Subset Sum
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October 17th, 2018
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Summary - Subset Sum

- Is an NP-Complete problem.
- Given a set of numbers and a target sum, find a set that totals that target sum.
- Dynamic Programming algorithm achieves best results both for performance and parallelization.

Algorithm 1 SubsetSumSeq

Ensure: A subset which adds up to a given sum.
1: procedure SubsetSumSeq(Set, Sum)
2: \hspace{1em} for index 0 to n do
3: \hspace{2em} refTable[index][0] = TRUE
4: \hspace{1em} for index 1 to n do
5: \hspace{2em} currPos = set[index]
6: \hspace{2em} for index2 0 to setLen - 1 do
7: \hspace{3em} refTable[index][index2] = refTable[index - 1][index2]
8: \hspace{2em} for index2 0 to sum do
9: \hspace{3em} newPos = currPos + index2
10: \hspace{3em} if bitAt(refTable[index][index2]) == 1 AND newPos <= sum then
11: \hspace{4em} changeValue(refTable[index - 1], newPos)

Algorithm 2 SubsetSumSmp

Ensure: A subset which adds up to a given sum.
1: procedure SubsetSumSmp(Set, Sum)
2: \hspace{1em} parallelFor index 0 to n do
3: \hspace{2em} refTable[index][0] = TRUE
4: \hspace{1em} end
5: \hspace{1em} for index 1 to n do
6: \hspace{2em} currPos = set[index]
7: \hspace{2em} parallelFor index2 0 to setLen do
8: \hspace{3em} refTable[index][index2] = refTable[index - 1][index2]
9: \hspace{2em} end
10: \hspace{1em} parallelFor index2 0 to sum do
11: \hspace{2em} newPos = currPos + index2
12: \hspace{2em} if bitAt(refTable[index][index2]) == 1 AND newPos <= sum then
13: \hspace{3em} changeValue(refTable[index - 1], newPos)
14: \hspace{2em} end

Figure 1: Image - Sequential & Parallel Algorithms
“Parallel Solution of the Subset-sum Problem: An Empirical Study” [Bok11]

- Bokhari, Saniyah S.
- Ohio State University (2011)
Paper One Analysis

Problems

- The paper parallelizes subset sum problem on three different architectures (Cray XMT, IBM x3755, NVIDIA FX 5800).
- Two different algorithms for parallelization.

Conclusions

- IBM x3755 - Scales well up to 8 cores
- Cray XMT - Good scaling up to 16 nodes
- NVIDIA FX 5800 - Good for smaller problems that fit in memory

How we will use this

- Similar variant of subset-sum
- Dynamic algorithm used for Cray XMT is similar to our design and provides a guideline
“Parallel implementation of the modified subset sum problem in CUDA” [RMGF14]

- Z. Ristovski, I. Mishkovski, S. Gramatikov and S. Filiposka
- 2014 22nd Telecommunications Forum Telfor (TELFOR)
Problems

• A shift is happened from parallel computing on a CPU, to using both GPU and CPU in tandem.

Conclusions

• Using GPU integration they were able to speed up the processing of subset sum by 20 times.

• Can be used for both cryptography and VoD streaming.

How we will use this

• We will look into ways to speed up our processing of subset sum. We will consider speeding it up through using the GPU.
“Parallel Implementation of the Modified Subset Sum Problem in OpenCL” [PM15]

- D. Petkovski, and I. Mishkovski
- ICT Innovations 2015 Web Proceedings ISSN 1857-7288
Problems

- Parallelization of \texttt{SubsetSum} so that memory allocation is \textit{dynamic} and less memory is required for a solution

Conclusions

- There’s a paradigm shift in the parallel world. People need to figure out how to take advantage of the GPUs that they have to increase efficiency.

How we will use this

- This algorithm is focused on memory efficiency, and we will use it to develop our algorithm further
Final Remarks

Original hypothesis

- Parallelization will help, but only to an extent
- Beyond a threshold, we will be subject to diminishing returns

Current thoughts

- Ensure that scaling is taken into account
- Memory efficiency is a new point of interest
Any Questions?
Saniyah S. Bokhari, *Parallel solution of the subset-sum problem: An empirical study*, Ohio State University, 2011, Date Accessed: September 24, 2018

URL: https://pdfs.semanticscholar.org/f3fc/b462b7366ab7d91febe5fb92113535ff63dd.pdf.


Z. Ristovski, I. Mishkovski, S. Gramatikov, and S. Filiposka, *Parallel implementation of the modified subset sum problem in cuda*, 923–926, Date Accessed: September 19, 2018