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

$$e = \lim_{n \to \infty} \left(1 + \frac{1}{n}\right)^n$$

$$\frac{1}{e} = \lim_{n \to \infty} \left(1 - \frac{1}{n}\right)^n$$

$$e = \sum_{n=0}^{\infty} \frac{1}{n!}$$

$$e = \lim_{x \to 0} (1 + x)^{\frac{1}{x}}$$

Inequalities

$$\left(\tfrac{n}{k}\right)^k \leq \tbinom{n}{k} < \left(\tfrac{en}{k}\right)^k$$

$\forall x > 0$ $$\left(1 + \tfrac{1}{x}\right)^x < e < \left(1 + \tfrac{a}{x}\right)^{x+1}$$

$\forall x > 1$ $$\left(1 - \tfrac{1}{x}\right)^x < \tfrac{1}{e} < \left(1 - \tfrac{1}{x}\right)^{x-1}$$

$$1 + x \leq e^x$$

$$\left(\Pi_{i=1}^n a_i\right)^{\frac{1}{n}} \leq \tfrac{1}{n} \Sigma_{i=1}^n a_i$$

Approximation Formulas

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

Abstract Algebra

Field

A set F with two binary operations $+$ and $\cdot$ ia a *field* if:

1. $+$ and $\cdot$ are commutative
2. $+$ and $\cdot$ are associative
3. $+$ and $\cdot$ have identities, 0 and 1 respectively, $0 \neq 1$
4. every element $a \in F$ has inverse for $+$, written $-a$
5. every element $a \in F$ has inverse for $\cdot$, written a^{-1}
6. $\forall a, b, c \in F,\ a \cdot (b + c) = a \cdot b + a \cdot c$

Vector Space

A set V over a field F with a binary operation $+$ is a vector space if:

1. $+$ is commutative
2. $+$ is associative
3. $+$ has identity $\vec{0}$
4. every $\vec{x} \in V$ has inverse for $+$, written $-\vec{x}$
5. $\alpha(\vec{x} + \vec{y}) = \alpha\vec{x} + \alpha\vec{y}$
6. $(\alpha + \beta)\vec{x} = \alpha\vec{x} + \beta\vec{x}$
7. $(\alpha\beta)\vec{x} = (\alpha)(\beta\vec{x})$
8. $1\vec{x} = \vec{x}$

Linear Algebra

Linear Map

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

1. $f(\mathbf{u} + \mathbf{v}) = f(\mathbf{u}) + f(\mathbf{v})$
2. $f(c\mathbf{u}) = cf(\mathbf{u})$

Probability

Jensen's Inequality: for any convex function f

$$E[f(X)] \geq f(E[X])$$

Complexity

Misc

Geometric Series

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