Sistemas Operativos: Trabalho 1

Taxas de Leitura/Escrita de processos em bash

1º: Como primeiro passo neste projeto, é necessário verificar os parâmetros, sendo que apenas o tempo de leitura é um parâmetro obrigatório:

```
while getopts "c:s:e:u:m:M:p:rw" OPTION; do case $OPTION in
```

Figura 1: parâmetros aceites

As opções 'c', 's', 'e', 'u', 'm', 'M' e 'p', sempre que utilizadas, devem ser seguidas de um valor; o mesmo não é válido para 'r' e 'w';

```
c=${OPTARG}; #regex
s)
    s=${OPTARG}; #data min (se s então next tem que ser e)
e)
    e=${OPTARG}; #data max
u)
    u=${OPTARG}; #user
    ;;
m)
    m=${OPTARG}; #min pid;
    ;;
M)
    M=${OPTARG}; #max pid;
    ;;
    p=${OPTARG}; #num processos aka linhas impressas;
    ;;
    reverse=1
    sort_writeb=1
    ;;
```

Figura 2: Definição de parâmetros válidos

2º: Depois de verificar quais os parâmetros selecionados, temos que efetuar uma verificação dos argumentos, isto é, se cumpre o requisito mínimo (./rwstat.sh *número de segundos*):

Figura 3: Verificação de argumentos

Caso, ou o argumento não tenha sido inserido, ou o argumento não seja numérico, ou ainda que seja um inteiro menor que 1, o programa não irá correr e imprime uma mensagem de erro.

3º: A função 'get_pids' tem como objetivo a leitura de todos os processos (contidos em /proc). Depois de filtrar apenas aqueles cujo nome é composto por números, irá verificar se, dados os parâmetros escolhidos pelo utilizador, o processo em questão cumpre todos os critérios selecionados; caso cumpra, o 'path' para esse processo será guardado num array, caso contrário, descartamos o processo e vamos analisar o próximo.

```
get_pids () {
    for pid in /proc/*; do
        actual_pid="$(basename $pid)" # basename /Users/path/file.txt retorna file.txt
    if ! [[ $actual_pid =~ ^[0-9]+$ ]]; then
        continue
        fi
```

Figura 4: Verificação do nome dos processos

```
if [ -r "$pid/io" ] && [ -r "$pid/comm" ]; then # se tivermos permissão de leitura
   if [[ $c != '' ]] ; then
        comm=$(cat $pid/comm);
        if ! [[ $comm =~ $c ]]; then
        continue
        fi
fi
```

Figura 5: Se pudermos ler dos ficheiros, começamos a verificação

Caso a opção '-c' tenha sido selecionada pelo utilizador, entramos dentro do segundo 'if'; de seguida, vamos verificar se, para esse processo, o valor em 'comm' contém a expressão regular inserida (valor na variável 'c'); se sim, iremos continuar a analisar este processo, caso contrário, o comando 'continue' irá saltar para a próxima iteração do ciclo for, isto é, para a análise de um novo processo.

```
if [[ $s != '' && $e != '' ]] ; then
   date=$(ls -ld /proc/$actual pid)
   date=$(echo $date | awk '{ print $6" "$7" "$8}')
   date=$(date -d "${date}" +"%s")
   if [[ $u != '' ]] ; then
   id="$( stat -c "%u" /proc/${actual pid} )"
   user="$( id -nu ${id} )'
   if ! [[ $user =~ $u ]]; then
if [[ $m != '' ]] ; then
   if ! [[ $actual_pid -gt $m ]]; then
      continue
if [[ $M != '' ]] ; then
if ! [[ $actual_pid -lt $M ]]; then
      continue
pidlist+=($pid) #add to array
```

Figura 6: verificação dos restantes parâmetros e adição dos processos a um array

4º: A função 'read_pids' serve para, depois de obtermos em 'pidlist' (fig.6) todos os processos que verificam as condições estabelecidas pelo utilizador, para cada um desses processos, obter os valores de 'rchar' e 'wchar', necessários para calcular "READB", "WRITEB", "RATER" e "RATEW".

Figura 7: ir buscar os valores de rchar e wchar

No código acima (fig.7) podemos ver que para todos os valores da nossa lista de processos válidos, caso eles ainda existam, vamos primeiro buscar toda a linha onde está presente a expressão 'rchar'/'wchar', e seguidamente, filtrar essa linha de forma a ficarmos apenas com o valor da variável, isto é, o valor numérico presente nessa linha.

```
if [[ $read -eq 1 ]]; then #se já tiver sido executado 1 vez
    op1=${rchar_pre[count]}
    res=$(echo "$(($rchar - $op1))")
    rchar_list+=($res)
    op2=${wchar_pre[count]}
    res2=$(echo "$(($wchar - $op2))")
    wchar_list+=($res2)
    count=$((count+1))
else #caso contrário ler para preencher lista
    rchar_list+=($rchar)
    wchar_list+=($wchar)
fi
```

Figura 8: cálculo dos valores necessários

Na segunda parte da função 'read_pids' (fig.8) é onde efetuamos o cálculo dos valores de "READB" e "WRITEB", fazendo a diferença entre o valor obtido na segunda leitura (após o sleep de x segundos) e os valores obtidos na primeira leitura, que ficam guardados em 'rchar_list' e em 'wchar list'.

5º: Após ter as funções 'get_pids' e 'read_pids' em funcionamento, podemos proceder à sua chamada e à execução do programa:

```
read=0
get_pids
read_pids
rchar_pre=("${rchar_list[@]}")
wchar_pre=("${wchar_list[@]}")
sleep $1
rchar_list=()
wchar_list=()
read=1
read_pids
```

Figura 9: Execução das Funções

Começamos por dar à variável 'read' o valor '0' (ainda não foi efetuada nenhuma leitura); seguidamente invocamos a função 'get_pids' de forma a preencher a nossa lista de processos válidos, necessária para o funcionamento da segunda função a ser executada, 'read_pids'. Dado que

o valor de 'read' está a 0, os valores de 'rchar' e 'wchar' de cada um dos processos da nossa lista serão guardados num array. Temos, no entanto, de copiar ambos esses arrays para 'rchar_pre' e 'wchar_pre' (arrays com os valores pré uso do comando 'sleep'), pois os arrays originais vão ser overwriten numa execução seguinte.

Na etapa seguinte, vamos fazer um 'sleep' de um tempo pré-determinado pelo utilizador; vamos também esvaziar as listas de 'rchar' e 'wchar', de forma a podermos guardar os valores pós 'sleep', assim como atribuir a 'read' o valor '1', de forma a forçar a função 'read_pids', que será novamente executada, a calcular os valores de "READB" e "WRITEB" para cada processo após ler os valores de 'rchar' e 'wchar' pela segunda vez (fig.8).

6º: Sabendo agora os valores de 'rchar' e 'wchar' resta-nos calcular a rate de escrita e de leitura, "RATER" e "RATEW", ir buscar os valores de "COMM" e de "USER", e a "DATE" do processo, assim como a sua impressão na forma de tabela.

```
k=0
printf '%-20s\t\t %8s\t\t %10s\t %10s\t %9s\t %10s\t %10s\t %10s\n' "COMM" "USER" "PID" "READB" "WRITEB" "RATER" "RATEW" "DATE"
for pids in "${pidlist[@]}"; do

actual_pids="$(basename $pids)"
comm=$(cat $pids/comm);
date=$(ls -ld /proc/$actual_pids)
date=$(echo $date | awk '{ print $6" "$7" "$8}')
id="$( stat -c "%u" /proc/${actual_pids} )"
user="$( id -nu ${id} )"
rchar=${rchar_list[k]}
wchar=$(echo "scale=3; ($rchar/$1)" | bc)
ratew=$(echo "scale=3; ($wchar/$1)" | bc)

printf '%-30s\t %-20s\t %10s\t %10s\t %10s\t %10s\t %5s\n' "$comm" "$user" "$actual_pids" "$rchar" "$wchar" "$rater k=$((k+1))
done | sort -n -k $sort $reverse | head -n $p
```

Figura 10: valores finais e impressão

Para cada um dos processos na nossa lista, vamos buscar os valores necessários para imprimir na tabela aos respetivos ficheiros:

```
actual_pids="$(basename $pids)"
comm=$(cat $pids/comm);
date=$(ls -ld /proc/$actual_pids)
date=$(echo $date | awk '{ print $6" "$7" "$8}')
id="$( stat -c "%u" /proc/${actual_pids} )"
user="$( id -nu ${id} )"
```

Figura 11: comm, user, date e pid

Como em 'read_pids' (figs.7 e 8) obtivemos os valores de "READB" e "WRITEB", dividindo cada um deles pelo intervalo de tempo inserido pelo utilizador, obtemos assim a taxa de escrita e de leitura, "RATER" e "RATEW":

```
rchar=${rchar_list[k]}
wchar=${wchar_list[k]}
rater=$(echo "scale=3; ($rchar/$1)" | bc)
ratew=$(echo "scale=3; ($wchar/$1)" | bc)
```

Figura 12: cálculo dos valores restantes

Numa etapa final, resta-nos imprimir os valores, o que nos leva ao problema da organização dos dados. Para resolver este problema podemos utilizar os comandos 'sort' e 'head' depois do ciclo de impressão:

```
printf '%-30s\t %-20s\t %10s\t %10s\t %9s\t %
done | sort -n -k $sort $reverse | head -n $p
```

Figura 13: print e sort

O comando 'sort' irá esperar que o ciclo for acabe, e seguidamente irá organizar todos os valores que serão impressos de acordo com os critérios escolhidos. Por definição, as variáveis 'sort' e 'reverse' estão, respetivamente, com os valores '4' (respetivo à coluna número 4 da tabela, "READB") e '-r' (de forma a não apresentar primeiro os processos que não escrevem ou leem nada).

Caso o utilizador execute o script com '-w', o valor de 'sort' irá passar a 7 (coluna correspondente à taxa de escrita); caso use '-r', 'reverse' irá ficar com sem nenhum valor, como podemos verificar em fig.2.

O comando 'head', quando usado com '-n', irá estabelecer um limite (valor de p) para o número de linhas que se podem imprimir.

Apresentação De Resultados:

andregomes 040LAPTOP-6PIA	CK3E:~/SO/proj1\$./rwstat.sh 1	Θ					
COMM	USER	PID	READB	WRITEB	RATER	RATEW	DATE
					67441.100		
rwstat.sh	andregomes04	2968	674411	1003		100.300	Dec 2 21:36
node	andregomes04	399	728	430	72.800	43.000	Dec 2 19:23
node	andregomes04	392	68	68	6.800	6.800	Dec 2 19:23
node	andregomes04	383	68	68	6.800	6.800	Dec 2 19:23
node	andregomes04	339	38	30	3.800	3.000	Dec 2 19:23
sleep	andregomes04	2966	Θ	Θ	0	0	Dec 2 21:36
sh	andregomes04	335	0	0	0	9	Dec 2 19:25
sh	andregomes04	330	0	Θ	0	0	Dec 2 19:25
sh	andregomes04	329	0	Θ	Θ	Θ	Dec 2 19:23
rwstat.sh	andregomes04	2781	0	Θ	Θ	0	Dec 2 21:36
			Ö	ĕ	Ö	Ö	Dec 2 19:23
node	andregomes04	580					
node	andregomes04	410	Θ	Θ	Θ	0	Dec 2 19:23
node	andregomes04	350	Θ	62	Θ	6.200	Dec 2 19:23
bash	andregomes04	9	0	0	0	0	Dec 2 19:21
Dasii	and regonies 04	,	0	U	0	0	DEC 2 19.21
andresses CHOLADTOD-CDTA	CK3E: <mark>~/SO/proj1\$./rwstat.sh -</mark>	o podo 10					
COMM	USER	PID	READB	WRITEB	RATER	RATEW	DATE
node	andregomes04	399	736	438	73.600	43.800	Dec 2 19:23
node	andregomes04	392	68	68	6.800	6.800	Dec 2 19:23
node	andregomes04	383	68	68	6.800	6.800	Dec 2 19:23
node	andregomes04	339	38	30	3.800	3.000	Dec 2 19:23
node	andregomes04	580	Θ	Θ	Θ	0	Dec 2 19:23
		410	0	0	0	0	Dec 2 19:23
node	andregomes04						
node	andregomes04	350	0	62	Θ	6.200	Dec 2 19:23
andregomes04@LAPTOP-6PIA	CK3E:~/SO/proj1\$./rwstat.sh -	u andregomes04 10					
COMM	USER	PID	READB	WRITEB	RATER	RATEW	DATE
rwstat.sh	andregomes04	4194	674470	1053	67447.000	105.300	Dec 2 21:45
node	andregomes04	399	728	430	72.800	43.000	Dec 2 19:23
node	andregomes04	392	68	68	6.800	6.800	Dec 2 19:23
			68	68		6.800	Dec 2 19:23
node	andregomes04	383			6.800		
node	andregomes04	339	38	30	3.800	3.000	Dec 2 19:23
sleep	andregomes04	2966	Θ	Θ	Θ	0	Dec 2 21:36
sh	andregomes04	335	Ö	Ö	Ö	Ö	Dec 2 19:25
sh	andregomes04	330	0	Θ	Θ	Θ	Dec 2 19:25
sh	andregomes04	329	Θ	Θ	Θ	Θ	Dec 2 19:23
rwstat.sh	andregomes04	2781	Θ	Θ	0	Θ	Dec 2 21:36
							Dec 2 19:23
node	andregomes04	580	Θ	Θ	0	0	
node	andregomes04	410	0	Θ	Θ	Θ	Dec 2 19:23
node	andregomes04	350	Θ	93	Θ	9.300	Dec 2 19:23
							Dag 2 10.21
bash	andregomes04	9	0	Θ	0	0	Dec 2 19:21
						0	Dec 2 19:21
bash	andregomes04	9	Θ	Θ		0	Dec 2 19:21
bash andregomes04@LAPTOP-6PIA	andregomes04 CK3E:~/SO/proj1\$./rwstat.sh -:	9 s "Dec 2 20:00" –e	0 "Dec 2 22:00"	10	0	•	
bash	andregomes04	9	Θ	Θ		0 RATEW	Dec 2 19:21 DATE
bash andregomes04@LAPTOP-6PIA COMM	andregomes04 CK3E:~/SO/projl\$./rwstat.sh -: USER	9 s "Dec 2 20:00" -e PID	0 "Dec 2 22:00" : READB	0 10 WRITEB	0 RATER	RATEW	DATE
bash andregomes04@LAPTOP-6PIAG COMM rwstat.sh	andregomes04 CK3E:~/SO/proj1\$./rwstat.sh -: USER andregomes04	9 s "Dec 2 20:00" -e PID 4780	"Dec 2 22:00" : READB 151080	0 10 WRITEB 206	0 RATER 15108.000	RATEW 20.600	DATE Dec 2 21:48
bash andregomes04@LAPTOP-6PIA COMM rwstat.sh sleep	andregomes04 CK3E:~/SO/proj1\$./rwstat.sh -: USER andregomes04 andregomes04	9 s "Dec 2 20:00" -e PID 4780 2966	0 "Dec 2 22:00" : READB 151080 0	0 10 WRITEB 206 0	0 RATER 15108.000 0	RATEW 20.600 0	DATE Dec 2 21:48 Dec 2 21:36
bash andregomes04@LAPTOP-6PIAG COMM rwstat.sh	andregomes04 CK3E:~/SO/proj1\$./rwstat.sh -: USER andregomes04	9 s "Dec 2 20:00" -e PID 4780	"Dec 2 22:00" : READB 151080	0 10 WRITEB 206	0 RATER 15108.000	RATEW 20.600	DATE Dec 2 21:48
bash andregomes04@LAPTOP-6PIA COMM rwstat.sh sleep	andregomes04 CK3E:~/SO/proj1\$./rwstat.sh -: USER andregomes04 andregomes04	9 s "Dec 2 20:00" -e PID 4780 2966	0 "Dec 2 22:00" : READB 151080 0	0 10 WRITEB 206 0	0 RATER 15108.000 0	RATEW 20.600 0	DATE Dec 2 21:48 Dec 2 21:36
bash andregomes84@LAPTOP-6PIAG COMM rwstat.sh sleep rwstat.sh	andregomes04 CK3E:~/SO/proj1\$./rwstat.sh -:	9 s "Dec 2 20:00" -e PID 4780 2966 2781	0 "Dec 2 22:00" : READB 151080 0 0	0 WRITEB 206 0 0	0 RATER 15108.000 0	RATEW 20.600 0	DATE Dec 2 21:48 Dec 2 21:36
bash andregomes84@LAPTOP-6PIAG COMM rwstat.sh sleep rwstat.sh	andregomes04 CK3E:~/SO/proj1\$./rwstat.sh -:	9 s "Dec 2 20:00" -e PID 4780 2966 2781	0 "Dec 2 22:00" : READB 151080 0 0	0 WRITEB 206 0 0	0 RATER 15108.000 0	RATEW 20.600 0	DATE Dec 2 21:48 Dec 2 21:36
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andregomes040LAPTOP-6	PIACK3E:~/SO/proj1\$./rwstat.sh -	-w 10					
COMM	USER	PID	READB	WRITEB	RATER	RATEW	DATE
rwstat.sh	andregomes04	7700	674443	1060	67444.300	106.000	Dec 2 22:02
node	andregomes04	399	728	430	72.800	43.000	Dec 2 19:23
node	andregomes04	392	68	68	6.800	6.800	Dec 2 19:23
node	andregomes04	383	68	68	6.800	6.800	Dec 2 19:23
node	andregomes04	350	Θ	62	0	6.200	Dec 2 19:23
node	andregomes04	339	38	30	3.800	3.000	Dec 2 19:23
sleep	andregomes04	2966	0	0	0		Dec 2 21:36
sh	andregomes04	335	0	Θ	0		Dec 2 19:25
sh	andregomes04	330	0	Θ	0		Dec 2 19:25
sh	andregomes04	329	0	0	0	0	Dec 2 19:23
rwstat.sh	andregomes04	2781	0	Θ	0	Θ	Dec 2 21:36
node	andregomes04	580	0	Θ	0	0	Dec 2 19:23
node	andregomes04	410	Θ	Θ	Θ	Θ	Dec 2 19:23
bash	andregomes04	9	0	0	0	0	Dec 2 19:21
andregomes04@LAPTOP-6							
COMM	USER	PID	READB	WRITEB	RATER	RATEW	DATE
rwstat.sh	andregomes04	22560	674314	1002	674314.000	1002.000	Dec 2 22:44
node	andregomes04	399	69	40	69.000	40.000	Dec 2 19:23
node	andregomes04	383	15	15	15.000	15.000	Dec 2 19:23
0.001.4.07.00.61	7716107 (00/ 100/						
	PIACK3E: ~/SO/proj1\$./rwstat.sh -		DEADD	HOTTED	DATED	DATEM	DATE
COMM	USER	PID	READB	WRITEB	RATER	RATEW	DATE
bash	andregomes04	9	0	0	0	0	Dec 2 19:21
node	andregomes04	339	0	0	0	0	Dec 2 19:23
node	andregomes04	350	0	31	0	31.000	Dec 2 19:23
node	andregomes04	383	0	0	0	0	Dec 2 19:23
node	andregomes04	410	0	Θ	Θ	Θ	Dec 2 19:23