~ Python Pirates

Team Reference Document

17/11/2022

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9. Mathematics

9.1. Sequences.

9.1.1. *Arithmetic progression sum.* Def. $a_n = a + (n-1)d$

$$a + ... + z = \frac{n(a+z)}{2}$$

where a: first number, z: last number, n: amount of numbers

9.1.2. *Geometric progression.*

$$\sum_{n=0}^{n-1} ar^k = ar^0 + ar^1 + ... + ar^{n-1} = a\left(\frac{1-r^n}{1-r}\right)$$

for $r \neq 1$

9.1.3. *Triangular numbers.*

$$\sum_{x=1}^{n} x = 1 + 2 + 3 + ... + n = \frac{n(n+1)}{2} = \binom{n+1}{2}$$

9.1.4. *Square pyramidal numbers.*

$$\sum_{x=1}^{n} x^2 = 1^2 + 2^2 + 3^2 + ... + n^2 = \frac{n(n+1)(2n+1)}{6}$$

9.1.5. *Harmonic numbers.*

$$\sum_{x=1}^{n} \frac{1}{x} = 1 + \frac{1}{2} + \frac{1}{3} + ... + \frac{1}{n} \leq \log_2(N) + 1$$

9.1.6. *Fibonacci (closed-form).*

$$\text{fib}(n) = \frac{(1+\sqrt{5})^n - (1-\sqrt{5})^n}{2^n\sqrt{5}}$$

9.2. Geometry. Geometric areas

Trapezoid area $A = \frac{h}{2} \cdot (a+b)$ where a and b are parallel
Sphere surface area $S = 4\pi \cdot r^2$
Sphere volume $V = \frac{4}{3} \cdot r^3$
Cone surface $S = \pi r(l+r)$
Cone volume $V = \frac{1}{3}\pi hr^2$

9.3. **Combinatorics.** Combinations and Permutations

$P(n,r) = \frac{n!}{(n-r)!}$

$C(n,r) = \binom{n}{r} = \frac{n!}{r!(n-r)!}$

$C(n,r) = C(n,n-r)$

$P(X=r) = C(n,r) \cdot p^r \cdot (1-p)^{n-r}$

9.4. **Combinatorics.** Bayes' Theorem

$P(B|A) = \frac{P(A|B)P(B)}{P(A)}$

$P(B|A) = \frac{P(A|B)P(B)}{P(A|B)P(B)+P(A|\bar{B})P(\bar{B})}$

$P(B_k|A) = \frac{P(A|B_k)P(B_k)}{P(A|B_1)P(B_1)\cdot\ldots\cdot P(A|B_n)P(B_n)}$

10. Python standard library