FIT3142 Laboratory #8
Amdahl's Law and Grid/Cloud Performance Modelling

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Contents

1 Laboratory Task Definition (100% Marks)

Background

This laboratory exercise deals with Amdahl's Law, which is covered in Topics 8 and 9. Please read through the slides covering this material before you attend the laboratory.

Amdahl's Law shows that computational activities which can be parallelised display "linear speedup" with an increased number of processors only if the algorithm does not include a "serial" component, where there is a mutual dependency between parallel tasks. If the parallel processing computer system is a cluster, grid or cloud, then an additional serial delay arises as a result of the inter-process communications channel and network it running over.

This is detailed in the lecture slides.

Your individual Tasks comprise the following:

1.1 Task 1 (50% Marks)

1. Using `gnuplot` from your Linux account, examine the provided sample showing the Speedup versus Number of processors (Amdahls law) for up to 48 processors (`gnuplot Amdahl-Sample-Plot.plt`) with serial components of 1.31 percent and 1.5 percent. This plot file will produce a postscript file that you can convert to pdf with the `ps2pdf` tool.

2. Now modify the provided plot file to instead plot Speedup versus the Number of processors, i.e. Amdahls Law, for serial components of 0.1 percent, 0.5 percent, 1 percent, 2 percent, 3 percent, 4 percent and 5 percent, assuming up to 128 processors in your multiprocessing system.

   (a) Explain the observed behaviour in the plots.
   (b) Why is the performance of the multiprocessing system so sensitive to the serial component in the calculation.

3. Save this file as *MyStudentNumber-Task1.1.plt* and set its output file to be *MyStudentNumber-Task1.1.ps*. This plot file will produce a postscript file that you can convert to pdf with the `ps2pdf` tool.

   (a) Explain the observed behaviour in the plots.

   (b) Why is the performance of the Grid/Cloud application and system so sensitive to the network delay component in the calculation?

4. Modify *Amdahl-Sample-Plot.plt* or *MyStudentNumber-Task1.1.plt* to plot Amdahls Law for Grids, which is described in the lecture slides. Save this file as *MyStudentNumber-Task1.2.plt* and set its output file to *MyStudentNumber-Task1.2.ps*. You should plot Speedup versus the Number of processors for serial components of 0.1 percent, 0.5 percent, 1 percent, 2 percent, 3 percent, 4 percent and 5 percent, assuming up to 128 processors in your multiprocessing system and an application network serial component of 0.1 percent.

1.2   Task 2 (50% Marks)

1. Using the provided Gnuplot file *Amdahl-MM1-Plot.plt*, model the impact of queue utilisation on scalability for a grid application, for network utilisation values of 0.1 to 0.9, in increments of 0.1, and a delay factor of 0.01.

   (a) Explain the observed behaviour in the plots.

   (b) Explain the impact of network utilisation on the scalability of this application.

2. Increase the network 'delay factor' value twofold, and then fourfold, eightfold and sixteenfold, and rerun the model each time.

   (a) Explain the observed behaviour in the plots.

   (b) Explain the impact of network delays on the scalability of this application.

2   Assessment Checklist

1. (2 marks) Show and describe in words successful completion of Task 1; email your plots to your tutor.

2. (2 marks) Show and describe in words successful completion of Task 2; email your plots to your tutor.