UNIVERSITÀ DEGLI STUDI DI TRIESTE

First FHPC Assignment

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October 29, 2019

1 PREVIEW

In this assignment we will present the following subjects:

- the production of a parallel program code
- the graphs of the theoretical and real speedup of the code
- anything else

Figure 1.1: Photo of a parallel program

2 SECTION 0

2.1 Laptop theoretical peak performance

We want to calculate the theoretical peak performance of our own portable computer by using the formula $theoreticalpeakperformance = clock_frequencyxFLOPsxnumberofcores$. We gather that $clockfrequency = 2.90Ghz, FLOP = 16$ and $numberofcores = 2$ for our computer architecture,an intel i7 with a kaby lake microarchitecture; thus we compute $theoreticalpeakperformanc$ $92.8GFlops/s$

	Your model	CPU	Frequency	Number of Cores	Peak Performance
laptop	Asus F556U	Intel Core i7-7500	2.90 GHz	2	92.8 GFLOPs/s

2.2 Smartphone theoretical peak performance

We installed "‘Mobile Linpack"’ app and we run a few test. We report here some results,even on repeated trials:

	Model	Sustained performance	Matrix size	Peak performance	Memory
Cellphone	Samsung Galaxy XCover 4	114,81 Mflops/s	250	not calculated	16,00 GB
		145.53 Mflop/s	500		
		157.5 Mflop/s	800		
		201.32 Mflop/s	800		
		155.93 Mflop/s	900		
		109.88 Mflop/s	1000		
		103.14 Mflop/s	2000		

2.3 Laptops,smartphones and the top 500

Let’s check now whether our technologies would have competed with the Top500 supercomputers in the past:

	Model	Performance	Top 500 year& position	number 1 HPC system
Smartphone	Samsung Galaxy XCover 4	201,32 Mflops/s	does not enter in the top500 of the first year of measurement, the 500th Supercomputer has an Rmax of 0.5 GFlops/s (equal to 2.4 times our smartphone peak performance)	Numerical Wind Tu nel,Fujitsu Natio Aerospace Laboratory Japan is first in the year 19 with a Rmax equal to 12 GFlops/s (equal to 616 tim our cellphone’s sustain peak performance)
Laptop	ASUS F556U	92.8 GFLOPs/s	3rd position at nov 1993. Remains in the top 10 until nov 1996	We have the same top po tion with a Rpeak equal 235.8 GFlops/s(equal to times our laptop’s theore cal peak performance)

3 SECTION 1

3.1 Model for a serial and parallel summation of n numbers

Here we discuss about modeling a simple program which consists of summing n numbers. A simple pseudocode for the serial program would be:

Data:array $A[]$ of values
for i from 1 to n **do**
  sum = sum + A[i]
end for
return sum

If we choose T_{comp} as the time to compute a floating point operation we could calculate the total time of a serial computation as $T_s = N * T_{comp}$,whereas the code simply computes N times the sum of two values.

For the parallel program we complicate a little the execution:

Data:array $A[]$ of values
Environment: p parallel processors
if Master process **then**
Read and Split $A[]$ into p subarrays $A_i[]$
Send $p-1$ subarrays to the other $p-1$ processors
for i from 1 to n/p **do**
$sum_i = sum_i + A_i[i]$
end for
Collect the resulting $p-1$ values sum_i from the processors
for i from 1 to p **do**
$sum = sum + sum_i$
end for
end if
if Slave process **then**
Receive subarrays $A_i[]$ from the Master process
for i from 1 to n/p **do**
$sum_i = sum_i + A_i[i]$
end for
Send sum_i back to the Master process
end if
return sum

If we define the times T_{read} to indicate the time needed to read a variable,and T_{comm} to indicate the time needed to communicate a variable, we can deduce the theoretical execution time of the model:

Read and Split $A[]$ into p subarrays $A_i[]$
EXECUTION TIME: T_{read}

Send $p-1$ subarrays to the other $p-1$ processors
EXECUTION TIME: $T_{comm} * (p-1)$

for i from 1 to n/p **do**
$sum_i = sum_i + A_i[i]$
end for
EXECUTION TIME: $p + n/p * T_{comp} = n * T_{comp}$
Notice that this is a parallel execution, the subarrays are added inside each processor

Send sum_i back to the Master process
EXECUTION TIME: (p-1)*T_{comm}
for i from 1 to p **do**
$sum = sum + sum_i$
end for

EXECUTION TIME: (p-1)*T$_{comp}$
The total sum gives $T_p =$

4 Interpreting Equations

4.1 Identify the author of Equation 4.1 below and briefly describe it in English.

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)} \tag{4.1}$$

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4.2 Try to make sense of some more equations.

$$\begin{aligned}(x+y)^3 &= (x+y)^2(x+y)\\ &= (x^2+2xy+y^2)(x+y)\\ &= (x^3+2x^2y+xy^2)+(x^2y+2xy^2+y^3)\\ &= x^3+3x^2y+3xy^2+y^3\end{aligned} \tag{4.2}$$

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$$A = \begin{bmatrix} A_{11} & A_{21} \\ A_{21} & A_{22} \end{bmatrix} \tag{4.3}$$

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5 Viewing Lists

5.1 Bullet Point List

- First item in a list
  - First item in a list
    - First item in a list
    - Second item in a list
  - Second item in a list
- Second item in a list

5.2 Numbered List

1. First item in a list
2. Second item in a list
3. Third item in a list

Per 50g	**Pork**	**Soy**
Energy	760kJ	538kJ
Protein	7.0g	9.3g
Carbohydrate	0.0g	4.9g
Fat	16.8g	9.1g
Sodium	0.4g	0.4g
Fibre	0.0g	1.4g

Table 6.1: Sausage nutrition.

6 Interpreting a Table

6.1 The table above shows the nutritional consistencies of two sausage types. Explain their relative differences given what you know about daily adult nutritional recommendations.

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7 Reading a Code Listing

Listing 1: Luftballons Perl Script.

```perl
#!/usr/bin/perl

use strict;
use warnings;

for (1..99) { print $_." Luftballons\n"; }

# This is a commented line

my $string = "Hello World!";

print $string."\n\n";

$string =~ s/Hello/Goodbye Cruel/;

print $string."\n\n";

finale();

exit;

sub finale { print "Fin.\n"; }
```

7.1 How many luftballons will be output by the Listing 1 above?

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7.2 Identify the regular expression in Listing 1 and explain how it relates to the anti-war sentiments found in the rest of the script.

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