Differentiate Sparse Matrix with a Reversible Embeded Domain-Specific Language

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1 Summary of the Proposal

Sparse matrices are extensively used in scientific computing, however there is no automatic differentiation package in Julia yet to handle sparse matrix operations yet. This project will utilize the reversible embedded domain-specific language NiLang.jl to differentiate sparse matrix operations by re-writing the sparse functions in Julia base in a reversible style. We will port the generated backward rules to ChainRules.jl as an extension, where ChainRules.jl is the most popular Julia package providing backward rules for automatic differentiation packages.

2 Introduction

Content included in **Para1**

- Importance of Sparse Matrix
- Automatic Differentiation topic generalization
- Reviewing previous tools, forward AD, reverse AD and mixed AD

Content included in **Para2**

- Gap between classical AD and eDSL[2]
- Outline purpose: implement AD for sparse matrix operations
- Summarize methods and expected outcome
- State the value

Content included in **Para3**

- Structure of this proposal

3 Goal and Objectives

- An automatic differentiation on sparse matrix Julia package writen by NiLang
- Test converage above 80%
- Export chain rules into ChainRules.jl

4 Design and Decision Details

4.1 SparseCSC

SparseCSC format for sparse matrix in julia

4.2 Low Level Operations

sparse matrix operation
    sparse tensor operation (needed?)

4.3 High Level Operations

pca-lowrank, svd-lowrank

4.4 Export Chain Rules into ChainRules.jl

define rules for sparse matrix

5 Delivery, Schedule and Timeline

5.1 Delivery

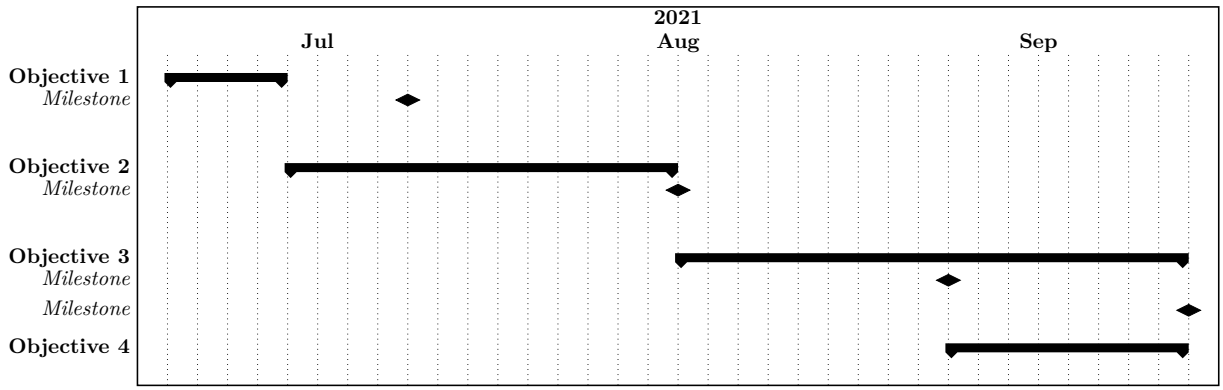
expectation packages

5.2 Schedule

ask advice from mentors

5.3 Timeline

Gantt chart [1]



References

[1] HL Gantt. Work, wages and profit, published by the engineering magazine. *New York*, 1910.

[2] Jin-Guo Liu and Taine Zhao. Differentiate everything with a reversible embeded domain-specific language. *arXiv preprint arXiv:2003.04617*, 2020.

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EDUCATION

9.2020 - 6.2023 **Master of Applied Mathematics** at Fudan University
Supervised by Young PI Weiyang Ding
Focus on Numerical Optimization and Matrix Computation

9.2016 - 7.2020 **Bachelor of Mathematics and Applied Mathematics** at Lanzhou University

SKILLS AND QUALIFICATIONS

Programming Languages

Advanced skills Samples, sample, sample
Basic skills Samples, sample, sample

Languages

Native Sample language
Advanced Sample language
Basics Sample language

WORK EXPERIENCE

10.2019 - 12.2019 **NLP Researcher in Core Development Platform** at iFLYTEK

- task1
- task2
- task3

PROJECTS

5.2021 - now **Lowranksvd.jl** Lowranksvd.jl

- Sample task
- Sample task
- Sample task