

Computer Science Cheat Sheet

Greek Alphabet

A	α	Alpha	I	ι	Iota	P	ρ	Rho
B	β	Beta	K	κ	Kappa	Σ	σ	Sigma
Γ	γ	Gamma	Λ	λ	Lambda	T	τ	Tau
Δ	δ	Delta	M	μ	mu	Y	υ	Upsilon
E	ϵ	Epsilon	N	ν	nu	Φ	ϕ	Phi
Z	ζ	Zeta	Ξ	ξ	Xi	X	χ	Chi
H	η	Eta	O	o	Omicron	Ψ	ψ	Psi
Θ	θ	Theta	Π	π	Pi	Ω	ω	Omega

e

$$e = \lim_{n \rightarrow \infty} \left(1 + \frac{1}{n}\right)^n$$
$$\frac{1}{e} = \lim_{n \rightarrow \infty} \left(1 - \frac{1}{n}\right)^n$$
$$e = \sum_{n=0}^{\infty} \frac{1}{n!}$$
$$e = \lim_{x \rightarrow 0} (1+x)^{\frac{1}{x}}$$

Inequalities

$$\binom{n}{k}^k \leq \binom{n}{k} < \left(\frac{en}{k}\right)^k$$
$$\forall x > 0 \qquad \left(1 + \frac{1}{x}\right)^x < e < \left(1 + \frac{a}{x}\right)^{x+1}$$
$$\forall x > 1 \qquad \left(1 - \frac{1}{x}\right)^x < \frac{1}{e} < \left(1 - \frac{1}{x}\right)^{x-1}$$
$$1 + x \leq e^x$$
$$\left(\prod_{i=1}^n a_i\right)^{\frac{1}{n}} \leq \frac{1}{n} \sum_{i=1}^n a_i$$

Approximation Formulas

Stirling’s formula $n! \approx \sqrt{2\pi n} \left(\frac{n}{e}\right)^n$

Abstract Algebra

Field

- A set F with two binary operations $+$ and \cdot ia a *field* if:
- $+$ and \cdot are commutative
 - $+$ and \cdot are associative
 - $+$ and \cdot have identities, 0 and 1 respectively, $0 \neq 1$
 - every element $a \in F$ has inverse for $+$, written $-a$
 - every element $a \in F$ has inverse for \cdot , written a^{-1}
 - $\forall a, b, c \in F, \ a \cdot (b + c) = a \cdot b + a \cdot c$

Vector Space

- A set V over a field F with a binary operation $+$ is a vector space if:
- $+$ is commutative
 - $+$ is associative
 - $+$ has identity $\vec{0}$
 - every $\vec{x} \in V$ has inverse for $+$, written $-\vec{x}$
 - $\alpha(\vec{x} + \vec{y}) = \alpha\vec{x} + \alpha\vec{y}$
 - $(\alpha + \beta)\vec{x} = \alpha\vec{x} + \beta\vec{x}$
 - $(\alpha\beta)\vec{x} = (\alpha)(\beta\vec{x})$
 - $1\vec{x} = \vec{x}$

Linear Algebra

Linear Map

- Let \mathbf{V} and \mathbf{W} be vector spaces over the same field \mathbf{K} . A function $f : \mathbf{V} \rightarrow \mathbf{W}$ is a linear map if for any two vectors $\mathbf{u}, \mathbf{v} \in \mathbf{V}$ and any scalar $c \in \mathbf{K}$:
- $f(\mathbf{u} + \mathbf{v}) = f(\mathbf{u}) + f(\mathbf{v})$
 - $f(c\mathbf{u}) = cf(\mathbf{u})$

Probability

- Jensen’s Inequality:** for any convex function f
- $$E[f(X)] \geq f(E[X])$$
- Markov’s inequality:**
- $$P(X \geq \alpha E[X]) \leq \frac{1}{\alpha}$$

Complexity

Misc

Geometric Series

$$\sum_{i=1}^n aq^i = \frac{a(1 - q^n)}{1 - q}$$