Meaning behind $r$. 

Fact: In the numerator of the computational formula for $r$ is the expression

$$\sum xy - \frac{1}{n}(\sum x)(\sum y).$$

This is actually algebraically equivalent to

$$\sum xy = \sum (x-\bar{x})(y-\bar{y})$$

Note also that the square roots in the denominator are closely related to the standard deviations, $s_x$ and $s_y$, of $x$ and $y$ respectively.

$$s_x = \sqrt{\frac{\sum x^2 - \frac{1}{n}(\sum x)^2}{n-1}} \quad \text{and} \quad s_y = \sqrt{\frac{\sum y^2 - \frac{1}{n}(\sum y)^2}{n-1}}.$$

So $r$ can be rewritten as follows:

$$r = \frac{\sum xy - \frac{1}{n}(\sum x)(\sum y)}{\sqrt{\sum x^2 - \frac{1}{n}(\sum x)^2} \cdot \sqrt{\sum y^2 - \frac{1}{n}(\sum y)^2}} = \frac{\sum (x-\bar{x})(y-\bar{y})}{\sqrt{(n-1)s_x^2} \cdot \sqrt{(n-1)s_y^2}} = \frac{\sum (x-\bar{x})(y-\bar{y})}{s_x \cdot s_y}.$$ 

$$= \frac{\sum (x-\bar{x})(y-\bar{y})}{(n-1)s_x \cdot s_y} = \frac{\sum \frac{x-\bar{x}}{s_x} \left( \frac{y-\bar{y}}{s_y} \right) s_x \cdot s_y}{n-1} = \frac{\sum z_x \cdot z_y}{n-1} = \text{average of } \frac{z_x \cdot z_y}{n-1}.$$