Applied Mathematical Thinking

Given by

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The course is about mathematical thinking – so let's start thinking!

What are our natural mathematical abilities?

How do they relate to our general abilities to think?

Why do we have these abilities?

Why count?

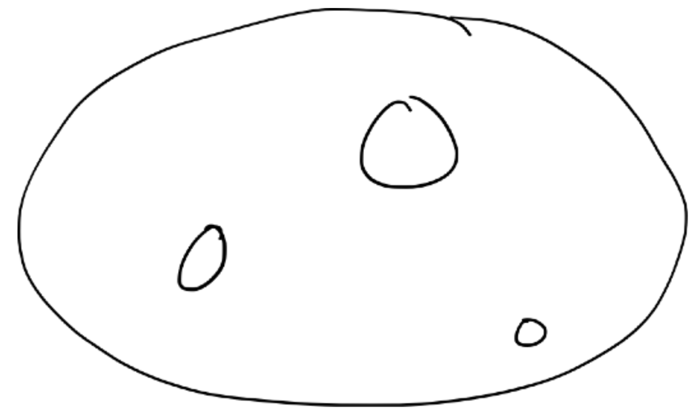
Should we buy guineapigs?

Non-mathematical and mathematical considerations?

focus
shutter speed
aperture
focal length
resolution
⋮

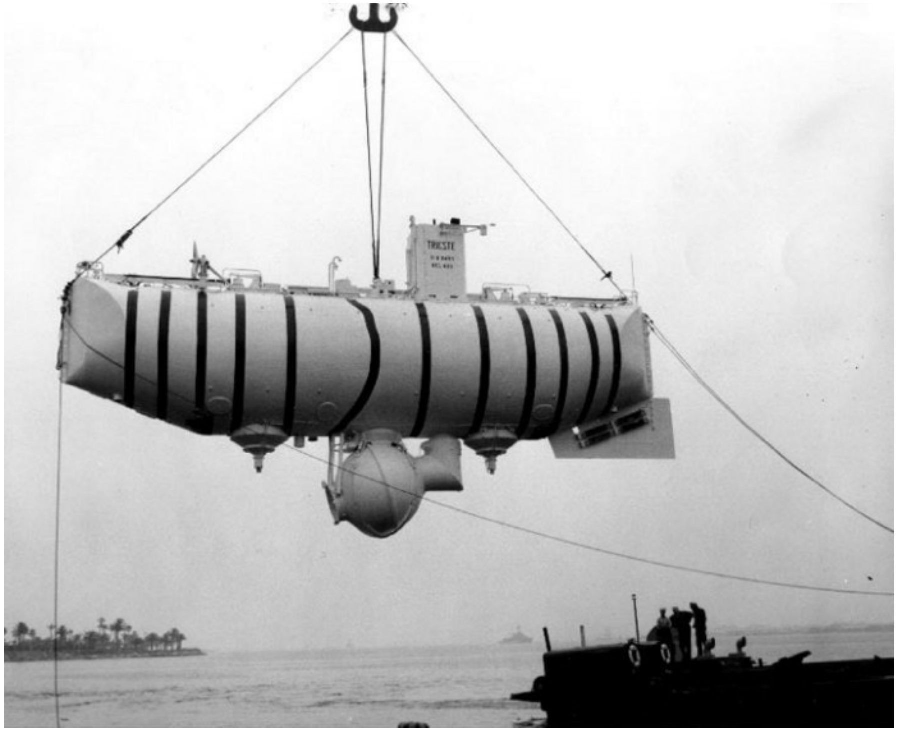
If young people cannot find housing, should we build more housing for young people?

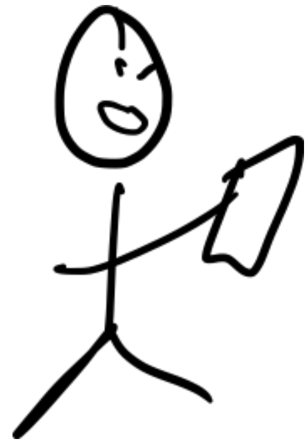
We naturally make quantitative and other abstract considerations in very different situations



Mathematical thinking is often applied to particular mathematical aspects of larger non-mathematical situations

Clear understanding and logical reasoning is useful to get things right



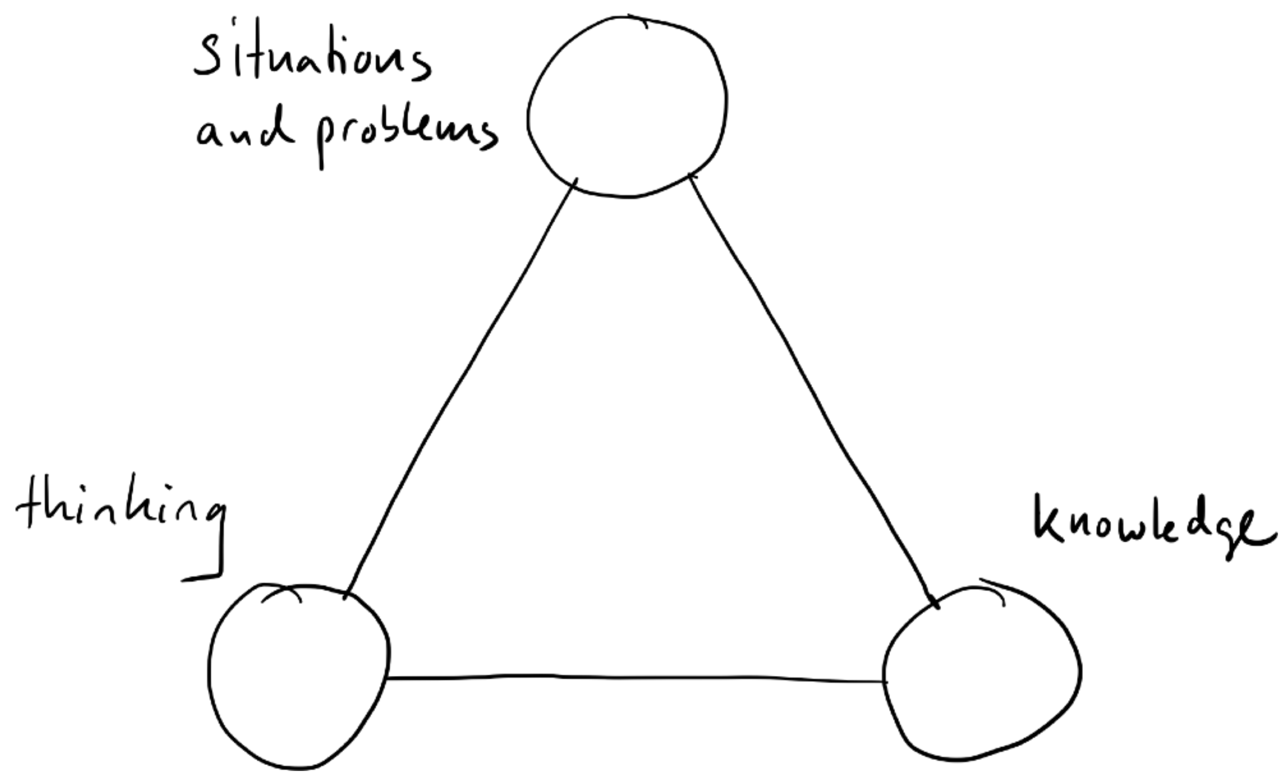


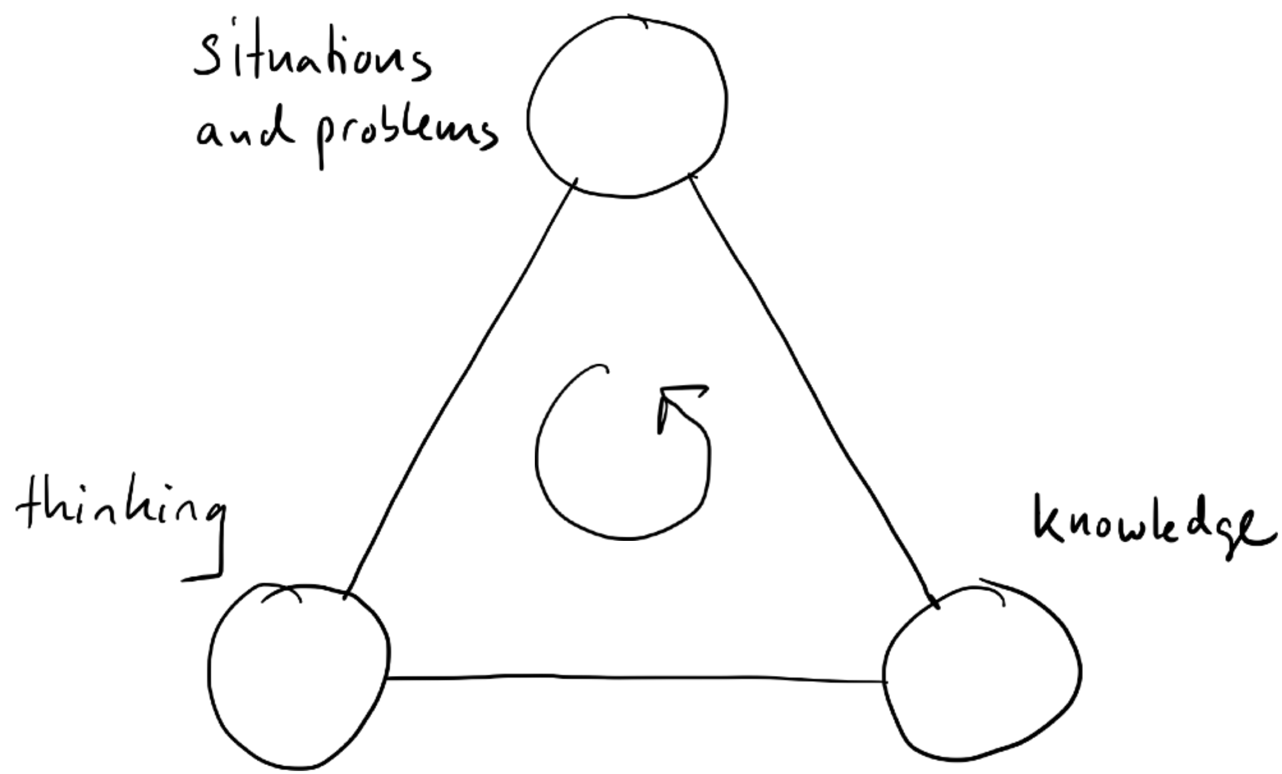
Last month I walked 22143 steps, read 1241 pages, and…

Sometimes mathematical thinking is needed, sometimes not…

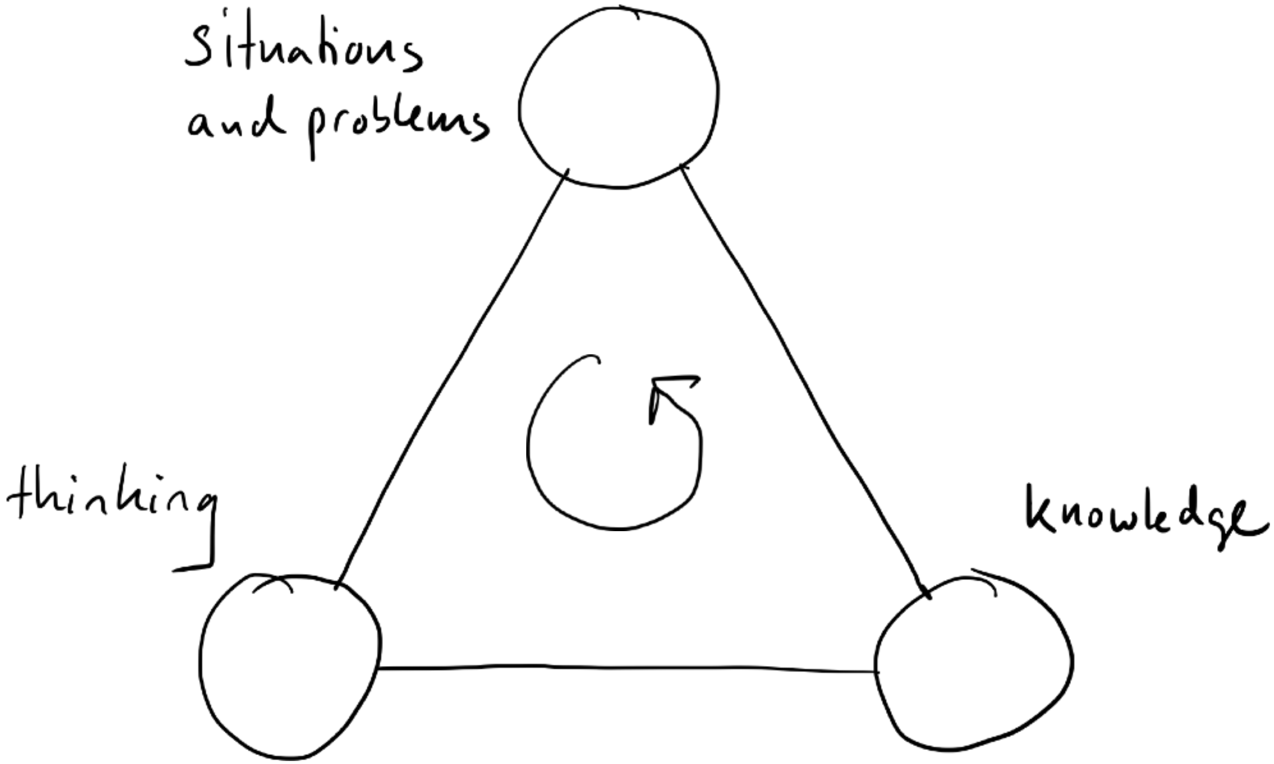
What do we want to learn?

And how?


situations
and problems
thinking
knowledge


situations
and problems
thinking
knowledge

Be familiar with different settings
where mathematical thinking is used

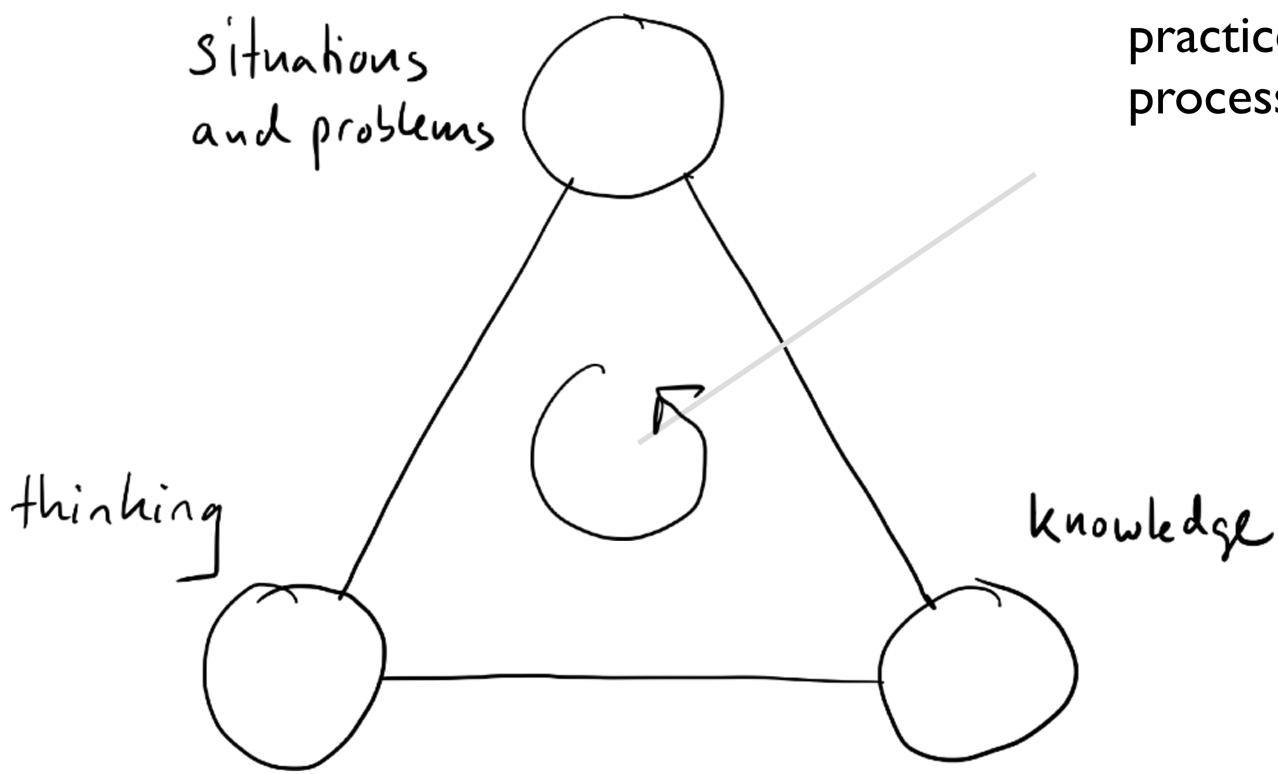


Think and work
mathematically as people
with experience do

Be able to use
mathematical
knowledge

consider varied
realistic problems

practice entire
process



practice your
thinking

try to discover
own knowledge

learn knowledge
found by others

We want to build on your natural abilities to think, not replace them!

“Weekly” modules

1. Monday introduction
2. Do problems and get supervision during the week
3. Thursday next week is follow-up lecture
4. Reflection

Most modules have a main theme

How to work with the problems

Real problem solving exercises! Do your best, but solutions do not have to be perfect.

In learning problem solving, the path towards the solution is more important than the actual solution. Failure is a learning opportunity!

Do not read or search for solutions! Do not spread your solutions to other groups!

Don’t worry about passing!

Ask us for help along the way! We give help incrementally, so ask several times about the same exercise!

It can be rewarding to discuss with us even if you are doing fine!

Learn basic Mathematica first to save you trouble!

Manage your time! You have about 20 hours each week.

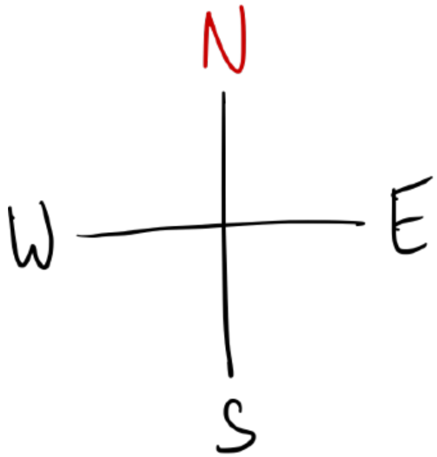
Some things are new this year so we may need to make some adjustments along the way

Some students have taken university math, others not.

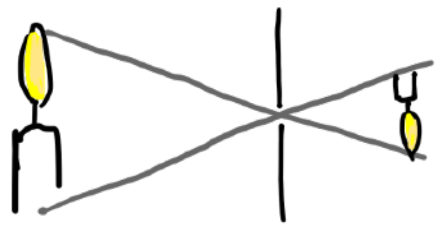
Two courses in one: DIT856 and DIT025

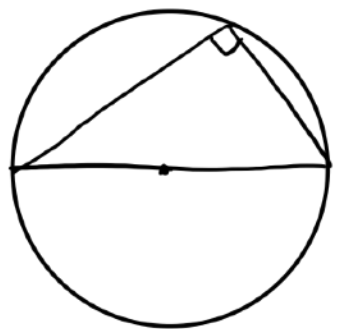
about the problems

keeping track



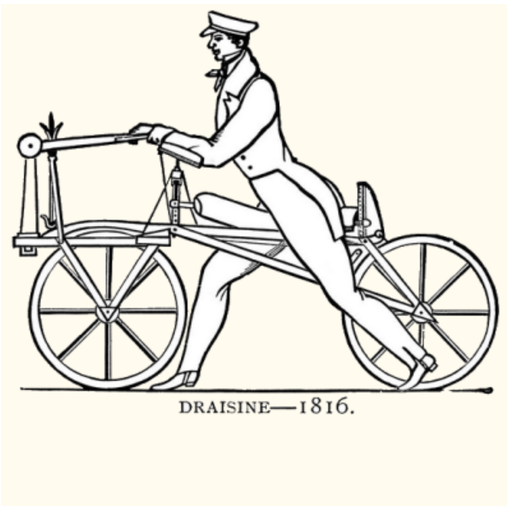
investigating
the world





investigating
the abstract

design



DRAISINE—1816.

Abraham Wald and the planes

Section of plane	Bullet holes/sq ft
Engine	1.11
Fuselage	1.73
Fuel system	1.55
Rest of plane	1.80

lower bound to the Q_i could be obtained. The assumption here is that the decrease from q_i to q_{i+1} lies between definite limits. Therefore, both an upper and lower bound for the Q_i can be obtained.

We assume that

$$\lambda_1 q_i \leq q_{i+1} \leq \lambda_2 q_i ,$$

where $\lambda_1 < \lambda_2 < 1$ and such that the expression

$$\sum_{j=1}^{n} \frac{a_j}{\lambda_1^{\frac{j(j-1)}{2}}} < 1 - a_o \qquad \text{(A)}$$

is satisfied.

The exact solution is tedious but close approximations to the upper and lower bounds to the Q_i for $i < n$ can be obtained by the following procedure. The set of hypothetical data used is

$a_o = .780 \qquad a_3 = .010$
$a_1 = .070 \qquad a_4 = .005$
$a_2 = .040 \qquad a_5 = .005$
$\lambda_1 = .80 \qquad \lambda_2 = .90$

Condition A is satisfied, since by substitution

$$.07 + \frac{.04}{.8} + \frac{.01}{(.8)^3} + \frac{.005}{(.8)^6} + \frac{.005}{(.8)^{10}} = .20529 ,$$

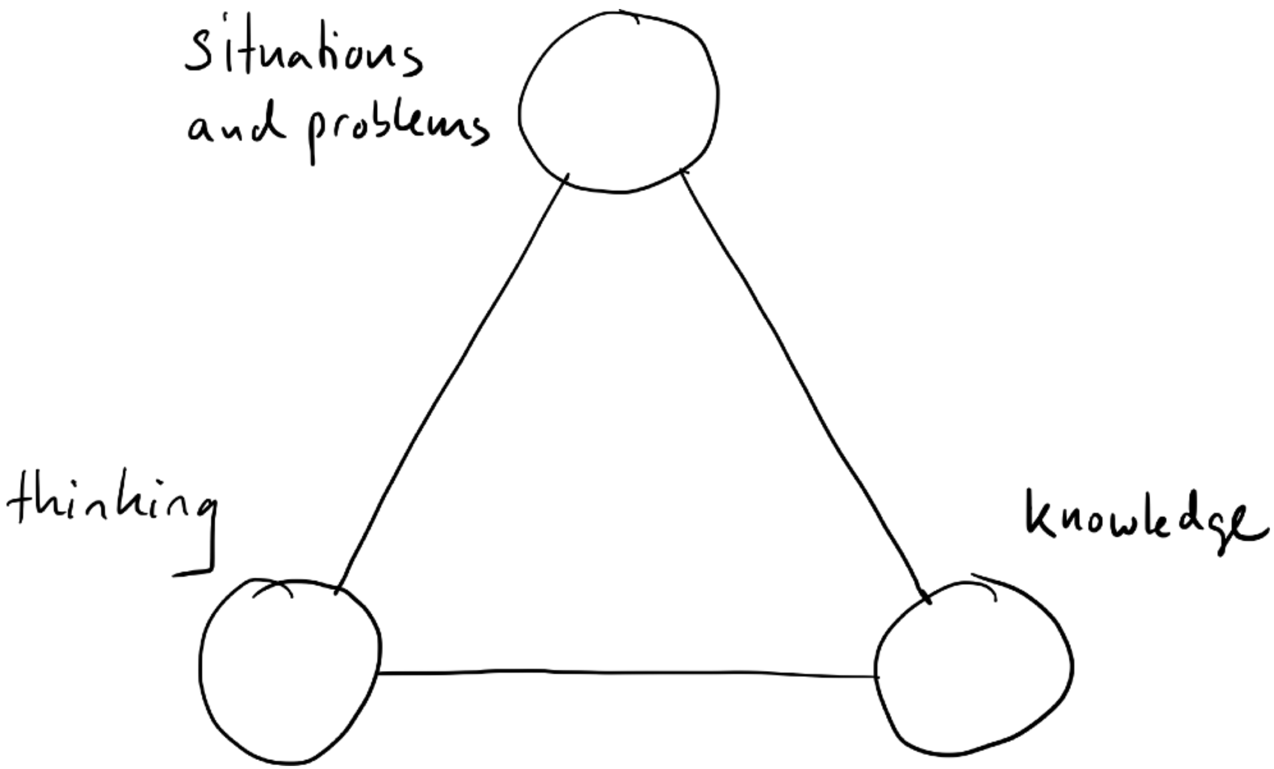
which is less than

$$1 - a_o = .22 .$$

THE LOWER LIMIT OF Q_i

The first step is to solve equation 66. This involves the solution of the following four equations for positive roots g_o, g_1, g_2, g_3.

from Ellenberg: How not to be wrong



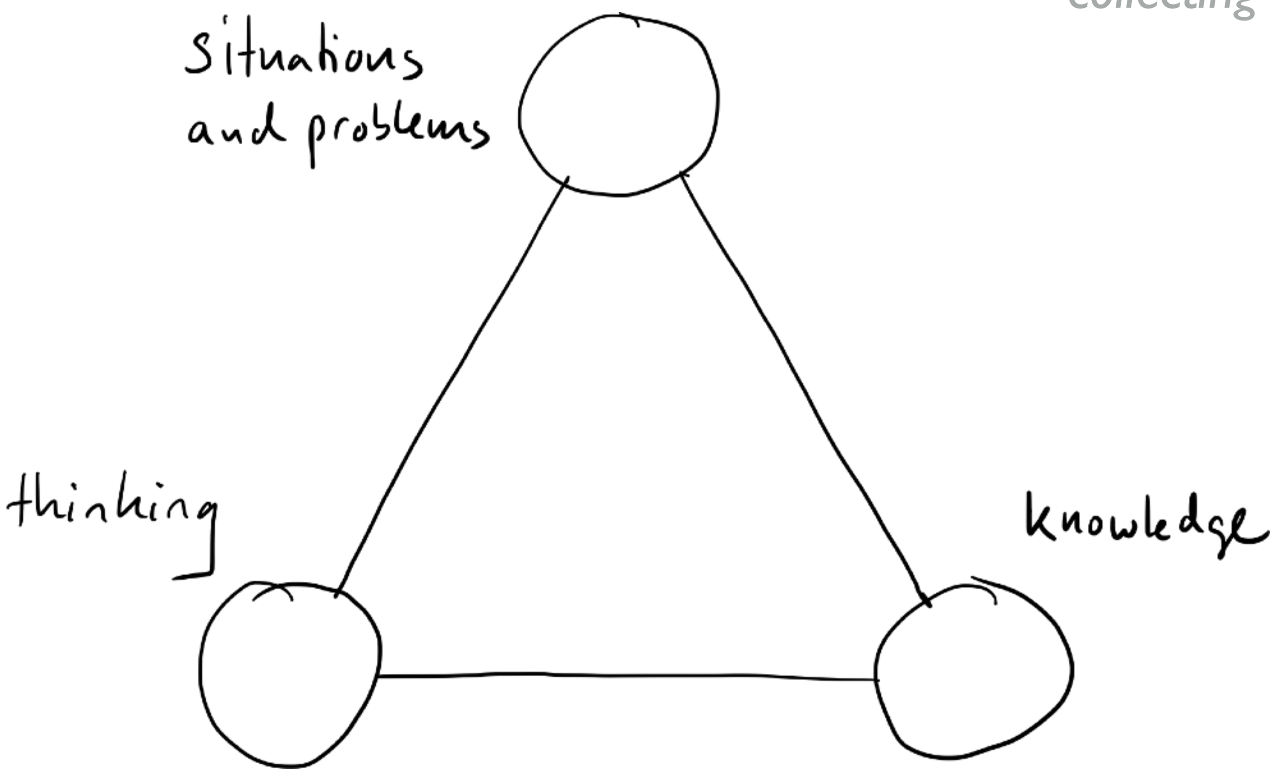
A single problem gives many learning opportunities!

As in the real world, the questions in the course are not always precisely formulated. It is up to you to interpret them sensibly!

You need an investigative attitude!

In many courses

the focus is on collecting solutions

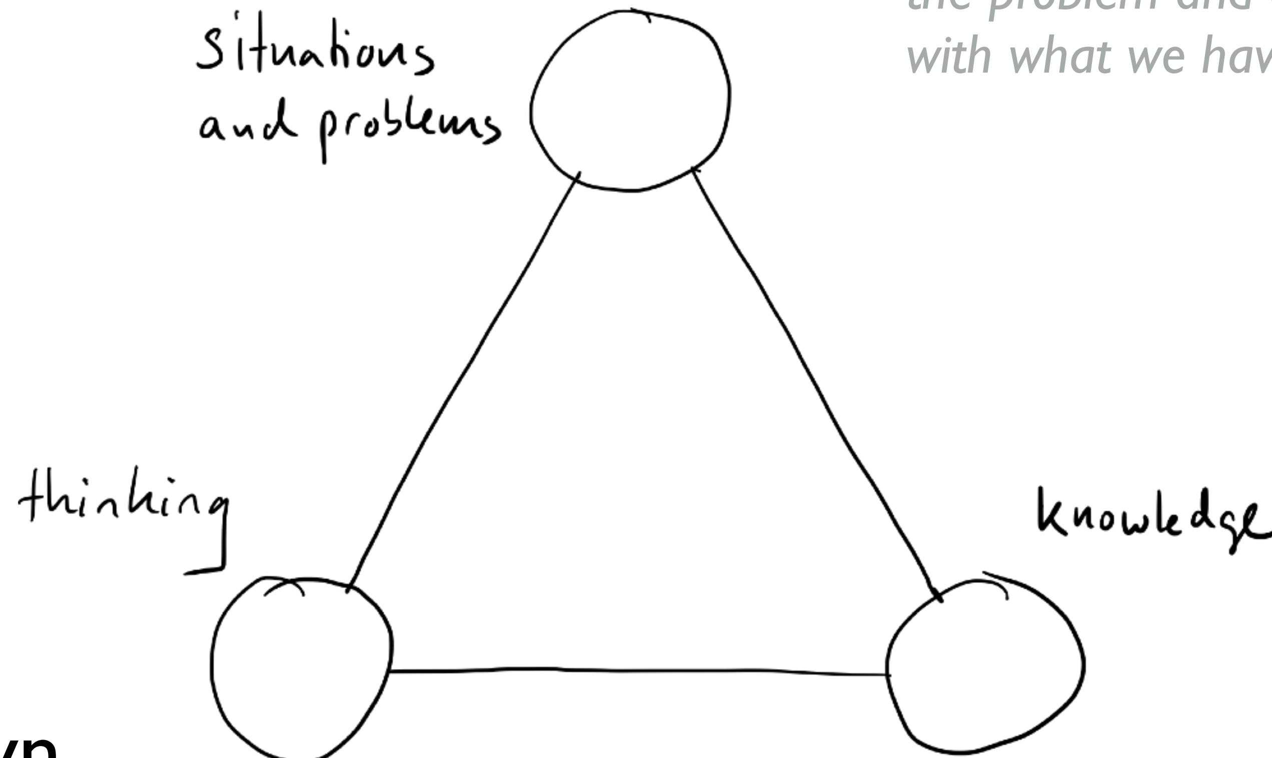


use known method
ask the teacher
search the internet
read book

In this course

understand
the problem

the focus is on thinking about the problem and do the most with what we have!



own
thinking

teacher helps to
practice own thinking

if we are lucky, some knowledge that we have may also be useful

On Thursday

A more extensive introduction to mathematical thinking

Questions?

Create groups!