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Trainers Support

Algorithmic Thinking

Algorithmic Thinking for Migrants Teachers Education

2021-1-EL01-KA210-ADU-000035033

LESSON #3

TITLE: PROBLEM-SOLVING TECHNIQUES

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LESSON #3 – PROBLEM SOLVING TECHNIQUES

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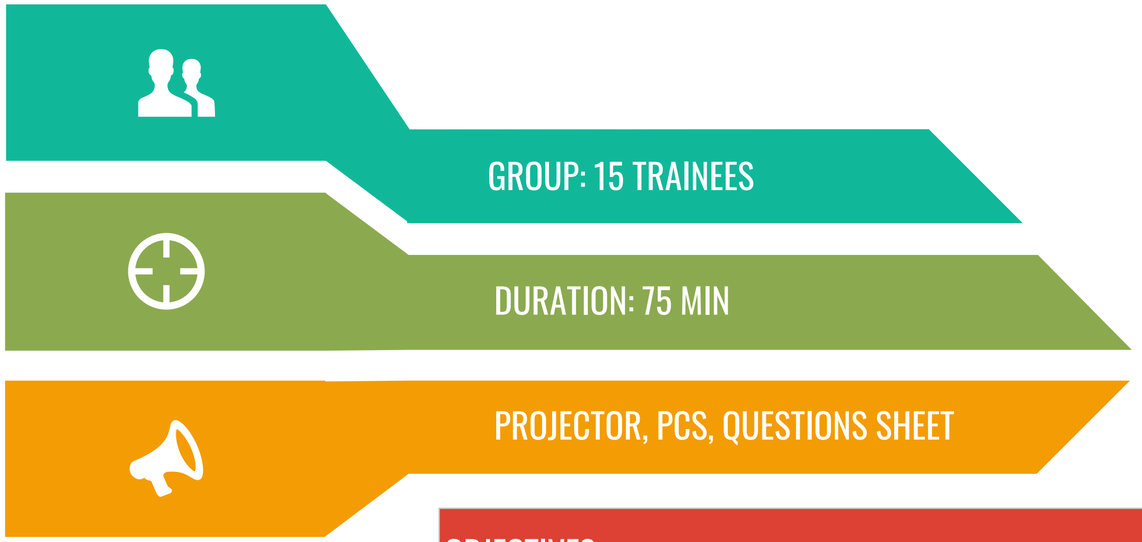
LESSON REQUIREMENTS



OBJECTIVES

- LEARN USEFUL TECHNIQUES FOR PROBLEM-SOLVING
- EXPLAIN HOW TO APPLY A SYSTEMATIC APPROACH TO PROBLEM-SOLVING.
- DISCUSS HOW TO CREATE A PROBLEM DEFINITION.
- INTRODUCE STRATEGIES AND CONSIDERATIONS FOR THE DEVISING OF SOLUTIONS.
- EXPLAIN DECOMPOSITION AS A PROBLEM-SOLVING STRATEGY.

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LESSON #3 – PROBLEM SOLVING TECHNIQUES

DEFINING A PROBLEM

The hardest part of problem solving is characterizing the problem.

Reasons for Analyzing a problem:

1. We might find things undesirable for any number of reasons.
2. Maybe the current process is too slow.
3. Maybe we regularly need to make certain decisions, but we have too much data to handle.
4. Maybe we have missing information about how something behaves.

It is foolish to answer a question that you do not understand:

1. If someone else gave it to you, try restating the problem in your own words.
2. Try and represent the problem using pictures and diagrams. Humans deal better with visual representations.
3. There will be knowns and unknowns at the start. You should ensure that enough information is known for you to form a solution. If there isn't, make the unknowns explicit

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DEFINING A PROBLEM

- Whatever the problem, the key thing to remember is that a goal defines what needs to be done and not how it should be done. Thinking about details like designs and algorithms. Focus instead on what your goal looks like.

- However you specify the goal, make sure that your language is clear and specific. For example, if you aim to improve the speed of the current system, don't specify your end goal simply as *'it should be faster'*. Give it measurable accuracy

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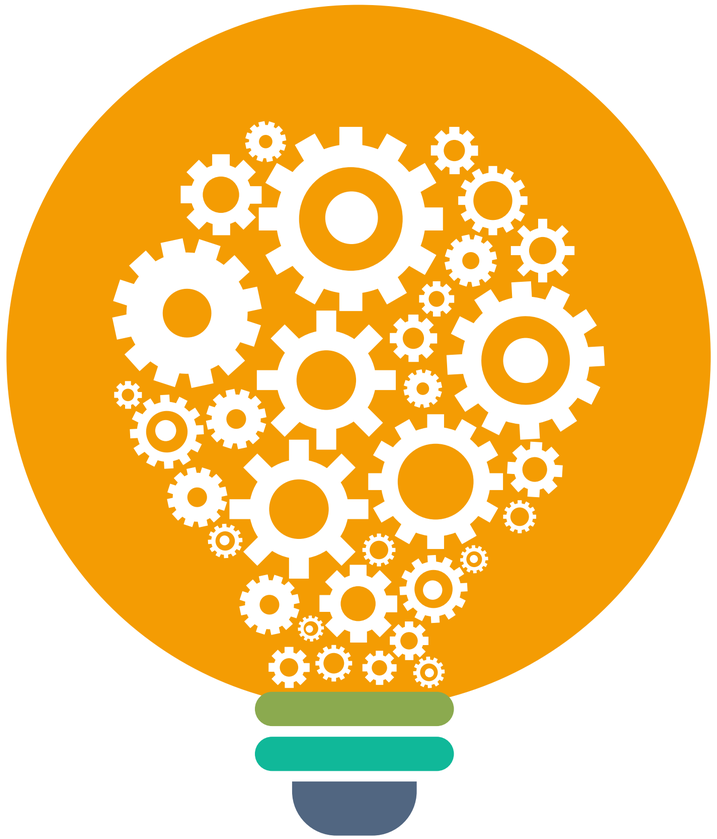
DEVISING A SOLUTION: SOMETHING TO KEEP IN MIND

1. Quality

First, notice that we say a solution and not the solution. For any problem, there are usually multiple solutions: **some good, some terrible and others somewhere in-between**. We should focus on finding the best solution you can.

For the overall problem, there is likely no perfect solution. Trade-offs between competing parts are almost inevitable. On the other hand, individual parts of a problem may be 'perfected', in as much as their role in the overall solution might be optimizable.



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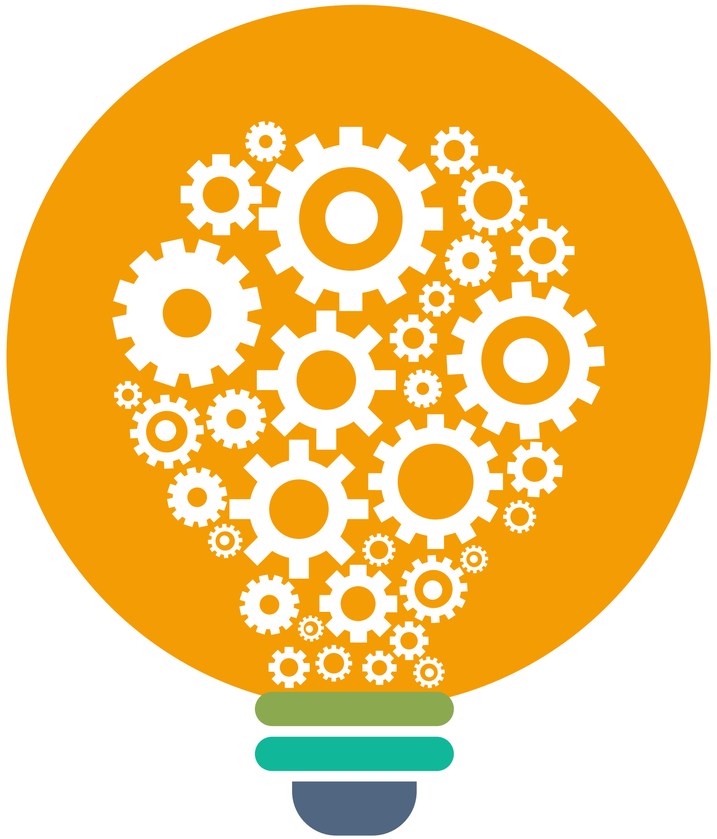
DEVISING A SOLUTION: SOMETHING TO KEEP IN MIND

2. Collaboration

Making problem-solving a collaborative effort is often helpful. Something as simple as explaining our current work out loud often helps us to spot mistakes or potential improvements. Seek out the views of others. People's minds work in different ways.

While we have the attention of other people, try brainstorming with them. Brainstorming sessions thrive on spontaneity. All ideas, however radical they seem, should be recorded, and we should reject nothing out of hand. In fact, wild ideas are to be encouraged. In among those crazy ideas may lie the seeds of a creative new approach that we might ordinarily have missed or self-censored.



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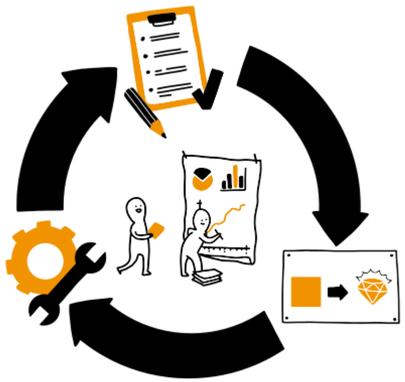
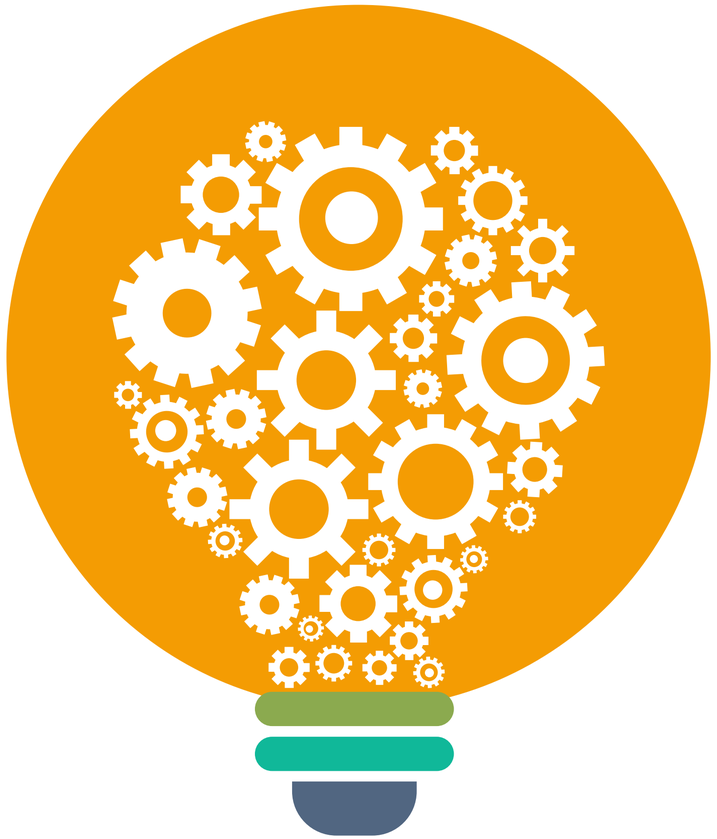
DEVISING A SOLUTION: SOMETHING TO KEEP IN MIND

3. Iteration

We should accept that our first attempt at a solution will rarely be the best one. Instead of trying to solve everything in one fell swoop, take an iterative approach.

Go back and repeat some of the previous steps in an attempt to improve our current solution.





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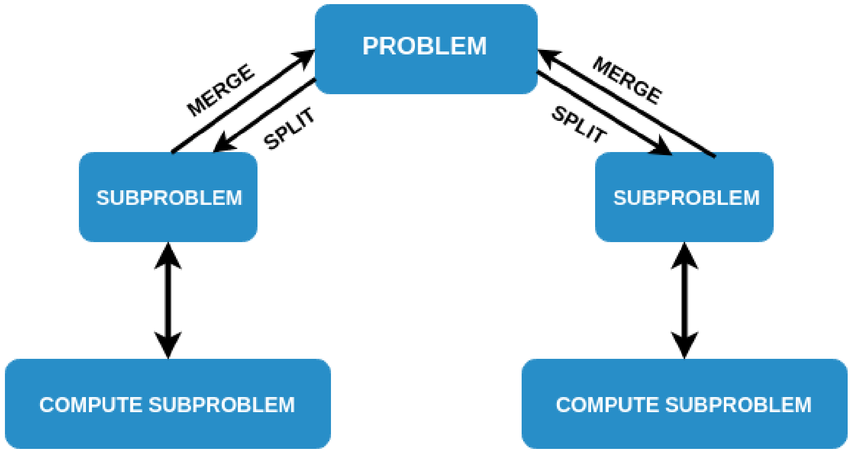
DECOMPOSITION

Algorithmic thinking promotes decomposition, which is an approach that seeks to break a complex problem down into simpler parts that are easier to deal with.

Decomposition is a divide-and-conquer strategy, something seen in numerous places outside computing:

- Politicians use it to break opposition up into weaker parties who might otherwise unite into a stronger whole.
- When faced with a large, diverse audience, marketers segment their potential customers into different stereotypes and target each one differently.



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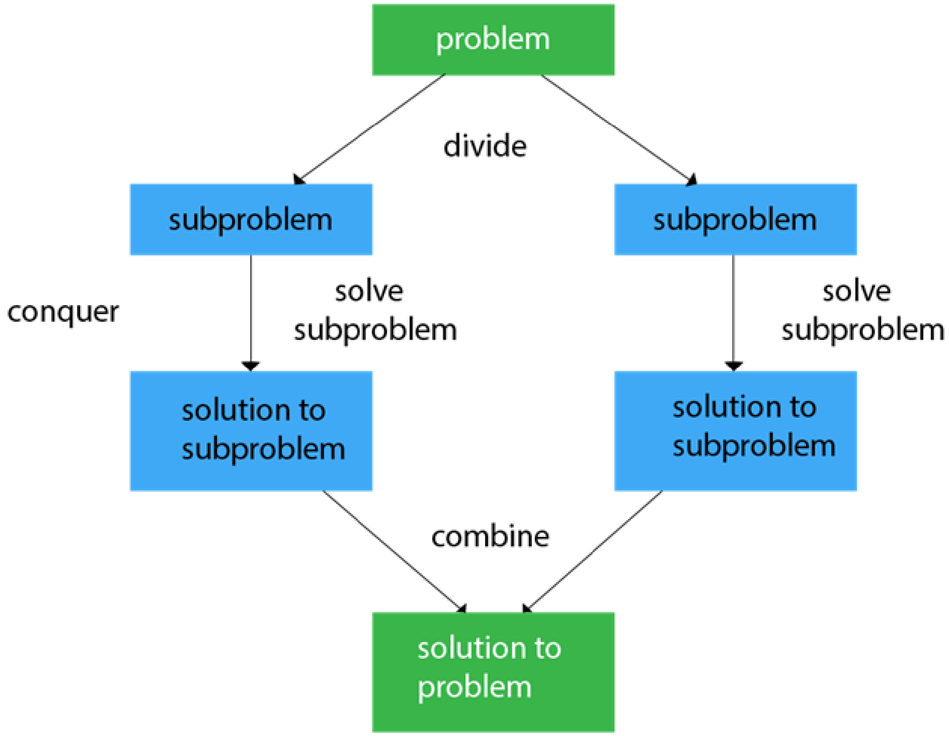
DECOMPOSITION

By applying decomposition, we aim to end up with a number of sub-problems that can be understood and solved individually. This may require to apply the process.

That is to say, the problem is re-formed as a series of smaller problems that, while simpler, might be still too complex, in which case they too need breaking down, and so on.

Visually this gives the problem definition a tree structure.



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ACTIVITY #3.1

The trainer shares a handout with exercises. Same questions are seen below. Mark the following statements as true or false:

- Goal defines how the problem should be solved, not what needs to be done. (False)
- It is inadvisable to begin writing a solution before the goal is defined. (True)
- For any non-trivial problem, there is likely only one solution. (False)
- Decomposition guarantees an optimal solution. (False)
- A tree structure is hierarchical in nature. (True)

CORE SKILLS DEVELOPED

- Problem solving skills
- Reasoning skills
- Technical skills
- Time management skills

TIMING

30 min

REQUIRED TOOLS

PC, projector, sheet

REFERENCES

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