On Making Printed Math Class Materials with Figures Based on Symbolic Thinking

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Contents

1. What is KETpic ?

1.1. Characteristics of KETpic

- KETpic is a plug-in based on CAS programs such as Maple, Mathematica, Maxima, Risa/Asir, Matlab, Scilab and R.
- KETpic is a tool to insert expressive figures and tables and make original LaTeX commands in LaTeX documents.
- KETpic generates LaTeX-readable codes with the aid of CAS into a text file (which has very small size), and graphical image files are no longer required.

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- The figure is a line drawing.
- The figure has accurate length.

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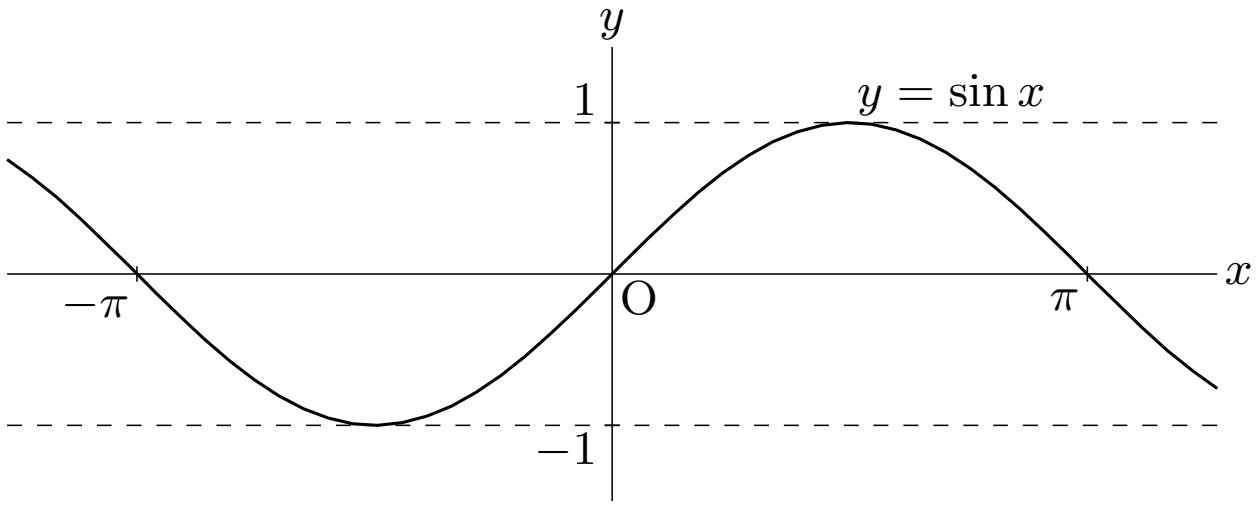

Fig.1. A graph of the sine curve

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- The accessories in the figure, for example,
  chracters, mathematical expressions,
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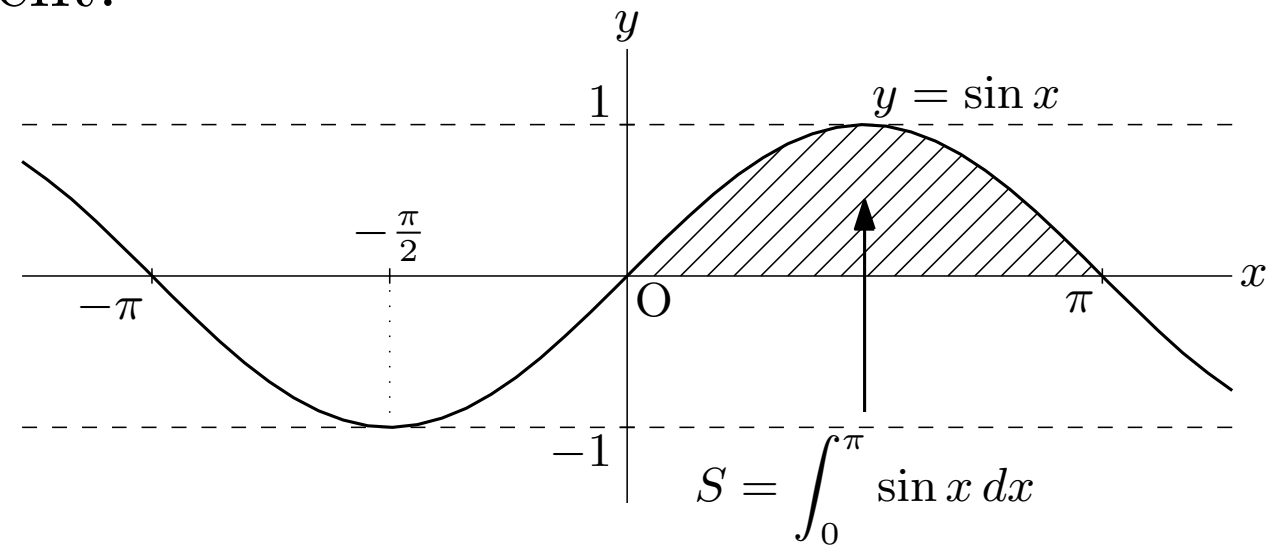

Fig.2. A graph of the sine curve

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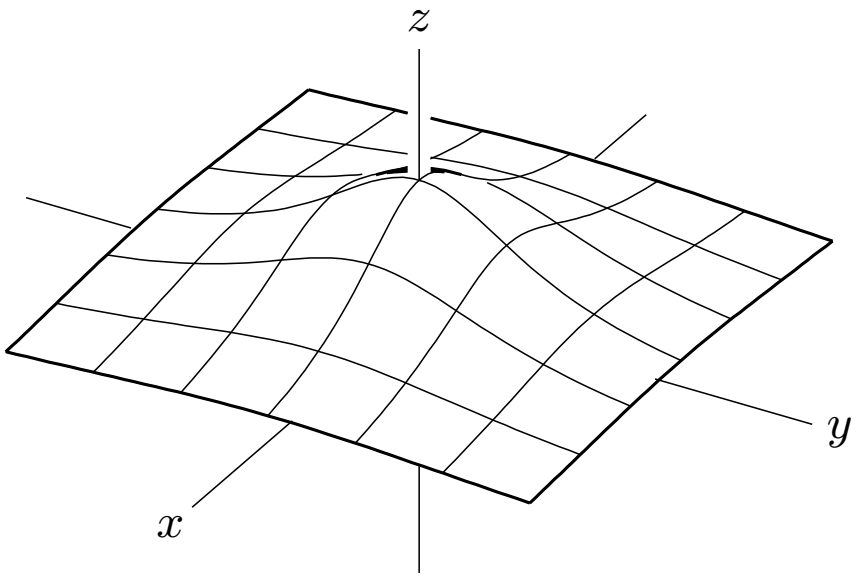

Fig.3. A surface

2. On making math class materials with figures

2.1. Necessity of Figures in Math Class Materials

When a mathematics teacher wishes to make students
understand a mathematical concept and
be awaked to the solution of a mathematical problem,
it plays an impotant role to show them original figures
in his class materials.

2.2. An Example of Class Materials

The Napier's Number e

On the Napier's number e, the followings hold:

(1) Define the Napier's number e by

$$(e^x)'\Big|_{x=0} = \lim_{\Delta x \to 0} \frac{e^{\Delta x} - 1}{\Delta x} = 1.$$

(2) $e = 2.718 \cdots$.

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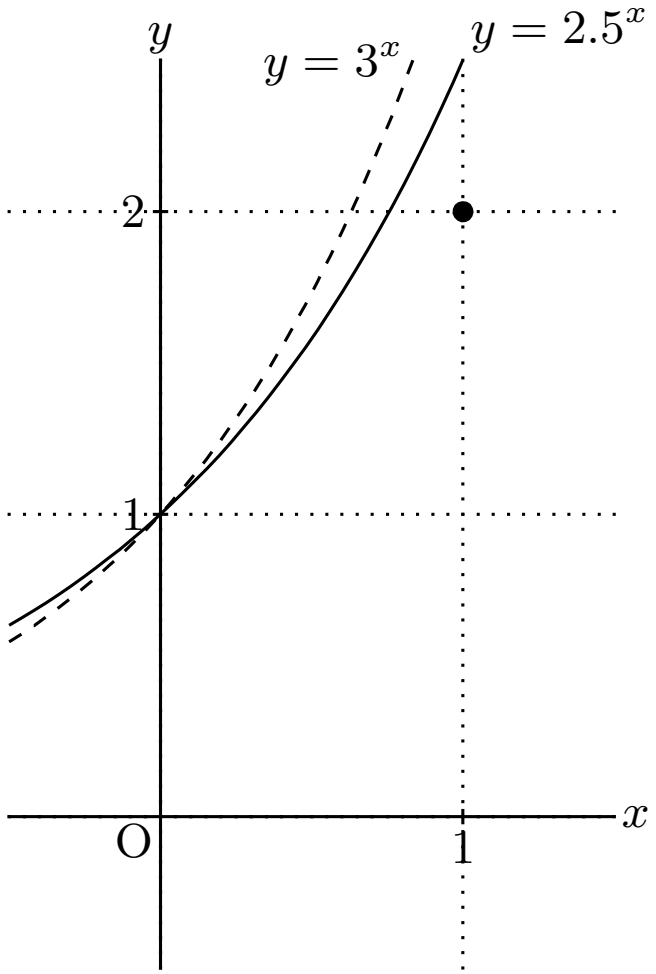

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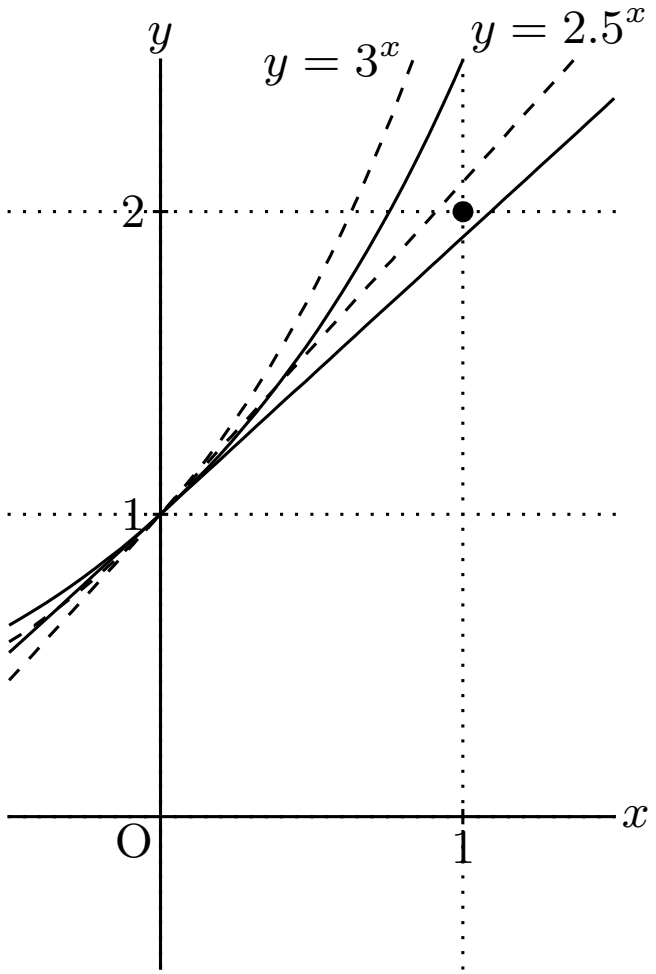

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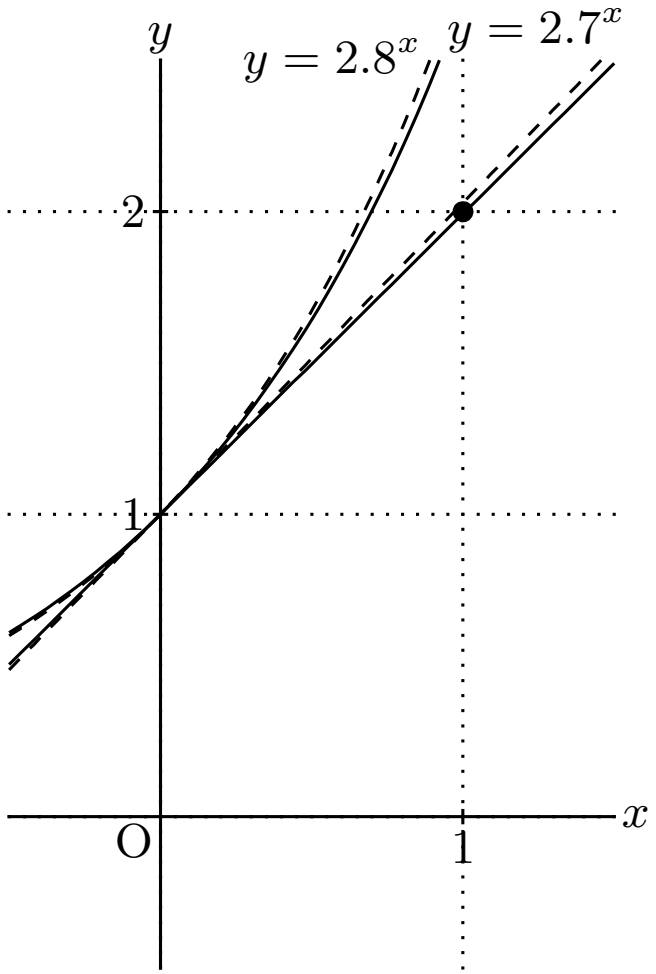

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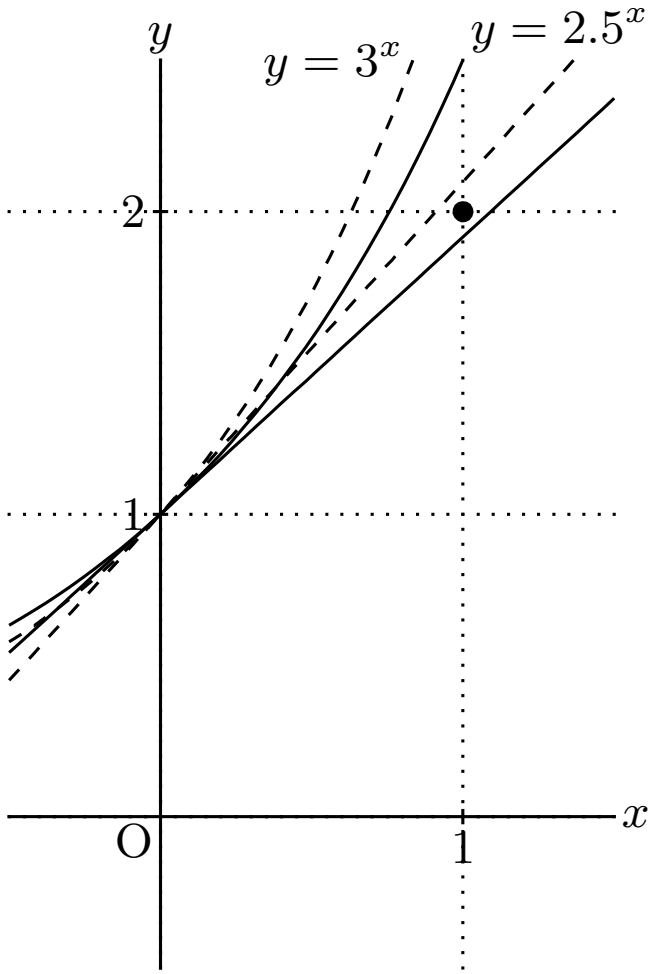
Load KETpic into Scilab.
In Scilab



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Setwindow([-0.5,1.5],[-0.5,2.5]);
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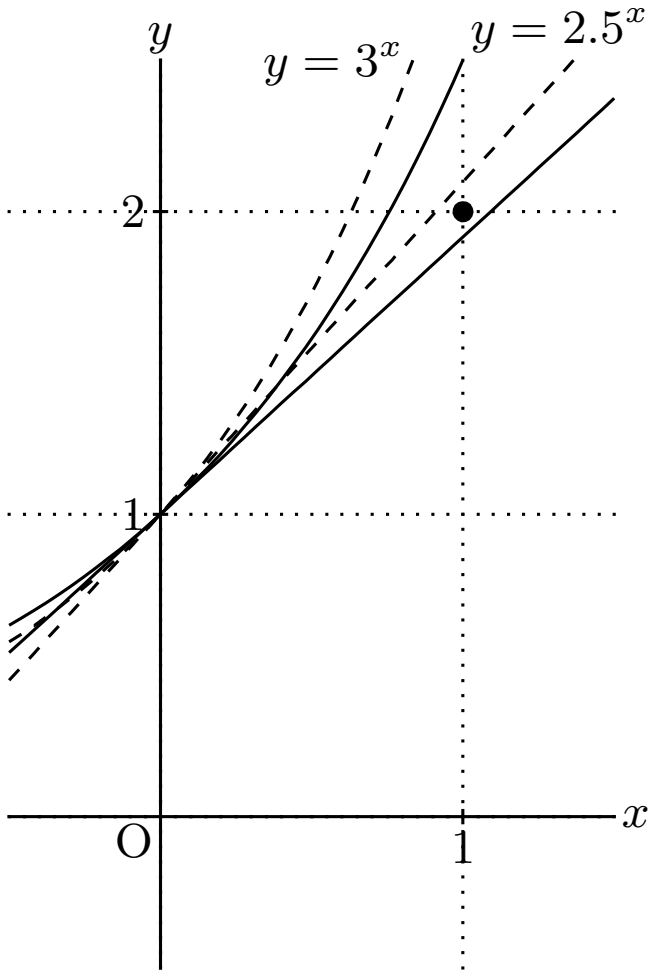

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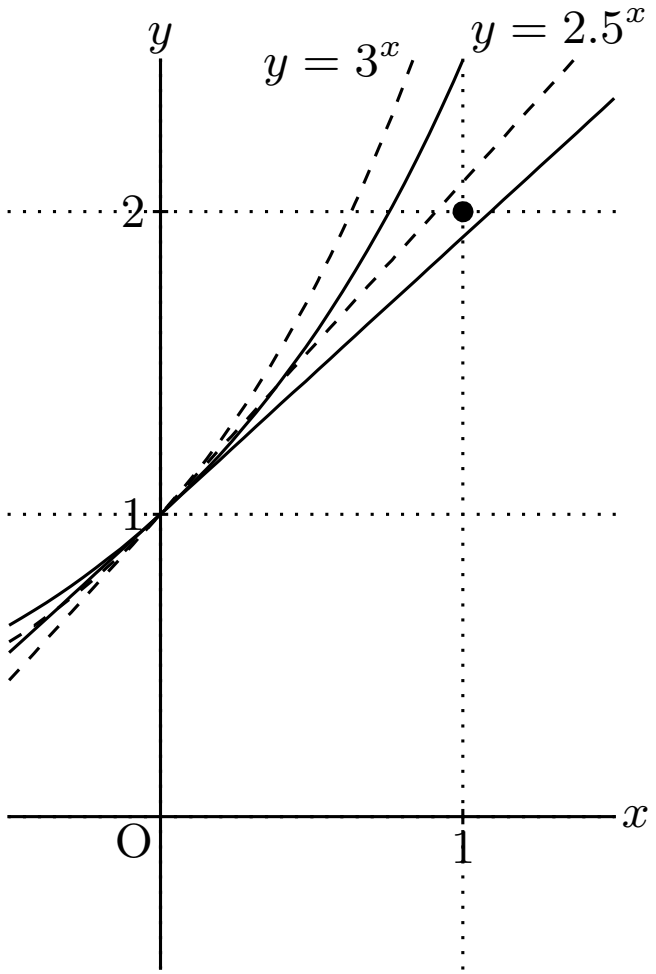
G1=Plotdata('2.5^x','x');
G2=Plotdata('3^x','x');
M1=Derivative('2.5^x','x',0);
G3=Plotdata('M1*x+1','x');
M2=Derivative('3^x','x',0);
G4=Plotdata('M2*x+1','x');
```



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Since KETpic commands are symbolic, we cannot see the righthand figure but can image it.

'Symbolic Thinking' means that math teacher can concentrate the improvement of figures in his class materials while he makes KETpic program of the figures.

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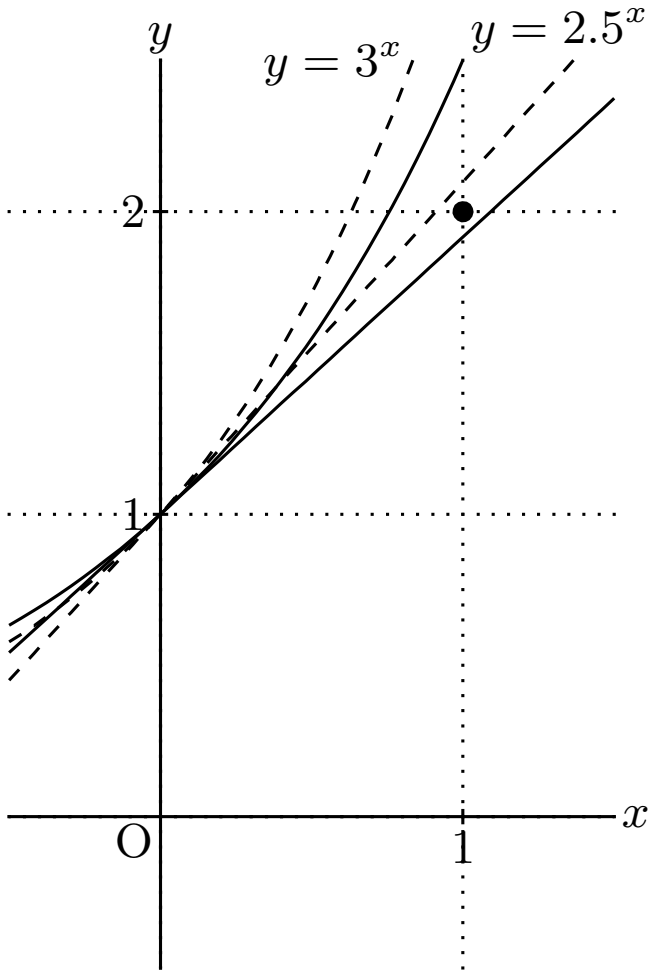

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This program is not so good for estimating the value a of $y = a^x$.

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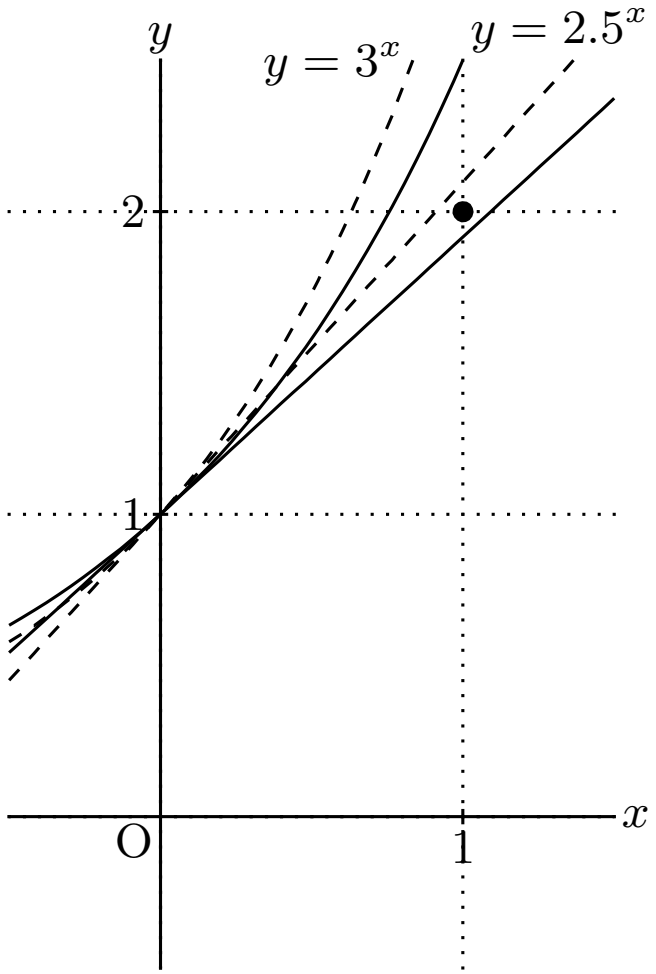

2.3. Making Figures in Class Materials

A good program is as follows:

```
Setwindow([-0.5,1.5],[-0.5,2.5]);
Gp0=Graphpaper(1);
A=[2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 3];
G1=Plotdata('A(1)^x','x');
G2=Plotdata('A(6)^x','x');
M1=Derivative('A(1)^x','x',0);
G3=Plotdata('M1*x+1','x');
M2=Derivative('A(6)^x','x',0);
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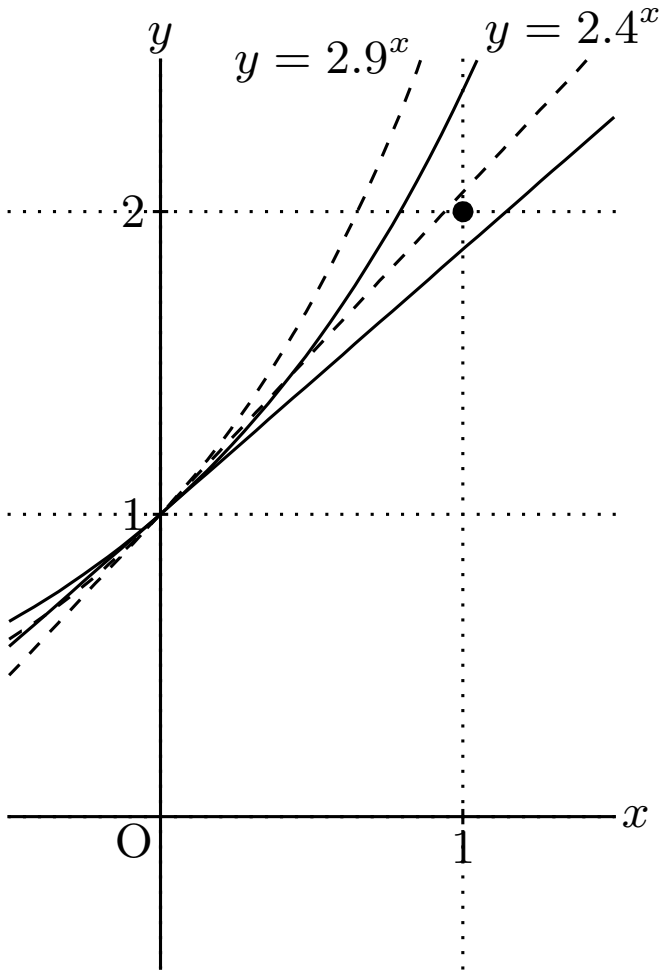

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G1=Plotdata('A(2)^x','x');
G2=Plotdata('A(7)^x','x');
M1=Derivative('A(2)^x','x',0);
G3=Plotdata('M1*x+1','x');
M2=Derivative('A(7)^x','x',0);
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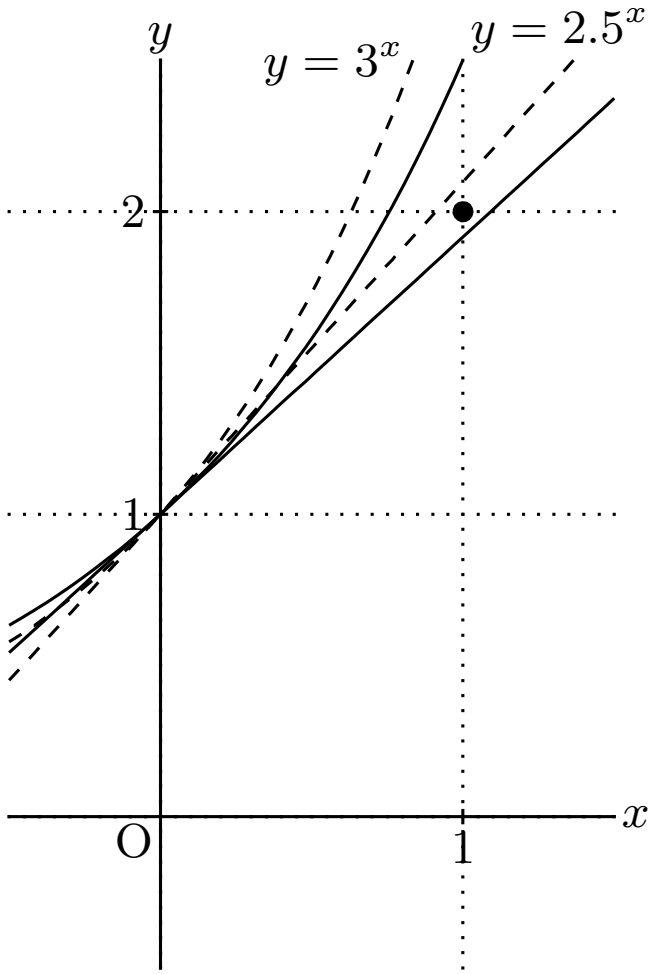

4. Coclusion and future works

4.1. Conclusion

- It is necessary for mathematics teachers to use figures in their class materials because they wish to make their students understand a mathematical concept and be awaked to the solution of a mathematical problem.

4.1. Conclusion

- If mathematics teachers make figures in their class materials based on symbolic thinking by using KETpic, then they obtain the following efficiencies:
  - They can make figures as is freehand sketch.
  - They can make printed class materials as they wanted.
  - They can concentrate to improve on figures in their printed class materials.

4.2. Future works

- I am going to search for the effect of symbolic thinking by checking the figure documentation made by some mathematics teachers.
- I am going to study the mathematics teacher's cognitive system of making figures in the class materials.

4.2. Future works

- I am going to determine the necessary conditions for making printed math class materials, which are
  - mathematics teachers' knowledge on mathematical concepts,
  - mathematics teachers' ideas and expressions for printed math class materials,
  - symbolic thinking while mathematics teachers make printed math class materials,

  and so on.

Hvala vam na pažnji

Thank you for listening

ご清聴
ありがとうございました