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PH-DOC

2019ázt'05æIJL28æÚě

C / C++ / C#

**CRC-16**

CRC-16Ařèl'dãCLædIJãGžçñèàRûãAõãAšãAíãAđãAğãĂããÇTãÇããCđãCñãCšãCšãCĚãČLãČDãČĜãČijãČfèžcéĂããAñãA  
èLçóUãCèãCñãCřãCřãCzãCããAřãAíãAřãAšãAđãAğãĂããÇTãÇããCđãCñãCšãCšãCĚãČLãČDãČĜãČijãČfèžcéĂããAñãA  
ãLãIãJãŠããAđ(ãinit), ãRãDãèãžãèãEãèãLãŽ(ãrefin), ãRãDãèãžãèãGãžãLãŽ(ãrefout), æÕãSãžãÛãÇãZãDãèãÛãÇãRãEãSãNããGãžãLãŽ(ãxorout)ãAãNãÇãTãřãAãIããCãLã  
ãČLããAãŘããĚããČãRããCãNããAãĚããDããCãNããCãŠããČãIããÇããĚããAãñããAãřããDããLãDããAãNããAãđããAãŠããCãLããCãNããAãĚããDããAãĚããĂããCatalogue  
of parametrised CRC algorithms with 16bits ãAãñããCãLããCãNããAãřããAãĚããCãLããAãŘããÇããèããCãLããCãNããAãŠããCãRããCã  
16ããAãIããAãÛããAãĚããžããèããÿãNããAãšã30çlõèãđããAãNããAãČããCãLããAãĚããAãŽããĂããAãŠããAãŠããAãğããAãřããCãIããCãzããCãLããCãSãçãæãĚããAãñããAãŽããCãNããAãŠããCãAãñãã

ARC

CRC-16/AUG-CCITT

CRC-16/BUYPASS

CRC-16/CCITT-FALSE

CRC-16/CDMA2000

CRC-16/CMS

CRC-16/DDS-100

CRC-16/DECT-R

CRC-16/DECT-X

CRC-16/DNP

CRC-16/EN-13757

CRC-16/GENIBUS

CRC-16/GSM

CRC-16/LJ1200

CRC-16/MAXIM

CRC-16/MCRF4XX

CRC-16/OPENSAFETY-A

CRC-16/OPENSAFETY-B

CRC-16/PROFIBUS

CRC-16/RIELLO

CRC-16/T10-DIF

CRC-16/TELEDISK

CRC-16/TMS37157

CRC-16/USB

CRC-A

KERMIT

MODBUS

NRSC\_5

X-25

XMODEM

ãAãČãAãIããAãšããAãõããCãÛããCãñããCãÿããCãřããČãLããAãğããAãšããAãõããCãLããAãĚããAãIããRãDããLãDããAãNããGãžããAãĚããAãDããAãšããAãIããCãLããAãIããCãNããAãřããCãTããæãŽããCã  
ãAãžããAãIããCãŠããAãIããAãõãããřããLããAãřããDããJããAãñããAãNããCãRããCã16ããCãSããCãAããCãğããCãCããCãřããCãĚããCãããAãIããAãZããCãNããAãCãçãTãšãæãLãřããDããZããEããIããĚããAãřããAã  
ããAãÛããAãĚããDããAãñããAãřããCãđããCãšããCãĚããCãIããĚããCãCããCãLããÿããLããAãğããAãIããAãÛããAãDããCãĚããCãIããCãžããCãšããCãIããCãLããCãSããAãIããAãõããAãĚããAãšããCãèãEããAã

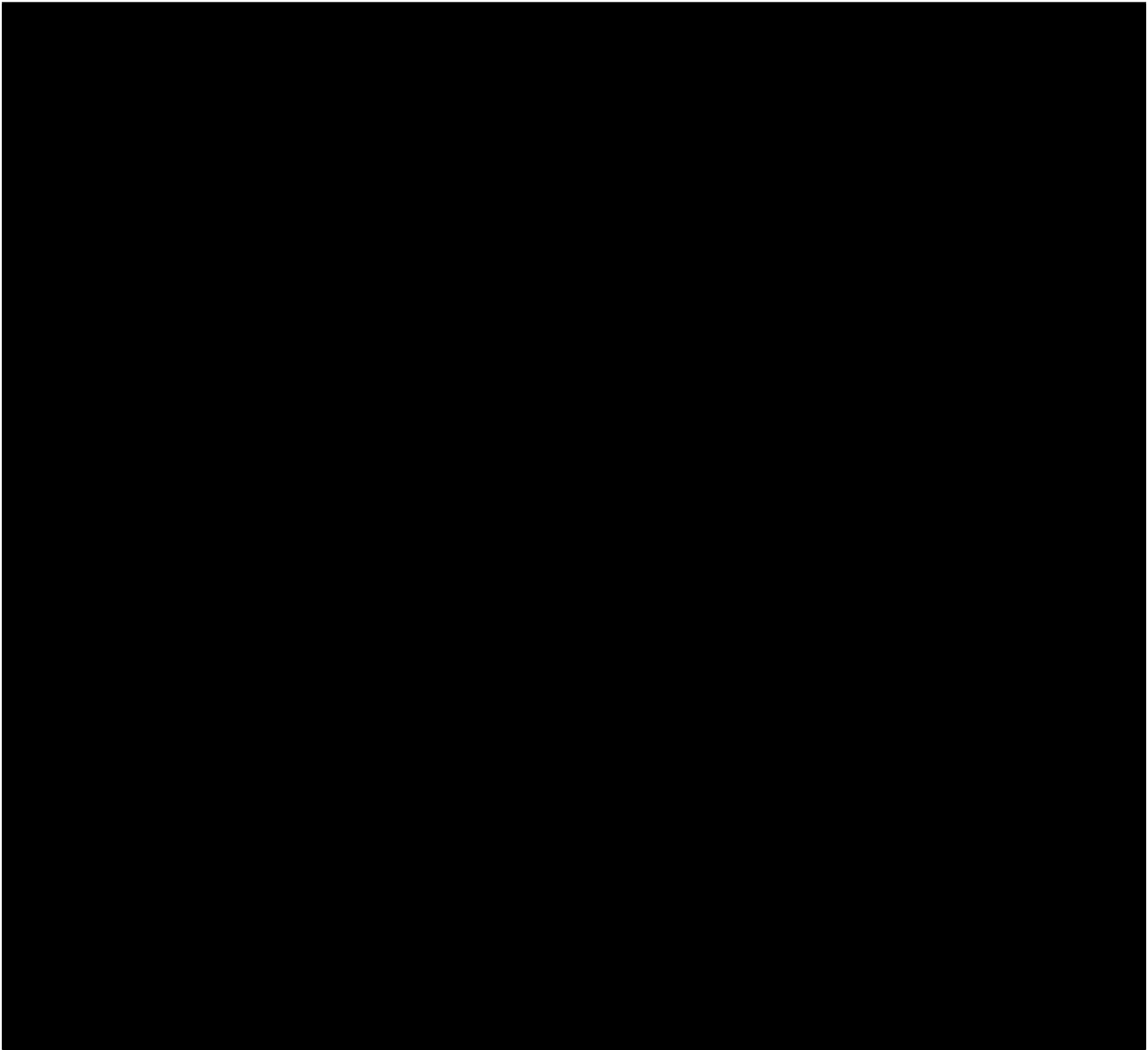
## CRC-16

Catalogue of parametrised CRC algorithms with 16bits

Polynomial	0x1021	Initial value	0xffff
Refin		Refout	
Xorout	0x0000		
Seed	123456789		
Check	0x29b1		

CRC-16

A Painless Guide to CRC Error Detection Algorithms





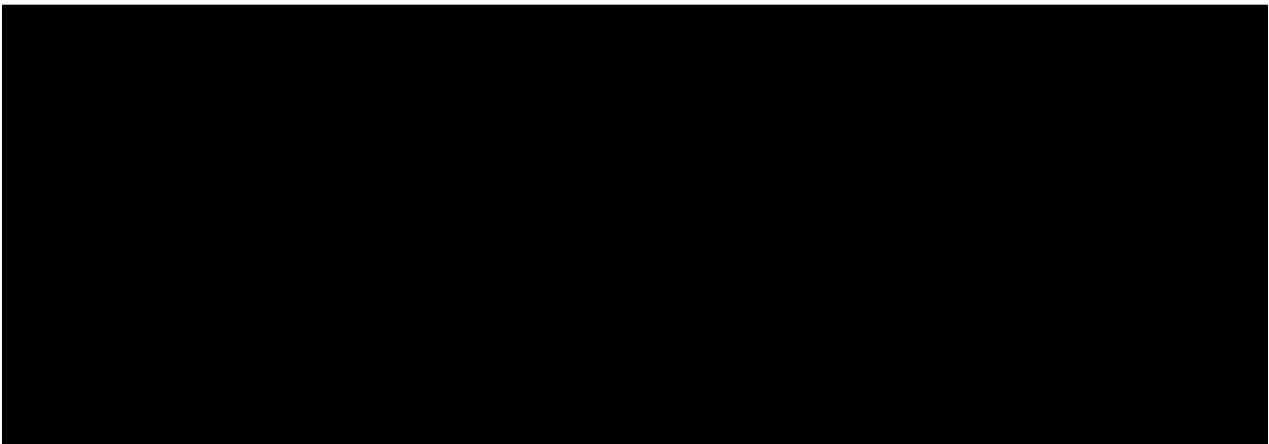
## MS-DOS 6.0 32-bit C Compiler

MS-DOS 6.0 32-bit C Compiler  
32-bit C Compiler for MS-DOS 6.0

1. Compiler options

2. Compiler options [BX, BP] + [SI, DI] compiler flags

MS-DOS 6.0 32-bit C Compiler  
32-bit C Compiler for MS-DOS 6.0  
NASM Hello, world!



MS-DOS 6.0 32-bit C Compiler  
MS-DOS MASM 32-bit C Compiler  
32-bit C Compiler for MS-DOS 6.0

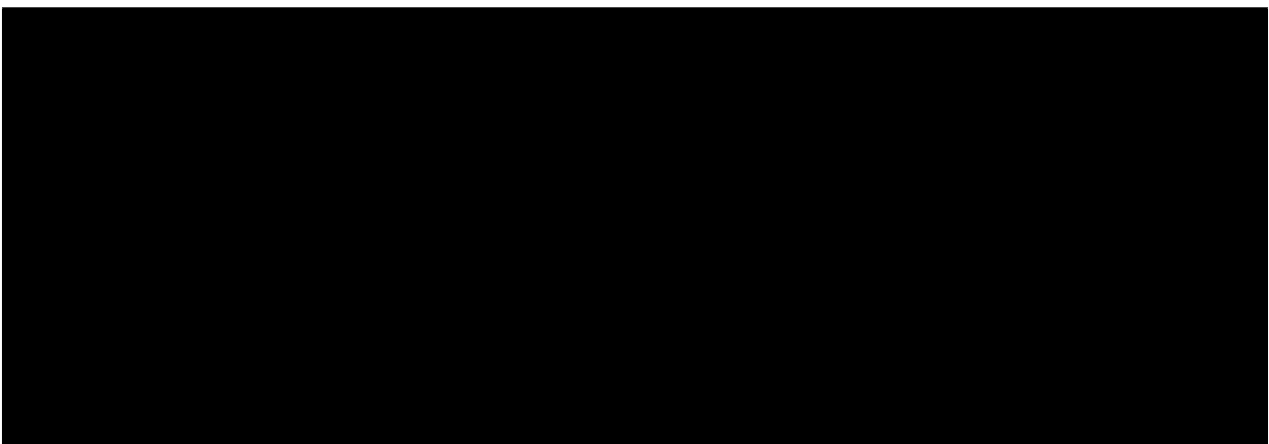
MS-DOS 6.0 32-bit C Compiler  
32-bit C Compiler for MS-DOS 6.0  
NASM Hello, world!

MS-DOS 6.0 32-bit C Compiler  
32-bit C Compiler for MS-DOS 6.0  
NASM Hello, world!

NASM 6.0 32-bit C Compiler



MS-DOS 6.0 32-bit C Compiler



(MS-DOS 6.0 32-bit C Compiler)

```
COMactCaacdncnsyOaAlaCnAraAAosseaNrreCjaAfaCzAcLacuauCnaCracfaaCSaGzaLzaUaAiAAza
```

## azzæDRæAoaCUæCraCraCaaAnaCzaCæaCUæCUæCraCraCaaCSašNaCAejijaCA

```
Visual C++ aCSetuNTaAUæAæAAazzæDRæAoaCUæCraCraCaaAnaCzaCæaCUæCUæCraCraCaaCSašNaCAejijaCA  
āāNāCŪāCācyāCgaCrāCāLāā→āāN(āCŪāCācyāCgaCrāCāLāā) āAaCūāCāCSāCEāCāā→āāNægNæLRāCŪāCāC  
āānāĀāCzāCāCŪāCŪāCraCraCāāCSē;āLāāAZāCNāCāCŪāCŪāCgaCgaAgāELāAzaĀfāAšMZYāCCāCĀāCSēŁ  
āĀIāĀŪāAæāCSāCnāCLāAZāCNāĀIāĀAMS-DOSāAgāNTāĀNāĀŪāAšēZāĀn Hello, world!  
āĀIāGzāLZāAZāCNāCŪāCraCraCāāCSCTšæLRāAgāĀDāĀ;āAZāĀC
```

## NetworkStream#DataAvailableAræ;æAææAææAræADæAšĀĀĀĀ

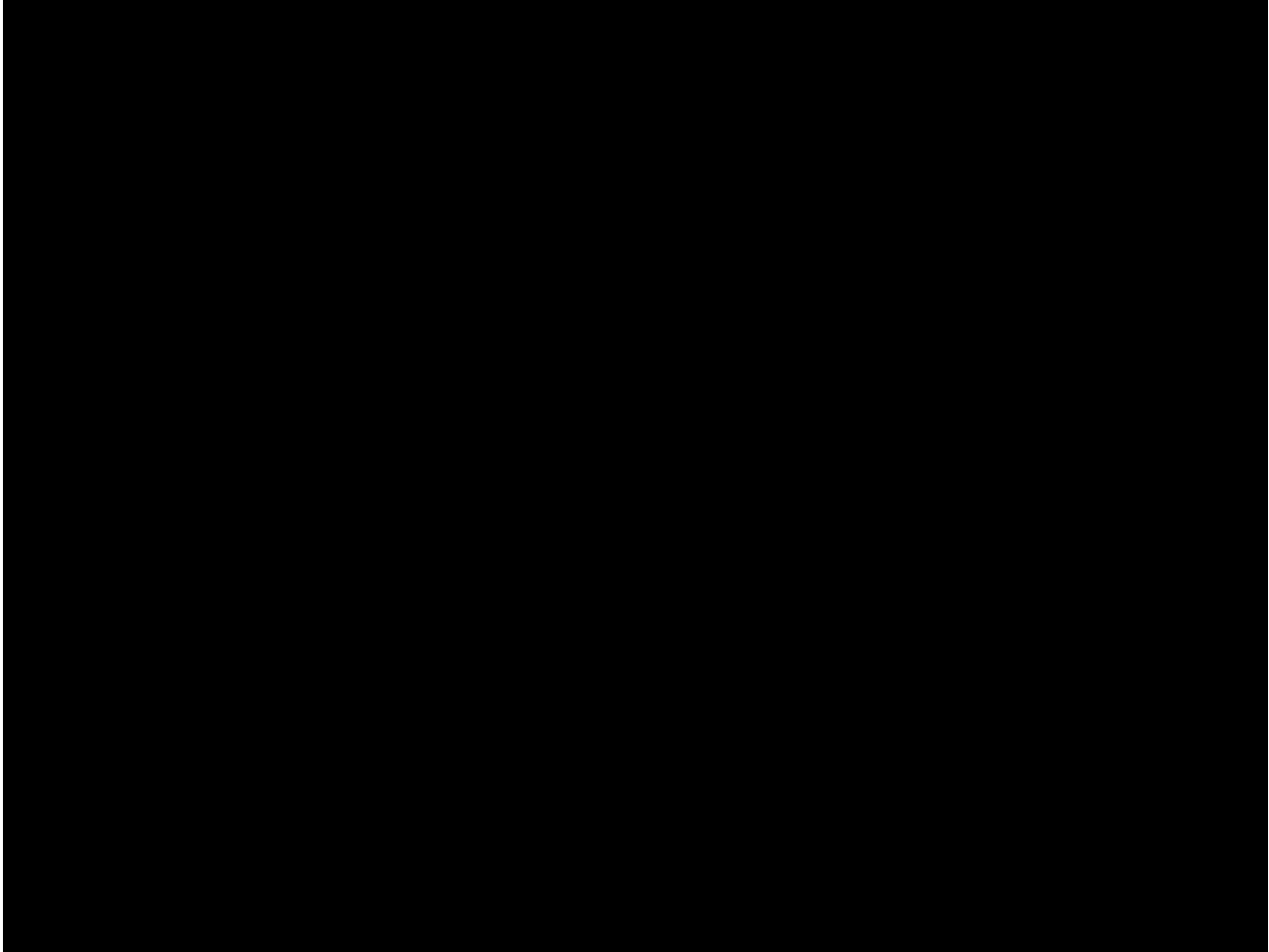
```
C#āAš NetworkStream.DataAvailable āAræĀĀ TcpClient#GetStream()  
āĀIāĀfāĀNāCLā; ŪāCLāCNāCNāCzāCLāCāCijaCāāAnaCgaCijaCāāNāĀCāCNāĀNāĀfāĀĀāNāCSēceHāAZāCNāCŪ  
MSDNāAšōāEnāijRāCāCŪāCāāCzāāNāĀrāCŪāCsaCUāCnāCsaCijaCLāĀnejLāAæāAæāĀDāĀ;āAZāĀNāĀĀAšāCŪ
```

## āCSāCijaCLāAšōelnaēYŌ

```
NetworkStream#Read(Byte[], Int32, Int32) āAræCŌāCzāCŪāCraCraCāāCraCraCāāAgāCraCāCāCLāLŪāCSēhjaĀŁāRŪāAæāĀ  
ēŁTāCLāĀdāAr0āzēäyLāAšōæTrāAgāĀĀāC;āCSāCāCLāĀNēŪLāĀYāCLāCNāĀæāĀDāCŪāāĀRĀĀIāRŪāŁāāCgaCijaCāā  
NetworkStream#DataAvailable āAræRŪāŁāāCgaCijaCāāNāĀCāCNāĀIāCLtrueāĀāĀIāĀDāĀIāCLfalseāCSēŁTāĀŪāĀ;  
āyĀēēNēLrāĀTāĀIāĀĀāIāCzāCijaCLāĀnēēNāĀLāĀ;āAZāĀNāĀĀænaāAšōTRēāNāĀNāĀCāCLāĀ;āAZāĀC
```

## TCPāCSāCSāCāCLāĀrāLEĀL'sāĀTāCNāĀĀĀĀ

```
āAšāĀĀĀdāAšTCPāCSāCSāCāCLāĀgæIĴšā;ĒāĀŪāĀæĀĀDāCNāĒlāCgāCijaCāāCšāRŪāŁāāAgāĀĀĀCNāĒlēIjaĀrāĀCā  
ā;NāĀLāĀrāĀĀ64āCRāCāCāLāAšōāCgaCijaCāāCSēĀĀāŁāāZāCNāāāRĀĀnāĀĀĀĀĀĀĀĀĀĀĀĀĀĀĀĀĀĀĀĀĀĀĀĀĀĀĀĀĀĀ  
āĀIāĀšōāNzāNTāCSēd'zāAZāAšōāĀNænaāAšōāCSāCijaCLāĀgāAZāĀCWindowsāĀgāCMac OS  
XāĀgāCāēIĴāĀĀāĀn2āCRāCāCāLēĀĀāŁāāĀŪāĀæāĀAšōāCSāCSāCāCLāĀg62āCRāCāCāCLēĀĀāŁāāŪāĀ;āAZā
```



ãAŞãAõãCşãČijãČLãAřãĀãČŋãČijãČŋãČŋãČãČLãČňãCžãAõ50000ãČlãČijãČLãAŋTCPãČťãČijãČRãČSãžzãAęãĀãĀLãĀãAŞãAõãCŮãČŋãČřãČřãČããAõãGžãLŽãAřãĀA



ãAĀãAĀãČLãĀãĀæIJšãĵĒãAŮãAŞ64ãČRãČďãČLãAõãRŮãĚãĀňãAřãAĀãČLãAĀãĀDãAŞãAĀãĀÑãAČãČLãAĵĵãAŽãĀČ  
æŞňãijçZDãAĀãČDãČČãČLãČřãČijãČřãAõãĀĒũãĀĀãAŮãĀę Thread.Sleep()  
ãČSãĒãĀãĀęãĀďãČSãďgãĀDãĀRãĀŮãĀęãĀDãĀRãĀĀãĀççzãĀÑãĀňãĀĒãĀĵãĀRãĀDãĀÑãĀĀãĀDãĀŞãĀĀãĀÑçzëHD

**äyĀãžęãĀňãĒĀãČGãČijãČĚãČSãĀãČŇãAřãĀDãĀDãĀõãAğãĀřĀiijS**

ãCžãČLãČĀãČijãČããĀňãĀĀãAõãČĵãžãGžãLŽãAŽãAŽãĀZãĀZãĀõãGęçREãĀğãĒĀãČGãČijãČĚãČSãĀãĒãĀãAŽãČŇãAřãĀA  
ãČřãČďãCŮãČřãČĀãAõãČRãČČãČřãČĀãČĀãČĀãČřãAõãžTęęYãĀňãČLãČŇãĀĀãAŞãČDãČČãĀČãČĚãĀĵĵãAŽãAŮãĀA  
ãĀĀãČČãĀĀãČČãĀãČŇãČGãČijãČĚãĀňãďgãĀDãĀDãĀĀãĀRLãAřãĀãĀãČďãČijãČťãČDãČČãČLãČřãČŋãČijãČããĀňãRŮãČ  
ãĒãĒãĒãĀĤãČŇãAŞãČSãČSãČČãČLãĀŇãĀLřçĀãAŽãČŇãĒũŞãĀňãRŮãĒãĒãGęçREãČSãAŽãČŇãAřãĀA0ãČRãČďãČLãRŮãĒ

**ãAğãAřãĀřãĀĒãAŽãČŇãAřãĀDãĀDãĀõãĀňĀiijS**

ãČĚãČďãČããČããČęãČLãĀĀãČŮãČŋãČČãČŋãČşãČřãGęçREãČŞçťDãĀĚãĀĀLãČRãAŽãČŇãĀžãĀDãĀğãAŽãĀČ  
ReceiveTimeout ãCŮãČŋãČSãČĒãČããĀňãCŮãČŋãČLãČşãČŇãĀğãõZãČĀãČŇãĀĀãAŞãČDãĀõãČĚãČďãČããČããČęãČĒã  
BinaryReader ãAõãČLãĀĒãĀĀãCŮãČŋãČČãČŋãČşãČřãĀĤãĀĚĵĵãĀĚãČSãAŽãČŇãČřãČřãČžãČSãĵĵãĀĒãĀęãĀĀãĀğãČGã

**x86 Load Effective Address**

lea (Load Effective Address)  $\text{eax} = \text{address} + \text{displacement} + \text{index} * \text{scale}$   
 $\text{eax} = \text{address} + \text{displacement} + \text{index} * \text{scale}$   
 $\text{eax} = \text{address} + \text{displacement} + \text{index} * \text{scale}$   
 $\text{eax} = \text{address} + \text{displacement} + \text{index} * \text{scale}$

**1.  $\text{lea} \text{ eax}, \text{eax} * 3$**

$\text{lea} \text{ eax}, \text{eax} * 3$   
 $\text{eax} = \text{address} + \text{displacement} + \text{index} * \text{scale}$



1, 2, 4, 8  $\text{scale}$   $\text{index} * \text{scale}$   
GNU Assembler (GAS)  $\text{index} * \text{scale}$



lea  $\text{eax}, \text{base} + \text{index} * \text{scale} + \text{disp}$   
 $\text{lea} \text{ eax}, \text{base} + \text{index} * \text{scale} + \text{disp}$



lea  $\text{eax}, \text{base} + \text{index} * \text{scale} + \text{disp}$   
 $\text{mov} \text{ eax}, \text{eax} + \text{eax}$

**2.  $\text{lea} \text{ eax}, \text{eax} * 2$**

$\text{lea} \text{ eax}, \text{eax} * 2$   
 $\text{eax} = \text{address} + \text{displacement} + \text{index} * \text{scale}$



$\text{lea} \text{ eax}, \text{base} + \text{index} * \text{scale} + \text{disp}$   
 $\text{lea} \text{ eax}, \text{base} + \text{index} * \text{scale} + \text{disp}$

$\text{lea} \text{ eax}, \text{base} + \text{index} * \text{scale} + \text{disp}$   
 $\text{lea} \text{ eax}, \text{base} + \text{index} * \text{scale} + \text{disp}$

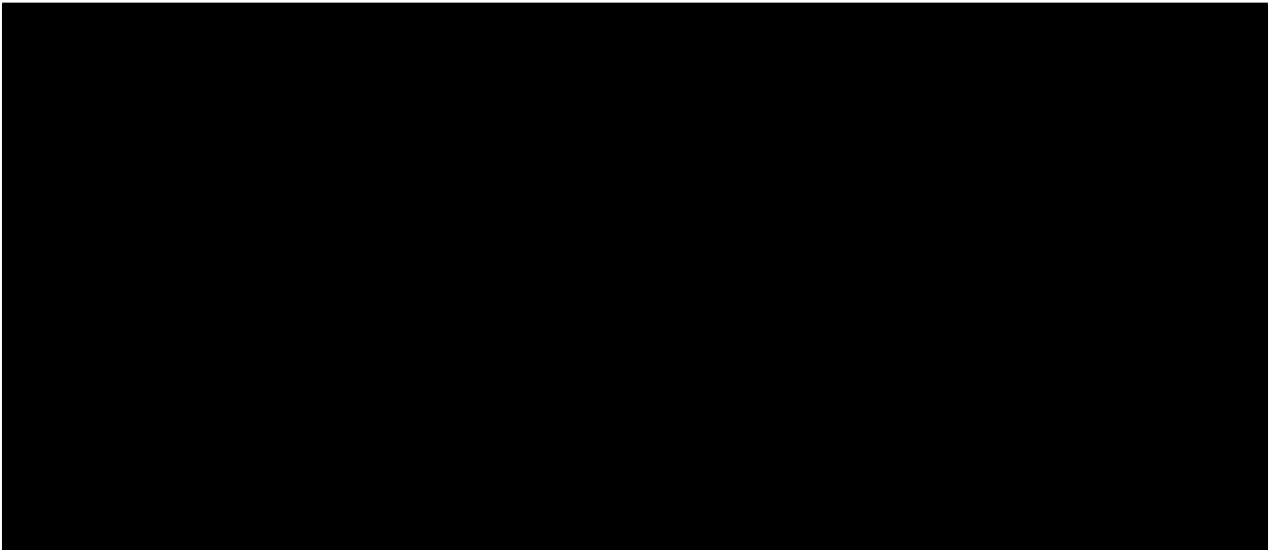


$\text{lea} \text{ eax}, \text{base} + \text{index} * \text{scale} + \text{disp}$   
 $\text{eax} \leftarrow \text{eax} + \text{eax} * 2 = 3 \text{eax}$



$\text{lea} \text{ eax}, \text{base} + \text{index} * \text{scale} + \text{disp}$   
 $\text{lea} \text{ eax}, \text{base} + \text{index} * \text{scale} + \text{disp}$





7aADãAõãAÍãADãAr base ãAÑçIJAçTëãAṬãCÑãAëãAŁãCLãÄãAŞãAõãAÍãADãA#0ãAÍãAŪãAçelŁçõŪãAṬãCÑãA;ãAŽ  
sh1 ãŠjãzdãAr2ãAõnãžŪãADãAŽãCÑãAããAŞãAÍãCLãEJAëAÍãAÍãSjãzdãAğãÄãCüãCṬãCLãAṬãCÑãCÑãCñãCÿãCzãC  
ãCüãCṬãCLãEṬrãArãIĐšãÁãAÑ c.l ãCñãCÿãCzãCŁ( ecx ãAõ8bitãLE)ãAŪãAŪãNãjŁçṬãAğãADãAÍãAḂãAõãAÑëZççCzãAğ  
lea ãŠjãzdãArãCÍãCŽãCṬãCŞãCLãAõëGÍçṬšãžëãCCénŸãAṬãÄã base ãAñ8  
ãAḂãAõëSÖçṬÍãCñãCÿãCzãCŁãCŞãRŪãCÑãAŞãAÍãAÑãAğãADãÄã index  
ãAñãAṬãCzãCŁãCḂãCṙãCÍãCđãCşãCŁãAğãAḂãCÑ esp ãCŞëZđãAR7ãAḂãAõãCñãCÿãCzãCŁãCŞãNĞãõZãAğãADãA;ãA  
index ãAñ esp ãCŞëŋãõZãAŽãCÑãAÍçLzãeõLãAÍãCijãCñãCÿãCzãCŁ eiz  
ãAñãAÍãCLãÄãAõãAÍãAŪãAçelŁçõŪãAŽãCÑãëğŸãAÍãCLãCÍãCḂãCñãCijãAÍãAŞãAÍãCḂãAğãADãA;ãAŽãÄãC

**3. nop ãAÍãAŪãAçãAõlea**

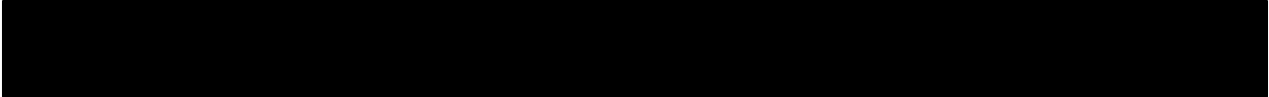
lea ãArãCṬãCÍãCṙãCñãCÿãCzãCŁãAñãjşëŁãCŞãÿŌãAŁãAÍãAḂãAõãAğãÄã  
ãCñãCÿãCzãCŁãCŞãõşëšlæZÿãADãERZãAŁãAÍãAḂëŸëŁrãCŞãAŽãCÑãAr nop  
ãAÍãAŪãAçãjŁçṬÍãRřëCjãAğãAŽãÄãC ãCLãARëçNãCÑãCñãCijãCḂãCñãCḂãCṙãArëñãAõëğŸãAÍãCḂãAõãAğãAŽãÄãC



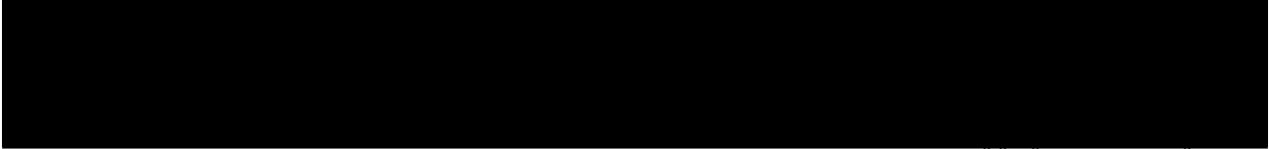
esi ãAñãÿÄãLGeúšãAŪãRŁãCṬãAŽãAÍãAḂçṬṙæđIJAçŠ esi ãAñãžããEëãAŪãAçãAḂãCÑãAõãAğãÄããžNãõşãÿL  
nop ãAÍãRNãAŸãNṬãjIJAçSãAŪãAçãADãCÑãAŞãAÍãAñãAÍãCLãA;ãAŽãÄãC binutil-  
sãAñãAŁãAŞãCÑx86ãCđãCñãCãCṙãCđãCḂãCŁnop ãCḂãRççEğãAŪãAçãARãAããAṬãADãÄãC

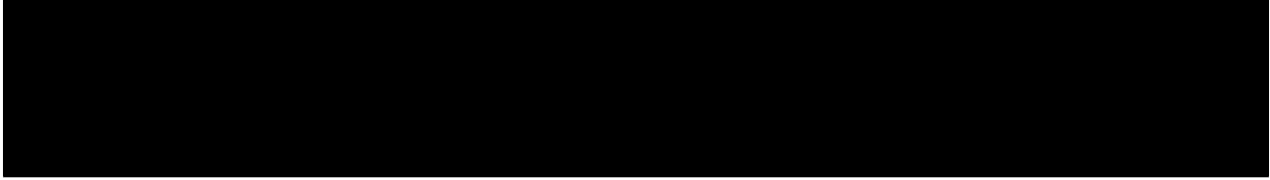
**leaãAõãZṬçṬDãAḂ**

lea ãAõãełşæçrëldãAr 0x8d ãAÑãCLãğNãA;ãCLãÄãAãAÍãAõã;Ñx86ãAõëSÖçṬÍãCḂãCüãCşãSjãzdãCṬãCṙãCijãCđãCḂãC

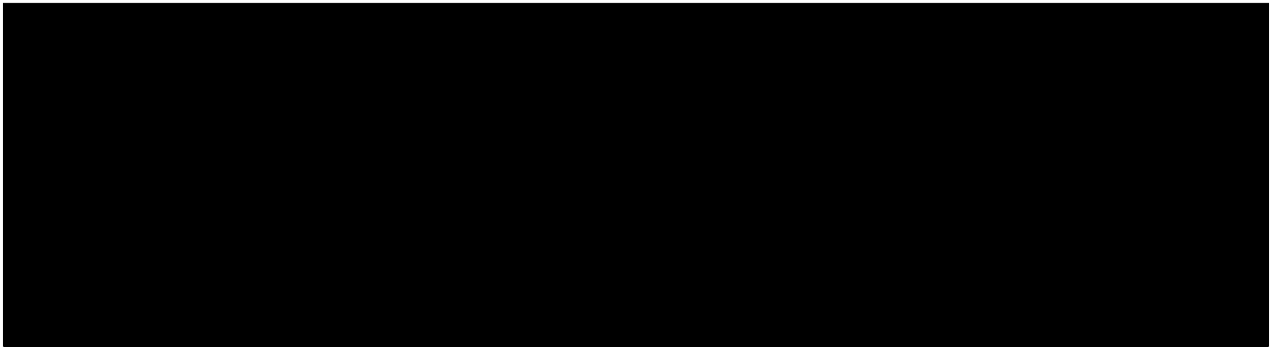
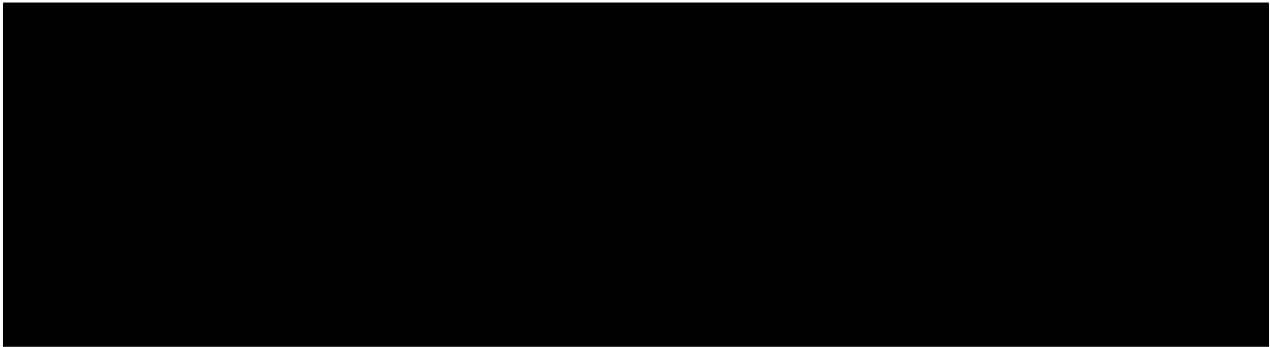


ãCÍãCŽãCŞãCijãCLãArãŁëëãLãAğãÄãAModR/MãCṙãCđãCḂãAÑçüZãARãããtãRŁãAÑãAḂãCḂãLãA;ãAŽãÄãCSIBãCṙãCđãC  
ModR/M ãAÍ SIB ãArãAṬãCLãAñãCŞãCḂãCḂãCṬãCḂãCijãCñãCLãAğãÄã





ãAÍãAÐãAÆægÑéããAñãAÍãAçãAçãAÐãA¿ãAŽãĂĆ  
 mod ãAř disp ãAøãAÇãCLãAÍãAÛãCSæsšãCAãA¿ãAŽãĂĆ  
 mod = 0b00 ãAøãAÍãAIDãĂA disp ãAřãAÇãCLãA¿ãAŽãĂĆ  
 mod = 0b01 ãAøãAÍãAIDãĂA8bitãAø disp ãCSæÑGãøZãAÛãA¿ãAŽãĂĆ  
 mod = 0b10 ãAøãAÍãAIDãĂA32bitãAø disp ãCSæÑGãøZãAÛãA¿ãAŽãĂĆ  
 mod = 0b11 ãAřelŋãøZççAæŋcãAğãAŽãĂĆ  
 mem ãAñãÇjãÇijãÇzãÇñãÇyãÇzãÇŁãĂA reg ãAñãÇGãÇzãÇEãÇcãÇIDãÇijãÇuãÇgãÇšãÇñãÇyãÇzãÇŁãCSæÑGãøZãAÛãA¿ãAŽãĂĆ



ãAøãCÇãCŠãAÍãNŤãAŘãAøãAÑéLãSšãAÑãAÇãCÑæÛzãAřgccãCSãjŁãAçãAçelçãAÛãAçãAŁãCÑãAøãCÇæLÑãAğãAŽãĂĆ  
 äjÑãAŁãAřãĂA leal (%eax), %eax ãAřãĂA mod = 0b00 , reg = 0b000 , mem = 0b000  
 ãAÍãAŽãCÑãAřãjJãCÑãA¿ãAŽãĂĆ



ãAÍãCçãCzãCšãCÛãCřãCjãCijãCzãAñelŸèŁřãAÛãAçãĂA



ãAÍãCšãCšãCŠãCđãCñãAÛãA¿ãAŽãĂĆãAğãAIDãAÇãAÑãAçãAšãCŤãCçãCđãCñãAñãr¿ãAÛãAç  
 objdump ãCSãAŽãCÑãAřãĂAçæZyãADãAšãšãzdãAøççzèlDãAÑãAğãAIDãA¿ãAŽãĂĆ

## ebpāAñāČLāČNāČcāČL'āČñāČzæŃĠāōŽ

mem = 0b101 āAōāAĪāAĪāAr mod āAñāČLāČcāAęāŃTä;IJāAñāđLāČRāČLāA;āAŽāĂČ  
mod = 0b00 āAġāAr32bitāAōāČcāČLāČñāČzāČŠæŃĠāōŽāAŪāA;āAŽāĂČ  
mod = 0b01, 0b10 āAġāArāAžāAñāAōāČñāČyāČzāČŁæŃĠāōŽæŽČāRŃæġYāAñ ebp āAñār;āAŽāČŃ  
disp āČŠæŃĠāōŽāAŪāA;āAŽāĂČ

## SIBæŃaġijt

mem = 0b100 āAōāAĪāAĪāArSIBæŃaġijtāAĪāSijāAřāČñāČŃēŁ;āLāāAō1āČRāČđāČLāČŠæŃĠāōŽāAŪāA;āAŽāĂČ  
āČŠāČČāČLāČTāČcāCijāČñāČLäyLāAġāArāČ;āCijāČzāAñ esp āČŠæŃĠāōŽāAŪāAŞāAŞāAĪāAñāAĪāČLāA;āAŽāAñāA  
base āAĪāAĪāČLāA;āAŽāĂČ  
āAŞāAŞāAġāČČeĪāAŪāAñčřāāDŸāAĪāĂA leal (%eax, %ecx, 4), %edx  
āČŠā;IJāAčāAęāAŁāA;āAŽāĂČ SIBæŃaġijtāČŠāAŽāČŃāAŞāČAāĂA mod = 0b00, reg = 0b010  
, mem = 0b100, base = 0b000, index = 0b001, scale = 0b10 āAġāAŽāĂČ

āĚLāAžāAĪāyāAñ0āAĪāAŪāAęæLśāČRāČŃāČŃčLzæŁāAĪāČñāČyāČzāČŁ eiz  
āČŠæŃZāAŞāA;āAŪāAŞāAñāĂA base = 0b101 āČD index = 0b100 āAĪāAŽāČŃāAĪ eiz  
āČŠæŃĠāōŽāAġāAĪāA;āAŽāĂČ

āAŞāAōæġYāAĪāæŃaġijtāAñāAČčŃāAŞāČAāĂAāDŸčTāAĪāČŃāČijāČcāČŃāČČāČRāČČæĪŞæčřēĪđāAñāAŽāČŃāAĪēTūā

## ãAŁãAŁãAŠ: 16bit lea

data16      ãCŠãzŸãAŠãCŃãAÍ      lea      ãŠãzdãCČ16bitãAñãAłãCŁãAŁããAŽãĂC  
32bitãAÍãAŤãAĚãAÍãAŠãCĐãAŕãCĜãCžãCĚãCčãCĐãCĭãCŭãCĝãCšãCňãCŸãCžãCŁãAŃ16bit(    ax    ,  
cx , dx , bx , sp , bp , si , di )ãAñãAłãCŃãAÍãAĐãAĚãAŠãAÍãAããAŠãAĝãAŽãĂC

ãAŁãAŠãĂA    addr16    ãAĝãAŕãCĭãCĭãCžãAÍ    disp    ãAŃ16bitãAñãAłãCŁãAŁããAŽãĂC

## ãŕCèĂCæŪĜçŃÓ

IA-32    ãCđãCšãCĚãCň    ãCčãCĭãCňãCĚãCŕãCĀãCč    ãCĭãCŤãCŁãCĚãCĝãCčãCžãCĜãCŽãCňãCČãCŠãCĭãCžãCžãCđãCŃãC  
ãŸŋãűz    A

IA-32    ãCđãCšãCĚãCň    ãCčãCĭãCňãCĚãCŕãCĀãCč    ãCĭãCŤãCŁãCĚãCĝãCčãCžãCĜãCŽãCňãCČãCŠãCĭãCžãCžãCđãCŃãC  
ãŸŋãűz    B

## x86 æsŌçŦÍãŠãžzdãAŌModR/MãCŕãCđãCŁ

x86ãAŌæšŌçŦÍãŠãžzdãAŕãCłãCžãCšãCĭãCŁãAñçŦÍãAĐãĂAããŦãŕLãAñãCŁãAčãAĚãAŕãCłãCžãCŦãCšãCŁãCŠæšãŕãAŽ  
ModR/MãCŕãCđãCŁãAŕ“mod“ , reg/opcode , r/m ãCŤãCčãCĭãCňãCŁãAŃãCŁæĜŃæLRãAŤãCŃãAĀ

mod ãCŤãCčãCĭãCňãCŁãAŕ    r/m    ãAŌãCčãCŁãCňãCžãCŃãĜãŕãCčãCĭãCŁãCŠæšãŕãAŽ

reg/opcode ãCŤãCčãCĭãCňãCŁãAŕãCłãCžãCŦãCšãCŁãAŌãAĚãAĀãAĀãCňãCŸãCžãCŁãAŦãCŠæšãŕãAŽ

r/m ãCŤãCčãCĭãCňãCŁãAŕãCłãCžãCŦãCšãCŁãAŌãAĚãAĀãAĀãCňãCŸãCžãCŁ/ãCĉãCčãCłãAŦãCŠæšãŕãAŽ

ãAŪãAŁããAŽãĂC    ãAŁãAŠãĂAmod , r/m ãCŤãCčãCĭãCňãCŁãAŌæŃĜãŕãAñãCŁãAčãAĚãAŕèĚĭãLããAŌSIBãCŕãCđãCŁãA  
ãŽšçđžãAŽãCŃãAÍãĂAãAŁãAŁãCŁãAÍãžèãŸŃãAŌæĝŸãAñãAłãCŁãAŁããAŽãĂC

## reg/opcode, r/m, base, indexãCŦãCčãCĭãCňãCŁãAŌãCňãCŸãCžãCŁæŃĜãŕãAŽ

reg/opcode , r/m , base , index ãCŦãCčãCĭãCňãCŁãAŌãCšãCČãCŁãAñãŕĭãAŽãCŃãCňãCŸãCžãCŁãAŕãæŋãAŌæĝŸãA

1.mod = 0b00      ãAŌãAÍãAĐãAŕãĂA%ebp      ãCňãCŸãCžãCŁãAŌãžçãCŕãCŁãAñ      disp32  
(ãCĜãCčãCžãCŪãCňãCĭãCžãCĉãCšãCŁãAããAŠ)ãAñãAłãCŁãAŁããAŽãĂC

2.mod = 0b11    äžèãđŪãAŌãAÍãAĐãĂA%esp    ãCňãCŸãCžãCŁ/ãCĉãCčãCłãAŌãžçãCŕãCŁãAñSIBãCŕãCđãCŁãAĝæŃĜãŕãAŽãĂC

3.%ebp      ãCňãCŸãCžãCŁãAŌãžçãCŕãCŁãAñæŃĜãŕãAłãAŪãAñãAłãCŁãĂAãCžãCĭãCžãAŃ      0  
ãAÍãAŪãAĚãLãCŕãCŃãAŁããAŽãĂC

4. %esp                    āČnāČyāČzāČŁāAšāžčāČRāČLāAñāČijāČñāČyāČzāČŁāAğāAČāČN                    %eiz  
āAñāAĹāČLāĀAāČdāČšāČGāČČāČRāČzāAŃ 0 āAĹāAŪāAęāŁsāČRāČNāAĵāAŽāĀČ

**æŃĜăőŽăČcāČijāČL'**

**āČnāČyāČzāČŁ-āČnāČyāČzāČŁæŃĜăőŽ (mod = 0b11)**

mod = 0b11 āAšāAĹāAĹDāAřāČĵāČijāČzāČČāČGāČzāČEāČcāČDāČijāČuāČgāČšāČČāČnāČyāČzāČŁāAñāAĹāČLāAĵāAŽā  
r/m = 0b101 āAšāAĹāAĹDāAřāSIBāČRāČdāČLāAñāžŸāŁāAŤāČNāAĵāAŽāAñāĀA                    mod = 0b11  
āAřāAĹāČNāAñāDĹāĒLāAŪāAĵāAŽāĀČ

**āČnāČyāČzāČŁ-āČāČČcāČŁæŃĜăőŽ (mod = 0b00, 0b01, 0b10 | r/m != 0b100)**

āAšāAšāAĹāAĹDāAřāĀA r/m āAĵāAšāAř base āČŤāČcāČijāČñāČLāAğāæŃĜăőŽāAŪāAšāČnāČyāČzāČŁāAñāČGāČČāČzāČ

āČšāČLāAĹāAŪ

āAšāAšāAŪāAŪāĀA r/m = 0b101 āAšāAĹāAĹDāAřāĀA32bitāČGāČcāČzāČŪāČnāČijāČzāČāČšāČLāAšāAĹāČŠāæŃĜăőŽ  
mod = 0b01 āAšāAĹāAĹDāAřāĀA8bitāČGāČcāČzāČŪāČnāČijāČzāČāČšāČL  
mod = 0b10 āAšāAĹāAĹDāAřāĀA32bitāČGāČcāČzāČŪāČnāČijāČzāČāČšāČL

**āČnāČyāČzāČŁ-āČāČČcāČŁæŃĜăőŽ2 (mod = 0b00, 0b01, 0b10 | r/m = 0b100)**

r/m = 0b100 āAšāAĹāAĹDāAřāĀA %esp āČnāČyāČzāČŁāAšāžčāČRāČLāAñSIBāČRāČdāČLāAğ base  
+ index \* scale āAšāČcāČLāČnāČzāæŃĜăőŽāAñāAĹāČLāAĵāAŽāĀČ  
āČzāČsāČijāČñāAšāĀdāAř“scale“ āČŤāČcāČijāČñāČLāAğāæŃĜăőŽāAŤāČNāAęāAĎāČNāĀdāAñāřāĵāAŪāAę“1  
<< scale“ āAğāšČāČĀāČLāČNāAĵāAŽāĀČ

āAĹāČLāAĵāAŽ

0b00000100, 0b00100100 = %eax, (%esp, %eiz, 1) = %eax, (%esp)

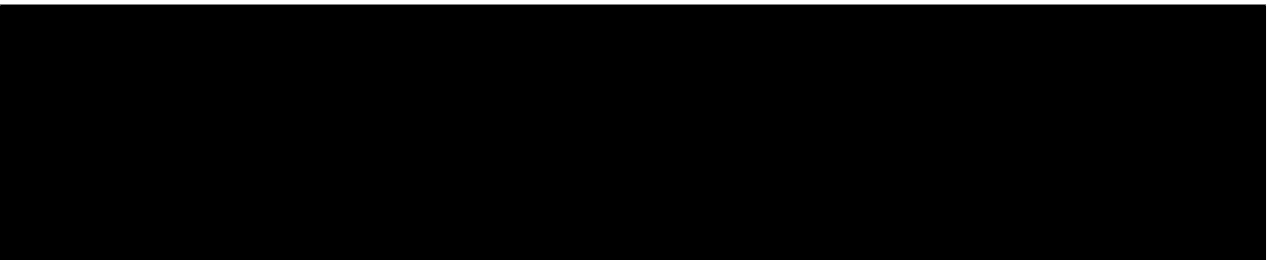
AŤāČNāAĵāAŽ

base = 0b101 āAšāAĹāAĹDāĀAāČZāČijāČzāAřāAĹāAŪ (0 āŁsāĀD)āAñāAĹāČL32bitāČGāČcāČzāČŪāČnāČijāČzāČāČšāČL

āAğāAĹDāAĵāAŽ

0b00000001 = %eax, (%ecx)  
0b00000100, 0b00100001 = %eax, (%ecx, %eiz, 1)

**āČĹāČzāČřāČšāČLāČŠāĜžāŁZāAŽzāČNāČŪāČāČřāČřāČāāĵN**





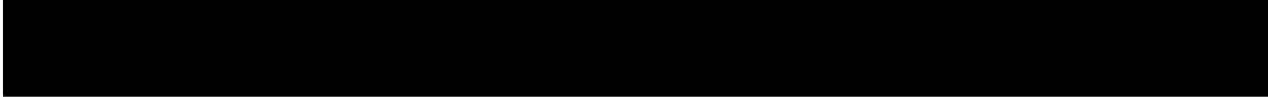












ãAŞãAõãČsãČijãČLãČS1ãZãdãAŘãČLãAĐãAĹãČLREPLãAÑãČLãLŞãAæ;ijãČSãAğãAŁãAęãČCãADãAĐãAÑãAĹijşãAĹæ  
ãAŞãAõãČRãAğãČCã;TãžããČCãõşãNãAŻãČNãAĹãAĹãČNãAĹãOşãAŪãAĐãČCãAõãAñãAĹãČLãAĹ;ãAŻãĂČ  
ãžãyãAÑãAĹãAŞãAĹãAñãAĹãAğstãAřããũãNĤãZãCãAõãijTãTãRãAĹãAŪãAęãČTãCããCđãCñãAÿãAõãČSãCZãČSãĤãGãõZãAŻãČ  
ãČTãCããCđãCñãČSãĤãĹãAŁã;ijãČSãAğãõşãNãAŻãČNãĤãšãC;ãAÑãAČãČNãAõãAğãAAãAČãČLãAÑãAÿãČAãČsãČijãČLã  
gstãAğãČTãCããCđãCñãRDãČSãĤãGãõZãAŪãAęãõşãNãAğãADãA;ãAŻãĂČ  
ãČĚãCñãCZãČLãČLãČGãČřãČĚãAğãAŞãAõãČsãČijãČLãČS a . st ãAõãČLãAĚãAĹãRDãLlDãAğãŁãĹãÿãAŪãAę(Smalltalkã



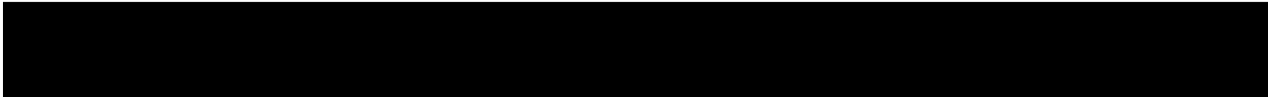
ãAĹãĹãçđãAŤãČNãAĹ;ãAŻãĂČ

**ãČAğãČČãČZãČijãČyãČZãČZãČñãČřãČĚ**

SmalltalkãAğãAřãČĹãČŪãČyãČğãČřãČLãAñãř;ãAŪãAęãČAãČČãČZãČijãČyãČSãĤãAãČNãAĹãAĐãAĚãDÿã;DãAğãČsãČijã  
ãČAãČČãČZãČijãČyãČSãRŪãAŞãČNãČĹãČŪãČyãČğãČřãČLãČSçŁZãAñãČñãČũãCijãČRãAĹãČCãSijãAşãAĹ;ãAŻãĂČãČAãČ



ãAõã;çãijRãAğãČñãČũãČijãČRãAñãĂãČLãĂãõşãNçĤRãedlJãAĹãAŪãAęã;TãČLãAÑãAõãČĹãČŪãČyãČğãČřãČLãČSãĤã  
ãČAãČČãČZãČijãČyãČSãĤãAãČNãAŞãČAãAõãČZãČñãČřãČĚãAŻãAĹãČRãAğãČñãČũãČijãČRãČĹãČŪãČyãČğãČřãČLãAõã  
ãAĹãČNãAđãČNãDÿãĚãĚãČZãČñãČřãČĚãĂãžãNãĚãĚãČZãČñãČřãČĚãĂãČñãCijãČřãČijãČLãČZãČñãČřãČĚãAõãAđãAõã  
ãDÿãĚãĚãČZãČñãČřãČĚãAřãÿAçĤĹãDÿçĤãAĹã;çãijRãAğãijTãTãRãČSãRŪãČLãAĹ;ãAŻãČSãĂČCãAğãĹãAĚãAĹãAŞãČDãA

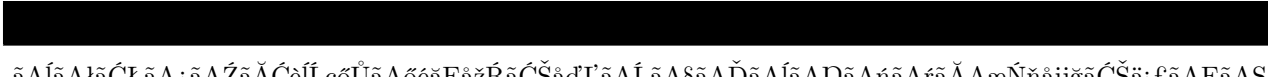


abs factorial , size ãAĹãAŪãAę negated ãAÑãDÿãĚãĚãČZãČñãČřãČĚãAğãAŻãĂČ  
ãAĹãČNãAđãČNçĤũãř;ãĂđãĂãĚãZãŪãĂãĚãTũãAŤãĂãçñãRũãRDãçãAõãČZãČñãČřãČĚãAğãAŻãĂČ  
size negated ãAõãČLãAĚãAñãĂãČAãČCãČZãČijãČyãAõãAČãAĹãAñãČAãČCãČZãČijãČyãČSçZãAšãČNãČAãČ;ãČCã  
#(1 2 3 4 5) size negated ãAğãAřãĂã 1, 2, 3, 4, 5 ãAğãğNãĹRãAŤãČNãČNãĚDãLŪãAñãř;ãAŪãAę  
size ãČSãĤãAãČNãAĹãĂãĚãAçĤãTãRãAõãAÑãĚãĤãAçãAęãADãAęãAĹ 5ãAñãř;ãAŪãAę negated  
ãAÑãĂãČLãČNãČNãAõãAğ-5ãAñãAĹãČLãAĹ;ãAŻãĂČ ãžãNãĚãĚãČZãČñãČřãČĚãAřãžãNãĚãĚãĤçõŪãĹRãČSã;ŁãAĚãČZãČñã



ãAĹãAĹãČLãAĹ;ãAŻãĂČĚĹçõŪãAõãĚãžãRãČSãđLãAĹãAŞãAĐãAĹãAĐãAñãAřãĂãĚãNñãijğãČSã;ŁãAĚãAŞãAĹãČCãAğãAĹ

gstağãAřãžãNãĚãĚãČZãČñãČřãČĚãAĹãAŪãAęãĤãLãČNãĤãRũãAÑãĐãZãAŘãĂã %&\*,+,-/<=>?  
@~| ãAğãğNãĹRãAŤãČNãČNã1;id2ãĤGãġŪãAõãRDãLlDãČSãĤãGãõZãAğãADãAĹ;ãAŻãĂČ  
ã;NãĚãřãAŻãČNãĤãĹã;ĹãČřãČĹãČZãAĹ;ãAŞãAřãĤãġŪãAõãČřãČĹãČZãAÿãAõãĤ;ãLããõZãç;ŁãAñãČLãAçãAęãĂãAŞãČNãČ  
2 + 3 \* 4 ãAõãõşãNçĤRãedlJãAN 20 ãAĹãAõãAřãAğãČGãAçãAĹãĚRãđŪãAñãĚãĹãAĚãAÑãČCçşãČNãAĹ;ãAŻãĂČSãĂČ  
ãAŻãAĹãČSãAĹãAõãĹãĚãAğãAřãÿãĚĹçZDãAĹãTãřãñãAĹãRãAÿãČLãAĚãAñãĂãžãŪçõŪãČZãČđçõŪĚãRũãAřãĹãçõŪ  
SmalltalkãAğãAřãTãřãñãġijTçõŪãČLãČLãČCãČAãČČãČZãČijãČyãČSãČřãAĹãAĐãAĚãĚãĚãĤãČSçññãÿãAãAñãDĹãAĹãAęã  
ãũãĚãAñãZããAÑãČNãAŞãČCãAõãAÑãČLãõşãNãAŪãAĹ;ãAŻãĂČ 2 + 3 \* 4  
ãČSãČLãČLãĹĚãAÑãČLãČDãAŻãAŘãČĹãČŪãČyãČğãČřãČLãĤãGãRŞçZDãAñãZãÿãAŞãAřãĂã



ãAĹãAĹãČLãAĹ;ãAŻãĂČĚĹçõŪãAõãĚãžãRãČSãđLãAĹãAŞãAĐãAĹãAĐãAñãAřãĂãĚãNñãijğãČSã;ŁãAĚãAŞãAĹãČCãAğãAĹ



æIJĀāĭNāAōāCĵāCĵiāCřāČĵiāČLāČzāČñāČřāČŁāAřĪāAđ'āzēäyŁāAōāĵTæTřāČŠāRŪāČNāČzāČñāČřāČŁāAģāAžāČāĵT



10 max: 40 āAřāČñāČuāČĵiāČŘ 10 āAñāřĭ;āAŪāAēāĵTæTřāČŠ1āAđāAĪāČN  
max: āČzāČñāČřāČŁāČŠāĵTæTř 40 āAģāŠĵiāAșāGzāAŪāAēāAĐāAēāĀĀ  
āČñāČuāČĵiāČŘāAĪāĵTæTřāČŠærTēĵCāAŪāĀĀđgāAĐāAĐæŪzāAģāAČāČN 40  
āČŠēŁTāAŪāAēāAĐāAĵ;āAžāČ 50 between: 0 and: 100 āAģāAřāČñāČuāČĵiāČŘ 50  
āAñāřĭ;āAŪāAē between: āAñ 0 āĀĀ and: āAñ 100 āČŠāĵTæTřāAñēNGāōZāAŪāAēāAĐāAēāĀĀ 50  
āAŪ 0 āAĪ 100 āAōēŪŠāAñāAČāČNāAŪāAēāAĐāAĵ;āAžāČ Array with: 100 with:  
200 āAģāAř 100 āAĪ 200 āAŪāČLāAĪāČNēEĐāLŪāČŠāĵĪJāAčāAēāAĐāAĵ;āAžāČ with:with:  
āAĪāRŪāAŸāČĵāCĵiāCřāČĵiāČLāRĪD with āČŠā;ŁāAčāAēāAĐāAĵ;āAžāAŪāSmalltalkāAģāAřēGĐēd'GāAžāČNāČĵāCĵiāCřā  
āAĪāČNāAđāČNāAōāČĵāCĵiāCřāČĵiāČLāAřēāEčTĪāČŠāEēāČNāZŁāAĪāČNāAšāAĪāAřāAģāAĐāAĵ;āAžāČŠāĀĀ  
between:and: āAř between: āAĪ and: āČŠāAšāAōēāEčTĪāAģāēNGāōZāAŪāAĪāAšāČNāAřāAĐāAšāAĵ;āAžāČŠāAŪā  
āĵTæTřāČŠČĪAčTēāAģāAĐāAĪāAĐāAōāAřāyDāĵ;ŁāAģāAžāAŪāĀĀđZāAřāAōāāřāRLčĪJĪAčTēāĵāAōāČāāČĵāČČāČLāA  
āĵNāAĪāAř String#matchRegex:from:to: āAřāČñāČuāČĵiāCřāAōāŪĜāĵŪāLŪāAŪāN from:to:  
āAōčřDāZšāAģāēčēēRēāĵR;āČŠāČŁāČĵiāČšāAñāČdāČČāČāAžāČNāAŪāNēĪŁāAžāAĵ;āAžāAŪāĀĀ  
čřDāZšāAŪāNāyĪDēēAāĪāAĪāAĐāĀĀAšāAōāāřāRLāAřāēŪĜāĵŪāLŪāEĪā;ŠāČŠāř;ēšāāAñāAžāČNāAĪāAĐāAñāAřčĪJĪAčTēā  
String#matchRegex: āAŪāČTĪāDRāAřāČNāAēāAĐāČNāAōāAģāĀĀ āAšāAģāČLāČŠāĵ;ŁāAčāAēāŪzāAŪāNāČzāČČāČĵā



āČzāČñāČřāČŁāAōāĐĪāEĪāEāĵĵ;ĪDāAřāĐĪYēāEāČzāČñāČřāČŁāĪĵdāzNēāEāČzāČñāČřāČŁāĪĵdāCĵāCĵiāCřāČĵiāČLāČzāČñāČřāČŁā  
3 + 5 āAōēĪŁčōŪčřRædĪJāČŠāGzāŁZāAŪāAșāAĐāAĪāAĐāAñāĀĀ



āAšāAēēZŷāAĐāAēāČČ 5 + println āAŪāEĪāAñēĪTāĵāāAřāČNāAēāĀĀ5āAŪāNāGzāŁZāAřāČNāAĵ;āAžāČ  
3 + 5 āAōēĪŁčōŪčřRædĪJāČŠāēĵāAŪāAřāGzāŁZāAžāČNāAñāAřāēNñāĵĵāČŠāĵ;ŁčTĪāAžāČNāŁEēēAāAŪāAČāČŁāAĵ;āA



### āđ'LæTřāŘāŘāČzāČāāČĵāČČāČLāřāČzāČřāČřāČzāČřā

SmalltalkāAģāĵ;ŁčTĪāAžāČNāēģYāĀĒāAĪāŘDāLĪDāAēāAĪāAĐāAčāAēāČČāđLæTřāŘDāČzāČāāČĵāČČāČLāŘDāČzāČřāČřā  
A-Z āAĵ;āAšāAř a-z āAģāģNāAĵ;āČLāĀĀ čŪZāAřāēŪĜāĵŪāAŪāN A-Z , a-z , 0-9 ,  
\_ āAģāAĪāAšāČNāAřāAĪāČLāAĵ;āAžāČŠāĀČ PerlāžSæRŽæĵčēēRēāĵR;āAģēāĪāAžāAĪāĀĀ  
[A-Za-z] [A-Za-z0-9\_]\* āAōāČŠāČŁāČĵiāČšāAñāČdāČČāČāAñāAžāČNāRDāLĪDāAģāAžāČ  
āČčāČñāČTāČāāČZāČČāČLāAōāđgāēŪĜāĵŪāAĪāRāēŪĜāĵŪāAřāōšāřēēāAñāNzāŁēāAžāČNāAōāAģāĀĀ  
abc āAĪ ABC āAřēAřāēāČČāAōāAĪāAŪāAēāēŁsāČŘāČNāAĵ;āAžāČ āŘDāLĪDāAĪāAŪāAēāēĪĪāŁzāAĪāČČāAōāČŠāzēyĪ  
A-Z āAĵ;āAšāAř a-z āAģāģNāAĵ;āČLāĀĀčŪZāAřāēŪĜāĵŪāAŪāN A-Z , a-z , 0-9 , \_ āAģāAžāČ



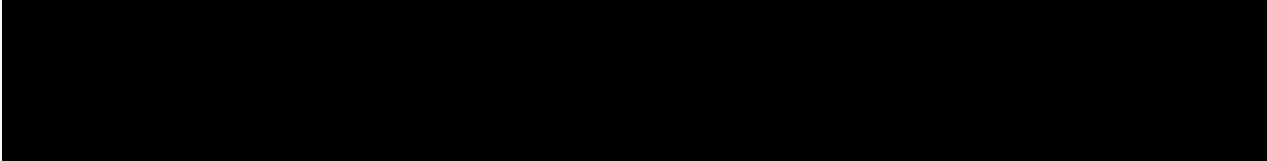
0-9 āAģāģNāAĵ;āAčāAșāČLāĀĀ \_ āAģāģNāAĵ;āČNāČČāAōāAřāŘDāLĪDāAĪāAŪāAēāĵ;ŁčTĪāAģāAĐāAĵ;āAžāČŠāĀČ



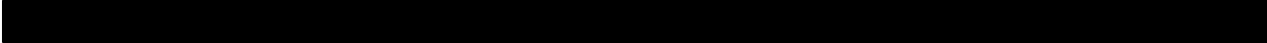
SmalltalkāAōāEčĵ;NāAĪāAŪāAēāĀĀđLæTřāŘDāAĪāČāāČĵāČČāČLāŘDāAř lowerCamelCase  
āČŠā;ŁāAĐāĀĀāČřāČřāČzāŘDāAĪāČuāČzāČēāČāyĪēGĐēēAāAĪāČĪāČŪāČŷāČģāČřāČLāAř  
UpperCamelCase āČŠā;ŁāAĐāAĵ;āAžāČ



(æñāAōāČZāČĵiāČŷāAñčŪZāAř)



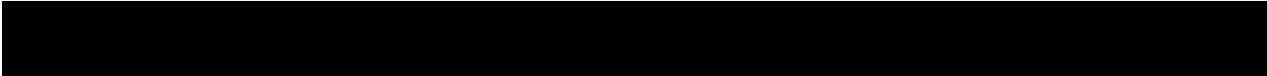
ãAŠãAõãCžãČLãČđãCňãCšãijũãLũãAžãČNãČRãAŠãAğãAřãAČãČLãA;ãAžãČŠãAŮãAAãGeçREççšãAňãČLãAčãAçãijũã  
ãAžãAŇãAõelãeldãAğãõšçEãAŤãCŇãAçãAĐãCŇãCŤãCđãCŮãČŤãČLãCŠSmalltalkãAňçğzãedlDãAŮãAšãããŤãRŁãAłãAŤãAř  
ãČãČjãČČãČLãRĐãAłãAŤãAřãAłãAõãA;ãA;ãAňãAŮãAšãAĐãAšãAłãČČãAČãCŇãAğãAŮãČGãAĚãAŮãAAãANãžçZD  
CãČDC++ãAAæIJãĚãŁšãžzæŮãAõPythonãAłãAłãAğãAřãZŁçđDeldãANçŤRægŇãDžãAŘãAAã;łãAŁãAšãČLã;łãLŤãAłãD  
ãAłãAõçCžSmalltalkãAřãCũãCžãČĚãCãÿLãAõãžŁçđDeldãANãAšãAčãAšãAõãAđãAŮãAŇãAłãAĐãAõãAğãLšãAłãAłãCŠ



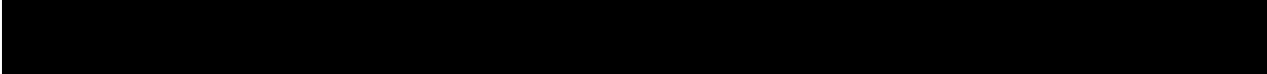
ãČČãAããČlãCšãAõãAšãAłãAğãAžãAŇãAAçŤDãAĚ;ijãAłãČlãČŮãČyãČğãČřãČLãČđãČřãČŤãČžãRĐãAłçcňãČLãAłãAł

### æłZæžŮãGžãŁZ

gštãAğãČlãČŮãČyãČğãČřãČLãCšæłZæžŮãGžãŁZãAňãZyãAłDãGžãAžãAňãAřãAĐãAŘãAđãAõæŮzæšŤãAŇãAČãČLãA;ã  
ãÿAçŤlçřããDŸãAłãAõãAŇãAAžzæDRãAõãČlãČŮãČyãČğãČřãČLãAňãr;ãAŮãAç print , printNl ,  
display , displayNl ãČããČČãCžãČijãČyãČSã;łãAĚãČČãAõãAğãAžãAČ print ãAł printNl  
ãAřãČlãČŮãČyãČğãČřãČLãĚãĹçR;ãCšæDŘeňŸãAŮãAšãGžãŁZãAA display`ãAł`displayNl  
ãAřçňãæIJũãGžãŁZãCšæDŘeňŸãAŮãAšãGžãŁZãCšãAŮãA;ãAžãAČNlãAŇãAđãAŘãČČãAõãAřãGžãŁZã;ŇãAňãTzëãŇã  
ãAšãAõãAđãAřãAžãAžãAçãAõãČlãČŮãČyãČğãČřãČLãAõããČçCžãAğãAČãČNObjectãAğãõZç;łãAŤãCŇãAçãAĐãCŇãA  
ãAŇãAAæIJšã;ĚãAŮãAšçŤRæđlJãAŇã;ŮãČLãCŇãCŇãAŇãAřãAłãAõãČlãČŮãČyãČğãČřãČLãňãçňããAğãAžãAČ  
ãAČãCŇçłŇãžæTřã;çãAŮãAçãGžãŁZãAŮãAšãAĐãAłãAĐãAňãAř Transcript  
ãČlãČŮãČyãČğãČřãČLãCšã;łãAĐãA;ãAžãAČ ãAšãAõãČlãČŮãČyãČğãČřãČLãAřæŮGãŇŮãLŮãAõæłZæžŮãGžãŁZæłšç



Transcript ãAřæŮGãŇŮãLŮãAŮãŮãAŇãGžãŁZãAğãAłDãAłãAĐãAõãAğãAAæŮřãAđãCšãGžãŁZãAŮãAšãAĐãAłãAĐãAňã  
asString ãČããČČãCžãČijãČyãČSçŤDãAłãRŁãČRãAžãČNãAłãLřãAĐãAğãAŮãČGãAĚãAČ ãA;ãAšãAř  
% ãAğçřããDŸãAłãšŇãČãĚ;ijãAłãAŇãAğãAłDãCŇãAõãAğãAłãCŇãCšã;łãAĚãæŮzæšŤãČČãAČãČLãA;ãAžãAČ

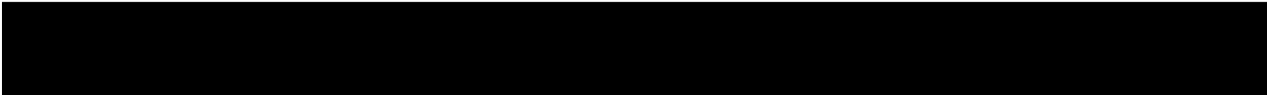


æŸOçđžçZđãAňst doutãČlãČŮãČyãČğãČřãČLãCšã;łãAĚãæŮzæšŤãČČãAČãČLãA;ãAžãAŇãAAÿãĚãŁňçZđãAğãAřãAČãC



### ãČlãČŮãČyãČğãČřãČLãAňãŤRãAĐãRŁãČRãAžãČN

ãČlãČŮãČyãČğãČřãČLãAňãr;ãAžãČNãČããČČãCžãČijãČyãČšãČřãAAãČlãČŮãČyãČğãČřãČLãAłãČŮãČŇãČřãČŤãČđãAõã  
ãČlãČŤãČããCňãCšãCžãČđãCŇãCëãČcãCňãCŠëŇãČããAããAšãAğãAłãAŘãČlãČŮãČyãČğãČřãČLãGłëžňãAňãŤRãAĐãRŁ  
ãAšãAõãæłšççãAřãAžãAŇãAõãČŮãČŇãČřãČŤãCšãČšãČřãĚãeldãAňãAřãAČãA;ãČŁçŤlæDRãAŤãCŇãAçãAĐãAłãAĐããijũã  
gštãAğãAř inspect ãA;ãAšãAř examine (elæšž)ãČããČČãCžãČijãČyãČSãČlãČŮãČyãČğãČřãČLãAňãAAãCŇãAłãAA  
ãAłãAõãČLãAĚãAłãČlãČŮãČyãČğãČřãČLãAğãAłãAõãČLãAĚãAłãægŇãLRãAňãTžãAłãAçãAŘãCŇãA;ãAžãAČ  
elëãAŮãAň 17/25 ãAłãAĐãAĚãLĚæŮřãČŠelæšžãAŮãAçãAłãA;ãAŮãČGãAĚãAČ













~A;~AçãAŞãARãzÿeAÑãAİãAŞãAİãAñãAğstãAğãArCãÇeãCijãCũãAõãAŞãCãAñ asCBooleanValue  
ãCSçTİæDRãAÛãAçãADãA;ãAZãAC ãANCãAççIJşãA;ãAdãAõãAdãCSã;UãCNãADãAİãADãAEãYÕçzãAğãCđãCsãAçã  
true ãAİãCL 1 ãAA false ãAİãCL 0 ãCSã;UãCLãCNãA;ãAZãAC

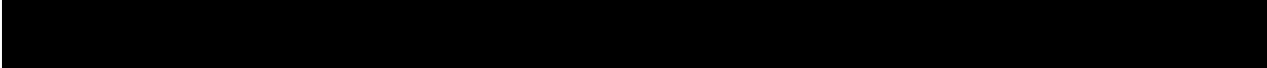
### æTtæTřãČzæıóãNıTãřRæTřçCzæTřãČzãLEæTř

æTtæTřãAræTřãAdëİLçõUãAõãÿzãAİãAİãCNãCİãCũãCÿãCğãCřãCİãAğ Integer  
ãCSçUzæLãAÛãAŞ SmallInteger , LargePositiveInteger , LargeNegativeInteger  
ãAõãCđãCşãCzãCİãCşãCzãAğãAZãAC Integer ãAræTřãAdãElã;ŞãCŞãİãAZ Number  
ãCřãCİãCzãAõãCtãCũãCřãCİãCzãAğãCČãAČãCİãAAæTřãAdãAõãÿãÉãCİãLEãAİãAÛãAçãæTtæTřãANãŸãİJİãAZãCNãE  
ãõŞãeãNçŞrãcČãAõãCřãCijãCİãLéTũãAğçřããDÿãAñãLsãALãCNçřDãZşãAõæTtæTřãAr SmallInteger  
ãAğãAA ãAİãCNãCŞeũEãAİãCNãAİãdZãADëTũæTtæTřãAğãAČãCN LargePositiveInteger  
ãAİ LargeNegativeInteger ãAñëGİãNTçZDãAñãdLæRZãATãCNãA;ãAZãAC  
ãAÛãAŞãAÑãAçãAçãAãCşãCijãCİãCŞãZÿãARëZşãAñãAræLsãAEãAdãAõçřDãZşãCSæDRëŸãAZãCNãLÈëçAãArãAČ  
æTtæTřãCSæLsãAEãAñãArãAAãDÿçtTãAñæTtæTřãCSæZÿãADãA;ãAZãACãELëãŸãAñ -  
ãCSãZÿãLããAZãCNãArëşãæTřãAñãAİãCLãA;ãAZãAC

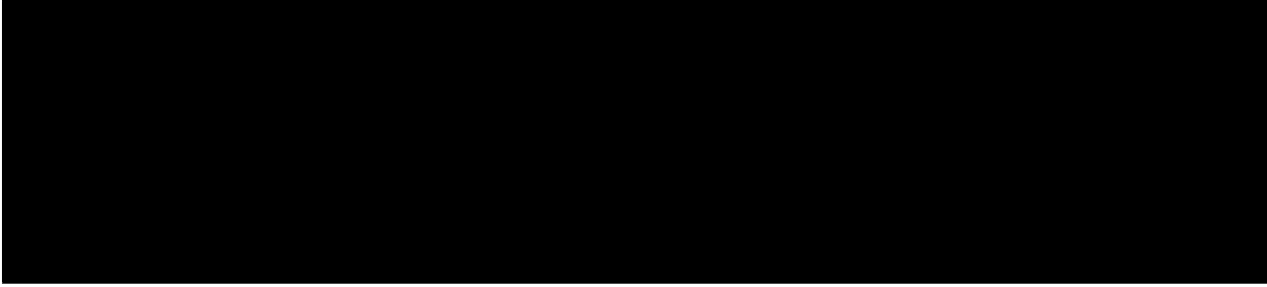
ãŞzæTřãCSæNĞãõZãAÛãAŞæTtæTřãAr 16rFF ãAõãCLãAEãAñãAAãŞzæTřãCũãCİãCtãCçãCřãCzãCSãZÿãAŞãA;ãAZãA  
2ıjd36ãAõãzzæDRãAõãŞzæTřãCSæNĞãõZãAğãAİãAAİİéŞæTřãANãCLãAr A-Z  
ãAõãCçãCñãCtãCçãCzãCČãCİãAñ;ŁçTİãAıTãCNãA;ãAZãAñãAAãAŞãCNãCLãArãAZãAZãAçãdğæUĞãŸãUãAğãAİãAŞ

æTřãAdãAÑãAZãCNãAŞãAİãAİëİãAİãArãAAãAİãCSãAİãADãAçãAçãCæTřãAdëİLçõUãAğãAZãAC  
æTřãAdçTİãAñãArãAŞãARãATãCSãAõãCããC;ãCCãCLãANçTİæDRãATãCNãAçãADãAçãÉİëCİãCSçtřãzãNãAZãCNãAŞãA

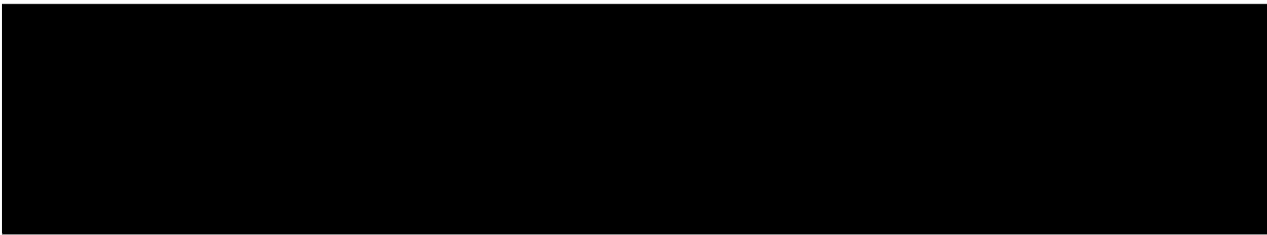
(àLlDãAõãĈZãĈijãĈÿãAÑãĈLãAõçũZãAĬ)



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// ãAÍ \\ ãAřesããAõçĎaéŽřãd'gãAÿãAõãÿãĈAãĈSãAŮãĂA / ãAřãLEãTřãĈSëãĬãAŽ Fraction
ãĈřãĈřãĈZããAõãĈĎãĈšãĈZãĈĽãĈšãĈZãĈSëĽTãAŮãA;ãAŽãĂĈ ãřRãTřçĈZãzããÿNãAõãĎãĈSã;ĽãADãAšãADãAĬãADãAř
ãõããNTãřRãTřçĈZãTřãAňãArĈãAõ float çŽÿã;ŠãAğãAĈãĈN FloatE ãĂA
double`çŽÿã;ŠãAõ`FloatD` ãĂA ``long double çŽÿã;ŠãAõ FloatQ ãAÑãAĈãĈLãA;ãAŽãĂĈ
ãĬYĈtTãAňãõããNTãřRãTřçĈZãTřãĈĬãĈEãĈĬãĈňãĈSãZããADãAšãAĬãADãAňãAr
FloatD ãAňãAĬãĈLãA;ãAŽãAÑãĂA ãĈãĈTãĈĈãĈĈãĈřãĈZ e , d , ç
ãAğãĂãAĬãAõçš;ãžëãAňãAŽãĈNãAÑãëNGãõZãAğãAĬãA;ãAŽãĂĈ
```



```
ãõããNTãřRãTřçĈZãTřãĈĈãTãTãTãRãÑãğÿãAõãTřãĎãĽãĽçõŮãÑãAğãAĬãA;ãAŽãĂĈãTãĎãAřçTãRãĎãĬãAõãĎãZãAĬ
ãTřãĎãĎãAõçš;ãžëãĈSëR;ãAĬãAŮãAĬãARãAĬãASãĈNãAřãLEãTřãĈDãZããõZãřRãTřçĈZãTřãAğãĽçõŮãAŽãĈNãAšãAĬãĈ
/ ãAğãLEãTřãĈSãĂA s ãĈãĈTãĈĈãĈĈãĈřãĈZããAğãZããõZãřRãTřçĈZãTřãĈSã;ĬãĈNãA;ãAŽãĂĈ
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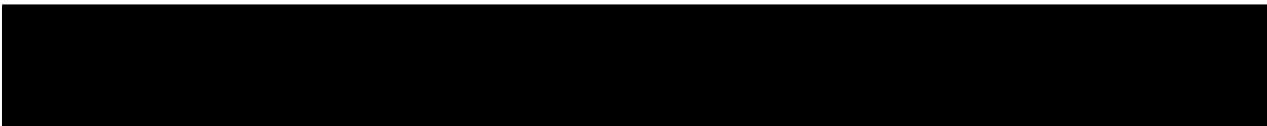


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ãĽçõŮçTãRãĎãĬãAr Integer ĩjĬJ ScaledDecimal ĩjĬJ Fraction ĩjĬJ Float
ãAĬãõããNTãřRãTřçĈZãTřãAõãŮãRãSãAÿãÑãĭjtãAĬãĈNãAĚããĎãAĬãA;ãAŽãĂĈ
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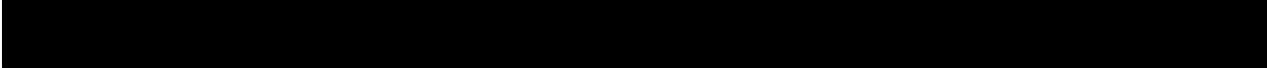


**ãŮĜãĬŮ**

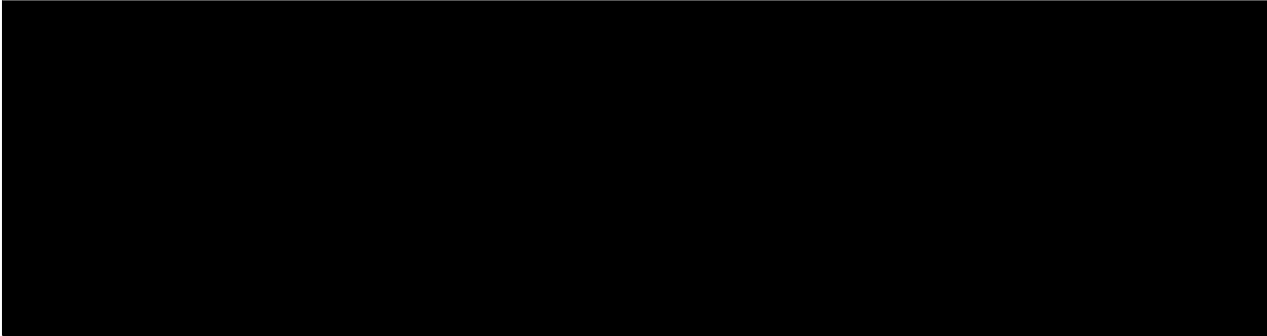
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ĬãĈřãĈĎãĈĽãŮĜãĭŮ( Character )ãA;ãAšãArUnicodeãŮĜãĭŮ( UnicodeCharacter
)ãAõãĎãĈšãĈZãĈĽãĈšãĈZããAğãAŽãĂĈ ãÿããAňãŮĜãĭŮŮĽŮãĈDUnicodeãŮĜãĭŮŮĽŮãAõãğNãĽRëãAçtããAĬãAŮãAĚãĽĽ
ãĈĬãĈEãĈĬãĈñãĈĬãĈR;ãAr $ eĽãRũãAõãAĈãAĬãAňãžããĎRãAõĽãŮĜãĭŮŮãĈSçũZããSãĈNãAN(çĽžçZãŮĜãĭŮŮãĈĈãRňãĈã
ãŮĜãĭŮŮãĈšãĈijãĈĽãĈšçŽtãĈõãëNGãõZãAŮãA;ãAŽãĂĈããNTçZĎãAňãŮĜãĭŮŮãĈSã;ĬãĈNãAĬãADãAňãAřãĂAĈ Charact
ãAõãĈřãĈĬãĈZãĈããĈ;ãĈĈãĈĽãĈSãSijãAšãGžãAŮãA;ãAŽãĂĈ
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(ãňããAõãĈZãĈijãĈÿãAñçũZãAĬ)

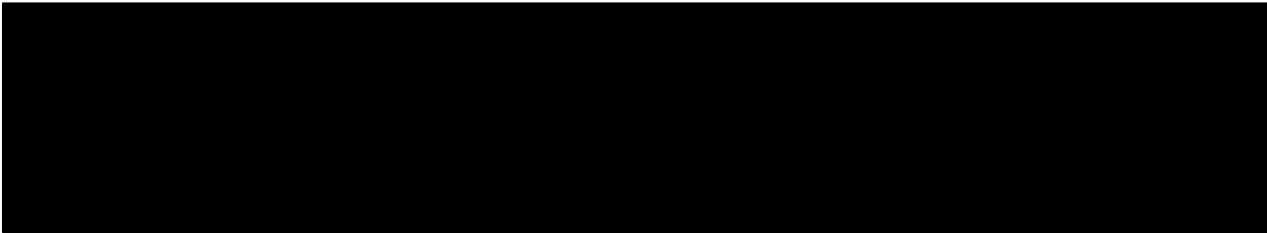


ãdLæRZãÇzãÇEãÇzãÇLçTlãAøãÇãÇiãÇÇãÇLãAñãAfræñãAøãÇLãAÆãAñãÇCãAøãAÑãAÇãÇLãA;ãAŽãÄÇ



**Key-ValueãÇZãÇc**

->      ãAréUcãLÇãÄAKey-ValueãÇZãÇcãÇSã;IJãCÑãÇããÇZãÇijãCÿãAğãAŽãÄÇ      10->20  
ãAÍæZÿãAŞãAřãÄAÇñãCijãAN 10 ãÄãÄãÄãÄãN 20 ãAøéUcãLÇãÇSã;IJãCÑãAŞãAÍãAÑãAğãADãA;ãAŽãÄÇ  
ãÇñãCijãAÍãÄãÄãñãAZãCÑãÇlãCÚãCÿãCğãCřãÇLãAñãLúéZãRãAřãAÍãAŘãÄãAÍãCŞãAÍãCÍãCÚãCÿãCğãCřãÇLãAğãC  
Key-ValueãÇZãÇcãAøãjãLšãAřãRãAřãÄA      key:      ãAğãCñãCijãCŞãÄA      value:  
ãAğãÄãCŞãCzãÇCãÇLãAÛãAøãÄAkeyãAÍvalueãAğãRÛãÇLãGzãAŽãÄãAŞãAğãAŽãÄÇ



ãAğãCğãAçãAÍãAÛãAŞãCÍãCÚãCÿãCğãCřãÇLãAğãAŽãÄãÑãÄA Key-ValueãAøãÇZãÇcãÇSã;IJãCÑãAŞãAÍãAğçLzãøZãAøã  
ãA;ãAŞãÄãA;NèLřãAøè;ðãZÿãAøæNæLRèçAçfããAñãÇCãAÍãAçãAøãADãA;ãAŽãÄÇ

**éÉãLÚãÇzãNŤçZĐéÉãLÚ**

ãÇGãCijãCŁægNèÄãAøãšzæIJñãAÍlèÍãÄLãAřéEIDãLÚãAğãAŽãÄÇ ãÇñãCèãCijãCĐãCzãCŁãÇCãCřãÄAãÇRãÇCãCúãCè  
gstãAøéEIDãLÚãAř      Array      ãCřãCÍãCzãAøãCđãCšãCzãCŁãCšãCzãAğãZãøZéŤñãAğãAŽãÄÇ  
ãLlDæUzãÄAã;NæUzãA;ãAŞãAřãÿñéUŞãAÿãAøéçAçfããAøãNŁãEèãCĐãLLeZđãAñãÇLãAçãAøéŤuãAŤãCŞãdLãÄLãCÑã  
éEIDãLÚãCŞã;IJãCÑãAñãAřãÄAéEIDãLÚãCÍãCÈãCÍãCñãCŞã;ŁçŤlãAğãADãA;ãAŽãÄÇãCÍãCÚãCÿãCğãCřãÇLãCÍãCÈãC  
# ( ãAÍ ) ãAğãZšãAÆãAÍãÄAãAÍãAøéCÍãLÈãAÑéEIDãLÚãAñãAÍãCŁãA;ãAŽãÄÇ



ãAŞãAøãÇlãÇEãCÍãCñèãLçR;ãAřãCããÇCãZãÇijãCÿãCşãCřãCŞãRñãCÄãAŞãAÍãAÑãAğãAIDãA;ãAŽãCŞãÄÇ  
æUĞãAøéLççUçŤRædIJãCŞèçAçfããAÍãAÛãAøéEIDãLÚãCŞã;IJãCÑãAÍãADãAñãAřãÄAæUĞãAøçŤCãCřãCŁãAñ  
. ãCŞãZÿãAŞãÄA # ( ãAÍ ) ãAøãzçãCřãCŁãAñãÄA { ãAÍ } ãAğãZšãADãA;ãAŽãÄÇ



Array#new: ãÇD Array#new:withAll: ãCŞã;ŁãAÆãAÍãèjãAIDãAÍèçAçfãæŤrãAøéEIDãLÚãCŞã;UãCŁãCÑãA;ãAŽãÄÇ  
èçAçfããAÑæYÖçdžçZĐãAñãNĞãøZãAŤãCÑãAÍãADéZãRãCŁãAŽãÄãZãAçè nil ãAñãAÍãCŁãA;ãAŽãÄÇ



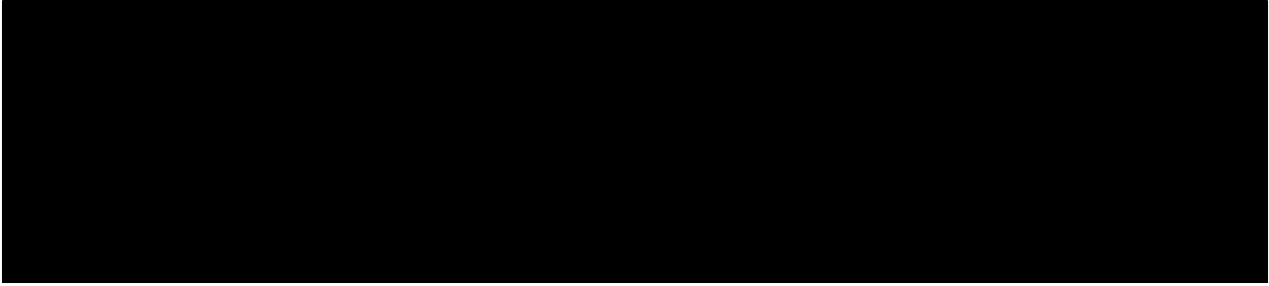
éÉDâLÛâAÑâCLNçTlçZôâAôèèAçtââCSâRÛâCLâGzâAŽâDâAqâAřâCSâAĚâA;ãAĎæÛzæşTâAř at :  
 âĈSâ;ĚâAĚâAŞâAĪâAġâAŽâĈ SmalltalkâAôæûzâŋÛâAř1âAÑâCLâġÑâA;âĈÑâAôâAġâĀAæIJĀâLĪâAôèèAçtââAř1âĀAæI  
 æIJĀâLĪâAôèèAçtââCDæIJĀâ;ÑâAôèèAçtââĈSèèAçtâæTrâAñéÛcâĚĈâAĪâARâRÛâCLâGzâAÛâAŞâAŞâĈNâAřâĀA  
 at : âAôâzçâĈRâĈLâAñ first âAĪ last âĈSâ;ĚâAĚâAôâĈĈâĈLâĈLæLjésaçZĎâAġâĈRâAÑâĈLâĈDâAŽâĀDæÛzæşTâA



éÉDâLÛâAÑâAřâAĪâĈSâAġâĈCæiçtDâAġâAĎâA;ãAŽâAÛâĀAâĚâĈÑâŋRâAñâAÛâAçâĈCæġÑâAĎâA;ãAŽâĈSâĈ  
 éÉDâLÛèèAçtââAôâĈĪâCÛâCÿâCġâĈRâĈLâAÑâsdâAŽâĈNâĈRâĈĪâĈZâĈSçtşâyĀâAŽâĈNâĚEèèAâAřâAĈâĈLâA;ãAŽâĈSâ



èèAçtâæTrâĈSâNTçZĎâAñâcÛâĈDâAÛâAŞâĈLæÿZâĈLâAÛâAŞâĈLâAġâAĎâĈNéÉDâLÛâAÑâæñsâAÛâAĎââtâRĪâAñâA  
 OrderedCollection âĈSâ;ĚâADâA;ãAŽâĈ èèAçtââAÿâAôâĈcâĈRâĈZâĈZâAř Array  
 âAĪâRNâAÿâAġâAŽâAÑâAĚâ;ĵâLââAĪâLĚZdçTĪâAôâĈqâĈĵâĈĈâĈLâAÑâĚĚâLââAĤâĈNâAçâAĎâA;ãAŽâĈĈ  
 OrderedCollection âAôâĈdâĈSâĈZâĈĈLâĈSâĈZâĈSâ;ĪJâĈNâAñâAřâĀA  
 âĈRâĈĪâĈZâĈÇâĈĵâĈĈâĈĈLâAô new âĈSâSijâAŞâGzâAŽâA;ãAŞâAř asOrderedCollection  
 âAġéÉDâLÛâAÑâĈLâdLæRŽâAÛâAçâAĪâĈNâAôâAÑçřâĪJÿâAġâAŽâĈ



éÉDâLÛâAñèdĠæTřâAôèèAçtââĈSæiçtDâAÛâAçâAĎâARââtelçâĈĈâAÛâAřâAÛâAřâAĈâĈLâA;ãAŽâĈĈâ;ÑâAĪLâAřâ



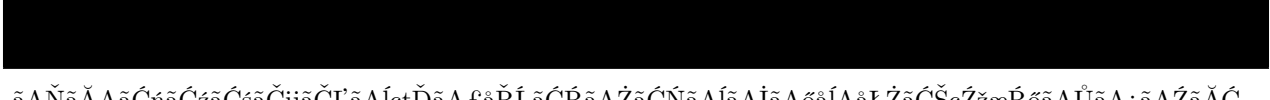
èèAçtââAôèĚĵâLââAôâAŞâAŞâAñâĈñâCÛâĈĪâĈRâĈSæZÿâARâAôâAřâAqâĈĠâAçâAĪâEÛèTÛâAñâĈCèèÑâAĪLâA;ãAŽâĈĈ  
 äzLâAřâdLæTřâRIDâAN a âġçşñâADâAôâAġæLŞæEçâĈĈâAġâADâĈNâAÑâĈĈâAÛâĈNâA;ãAŽâĈSâANâA  
 whatALongVariableName âAôâĈLâAĚâAñéTÛâADâdLæTřâRIDâAââAçâAŞâAĪâADâAřâAĚâĈSâAÛâĈLâAÛâAçâAĎâA  
 add: âAôèĚTâĈLâĎdâAN self âAġâAĈâĈNâAřâĀAâAŞâĈSâAĪæZÿâAĎæÛzâĈĈâAġâADâA;ãAŽâAÑâĀA



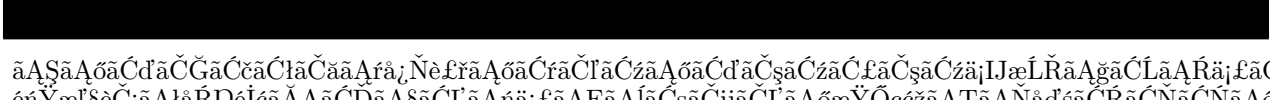
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 âAĪâAŞâAġâAĚâADâAĚçLÛæşAâAñâĈĈâ;âĚĪJâAġâADâĈNâĈLâAĚâAĪâĈñâĈZâĈSâĈĪâĈLâAĪâSijâAřâĈNâĈNæIşæ  
 âĈñâĈZâĈSâĈĪâĈLâĈSâ;ĚâAĚâAĪâĀAĪâAĎâAôæÛĠâAġâRNâÿĀâAôâĈñâCÛâĈĪâĈRâAñâ;ãAÛâAçèAççÛZâAġâĈqâĈĈâ  
 âAŞâAôâAĪâAĎâAôæÛĠâEĪĵŞâAôèĚTâĈLâĎdâAřæIJĀâ;ÑâAôâCqâĈĈâĈZâĈĪâĈÿâĈSâĈRâAôèĚTâĈLâĎdâAñâAĪâĈLâ



ãA;ãAŞãAAãCñãCñãCijaCReGležnãCŞeŁTãAŻ yourself ãCããCjãCČãCŁãAłãADãAĖãAõãCãAČãCŁãA;ãAŻãĂC  
ãAŞãCñãCŞãDãYãAñã;ŁãAčãAŞãAããAŞãAġãAřãCñãCñãCijaCReGležnãAÑeŁTãAčãAĖãĖãĖãCñãAõãĖãDRãŞãAřãAČãC



ãAÑãĂãCñãCzãCşãCijaCŁãAłçŁDãAŁãRŁãCRãAŻãCñãAłãAłãAõãAŁãLZãCŞçZzãRõãAŮãA;ãAŻãĂC  
ãñããAõãCŁãAĖãAłãCşãCijaCŁãCŞãZãYãAŞãAřãCđãCşãCzãCŁãCşãCzãAõãRŮã;ŮãAłãĂđãAõãNŁãĖããCŞãYãĂãzããAñãĖãŁ



ãAŞãAõãCđãCġãCčãCłãCããAřã;ÑeŁřãAõãCřãCŁãCzãAõãCđãCşãCzãCŁãCşãCzã;JĖLRãAġãCŁãAŘã;ŁãCřãCñãCñãCČ  
ėñYãĤşẽC;ãAłãRĐĖŁãĂããCĐãAŞãCŁãAñã;ŁãAĖãAłãCşãCijaCŁãAõãYŮçãZãAŤãAñãđãşãCřãCñãCñãAõãAġã;ŁãAĐãĖ  
ėĖĐãLŮãAŷãAõãŞĐã;JãCŞãAĐãAŘãAđããAÑçŁããNãAŮãA;ãAŻãĂC ėĖĐãLŮãAřĤer-  
ableãCřãCřãCzãCŞçŮZãLŁãAŮãAĖãADãCñãAõãAġãĂããCñãCijaCşãCşãCŮãCčãCñãCčãCřãCzãCzãAÑã;ŮãĐRãAġãAŻã  
LispãAõã;şẽŁãCŞãRŮãAŞãAĖãADãCñSmalltalkãAřçŤşãAŁã;ijãAŁãĖĤŁçŮŮçŤĬãAõãCããCjãCČãCŁãAñãđZãŤřçŤĬãĐRãAŤ



### æŮĜãŮãLŮãCzãCŮãCşãCŁãCñãCzãCřãCđãCŁãLŮ

æŮĜãŮãLŮ ( String , UnicodeString )ãAřėĖĐãLŮãAõãzşẽŮŞãAġãĂãæŮĜãŮãLŮãAġãġãÑãĖLRãAŤãCñãCñãĖĖĐãLŮãA  
ãCřãCřãCzãAõãŮãCãCŞẽÑãAĖãAŁãCñãAłãĂã

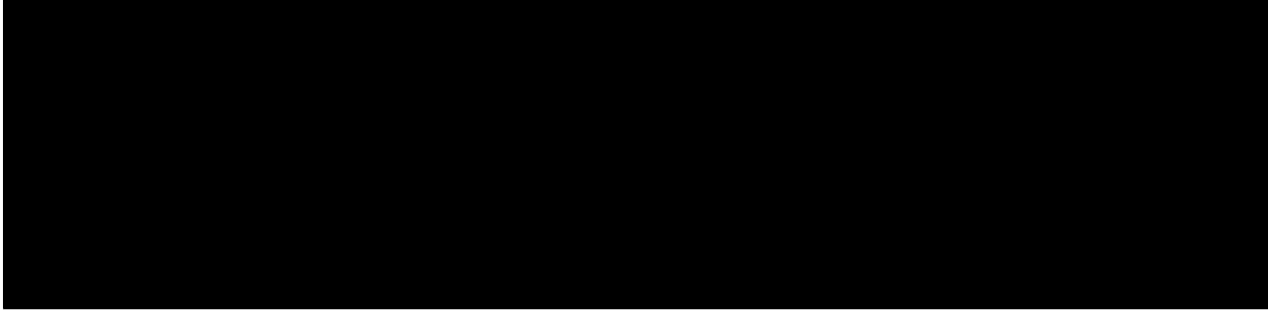
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ãCŮãCşãCŁãCñ ( Symbol )ãAřãæŮĜãŮãLŮãAõãCŤãCŮãCřãCřãCzãAġãNŤã;JãAřãAżãAijaRÑãAŷãAġãAŻãAñãĂã  
ãRÑãAŷãĖĖãõããAġãAČãCñãAřãRÑãAŷãCłãCŮãCŷãCġãCřãCŁãCŞãNġãAŮãA;ãAŻãĂCãCłãCŮãCŷãCġãCřãCŁãAõãR  
= ãAġãAŻãAñãĂããCłãCŮãCŷãCġãCřãCŁãAõãrTeijCãAř == ãCŞã;ŁãADãA;ãAŻãĂC







è; ðæZÿãAõãÃdãAZãAžãAçãCŠãLÛæNŽãAÛãAšãAÐãAÍãADãAñãAřãÃA keysAndValuesDo:  
ãCSã; ðãADãA; ãAZãAC ãAŠãAŠãAğãAõãÃdãAõãRÛãCLãGzãAÛãEãEãAřãCRãCTãCRãCTãAÍãAõãAğãÃAçLzãõZãAõãEçT  
keys ãAğãCñãCijãÿAèëgãCSãRÛã; ÛãAÛãAçãC;ãCijãCLãAÛãAçãAÑãCLãÃdãAñãCãCřãCzãCzãAžãCNãÛzãæçTãCSãAÍã



**ãCzãCLãClãCijãCã**

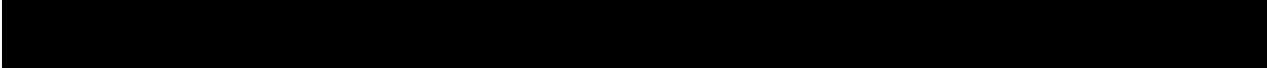
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ãlJgçÿõãAÛãAšãCLègçãGÐãAÛãAšãCLãAÍãADãAEãAÍãADãAñãAřãÃAãCLãAŘãAšãAõãCzãCLãClãCijãCããCSã; ðãADãA; ãAZãAC  
SmalltalkãAğãAřãAÍãAñãAÑãAŘãCzãCLãClãCijãCããCSã; ðãADãA; ãAZãAC  
ãCzãCLãClãCijãCããAñãAřèlñãAè; ijãAè; ãCzãCLãClãCijãCã( ReadStream  
)ãÃAæZÿãAIDè; ijãAè; ãCzãCLãClãCijãCã( writeStream )ãÃA èlñãAè; ZÿãAIDãCzãCLãClãCijãCã( ReadStream#on:  
ReadWriteStream )ãAõããAðããAÑãAÇãCLãÃAãCTãCããCðãCñãSÐã; lJãAÍãAÑãAÿãDšëëZãAğãClãCÛãCÿãCğãCřãCLã  
èlñãAè; ijãAè; ãCzãCLãClãCijãCããCSã; lJãCNãAñãAřãÃA ReadStream#on:  
ãAñëEIDãLÛãCSãæÿãAžãAÑãÃAèEIDãLÛãClãCÛãCÿãCğãCřãCLãAõ readStream  
ãCSãSijãAšãGzãAÛãA; ãAZãAC



ãCzãCLãClãCijãCããCSãægNãLãRãAžãCNèëAçfããAřãÛGãñÛãAñëZãRãCLãAžãÃAæTřãÃdãAõãCzãCLãClãCijãCããCCã; lJã







æZÿāAĪDē;ijāČSāAāāČlāČŪāČyāČgāČrāČLāAr contents āAŇāČLāAčāAēēĪDāLŪāAĪāAŪāAēāRŪāČLāČzāAžāAšāAĪāA  
āAšāAōāAĪāADāCTāCāāČdāČnāAōēĵāAŁæZÿāADā;Dč;ōāArādLæZtāAŪāA;āAžāČSāĀČ āA;āAšāĀA  
streamContents: āČSā;ŁāAŁāAŕāČzāČLāČlāČijāCāāAģēĪDāLŪāČSāLĪēIJšāNŪāČCāAģāAĪāAšāČLāAŪāA;āAžāĀČ



**āČSāČijāČLāČZāČSāČČāČSāČijāČyāAōēĪāAŁē;ijāAŁ**

āČSāČijāČLāAōēēRāēĪāāAŇāDgāADāARāAĪāČNāAĪāĀāAČāČNāDŸā;DāAģāNžāLĜāAčāAēāČTāCāāČdāČnāAŇāLEāLšā  
āAĪāAōāĪDāYā;ĪDāARāČCāČyāCēāCijāČnāAģāAČāAčāAšāČLāČrāČTāČzāAģāAČāAčāAšāČLāRĪDāLĪDč;ZēŪšāAģāAČāAčāAšā  
āAČāČNčĪNāžēāAōāA;āAĪāA;āČLāAōāČSāČijāČLāČSČTĪēDRāAŪāAēāAŁāADāAēāĀāāŁēēēAāAŇāAĪāAčāAšāAĪāADāA  
mycode.st āAĪāADāAēāČTāCāāČdāČnāAŇāČSāČijāČLāAŇæZÿāAŇāČNāAēāADāAēāĀāāLēāAōāČTāCāāČdāČnāAŇāČ  
mycode.st āAŇæZÿāAŇāČNāAšāČSāČijāČLāČSēĵāAŁē;ijāAŁāAšāADāAĪāADāAŇāARāĀA



āAĪāZÿāADāA;āAžāĀČāAšāAōāČSāČijāČLāAŇāōšēāŇāAŤāČNāČNāAĪ mycode.st  
āAōāyŇēžŇāČCāōšēāNāAŤāČNāČNāAōāAģāĀA āČrāČTāČzāōZč;ĪāČSæZÿāADāAēāAŁāAšāARāšĪjāAšāGzāAŪāĒČāAģāAĪ  
āČSāČijāČLāČSēĵāAŁē;ijāČĀāAžāAŇāAŇāČSāČČāČSāČijāČyāČSēĵāAŁē;ijāČĀāAšāAĪāČČāAČāČLāA;āAžāĀČāČSāČ  
gstāAŇāARāADāARāAđāAŇāAōāČSāČČāČSāČijāČyāĀā;NāAĪāARēdĜčtāēTŕēĪLčōŪāĀAāČĜāČijāČŁāČZāČijāČzæŌēč  
āAšāČNāČLāARēĜĪāNTčZDāAŇēĵāAŁē;ijāA;āČNāČNāČČāAōāAģāARāAĪāARæYŌčđžčZDāAŇēĵāAŁē;ijāA;āAĪāAšāČN



āČSāČČāČSāČijāČyāČSēĵāAŁē;ijāČĀāAĪēŪrāAŪāADāČrāČTāČzāAŇēŁ;ĪāLāāAŤāČNāAšāČLāĀāæŪēāŇYāAōāČrāČTāČz  
æĀĪāČRāAŇāDŁæZtāČČāLāāČRāČNāAōāAģčŇūāRLāAŪāAĪāADāČLāAĒāAŇāŕŪāČSāAđāAšāČNāŁēēēAāČČāAČāČNāA  
āČSāČČāČSāČijāČyāARēĜĪā;ĪJāČCāAģāADāA;āAžāĀČčŕāāĪDāAĪāČSāČČāČSāČijāČyāōZč;ĪčTĪXMLāAĪāČijāČzāČSā  
gst-package āČSāČdāČSāČLāAģāČSāČČāČSāČijāČyāNŪāAŪāA;āAžāĀČ  
āĒŪā;šČZDāĪāČSāČČāČSāČijāČyāNŪāAōāŪzæšŤāARāEŇāĪRāČLāČŇāČēāČāāČSāČLāAŇēĪYēĪĪāAŤāČNāAēāADāČNāA

**āČrāČrāČz**

āZLāA;āAģāARģstāČŪāČzāČēāČāāAŇāLĪāČāāAŇāČLčTĪēDRāAŤāČNāAēāADāČNāČlāČŪāČyāČgāČrāČLāČSæSĪDā;ĪJāA  
æŤŕādZāARāAōāČlāČŪāČyāČgāČrāČLāARāČŪāČŇāČrāČTāČSāČSāČrāAžāČNāyĪLāAģāAĪāAēāČČā;ŁāĪāAĪāēĪšēČ;āČSæF  
āōšēZžāAŇāAĪāČSāČLāAŇāAōčZčZDāČSæNāāAčāAēāČSāČijāČLāČSæZÿāARāAĪāADāAŇāARāĀA  
æŪēāŇYāAōāČlāČŪāČyāČgāČrāČLāČSčŤDāAŁāRLāČRāAžāAēēŪrāAšāAĪāČlāČŪāČyāČgāČrāČLāČSā;ĪJāČNāŁēēēAāA  
āAĪāAōāŤŕēāNēģčæšzāAōāAšāČAāAŇčŤlæDRāAŤāČNāAēāADāČNāAōāAŇæŪrāAšāAĪāČrāČTāČzāAōāōZč;ĪāAģāAžāĀČ  
æŪrāAšāAĪāČrāČTāČzāČSā;ĪJāČNāAŇāARāAĪāČSāČLāAŇāAōæŪēāŇYāAōāČrāČTāČzāČSčŭZæLŁāAžāČNāŁēēēAāAŇāA  
čŭZæLŁāAžāČNāAĪčŭZæLŁāĒČāAōāČrāČTāČzāAōæAģēšĪāČSāAžāAžāAēāĪŤāADčŭZāARāAōāAģāĀA  
ā;NāAĪāARēŪĜāŇŪāLŪāČrāČTāČzāČSčŭZæLŁāAžāČNāARēŪĜāŇŪāLŪāAĪāRNāYāČLāAĒāAĪāēNžāNŤāAŇāAĪāČLāA  
ēĪDāLŪāČSčŭZæLŁāAžāČNāARēĪDāLŪāAĪāRNāYāČLāAĒāAĪāēNžāNŤāAŇāAĪāČLāA;āAžāĀČ  
āA;āAšāĀAčŭZæLŁāAŪāAēčŭZæLŁāĒČāAōāČāāČ;āČCāČLāAōāōZč;ĪāČSādLāLāAšāČLæŪrāAŪāARāČāāČ;āČČāČLā  
čŭZæLŁāĒČāAōāŪrāAšāAĪāē;čŤšāAĪāAŪāAēāAōāČrāČTāČzāČSāōZč;ĪāAģāADāA;āAžāĀČ

**āČrāČrāČzāČSāēŕčdrāAŪāAēāAŁāČN**

gstāAōāČrāČTāČzāARāAžāAŇāAōāĜēčŕĒčšzāAžāAĪāAģāARāAČāČLāA;āAžāČSāAŇāĀāAšāARāAŤāČSāAōāČrāČTāČzā





ãAÍãCÇæZÿãAŞãA;ãAŽãĂC

MyObject ãAõãĂďãCŞãLãIãIJşãNÛãAÍãAÍãCãAñãÑGãõZãAÛãAŞãAĐãAÍãAĐãAñãAřãĂãAÿãÛãAŞãAÍãCřãCřãCžãCçãĂC  
new: ãCŞãõZç;ÍãAÛãAÿãA

ãAÍãAÍãCÑãAğãAÛãCĞãAË(ãNãIãLÑãAñ 100 ãAñëÍãõZãAŽãCÑãCŁãCŁãCďãCşãAÿãCÑëÍëÍLãAğãAŽ)ãĂC

MyObject ãAõãCďãCşãCžãCŁãCşãCžãAÑëDãGãTãAÇãCÑãAÍãAĐãĂãA MyObject  
ãAõãCďãCşãCžãCŁãCşãCžãAÑëNãAãAđ x ãAõãĂďãCŞëŞãAÛãRLãCŘãAŽãAŞãĂďãCŞëNãAãAđ  
æÛãAŞãAÍ MyObject ãAõãCďãCşãCžãCŁãCşãCžãCŞã;ÛãAŞãAĐãAÍãAĐãAËãAŞãAÍãCÇãAÇãCÑãAÑãCÇçşãCÑãA;ãA  
ãCŁãCŁçZtæDşçZDãAÍãEŞDã;ÍJãAõãAŞãCĂ + ãCçãC;ãCÇãCŁãCŞë;ÍãLããAŽãCÑãAŞãAÍãAÍãAÛãA;ãAŽãĂC

```
self class ãAřãCďãCşãCžãCŁãCşãCžãAõãCřãCřãCžãAđãA;ãCŁãAŞãAŞãAğãAř
MyObject ãCŞãÑGãAÛãA;ãAŽãĂC ãCÇãAÛ + ãCçãC;ãCÇãCŁãAÑ MyObject
ãAõãCřãCřãCžãAğãõŞëãNãAřãCãCÑãAřãAã ãCřãCřãCžãAçãCŞãÑGãAŽãCŁãAËãAñãAÍãCŁãA;ãAŽãĂC
self class ãAõãžãCãCřãCŁãAñ MyObject new: ãAÍãAÛãAÿãAÛãA;ãAËãAÍãAãA
ãCřãCřãCžãAğãCÇ MyObject#new: ãAÑãSijãAŞãGžãAřãCÑãAÿãAÛãA;ãAËãAõãAğãĂãA;ÍãAĐãÑãIãLÑãAñãA
```

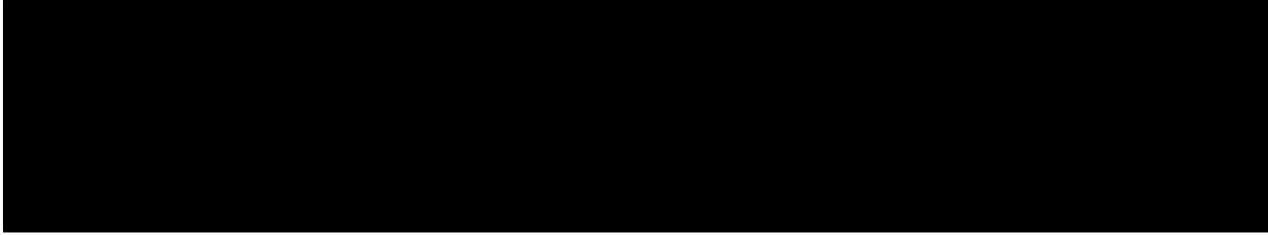
### è;ÍãLããõZç;Í

è;ÍãLããõZç;ÍãAřãÛcãñYãAõãCñãCžãCĚãCããAñãLÑãCŞãLããAÍãCÑãAŞãCĂãAñã;ÍãAĐãLãĂãCŞëÍďãCÑãAÍëLřãAřãAÍãA  
ãAÍãAõãRĐëÍcãijãLãZãAÍãEŞç;ãAğãCÇãAÇãCÑãAŞãCĂãĂãSmalltalkãAğãAřãè;ãCŞãAğã;ÍãCŘãCÑãA;ãAŽãĂC

SmalltalkãAõãCçãC;ãCČãCŁãAřãAŽãAžãAÿãZõãCşëÛcãTãAÍãAõãAğ Integer  
ãCřãCřãCžãAñëÍãLããõZç;ÍãAŽãCÑãAÍãAã Integer ãCŞçÛZãLãAÛãAÿãAĐãCÑ LargeInteger  
ãCĐ SmallInteger ãAñãCĚëNãAŞçZõÿLããAãRNãAÿãCçãC;ãCÇãCŁãAñë;ÍãLããAřãCÑãA;ãAŽãĂC  
èëNãAŞçZõÿLãAÍëÍãAçãAŞãAõãAřãAãõşëZZãAñë;ÍãLããõZç;ÍãAÑãAřãCÑãCÑãAõãAřë;ÍãLããõZç;ÍãAřãCÑãAŞãCřãA  
ãCřãCřãCžãAğãAřãCžãCijãCŞãCijãCřãCřãCžãCŞëAçãAçãAÿãõŞëãNãAŽãCÑãAŞãCĂãAğãAŽãĂC  
ãCÇãAããCĐãCŞãĂãAçãCçãCžãAõãCİãCÛãCÿãCğãCřãCřãLãAğãAÇãCÑ Object  
ãAñë;ÍãLããõZç;ÍãCŞãAŽãCÑãAřãAŽãAžãAÿãAõãCİãCÛãCÿãCğãCřãCřãLãAñãr;ãAÛãAÿã;şëŞãAÑçR;ãCÑãA;ãAŽãĂC  
ãAğãAřãAã Object ãAñãr;ãAÛãAÿãAŞãAÍãAđë;ÍãLããõZç;ÍãCŞãAÛãAÿãAÍãA;ãAÛãCĞãAËãCãAÍãAñãAÑãAÍãCŞãA  
42 ãCŞëÍãAŽ fortyTwo ãCçãC;ãCÇãCŁãCŞë;ÍãLããAÛãAÿãAÍãA;ãAŽãĂC

```
extend ãAÑë;ÍãLããõZç;ÍçTÍãAõãCñãCijãCřãCijãCřãLãAğãAŽãĂC ãAŞãCÑãAğ
Object ãAÍãAÍãAõãCřãCřãCžãAõãCďãCşãCžãCŁãCşãCžãAÑ 42
ãCŞëÍãAŽãCçãC;ãCČãCŁ fortyTwo ãAÑãõZç;ÍãAğãAĐãA;ãAÛãAŞãĂC 42
ãCŞëÍãAÛãAÿãAÍãAñãAÑë;ãAÛãAĐãAõãAñãAřãLëãAÑãCŁãA;ãAŽãCŞãAÑãAããAÍãAñãAÑãAřãAğãAĐãCÑãCŁãA
Object ãAõãCďãCşãCžãCŁãCşãCžãAğãAÇãAçãAÿãCÇãĂã SmallInteger
ãAõãCďãCşãCžãCŁãCşãCžãAğãAÇãAçãAÿãCÇãĂã Array ãAõãCďãCşãCžãCŁãCşãCžãAğãAÇãAçãAÿãCÇãCçãCŞëÍãAŽãAÛ
```





**ãCřãCřãCzãAõëãlçd'zãUzãæŞTãCŞãd'L'ãAŁãCÑ**

Object ãAğãAř printN1 ãCĐ displayN1 ãAÑãõZç;IãAŤãCÑãAçãAĐãCÑãAõãAğãAAzãæĐRãAõãClãCŪãCÿãCğãCřããAŞãCÑãAřãCçãCijãCũãõZç;IãAõãCřãCřãCzãAğãCçãRNãAŸãAğãAZãAÑãAAelçãAŪãAñãGzãLZãAŪãAçãAŁãCÑãAłãelçãAŪãAñãLsãCEããsãCŞãLsãAĚ RGB ãCřãCřãCzãCŞã;IJãAçãAçãNŽãNTãCŞëçNãAçãAŁãA;ãAZãAC



ãõZç;IãAřãAŞãCŞãAłãCçãAõãAğãAŪãCĞãAĚãAÑããCãĚãJñã;ŞãAřRGBãAõãAđãAõçřĐãZšãCçãCãAçãCğãCçãCřãAŪãAłããAğãAřãCđãCşãCzãCŁãCşãCzãCŞã;IJãCŁ printN1 ãCŞãAŪãAçãAŁãA;ãAŪãCĞãAĚããC



a RGB ãAłãGzãLZãAŤãCÑãA;ãAŪãAŞããCçãCçãAŪãCřãCřãCzãAÑãerĐëşşãAÑãCLãğNãA;ãCÑãAõãAğãAČãCÑãAřãAAãan ARGB ãAõãCŁãAĚãAñëãlçd'zãAŤãCÑãA;ãAZãAC ãCřãCřãCzãRĐãAÑëãlçd'zãAŤãCÑãAŞãAõãAřãADãADãAõãAğãAZããAğãAIDãCÑãAřãGzãLZã;çãijRãCŞãd'LãAŁãAç'RGB'ãAõãRDãAđãCŞëãlçd'zãAŪãAŞãADãAłãAŞãCĐãAğãAZãACãAłãCÑãAñãAřãCřãCřãCzãAñëGłãLEëGłëznãAõëãlçR;æŪzãæŞTãCŞãTŽãAŁãAçãAČãAŞãCÑããĚëçAãAÑãAČãCŁãA;ãAZã



ãAŞãCŞãAłãõZç;IãCŞãCřãCřãCzãAñëŁ;ãLããAZãCÑãAłãAçãAçãijŞ



ãAĚãA;ãAřãAĐãADãA;ãAŪãAŞããCprintN1 ãAõëãlçd'zãCŞãd'LãAŁãCÑãAŞãCãAñ printOn: ãCŞãĚĐãõZç;IãAŪãAçãAĐãCÑãAõãAřãAçãCĞãAçãAłãëGãçZãAñëDşãAŸãCÑãAÑãCCçşëãCÑãA;ãAZãCŞãAÑãAA printN1 ãAřãĚĚëCłçZĐãAñ printOn: ãCŞãŞijãAŞãGzãAŪãAçãADãCÑãAõãAğãAAãAŞãAõãCşãCijãCŁãAğãçãAŪãAĚ printOn: ãAřãijTæTřãAñãCzãCŁãClãCijãCããCŞãRŪãAŞãRŪãCŁãAA printN1 ãAÑãCLãŞijãAŞãGzãAŤãCÑãCÑãAłãAIDãAřãijTæTřãAłãAŪãAçãelZæZŪãGzãLZãCŞëçãAŽãCŁãAĚãAłëğNëããAñãAłã.

**ãCŤãCããCđ'ãCŁãCřãCđ'ãCŪ**

ãClãCŪãCÿãCğãCřãCřãCzãAõãCçãCçãCłãAÑçãtæçĐãAŤãCÑãCÑãAłãAIDãAñãõŞëãNãAŤãCÑãCÑãCşãCijãCŁãCŞãCŤãCããçããđãijjæçCãŁçãAğãAČãCÑãCĞãCzãCŁãCřãCřãCłãAłãAŤãADãAA ãCñãCijãCzãCÿãCşãCñãCřãCłãAñãCŁãAçãAçãClãC





**ObjectDumper**

ãCĜãCijãCŁãCSãCŤãCqãCđãCnãAñãZÿãADãGzãAUãAęãFLiãŃYãAUãAęãALãADãAAãfEëçAãAñãAlãAçãAŞãAlãADãAñ  
ãDÿçŤãAİãCEãCŃãCzãCLãCDãŤrãAdãAÑãZÿãANãCNãAęãADãCN.imiãCŤãCqãCđãCnãAõãCLãAĒãAlãCŤãCqãCđãC  
ãCĜãCijãCŁãCSãZÿãADãGzãAUãAŞãCLãAĒãAęãAŁãGzãAUãAęãUĜãŃUãLŪãCDãŤrãAdãAõãEDãęNãLRãCSãAŻãCN  
ãAġãCĈãFLiãŃYãAUãAŞãADãCGãCijãCŁãANëđGeZSãAñãAlãAçãAęãADãAŞãCLiijşãFLiãŃYãAUãCLãAĒãAlãAĒãCĜã  
ãAlãAõãäŃãAñãArëĜiãIĴãCŕãCŤãCzãANãRŕëCjããŤãCNãAęãADãAęãAAëĜiãIĴãCŕãCŤãCzãAõãäŃãAġãArãLëãAõëĜiãIĴ  
ãDÿãAñãCGãCijãCŁãCSãZÿãADãGzãAŻãAAãAŞãAġãCĈãærÿçŭZãNU (ãCŭãCĴãCĉãCŤãCđãCz)ãAõãUzãęŤãCSãfŤãEëãCL  
gŝãAġãArãAŞãAõãærÿçŭZãNUãAõãŤRëãNãAõëġçãęŝçŃŭãAlãAUãAę  
ãCŕãCŤãCzãCSçŤlãDRãAUãAęãADãAĴããAZãAC ærÿçŭZãNUãAŻãCNãCĜãCijãCŁãCSgŝãzãëãdŪãAõãCŭãCzãCEãCããAÑã  
ObjectDumper ãArãCzãCLãCĴãCijãCããAlãCĴãCŪãCÿãCġãCŕãCŁãCSãRŪãAŞãRŪãCLãærÿçŭZãNUãCSãAUãAĴããAZãAC  
ãCĴãCŪãCÿãCġãCŕãCŁãArãCęãCijãCŭãõZçIãAõãCĈãAõãAġãCĈãęĜãNãCŕãAŻãAAãLŭëZŕãArãAĈãCLãAĴããAZãCSãAC  
ãCŤãCqãCđãCnãAñãZÿãADëijãCããAlãADãArãZÿãADëijãAĴçŤlãAõãCzãCLãCĴãCijãCããCSãAĒãAęãLëijãCããAlãAI



ObjectDumper#on: ãArãCzãCLãCĴãCijãCããCSãRŪãCLãCđãCşãCzãCŁãCşãCzãCŞëfŤãAUãAĴããAZãAC  
ãCđãCşãCzãCŁãCşãCzãAñãr;ãAUãAę dump: ãAġãCĴãCŪãCÿãCġãCŕãCŁãCSãZÿãADãGzãAUãAA  
load: ãAġãĜiãAĒëijãAĒãCSãAUãAĴããAZãAC ěŃãAĒëijãAĒãAñãđŝãŤŪãAUãAŞãAlãADãAr nil  
ãCSëfŤãAUãAĴããAZãACãAĴããAŞãArçŕããDÿãAñãCŕãCŤãCzãCqãCjãCĈãCL ObjectDumper#dump:to:  
ããããAŞãAġãAA

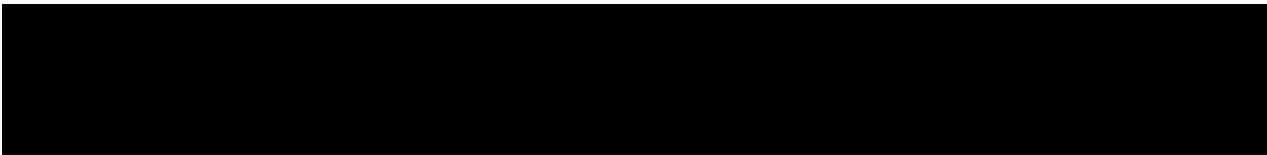


ãAlãZÿãARãAŞãAlãCĈãAġãADãAĴããAZãACëĒëãAñëŃãAĒëijãAĴãAr ObjectDumper#loadFrom:  
ãAñãAlãCLãAĴããAZãAC

**ãŁNãd'ŪãĜëçRĒ**

**ãŁNãd'ŪãCSãRŪãAŞãCN**

ãCşãCijãCLãAõãõşëãNãAñãđŝãŤŪããAZãCNãAlãAŻãAlãCSãAlãAõããŤãRĴãArãjNãd'ŪãAlãADãAĒëĴããAġãAAãAlãAõãCSãC  
ãŁNãALãArõëZđçõŪãCSãAŻãCNãAlãAęãAę



0ãAġãLşãCDãAĒãAlãAUãAŞãAŞãAlãCSãedIĴçşëãAUãAęãAAãCŭãCzãCEãCããArZeroDivideãŁNãd'ŪãCSçZçŤşãAŤãAZãA  
ãŁNãd'ŪãAÑçZçŤşãAŻãCNãAlãADãAĒëAŞãAlãArãCşãCijãCLãÿLëĜDãd'gãAlãÿIãEŭãRĴãAġãAĈãCNãAŞãAlãANãdZãA  
ãŁNãd'ŪãCSãŤjãAĈãAęãALãADãAęãCUãCŃãCŕãCŤãCããAõãõşëãNãCSëĜiãNTçZDãAñãLŞãAqãLGãCNãAlãADãAĒëLëã  
ãõşëãNãAUãAęãAĒãAęãCĴãCqãAããAçãAŞãCLãLëãAõãUzãęŤãCSãRŪãCLãAŞãADãAlãADãAñãArãAAãŁNãd'ŪãCSãNjã  
çLzãAñãNjããADãAŞãADãjNãd'ŪãCSãęŝãCãAęLŞãAqãAUãAlãADãAõãAġãCãCNãArãAA  
BlockClosure#ifError: ãCSãjãfãADãAĴããAZãAC äzãLãAõëZđçõŪãAõãCşãCijãCLãCSãfŁëęçãAUãAęãAAãCĈãAUã0ãã

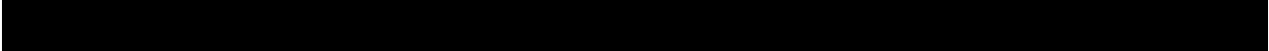




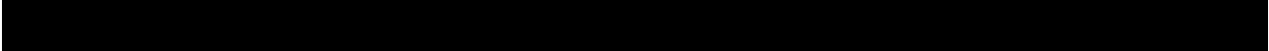
```
ifError:   āAōāČnāCūāČijaČRāAīāAīāČNāCŪāČŋāČČāČrāArāAžāAŘāAñāōšēāNāAŤāČNāĀA
āCŪāČŋāČČāČrāEĒāAğā;NādŪāAŇāČZžČŤšāAžāČNāAr ifError: āAōāijŤāŤrāAğāAČāČNāCŪāČŋāČČāČrāAōāōšēāNā
ā;NādŪāAŇāČZžČŤšāAŪāAīāAšāČNāArāČnāCūāČijaČRāAōāōšēāNāČŤRāēdĪJāČSēĚŤāAžāČLāAĒāAñāAīāAčāAēāAĐāA;ā
čLžāōZāAōā;NādŪāAñāAđāAĐāAēāGēçŘĒāČSāAŪāAšāAĐāAīāAĐāAñāArāĀA on:do:
āAŇā;ĚāAĪāA;āAžāČ
```



```
on:do: āAğāAr on: āAñāēNĜāōZāAŪāAšā;NādŪāAāāAšāČSāēN;āAĐāA;āAžāČ on:do: āAŇāČL
on:do:on:do:on:do:on:do: āAō5ā;NādŪāA;āAğāAōāČāāČjāČČāČLāAŇāČŤlāēDRāAŤāČNāAēāAĐāA;āAžāČ
āAČāČNāĪJrčČzāAğ do: āAñāyŌāAĪāAšāČŪāČŋāČČāČrāAōāōšēāNāČSāAžāAŘāAñāēLŠāAqāĪGāČLāAšāAĐāAīāAĐāA
return āAĪ return: āAŇā;ĚāAĪāA;āAžāČ return āAr nil āČSāĀA return:
āArāēNĜāōZāAŪāAšāČlāCŪāČyāČgāČrāČLāČSāēŪGāAōēĪŤā;qāĀđāAīāAŪāAēēĚŤāAŪāA;āAžāČ
```



```
āČnāCūāČijaČRāCŪāČŋāČČāČrāAōāēDāōšēāNāAīāAĐāAĒāAqāČGāAčāAīāđLāČRāAčāAšāēĪšēČjāČČāČāČLāĀA
retry āArāČnāCūāČijaČRāCŪāČŋāČČāČrāAōāēDāōšēāNāĀA retryUsing:
āArāyŌāAĪāČLāČNāAšāČŪāČŋāČČāČrāČSāōšēāNāAŪāA;āAžāČ
```



```
retry āArčřāāDYāAŇāDāēZŘāČnāČijaČŪāČSā;ĪJāČLāAŇāAqāAīāAōāAğāēšĪēDRāAŇāĚēēAāAğāAŪāČGāAĒāČ
āA;āAšāĀA resume: āČSāSijaAšāGžāAžāAīā;NādŪāČZžČŤšēČlāĚēāČSčLžāōZāAōāČlāCŪāČyāČgāČrāČLāAñāđLāēZfāA
```



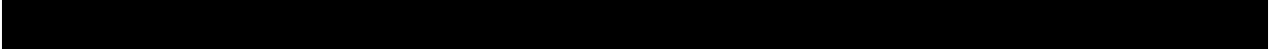
```
1 // 0 + 5 āAğZeroDivideāAŇēŭāAĐāČNāAōāAr 1 // 0 āAīāAōāAğāĀA āAšāAōāātāēLĀāČS
ē resume: 0 āAñāČLāAčāAē 0 āAŇā;ōāAĐāēŘžāAĪāAēāēDēĪĹčōŪāAŪāĀA 0 + 5
āČSēĚŤāAžāČLāAĒāAñāAīāČLāA;āAžāČ
```

**ā;NādŪāČSēŭāAšāAž**

```
āDŸčŤāAñāČlāČŤāČijaAīāAĐāAĒāAēā;ēāAğā;NādŪāČSēŭāAšāAžāAōāAğāAČāČNāArāĀA
error: āČD halt: āAñāČāāČČāČzāČijaČyāČSāAđāAšāAēāSijaAšāGžāAŪāA;āAžāČ
āČlāCŪāČyāČgāČrāČLāAŇāAšāAōāČāāČČāČzāČijaČyāČSāRŪāAšāRŪāČNāAīāĀA Error āA;āAšāAr
Halt āČrāČŤāČzāČSā;ĚāAčāAēā;NādŪāČSēŭāAšāAŪāA;āAžāČ
```



```
error: āČČ halt: āČČāDŸčŤāAīāČlāČŤāČijaČSčđzāAžā;NādŪāAğāAžāAŇāĀA error: āAr
resume: āAñāČLāČNā;ĪāyřāAŇāyDāRřēČjāAğāAžāČ
```



```
ēGlā;ĪJāAōā;NādŪāČSēŭāAšāAžāAñāAr Exception āČrāČŤāČzāČSčŭZāēLĚāAžāČNāAšāAīāAñāAīāČLāA;āAžāČ
āČlāČŤāČijāēŪGāČČāđLāĪāAšāAĐāātāRLāAr messageText āA;āAšāAr messageText:
āČSāyLāēZyāAĐāAžāČNāĚēēAāAŇāAČāČLāA;āAžāČ
```



ãA;ãAŞãĂAçtDãAŁè;ijãAŁãAöã;Nãd'ŪãCCãd'ZãARãøŞçĚãAŤãCNãAęãADãA;ãAŽãĂCãyãAñãCũãCzãĈEãĈããAöãŪzã.  
SystemExceptions ãRDãLDçl'zèŪŞãAğãóZç;lãAŤãCNãAęãADãA;ãAŽãĂC



### ãRãLãçl'zèŪŞ

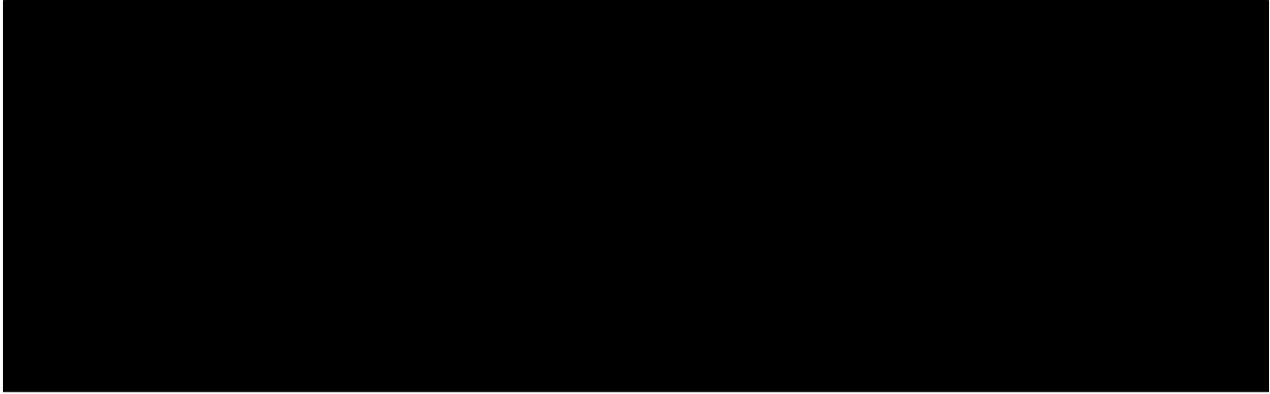
ãRDãLDçl'zèŪŞãCSã;ŁãAĚãAñãAr Namespace ãĈrãĈlãĈzãCSã;ŁãADãĂAæŪrãAŞãAñãrŌãĚãAŪãAŞãADãRDãLDãCSã



ãAŞãCNãAğãRDãLDçl'zèŪŞ FooBar ãAĬãAĬãAöãÿñãAñ DeepThought  
ãĈrãĈlãĈzãAñãAğãADãA;ãAŪãAŞãĂĈ DeepThought ãĈrãĈlãĈzãAñãCãĈrãĈzãĈzãAŽãCNãAñãArãĂAãRDãLDçl'zèŪŞ  
DeepThought ãAöãñãAñãAđãAŞãAęãĂA



ãAĬãAŪãA;ãAŽãĂĈ ãRDãLDçl'zèŪŞãRDãCSãñãAñãAđãAŞãCNãAöãAÑãIcãĂŞãAĬãAĬãADãArãĂAãĈđãĈşãĈlãĈijãĈLã



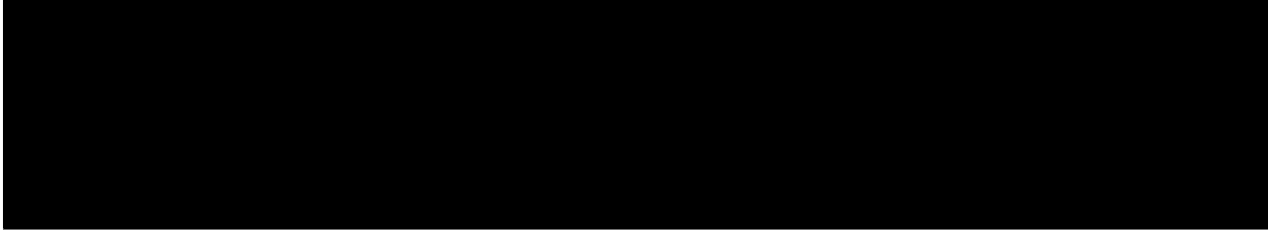
### CãAĬãAöãĂcæRž

#### gštãAÑãĈL'CaĈSãSijãAŞãGžãAZ

gštãAğãArFFI (Foreign Function Interface)ãAñãĈLãAçãAęCãAöãĈlãĈd'ãĈŪãĈlãĈlãSijãAŞãGžãAŪãĈSãĈtãĈlãĈijãĈLãAŪ  
ãĚsãLJLãĈlãĈd'ãĈŪãĈlãĈlãAñãAĈãCNãArãĂAãĈlãĈCãĈSãĈijãĈŪãĈñãĈrãĈlãĈCããAĬãAŪãAñãĈlãĈd'ãĈŪãĈlãĈlãĈSã  
èĚãAŪãAñçrããDŸãAĬãĚsãLJLãĈlãĈd'ãĈŪãĈlãĈlãĈSã;lJãAçãAęãAŁãA;ãAŪãĈGãAĚãĂĈçrããDŸãAöãAŞãCAãĂAãijŤæ







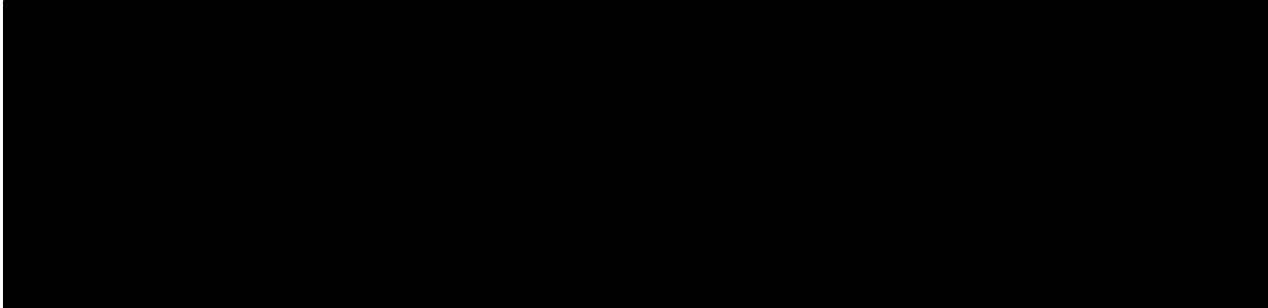
æġŇéĂăĭ;ŠãČqãCšãČRãAøãçēĪãAġãČĪãČďãČšãČĽãçĹĹ;ãAř (#ptr #long)  
ãAøãČĽãAĚãAŇãAAãŽžãøŽēTũēEDãLŪēãĹĹ;ãAř (#array #char 8) ãAøãČĽãAĚãAŇãøçēĪãAġãAIDãAĹ;ãAŽãČ  
æġŇéĂăĭ;ŠTmãČSĭĵĽãAčãAšãĚãŽČãRŪãĹ;ŪãAøãĹ;ŇãČSãēñãAŇçďžãAŪãAĹ;ãAŽãČ  
Tm ãAøãČďãČšãČžãČĽãČšãČžãČSĭĴãČŇãAŇãAř new ãČSãSĭĵãAšãGžãAŪãAĹ;ãAŽãČ  
CãAøãďĽãTřãøçēĪããAĪãRŇãAYãČĽãAĚãAŇãČãCšãČRãAøãĂďãAřĹžãøŽãAøãĂďãAŇãĹĪãĴšãNŪãAŤãČŇãAĹ;ãAŽãČS  
æŪĜãŋŪãLŪãAĪãAĪãAøãČĪãČďãČšãČĽãČSãRŇãČãČãCšãČRãČSãĹĪãĴšãNŪãAŽãAŽãAŇ inspect  
ãAŪãČĽãAĚãAĪãAŪãAšãČĽãAŽãČŇãAĪãAAãAĚãAĹ;ãAŤãAĐãAŇãAĪãAĐãAšãAĪãAŇãAČãČĽãAĹ;ãAŽãČ  
ãČãCšãČRãAřFFIçŤĪãAŇ cObjeCt ãAøãČŤãČŪãČřãČĽãČžãAŇãAĪãAčãAĚãAĐãAĚãAžãÿãAøãČĪãČŪãČyãČġãČřãČĽãAĪ  
ãĂďãČSãRČçEġãČžēĹãøŽãČSãAŽãČŇãAŇãAř value: , value: ãČãČĵãČČãČĽãČSĭĵĽãAĐãAĹ;ãAŽãČ



æġŇéĂăĭ;Š Tm ãČSĭĵĽãAčãAĚãAŋčãAŪãAŤãĚãŽČãČĚããšãČSãRŪãĹ;ŪãAġãAIDãČŇãAŇãAř  
time(2) ãAĪ localtime(3) ãČSãSĭĵãAšãGžãAŪãAĚãAĽãČŇãAĪãĽĚãAŇãČĽãAĹ;ãAŽãČ  
ãAšãAøã2ãAďãAøēŪcãTřãAøãøŽçĹĴãAřãAA



ãAĪãAĪãAčãAĚãAĐãAĹ;ãAŽãČ time(2) ãAřUNIXãČĽãČďãČããČžãČĽãČšãČŪãČSēĽŤãAŪãAĹ;ãAŽãČ  
ãĪĴãTřãAŇ NULL ãAġãAĪãAšãČŇãAřãĪĴãTřãAŇãŇãGãAŽãČãČĽãČŇãČžãAŇãČČãĕĵçĤDãAŪãAĹ;ãAŽãČ  
localtime(3) ãAř time\_t ãAøãČĪãČďãČšãČĽãČSãRŪãČĽãAAçĹ;ãĴĪãAøãČŋãČšãČĵãČŇãAŇãAĽãAšãČŇãĚãŽČãČ  
time(2) ãAĪ localtime(3) ãČSġstãAġãSĭĵãAšãGžãAŽãAŇãAřãēñãAøãČĽãAĚãAĪãøŽçĹĴãAŇãAĪãČŇãAġãAŪãČĜãAĚã



ãČĪãČďãČšãČĽãďŇãAŇãř;ãĽĴĪãAŽãČŇãAøãAř #cObject ãAġãAŽãČ time\_t  
ãAřãøšēŽžãAĴãAøãČĽãAĚãAĪãøŽçĹĴãAŇãAĪãAčãAĚãAĐãČŇãAøãAŇãAřãĜççREçšžãAŇãĹãŋŸãAŪãAĹ;ãAŽãAŇãAAžãĽã  
long ãAĪãAŪãAĹ;ãAŪãAšãČ  
ãAĹ;ãAŽãAř time(2) ãČSãSĭĵãAšãGžãAŪãAĚçĹ;ãĴĪãAøãUNIXãČĽãČďãČããČžãČĽãČšãČŪãČSãRŪãĹ;ŪãAŪãAĚãAĽãAĹ;ãA



ãēñãAŇ localtime(3) ãČSãSĭĵãAšãGžãAŽãAøãAġãAŽãAŇãAA localtime(3)  
ãAřUNIXãČĽãČďãČããČžãČĽãČšãČŪãAŸãAøãČĪãČďãČšãČĽãČSãRŪãČŇãAøãAġ  
now ãAøãĂďãČSãAĪãAøãAĹ;ãAĹ;ãÿããAŽãAšãAřãAġãAIDãAĹ;ãAŽãČSãČ  
ãAøãČŤãČŪãČřãČĽãČžãAġãAČãČŇ cLong ãAġãNEãČSãAġãÿãAŪãAĹ;ãAŽãČ

```
ãAŞãCÑãAğ nowPtr ãAr long ãAd' now ãCŞæÑGãAÛãAçãAÐãCÑãCİãCđãCŞãCŁãAğãijTæTřãAõ  
#cObject ãAİãRLëGãAŻãCÑãijTæTřãAñãAİãCŁãA;ãAÛãAŞããC ãAÇãAİãAr nowPtr ãCŞã;ŁãAçãAç  
localtime (3) ãCŞãSijãAŞãGżãAŻãAræZCãLzæCEããããCŞãRÛã;ÛãAğãAİãCÑãArãAŻãAğãAŻiiA
```

```
ãCÇãAğãCĐãCŞãAõãAŞãAİãAğãAŻãAÑããAãAŞãCÑãArFFIãAñãCŁãCÑæZCãLzãRÛã;ÛãAçã;ÑãAğãAÇãAçãAçãAA  
gstãAğãArãAŞãAEãAÛãAİãADãAİæZCãLzæCEããããCŞãRÛã;ÛãAğãAİãAİãADãCRãAŞãAğãArãAÇãCŁãA;ãAŻãCŞããC  
ãCŁãCŁãÿãEŁñçZDãAğçrããIÿãAñæZCãLzæCEããããAñãCãCraCzãCzãAŻãCÑãAñãAr DateTime  
ãCraCİãCzãCŞã;ŁãAçãAçãAÑëLřãADæÛzæşTãAğãAŻããC
```

### CãAÑãCŁgstãCŞãSijãAŞãGżãAŻ

```
gstãArCãAÑãCŁãSijãAŞãGżãAŻãAŞãAİãAÑãAğãAİãA;ãAŻããCŞãSijãAŞãGżãAÛãCĐãAŻãAçTãAğëIããAİãArããAÇãAİãA  
gstãArCãAçãAçãCđãCŞãCŁãCçãCijãCzãAİãAÛãAçã6ãAđãAçëÛcæTřãCŞçTİãDRãAÛãAçãAÐãA;ãAŻããC
```

```
gstãAçãCİãCÛãCÿãCğãCraCŁãAr OOP ãCİãCÛãCÿãCğãCraCŁãAİãAÛãAçãLsãCRãCÑããAãCđãCŞãCŁãCÛãCİãCŁãCÛãC  
ãCđãCŞãCŁãCÛãCİãCŁãCÛãCñãCñãCñãCñãAr gstpub.h ãAğãõçëIããAçTãCÑãAçãAçãLãCŁããA  
çŞřãçCãAñãCãCŁãCŁãA;ãAŻããAÑ /usr/local/include/gstpub.h ãAçãCŁãAçãAİããLããAñãCđãCŞãCzãCŁãCçijã  
ãAİãCÑãAđãCÑãAçëÛcæTřãAçã;ŁãAÐãÛzãArëZcãAÛãAÐãCãAçãAğãArãAÇãCŁãA;ãAŻãCŞããC  
CãAÑãCŁSmalltalkãAçãCİãCÛãCÿãCğãCraCŁãAÿãAçããLãRZãArãCÛãCñãCñãCñëÛcæTřãAñãCŁãAçãAçëGİãNçTãAğëãÑ  
msgSend () ãArãCñãCñãCijãCřããAãCzãCñãCraCŁãCŞãIJããLãAç2ãijTæTřãAİãAÛãAçãÿãOãAİããAçãõÑãCŁãAçãCİãC  
ãijTæTřãAçççCãCraCŁãAñãAr NULL ãCŞæÑGãõZãAŻããCÑãLëçãAãAÑãAÇãCŁãA;ãAŻããC
```

```
strMsgSend () ãAr msgSend () ãAñãijijãAçãAÐãA;ãAŻããAÑããAãCzãCñãCraCŁãAñçZtæOëCãAçãÛGãÿÛãLÛãCŞãÿãOã  
msgSend () ãAçãCÛãCçãCijãCŁãCñãCçãCçãLëÛcæTřãAğãAŻããC
```

```
vmsgSend () ãAr OOP ãAçëËDãLÛãCŞãRÛãCÑãCŞãCŁãCçijãCŞãAğãAŻããC
```

perform() ~ÁÍ performWith() ~ÁřáDÝčřTãAñäÿÖãAŁãAŞæŨĜãŋŨãLŨãCŞŞSmalltalkãAőãCşãCijãČřãAőãCúaČġãCijãČLãCńãCčãČLéŨčæřãAġãAŻãĂĆ

evalExpr() ~ÁÍ evalCode() ~ÁřáDÝčřTãAñäÿÖãAŁãAŞæŨĜãŋŨãLŨãCŞŞSmalltalkãAőãCşãCijãČLãAłãAŨãAęãóşëãÑã  
evalCode() ~ÁřáĂďãCŞëŁTãAŨãAĵãAŻãCŞãĂĆ

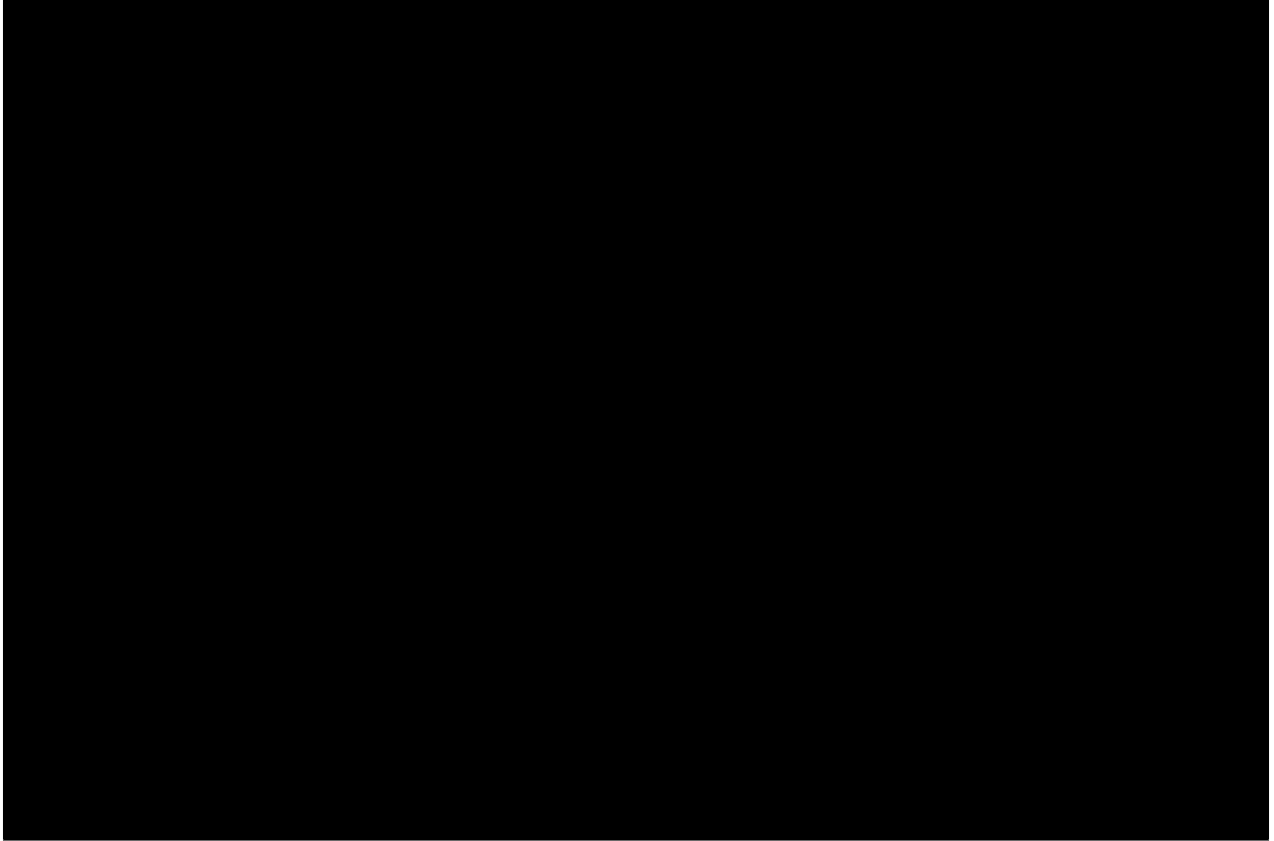
msgSendf() ~Ář printf(3) ~ÁőãČLãAĚãAłæŨĜãŋŨãLŨãCřTãCřãCijãČďãCčãČLãCŞãĵ;ġčřTãAŨãAęãĂã  
èĜłãŇřčŽDãAñCãĂİSmalltalkéŨŞãAőãCġãCijãČłãDLæRŽãCŞãAŨãAĵãAŻãĂCéĬčóŨčřRæđIJãAőãăžčãEéãĚLãAġãAČãC

msgSendf() ~ÁñãęããAŻãČġãCijãČłãAřëŋŸãLëãŋŖãAñãĵİãŋŸãAŨãĂãžëÿÑãAőçĬóëãďãAŃãAČãČLãAĵããAŻãĂĆ  
%t ~ÁÍ %T ~ÁCŞæŇĜãóŽãAŨãAŞãĂłãAĐãAñãAřãĂ2ãAďãAőãĭjřæřãAŇãĚĚëAãAñãAłãČLãĂã1ãAďčŽóãAñãďŇãĂã2ã  
%t ~ÁġãAřłãAďčŽóãAñãĚãóŽãAŨãAŞæŨĜãŋŨãLŨãAŇ typeNameToOOP() ~ÁñãęããAřãČŇãĂã %T  
ãAġãAřčŽřæŌë OOP ãďŇãCŞæŇĜãóŽãAŨãAĵãAŻãĂĆ

éŨčæřãAőãóşëãÑãAñãďşæřŨãAŨãAŞãĂłãAĐãAñãAřãĂãçřřæđIJãAőãďŇãAőãĚIJãAŸãAę 0  
ãAĵãAŞãAř NULL ~ÁŇçřřæđIJãAłãAłãČLãAĵããAŻãĂĆ

### ãAŁãAĵãĂŞ: ġstãAŇãČL'LuaãCŞãSijãAşãĜžãAŻ

LuaãCČġstãřŇæġŸãAñCãAőãCďãCşãCłãCřTãCġãCijãČžãCŞçřłæĐřãAŨãAęãAĐãCŇãAőãAġãĂãAłãCŇãCŞçŽřæŌëãŞİ  
LuaãAő luaL\_doststring() éŨčæřãCřãĵłãAčãAęLuaãCşãCijãČLãCŞãóşëãÑãAŻãCŇãAñãAřãĂãæñããAőãCşãCijãČLãC  
libluaãAřéŨŇçŽžçřł(devel)ãCŞãCČãCşãCijãČřãCŞãCďãCşãCžãČLãCijãCńãAŨãAęãAĐãAłãAĐãAłëëŇãAďãAŇãČLãAłãA



Links

ãŠNæŨĞçŦíelŸãRúéąđ

ãČŮãČlãČČãČLãČŦãČlãČijaČããŠijaAşãGzãAŮãAñãČLãČNãČGãČijaČLãAõãČđãČijaČüãČčãČlãČşãČř

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