Lab2 Part1实验文档

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**一、代码结构**

初始化：self.A 为(status\_num, status\_num)大小的状态转移矩阵，self.B为(status\_num，10)大小的发射矩阵，self.PI则是大小为(self.status\_num)的初始状态矩阵。A与B进行随机生成并保证标准化，PI的初始化则是假定了每个状态作为初始的概率一致，即1/status\_num

训练：首先根据观察序列计算forward概率alpha与backward概率beta，接着根据ppt上的公式计算A[i][j]、PI[i]、B[i][j]每个调整的数值，但是不是立刻调整，而是将每个要调整的值加总，在遍历完10000个观察序列后同意更新为平均值，因为如果不用batch就会无法训练出。但是如果单纯根据ppt上的公式对矩阵元素一个一个计算的话会太慢，因此通过对网络上代码的学习进行了矩阵计算的优化：本次lab矩阵计算应用的难点在于它并不像BP算法那样容易得出，而是需要借助一些中间量进行。例如通过forward计算中得到的c矩阵辅助beta的计算过程等等

生成10个最优序列：由于不会bean search，因此最终采取了遍历10^7种不同序列并比较其可能性，保留出现概率最大的前10个。

**二、最终产生的10个序列结果**

尽管模型状态数不同，但产生的序列的概率还是有一定的共性：如大多以3开头、出现3、9、0的次数较多等等

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 3333333 | 3339999 | 3333999 | 3323939 | 3339099 | 3399999 | 3333939 | 3333339 | 3339399 | 3332909 |

**三、模型参数**

我通过调参尝试，在5个隐状态、6个隐状态、8个隐状态与10个隐状态下分别做了尝试。保存下来的模型参数分别如下图所示：

1. status\_num = 6

Initial State Possibility

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1 | 2 | 3 | 4 | 5 | 6 |
| 0.01455175 | 0.21830628 | 0.0083224 | 0.31749309 | 0.27599712 | 0.16532935 |

Status change Possibility

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | 6 |
| 1 | 0.24043968 | 0.05310128 | 0.31218969 | 0.0034858 | 0.09746732 | 0.29331624 |
| 2 | 0.22327848 | 0.05886085 | 0.40036035 | 0.1124876 | 0.16860713 | 0.03640559 |
| 3 | 0.38145648 | 0.25599879 | 0.29596434 | 0.02871719 | 0.02007793 | 0.01778527 |
| 4 | 0.0790263 | 0.08110318 | 0.27696974 | 0.2662748 | 0.08320492 | 0.21342105 |
| 5 | 0.24033665 | 0.04105144 | 0.27127613 | 0.22766791 | 0.18906398 | 0.03060389 |
| 6 | 0.09419794 | 0.01194674 | 0.22152533 | 0.3451825 | 0.10629455 | 0.22085294 |

Emission Possibility

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 数字\状态 | 1 | 2 | 3 | 4 | 5 | 6 |
| 0 | 0.02349889 | 0.15131543 | 0.20044194 | 0.18565398 | 0.04806408 | 0.01268524 |
| 1 | 0.13619457 | 0.0372575 | 0.0414358 | 0.01058826 | 0.0161064 | 0.18668627 |
| 2 | 0.08458801 | 0.18318592 | 0.05585622 | 0.15779394 | 0.053885 | 0.20382301 |
| 3 | 0.13864665 | 0.08553189 | 0.07127905 | 0.25698002 | 0.16175119 | 0.02334879 |
| 4 | 0.04579063 | 0.03769872 | 0.19662321 | 0.00322938 | 0.11265076 | 0.03958196 |
| 5 | 0.13336945 | 0.10610831 | 0.04385369 | 0.17253113 | 0.04943031 | 0.07351512 |
| 6 | 0.14647477 | 0.14186353 | 0.03476586 | 0.05544677 | 0.26082206 | 0.08822737 |
| 7 | 0.13333058 | 0.10574135 | 0.03641779 | 0.07964423 | 0.17648976 | 0.15861551 |
| 8 | 0.09206554 | 0.1077609 | 0.06855135 | 0.01668027 | 0.07061691 | 0.12174972 |
| 9 | 0.06609252 | 0.04362109 | 0.25081452 | 0.06151049 | 0.05026494 | 0.0918381 |

2. status\_num = 8

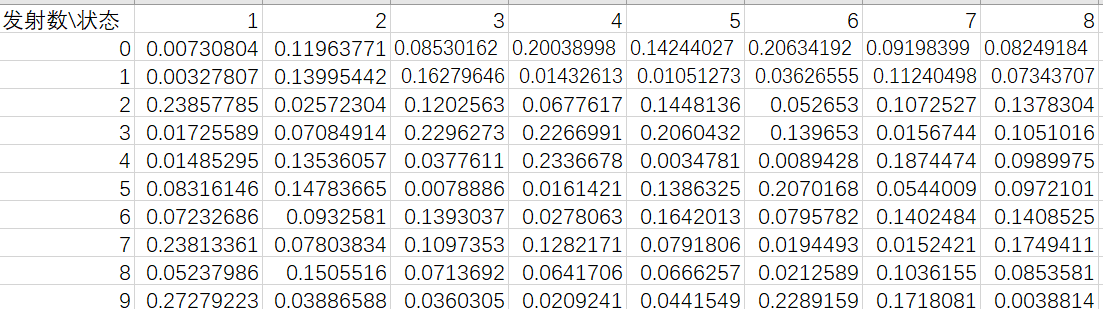
Initial State Possibility

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 0.08896672 | 0.00444292 | 0.09692621 | 0.02679784 | 0.38356568 | 0.05101121 | 0.01478506 | 0.33350437 |

Status change Possibility

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 现/下 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1 | 0.13464318 | 0.13278265 | 0.15456365 | 0.0638232 | 0.15283285 | 0.12604955 | 0.23155709 | 0.00374782 |
| 2 | 0.32202666 | 0.12702189 | 0.12466485 | 0.06083788 | 0.03503425 | 0.0315521 | 0.29848384 | 0.00037853 |
| 3 | 0.14652331 | 0.07631105 | 0.29626608 | 0.0925898 | 0.01801796 | 0.08475039 | 0.18373114 | 0.10181026 |
| 4 | 0.07528157 | 0.25798857 | 0.12635367 | 0.00382172 | 0.15289487 | 0.21279542 | 0.15924937 | 0.0116148 |
| 5 | 0.08686915 | 0.05389442 | 0.0854214 | 0.19083452 | 0.02829952 | 0.35451579 | 0.18565649 | 0.01450872 |
| 6 | 0.23709413 | 0.21998174 | 0.18758689 | 0.13429304 | 0.01544038 | 0.06712746 | 0.01227029 | 0.12620609 |
| 7 | 0.07035722 | 0.35369926 | 0.0758687 | 0.11619167 | 0.09182277 | 0.21070112 | 0.06712453 | 0.01423473 |
| 8 | 0.18967173 | 0.03312421 | 0.12312253 | 0.1848388 | 0.14833417 | 0.10685205 | 0.00120242 | 0.21285408 |

Emission Possibility



3. status\_num = 5

Initial State Possibility

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1 | 2 | 3 | 4 | 5 |
| 0.00779577 | 0.66937312 | 0.07275952 | 0.05854137 | 0.19153022 |

Status change Possibility

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Current/Next | 1 | 2 | 3 | 4 | 5 |
| 1 | 0.35872904 | 0.0968516 | 0.30383235 | 0.11809396 | 0.12249306 |
| 2 | 0.25362771 | 0.25534253 | 0.05726051 | 0.26436346 | 0.16940578 |
| 3 | 0.30413851 | 0.05227767 | 0.31894704 | 0.1211015 | 0.20353529 |
| 4 | 0.23115582 | 0.09748873 | 0.40531454 | 0.17697317 | 0.08906773 |
| 5 | 0.33907024 | 0.29440229 | 0.13799562 | 0.19032787 | 0.03820398 |

Emission Possibility

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 发射数字/状态 | 1 | 2 | 3 | 4 | 5 |
| 0 | 0.20221207 | 0.13852408 | 0.01958633 | 0.12835303 | 0.0325672 |
| 1 | 0.05149616 | 0.0422138 | 0.15060033 | 0.07858449 | 0.02583609 |
| 2 | 0.05232911 | 0.12913005 | 0.14189555 | 0.0765816 | 0.20421545 |
| 3 | 0.05290862 | 0.16882859 | 0.10018426 | 0.22555359 | 0.09107008 |
| 4 | 0.19438882 | 0.03875061 | 0.01794997 | 0.04558248 | 0.09341027 |
| 5 | 0.08366691 | 0.1267587 | 0.10953865 | 0.10514689 | 0.03399325 |
| 6 | 0.06113554 | 0.15298265 | 0.15218869 | 0.06399203 | 0.10165627 |
| 7 | 0.02303621 | 0.1299296 | 0.15911878 | 0.13694291 | 0.09716485 |
| 8 | 0.08516318 | 0.06813776 | 0.11878538 | 0.01863412 | 0.07506758 |
| 9 | 0.19370223 | 0.00478797 | 0.0301985 | 0.12069234 | 0.24508955 |