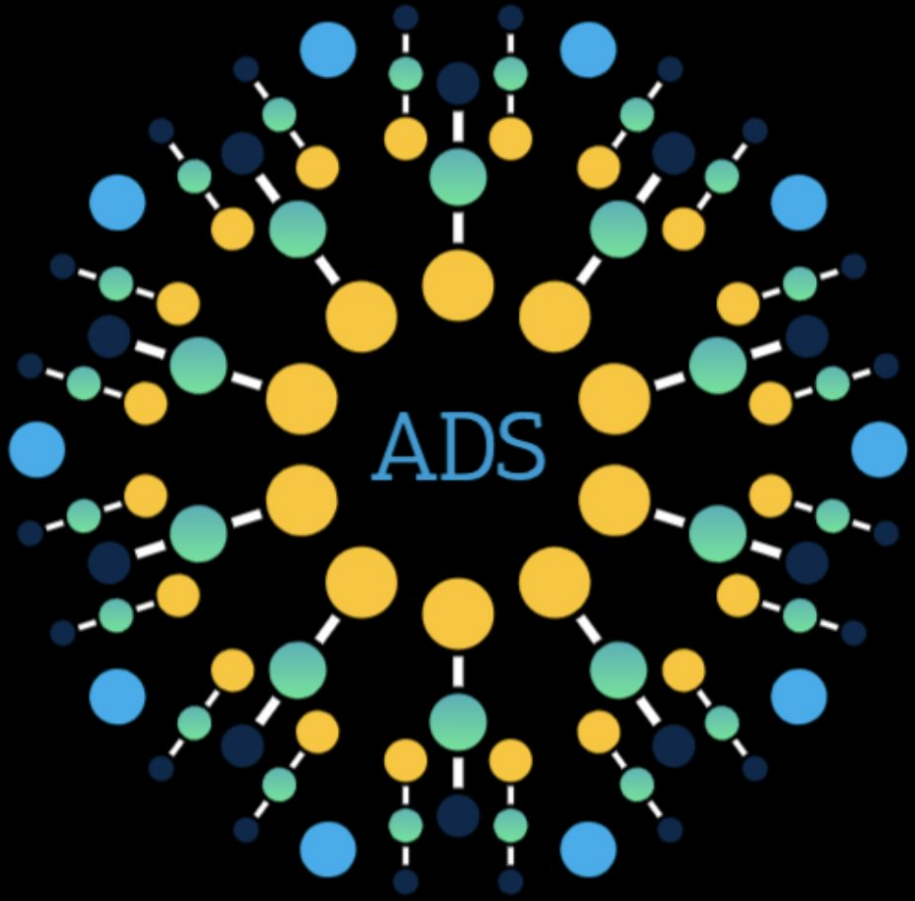

ADS

DrexelADS

Tech talk

What’s this about?

1. Cake cutting
2. Sorting/searching algorithms

The cake cutting problem

The cake : Heterogeneous, divisible resource

Fair division

From Wikipedia, the free encyclopedia

Fair division is the problem of dividing a set of resources among several people who have an entitlement to them, such that each person receives their due share.

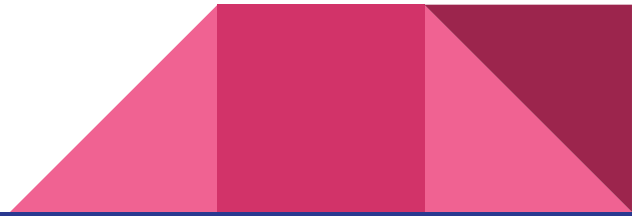
Fairness

Envy-free: Each person feels that their piece is *at least as good as* the others' pieces

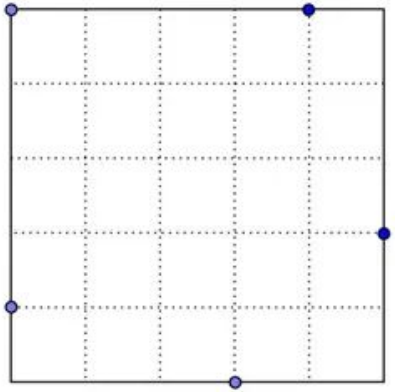
Proportional: Each person feels that their piece is 1/N of the cake

Equitable: Each view their piece the same as everyone else views their piece

Efficient: There are no other division that dominates this one for all players

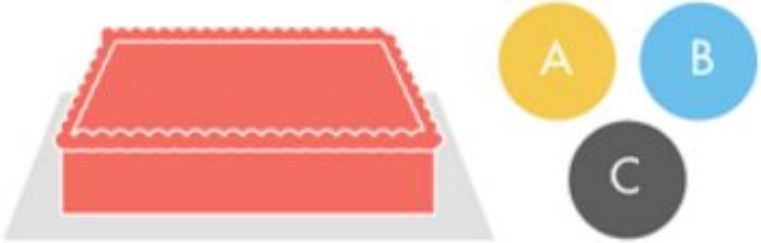


Dividing a cake among 2 people

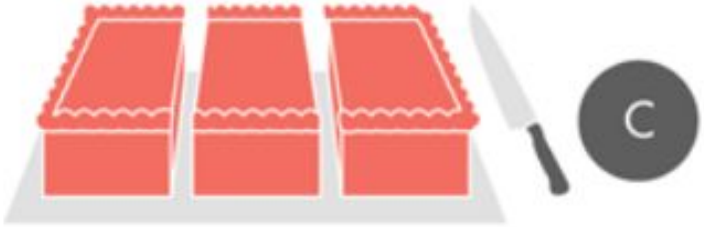


“I cut, you choose”

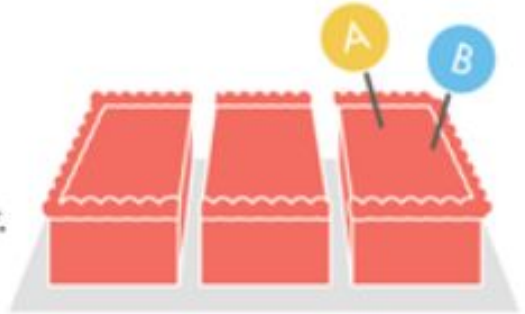
1. Alice, Bob and Charlie want to share a cake so that none of them envies other pieces.



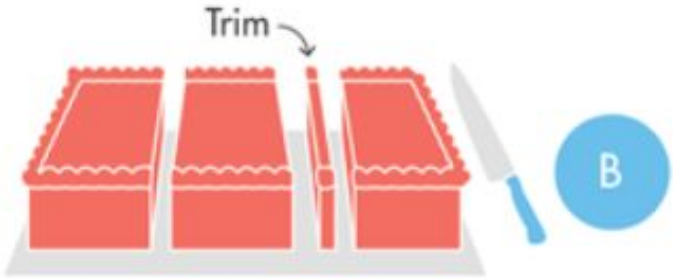
2. Charlie cuts the cake into three pieces that are equally valuable from his perspective.



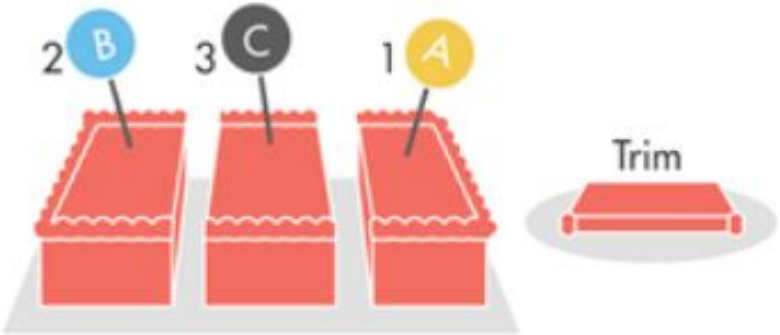
3 Alice and Bob identify their first choices.
If they identify the same choice, things get tricky.



4 Bob trims his preferred piece to match his second most preferred piece.



5 Putting the trim to one side they choose in this order: Alice first*, Bob second and Charlie last.



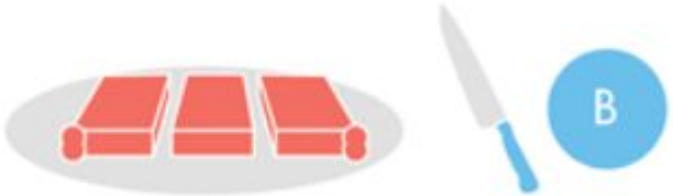
It is envy free

...for Alice, because she got first choice.

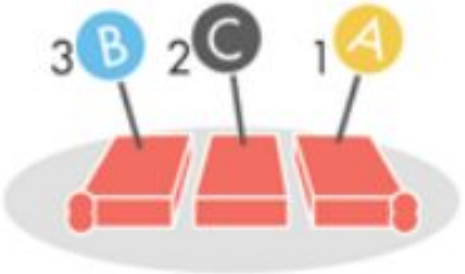
...for Bob, because his second choice was equally valuable.

...for Charlie, because the three original slices were equal to him.

6 To divvy up the trimmed slice, first Bob cuts the trim into three pieces that are equally valuable from his perspective.



7 Now they choose a portion of trim in this order:
Alice first, Charlie second and Bob last



It is envy free

...for Alice, because she got her first choice.

...for Charlie, because he got to choose before Bob.

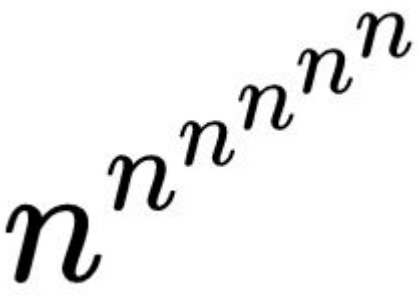
...for Bob, because the three pieces of trim were equal to him.

A bit history

Selfridge-Conway (1960)

Brams-Taylor (1995)

Aziz-Mackenzie (2016)



Dubins-Spanier moving knife

Proportional:
Each person feels that their piece is 1/N of the cake

Cutting a “bad” cake

House chore division

Rent harmony

Cutting an “uncuttable” cake