FAKTORIALLAR

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Annotatsiya
Ushbu maqolada faktoriallar haqida to'liq ma'lumot keltirilgan. Ikkinchi va uchinchi tartibli faktorillarni hisoblash usulllari keltirib o'tilgan. k - tartibli faktoriallar haqida ma'lumot va ularni hisoblash usullari keltirilgan.

Аннотация
В этой статье представлена подробная информация о факторах. Приведены методы расчета факторов второго и третьего порядка. Информация о порядковых множителях и методах их расчета.

Annotation
This article provides detailed information on the factors. The methods of calculating the second and third order factors are given. Information on ordinal factors and methods of their calculation.

Kalit so'zlar
Faktorial, ikkilamchi faktorial, k - tartibli faktorial, subfaktorial, Pikoverning superfaktoriali, giperfaktorial

Ключевые слова
Факториал, вторичний факториал, факториал к-го порядка, субфакториал, суперфакториал Пиковера, гиперфакториал.

Keywords
Factorial, secondary factorial, k-order factorial, subfactorial, Pickover's superfactorial, hyperfactorial.

Ta'rif: Faktorial deb, 1 dan tayin bir n natural songacha bo'lgan barcha natural sonlarning ko'paytmasi($n! = 1 \cdot 2 \cdot ... \cdot n$) ga aytiladi.

"Faktorial" so'zi inglizcha **"faktor"** ko'paytuvchi so'zidan kelib chiqgan.

Misol: $1! = 1$; $2! = 1 \cdot 2 = 2$; $3! = 1 \cdot 2 \cdot 3 = 6$;...; $n! = 1 \cdot 2 \cdot ... \cdot n$.

Eslatma: $0! = 1$ ekanligini isbotlaymiz.

Isbot: $n! = \dfrac{(n+1)!}{(n+1)}$ n faktorial quyidagi formula oqali aniqlanadi.

Agar $n=1$ bo'lsa, $1!=\dfrac{(1+1)!}{(1+1)}=\dfrac{2!}{2}=1$ ekanligini ko'rsatishimiz mumkin.

Agar $n=2$ bo'lsa, $2!=\dfrac{(2+1)!}{(2+1)}=\dfrac{3!}{3}=2$ ekanligini ko'rsatishimiz mumkin.

Agar $n=3$ bo'lsa, $3!=\dfrac{(3+1)!}{(3+1)}=\dfrac{4!}{4}=6$ ekanligini ko'rsatishimiz mumkin.

Agar $n=0$ bo'lsa, $0!=\dfrac{(0+1)!}{(0+1)}=\dfrac{1!}{1}=1$ ekanligini ko'rsatishimiz mumkin.

Ikkilamchi faktorial: Agar berilgan $n!!$ faktorialda n toq son bo'lsa, $n!!$ n gacha bo'lgan toq sonlar ko'paytmasiga, n juft son bo'lsa $n!!$ n gacha bo'lgan juft sonlar ko'paytmasiga teng bo'ladi.

$$n!!=\begin{cases} n-toq\,son \Rightarrow 1\cdot3\cdot5\cdot7\cdot\ldots\cdot n \\ n-juft\,son \Rightarrow 2\cdot4\cdot6\cdot8\cdot\ldots\cdot n \end{cases}$$

Misol: $5!!=1\cdot3\cdot5=15$; $6!!=2\cdot4\cdot6=48$

Faktoriallar soni yetarlicha ko'p bo'lgan hollar uchun, quyidagi

$$\underset{k\,ta}{n!!!\ldots!}=\begin{cases} n\cdot(n-k)\cdot(n-2k)\ldots(n\bmod k):n \ \ k\,ga\,bo'linmasa \\ n\cdot(n-k)\cdot(n-2k)\ldots\cdot k:n \ \ k\,ga\,bo'linsa \\ \underset{k\,ta}{n!!!\ldots!}=n \ \ \ bo'ladi, agar\,k>n\,bo'lsa \end{cases}$$

formula orqali aniqlanadi.

$n\bmod k$ - n ni k ga bo'lgandagi qoldiq ifodasi.

$6!!!=6\cdot3=18$ $\ k=3;\,n=6$

$7!!!=7\cdot4\cdot1=28$ $\ k=3;\,n=7$

$\underset{5\,ta}{4!!!!!}=4$ $\ \ 5>4$ bo'lganligi uchun.

Ta`rif: Biron natural sonning subfaktoriali quyidagi $n!=n!\displaystyle\sum_{k=0}^{n}\dfrac{(-1)^{k}}{k!}$ formula orqali topiladi va quyidagi $!n \Rightarrow subfaktorial$ ko'rinishda belgilanadi.

$$1!=1!\sum_{k=0}^{1}\frac{(-1)^{k}}{k!}=\frac{(-1)^{0}}{0!}+\frac{(-1)^{1}}{1!}=1-1=0$$

$$2!=2!\sum_{k=0}^{2}\frac{(-1)^{k}}{k!}=2\left(\frac{(-1)^{0}}{0!}+\frac{(-1)^{1}}{1!}+\frac{(-1)^{2}}{2!}\right)=2\cdot\left(1-1+\frac{1}{2}\right)=1$$

Superfaktorial: Superfaktorial tushunchasi fanga dastlab 1995 yil **Neyl Sloan** va **Simon Pluffe** kiritgan. n sonining superfaktorial bu n dan katta bo`lmagan sonlarning faktoriallar ko`paytmasiga teng.

$$sf(n) = \prod_{k=1}^{n} k!$$

Misol: $sf(5) = ?$ $\quad sf(5) = 1! \cdot 2! \cdot 3! \cdot 4! \cdot 5! = 34560$

Pikoverning superfaktoriali: Uning 1995 yilgi kitobida cheksizlikning kalitlari "**Klifford Pikover**" boshqa funksiyani aniqladi va quyidagi $n\$$ - superfaktorial deb belgilanadi. U tomonidan belgilanadi.

$$n\$ = n!^{n!^{\cdot^{\cdot^{n!}}}} \Big\} n! \, ta$$

Misol: $1\$ = 1 \quad 2\$ = 2^2 = 4 \quad 3\$ = 6^{6^{6^{6^{6^6}}}}$

Giperfaktorial: Giperfaktorial tushunchasini fanga dastlab 2000-yili **Genri Bottomli** kiritgan. n sonining giperfaktorial bu n dan katta bo`lmagan sonlarning superfaktoriallar ko`paytmasiga teng va quyidagi $gf(n) = \prod_{k=1}^{n} sf(n)$ ko'rinishda belgilanadi.

Masalan: $gf(4) = ?$

$gf(4) = sf(1) \cdot sf(2) \cdot sf(3) \cdot sf(4) = 1 \cdot 2 \cdot 12 \cdot 288 = 6912$

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