

1. For development of code in Linux, GCC and GDB are the preferred compiler and debugger to use. Go to [www.asterisk.org](http://www.asterisk.org) and download Asterisk. Look at <https://wiki.asterisk.org/wiki/display/AST/Beginning+Asterisk> and read the sections on Beginning Asterisk, Installing Asterisk, and the Hello World Project. Use either the Angstrom package repository to install the asterisk package directly after connecting the Raspberry Pi Model 3 to the internet under Linux. Carefully read the documentation and online guides and incorporate Asterisk, the open source PBX into one of your Linux SD cards. How much memory is used by the code? (What is the image size?)

```

307 root      20   0   0   0   0 S   0.0   0.0   0:00.00 vchi
308 root      10 -10   0   0   0 S   0.0   0.0   0:00.00 SMIO
pi@raspberrypi:~$ df -H
Filesystem      Size  Used Avail Use% Mounted on
udev            335M   0 335M   0% /dev
tmpfs           96M  1.1M  95M   2% /run
/dev/mmcblk0p2  15G  3.3G  11G  24% /
tmpfs           477M   0 477M   0% /dev/shm
tmpfs           5.3M  13k  5.3M   1% /run/lock
/dev/mmcblk0p1  535M  64M  471M  12% /boot/firmware
tmpfs           96M   0  96M   0% /run/user/1000
pi@raspberrypi:~$ |
top - 16:56:12 up 5:20, 3 users, load average: 0.06, 1.28, 3.65
Tasks: 133 total, 2 running, 131 sleeping, 0 stopped, 0 zombie
%Cpu(s): 1.3 us, 1.1 sy, 0.0 ni, 97.2 id, 0.2 wa, 0.0 hi, 0.2 si, 0.0 st
MiB Mem : 908.5 total, 86.5 free, 192.7 used, 693.5 buff/cache
MiB Swap: 100.0 total, 97.2 free, 2.8 used, 715.8 avail Mem

  PID USER      PR  NI  VIRT  RES  SHR S %CPU  %MEM    TIME+  COMMAND
 273 root        20   0 25832 6508 3824 S  4.9   0.7   3:05.05 systemd-udev
11200 root        20   0 3335556 51640 3880 S  1.6   5.8   0:13.00 vchi

```

2. Using either a SIP phone plugged into the same LAN as the Raspberry Pi Model 3 (you may need an Ethernet switch to create the network), or with a PC running a softphone application connected to the Raspberry Pi Model 3, configure Asterisk to provide a voicemail message at extension 100. Configure your SIP phone or softphone and register with Asterisk. Show your Asterisk setup in a screenshot.

```

[transport-udp]
type=transport
protocol=udp
bind=0.0.0.0

[6001]
type=endpoint
context=from-internal
disallow=all
allow=ulaw
auth=6001
aors=6001

[6001]
type=auth
auth_type=userpass
password=unsecurepassword
username=6001

[6001]
type=aor
max_contacts=1
~
~
~
~

```

Please see the attached video voice\_mail.mp4.

3. Make a call to extension 100 and record what you hear. Show your Asterisk setup in a screenshot.

```

pi@raspberrypi: /etc/asterisk
[from-internal]
exten = 100,1,Answer()
same = n,Wait(1)
same = n,VoiceMail(100@default)
same = n,Hangup()
~
~
~
~

```

Please see the attached video hello\_world.mp4.

4. [Optional, for 5 extra credit points] Add another SIP phone or softphone to the network, and make a phone-to-phone call.

Please see the attached video extra\_credit.mp4.