NUS National University of Singapore

School of Computing

Computational Thinking

(Polya's 4-Step Problem Solving Process)

Video 5.06

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Learn the 4-Step PS Process
Learn to Ask Questions

Content

- Components of the CT Segment
- Self-Introduction
- Quick intro to CS and CT
- CT is for Everyone
- Problem Solving via “Asking Questions”

First, a Quote…

A great discovery solves a great problem,
but there is a grain of discovery
in the solution of any problem.

Your problem may be modest;
but if it challenges your curiosity and
bring into play your inventive faculties,
and if you solve it by your own means,
you may experience the tension and
enjoy the triumph of discovery.

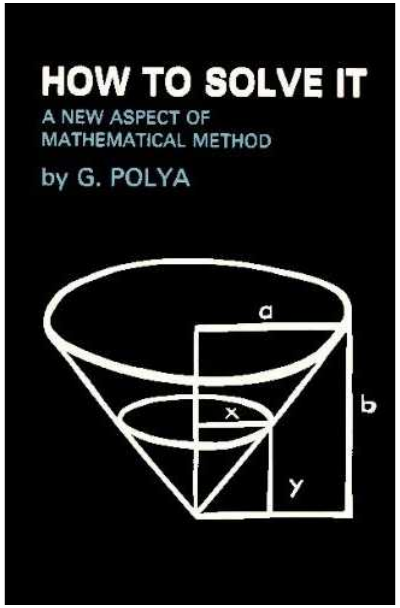
G. Polya, 1945

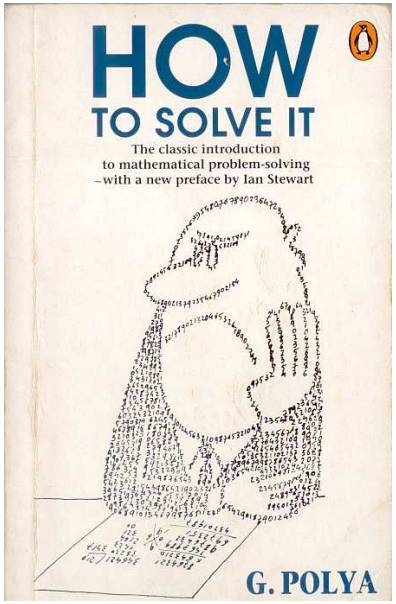
G. Polya (1887-1985)

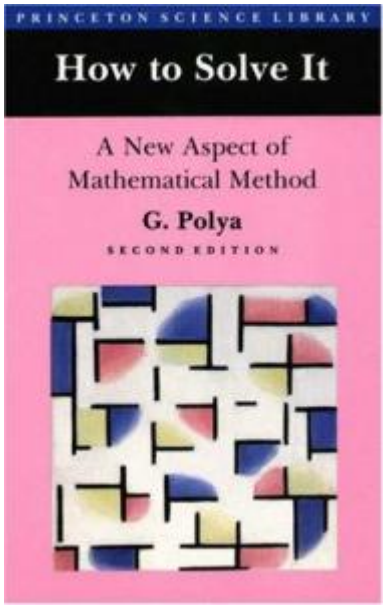
Experience the Aha! moment

and… you keep this triumph for a lifetime

"How to Solve It", George Polya







The most widely cited reference for problem solving in all disciplines

Polya's Four Stages of PS

I. UNDERSTANDING THE PROBLEM

You have to understand the problem

II. DEVISING A PLAN

Find the connection between data and the unknown.
You should obtain eventually a *plan* for the solution

III. CARRYING OUT THE PLAN

Carry out your plan

III. LOOKING BACK

Examine the solution you obtained

I. UNDERSTANDING THE PROBLEM

What is the unknown? ..What are the data?
What is the condition?
Is it possible to satisfy the condition?
Is it sufficient? or redundant? or contradictory?
Draw a figure? Introduce suitable notations?
Separate the various parts of the condition?
Can you write them down?

When you are stuck,
you should ask Questions
to help generate ideas

II. DEVISING A PLAN (1)

Have you seen it before?

or seen it in a slightly different form?

Do you know a related problem? *or a useful theorem?*

Look at the unknown!

Problem with a similar unknown?

Related problem and solved before?

Can you use it?

or its results? *or its method?*

or add auxiliary element to make it possible?

Can we solve some small instances?

And look for a pattern?

This step is hard; Needs more Questions to help

II. DEVISING A PLAN (2)

More Questions

Can you re-state the problem?

Re-state it still differently?

Go back to definitions

Try to solve a related problem first?

A more accessible related problem?

A more general problem? More special problem?

An analogous problem?

Solve part of the problem first?

Keep only a part of the condition, drop the other part;

How far is the unknown then determined, how can it vary?

II. DEVISING A PLAN (3)

Can you derive something useful from the data?

What other data appropriate to determine the unknown

Can you change the unknown or the data or both to get

the new unknown and the new data nearer to each other

Did you use all the data? the whole condition?

Have you taken into account all essential notions involved?

Step 2 is the "hardest",
so it has the most questions
to help you get unstuck.

III. CARRYING OUT THE PLAN

Carry out your plan of solution.

Check every step.

Can you see clearly that each step is correct?

Can you prove that it is correct?

The plan is rough, so here you carry out the plan carefully, step-by-step

IV. LOOKING BACK

Can you check the result?

Can you check the argument?

Can you derive the result differently?

Can you see it in a glance?

Can you use the result, or the method,
for other problem?

Looking back helps you
to gain insights into
your solution/approach

Quick Summary:

- Learned to Polya's 4-Step PS Process
- The Key is "Asking Simpler Questions"
  - They point you to different directions
- Step 2 is akin to "Divergent Thinking"
- Step 4 is important and most beneficial
  - Encourages self reflection
  - Enhances future problem solving…

(End of video 5.06)

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