KETpic as a tool to make teaching materials and its recent developments

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CAS has become the preferred tool to generate high-quality graphics for scientific research and education today. However, it takes much effort to assure both high-quality of graphics and high-quality of typesetting in mathematical documents. For instance, embedding the graphics generated with CAS into preferred documents such as LaTeX is limited, cumbersome and inefficient.

To remedy this issue, we have developed a macro package of CAS named KETpic, It generates LaTeX - readable code with the aid of CAS, so that image files are neither invoked nor required. Graphics drawn with KETpic has many merits as follows:

(1) Accuracy in shape and length is guaranteed when embedded into LaTeX documents.

(2) Rich mathematical expressions (with the same quality as in LaTeX documents) and various accessories (such as hatchings, shadings and arrow lines) can be easily inserted into figures.

(3) The size of graphical (Tpic) files is astonishingly small compared to their image file counterparts. So that they are suitable for fast web-tech based communication.

Recently, the functionality of KETpic is largely extended so that it can be used for wider purposes, such as editing examination papers, proofreading of textbooks, preparing problems and solutions for tutorials, and so on. The capability to easily generate new graphical commands of LaTeX has been equipped. Moreover, the “picture”-like environment, “layer”, which is newly generated by KETpic endows LaTeX graphics with much greater flexibility and much wider use (see the example below).

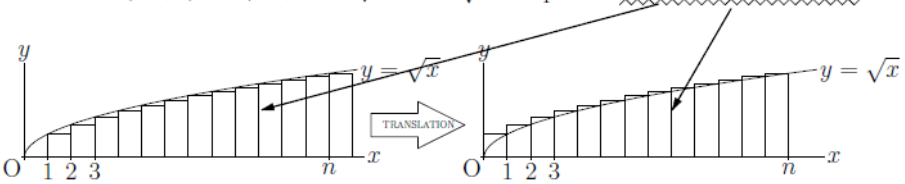
PROBLEM

Show the following inequality:

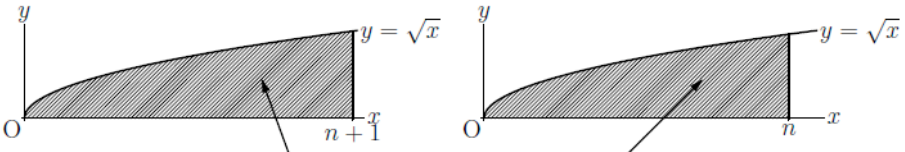
$$\frac{2}{3}n^{\frac{3}{2}} < \sqrt{1}+\sqrt{2}+\sqrt{3}+\cdots+\sqrt{n-1}+\sqrt{n} < \frac{2}{3}(n+1)^{\frac{3}{2}}$$

SOLUTION

The sum $\sqrt{1}+\sqrt{2}+\sqrt{3}+\cdots+\sqrt{n-1}+\sqrt{n}$ is equal to total area of the boxes.



Therefore, they can be compared to the area of the hatched region below.



The former is equal to

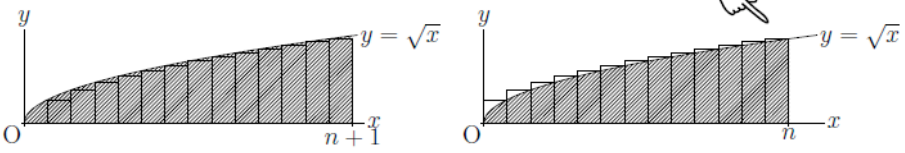
$$\int_0^{n+1} \sqrt{x}dx = \left[\frac{2}{3}x^{\frac{3}{2}}\right]_0^{n+1} = \frac{2}{3}(n+1)^{\frac{3}{2}}$$

The latter is equal to

$$\int_0^{n} \sqrt{x}dx = \left[\frac{2}{3}x^{\frac{3}{2}}\right]_0^{n} = \frac{2}{3}n^{\frac{3}{2}}$$

By comparing these areas in the following figures

The area of boxes exceeds



we can obtain the inequality.

The area of hatched region exceeds

In this talk, we will explain these developments in detail. Also some examples will be displayed to illustrate that the LaTeX graphics generated with KETpic is very effective for mathematics education.