NEW AND INTERESTING MATHEMATICAL FORMULAS

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Number Theory

“Wherever a number is the beauty”

[Proclo]

Abstract

This article disseminates a series of new and interesting mathematical formulas, there are formulas of prime numbers, fibonacci sequence, square root and others as product of the investigations of the author since 2011.

Keys. Mathematical Formulas, New Formulas, Number Theory, Prime Numbers, Fibonacci Sequence, Square Root, Interesting Formulas, Math.

FÓRMULAS

1) Formula that produces prime numbers.

$$a(n)= \sum_{m=1}^{\frac{n^2}{2}} \left\lfloor \left\lfloor \frac{n}{\sum_{j=1}^{m} \left\lfloor \left\lfloor \mathrm{GCD}\left[2, \frac{(j-1)!+1}{j}\right] \right\rfloor \right\rfloor} \right\rfloor^{\frac{1}{n}} \right\rfloor + 1$$

This is the code of Wolfram Mathematica:

```
F[n_] :=n*Floor[GCD[((n-1)!+1)/n,2]];
P[n_] :=1+Sum[  Floor[ Floor[ n/(Sum[ Floor[F[j]/j],{j,1,m}])]^(1/n)   ],{m,1,(n/2)*n}];
AbsoluteTiming[Table[P[n],{n,2,10}]]
{0.0660029 Second,{2,3,5,7,11,13,17,19,23}}
```

2) Formula to test prime numbers.

$$\mathbf{a(n)} = n \left\lfloor \frac{2}{n - \sum_{i=1}^{n} \left\lceil \left\{ \frac{n}{i} \right\} \right\rceil} \right\rfloor$$

Si a(n)= n, entonces "n" es Primo, para n>1.

DONDE

$\{\square\}$ *Parte Fraccionaria (Fractional Part)*

$\lceil \square \rceil \rightarrow$ *Función Techo (Ceiling)*

$\lfloor \square \rfloor \rightarrow$ *Función Piso (Floor)*

CÓDIGO EN MATEMATHICA
Table[n* Floor[2/(n-Sum[Ceiling[FractionalPart[n/i]],{i,1,n}])],{n,2,100}]

3) This formula return the sum of predecessors to a natural number, based wilson's theorem.

$$a(n) = \sum_{i=1}^{n-1} i * \left\lfloor \frac{(i-1)!\, mod\ i + 1}{i} \right\rfloor - 1$$

Para toda n>1

{0,2,5,5,10,10,17,17,17,17,28,28,41,41,41,41,58,58,77,77,77,77,100,100,100,100,100,100,129,129,160,160,160,160,160,160,197,197,197,197,238,238,281,281,281,281,328,328,328,328,328,328,381,381,381,381,381,381,440,440,501,501,501,501,501,501,568,568,568,568,639,639,712,712,712,712,712,712,791,791,791,791,874,874,874,874,874,874,963,963,963,963,963,963,963,963,1060,1060,1060}

CÓDIGO PARA EL PROGRAMA WOLFRAM MATEMATHICA

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Table[    Sum[ i*Floor[ (Mod[ (i-1)!,i] +1) /i] ,{i,1,n-1}]-1,{n,2,100}]
```

4) Formula for counting prime numbers < 10^n

$$\sum_{n=1}^{10^n} \left\lfloor \frac{2}{\sum_{k=1}^{n} \left(\frac{-n+(n-1) \bmod k+1}{k} + \frac{n-n \bmod k}{k} \right)} \right\rfloor - 2$$

{0, 4, 25 …

5) Formula for calculate perfect numbers.

FÓRMULA PARA CALCULAR NÚMEROS PERFECTOS

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$$\mathbf{a(n)} = n - \sum_{i=1}^{\left\lfloor \frac{n}{2} \right\rfloor} i \left\lfloor \frac{1}{\left\lceil \left\{ \frac{n}{i} \right\} \right\rceil + 1} \right\rfloor$$

Sí a(n)=0 entonces "n" es Perfecto.

DONDE

$\{\square\} \rightarrow$ *Parte Fraccionaria (Fractional Part)*

$\lceil \square \rceil \rightarrow$ *Función Techo (Ceiling)*

$\lfloor \square \rfloor \rightarrow$ *Función Piso (Floor)*

CÓDIGO EN MATEMATHICA

```
Table[  n- Sum[  i*Floor[1/(1+
Ceiling[FractionalPart[n/i]])],{i,1,Floor[n/2]} ] ,{n,1,500}]
Flatten[Position[CC,0]]
```

6) Formula for calculate the amount of divisors of natural number.

FÓRMULA QUE DEVUELVE LA CANTIDAD DE DIVISORES DE UN NÚMERO NATURAL "n".

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$$\mathbf{a(n)} = n - \sum_{i=1}^{n} \left\lceil \left\{ \frac{n}{i} \right\} \right\rceil$$

DONDE

$\{\square\} \rightarrow$ *Parte Fraccionaria (Fractional Part)*

$\lceil \square \rceil \rightarrow$ *Función Techo (Ceiling)*

CÓDIGO EN MATEMATHICA

```
Table[ n-Sum[
Ceiling[FractionalPart[n/i]],{i,1,n}],{n,1,100}]
```

7) Formula for calculate the square root.

FÓRMULA QUE CALCULA LA RAIZ CUADRADA DE UN NÚMERO CON UNA EXCELENTE APROXIMACIÓN

(BASADO EN EL MÉTODO HINDÚ)

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$$\sqrt{n} \approx \frac{A^4 + 6A^2n + n^2}{4A^3 + 4An}$$

Donde:

$$A = \sum_{i=1}^{\frac{n}{2}} \left\lceil \frac{\left\lfloor \frac{n-1}{i^2+i} \right\rfloor}{2n} \right\rceil + 1$$

8) Formula for calculate the Fibonacci sequence.

FÓRMULA QUE PRODUCE LA SUCESIÓN DE FIBONACCI

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$$a(n) = \sum_{i=1}^{\infty} \left\lceil \frac{\left\lfloor \frac{n-1}{\left\lfloor \frac{\log(\sqrt{5}\,(i+0.2))}{\log(\phi)} \right\rfloor} \right\rfloor}{2n} \right\rceil + 1$$

9) Formula for calculate the square root, a good aproximation.

FÓRMULA PARA CALCULAR
LA RAÍZ CUADRADA DE UN NÚMERO REAL
(Excelente Aproximación)

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$$\sqrt{n} \approx A + \frac{n - A^2}{2A} \quad \text{Where } A = 1 + \sum_{i=1}^{\frac{n}{2}} \left\lfloor \frac{\left\lfloor \frac{n-1}{i^2+i} \right\rfloor}{2n} \right\rfloor$$

Código Wolfram Mathematica
Table[N[(1+ Sum[Ceiling[Floor[(n-1)/(i^2+i)]/(2n)] ,{i,1, n/2 }]) + (n-(1+ Sum[Ceiling[Floor[(n-1)/(i^2+i)]/(2n)] ,{i,1, n/2 }])^2)/(2(1+ Sum[Ceiling[Floor[(n-1)/(i^2+i)]/(2n)] ,{i,1, n/2 }])) ,5] ,{n,1,50}]
FIRST 100 VALUES: {1.0000,1.5000,1.7500,2.0000,2.2500,2.5000,2.6667,2.8333,3.0000,3.1667,3.3333,3.5000,3.6250,3.7500,3.8750,4.0000,4.1250,4.2500,4.3750,4.5000,4.6000,4.7000,4.8000,4.9000,5.0000,5.1000,5.2000,5.3000,5.4000,5.5000,5.5833,5.6667,5.7500,5.8333,5.9167,6.0000,6.0833,6.1667,6.2500,6.3333,6.4167,6.5000,6.5714,6.6429,6.7143,6.7857,6.8571,6.9286,7.0000,7.0714,7.1429,7.2143,7.2857,7.3571,7.4286,7.5000,7.5625,7.6250,7.6875,7.7500,7.8125,7.8750,7.9375,8.0000,8.0625,8.1250,8.1875,8.2500,8.3125,8.3750,8.4375,8.5000,8.5556,8.6111,8.6667,8.7222,8.7778,8.8333,8.8889,8.9444,9.0000,9.0556,9.1111,9.1667,9.2222,9.2778,9.3333,9.3889,9.4444,9.5000,9.5500,9.6000,9.6500,9.7000,9.7500,9.8000,9.8500,9.9000,9.9500,10.000}

10) Formula that return a max digit of natural number.

FÓRMULA QUE DADO UN NÚMERO NATURAL "k"
DEVUELVE EL DÍGITO MAYOR DE ESTE NÚMERO.

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$$a(1) = k \bmod 10$$

$$a(n) = [a(n-1) + w \bmod 10 + |w \bmod 10 - a(n-1)|]/2$$

DONDE:

$$w = \left\lfloor \frac{k}{10^{n-1}} \right\rfloor \text{ Para todo n=1...}[Log10(10k)]$$

$\lfloor \square \rfloor \rightarrow$ *Función Piso (Floor)*
$|\square| \rightarrow$ *Valor Absoluto (Abs)*
Mod →Función Residuo (Mod)

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k=211;
b[1]=Mod[k,10];
b[n_]:= (b[n-1] + Mod[Floor[k/10^(n-1)] ,10] + Abs[Mod[Floor[k/10^(n-1)] ,10]- b[n-1]])/2
Table[b[n],{n,1,Floor[Log[10,10k]]}]