LLM+RAG+Lora实战 实验指导书

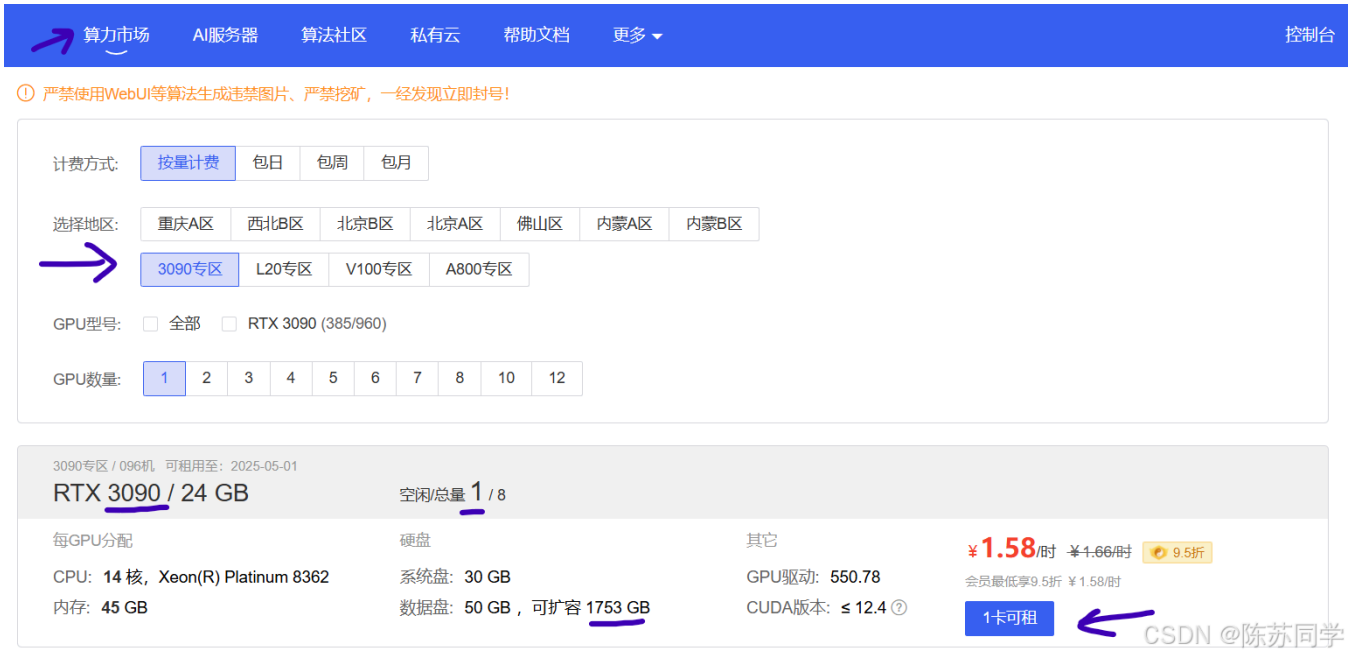
一、在 autodl 上租服务器

1.在AutoDL上注册账号

官网链接：https://www.autodl.com/

AutoDL是很常用的算力云，账号注册完成后，便可进入算力市场，挑选GPU。

2. 在算力市场选择GPU



- 对于本实验，选择30系列或40系列**24G以上显存**的GPU即可。
- 地区可自选，哪个地区有空闲GPU就选哪个地区。

3. 创建实例

选择 pytorch 2.3.0、cuda 12.1 的版本，如下图。

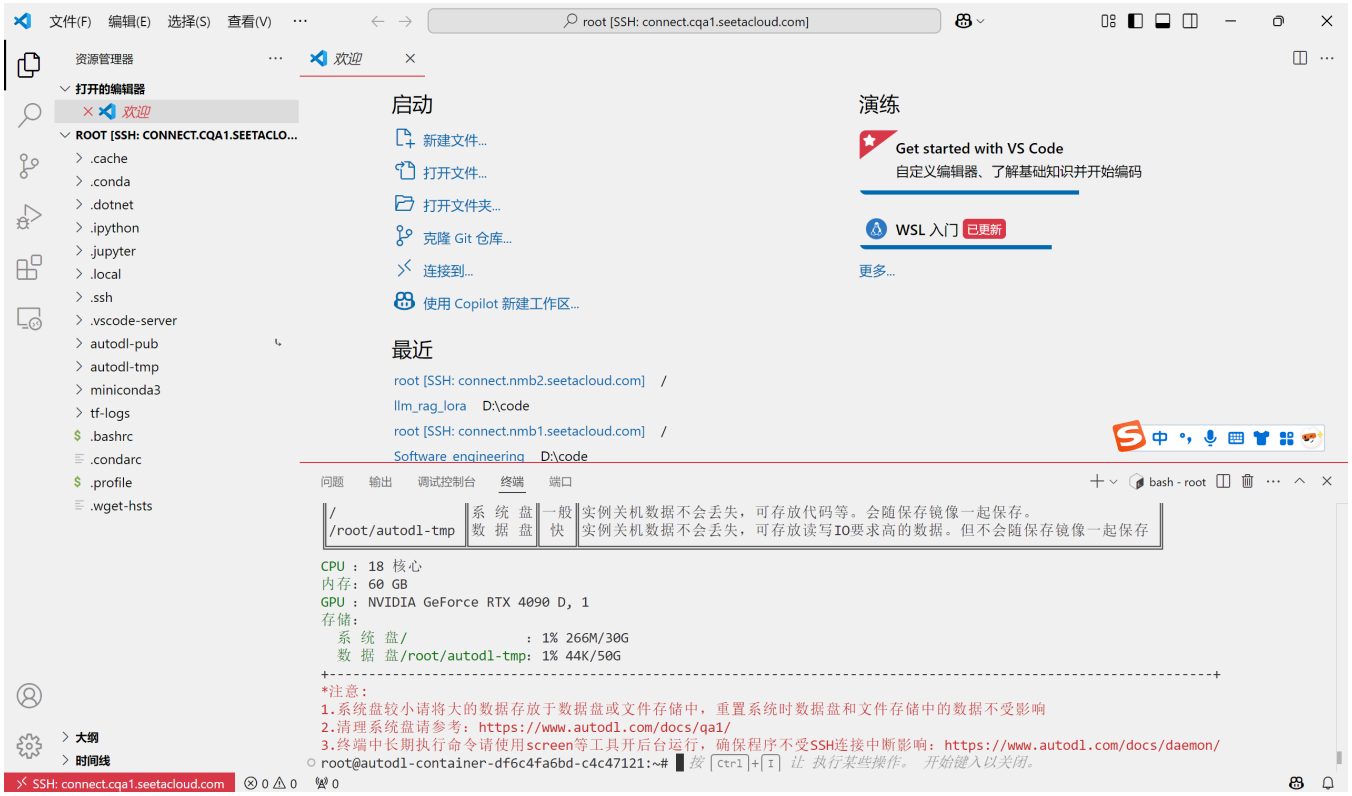
点击创建实例。

4. VSCode远程连接服务器

创建成功后服务器会自动开机，如下图

参考 该博客 完成VSCode远程连接服务器操作。我们的后续工作将在vscode中展开。

连接成功的界面：



关于autodl的更多内容可参考 该博客。

二、部署 Llama-3.1-8B 模型

1.环境配置

在终端运行：

```
 sudo apt update
sudo apt upgrade -y
sudo apt autoremove -y
```

更新过程中如果遇到下图所示的界面，选择 1 即可。

```
A new version (/tmp/tmp.DDnFLeOwwe) of configuration file /etc/ssh/sshd_config is available, but the version installed
currently has been locally modified.

  1. install the package maintainer's version            5. show a 3-way difference between available versions
  2. keep the local version currently installed          6. do a 3-way merge between available versions
  3. show the differences between the versions           7. start a new shell to examine the situation
  4. show a side-by-side difference between the versions
What do you want to do about modified configuration file sshd_config?
Progress: [ 96%] [#########################################################################################################################.....]
```

```
 # 升级pip
python -m pip install --upgrade pip

apt-get install -y wget curl git pciutils lshw  # 硬件检测工具

# conda 初始化
conda init bash
source ~/.bashrc

# 创建虚拟环境
conda create --name rag_lora python=3.12
# 查看已创建的虚拟环境
conda env list
# 切换到我们新创建的rag_lora环境
conda activate rag_lora
```

2. clone仓库

```
 # clone 仓库
git clone https://github.com/Hami-8/LLM-RAG-Lora.git
```

如果clone出现了因网络问题失败的情况，尝试以下方法：

```
 source /etc/network_turbo
git clone https://github.com/Hami-8/LLM-RAG-Lora.git
unset http_proxy && unset https_proxy
```

3. 安装依赖的包

```
 cd LLM-RAG-Lora
pip install -r requirements.txt
```

4. 下载模型

```
 cd Deploy-Llama-3
python model_download.py
```

我们提供了两种模型可供选择，分别是 Llama-3.1-8B-Instruct 和 DeepSeek-R1-Distill-Llama-8B。现在的代码默认下载Llama-3.1-8B-Instruct，如果你想要下载DeepSeek-R1-Distill-

Llama-8B，解掉对应代码的注释即可。

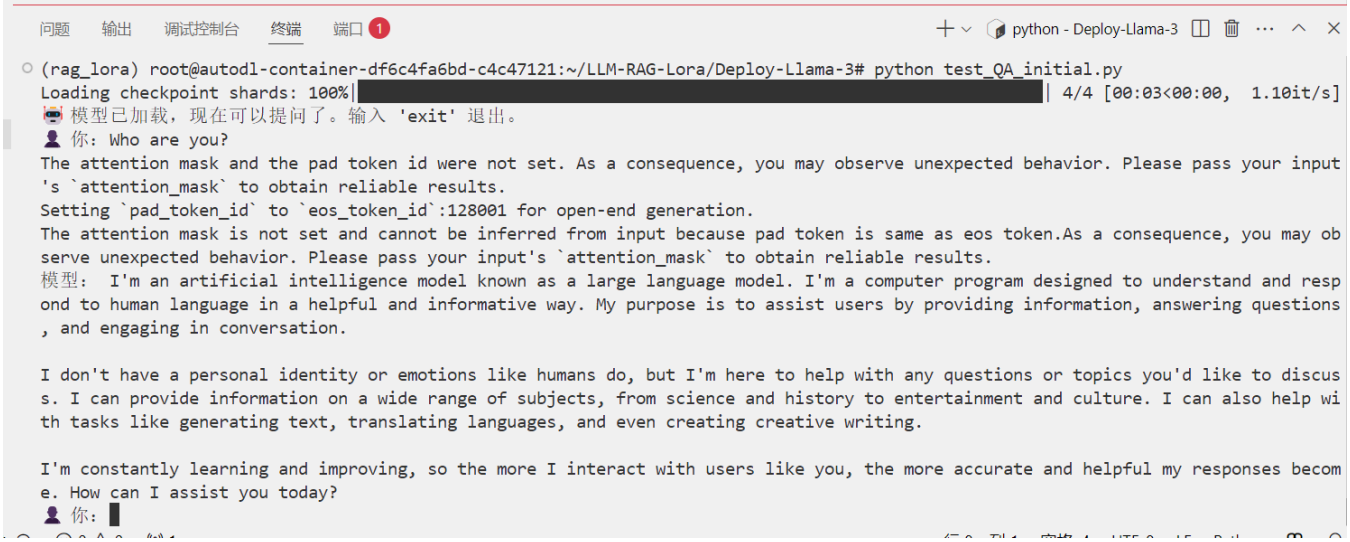
```
# model_download.py

import torch
from modelscope import snapshot_download, AutoModel, AutoTokenizer
import os

model_dir = snapshot_download('LLM-Research/Meta-Llama-3.1-8B-Instruct', cache_dir='/root/autodl-tm
model_dir_2 = snapshot_download('mirror013/mxbai-embed-large-v1', cache_dir='/root/autodl-tmp', rev

# 如果你想下载 DeepSeek-R1-Distill-Llama-8B，解掉下面代码的注释即可。
# 模型会下载到/root/autodl-tmp/deepseek-ai/DeepSeek-R1-Distill-Llama-8B 文件夹下
# model_dir_3 = snapshot_download('deepseek-ai/DeepSeek-R1-Distill-Llama-8B', cache_dir='/root/auto
```

5. 测试

进行交互式问答测试，输入exit退出交互式问答。

```
python test_QA_initial.py
```

运行效果如图：



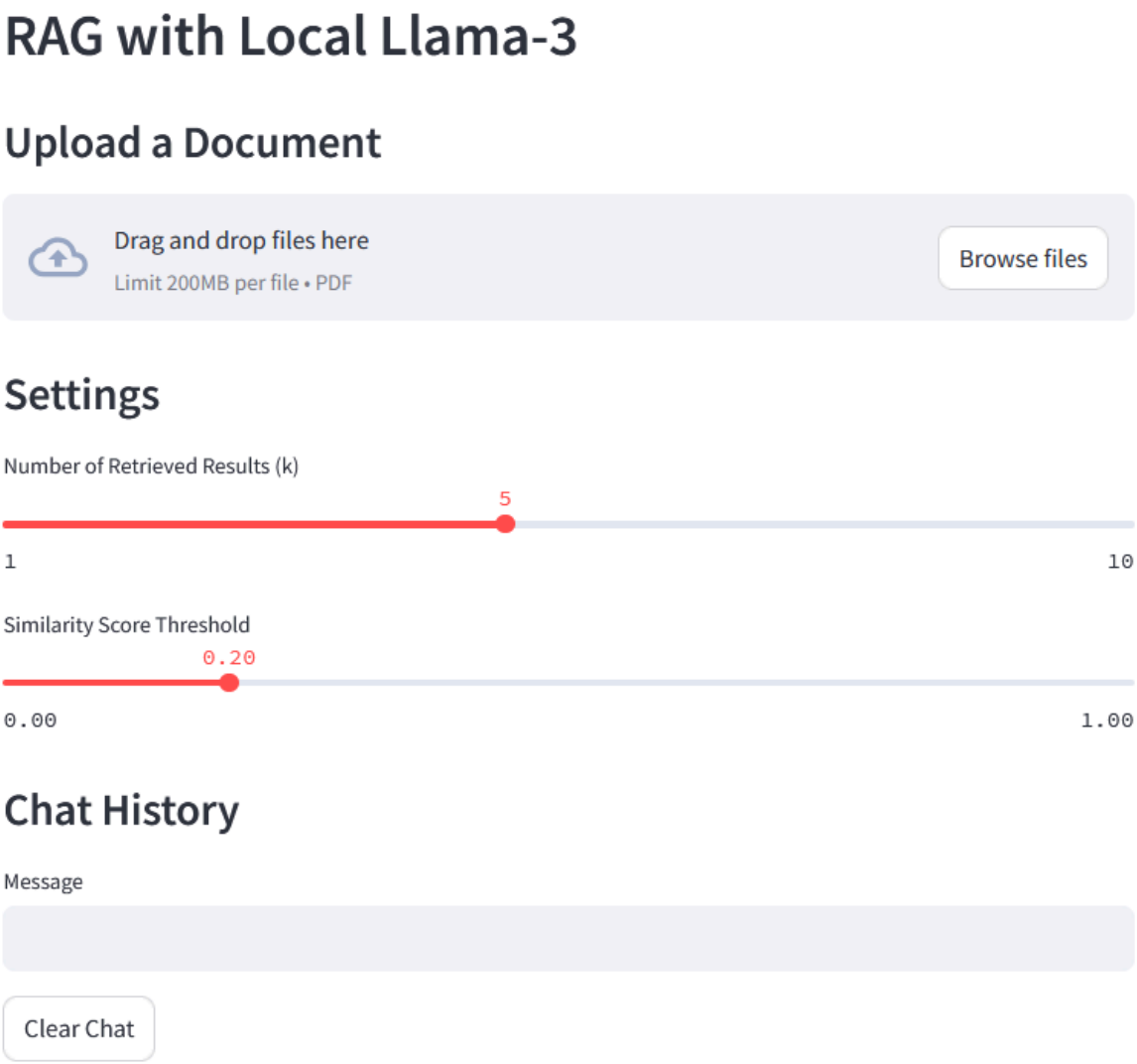
三、构建RAG

RAG项目参考 该仓库 进行改进。

通过streamlit打开网页进行交互，在网页上可上传PDF作为RAG的内容，所用命令如下。

```
 cd ../RAG-Llama-3
streamlit run app.py
```

网页如下图：



不用RAG的结果

比如我们问模型一个问题 : What is the GRPO?

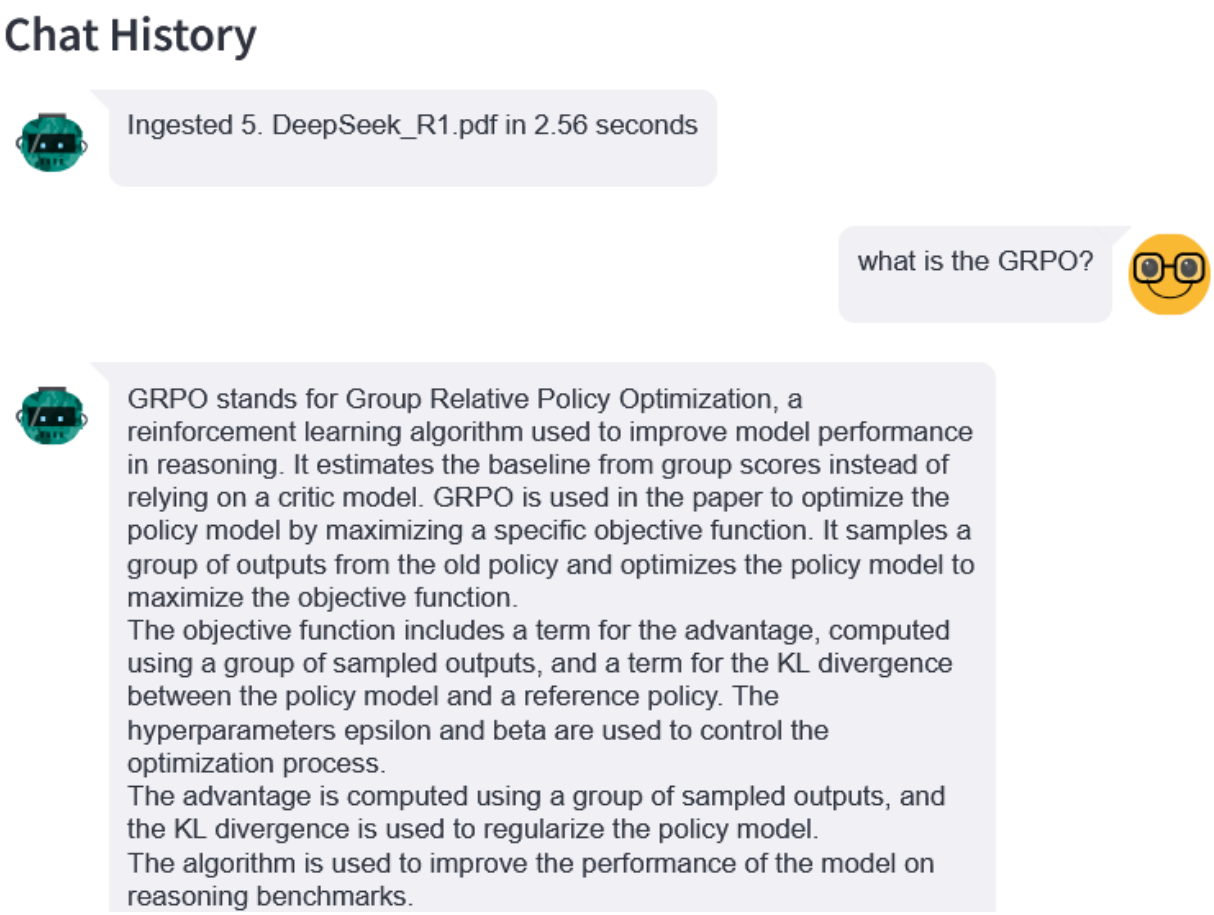
我们知道 GRPO的全称为Group Relative Policy Optimization，是DeepSeek-R1核心强化学习算法。

在不用RAG时，可以看到模型回答的完全不沾边。

```
(rag_lora) root@autodl-container-df6c4fa6bd-c4c47121:~/LLM-RAG-Lora/Deploy-Llama-3# python test_QA_initial.py
Loading checkpoint shards: 100%|████████████████████████████████████████████████| 4/4 [00:02<00:00,  1.34it/s]
🤖 模型已加载，现在可以提问了。输入 'exit' 退出。
👤 你：what is the GRPO?
The attention mask and the pad token id were not set. As a consequence, you may observe unexpected behavior. Please pass your input
's `attention_mask` to obtain reliable results.
Setting `pad_token_id` to `eos_token_id`:128001 for open-end generation.
The attention mask is not set and cannot be inferred from input because pad token is same as eos token.As a consequence, you may ob
serve unexpected behavior. Please pass your input's `attention_mask` to obtain reliable results.
模型：  The GRPO stands for the General Register of Personal Data Processors. However, it is more commonly known as the General Regi
ster of Personal Data Processors, but more specifically it is the General Register of Personal Data Processors in the context of th
e UK's Data Protection Act 2018.
👤 你：exit
👋 再见！
```

用RAG的结果

我们把deepseek-r1的技术论文传到RAG中，再对它进行提问，可以看到他基本回答正确。



四、Lora微调

Lora项目参考 该仓库 进行改进。

训练

```
 cd ../Lora-Llama-3
python train.py
```

训练出的Lora参数会保存在 llm_rag_lora/Lora-Llama-3/output/llama3_1_instruct_lora 中。

测试

三种测试文件

- test_QA_initial.py 不附加Lora的交互式问答测试。
- test_QA.py 附加Lora的交互式问答测试。
- test.py 附加Lora的非交互式测试。

```
python test_QA.py
```

导出

我们可以把 LoRA 权重 合并进基座模型，导出为一个新的 HuggingFace-格式模型目录。在 Lora-Llama-3 中运行：

```
python merge_lora.py
```

即可将训练后的 LoRA 权重 合并进基座模型，导出的模型
在 `/root/autodl-tmp/LLM-Research/Meta-Llama-3___1-8B-Instruct_Lora` 文件夹中。

五、Lora with RAG

进行完上一步 合并Lora权重进基座模型后，我们就可以构建 Lora with RAG 了，只需修改 `./RAG-Llama-3/rag.py` ：

```
 # ./RAG-Llama-3/rag.py
- llm_path: str = "/root/autodl-tmp/LLM-Research/Meta-Llama-3___1-8B-Instruct",
+ llm_path: str = "/root/autodl-tmp/LLM-Research/Meta-Llama-3___1-8B-Instruct_Lora",
```