A Brief Introduction to Me and My Research

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目录

个人简介

研究经历

- 偏微分方程的有限元方法研究
- 预训练模型的可解释性研究
- Kaggle Question Answering 项目
- Kaggle Sentence Classification 项目
- 金融知识图谱自动化构建项目

总结

个人简介

- 上海财经大学, 数学与应用数学专业, 年级排名 **13/104**, 本学期成绩排名 **1/104**. TOEFL 102 分.

- 主要课程: **数学分析 (3.3), 高等代数 (4.0), 概率论 (4.0), 文本挖掘 (4.0), 深度学习 (4.0), 人工智能 (4.0).**

- 完成多项自然语言处理相关研究项目, 且有一篇计算数学论文已发表在 SCI 一区杂志.

- 曾获高中全国物理竞赛省一等奖 (实验部分全省第 8 名), 自学大学与研究生阶段物理课程, 数理基础扎实.

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有限元方法简介

Finite element space and grids:

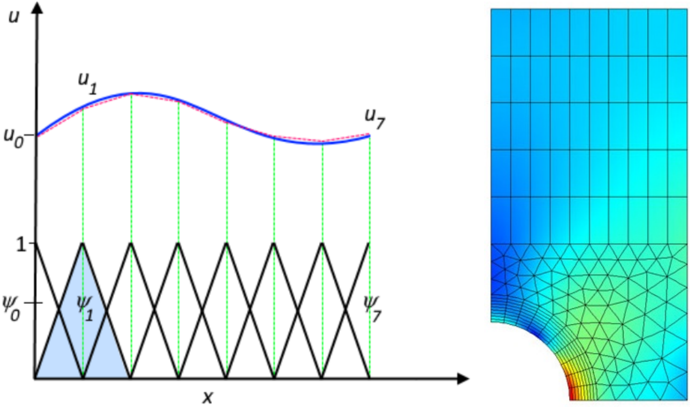


图: Linear basis in 1D; Grids

主要内容

Equation:

$$\begin{cases} \varepsilon^2\Delta^2 u - \Delta u = f & \text{in } \Omega, \\ u = \partial_n u = 0 & \text{on } \partial\Omega, \end{cases}$$

- Original ways to solve:
  - Conforming elements: computational expensive
  - Non-conforming elements: isn't convergent

主要内容

Our work:

- Modified the right hand side via projection:

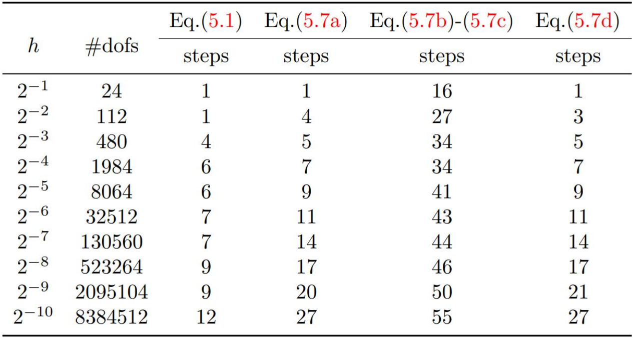
$$\begin{aligned} (\nabla w_h, \nabla \chi_h) &= (f, \chi_h) && \forall \chi_h \in W_h \\ \varepsilon^2 a_h(u_{h0}, v_h) + b_h(u_{h0}, v_h) &= (\nabla w_h, \nabla_h v_h) && \forall v_h \in V_{h0} \end{aligned}$$

- Decoupled the left hand side into four simple equations:

$$\begin{aligned} (\operatorname{curl}_h z_h, \operatorname{curl}_h v_h) &= (\nabla w_h, \nabla_h v_h) && \forall v_h \in V_{h0} \\ (\phi_h, \psi_h) + \varepsilon^2 (\nabla_h \phi_h, \nabla_h \psi_h) + (\operatorname{div}_h \psi_h, p_h) &= (\operatorname{curl}_h z_h, \psi_h) && \forall \psi_h \in V_{h0}^{CR} \\ (\operatorname{div}_h \phi_h, q_h) &= 0 && \forall q_h \in \mathcal{Q}_h \\ (\operatorname{curl}_h u_{h0}, \operatorname{curl}_h \chi_h) &= (\phi_h, \operatorname{curl}_h \chi_h) && \forall \chi_h \in V_{h0} \end{aligned}$$

实验结果

- Equations solved efficiently with the simplest elements.
- Final paper published in *Journal of Scientific Computing*.



h	#dofs	Eq.(5.1)	Eq.(5.7a)	Eq.(5.7b)-(5.7c)	Eq.(5.7d)
		steps	steps	steps	steps
2^{-1}	24	1	1	16	1
2^{-2}	112	1	4	27	3
2^{-3}	480	4	5	34	5
2^{-4}	1984	6	7	34	7
2^{-5}	8064	6	9	41	9
2^{-6}	32512	7	11	43	11
2^{-7}	130560	7	14	44	14
2^{-8}	523264	9	17	46	17
2^{-9}	2095104	9	20	50	21
2^{-10}	8384512	12	27	55	27

图: Robust iteration steps when solving

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研究背景

Existing methods

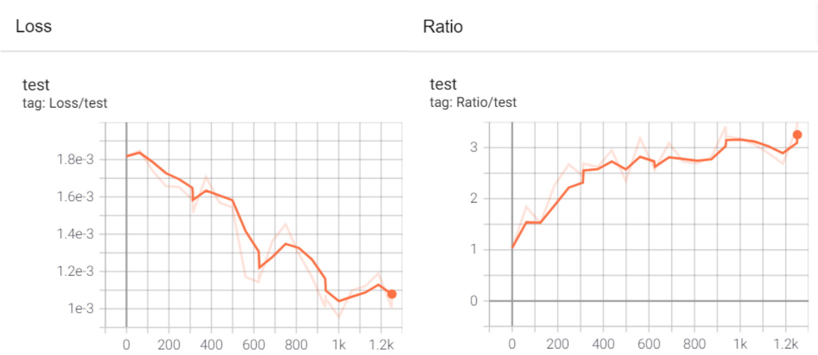
- Gradient based methods: gradient, dot product with embeddings, integrated gradient ...
- Perturbation based methods: input reduction, adversarial perturbations ...

Trying to explain the **relations between words** that model is learning during the training process.

$$
\begin{aligned}
Loss\left(x_1,\ldots,x_d\right) =& f\left(a_1,\ldots,a_d\right)+\sum_{j=1}^{d}\frac{\partial f\left(a_1,\ldots,a_d\right)}{\partial x_j}\left(x_j-a_j\right)\\
&+\frac{1}{2!}\sum_{j=1}^{d}\sum_{k=1}^{d}\frac{\partial^2 f\left(a_1,\ldots,a_d\right)}{\partial x_j\partial x_k}\left(x_j-a_j\right)\left(x_k-a_k\right)\\
&+\frac{1}{3!}\sum_{j=1}^{d}\sum_{k=1}^{d}\sum_{l=1}^{d}\frac{\partial^3 f\left(a_1,\ldots,a_d\right)}{\partial x_j\partial x_k\partial x_l}\left(x_j-a_j\right)\left(x_k-a_k\right)\left(x_l-a_l\right)+\cdots
\end{aligned}
$$

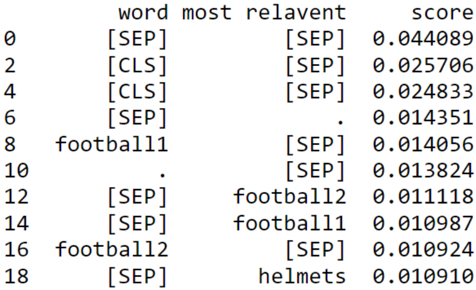
实验结果

- Model learning relations between ”essential” words?
- $\frac{\partial Loss}{\partial E_i E_j}$ durning training BERT-Base:



实验结果

- Sentences:
  1. Two young boys of opposing teams play football$_1$, while wearing full protection uniforms and helmets.
  2. Boys play football$_2$.

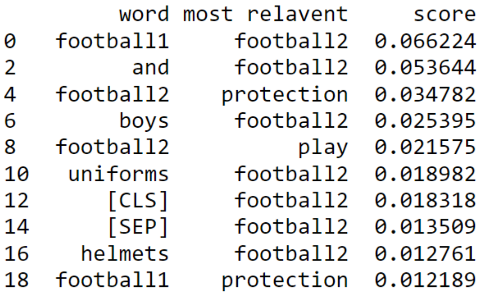


```
         word most relavent     score
0       [SEP]          [SEP]  0.044089
2       [CLS]          [SEP]  0.025706
4       [CLS]          [SEP]  0.024833
6       [SEP]              .  0.014351
8   football1          [SEP]  0.014056
10          .          [SEP]  0.013824
12      [SEP]      football2  0.011118
14      [SEP]      football1  0.010987
16  football2          [SEP]  0.010924
18      [SEP]        helmets  0.010910
```

图: At the beginning of training

实验结果

- Sentences:
  1. Two young boys of opposing teams play football$_1$, while wearing full protection uniforms and helmets.
  2. Boys play football$_2$.



```
             word most relavent     score
0    football1      football2  0.066224
2          and      football2  0.053644
4    football2     protection  0.034782
6         boys      football2  0.025395
8    football2           play  0.021575
10    uniforms      football2  0.018982
12       [CLS]      football2  0.018318
14       [SEP]      football2  0.013509
16     helmets      football2  0.012761
18   football1     protection  0.012189
```

图: Trained for 200 batches

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项目介绍

数据集介绍

- Used the Natural Questions (NQ) (**Kwiatkowski et al., 2019**) dataset from Google AI.
- Each example is comprised of a google query and a corresponding Wikipedia page.

主要方案

- Fine-tuning on SQuAD 2.0
- Mixed Precision Training
- Hard Negative Sampling
- Sifting candidates

实验结果

Model	Public F1	Private F1
Kaggle Best	0.713	0.717
BERT Base baseline	0.516	0.482
BERT Base (Hard Negative Sampling)	0.579	0.574
BERT Sifted* → ALBERT xlarge	**0.640**	**0.659**
Sifted → BERT Base+ALBERT$_{\text{(ensemble)}}$	0.665	0.666
Sifted → BERT Large+ALBERT$_{\text{(ensemble)}}$	**0.738**	**0.718**

* Sifted here stands for first using BERT base to sift candidates

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主要内容

数据集介绍

- Complaints from citizens. The task is to predict label (200 classes in total).

主要方案

- Pre-trained models on similar dataset THUCNews.
- Adopted **focal loss** for the long-tailed distributed labels.
- Designed a **auxiliary sentence pair task**.
- Also tried adversarial training, data augmentation, pesudo labels, adding other layers after BERT, using RoBERTa-wwm, ERNIE, etc.

Focal Loss

- The 200 labels are long-tailed distributed.
- Scaled losses according to how difficult the example is to predict.

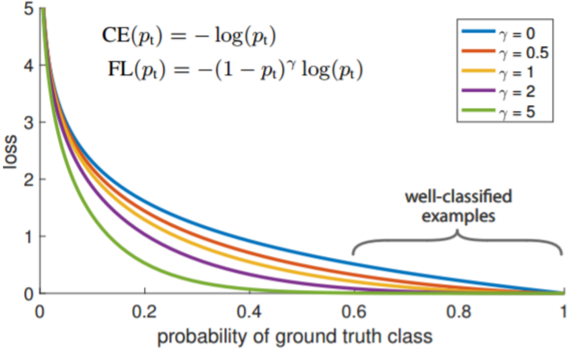
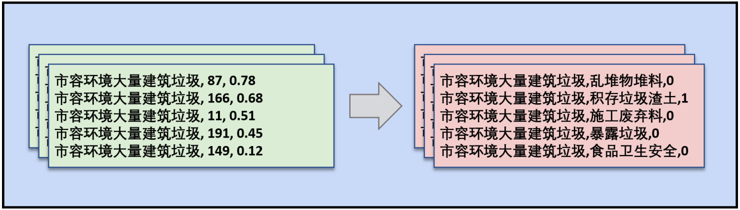


图: Different Loss Functions

辅助任务设计

- The original classification task failed to utilize information in the labels.
- An auxiliary sentence pair task is then designed.



市容环境大量建筑垃圾, 87, 0.78
市容环境大量建筑垃圾, 166, 0.68
市容环境大量建筑垃圾, 11, 0.51
市容环境大量建筑垃圾, 191, 0.45
市容环境大量建筑垃圾, 149, 0.12

市容环境大量建筑垃圾,乱堆物堆料,0
市容环境大量建筑垃圾,积存垃圾渣土,1
市容环境大量建筑垃圾,施工废弃料,0
市容环境大量建筑垃圾,暴露垃圾,0
市容环境大量建筑垃圾,食品卫生安全,0

图: Generating pair data

实验结果

- Highest score in class (led by 0.4%).

表: Selected Experiment Results

Model	Public score	Private score
ERNIE[1]	0.7981	0.8000
ERNIE[2]	0.7995	0.8030
ERNIE[3]	0.8049	0.8010

[1] Original Task: text classification

[2] Focal Loss

[3] Auxiliary Task: sentence pair classification

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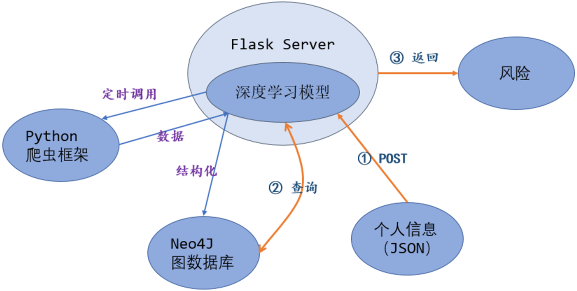
项目简介

- 与平安公司导师合作的应用型研究项目, 旨在帮助信贷面审人员快速识别申请人相关的潜在风险.
- 作为项目负责人, 每周组织组会学习分享实体识别, 关系抽取等知识图谱构建的关键技术.
- 使用 BERT 抽取最新资讯中涉及的风险事件, 并将风险标签与资讯文本共同输入 BERT-BiGRU, 进一步提升了实体识别任务的准确率.

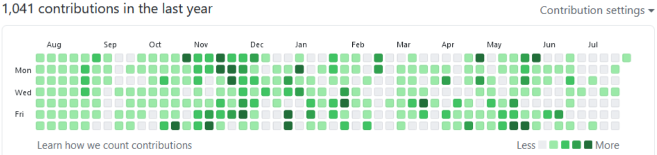
项目简介

- 完成了从数据的自动化爬取, 构建知识图谱到 Neo4j 图数据库存储和前端应用的完整流程.
- 被选为校“大学生创新创业计划”优秀项目, 并在学术论坛登台展示 (2%), 目前正进一步参加上海市相关竞赛.



总结

- 具有良好的数学基础和丰富 NLP 项目经验.
- 积极乐观热爱研究, 自学能力强能主动探索.
- 希望有机会能在中文信息处理实验室继续提升自己, 为中文文本的研究贡献力量.



1,041 contributions in the last year

Thanks for your attention!