

\*\*\*\*\*Draft\*\*\*\*\*

**QEMU Ultibo Bare Metal  
SVD  
with  
Remote Shell and Web Status  
07/28/21**

\*\*\*\*\*Draft\*\*\*\*\*

**Note:**

<https://ultibo.org/forum/viewtopic.php?f=13&t=1303&p=11632#p11632>

By Ultibo Wed Jul 21, 2021 9:01 pm

I suspect the version of QEMU that you have on the RPi3B+ is later than the one on the RPi4, try doing `qemu-system-arm -version` on each one.

We recently discovered that the Ultibo SD card driver was not compatible with the latest versions of QEMU, a fix for this is included in the release from today (Ultibo core 2.1.079) so if you update your RTL to the latest either using the RTL Builder or by rerunning the `ultiboinstaller` script then it should work now.

<https://en.m.wikipedia.org/wiki/QEMU>. On the pi400-1 I ran `./ultiboinstaller.sh` on pi400-1.

QEMU is a [hosted virtual machine monitor](#): it emulates the machine's [processor](#) through dynamic [binary translation](#) and provides a set of different hardware and device models for the machine, enabling it to run a variety of [guest operating systems](#). It also can be used with [Kernel-based Virtual Machine](#) (KVM) to run virtual machines at near-native speed (by taking advantage of hardware extensions such as [Intel VT-x](#)). QEMU can also do emulation for user-level processes, allowing applications compiled for one architecture to run on another.[\[3\]](#)

**Note :** Additional software is needed to run QEMU “`sudo apt-get install qemu-system-arm`”. The following programs are added.

`/usr/bin/qemu-img /usr/bin/qemu-nbd /usr/bin/qemu-system-aarch64  
/usr/bin/qemu-io /usr/bin/qemu-pr-helper /usr/bin/qemu-system-arm`

The command line for starting **Lazarus IDE (Ultibo Edition)** “`~/ultibo/core/lazarus.sh`”

`builddlib.sh`

```
#!/bin/bash
#export PATH=/home/devel/ultibo/core/fpc/bin:$PATH
rm -f *.o
rm -f libsvd.a
```

```
arm-none-eabi-gcc -I../include -O3 -mabi=aapcs -marm -march=armv7-a -mfpu=vfpv3-d16 -
mfloat-abi=hard -c svd.c -o svd.o
arm-none-eabi-gcc -I../include -O3 -mabi=aapcs -marm -march=armv7-a -mfpu=vfpv3-d16 -
mfloat-abi=hard -c disp_mat.c -o disp_mat.o
arm-none-eabi-gcc -I../include -O3 -mabi=aapcs -marm -march=armv7-a -mfpu=vfpv3-d16 -
mfloat-abi=hard -c trans_mat.c -o trans_mat.o
arm-none-eabi-gcc -I../include -O3 -mabi=aapcs -marm -march=armv7-a -mfpu=vfpv3-d16 -
mfloat-abi=hard -c mul_mat.c -o mul_mat.o
arm-none-eabi-gcc -D_POSIX_THREADS -lpthread -I../include -O3 -mabi=aapcs -marm -
march=armv7-a -mfpu=vfpv3-d16 -mfloat-abi=hard -c mythread.c -o mythread.o
arm-none-eabi-gcc -I../include -O3 -mabi=aapcs -marm -march=armv7-a -mfpu=vfpv3-d16 -
mfloat-abi=hard -c pnmio.c -o pnmio.o
arm-none-eabi-gcc -I../include -O3 -mabi=aapcs -marm -march=armv7-a -mfpu=vfpv3-d16 -
mfloat-abi=hard -c error.c -o error.o
```

```
echo "Compiling example ultibo_th_svd "
```

```
arm-none-eabi-gcc -DUltibo -D_POSIX_THREADS -lpthread -I../include -O3 -mabi=aapcs -marm
-march=armv7-a -mfpu=vfpv3-d16 -mfloat-abi=hard -c master.c -o ultibo_th_svd.o
```

```
#gcc test_svd.c svd.o disp_mat.o -lm -o test_svd
```

```
arm-none-eabi-ar rcs libsvd.a *.o
```

```
arm-none-eabi-ar -t libsvd.a > libsvd_obj.txt
```

```
#fpc -vi -B -Tultibo -Parm -CpARMV7A -WpRPI3B @/home/devel/ultibo/core/fpc/bin/RPI3.CFG
-O4 svd_FS_RPi3.lpr
```

```
./buildlib.sh
```

```
Compiling example ultibo_th_svd
```

```
less libsvd_obj.txt
```

```
disp_mat.o
```

```
error.o
```

```
mul_mat.o
```

```
mythread.o
```

```
pnmio.o
```

```
svd.o
```

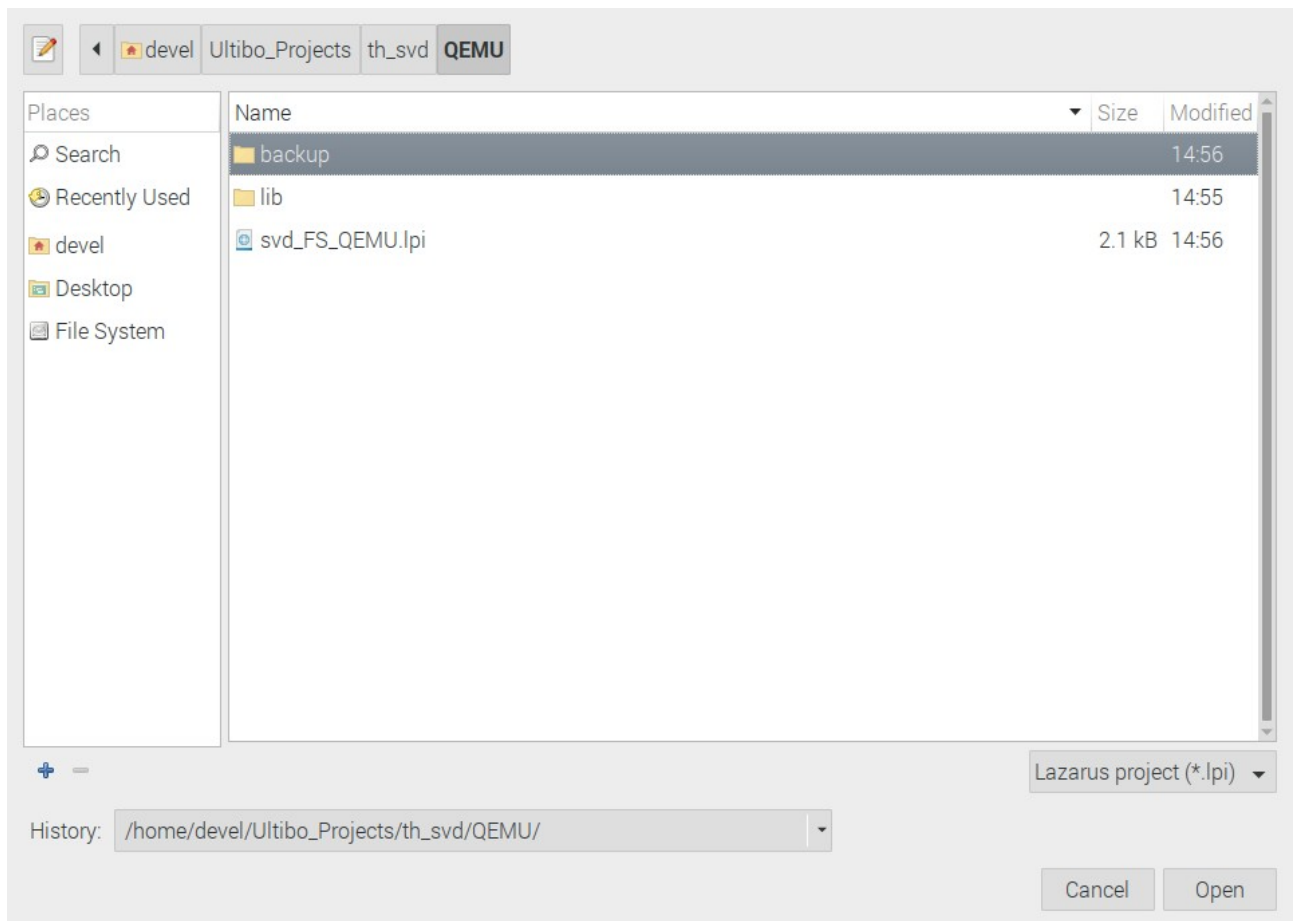
```
trans_mat.o
```

```
ultibo_th_svd.o
```

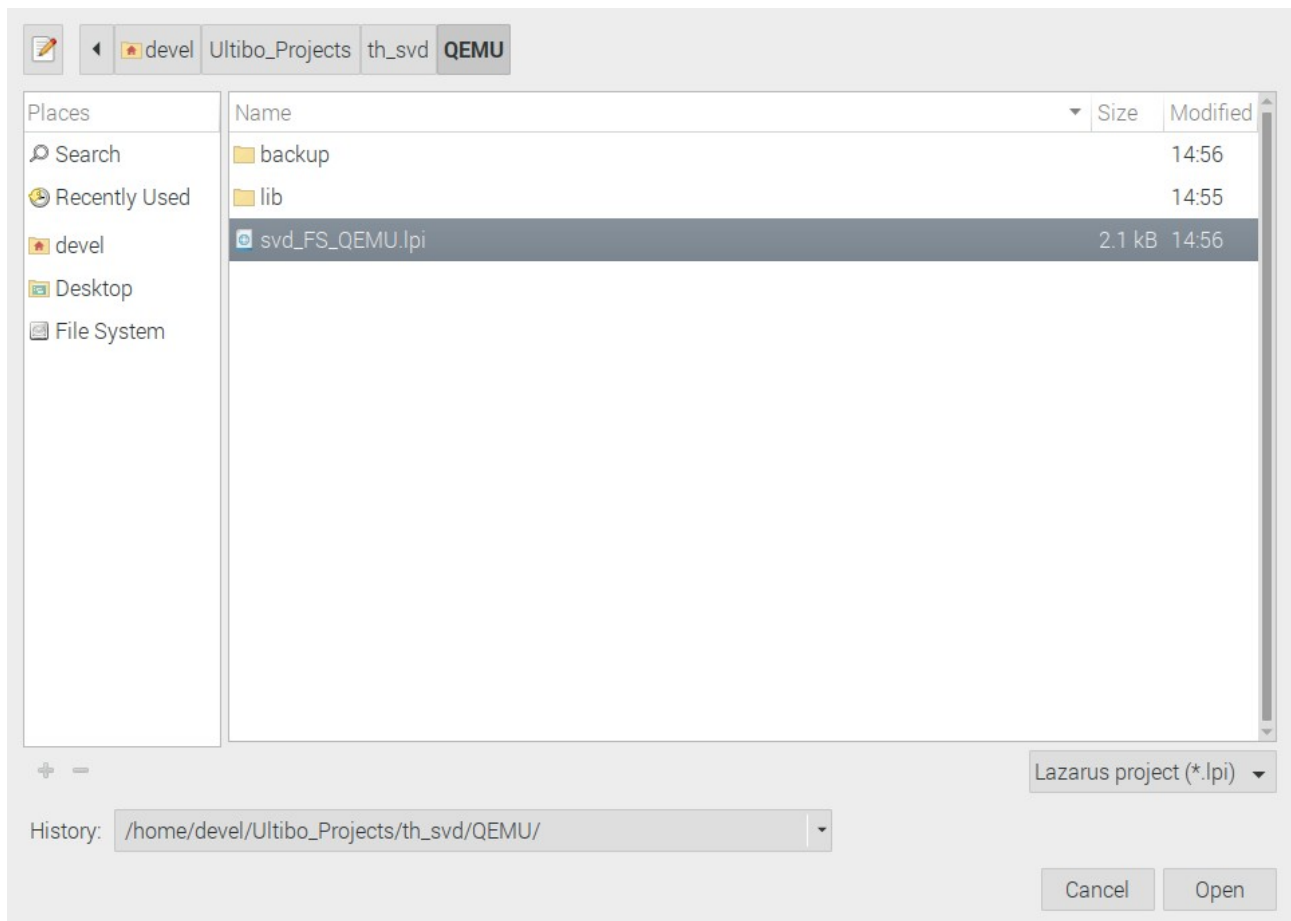
```
ls -la libsvd.a
```

```
-rw-r--r-- 1 devel devel 33010 Jul 27 17:33 libsvd.a
```

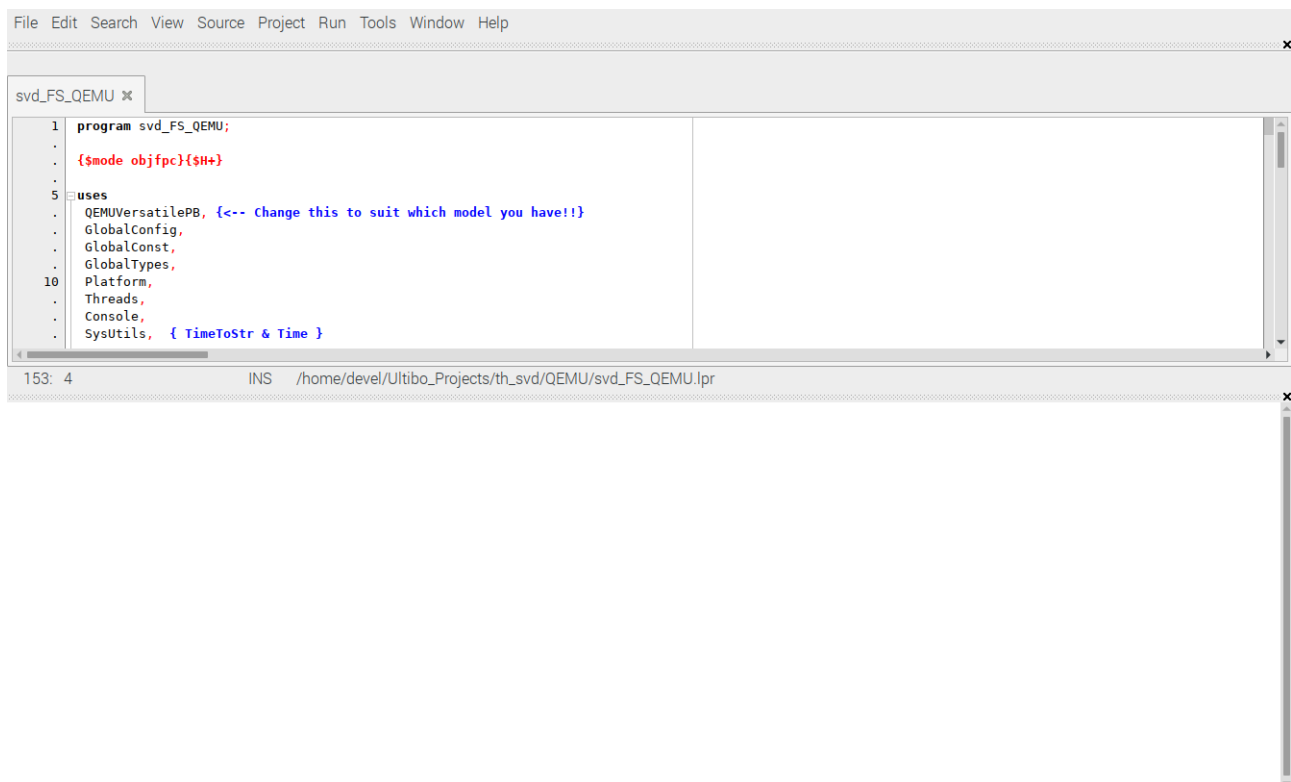
```
Project/Open Project
```



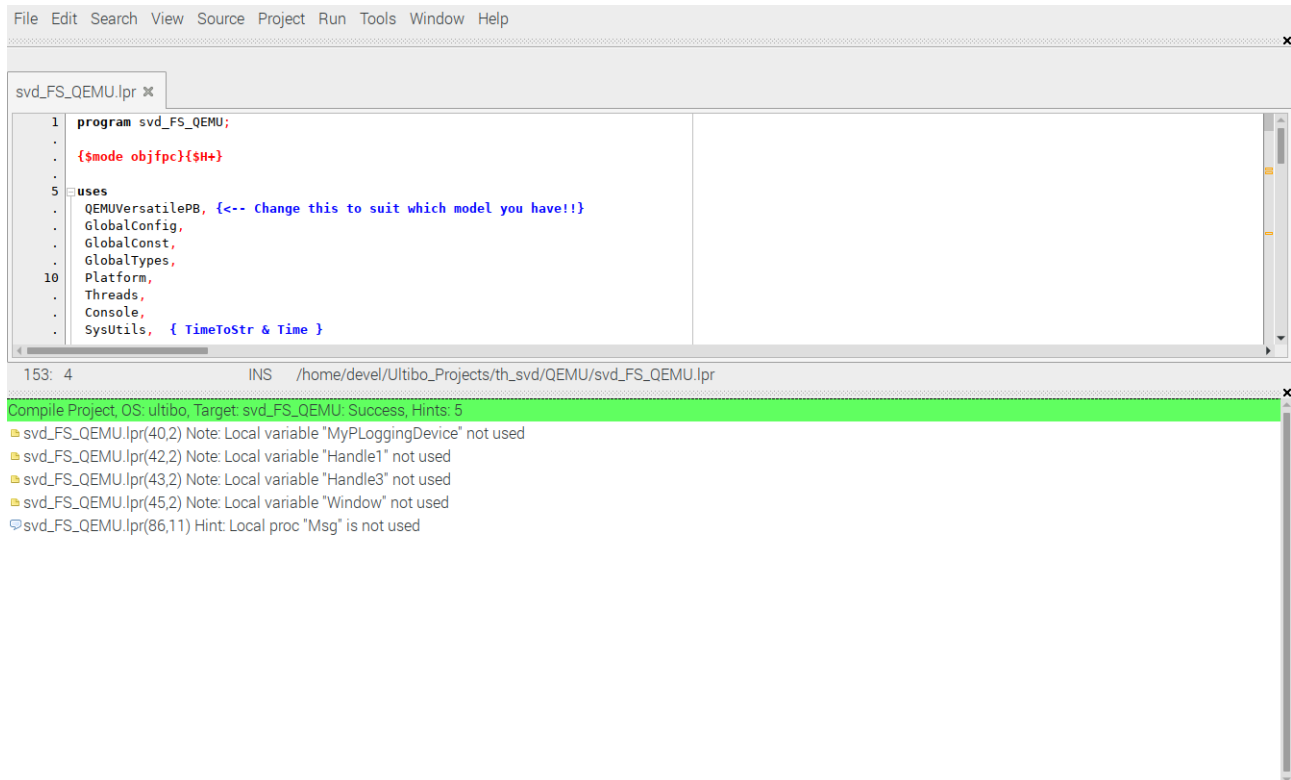
Select svd\_FS\_QEMU.lpi



## Depress Open



Run/Compile The kernel.bin is created when the Green bar appears.



qemu-img create disk.img 25M

Formatting 'disk.img', fmt=raw size=26214400

sudo fdisk disk.img

Welcome to fdisk (util-linux 2.33.1).

Changes will remain in memory only, until you decide to write them.

Be careful before using the write command.

Device does not contain a recognized partition table.

Created a new DOS disklabel with disk identifier 0x165f8cb7.

Command (m for help): n

Partition type

p primary (0 primary, 0 extended, 4 free)

e extended (container for logical partitions)

Select (default p): p

Partition number (1-4, default 1): 1

First sector (2048-51199, default 2048):

Last sector, +/-sectors or +/-size{K,M,G,T,P} (2048-51199, default 51199):

Created a new partition 1 of type 'Linux' and of size 24 MiB.

Command (m for help): t

Selected partition 1

Hex code (type L to list all codes): L

0 Empty	24 NEC DOS	81 Minix / old Lin	bf Solaris
1 FAT12	27 Hidden NTFS Win	82 Linux swap / So	c1 DRDOS/sec (FAT-
2 XENIX root	39 Plan 9	83 Linux	c4 DRDOS/sec (FAT-
3 XENIX usr	3c PartitionMagic	84 OS/2 hidden or	c6 DRDOS/sec (FAT-
4 FAT16 <32M	40 Venix 80286	85 Linux extended	c7 Syrix
5 Extended	41 PPC PReP Boot	86 NTFS volume set	da Non-FS data
6 FAT16	42 SFS	87 NTFS volume set	db CP/M / CTOS / .
7 HPFS/NTFS/exFAT	4d QNX4.x	88 Linux plaintext	de Dell Utility
8 AIX	4e QNX4.x 2nd part	8e Linux LVM	df BootIt
9 AIX bootable	4f QNX4.x 3rd part	93 Amoeba	e1 DOS access
a OS/2 Boot Manag	50 OnTrack DM	94 Amoeba BBT	e3 DOS R/O
b W95 FAT32	51 OnTrack DM6 Aux	9f BSD/OS	e4 SpeedStor
c W95 FAT32 (LBA)	52 CP/M	a0 IBM Thinkpad	hi ea Rufus alignment
e W95 FAT16 (LBA)	53 OnTrack DM6 Aux	a5 FreeBSD	eb BeOS fs
f W95 Ext'd (LBA)	54 OnTrackDM6	a6 OpenBSD	ee GPT
10 OPUS	55 EZ-Drive	a7 NeXTSTEP	ef EFI (FAT-12/16/
11 Hidden FAT12	56 Golden Bow	a8 Darwin UFS	f0 Linux/PA-RISC b
12 Compaq diagnost	5c Priam Edisk	a9 NetBSD	f1 SpeedStor
14 Hidden FAT16 <3	61 SpeedStor	ab Darwin boot	f4 SpeedStor
16 Hidden FAT16	63 GNU HURD or Sys	af HFS / HFS+	f2 DOS secondary
17 Hidden HPFS/NTF	64 Novell Netware	b7 BSDI fs	fb VMware VMFS
18 AST SmartSleep	65 Novell Netware	b8 BSDI swap	fc VMware VMKCORE
1b Hidden W95 FAT3	70 DiskSecure Mult	bb Boot Wizard hid	fd Linux raid auto
1c Hidden W95 FAT3	75 PC/IX	bc Acronis FAT32 L	fe LANstep
1e Hidden W95 FAT1	80 Old Minix	be Solaris boot	ff BBT

Hex code (type L to list all codes): 4

Changed type of partition 'Linux' to 'FAT16 <32M'.

Command (m for help): p

Disk disk.img: 25 MiB, 26214400 bytes, 51200 sectors

Units: sectors of 1 \* 512 = 512 bytes

Sector size (logical/physical): 512 bytes / 512 bytes

I/O size (minimum/optimal): 512 bytes / 512 bytes

Disklabel type: dos

Disk identifier: 0x165f8cb7

Device	Boot	Start	End	Sectors	Size	Id	Type
disk.img1		2048	51199	49152	24M	4	FAT16 <32M

Command (m for help): w

The partition table has been altered.

Syncing disks.

mkdosfs disk.img

mkfs.fat 4.1 (2017-01-24)

sudo mount disk.img /mnt/img1

sudo cp -R ~/Ultibo\_Projects/Little\_Interpreted\_Language/img-tests/disk/\* /mnt/img1

```
sudo cp *.pgm /mnt/img1/
```

```
ls /mnt/img1
```

```
'Another File.txt' blu.pgm grn.pgm red.pgm 'Test File.txt' www
```

```
sudo umount /mnt/img1
```

```
./startqemu.sh
```

```
#!/bin/bash
```

```
qemu-system-arm -machine versatilepb -cpu cortex-a8 -kernel kernel.bin \
```

```
-net
```

```
user,hostfwd=tcp::5080-:80,hostfwd=tcp::5023-:23,hostfwd=udp::5069-:69,hostfwd=tcp::6050-:505
```

```
0 -net nic \
```

```
-drive file=disk.img,if=sd,format=raw
```

```
Machine View

Ultibo Core (Release: Beetroot Version: 2.1.079 Date: 21 July 2021)

21:48:45
TFTP Demo.
In main red.pgm Sred.bin rcred.bin 0 0
In main grn.pgm Sgrn.bin rcgrn.bin 0 0
In main blu.pgm Sblu.bin rcblu.bin 0 0
name: Allen
age: 20
0x0

1st thread processing th_id[0] 0x4cdebe0
In mysd input_file: red.pgm
In mysd first_output: Sred.bin
In mysd second_output: rcred.bin
In mysd status: 0
In mysd num_bytes_rd: 0

ncols=128 nrows=128
In mysd status input file read: 1 num_bytes_rd 16384
red.pgm th0.len1 = 0
len = 66048 th0.len2 = 66048 th0.len3 = 66048 th0.len4 = 66048
setting up ptrs with malloc
pa 0xc002d800 ppa 0xc002d600
pv = 0xc000d478 ppv = 0xc000d278
pvt = 0xc004dc98 ppvt = 0xc004da98
pds = 0xc003da90 ppds = 0xc003d890
puds = 0xc001d600 ppuds = 0xc001d400
pudsvt = 0xc006e0a8 ppudsvt = 0xc006dea8
```

svd

Ultibo Core (Release: Beetroot Version: 2.1.079 Date: 21 July 2021)

```
In mysvd status input file read: 1 num_bytes_rd 16384
red.pgm th0.len1 = 0
len = 66048 th0.len2 = 66048 th0.len3 = 66048 th0.len4 = 66048
setting up ptrs with malloc
pa 0xc002d888 ppa 0xc002d688
pv = 0xc000d478 ppv = 0xc000d278
pvt = 0xc004dc98 ppvt = 0xc004da98
pds = 0xc003da90 ppds = 0xc003d890
puds = 0xc001d680 ppuds = 0xc001d480
pudsvt = 0xc006e0a8 ppudsvt = 0xc006dea8
U row = 128 col = 128
Singular Values
V row = 128 col = 128
U' row = 128 col = 128
Call mul u * s
UDS row = 128 col = 128
Call mul u * ds * vt
USDVT row = 128 col = 128
ps converted from float to int 0xc0008cc4
# of data written 0x4000

2nd thread processing th_id[1] 0x4cdfbf0
In mysvd input_file: grn.pgm
In mysvd first_output: Sgrn.bin
In mysvd second_output: rcgrn.bin
In mysvd status: 0
In mysvd num_bytes_rd: 0

ncols=128 nrows=128
In mysvd status input file read: 1 num_bytes_rd 16384
grn.pgm th1.len1 = 0
len = 66048 th1.len2 = 66048 th1.len3 = 66048 th1.len4 = 66048
len = 66048 th1.len2 = 66048 th1.len3 = 66048 th1.len4 = 66048
setting up ptrs with malloc
pa 0xc0035ca0 ppa 0xc0035aa0
pv = 0xc0015890 ppv = 0xc0015690
pvt = 0xc00560b0 ppvt = 0xc0055eb0
pds = 0xc0045ea8 ppds = 0xc0045ca8
puds = 0xc0025a98 ppuds = 0xc0025898
pudsvt = 0xc00764c0 ppudsvt = 0xc00762c0
```

svd1



Ultibo Core (Release: Beetroot Version: 2.1.079 Date: 21 July 2021)

```
grn.pgm th1.len1 = 0
len = 66048 th1.len2 = 66048 th1.len3 = 66048 th1.len4 = 66048
len = 66048 th1.len2 = 66048 th1.len3 = 66048 th1.len4 = 66048
setting up ptrs with malloc
pa 0xc0035ca0 ppa 0xc0035aa0
pv = 0xc0015890 ppv = 0xc0015690
pvt = 0xc00560b0 ppvt = 0xc0055eb0
pds = 0xc0045ea8 ppds = 0xc0045ca8
puds = 0xc0025a98 ppuds = 0xc0025898
pudsvt = 0xc00764c0 ppudsvt = 0xc00762c0
U row = 128 col = 128
Singular Values
U row = 128 col = 128
U' row = 128 col = 128
Call mul u * s
UDS row = 128 col = 128
Call mul u * ds * vt
USDVT row = 128 col = 128
ps converted from float to int 0xc0008cc4
# of data written 0x4000

3rd thread processing th_id[2] 0x4ce0c00
In mysvd input_file: blu.pgm
In mysvd first_output: Sblu.bin
In mysvd second_output: rcblu.bin
In mysvd status: 0
In mysvd num_bytes_rd: 0

ncols=128 nrows=128
In mysvd status input file read: 1 num_bytes_rd 16384
blu.pgm th2.len1 = 0
len = 66048 th2.len2 = 66048 th2.len3 = 66048 th2.len4 = 66048
len = 66048 th2.len2 = 66048 th2.len3 = 66048 th2.len4 = 66048
setting up ptrs with malloc
pa 0xc00560b0 ppa 0xc0055eb0
pv = 0xc0021cb0 ppv = 0xc0021ab0
pvt = 0xc00764c0 ppvt = 0xc00762c0
pds = 0xc00662b8 ppds = 0xc00660b8
puds = 0xc0031eb8 ppuds = 0xc0031cb8
pudsvt = 0xc00968d0 ppudsvt = 0xc00966d0
```

svd2

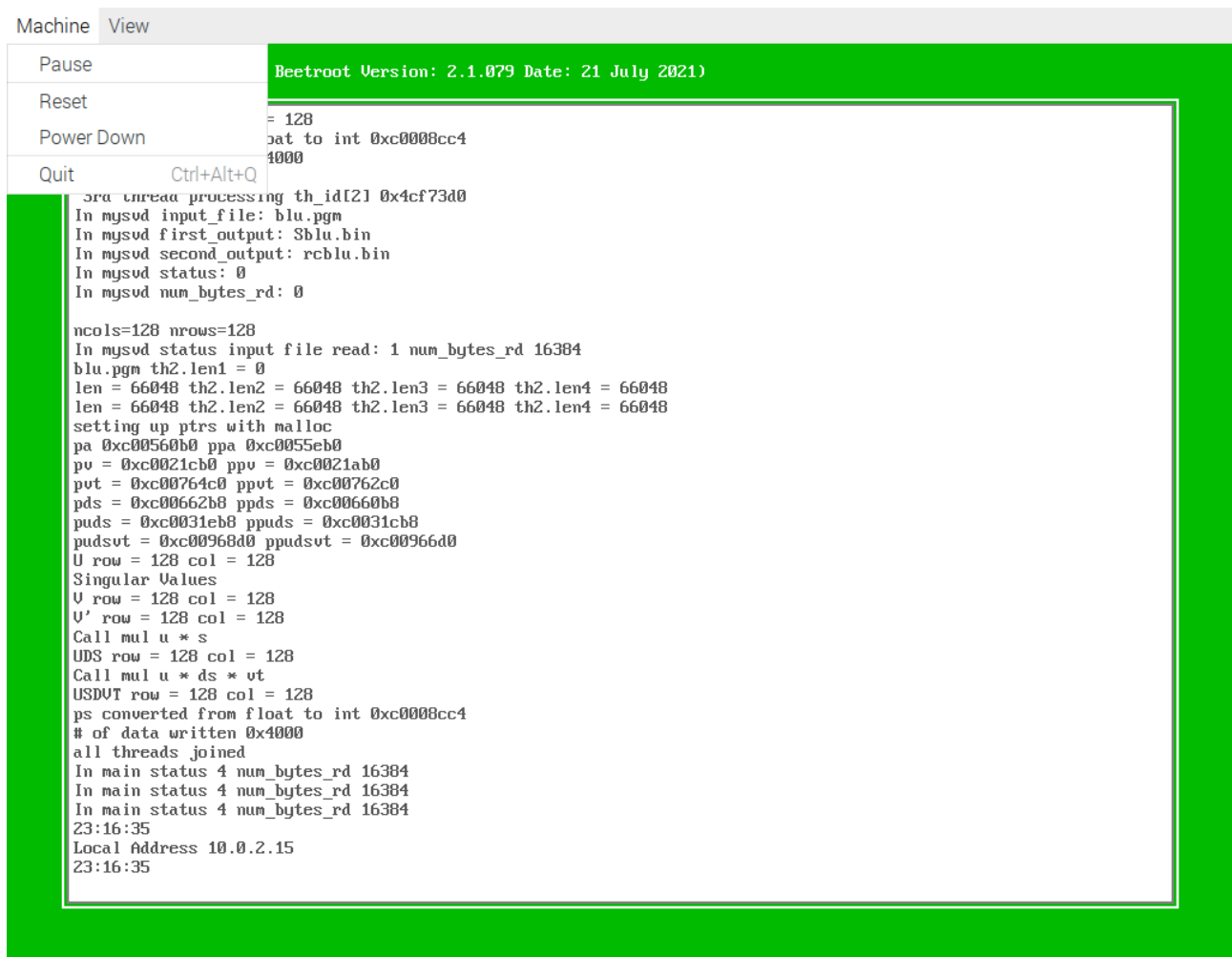
Ultibo Core (Release: Beetroot Version: 2.1.079 Date: 21 July 2021)

```
USDUT row = 128 col = 128
ps converted from float to int 0xc0008cc4
# of data written 0x4000

3rd thread processing th_id[2] 0x4ce0c00
In mysvd input_file: blu.pgm
In mysvd first_output: Sblu.bin
In mysvd second_output: rcblu.bin
In mysvd status: 0
In mysvd num_bytes_rd: 0

ncols=128 nrows=128
In mysvd status input file read: 1 num_bytes_rd 16384
blu.pgm th2.len1 = 0
len = 66048 th2.len2 = 66048 th2.len3 = 66048 th2.len4 = 66048
len = 66048 th2.len2 = 66048 th2.len3 = 66048 th2.len4 = 66048
setting up ptrs with malloc
pa 0xc00560b0 ppa 0xc0055eb0
pv = 0xc0021cb0 ppv = 0xc0021ab0
pvt = 0xc00764c0 ppvt = 0xc00762c0
pds = 0xc00662b8 ppds = 0xc00660b8
puds = 0xc0031eb8 ppuds = 0xc0031cb8
pudsvt = 0xc00968d0 ppudsvt = 0xc00966d0
U row = 128 col = 128
Singular Values
U row = 128 col = 128
U' row = 128 col = 128
Call mul u * s
UDS row = 128 col = 128
Call mul u * ds * vt
USDUT row = 128 col = 128
ps converted from float to int 0xc0008cc4
# of data written 0x4000
all threads joined
In main status 4 num_bytes_rd 16384
In main status 4 num_bytes_rd 16384
In main status 4 num_bytes_rd 16384
21:49:18
Local Address 10.0.2.15
21:49:19
```

svd3



Depress Quit

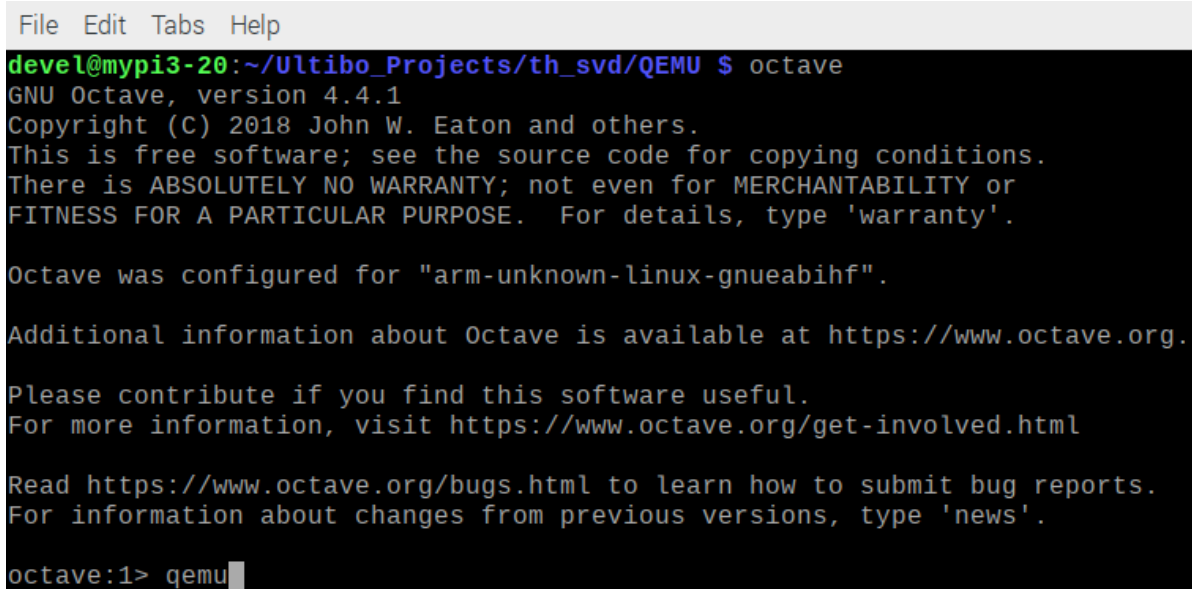
sudo mount disk.img /mnt/img1

```
ls -la /mnt/img1
total 278
drwxr-xr-x 3 root root 16384 Dec 31 1969 .
drwxr-xr-x 5 root root 4096 Jul 18 10:10 ..
-rwxr-xr-x 1 root root 53 Jul 27 17:14 'Another File.txt'
-rwxr-xr-x 1 root root 16444 Jul 27 17:14 blu.pgm
-rwxr-xr-x 1 root root 16444 Jul 27 17:14 grn.pgm
-rwxr-xr-x 1 root root 65536 Jul 27 17:16 rcblu.bin
-rwxr-xr-x 1 root root 65536 Jul 27 17:16 rcgrn.bin
-rwxr-xr-x 1 root root 65536 Jul 27 17:16 rcred.bin
-rwxr-xr-x 1 root root 16444 Jul 27 17:14 red.pgm
-rwxr-xr-x 1 root root 512 Jul 27 17:16 Sblu.bin
-rwxr-xr-x 1 root root 512 Jul 27 17:16 Sgrn.bin
-rwxr-xr-x 1 root root 512 Jul 27 17:16 Sred.bin
-rwxr-xr-x 1 root root 31 Jul 27 17:14 'Test File.txt'
drwxr-xr-x 2 root root 2048 Jul 27 17:14 www
```

sudo cp /mnt/img1/\*.bin .

ls -la \*.bin

```
-rwxr-xr-x 1 devel devel 2921536 Jul 27 15:46 kernel.bin
-rwxr-xr-x 1 devel devel 65536 Jul 27 17:19 rcblu.bin
-rwxr-xr-x 1 devel devel 65536 Jul 27 17:19 rcgrn.bin
-rwxr-xr-x 1 devel devel 65536 Jul 27 17:19 rcred.bin
-rwxr-xr-x 1 devel devel 512 Jul 27 17:19 Sblu.bin
-rwxr-xr-x 1 devel devel 512 Jul 27 17:19 Sgrn.bin
-rwxr-xr-x 1 devel devel 512 Jul 27 17:19 Sred.bin
```



```
File Edit Tabs Help
devel@myp13-20:~/Ultibo_Projects/th_svd/QEMU $ octave
GNU Octave, version 4.4.1
Copyright (C) 2018 John W. Eaton and others.
This is free software; see the source code for copying conditions.
There is ABSOLUTELY NO WARRANTY; not even for MERCHANTABILITY or
FITNESS FOR A PARTICULAR PURPOSE. For details, type 'warranty'.

Octave was configured for "arm-unknown-linux-gnueabi".

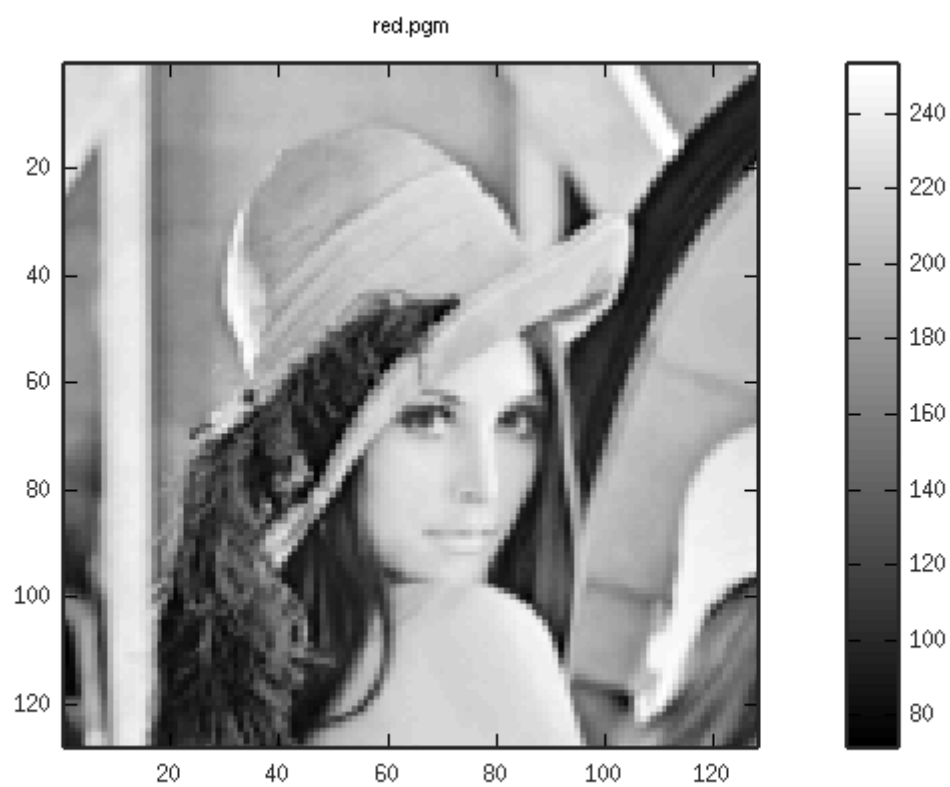
Additional information about Octave is available at https://www.octave.org.

Please contribute if you find this software useful.
For more information, visit https://www.octave.org/get-involved.html

Read https://www.octave.org/bugs.html to learn how to submit bug reports.
For information about changes from previous versions, type 'news'.

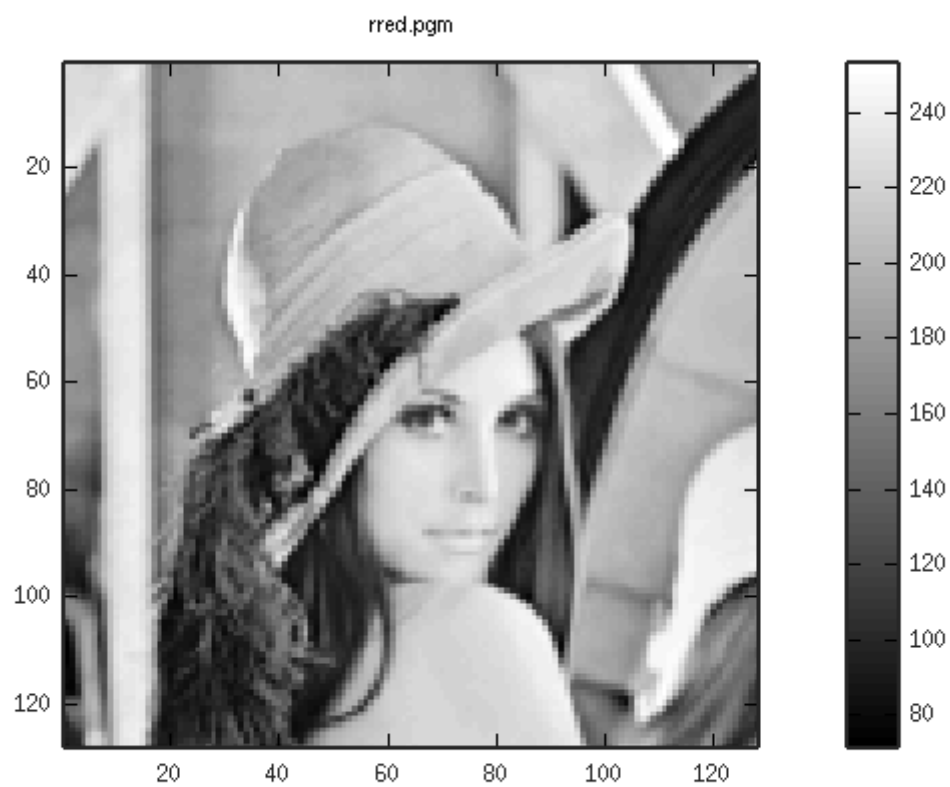
octave:1> qemu
```

Start octave



y2= 46.4231

oct1



y2= 46.4231

oct2

grn.pgm



$\mu_2 = -23.4383$

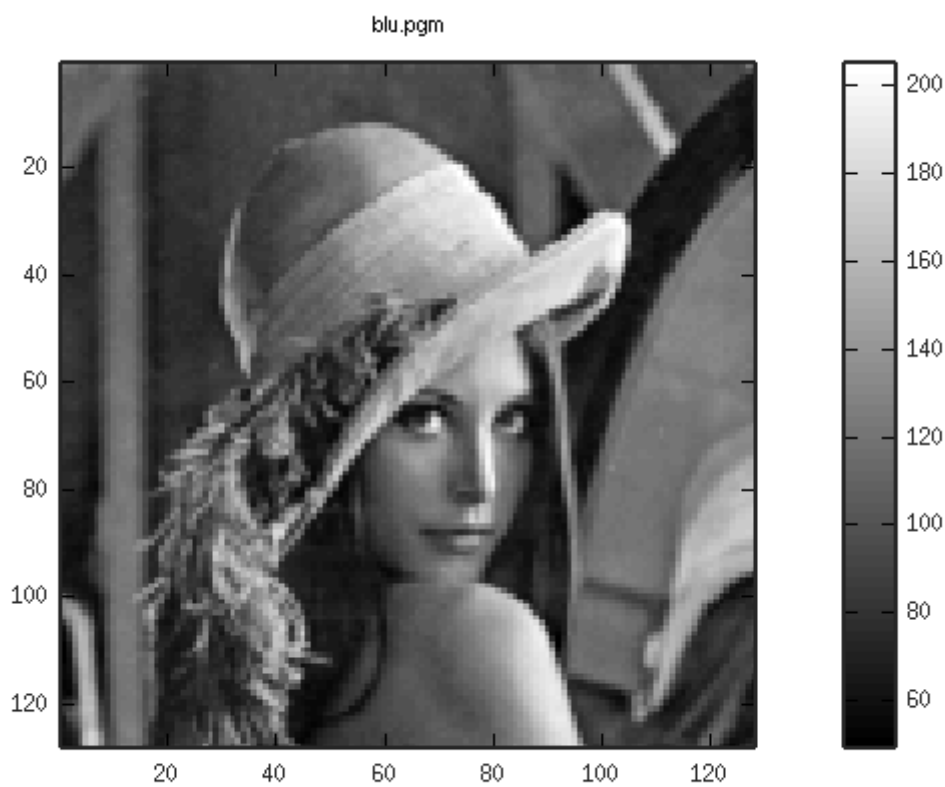
oct3

grn.pgm



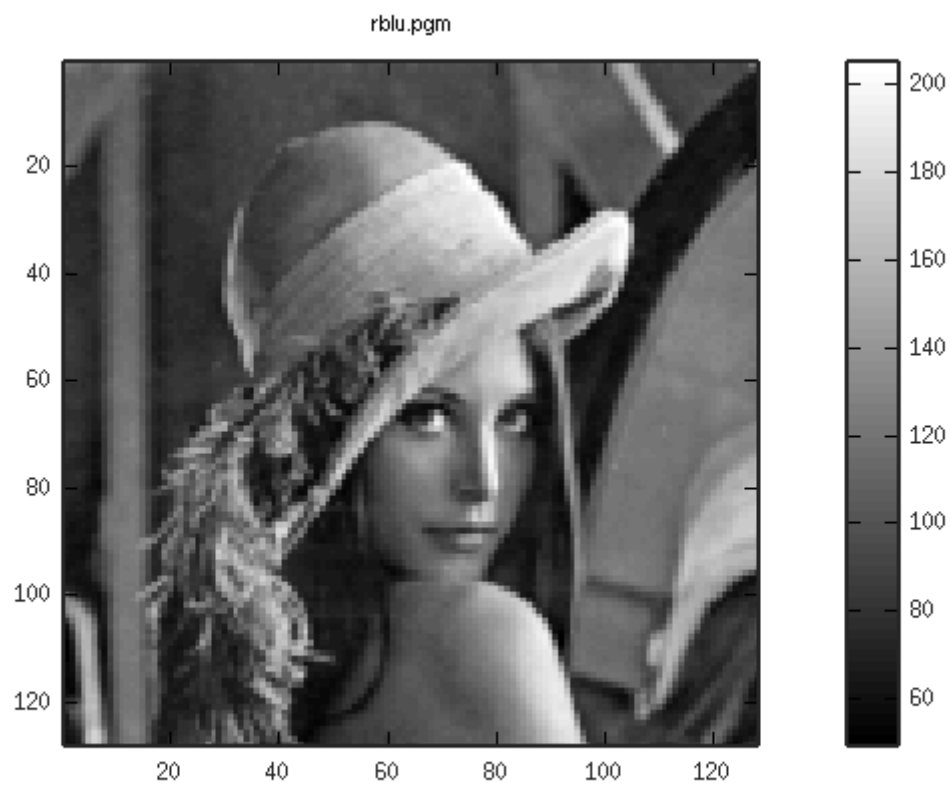
$\mu_2 = -23.4383$

oct4



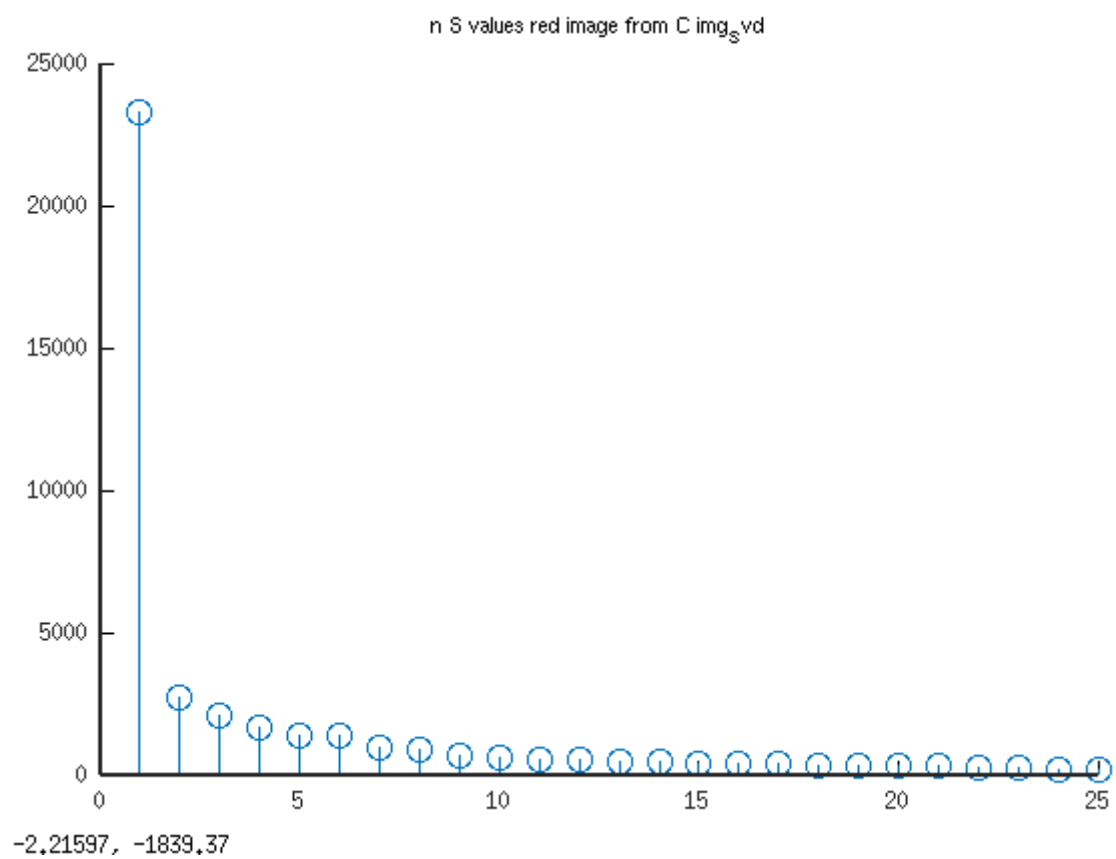
$\chi^2= 27.9341$

oct5



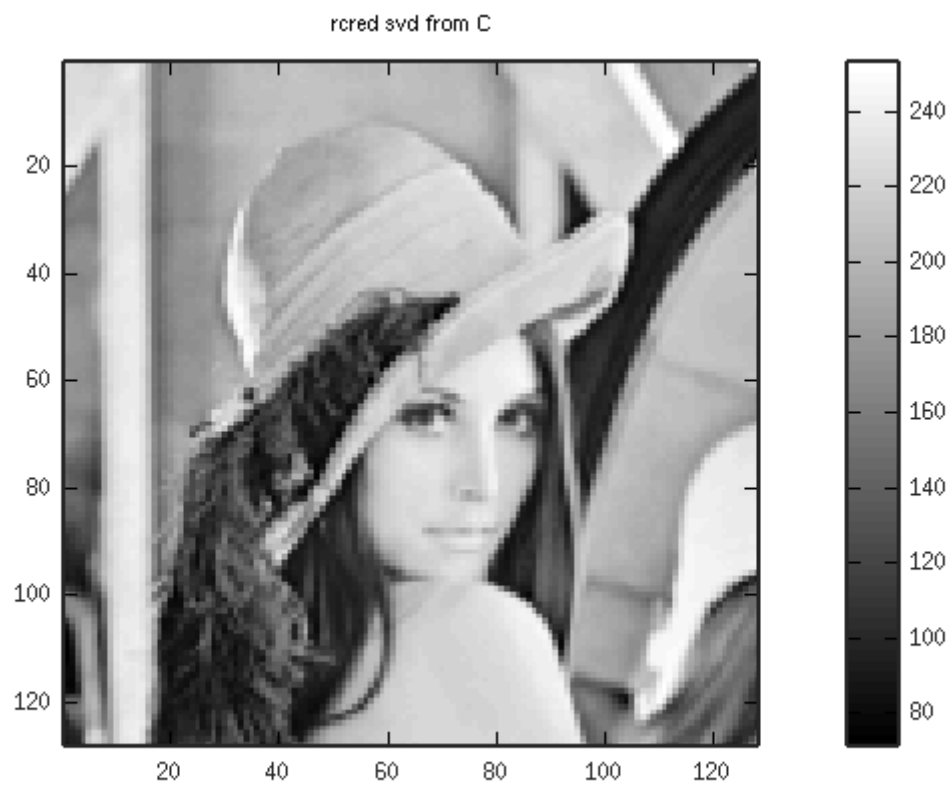
$\mu_2 = 27.9341$

oct6



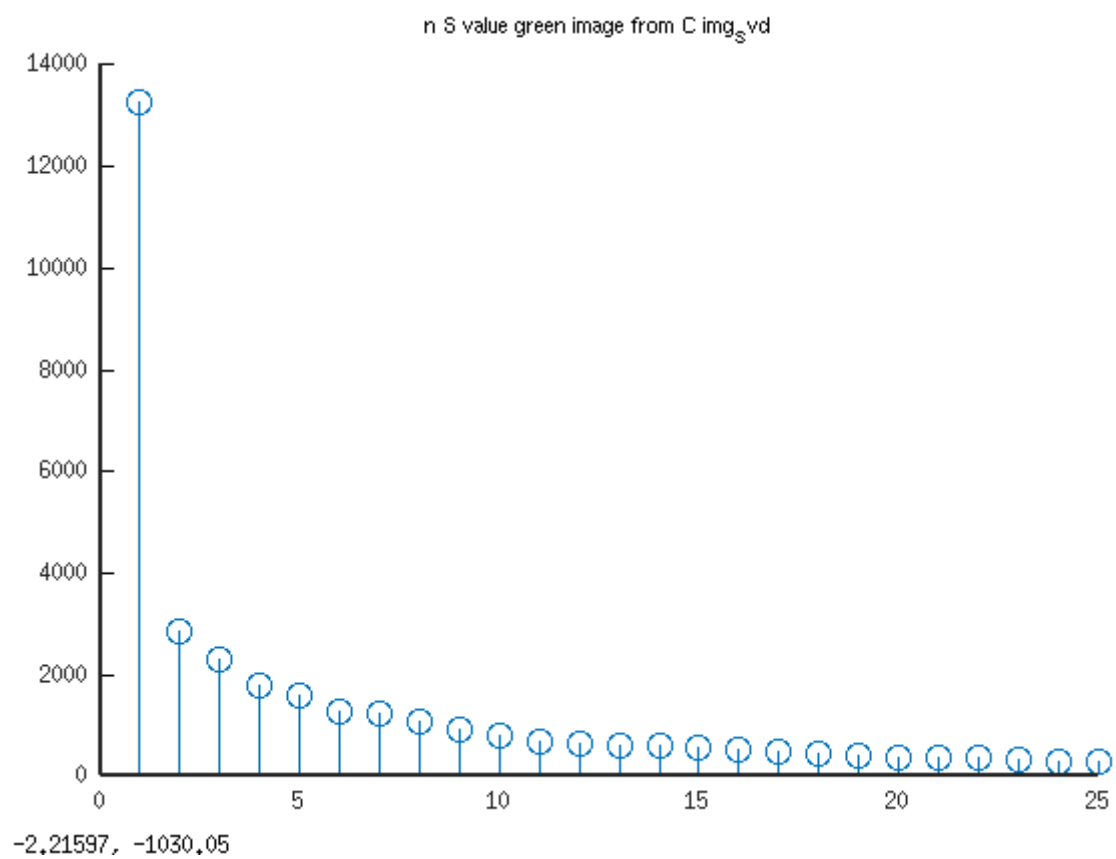
oct7



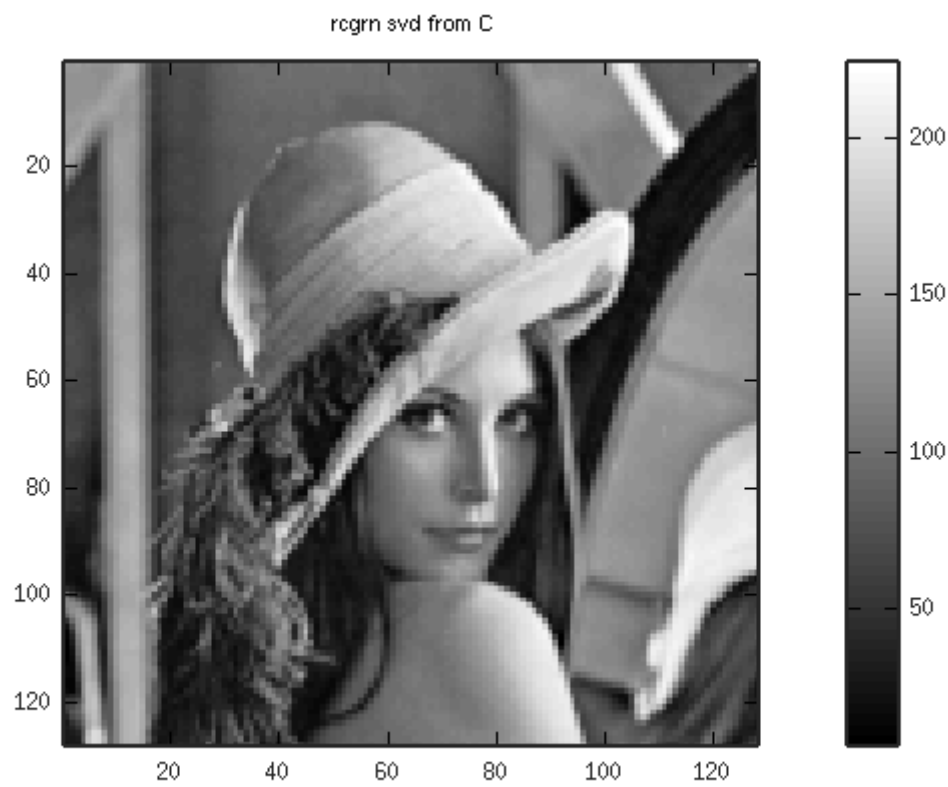


$\mu_2 = 106.775$

oct8

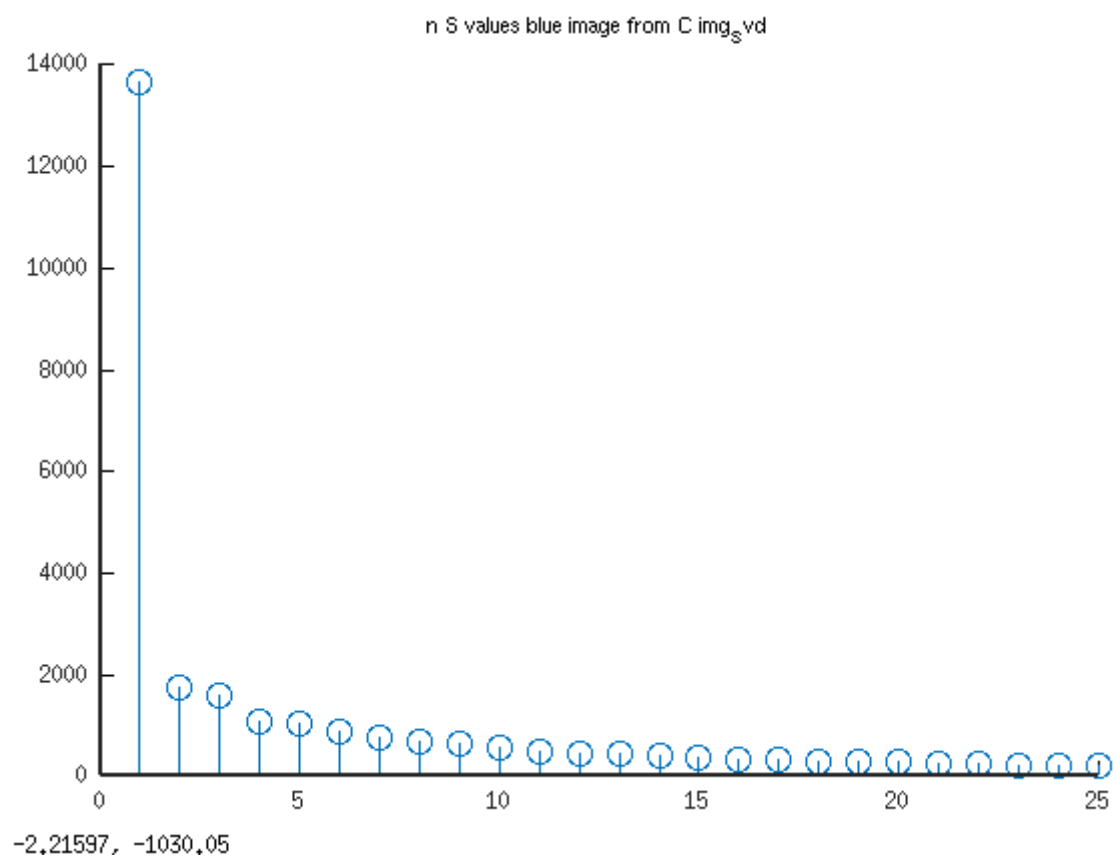


oct9

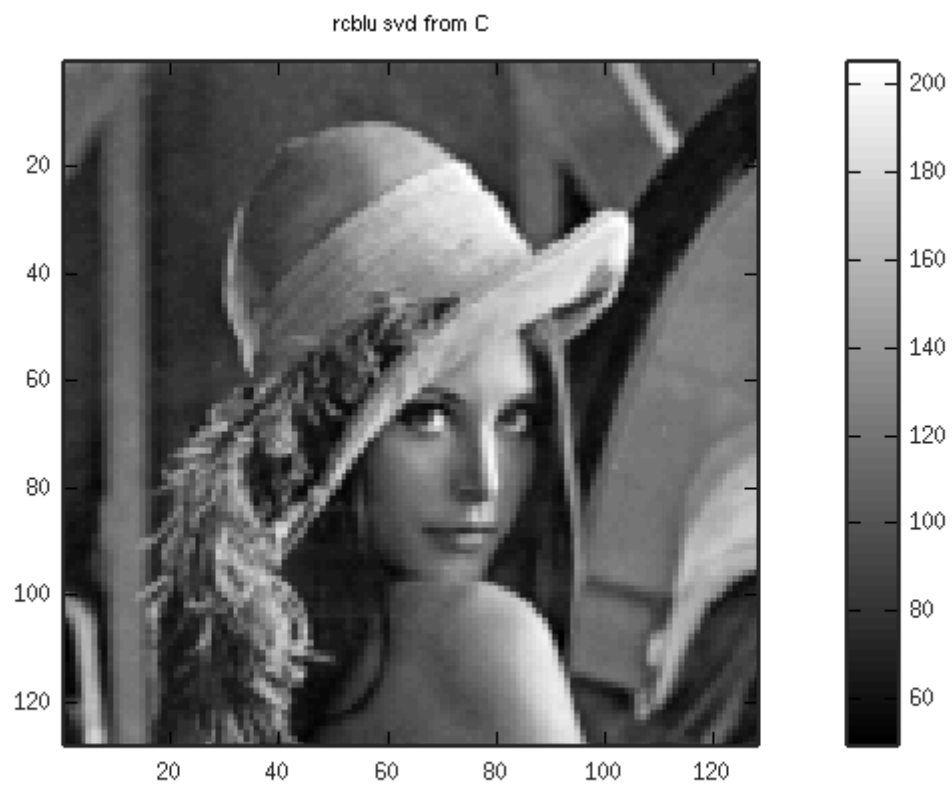


$\mu_2 = -23.4383$

oct10



oct11



$\mu_2 = 27.9341$

oct12

General

Ultibo Core (Release: Beetroot x

+

←

→

↺

🏠

🔒

pi400-1:5080/status

...

🔍

☆

📑

📄

👤

☰

Ultibo Core (Release: Beetroot Version: 2.1.079 Date: 21 July 2021)

General

Platform

Memory

Heap Blocks

CPU

FPU

GPU

RTL

Clock

Locale

Threading

Thread List

Scheduler

Devices

Drivers

Handles

USB

PCI

MMC / SD / SDIO

Network

Storage

Filesystem

Disk Cache

Keyboard

Mouse

Touch

Framebuffer

Environment

Page Tables

Vector Tables

IRQ / FIQ / SWI

GPIO

Configuration

General

Release Name: Beetroot

Release Version: 2.1.079

Release Date: 21 July 2021

Time (Local): 28-7-21 15:24:12

Time (UTC): 28-7-21 15:24:12

Timezone: UTC

Daylight Start: None

Daylight Date: N/A

Standard Start: None

Standard Date: N/A

Temperature (SoC): 0 degrees Celcius

Uptime: 0 days 00:02:28

Platform

Ultibo Core (Release: Beetr x +)

pi400-1:5080/status/platform

Ultibo Core (Release: Beetrout Version: 2.1.079 Date: 21 July 2021)

General	Platform	
<a href="#">Platform</a>	Board Type:	BOARD_TYPE_QEMUVPB
<a href="#">Memory</a>	Board Model:	0
<a href="#">Heap Blocks</a>	Board Serial:	0x0000000000000000
<a href="#">CPU</a>	Board Revision:	0x00000000
<a href="#">FPU</a>	Chip Revision:	0x00000000
<a href="#">GPU</a>	Firmware Revision:	0x00000000 (0)
<a href="#">RTL</a>	Machine Type:	MACHINE_TYPE_VERSATILEPB
<a href="#">Clock</a>	Memory Base:	0x00000000
<a href="#">Locale</a>	Memory Size:	268435456
<a href="#">Threading</a>	Page Size:	4096
<a href="#">Thread List</a>	Large Page Size:	65536
<a href="#">Scheduler</a>	Section Size:	1048576
<a href="#">Devices</a>	Power State	
<a href="#">Drivers</a>	POWER_ID_MMC0:	POWER_STATE_OFF
<a href="#">Handles</a>	POWER_ID_MMC1:	POWER_STATE_OFF
<a href="#">USB</a>	POWER_ID_MMC2:	POWER_STATE_OFF
<a href="#">PCI</a>	POWER_ID_MMC3:	POWER_STATE_OFF
<a href="#">MMC / SD / SDIO</a>	POWER_ID_UART0:	POWER_STATE_OFF
<a href="#">Network</a>	POWER_ID_UART1:	POWER_STATE_OFF
<a href="#">Storage</a>	POWER_ID_UART2:	POWER_STATE_OFF
<a href="#">Filesystem</a>	POWER_ID_UART3:	POWER_STATE_OFF
<a href="#">Disk Cache</a>	POWER_ID_USB0:	POWER_STATE_OFF
<a href="#">Keyboard</a>	POWER_ID_USB1:	POWER_STATE_OFF
<a href="#">Mouse</a>	POWER_ID_USB2:	POWER_STATE_OFF
<a href="#">Touch</a>	POWER_ID_USB3:	POWER_STATE_OFF
<a href="#">Framebuffer</a>		
<a href="#">Environment</a>		
<a href="#">Page Tables</a>		
<a href="#">Vector Tables</a>		
<a href="#">IRQ / FIQ / SWI</a>		
<a href="#">GPIO</a>		
<a href="#">Configuration</a>		

pi400-1:5080/status/mmc

Telnet Remote from mypi3-20 to pi400-1 QEMU

```
File Edit Tabs Help
devel@mypi3-20:~ $ telnet pi400-1 5023
```

Telnet Connection established.

```
File Edit Tabs Help
Ultibo Core (Release: Beetroot Version: 2.1.079 Date: 21 July 2021)
(Type HELP for a list of available commands)
>
```

Remote Directory

```
File Edit Tabs Help
Ultibo Core (Release: Beetroot Version: 2.1.079 Date: 21 July 2021)
(Type HELP for a list of available commands)
>dir
  Directory of C:\

27-7-21 23:14:30          53  Another File.txt
27-7-21 23:14:30          31  Test File.txt
27-7-21 23:14:30      <DIR>  www
27-7-21 23:14:54      16444  blu.pgm
27-7-21 23:14:54      16444  grn.pgm
27-7-21 23:14:54      16444  red.pgm
28-7-21 15:22:04          512  Sred.bin
28-7-21 15:22:05      65536  rcred.bin
28-7-21 15:22:20          512  Sgrn.bin
28-7-21 15:22:22      65536  rcgrn.bin
28-7-21 15:22:40          512  Sblu.bin
28-7-21 15:22:43      65536  rcblu.bin
      11 file(s) 247560 bytes
      1 dir(s)

C:\>
```

These were the input files to the SVD model.

blu.pgm grn.pgm red.pgm

These were the files created by Ultibo QEMU

rcblu.bin rcgrn.bin rcred.bin Sblu.bin Sgrn.bin Sred.bin