

5946 AAAA

Forays into Anti-Aliased Ascii Art

Aliasing is the term used for artifacts introduced when digitally sampling an analog source due to the finite resolution of the digital capture. Aliasing is a common problem in computer graphics, where lines and smooth curves appear jagged when plotted as pixels. For example, given an equation of a line to be plotted:

$$y = mx + b$$

a naive attempt to draw this line might result in something like

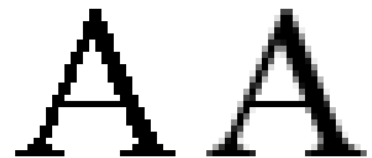
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looking more like a staircase than a smooth line.

Aliasing (a.k.a. *jaggies*) can be countered by *anti-aliasing* schemes in which pixels are drawn in varying shades of gray and, sometimes, diffused over neighboring pixels to yield a smoother-looking image when viewed from sufficient distance, as illustrated by the picture at the top of this page.



One scheme for anti-aliasing lines works on the idea of shading two pixels at a time for each value for each x . Given a point (x, y) where $y = mx + b$, let y_w be the “whole part” of y (the largest integer that is less than or equal to y) and let y_f be the “fractional part” of y such that

$$y_w + y_f = y$$

For example, if $y = 23.56$, then $y_w = 23$ and $y_f = 0.56$. Also, if $y = -1.3$, then $y_w = -2$ and $y_f = 0.7$.

Let the *gray level* of a pixel be a number from 0.0 to 1.0 where 0.0 denotes a pure white pixel and 1.0 denotes a pure black pixel. If y_f is zero, then shade the pixel (x, y_w) at a gray level of 1.0. If y_f is non-zero, then shade the pixel (x, y_w) at a gray level of $1 - y_f$ and shade the pixel $(x, y_w + 1)$ at a gray level of y_f .

Write a program to draw anti-aliased lines according to this scheme.

Input

The input set will consist of several cases. Each case is given as a single line, containing two numbers, m and b , denoting the slope and intercept of the line in the formula

$$y = mx + b$$

These numbers will be presented as floating point numbers with no more than 2 digits after the decimal point. m will be in the range 0.00 to 0.50 inclusive and b will be in the range -20.00 to 20.00 inclusive.

A zero value for both m and b signals the end of input and is not plotted.


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|             -+w# |
|           -+w#@#w+- |
|        -+w#@#w+- |
|  -+w#@#w+- |
| @#w+- |
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