*编译与运行

- 如果你没有 `Qpro` 命令工具, 运行: `pip3 install Qpro` 来安装它
- 使用以下命令来编译运行:

  ```
  cd Banker
  run -br -i
  ```

  程序将会被编译, 并使用 `dist/input.txt` 作为输入来运行.

- 你可以在Qpro查看关于Qpro的各种使用方法.

什么是银行家算法?

- 银行家算法是一个简单用于处理死锁的算法, 它的思路很简单,
- 如果当前资源能被某一进程分配出去, 则分配.
- 如果有进程结束则回收资源, 如此反复直到所有进程结束.

如何模拟实现?(模拟PPT上样例)

- 首先创建相应的矩阵和向量存储当前资源和进程状态.
- 创建5个线程模拟进程请求资源

  ```
  #define NUM_CUSTOMERS 5
  #define NUM_RESOURCES 3
  pthread_attr_init(&attr);
  pthread_mutex_init(&mutex, NULL);
  for (int i=0;i<NUM_CUSTOMERS;++i)pthread_create(&tid[i], &attr, Banker, (void*)i);
  for (int i=0;i<NUM_CUSTOMERS;++i)pthread_join(tid[i], NULL);
  ```

- 按照银行家算法的策略分配资源, 并在进程结束后回收资源

  ```
  void* Banker(void* Pid){
      int pid = (int)Pid;
      bool wait = true;
      while (finish[pid] == 0){
          while (wait){
              wait = false;
              for (int i=0; i < NUM_RESOURCES; ++i){
                  int need = max_need[pid][i] - curr[pid][i];
  ```

```
                if (need > avail[i])wait = true;
            }
        }
        pthread_mutex_lock(&mutex);
        printf("\nProcess p%d is allocated with: ", pid+1);
        for (int i=0; i < NUM_RESOURCES; ++i){
            int need = max_need[pid][i] - curr[pid][i];
            printf("%d ", need);
            curr[pid][i] += need;
            avail[i] -= need;
        }
        finish[pid] = 1;
        for (int i=0; i < NUM_RESOURCES; ++i)if (max_need[pid][i] !=
curr[pid][i])finish[pid] = 0;
        if (finish[pid] == 1){
            printf("\np%d has done!\n", pid+1);
            for (int i=0; i < NUM_RESOURCES; ++i){
                avail[i] += curr[pid][i];
                curr[pid][i] = 0;
                max_need[pid][i] = 0;
            }
        }
        cur_state();
        pthread_mutex_unlock(&mutex);
    }
    pthread_exit(0);
}
```

- 每一进程开始前, 打印当前资源分配状态:

```
void cur_state(){
    puts("\n---------------------------------");
    printf("Current available resources: ");
    for (int i=0;i<NUM_RESOURCES;++i) printf("%d%c", avail[i],
i==NUM_RESOURCES-1?'\n':' ');
    puts("\nCurrent max_need table:");
    for (int i=0;i<NUM_CUSTOMERS;++i)for (int
j=0;j<NUM_RESOURCES;++j)printf("%d%c", max_need[i][j],j==NUM_RESOURCES-
1?'\n':'\t');
    puts("\nCurrent allocation table:");
    for (int i=0;i<NUM_CUSTOMERS;++i){
        printf("p%d\t", i+1);
        for (int j=0;j<NUM_RESOURCES;++j)printf("%d%c", curr[i][j],
j==NUM_RESOURCES-1?'\n':'\t');
    }
    puts("\nCurrent need table:");
    for (int i=0;i<NUM_CUSTOMERS;++i){
        printf("p%d\t", i+1);
        for (int j=0;j<NUM_RESOURCES;++j)printf("%d%c", max_need[i][j] - curr[i][j], j==NUM_RESOURCES-1?'\n':'\t');
    }
}
```

输入数据:

- `dist/input.txt`:

```
10 5 7
3 3 2
0 1 0
2 0 0
3 0 2
2 1 1
0 0 2
7 5 3
3 2 2
9 0 2
2 2 2
4 3 3
```

程序输出

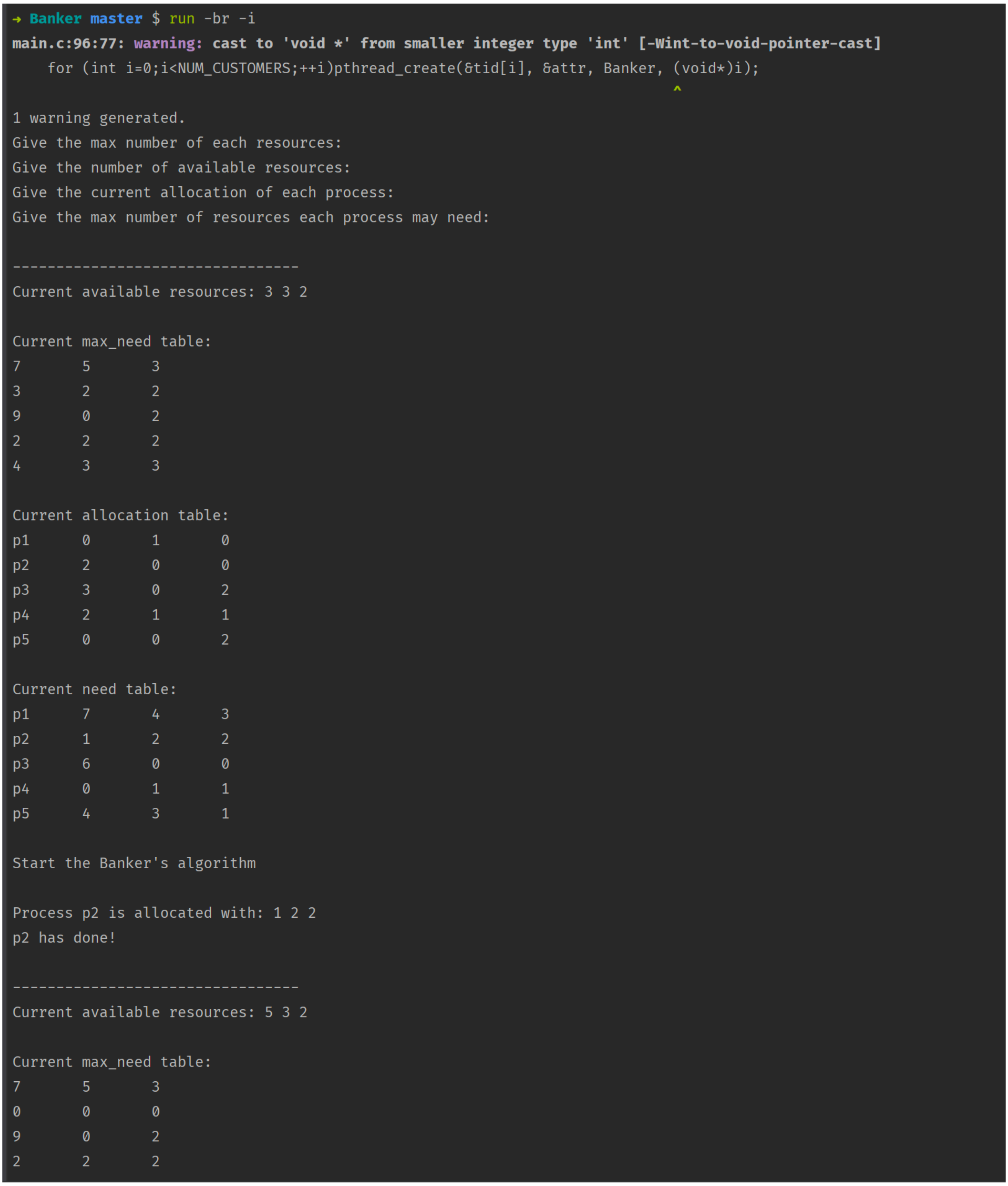
```
Give the max number of each resources:
Give the number of available resources:
Give the current allocation of each process:
Give the max number of resources each process may need:

---------------------------------
Current available resources: 3 3 2

Current max_need table:
7 5 3
3 2 2
9 0 2
2 2 2
4 3 3

Current allocation table:
p1  0 1 0
p2  2 0 0
p3  3 0 2
```

```
p4  2 1 1
p5  0 0 2

Current need table:
p1  7 4 3
p2  1 2 2
p3  6 0 0
p4  0 1 1
p5  4 3 1

Start the Banker's algorithm

Process p4 is allocated with: 0 1 1
p4 has done!

---------------------------------
Current available resources: 5 4 3

Current max_need table:
7 5 3
3 2 2
9 0 2
0 0 0
4 3 3

Current allocation table:
p1  0 1 0
p2  2 0 0
p3  3 0 2
p4  0 0 0
p5  0 0 2

Current need table:
p1  7 4 3
p2  1 2 2
p3  6 0 0
p4  0 0 0
p5  4 3 1

Process p5 is allocated with: 4 3 1
p5 has done!

---------------------------------
Current available resources: 5 4 5

Current max_need table:
7 5 3
3 2 2
9 0 2
```

```
0 0 0
0 0 0

Current allocation table:
p1  0 1 0
p2  2 0 0
p3  3 0 2
p4  0 0 0
p5  0 0 0

Current need table:
p1  7 4 3
p2  1 2 2
p3  6 0 0
p4  0 0 0
p5  0 0 0

Process p2 is allocated with: 1 2 2
p2 has done!

---------------------------------
Current available resources: 7 4 5

Current max_need table:
7 5 3
0 0 0
9 0 2
0 0 0
0 0 0

Current allocation table:
p1  0 1 0
p2  0 0 0
p3  3 0 2
p4  0 0 0
p5  0 0 0

Current need table:
p1  7 4 3
p2  0 0 0
p3  6 0 0
p4  0 0 0
p5  0 0 0

Process p3 is allocated with: 6 0 0
p3 has done!

---------------------------------
Current available resources: 10 4 7
Current max_need table:
7 5 3
0 0 0
0 0 0
0 0 0
0 0 0

Current allocation table:
p1  0 1 0
p2  0 0 0
p3  0 0 0
p4  0 0 0
p5  0 0 0

Current need table:
p1  7 4 3
p2  0 0 0
p3  0 0 0
p4  0 0 0
p5  0 0 0

Process p1 is allocated with: 7 4 3
p1 has done!

---------------------------------
Current available resources: 10 5 7

Current max_need table:
0 0 0
0 0 0
0 0 0
0 0 0
0 0 0

Current allocation table:
p1  0 0 0
p2  0 0 0
p3  0 0 0
p4  0 0 0
p5  0 0 0

Current need table:
p1  0 0 0
p2  0 0 0
p3  0 0 0
p4  0 0 0
p5  0 0 0
```

```
All processes have finished
```

运行截图:



```
➜ Banker master $ run -br -i
main.c:96:77: warning: cast to 'void *' from smaller integer type 'int' [-Wint-to-void-pointer-cast]
    for (int i=0;i<NUM_CUSTOMERS;++i)pthread_create(&tid[i], &attr, Banker, (void*)i);
                                                                            ^

1 warning generated.
Give the max number of each resources:
Give the number of available resources:
Give the current allocation of each process:
Give the max number of resources each process may need:

---------------------------------
Current available resources: 3 3 2

Current max_need table:
7       5       3
3       2       2
9       0       2
2       2       2
4       3       3

Current allocation table:
p1      0       1       0
p2      2       0       0
p3      3       0       2
p4      2       1       1
p5      0       0       2

Current need table:
p1      7       4       3
p2      1       2       2
p3      6       0       0
p4      0       1       1
p5      4       3       1

Start the Banker's algorithm

Process p2 is allocated with: 1 2 2
p2 has done!

---------------------------------
Current available resources: 5 3 2

Current max_need table:
7       5       3
0       0       0
9       0       2
2       2       2
```

感想:

通过本次实验我理解了银行家算法的具体实现, 和大致流程.