CS 2104
Introduction to Problem Solving

Deductive and Hypothetical Reasoning

Faryaneh Poursardar

Virginia Tech

Slides based on the “Problem Solving and Comprehension” book

Deductive and Hypothetical Thinking

The day before yesterday you did not get home until yesterday; yesterday you did not get home until today. If today you do not get home until tomorrow, you will find that I have left yesterday.

- The mental reasoning needed here is fundamental in solving many problems.
  - Comprehend verbal statements.
  - Move in some dimension.
  - Think backward through a sequence to see where a movement began.

Simple Problems

Making a diagram helps with these.

- Suppose Valentine's Day is 3 days after Friday. What day is Valentine's day?
- Suppose Lincoln's birthday is 4 days before Thursday. What day is Lincoln's Birthday?
- Suppose Christmas is 2 days before Wednesday?
  - What day is Christmas?
  - What day is 4 days before Christmas?

Slightly Harder

- Saturday is 5 days before Labor day. What day is Labor day?
- Suppose Christmas is 2 days after Thursday. What day is Christmas?
- Suppose Thursday is 2 days after Christmas. What day is Christmas?

Deduction

- Today is Thursday. What is 2 days after tomorrow?
- Yesterday was Monday. What is 4 days after tomorrow?
- Today is Saturday. What is the day after 4 days before tomorrow?

Break It Down

Many math problems are solved by breaking them into parts. Your brain can only hold so much at once.

- Today is Monday. What is 1 day after 3 days before yesterday?
  - Use a diagram, and take it one step at a time.

Examples

- Yesterday was Tuesday. What is 2 days before 4 days after tomorrow?
- Tomorrow is Sunday. What is 2 days after 3 days before yesterday?
- Yesterday was Saturday. What is 4 days before 7 days after 2 days before today?
- Today is Monday. What is 3 days after 2 days before 6 days after 5 days after tomorrow?

Subtle Variations

- What is the difference between these two questions?
  - Today is Sunday. What is 3 days after today?
  - Sunday is 3 days after today. What is today?

More Examples

- Friday is 3 days before yesterday. What is tomorrow?
- Monday is 5 days before 2 days after yesterday. What is yesterday?
- Wednesday is 6 days before 2 days after tomorrow. What is tomorrow?

Mixed Problems

- Yesterday was Friday. What is the third letter in the day after tomorrow?
- If 6 days ago was Wednesday, what is the second letter after the second letter in 2 days after tomorrow?

Math-like Problems

- A man divides $1622.50 among four persons so that the first has $40 more than the second, the second $60 more than the third, and the third $87.50 more than the fourth. How much did the fourth person receive?
- A man bequeathes to his wife 1/3 of his estate; to his daughter, 1/5 of it; to his son, ½ of the daughter's share. He divides the remainder equally between a hospital and a public library. What part is received by the hospital?

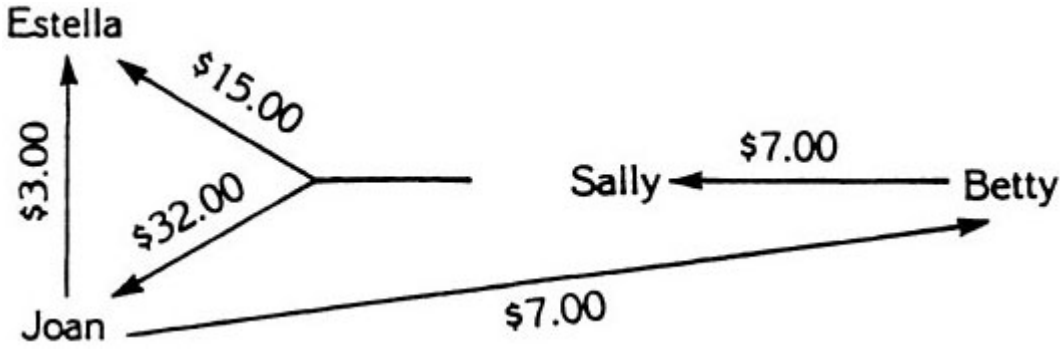
Mathematical Word Problems

- A lot of word problems involve math.
  - That just means they involve (simple) numerical relationships.
  - Its all about setting up the relationships, not about the arithmetic.
- Process:
  - Be concerned about accuracy
  - Proceed step-by-step
  - Restate and subvocalize
    - Repeat information, rephrase, weigh it, compare different facts
    - Clarify ideas for yourself

Old Problem

Sally loaned $7 to Betty. But Sally borrowed $15 from Estella and $32 from Joan. Moreover, Joan owes $3 to Estella and $7 to Betty. One day the women got together at Betty's house to straighten out their accounts. Which woman left with $18 more than she came with?

Hint: Make a **diagram** and use arrows to show which person has to **return money** to another person. Show the direction in which the money must be returned.



A Ratio Problem

A train can travel 10 miles in 4 minutes. How far will it travel in 14 minutes?

Alternative Solutions

- 14/4 = 3.5, so there are 3.5 (*4-minute*) units. The train goes 10 miles in each unit, so 3.5 x 10 = 35.

- Ratios: 10mi/4min = X mi/14min so (14)(10)/4 = X. X = 35mi.

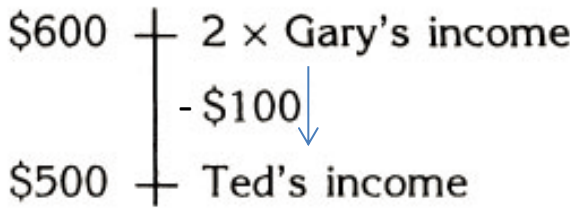
- How many miles in one minute? 10mi/4min = 2.5mi/min. So in 14 minutes, 14min x 2.5mi/min = 35mi.

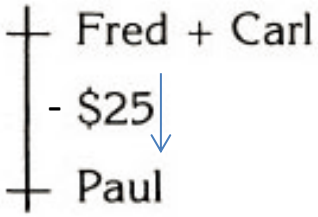
- Write and check physical units!

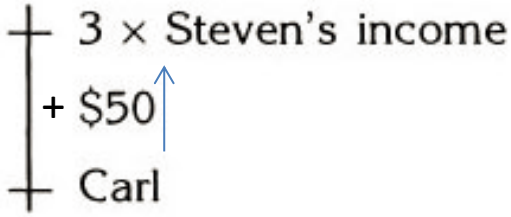
Sample Problems

- Ted's weekly income is $100.00 less than double Gary's weekly income. If Ted makes $500.00 a week, what does Gary make?

- Paul makes $25.00 a week less than the sum of what Fred and Carl together make. Carl's weekly income would be triple Steven's if he made $50.00 more a week. Paul makes $285.00 a week and Steven makes $75.00 a week. How much does Fred make?


$600
2 × Gary's income
- $100
$500
Ted's income


Fred + Carl
- $25
Paul


3 × Steven's income
+ $50
Carl