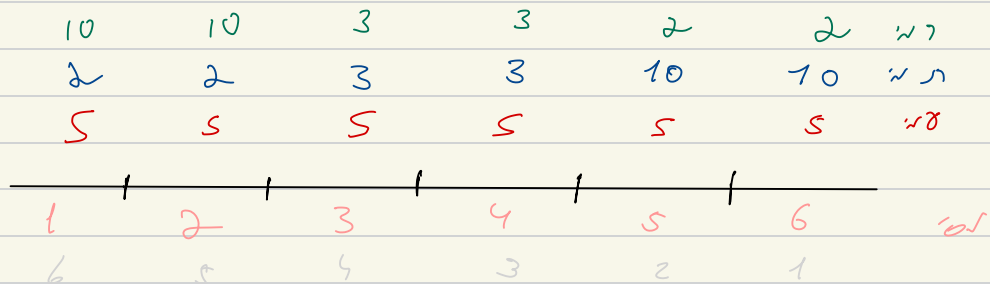
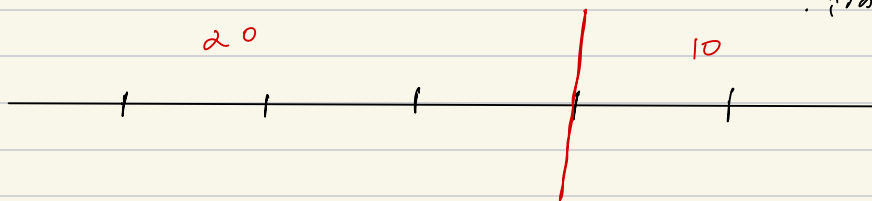


אלגוריתמים כלכליים מטלה 1 - שי גאלי



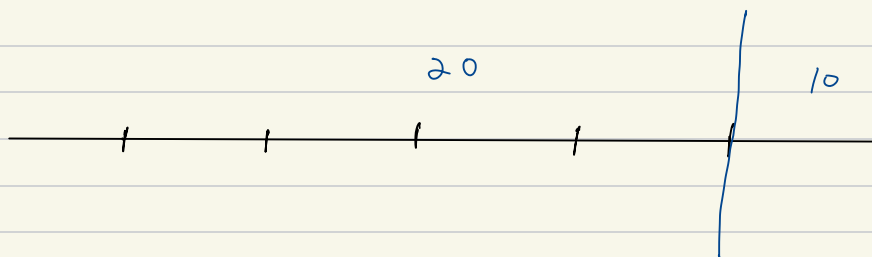
ר"ה ראוונה:

ע"ה גמל:



כ: $\frac{1}{n} = \frac{1}{3}$ הסכום הנכסף הוא 30 אז הלווה לוקח 10

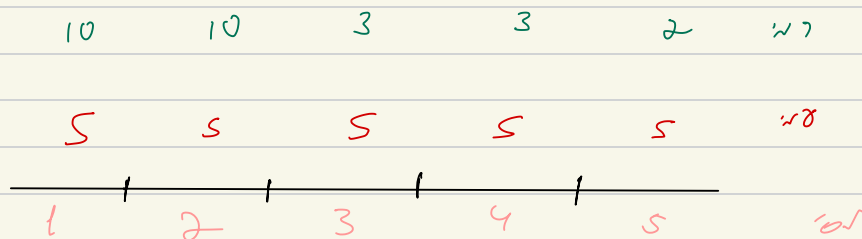
טאליס איך רמז: האם זה שווה לטל הלווה $\frac{1}{2} \Leftarrow$ המלך חזניי שווה 20, וכן היה אחרת לא, ואם איך המלך בך:



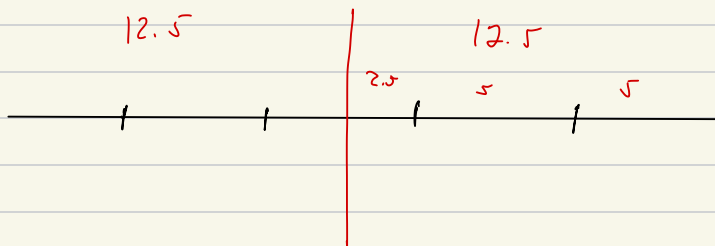
אנשים שמתגוררים במרכז הארץ, שיש להם 1/3
 של הכנסותיהם מהמסחר, שווה ל-1/4, 4

המחיר של המוצר הוא 6 ש"ח.
 המחיר של המוצר הוא 6 ש"ח.

המחיר של המוצר הוא 6 ש"ח.



המחיר של המוצר הוא 6 ש"ח.



המחיר של המוצר הוא 6 ש"ח.

המחיר של המוצר הוא 6 ש"ח.

סג' רחלון תה"ב

| | | | | | | |
|----------|-------|---------|---------|-----|---|--------|
| 10 ג'ניו | 11/12 | 3 חצ' 3 | 5, 4, 5 | טלח | - | 8 ז' - |
| 12.5 | 12.5 | | 6 | טלח | | ת"י |
| 21.5 | 21.5 | 3 חצ' 3 | 1, 2 | טלח | | ר"י |

לבדוק אם היה add קטנה:

| ז' / רחלון | 8 ז' | 5 ז' | 7 ז' |
|------------|------|------|------|
| 8 ז' | 12.5 | 10 | 6.5 |
| ת"י | 5 | 14.5 | 2 |
| ר"י | 12.5 | 6.5 | 21.5 |

לס' חל' חת'טא ב'ח' .

שאלה 5 סעיף ב

השתמשתי ב github copilot כאשר המודל Claude 3.7 Sinnet Thinking ואלו התוצאות שיצאו לי:

ShayGali: hello!

I'm taking a course in economic algorithms, and in the last class we learned about proportional division, and evenfree.

I have the following assignment, and I want you to help me with it:

Given a plot of land consisting of six adjacent areas, which must be divided between three players. The values they attribute to the different areas (in order) are:

- Ami:5,5,5,5,5,5.
- Tami:10,10,3,3,2,2.
- Rami:2,2,3,3,10,10.

Did you understand the data I sent you and can we continue the conversation to find different divisions of the area?

~~~

**GitHub Copilot:** Yes, I understand the data completely. Let's summarize:

We have a plot of land with 6 adjacent areas to divide among 3 players:

- Ami values each area equally at 5 points (total: 30)
- Tami values areas in decreasing order: 10, 10, 3, 3, 2, 2 (total: 30)
- Rami values areas in increasing order: 2, 2, 3, 3, 10, 10 (total: 30)

I'd be happy to help you explore different division methods for this land allocation problem. We can look at:

- Proportional divisions (each player gets at least  $\frac{1}{3}$  of their total valuation)
- Envy-free divisions (no player prefers another's allocation)
- Other fairness criteria

Would you like to start by examining a specific type of division, or shall I propose some possible fair allocations?

~~~

ShayGali: Let's explore proportional division first.

GitHub Copilot: # Proportional Division Analysis

For proportional division, each player should receive at least $\frac{1}{3}$ of their total valuation (which is 30 for each player, so they each need at least 10).

Let's explore some possible divisions:

Option 1: Adjacent Pairs

If we divide the 6 areas into 3 pairs of adjacent plots:

Allocation A:

- Ami gets areas 1-2 (value: $5+5=10$)
- Tami gets areas 3-4 (value: $3+3=6$)
- Rami gets areas 5-6 (value: $10+10=20$)

This fails proportionality since Tami only gets 6, which is less than her required 10.

Allocation B:

- Ami gets areas 3-4 (value: $5+5=10$)
- Tami gets areas 1-2 (value: $10+10=20$)
- Rami gets areas 5-6 (value: $10+10=20$)

This succeeds! Everyone gets at least 10.

Option 2: Non-Adjacent Allocations

We can also consider allocations where each player gets 2 non-adjacent plots:

Allocation C:

- Ami gets areas 1,6 (value: $5+5=10$)
- Tami gets areas 2,3 (value: $10+3=13$)

- Rami gets areas 4,5 (value: $3+10=13$)

This is proportional - everyone gets at least 10.

Would you like to explore more proportional divisions or shall we move on to discussing envy-free divisions?

~~~

**ShayGali:** OK, its look good.

can you give me an envy-free divisions?

**GitHub Copilot:** # Envy-Free Divisions

In an envy-free division, each player should prefer their own allocation over any other player's allocation. Given our players' values, I've found several envy-free divisions:

## Option 1: Adjacent Pairs

- Ami gets areas 3-4 (value:  $5+5=10$ )
- Tami gets areas 1-2 (value:  $10+10=20$ )
- Rami gets areas 5-6 (value:  $10+10=20$ )

Let's verify this is envy-free by checking if each player prefers their own allocation:

**\*\*From Ami's perspective:\*\***

- Ami's allocation (3-4): 10
  - Tami's allocation (1-2): 10
  - Rami's allocation (5-6): 10
- Ami values all allocations equally (doesn't envy anyone)

**\*\*From Tami's perspective:\*\***

- Tami's allocation (1-2): 20
- Ami's allocation (3-4): 6
- Rami's allocation (5-6): 4

→ Tami prefers her own allocation

**\*\*From Rami's perspective:\*\***

- Rami's allocation (5-6): 20

- Ami's allocation (3-4): 6

- Tami's allocation (1-2): 4

→ Rami prefers his own allocation

## ## Option 2: Non-Adjacent Allocation

- Ami gets areas 2 and 5 (value:  $5+5=10$ )

- Tami gets areas 1 and 3 (value:  $10+3=13$ )

- Rami gets areas 4 and 6 (value:  $3+10=13$ )

This is also envy-free, as we can verify by analyzing each player's perspective.

Both allocations are not only envy-free but also proportional, showing how we can achieve multiple fairness criteria simultaneously.

אם נשווה את התוצאות, נראה שהוא הצליח למצוא חלוקה הוגנת ללא קנאה, אבל האלגוריתם שלנו נתן חלוקה עם קנאה.

נראה שהמודלים מתקדמים מרגע לרגע, ויכול להיות שבעתיד הם יצליחו לחלק בצורה הוגנת. (גילוי נאות ניסיתי לשאול את gemini ואת chatgpt-4o בלי המוד חושב, והם נתנו חלוקות לא טובות.)