lets look at what we have

root@test-lvm:~# pvs
PV     VG     Fmt Attr  PSize  PFree
/dev/sda3  ubuntu-vg  lvm2 a-  <9.00g  <5.00g

root@test-lvm:~# vgs
VG        #PV  #LV  #SN   Attr  VSize  VFree
ubuntu-vg  1    1    0  wz--n--  <9.00g  <5.00g

root@test-lvm:~# lvs
LV     VG      Attr LSize  Pool Origin Data%  Meta%  Move Log Cpy%Sync Convert
ubuntu-lv  ubuntu-vg -wi-ao----  4.00g
root@test-lvm:~# df -h | grep mapper
/dev/mapper/ubuntu--vg-ubuntu--lv  3.9G   2.0G   1.8G   54% /
root@test-lvm:~# echo "this is our lvm volume"
this is our lvm volume
root@test-lvm:~#
echo "let's add our other disks as physical volumes" 

pvgrow /dev/sdb 
  Physical volume "/dev/sdb" successfully created.

pvgrow /dev/sdc 
  Physical volume "/dev/sdc" successfully created.

pvgrow /dev/sdd 
  Physical volume "/dev/sdd" successfully created.
Now let's add those disks to our volume group

```
# vgextend ubuntu-vg /dev/sdb
  Volume group "ubuntu-vg" successfully extended

# vgextend ubuntu-vg /dev/sdc
  Volume group "ubuntu-vg" successfully extended

# vgextend ubuntu-vg /dev/sdd
  Volume group "ubuntu-vg" successfully extended
```

```
As each of those disks was roughly 10 gigs, we now have ~40 gigs of space.
```
root@test-lvm:~# df -h | grep mapper
/dev/mapper/ubuntu--vg-ubuntu--lv 3.9G 2.0G 1.8G 54% /
root@test-lvm:~# echo "lets see if we can resize that partition... while it is mounted and we are using it."
lets see if we can resize that partition... while it is mounted and we are using it.
root@test-lvm:~# lvresize -r --size 10G /dev/mapper/ubuntu--vg-ubuntu--lv
   Size of logical volume ubuntu-vg/ubuntu-lv changed from 4.00 GiB (1024 extents) to 10.00 GiB (2560 extents).
Logical volume ubuntu-vg/ubuntu-lv successfully resized.
resize2fs 1.44.1 (24-Mar-2018)
Filesystem at /dev/mapper/ubuntu--vg-ubuntu--lv is mounted on /; on-line resizing required
old_desc_blocks = 1, new_desc_blocks = 2
The filesystem on /dev/mapper/ubuntu--vg-ubuntu--lv is now 2621440 (4k) blocks long.
root@test-lvm:~# df -h | grep mapper
/dev/mapper/ubuntu--vg-ubuntu--lv 9.8G 2.0G 7.4G 21% /
root@test-lvm:~# echo "yay!!"
yaydf -h | grep mapper
yaydf -h | grep mapper
root@test-lvm:~# echo "whoops. It worked"
whoops. It worked
root@test-lvm:~# _
```
"can I shrink it back down to 8 gigs?"
can I shrink it back down to 8 gigs?

```
root@test-lvm:~# lvresize -r --size 8G /dev/mapper/ubuntu--vg-ubuntu--lv
Do you want to unmount "/"? [Y|n] n
fsadm: Cannot proceed with mounted filesystem "/".
/sbin/fsadm failed: 1
  Filesystem resize failed.
```

root@test-lvm:~# _
root@test-lvm:~# echo "what about if I unmount it?"
what about if I unmount it?
root@test-lvm:~# lvresize -r --size 8G /dev/mapper/ubuntu--vg-ubuntu--lv
Do you want to unmount "/"? [Y/n] y
umount: /: target is busy.
fsadm: Cannot proceed with mounted filesystem "/".
/sbin/fsadm failed: 1
   Filesystem resize failed.
root@test-lvm:~# cd /
root@test-lvm:/# lvresize -r --size 8G /dev/mapper/ubuntu--vg-ubuntu--lv
Do you want to unmount "/"? [Y/n] y
umount: /: target is busy.
fsadm: Cannot proceed with mounted filesystem "/".
/sbin/fsadm failed: 1
   Filesystem resize failed.
root@test-lvm:/# echo "So we can't shrink while it is mounted"
So we can't shrink while it is mounted
root@test-lvm:/#
Output of `lvresize -r --size 14G /dev/mapper/ubuntu--vg-ubuntu--lv`:

Size of logical volume ubuntu-vg/ubuntu--lv changed from 10.00 GiB (2560 extents) to 14.00 GiB (35804 extents).
Logical volume ubuntu-vg/ubuntu--lv successfully resized.

Output of `resize2fs 1.44.1 (24-Mar-2018)`:

Filesystem at /dev/mapper/ubuntu--vg-ubuntu--lv is mounted on /; on-line resizing required
old_desc_blocks = 2, new_desc_blocks = 2
The filesystem on /dev/mapper/ubuntu--vg-ubuntu--lv is now 3670016 (4k) blocks long.

Output of `df -h`:

<table>
<thead>
<tr>
<th>Filesystem</th>
<th>Size</th>
<th>Used</th>
<th>Avail</th>
<th>Use%</th>
<th>Mounted on</th>
</tr>
</thead>
<tbody>
<tr>
<td>udev</td>
<td>1.9G</td>
<td>0</td>
<td>1.9G</td>
<td>0%</td>
<td>/dev</td>
</tr>
<tr>
<td>tmpfs</td>
<td>395M</td>
<td>952K</td>
<td>394M</td>
<td>1%</td>
<td>/run</td>
</tr>
<tr>
<td>/dev/mapper/ubuntu--vg-ubuntu--lv</td>
<td>14G</td>
<td>2.0G</td>
<td>12G</td>
<td>15%</td>
<td>/</td>
</tr>
<tr>
<td>tmpfs</td>
<td>2.0G</td>
<td>0</td>
<td>2.0G</td>
<td>0%</td>
<td>/dev/shm</td>
</tr>
<tr>
<td>tmpfs</td>
<td>5.0M</td>
<td>0</td>
<td>5.0M</td>
<td>0%</td>
<td>/run/lock</td>
</tr>
<tr>
<td>tmpfs</td>
<td>2.0G</td>
<td>0</td>
<td>2.0G</td>
<td>0%</td>
<td>/sys/fs/cgroup</td>
</tr>
<tr>
<td>/dev/sda2</td>
<td>976M</td>
<td>139M</td>
<td>771M</td>
<td>16%</td>
<td>/boot</td>
</tr>
<tr>
<td>/dev/loop0</td>
<td>87M</td>
<td>87M</td>
<td>0</td>
<td>100%</td>
<td>/snap/core/4917</td>
</tr>
<tr>
<td>tmpfs</td>
<td>395M</td>
<td>0</td>
<td>395M</td>
<td>0%</td>
<td>/run/user/1000</td>
</tr>
</tbody>
</table>

Output of `df -h | grep mapper`:

/dev/mapper/ubuntu--vg-ubuntu--lv

Output of `echo "I can grow it without unmounting though"`:

I can grow it without unmounting though

Output of `echo "And I kept my ext filesystem"`:

And I kept my ext filesystem