Advanced Linux Usage

170516
Martin Dahlö
martin.dahlo@scilifelab.uu.se

martin.dahlo@scilifelab.uu.se

SciLifeLab

Uppsala Multidisciplinary Center
Advanced UPPMAX Computational Science

UPPNEX

UPPSALA
UNIVERSITET

Enabler for Life Sciences

Multiple files

- Same program, many files

```
$ ls -l
total 0
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_1.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_2.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_3.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_4.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_5.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_6.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_7.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_8.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_9.bam
```

SciLifeLab
UPPSALA

- Same program, many files

```
$ ls -l
total 0
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_1.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_2.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_3.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_4.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_5.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_6.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_7.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_8.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_9.bam
$ my_prog sample_1.bam
```

- **Same program, many files**

```
$ ls -l
total 0
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_1.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_2.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_3.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_4.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_5.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_6.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_7.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_8.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_9.bam
$ my_prog sample_1.bam
$ my_prog sample_2.bam
```

● **Same program, many files**

```
$ ls -l
total 0
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_1.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_2.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_3.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_4.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_5.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_6.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_7.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_8.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 16:42 sample_9.bam
$ my_prog sample_1.bam
$ my_prog sample_2.bam
$ my_prog sample_3.bam
$ my_prog sample_4.bam
$ my_prog sample_5.bam
$ my_prog sample_6.bam
$ my_prog sample_7.bam
$ my_prog sample_8.bam
$ my_prog sample_9.bam
$
```
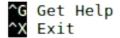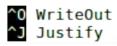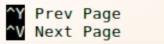
- Same program, many files
  - ○ 10 files? Ok
  - ○ 1000 files? Not ok..

- Same program, many files
  - 10 files? Ok
  - 1000 files? Not ok..
- Reproducibility
  - Self and others

- Same program, many files
  - 10 files? Ok
  - 1000 files? Not ok..
- Reproducibility
  - Self and others
- As always, scripts to the rescue!

```
total 0
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 17:18 sample_1.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 17:18 sample_2.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 17:18 sample_3.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 17:18 sample_4.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 17:18 sample_5.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 17:18 sample_6.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 17:18 sample_7.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 17:18 sample_8.bam
-rw-rw-r-- 1 dahlo dahlo 0 Sep  1 17:18 sample_9.bam
$ nano analysis.sh
```

Basic script

```
GNU nano 2.0.9              File: analysis.sh                    Modified

my_prog sample_1.bam
```
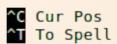
Basic script

```
  GNU nano 2.0.9              File: analysis.sh                        Modified

my_prog sample_1.bam
my_prog sample_2.bam




^G Get Help      ^O WriteOut     ^R Read File    ^Y Prev Page    ^K Cut Text     ^C Cur Pos
^X Exit          ^J Justify      ^W Where Is     ^V Next Page    ^U UnCut Text   ^T To Spell
```
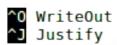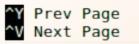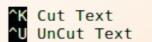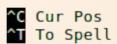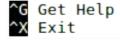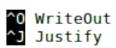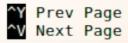
```
  GNU nano 2.0.9              File: analysis.sh                      Modified

my_prog sample_1.bam
my_prog sample_2.bam
my_prog sample_3.bam
my_prog sample_4.bam
my_prog sample_5.bam
my_prog sample_6.bam
my_prog sample_7.bam
my_prog sample_8.bam
my_prog sample_9.bam




^G Get Help    ^O WriteOut    ^R Read File   ^Y Prev Page   ^K Cut Text    ^C Cur Pos
^X Exit        ^J Justify     ^W Where Is    ^V Next Page   ^U UnCut Text  ^T To Spell
```
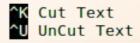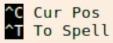
```
$ l
total 4,0K
-rw-rw-r-- 1 dahlo dahlo 267 Sep  7 09:34 analysis.sh
-rw-rw-r-- 1 dahlo dahlo   0 Sep  1 17:18 sample_1.bam
-rw-rw-r-- 1 dahlo dahlo   0 Sep  1 17:18 sample_2.bam
-rw-rw-r-- 1 dahlo dahlo   0 Sep  1 17:18 sample_3.bam
-rw-rw-r-- 1 dahlo dahlo   0 Sep  1 17:18 sample_4.bam
-rw-rw-r-- 1 dahlo dahlo   0 Sep  1 17:18 sample_5.bam
-rw-rw-r-- 1 dahlo dahlo   0 Sep  1 17:18 sample_6.bam
-rw-rw-r-- 1 dahlo dahlo   0 Sep  1 17:18 sample_7.bam
-rw-rw-r-- 1 dahlo dahlo   0 Sep  1 17:18 sample_8.bam
-rw-rw-r-- 1 dahlo dahlo   0 Sep  1 17:18 sample_9.bam
$
```

```
$ l
total 4,0K
-rw-rw-r-- 1 dahlo dahlo 267 Sep  7 09:34 analysis.sh
-rw-rw-r-- 1 dahlo dahlo   0 Sep  1 17:18 sample_1.bam
-rw-rw-r-- 1 dahlo dahlo   0 Sep  1 17:18 sample_2.bam
-rw-rw-r-- 1 dahlo dahlo   0 Sep  1 17:18 sample_3.bam
-rw-rw-r-- 1 dahlo dahlo   0 Sep  1 17:18 sample_4.bam
-rw-rw-r-- 1 dahlo dahlo   0 Sep  1 17:18 sample_5.bam
-rw-rw-r-- 1 dahlo dahlo   0 Sep  1 17:18 sample_6.bam
-rw-rw-r-- 1 dahlo dahlo   0 Sep  1 17:18 sample_7.bam
-rw-rw-r-- 1 dahlo dahlo   0 Sep  1 17:18 sample_8.bam
-rw-rw-r-- 1 dahlo dahlo   0 Sep  1 17:18 sample_9.bam
$ bash analysis.sh
```

- **Assigning**
  ```
  my_variable=5
  my_variable="nice text"
  ```

- ## Assigning
  ```
  my_variable=5
  my_variable="nice text"
  ```
- ## Using
  ```
  $my_variable
  ```

Variables

- ## Assigning
  ```
  my_variable=5
  my_variable="nice text"
  ```
- ## Using
  ```
  $my_variable
  ```

```
$ my_variable="Martin"
```

- ## Assigning
  ```
  my_variable=5
  my_variable="nice text"
  ```
- ## Using
  ```
  $my_variable
  ```

```
$ my_variable="Martin"
$ echo "Hello $my_variable"
```

- ## Assigning

```
my_variable=5
my_variable="nice text"
```
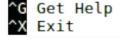
- ## Using

```
$my_variable
```
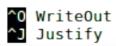
```
$ my_variable="Martin"
$ echo "Hello $my_variable"
Hello Martin
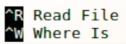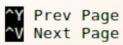```

```
  GNU nano 2.0.9   File: analysis.sh   Modified

my_prog sample_1.bam
my_prog sample_2.bam
my_prog sample_3.bam
my_prog sample_4.bam
my_prog sample_5.bam
my_prog sample_6.bam
my_prog sample_7.bam
my_prog sample_8.bam
my_prog sample_9.bam

^G Get Help   ^O WriteOut   ^R Read File   ^Y Prev Page   ^K Cut Text   ^C Cur Pos
^X Exit   ^J Justify   ^W Where Is   ^V Next Page   ^U UnCut Text ^T To Spell
```
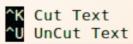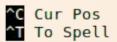
```
  GNU nano 2.0.9   File: analysis.sh   Modified

prefix="sample"

my_prog sample_1.bam
my_prog sample_2.bam
my_prog sample_3.bam
my_prog sample_4.bam
my_prog sample_5.bam
my_prog sample_6.bam
my_prog sample_7.bam
my_prog sample_8.bam
my_prog sample_9.bam

^G Get Help   ^O WriteOut   ^R Read File   ^Y Prev Page   ^K Cut Text   ^C Cur Pos
^X Exit   ^J Justify   ^W Where Is   ^V Next Page   ^U UnCut Text ^T To Spell
```
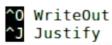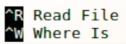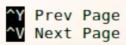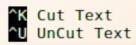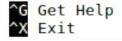
# Variables

```
prefix="sample"

my_prog ${prefix}_1.bam
my_prog ${prefix}_2.bam
my_prog ${prefix}_3.bam
my_prog ${prefix}_4.bam
my_prog ${prefix}_5.bam
my_prog ${prefix}_6.bam
my_prog ${prefix}_7.bam
my_prog ${prefix}_8.bam
my_prog ${prefix}_9.bam
```

```
  GNU nano 2.0.9                    File: analysis.sh                          Modified

prefix="dog"

my_prog ${prefix}_1.bam
my_prog ${prefix}_2.bam
my_prog ${prefix}_3.bam
my_prog ${prefix}_4.bam
my_prog ${prefix}_5.bam
my_prog ${prefix}_6.bam
my_prog ${prefix}_7.bam
my_prog ${prefix}_8.bam
my_prog ${prefix}_9.bam




^G Get Help    ^O WriteOut    ^R Read File   ^Y Prev Page   ^K Cut Text    ^C Cur Pos
^X Exit        ^J Justify     ^W Where Is    ^V Next Page   ^U UnCut Text  ^T To Spell
```
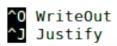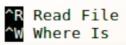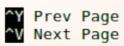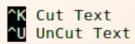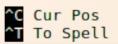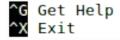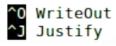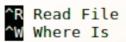
```
for variable_name in 1 2 3;
do
    echo $variable_name
done
```

```
$ bash loop_test.sh
1
2
3
$
```

SciLifeLab
UPPSALA

```
for variable_name in text works too;
do
    echo $variable_name
done
```

```
$ bash loop_test.sh
text
works
too
$
```

```
for variable_name in mix them 5;
do
    echo $variable_name
done
```

```
$ bash loop_test.sh
mix
them
5
$
```

```
  GNU nano 2.0.9              File: analysis.sh

prefix="sample"

for i in 1 2 3 4 5 6 7 8 9;
do
    my_prog ${prefix}_$i.bam
done




^G Get Help    ^O WriteOut    ^R Read File   ^Y Prev Page   ^K Cut Text    ^C Cur Pos
^X Exit        ^J Justify     ^W Where Is    ^V Next Page   ^U UnCut Text  ^T To Spell
```

```
GNU nano 2.0.9                    File: analysis.sh

prefix="sample"

for i in 1 2 3 4 5 6 7 8 9;
do
    echo my_prog ${prefix}_$i.bam
done




                              [ Wrote 7 lines ]
^G Get Help      ^O WriteOut      ^R Read File     ^Y Prev Page     ^K Cut Text      ^C Cur Pos
^X Exit          ^J Justify       ^W Where Is      ^V Next Page     ^U UnCut Text    ^T To Spell
```

```
GNU nano 2.0.9                    File:

prefix="sample"

for i in 1 2 3 4 5 6 7 8 9;
do
    echo my_prog ${prefix}_$i.bam
done
```

```
$ bash analysis.sh
my_prog sample_1.bam
my_prog sample_2.bam
my_prog sample_3.bam
my_prog sample_4.bam
my_prog sample_5.bam
my_prog sample_6.bam
my_prog sample_7.bam
my_prog sample_8.bam
my_prog sample_9.bam
$
```
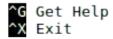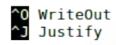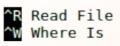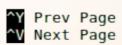
```
^G Get Help      ^O WriteOut     ^R Read Fi
^X Exit          ^J Justify      ^W Where I
```

```
$ ls *.bam
sample_1.bam   sample_3.bam   sample_5.bam   sample_7.bam   sample_9.bam
sample_2.bam   sample_4.bam   sample_6.bam   sample_8.bam
$
```
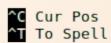
```
GNU nano 2.0.9                    File: analysis.sh

prefix="sample"

for file in $( ls *.bam );
do
    echo my_prog $file
done
```

```
                        [ Wrote 7 lines ]
^G Get Help    ^O WriteOut    ^R Read File    ^Y Prev Page    ^K Cut Text     ^C Cur Pos
^X Exit        ^J Justify     ^W Where Is     ^V Next Page    ^U UnCut Text   ^T To Spell
```

```
  GNU nano 2.0.9                    File: analysis.sh

for file in $( ls *.bam );
do
    echo my_prog $file
done
```

```
                              [ Wrote 7 lines ]
^G Get Help      ^O WriteOut      ^R Read File     ^Y Prev Page     ^K Cut Text      ^C Cur Pos
^X Exit          ^J Justify       ^W Where Is      ^V Next Page     ^U UnCut Text    ^T To Spell
```

Loop over files

```
for file in $( ls *.bam );
do
    echo my_prog $file
done
```

```
$ bash analysis.sh
my_prog sample_1.bam
my_prog sample_2.bam
my_prog sample_3.bam
my_prog sample_4.bam
my_prog sample_5.bam
my_prog sample_6.bam
my_prog sample_7.bam
my_prog sample_8.bam
my_prog sample_9.bam
$
```
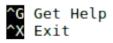
^G Get Help   ^O WriteOut   ^R Read Fi
^X Exit   ^J Justify   ^W Where I

```
$ bash analysis.sh /path/to/my/bams
```

Loop over files

```
for file in $( ls $1/*.bam );
do
    echo my_prog $file
done
```

Loop over files

```
for file in $( ls $1/*.bam );
do
    echo my_prog $file
done
```

```
$ bash analysis.sh .
my_prog ./sample_1.bam
my_prog ./sample_2.bam
my_prog ./sample_3.bam
my_prog ./sample_4.bam
my_prog ./sample_5.bam
my_prog ./sample_6.bam
my_prog ./sample_7.bam
my_prog ./sample_8.bam
my prog ./sample_9.bam
$
```

Loop over files

```
GNU nano 2.0.9                    File:

for file in $( ls $1/*.bam );
do
    echo my_prog $file
done
```
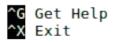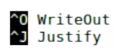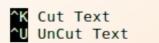
```
$ bash analysis.sh /path/to/my/bams
my_prog /path/to/my/bams/sample_1.bam
my_prog /path/to/my/bams/sample_2.bam
my_prog /path/to/my/bams/sample_3.bam
my_prog /path/to/my/bams/sample_4.bam
my_prog /path/to/my/bams/sample_5.bam
my_prog /path/to/my/bams/sample_6.bam
my_prog /path/to/my/bams/sample_7.bam
my_prog /path/to/my/bams/sample_8.bam
my_prog /path/to/my/bams/sample_9.bam
$
```

```
^G Get Help      ^O WriteOut     ^R Read F
^X Exit          ^J Justify      ^W Where
```

Loop over files

```
GNU nano 2.0.9              File: analysis.sh                           Modified

for file in $( ls $1/*.bam );
do
    my_prog $file
done
```
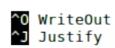
```
^G Get Help      ^O WriteOut      ^R Read File     ^Y Prev Page     ^K Cut Text      ^C Cur Pos
^X Exit          ^J Justify       ^W Where Is      ^V Next Page     ^U UnCut Text    ^T To Spell
```

Loop over files

```
$ my_prog sample_1.bam
$ my_prog sample_2.bam
$ my_prog sample_3.bam
$ my_prog sample_4.bam
$ my_prog sample_5.bam
$ my_prog sample_6.bam
$ my_prog sample_7.bam
$ my_prog sample_8.bam
$ my_prog sample_9.bam
```
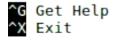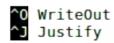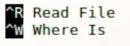
```
for file in $( ls $1/*.bam );
do
    my_prog $file
done
```

- **Control statement**

```
if true; then
  echo "This is true"
fi
```

- **Control statement**

```
if false; then
  echo "This is true"
fi
```

If

- **Control statement**

```
if [[ 5 < 9 ]]; then
  echo "This is true"
fi
```

- **Control statement**

```
if [[ 5 > 9 ]]; then
  echo "This is true"
fi
```

- **Control statement**

```
if [[ 5 == 9 ]]; then
  echo "This is true"
fi
```

- **Control statement**

```
if [[ "Hello" == "Hello" ]]; then
  echo "This is true"
fi
```

- **Control statement**

```
if [[ "Hello" == "Hi" ]]; then
  echo "This is true"
fi
```

- **Control statement**

```
if [[ "Hello" == "Hel"* ]]; then
  echo "This is true"
fi
```

- **For all samples except dog**

```
for file in $( ls $1/*.bam );
do
    echo my_prog $file
done
```

- ## For all samples except dog

```
for file in $( ls $1/*.bam );
do
    if [[ ... != "dog"* ]]; then

        echo my_prog $file

    fi
done
```

- **For all samples except dog**

```
for file in $( ls $1/*.bam );
do
    if [[ ... != "dog"* ]]; then

        echo my_prog $file

    fi
done
```

Ex: `$file` is `/path/to/dog_1.bam`

- **For all samples except dog**

```
for file in $( ls $1/*.bam );
do
    if [[ ... != "dog"* ]]; then

        echo my_prog $file

    fi
done
```

Ex: `$file` is `/path/to/dog_1.bam`

`basename $file`

- ## For all samples except dog

```
for file in $( ls $1/*.bam );
do
    if [[ ... != "dog"* ]]; then

        echo my_prog $file

    fi
done
```

Ex: `$file` is `/path/to/dog_1.bam`

`basename $file`

`dog_1.bam`

SciLifeLab
U P P S A L A

- For all samples except dog

```
for file in $( ls $1/*.bam );
do
    if [[ $(basename $file) != "dog"* ]]; then

        echo my_prog $file

    fi
done
```

Ex: `$file` is `/path/to/dog_1.bam`

`basename $file`

`dog_1.bam`

- **For all samples except dog**

```
for file in $( ls $1/*.bam );
do
    if [[ $(basename $file) != "dog"* ]]; then

        my_prog $file

    fi
done
```

Ex: `$file` **is** `/path/to/dog_1.bam`

`basename $file`

`dog_1.bam`

- Programming is programming
  - Perl, Python, Bash, and more

Different languages

- **Programming is programming**
  - Perl, Python, **Bash**, and more

```
for file in $( ls $1/*.bam );
do
    if [[ $(basename $file) != "dog"* ]]; then

        my_prog $file

    fi
done
```

Different languages

- Programming is programming
  - **Perl**, Python, Bash, and more

```
for file in $( ls $1/*.bam );
do
    if [[ $(basename $file) != "dog"* ]]; then

        my_prog $file

    fi
done
```

```
use strict;
use warnings;
use File::Basename;

foreach my $file (glob("$ARGV[0]/*.bam")) {

    if(basename($file) !~ "^dog.+"){

        system("my_prog", $file);
    }
}
```

- Programming is programming
  - Perl, **Python**, Bash, and more

```bash
for file in $( ls $1/*.bam );
do
    if [[ $(basename $file) != "dog"* ]]; then

        my_prog $file

    fi
done
```

```python
import glob
import sys
import subprocess
import os

for file in glob.glob( sys.argv[1] + "/*.bam" ):

    if not os.path.basename(file).startswith("dog"):

        subprocess.call( ["my_prog" , file] )
```

Different languages

- Programming is programming
  - Perl, Python, Bash, and more

- Start with one, git gud, (learn another)

Different languages

- Programming is programming
  - Perl, Python, Bash, and more

- Start with one, git gud, (learn another)

PYTHON

Laboratory time! (yet again)