# Bankers Algorithm

## Part 1. Will the restaurant be able to feed all parties?

### Solution:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Process** | **Allocation** | | **Max** | | **Available** | | **Need** | |
| Plates | Bowls | Plates | Bowls | Plates | Bowls | Plates | Bowls |
| P1 | 2 | 3 | 7 | 7 | 3 | 4 | 5 | 4 |
| P2 | 3 | 5 | 6 | 10 | 3 | 4 | 3 | 5 |
| P3 | 0 | 1 | 1 | 2 | 2 | 1 | 1 | 1 |
| P4 | 1 | 2 | 2 | 4 | 2 | 2 | 1 | 2 |

Step 0: We have 2 plates and 1 bowl.

Step 1: Check if we can serve P1, we cannot.

Step 2: Check if we can serve P2, we cannot.

Step 3: Check if we can serve P3, we can, now we have 2 plates and 2 bowls.

Step 4: Check if we can serve P4, we can, now we have 3 plates and 4 bowls.

Step 5: Check if we can serve P1 we cannot.

Step 6: Check if we can serve P2, we cannot.

Step 7: We give up on serving the parties, because it is impossible.

### Proof:

Claim: We cannot feed all the parties in the restaurant.

If there are no parties requesting resources from each other, all parties will be served.

Proof: By Banker’s algorithm.

We cannot serve P1 and P2, thus we start by serving party P3 with a single plate from our available plates. After P3 finishes eating and starts waiting for the waiter to request the next course, one plate and one bowl become available and are added to the available plates and bowls.

The next party we can serve is P4, after serving this party with one plate and two bowls, the party finishes eating, goes into waiting state and frees up two plates and four bowls.

Now, parties P1 and P2 are the only ones that have yet to be served. P1 requires five plates and four bowls, but we only have three plates available, thus we cannot serve P1. P2 requires three plates and five bowls. However, we only have four bowls available and cannot serve P4. Therefore, we cannot serve all parties in the restaurant.

Q.E.D., we have thus showed that not all parties in the restaurant can be fed, since we do not have enough plates or bowls to serve the last two parties, P1 and P2.

## Part 2. The unexpected party arrives

### Solution:

In part 1 we had 8 total plates and 12 total bowls. Our waiter handed out plates and bowls for the parties, leaving 2 plates and 1 bowl in the kitchen. But now, when the infamous party 5 has arrived, he gave away the last 2 plates. Now no one can be served without buying more plates. We need at least 1 plate to begin serving a party, so we begin at that.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Process** | **Allocation** | | **Max** | | **Available** | | **Need** | |
| Plates | Bowls | Plates | Bowls | Plates | Bowls | Plates | Bowls |
| P1 | 2 | 3 | 7 | 7 | 5 | 4 | 5 | 4 |
| P2 | 3 | 5 | 6 | 10 | 7 | 7 | 3 | 5 |
| P3 | 0 | 1 | 1 | 2 | 1 | 1 | 1 | 1 |
| P4 | 1 | 2 | 2 | 4 | 1 | 2 | 1 | 2 |
| P5 | 2 | 0 | 5 | 3 | 3 | 4 | 3 | 3 |

Step 0: We have 0 plate and 1 bowl.

Step 0.25: No parties can be served!

Step 0.5: We visit IKEA and buy a plate, now we have 1 plate and 1 bowl.

Step 1: Check if we can serve P1, we cannot.

Step 2: Check if we can serve P2, we cannot.

Step 3: Check if we can serve P3, we can, now we have 1 plate and 2 bowls.

Step 4: Check if we can serve P4, we can, now we have 2 plates and 4 bowls.

Step 6: Check if we can serve P5, we cannot.

Step 5: Check if we can serve P1 we cannot.

Step 6: Check if we can serve P2, we cannot.

Step 7: No parties can be served!

Step 7.5: We visit IKEA and buy 1 additional plate, now we have 3 plates and 4 bowls.

Step 8: Check if we can serve P5, we can, now we have 5 plates and 4 bowls.

Step 9: Check if we can serve P1, we can, now we have 7 plates and 7 bowls.

Step 10: Check if we can serve P2, we can, now we have 10 plates and 12 bowls.

Step 11: Celebrate, since we finished a difficult shift, all parties are served.

### Proof:

Claim: We can serve all 5 parties in the restaurant with 2 additional plates for a total of 10 plates and 12 bowls.

Proof: By Banker’s algorithm.

We start by adding two additional plates to our available plates, resulting in 2 dishes and 1 bowl available at the start.

Now we serve party P3, this frees 1 bowl, resulting in 2 plates and 2 bowls being available.

Next step is to serve P5, after they finish eating, we have 3 plates and 4 bowls available to the other parties.

Serving P5 next, results in 5 plates and 4 bowls being available after that party finishes dining.

P1 is served second to last, and after they have finished eating have 7 plates and 7 bowls available to the last party, P2.

P2 can now eat, resulting in all dinner parties being fed.

Q.E.D., we have now shown that all five parties in the restaurant can be fed by adding two additional plates to the restaurant’s plates, for a total of 10 plates and 12 bowls.