MPI and HPL on "DebianOnAndroid"

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I. Prerequisite 1: Debian On Android

A Debian machine must be already installed on Android and we suggest to use the Squeeze version of Debian, since it fits the most in out case. Older versions do not support any implementation of MPI, newer ones do not run on phones with an ARMv6 processor (or an earlier one). Anyway you are free to choose Debian Wheezy or Jessie if you phone has an ARMv7 or ARMv8 processor. To run Debian on Android you have to run the following commands into a Linux machine with root privileges:

- *apt-get install debootstrap*
- *dd if=/dev/zero of=debian.img seek=1024M bs=1 count=1*
- *mke2fs -F debian.img*
- *mkdir debian*
- *mount -o loop debian.img debian*
- *debootstrap –verbose –arch armel –foreign squeeze debian http://ftp.cz.debian.org/debian*
- *umount debian*

Now connect to your phone with *adb*, copy the *debian.img* into your Sd Card and run the following commands:

- Export your SdCard path (NB: it may be different): *export kit=/sdcard/*
- *export mnt=/data/local/mnt*
- *busybox mkdir -p $mnt*
- *export PATH=/usr/bin:/usr/sbin:/bin:$PATH*
- *export TERM=linux*
- *export HOME=/root*
- *busybox mknod /dev/loop0 b 7 0*
- *mount -o loop,noatime $kit/debian.img $mnt*

- *chroot $mnt /debootstrap/debootstrap –second-stage*
- *echo 'deb http://ftp.cz.debian.org/debian squeeze main' > $mnt/etc/apt/sources.list*
- *echo 'nameserver 8.8.8.8' > $mnt/etc/resolv.conf*

Now the installation is over, you can access Debian by chroot into the mounted filesystem:

- *chroot $mnt /bin/bash*

To return to the Android shell, simply type *exit*. Before proceeding with the next session, you should run the command *apt-get update*.

II. Prerequisite 2: C, C++ and Fortran compilers

C and C++ compilers are required in order to compile MPI programs written in C, while Fortran compiler is required to compile the ones written in Fortran. To later generate the hpl executable, we need to have all the three of them:

- Chroot into Debian
- Type: *apt-get install gcc g++ gfortran*

III. Prerequisite 3: SSH communication

To make multiple devices communicate with each other, it is necessary to initiate an SSH connection, that DO NOT require any authentication to boot the mpd daemon. To make it simple, let's install both the SSH client and server on every device, so that we will not have to wonder which device has to be the master and which ones the slaves.

- Type: *apt-get install openssh-client*
- Type: *apt-get install openssh-server*

If the device will refuse the SSH connection, try to flush the firewall with *iptables -F* and restart the SSH server with */etc/init.d/ssh restart*.
To make a test you can try with: *ssh localhost*.

IV. Prerequisite 4: BLAS libraries

We need two libraries containing files for computing linear algebra operations: libcblas.a and libatlas.a; you can retrieve these libraries in the way you prefer (you could also use other libraries..) but the simplest way (in order to have same installation paths) is:

- Type: *apt-get install libatlas-base-dev*

V. MPICH2 Installation

Running Debian should make the MPICH installation totally automatic:

- Type: *apt-get install mpich2*

If any error occurs, you will have to install it manually (Google it and good luck!). To check that everything is fine, type *which mpicc* that should show you the path where MPICH2 has been installed. You can test the installation running a simple HelloMPIWorld:

- To compile it: *mpicc HelloMPIWorld.c -o HelloMPIWorld*
- To run it: *mpirun -n 1 HelloMPIWorld*

VI. HPL Installation

When we are sure that the compilers, MPI and BLAS libraries have been successfully installed, we can start the installation of the HPL Benchmark.

- download the latest version (at this time 2.1): `http://www.netlib.org/benchmark/hpl/`
- unpack the tar.gz file in a path you prefer (from now on: PATHdir)
- write the makefile for your system architecture (see the next section for further information)
- move the makefile into your PATHdir
- type: *make arch=<arch>*
- test your installation (you should now have a directory *PATHdir/bin/<arch>* with executable file *xhpl* and text file *HPL.dat* inside):
  - move into *PATHdir/bin/<arch>*
  - Type: *mpirun -np 16 ./xhpl*

  You should see HPL performing some tests.

VII. Notes on how to write the Makefile

The makefile *Make.<arch>* is a text file containing all links to the libraries previously installed. The file is specific for your architecture and your system. We need to edit one of the template inside the folder *PATHdir/setup* and adapt it to our architecture.

- Copy one of the makefiles you find in the folder *PATHdir/setup* into *PATHdir/*
- Rename it with a name of you choice (e.g. *Make.squeeze*)

- Open it with a text editor and edit the following flags:
    - *ARCH=<arch>* (in our example ARCH=squeeze)
    - *TOPdir=PATHdir*
    - *MPdir=PATHinst* (choose the MPI installation folder of the implementation you want to use)
    - *MPlib=PATHinst/lib/<library>* (*<library>=libmpich.a* if you use MPICH or *<library>=libmpi.so* if you use openMPI)
    - *LAdir=/usr/lib/atlas-base*
    - *LAlib=$(LAdir)/libcblas.a $(LAdir)/libatlas.a*
    - *CC=PATHinst/bin/mpicc*
    - *LINKER=PATHinst/bin/mpif77*