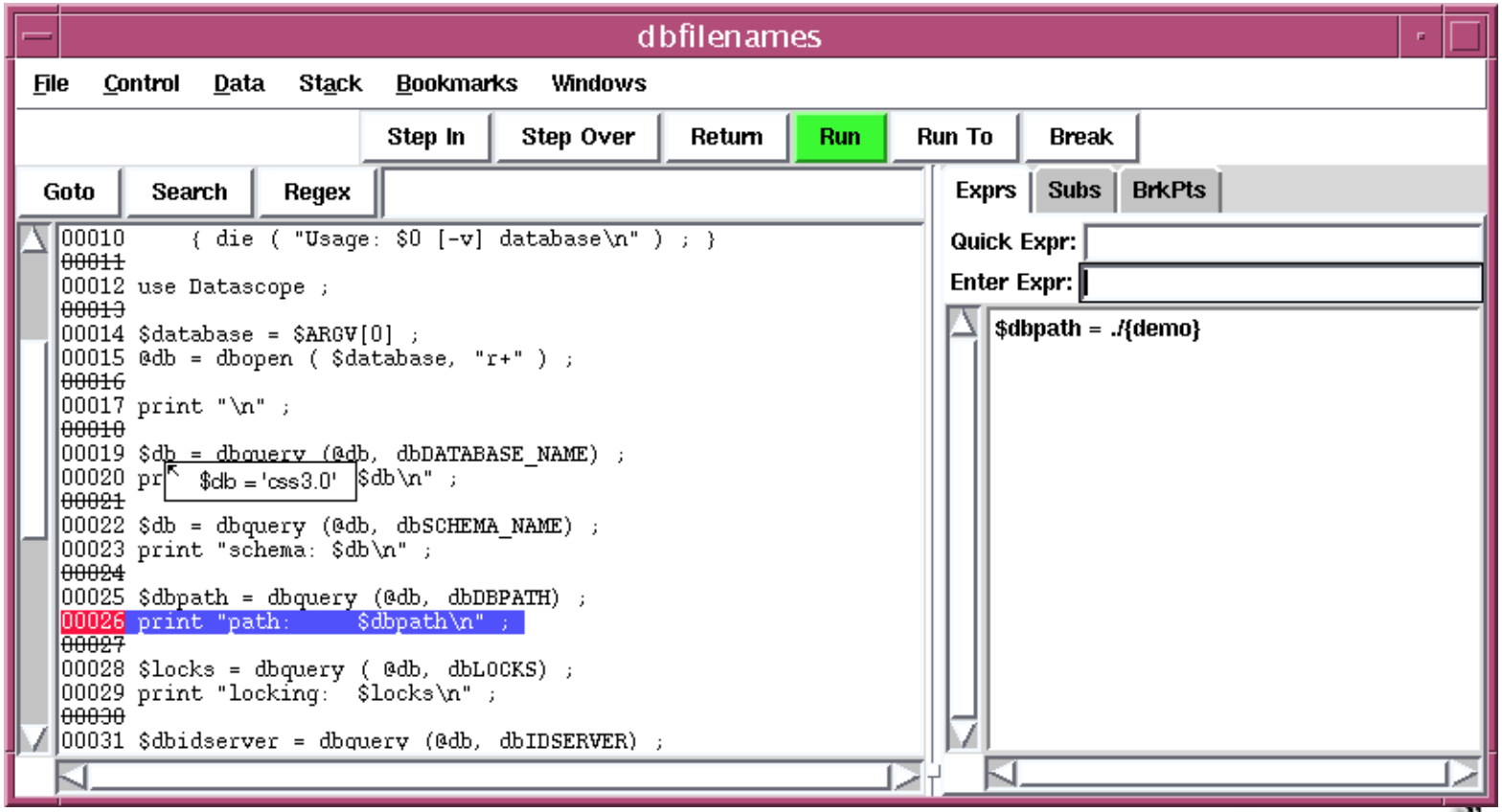
perldoc -q tk

http://www.perl.org

Perl and Perl/Tk Pocket references
O'Reilly

perl-widget

Perl debugger: perl -d:ptkdb



c hints

lint (lint wrapper)

indent (*look for .indent.pro*)

```
cextract -D__STDC__ -I/opt/antelope/dev/include -P +p

protoize -c "-I$ANTELOPE/include -I/opt/antelope/
  tcltk8.3/include"
```

ldlibs

C Debugging

```
ldd [-s] ‘which trexcerpt‘
```

truss

```
truss -a -vall -u\* -f -o /tmp/truss   ptree $$
```

stack trace on fault

```
elog_init(argc, argv) ;
```

collector in workshop

Memory problems

setenv LD_PRELOAD watchmalloc.so.1

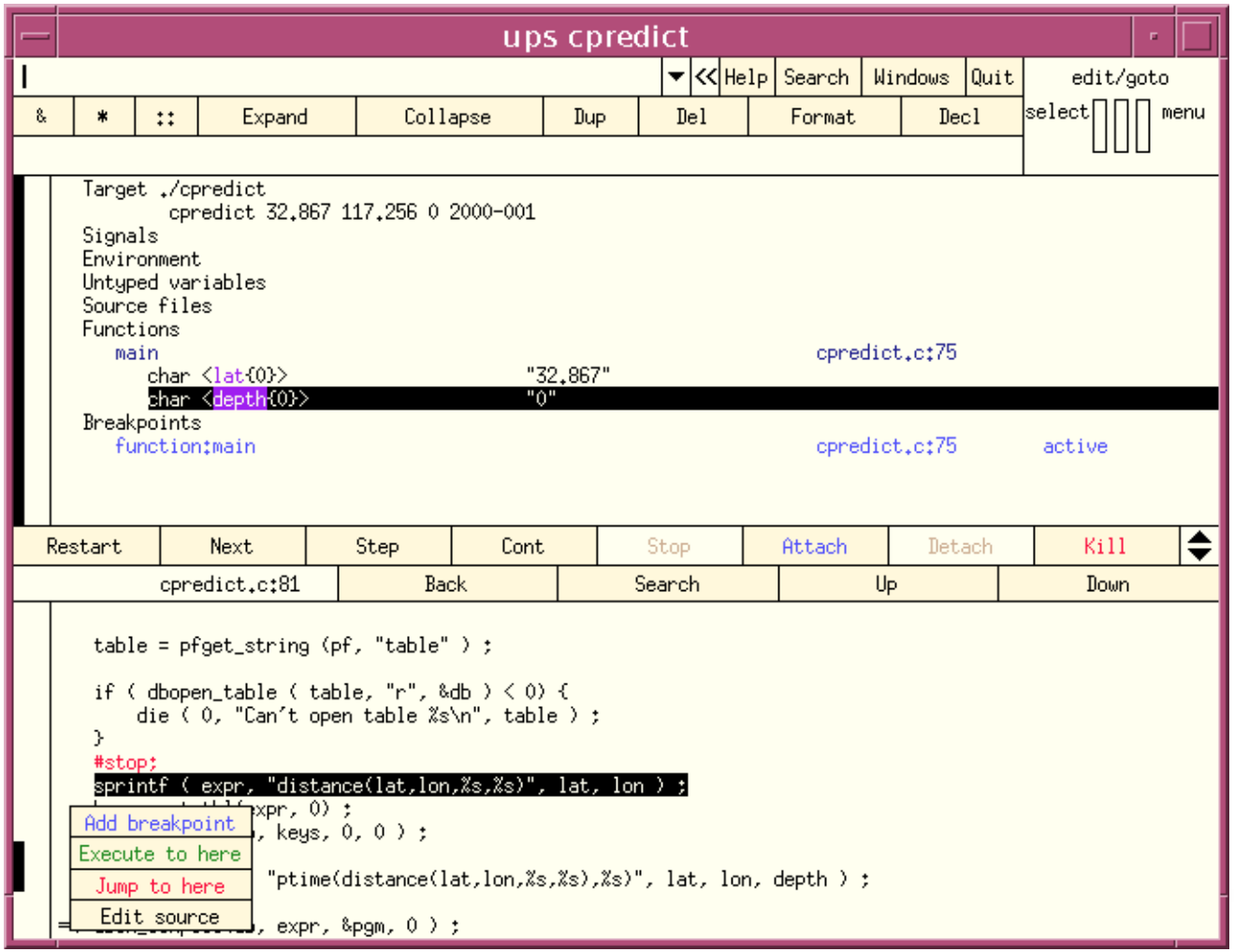
(`grepsrc -l LD_PRELOAD /usr/share/man/`)

workshop

works sometimes

purify

ups: the best debugger



Mini Applications

a command line window to an Antelope library function:

Datascope	*dbhelp, dbe, dbcalc*, ..
epoch time	*epoch*
parameter files	*pfecho*
path	*abspath, relpath, cleanpath*
orb/pkts	*orbstat -i*
travel times	*ttcalc*

Extending Antelope

your waveform format

your packet formats

your travel time calculator

your location program (in dbloc2)

your processing/editing/graphics program in dbe

elog ELOG_CALLBACK routines

Little known C interfaces

stock

- strmatches, strcontains
- hexdump
- abspath, relpath, cleanpath
- ask, askyn, askynaq

db

- dbprocess
- dbgroup (bundle, bundletype)
- dbcompile

dbstrtype

dbuntangle

dbsever

dbseparate

tt: ttcalc, ucalc

proj: pj_init, pf_fwd, pj_inv, pj_free

grx: fortran callable 2d graphics

vogle: c 3d graphics

pixaddress:

Contrived Problem:

print the arrival time for an event (at a certain time and coordinates), at a list of stations (from a database)

http://www.brtt.com/workshop.tar.gz

example code:

```
% ls $ANTELOPE/examples
c/        perl/     shell/    vogle/
fortran/  predict/  tcltk/
```

Shell example

```
#!/bin/sh
lat=$1
lon=$2
depth=$3
time=$4

epoch=`epoch +%E $time`
table=`pfecho -q predict table`

dbsort $table “distance(lat,lon,$lat,$lon)” |
dbselect - staname
  “strtime($epoch+ptime(distance(lat,lon,$lat,$lon),$d
  epth))”
```

Tcl/Tk Example

```
#!/bin/sh
# \
exec $ANTELOPE/bin/atcl $0 "$@"
package require Datascope
package require Tclx

set lat   [lindex $argv 0]
set lon   [lindex $argv 1]
set depth [lindex $argv 2]
set time  [lindex $argv 3]
set epoch [str2epoch $time]

set table [pfget predict table]
set db [dbopen_table $table r]
set db [dbsort $db
  distance(lat,lon,$lat,$lon)]
```

```
set n [dbquery $db dbRECORD_COUNT]
loop i 0 $n {
    set db [lreplace $db 3 3 $i]
    set pred [dbeval $db
  ptime(distance(lat,lon,$lat,$lon),$depth)]
    set pred [expr $pred+$epoch]
    set staname [lindex [dbgetv $db 0 $i staname] 0]
    puts [format "%-55s %s   (%s)" $staname [strtime
  $pred] [epoch2str $pred "%H:%M:%S.%s %z" ""]]
}
```

Perl Example

```
: # use perl
eval 'exec $ANTELOPE/../perl/bin/perl -S $0 "$@"'
if 0;

use lib "$ENV{ANTELOPE}/data/perl" ;
use Datascope ;

($lat, $lon, $depth, $time) = @ARGV ;
$epoch = str2epoch ($time) ;
$table = pfget (“predict”, “table”) ;

@db = dbopen_table($table, “r”) ;
@db = dbsort( @db, “distance(lat,lon,$lat,$lon)” ) ;

$n = dbquery (@db, “dbRECORD_COUNT”);
for ($db[3] = 0 ; $db[3]<$n ; $db[3]++){
```

```
        $pred = dbex_eval (@db,
          “ptime(distance(lat,lon,$lat,$lon),
             $depth)” ) ;
        $pred += $epoch ;
         ($staname) = dbgetv(@db, “staname”);
         printf “%-55s %s   (%s)\n”,
            $staname, strtime($pred),
            epoch2str($pred,
               “%H:%M:%S.%s %z”, “”) ;
    }
```

Matlab Example

```
#!/bin/sh
if [ $# != 4 ] ; then
    echo “Usage: $0 lat lon depth time”     exit 1
fi

exec /usr/local/bin/matlab -nodisplay -nojvm -nosplash
  << EOF > /dev/null
fid = fopen ( ‘/dev/stderr’, ‘w’ ) ;

lat = $1 ;
lon = $2 ;
depth = $3 ;
time  = ‘$4’ ;
epoch = str2epoch (time) ;

pf = dbpf ( ‘predict’ ) ;
```

```
dbtable = pfget ( pf, 'table' ) ;
[db, table] = strtok(dbtable, '.') ;
table = strrep(table, '.', '') ;

db = dbopen (db, 'r' ) ;
db = dblookup_table ( db, table)  ;

expr =  sprintf (
   'distance(lat,lon,%f,%f)', lat, lon);
db = dbsort( db, expr ) ;


expr = sprintf ('ptime(distance(lat,lon,%f,%f),%f)',
  lat, lon, depth ) ;
n = dbquery ( db, 'dbRECORD_COUNT' ) ;
for i = 0:1:n-1
    db.record = i ;
    pred = dbeval(db, expr) + epoch ;
```

```
        staname = dbgetv(db, 'staname' ) ;
        s = strtime(pred) ;
        fprintf ( fid, '%-55s %s\n',
             staname, s ) ;
    end
    exit ;
    EOF
```

C example

```
#include <stdio.h>
#include “coords.h”
#include “db.h”

static void
usage ()
{
    cbanner (“$Revision: 1.3 $”,
            “[-v] lat lon depth time”,
             “BRTT example”,
             “BRTT”,
             “support@brtt.com” ) ;
    exit (1);
}
int
main (int argc, char **argv)
```

```
{
    Dbptr    db;
    Pf      *pf;
    char    *table, *lat, *lon, *depth ;
    char     expr[256], staname[128],
                    *s1, *s2 ;
    int      n ;
    double   epoch, pred ;
    Tbl     *keys ;
    Expression *pgm ;

    elog_init ( argc, argv ) ;

    if (pfread ("predict", &pf) != 0)
        die (0, "Can't read pf\n");

    if (argc-optind != 4)
        usage ();
```

```
lat   = argv[optind++];
lon   = argv[optind++];
depth = argv[optind++];
epoch = str2epoch(argv[optind++]);

table = pfget_string (pf, “table” ) ;

if(dbopen_table(table, “r”, &db)<0)
    die(0,“Can’t open %s”, table ) ;
sprintf ( expr,
 “distance(lat,lon,%s,%s)”,lat,lon);
keys = strtbl(expr, 0) ;
db = dbsort( db, keys, 0, 0 ) ;

  sprintf ( expr,
“ptime(distance(lat,lon,%s,%s),%s),
    lat, lon, depth ) ;
```

```
    dbex_compile(db, expr, &pgm, 0 ) ;
    dbquery(db, dbRECORD_COUNT, &n ) ;
    for ( db.record=0 ; db.record<n ;
                                db.record++){
        dbex_eval (db, pgm, 0, &pred ) ;
        pred += epoch ;
        dbgetv(db,0,"staname",staname,0);
        s1=strtime(pred),
        s2=zepoch2str(pred,
              "%H:%M:%S.%s %z", "")) ;
        printf ("%-55s %s   (%s)\n",
                  staname, s1, s2 ) ;
        free(s1) ; free(s2) ;
    }
    dbex_free(pgm) ;
    return 0;
}
```

Fortran example

```
      program fpredict
      implicit none
#include “db.i”
      real*8 str2epoch, epoch, pred
      integer iargc, db(4), pf, pgm, i, result, n, keys
      character*256 table, expr, staname
      character*64 lat, lon, depth, time, stime

      call elog_init(0,0)

      call pfread(“predict”, pf, result )
      if ( result ) then
         call die ( “Can’t read parameter file” )
      endif
```

```
      if ( iargc() .ne. 4 ) then
         call die("Usage: fpredict lat lon depth time")
      endif

      call getarg(1, lat)
      call getarg(2, lon)
      call getarg(3, depth)
      call getarg(4, time)
      epoch = str2epoch(time)

      call pfget_string(pf, "table", table )

      if ( dbopen_table ( table, "r", db)  .LT. 0 )
     *    call die ( 0, "Can't open database" )
```

```
      write (expr, 100) lat, lon
100   format ('distance(lat,lon,', a, ',', a, ')')

      call strtbl(keys, expr, 0)
      call dbsort ( db, db, keys, 0, "" )

      write ( expr, 101) lat, lon, depth
101   format ('ptime(distance(lat,lon,',
     *                    a,',',a,'),',a,')')
      result = dbex_compile ( db, expr, pgm, 0 )
```

```
        call dbquery ( db, dbRECORD_COUNT, n )
        do i = 0, n-1
           db(4) = i
           result = dbex_eval ( db, pgm, 0, pred )
           pred = pred + epoch
           result = dbgetv(db, “”, “staname”, staname, 0)
           call strtime(stime, pred)
           write (*, 110) staname, stime
        end do

110     format ( a55, a )
        end
```

Makefile

```
BIN=cpredict fpredict mlpredict predict \
    tclpredict perlpredict

ldlibs=$(DBLIBS)
include $(ANTELOPEMAKE)
```

Missing `MAN1=`