Jul 31 2025 BDBP106: Linux and Python programming Lab 4
Learning goals: Linux OS commands ln, file, cat, more, less, head, tail, history and sort
NOTE: Save screenshots of each exercise, and upload your work to your github account as Lab4.pdf by end of Thursday Jul 31.

For this lab, download 'Heart.csv' to a folder called 'Lab4'. If the file download to the "Downloads" folder by default, move the file to the folder 'Lab4'.

EXERCISES Start a fresh terminal for this Lab.
(1) Create symbolic and hard links to the data file you downloaded. What happens if you use the same name for the links? Print the screenshot of the output message and paste it in your answers. Also how do you prove that you have created the links correctly? Use the appropriate command to prove it.

```
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$ ln Heart.csv Heart-hlink
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$ ln Heart.csv Heart-hlink
ln: failed to create hard link 'Heart-hlink': File exists
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$
```

```
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$ ls -li Heart.csv Heart-hlink
11802975 -rw-rw-r-- 2 ibab ibab 19925 Jul 31 14:22 Heart.csv
11802975 -rw-rw-r-- 2 ibab ibab 19925 Jul 31 14:22 Heart-hlink
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$
```

(2) What command will you use to determine the filetype of the downloaded data file? Execute this command and take a screenshot of the command and the output to paste it in your work.

```
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$ file Heart.csv
Heart.csv: CSV text
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$
```

(3) View the contents of the data file using more and less commands. How many pages are there?

8 spaces for more command - (more Heart.csv)

```
"301",57,1,"asymptomatic",130,131,0,0,115,1,1.2,2,1,"reversable","Yes"
"302",57,0,"nontypical",130,236,0,2,174,0,0,2,1,"normal","Yes"
"303",38,1,"nonanginal",138,175,0,0,173,0,0,1,NA,"normal","No"
```

less command – (less Heart.csv)

```
"302",57,0,"nontypical",130,236,0,2,174,0,0,2,1,"normal","Yes"
"303",38,1,"nonanginal",138,175,0,0,173,0,0,1,NA,"normal","No"
(END)
```

(4) Output the first 35 lines of the data file using the appropriate command. Save the screenshot in your work.

```
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$ head -n 36 Heart.csv
"","Age","Sex","ChestPain","RestBP","Chol","Fbs","RestECG","MaxHR","ExAng","Oldpeak
","Slope","Ca","Thal","AHD"
"1",63,1,"typical",145,233,1,2,150,0,2.3,3,0,"fixed","No"
"2",67,1,"asymptomatic",160,286,0,2,108,1,1.5,2,3,"normal","Yes"
"3",67,1,"asymptomatic",120,229,0,2,129,1,2.6,2,2,"reversable","Yes"
"4",37,1,"nonanginal",130,250,0,0,187,0,3.5,3,0,"normal","No"
"5",41,0,"nontypical",130,204,0,2,172,0,1.4,1,0,"normal","No"
"6",56,1,"nontypical",120,236,0,0,178,0,0.8,1,0,"normal","No"
"7",62,0,"asymptomatic",140,268,0,2,160,0,3.6,3,2,"normal","Yes"
"8",57,0,"asymptomatic",120,354,0,0,163,1,0.6,1,0,"normal","No"
"9",63,1,"asymptomatic",130,254,0,2,147,0,1.4,2,1,"reversable","Yes"
"10",53,1,"asymptomatic",140,203,1,2,155,1,3.1,3,0,"reversable","Yes"
"11",57,1,"asymptomatic",140,192,0,0,148,0,0.4,2,0,"fixed","No"
"12",56,0,"nontypical",140,294,0,2,153,0,1.3,2,0,"normal","No"
"13",56,1,"nonanginal",130,256,1,2,142,1,0.6,2,1,"fixed","Yes"
"14",44,1,"nontypical",120,263,0,0,173,0,0,1,0,"reversable","No"
"15",52,1,"nonanginal",172,199,1,0,162,0,0.5,1,0,"reversable","No"
"16",57,1,"nonanginal",150,168,0,0,174,0,1.6,1,0,"normal","No"
"17",48,1,"nontypical",110,229,0,0,168,0,1,3,0,"reversable","Yes"
"18",54,1,"asymptomatic",140,239,0,0,160,0,1.2,1,0,"normal","No"
"19",48,0,"nonanginal",130,275,0,0,139,0,0.2,1,0,"normal","No"
"20",49,1,"nontypical",130,266,0,0,171,0,0.6,1,0,"normal","No"
"21",64,1,"typical",110,211,0,2,144,1,1.8,2,0,"normal","No"
"22",58,0,"typical",150,283,1,2,162,0,1,1,0,"normal","No"
"23",58,1,"nontypical",120,284,0,2,160,0,1.8,2,0,"normal","Yes"
"24",58,1,"nonanginal",132,224,0,2,173,0,3.2,1,2,"reversable","Yes"
"25",60,1,"asymptomatic",130,206,0,2,132,1,2.4,2,2,"reversable","Yes"
"26",50,0,"nonanginal",120,219,0,0,158,0,1.6,2,0,"normal","No"
"27",58,0,"nonanginal",120,340,0,0,172,0,0,1,0,"normal","No"
"28",66,0,"typical",150,226,0,0,114,0,2.6,3,0,"normal","No"
"29",43,1,"asymptomatic",150,247,0,0,171,0,1.5,1,0,"normal","No"
"30",40,1,"asymptomatic",110,167,0,2,114,1,2,2,0,"reversable","Yes"
"31",69,0,"typical",140,239,0,0,151,0,1.8,1,2,"normal","No"
"32",60,1,"asymptomatic",117,230,1,0,160,1,1.4,1,2,"reversable","Yes"
"33",64,1,"nonanginal",140,335,0,0,158,0,0,1,0,"normal","Yes"
"34",59,1,"asymptomatic",135,234,0,0,161,0,0.5,2,0,"reversable","No"
"35",44,1,"nonanginal",130,233,0,0,179,1,0.4,1,0,"normal","No"
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$
```

(5) Output the last 15 lines of the data file using the appropriate command. Save the screenshot in your work.

```
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$ tail -n 15 Heart.csv
"289",56,1,"nontypical",130,221,0,2,163,0,0,1,0,"reversable","No"
"290",56,1,"nontypical",120,240,0,0,169,0,0,3,0,"normal","No"
"291",67,1,"nonanginal",152,212,0,2,150,0,0.8,2,0,"reversable","Yes"
"292",55,0,"nontypical",132,342,0,0,166,0,1.2,1,0,"normal","No"
"293",44,1,"asymptomatic",120,169,0,0,144,1,2.8,3,0,"fixed","Yes"
"294",63,1,"asymptomatic",140,187,0,2,144,1,4,1,2,"reversable","Yes"
"295",63,0,"asymptomatic",124,197,0,0,136,1,0,2,0,"normal","Yes"
"296",41,1,"nontypical",120,157,0,0,182,0,0,1,0,"normal","No"
"297",59,1,"asymptomatic",164,176,1,2,90,0,1,2,2,"fixed","Yes"
"298",57,0,"asymptomatic",140,241,0,0,123,1,0.2,2,0,"reversable","Yes"
"299",45,1,"typical",110,264,0,0,132,0,1.2,2,0,"reversable","Yes"
"300",68,1,"asymptomatic",144,193,1,0,141,0,3.4,2,2,"reversable","Yes"
"301",57,1,"asymptomatic",130,131,0,0,115,1,1.2,2,1,"reversable","Yes"
"302",57,0,"nontypical",130,236,0,2,174,0,0,2,1,"normal","Yes"
"303",38,1,"nonanginal",138,175,0,0,173,0,0,1,NA,"normal","No"
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$
```

(6) Use the history command to list the last few commands, and execute the second last command in your list. Do this using both the process ID and the first letter of the command.

Second last command

```
  343  head -n 36 Heart.csv
  344  tail -n 16 Heart.csv
  345  tail -n 15 Heart.csv
  346  history
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$
```

PID:

```
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$ !345
tail -n 15 Heart.csv
"289",56,1,"nontypical",130,221,0,2,163,0,0,1,0,"reversable","No"
"290",56,1,"nontypical",120,240,0,0,169,0,0,3,0,"normal","No"
"291",67,1,"nonanginal",152,212,0,2,150,0,0.8,2,0,"reversable","Yes"
"292",55,0,"nontypical",132,342,0,0,166,0,1.2,1,0,"normal","No"
"293",44,1,"asymptomatic",120,169,0,0,144,1,2.8,3,0,"fixed","Yes"
"294",63,1,"asymptomatic",140,187,0,2,144,1,4,1,2,"reversable","Yes"
"295",63,0,"asymptomatic",124,197,0,0,136,1,0,2,0,"normal","Yes"
"296",41,1,"nontypical",120,157,0,0,182,0,0,1,0,"normal","No"
"297",59,1,"asymptomatic",164,176,1,2,90,0,1,2,2,"fixed","Yes"
"298",57,0,"asymptomatic",140,241,0,0,123,1,0.2,2,0,"reversable","Yes"
"299",45,1,"typical",110,264,0,0,132,0,1.2,2,0,"reversable","Yes"
"300",68,1,"asymptomatic",144,193,1,0,141,0,3.4,2,2,"reversable","Yes"
"301",57,1,"asymptomatic",130,131,0,0,115,1,1.2,2,1,"reversable","Yes"
"302",57,0,"nontypical",130,236,0,2,174,0,0,2,1,"normal","Yes"
"303",38,1,"nonanginal",138,175,0,0,173,0,0,1,NA,"normal","No"
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$
```

First letter of the command

```
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$ !t
tail -n 15 Heart.csv
"289",56,1,"nontypical",130,221,0,2,163,0,0,1,0,"reversable","No"
"290",56,1,"nontypical",120,240,0,0,169,0,0,3,0,"normal","No"
"291",67,1,"nonanginal",152,212,0,2,150,0,0.8,2,0,"reversable","Yes"
"292",55,0,"nontypical",132,342,0,0,166,0,1.2,1,0,"normal","No"
"293",44,1,"asymptomatic",120,169,0,0,144,1,2.8,3,0,"fixed","Yes"
"294",63,1,"asymptomatic",140,187,0,2,144,1,4,1,2,"reversable","Yes"
"295",63,0,"asymptomatic",124,197,0,0,136,1,0,2,0,"normal","Yes"
"296",41,1,"nontypical",120,157,0,0,182,0,0,1,0,"normal","No"
"297",59,1,"asymptomatic",164,176,1,2,90,0,1,2,2,"fixed","Yes"
"298",57,0,"asymptomatic",140,241,0,0,123,1,0.2,2,0,"reversable","Yes"
"299",45,1,"typical",110,264,0,0,132,0,1.2,2,0,"reversable","Yes"
"300",68,1,"asymptomatic",144,193,1,0,141,0,3.4,2,2,"reversable","Yes"
"301",57,1,"asymptomatic",130,131,0,0,115,1,1.2,2,1,"reversable","Yes"
"302",57,0,"nontypical",130,236,0,2,174,0,0,2,1,"normal","Yes"
"303",38,1,"nonanginal",138,175,0,0,173,0,0,1,NA,"normal","No"
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$
```

(7) The sort command. For each of the exercises below, find the correct combination of options for the sort command using the man pages. Make sure to show your sequence of steps clearly in your submission work.

(i) Sort the data according to the first column, keeping in mind that the first column has numbers. Save the output in a new file called col1_sorted.out.

```
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$ sort -n Heart.csv -o col1_sorted.out
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$ head col1_sorted.out
0,"Age","Sex","ChestPain","RestBP","Chol","Fbs","RestECG","MaxHR","ExAng","Oldpeak"
,"Slope","Ca","Thal","AHD"
1,63,1,"typical",145,233,1,2,150,0,2.3,3,0,"fixed","No"
2,67,1,"asymptomatic",160,286,0,2,108,1,1.5,2,3,"normal","Yes"
3,67,1,"asymptomatic",120,229,0,2,129,1,2.6,2,2,"reversable","Yes"
4,37,1,"nonanginal",130,250,0,0,187,0,3.5,3,0,"normal","No"
5,41,0,"nontypical",130,204,0,2,172,0,1.4,1,0,"normal","No"
6,56,1,"nontypical",120,236,0,0,178,0,0.8,1,0,"normal","No"
7,62,0,"asymptomatic",140,268,0,2,160,0,3.6,3,2,"normal","Yes"
8,57,0,"asymptomatic",120,354,0,0,163,1,0.6,1,0,"normal","No"
9,63,1,"asymptomatic",130,254,0,2,147,0,1.4,2,1,"reversable","Yes"
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$
```

(ii) Sort the data according to the ‘Age’ column. Save the output in a new file called age_sorted.out.

```
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$ sort -n -k2,2 Heart.csv > age_sorted.out
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$ head age_sorted.out
0,"Age","Sex","ChestPain","RestBP","Chol","Fbs","RestECG","MaxHR","ExAng","Oldpeak","S
lope","Ca","Thal","AHD"
100,48,1,"asymptomatic",122,222,0,2,186,0,0,1,0,"normal","No"
101,45,1,"asymptomatic",115,260,0,2,185,0,0,1,0,"normal","No"
102,34,1,"typical",118,182,0,2,174,0,0,1,0,"normal","No"
103,57,0,"asymptomatic",128,303,0,2,159,0,0,1,1,"normal","No"
104,71,0,"nonanginal",110,265,1,2,130,0,0,1,1,"normal","No"
10,53,1,"asymptomatic",140,203,1,2,155,1,3.1,3,0,"reversable","Yes"
105,49,1,"nonanginal",120,188,0,0,139,0,2,2,3,"reversable","Yes"
106,54,1,"nontypical",108,309,0,0,156,0,0,1,0,"reversable","No"
107,59,1,"asymptomatic",140,177,0,0,162,1,0,1,1,"reversable","Yes"
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$
```

(iii) Sort the data in a reverse manner according to the ’RestBP’ column. Save the output in a new file called restbp_revsort.out.

```
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$ head restbp_revsort.out
0,"Age","Sex","ChestPain","RestBP","Chol","Fbs","RestECG","MaxHR","ExAng","Oldpeak","S
lope","Ca","Thal","AHD"
100,48,1,"asymptomatic",122,222,0,2,186,0,0,1,0,"normal","No"
101,45,1,"asymptomatic",115,260,0,2,185,0,0,1,0,"normal","No"
102,34,1,"typical",118,182,0,2,174,0,0,1,0,"normal","No"
103,57,0,"asymptomatic",128,303,0,2,159,0,0,1,1,"normal","No"
104,71,0,"nonanginal",110,265,1,2,130,0,0,1,1,"normal","No"
10,53,1,"asymptomatic",140,203,1,2,155,1,3.1,3,0,"reversable","Yes"
105,49,1,"nonanginal",120,188,0,0,139,0,2,2,3,"reversable","Yes"
106,54,1,"nontypical",108,309,0,0,156,0,0,1,0,"reversable","No"
107,59,1,"asymptomatic",140,177,0,0,162,1,0,1,1,"reversable","Yes"
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$
```

(iv) Repeat (ii) and (iii) by giving GNU-style parameters to the sort command. This is where man pages are extremely useful!

```
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$ sort --numeric-sort --key=2,2 Heart.csv >
 age_sorted_gnu.out
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$ sort --reverse --numeric-sort --key=3,3 H
eart.csv > restbp_revsort_gnu.out
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$ ls
age_restbp_sorted.out  agesorted.out    Heart.csv    restbp_revsort_gnu.out
age_sorted_gnu.out     col1_sorted.out  Heart-hlink  restbp_revsort.out
age_sorted.out         Heart1.csv       Heart-slink  sex-age_cp_sorted.out
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$
```

```
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$ head age_sorted_gnu.out
0,"Age","Sex","ChestPain","RestBP","Chol","Fbs","RestECG","MaxHR","ExAng","Oldpeak","S
lope","Ca","Thal","AHD"
100,48,1,"asymptomatic",122,222,0,2,186,0,0,1,0,"normal","No"
101,45,1,"asymptomatic",115,260,0,2,185,0,0,1,0,"normal","No"
102,34,1,"typical",118,182,0,2,174,0,0,1,0,"normal","No"
103,57,0,"asymptomatic",128,303,0,2,159,0,0,1,1,"normal","No"
104,71,0,"nonanginal",110,265,1,2,130,0,0,1,1,"normal","No"
10,53,1,"asymptomatic",140,203,1,2,155,1,3.1,3,0,"reversable","Yes"
105,49,1,"nonanginal",120,188,0,0,139,0,2,2,3,"reversable","Yes"
106,54,1,"nontypical",108,309,0,0,156,0,0,1,0,"reversable","No"
107,59,1,"asymptomatic",140,177,0,0,162,1,0,1,1,"reversable","Yes"
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$ head restbp_revsort_gnu.out
99,52,1,"nontypical",134,201,0,0,158,0,0.8,1,1,"normal","No"
98,60,0,"asymptomatic",150,258,0,2,157,0,2.6,2,2,"reversable","Yes"
97,59,1,"asymptomatic",110,239,0,2,142,1,1.2,2,1,"reversable","Yes"
96,52,1,"asymptomatic",128,255,0,0,161,1,0,1,1,"reversable","Yes"
9,63,1,"asymptomatic",130,254,0,2,147,0,1.4,2,1,"reversable","Yes"
95,63,0,"nonanginal",135,252,0,2,172,0,0,1,0,"normal","No"
94,44,0,"nonanginal",108,141,0,0,175,0,0.6,2,0,"normal","No"
93,62,1,"nonanginal",130,231,0,0,146,0,1.8,2,3,"reversable","No"
92,62,0,"asymptomatic",160,164,0,2,145,0,6.2,3,3,"reversable","Yes"
91,66,1,"asymptomatic",120,302,0,2,151,0,0.4,2,0,"normal","No"
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$
```

(v) Sort the data first according to age, and then according to RestBP. How would you do this? Explain the steps clearly.

```
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$ sort -n -k2,2 -k3,3 Heart.csv > age_restb
p_sorted.out
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$ head age_restbp_sorted.out
0,"Age","Sex","ChestPain","RestBP","Chol","Fbs","RestECG","MaxHR","ExAng","Oldpeak","S
lope","Ca","Thal","AHD"
100,48,1,"asymptomatic",122,222,0,2,186,0,0,1,0,"normal","No"
101,45,1,"asymptomatic",115,260,0,2,185,0,0,1,0,"normal","No"
102,34,1,"typical",118,182,0,2,174,0,0,1,0,"normal","No"
103,57,0,"asymptomatic",128,303,0,2,159,0,0,1,1,"normal","No"
104,71,0,"nonanginal",110,265,1,2,130,0,0,1,1,"normal","No"
10,53,1,"asymptomatic",140,203,1,2,155,1,3.1,3,0,"reversable","Yes"
105,49,1,"nonanginal",120,188,0,0,139,0,2,2,3,"reversable","Yes"
106,54,1,"nontypical",108,309,0,0,156,0,0,1,0,"reversable","No"
107,59,1,"asymptomatic",140,177,0,0,162,1,0,1,1,"reversable","Yes"
ibab@IBAB-Workshop-Comp015:~/Documents/lab4$
```

(vi) Sort the data according to sex, then according to age, then according to ChestPain. Explain the steps clearly.