MLGMPIDL:OCamlinterfaceforGMPandMPFRlibraries
(version1.2.1)
August14,2013

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nterface.
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:MPFRmulti-precisionfloating-pointversion,functionalve
rsion30
2

Chapter1
Module
Introduction
ThispackageisanOCamlinterfacefortheGMPinterface,whi
chisdecomposedinto7submodules,
correspondingtoCmodules:
•
:GMPintegers,withside-effectsemantics(asinClibrary)
:GMPrationals,withside-effectsemantics(asinClibrary)
:GMPmultiprecisionfloating-pointnumbers,withside-effe
ctsemantics(asinClibrary)
:GMPintegers,withfunctionalsemantics
:GMPrandomnumberfunctions
:MPFRmultiprecisionfloating-pointnumbers,withside-eff
ectsemantics(asinClibrary)
:MPFRmultiprecisionfloating-pointnumbers,withfunctio
nalsemantics
Therealreadyexistssuchaninterface,
mlgmp
[
http://www.di.ens.fr/~monniaux/programmes.html.en
],
writtenbyD.Monniaux.Themotivationforwritinganewonei
ntheAPRONprojectwere
1.Thefactthatmlgmpprovidesbydefaultafunctionalinter
facetoGMP,potentiallymorecostly
intermofmemoryallocationthananimperativeinterface.m
lgmpprovidesonlyarelativesmall
numbersoffunctionsinanimperativeversion.
2.ThecompatibilitywiththeCamlIDLtool.MLGmpIDLusesCa
mlIDL,sothatotherOCaml/C
interfaceswrittenwithCamlIDLmayreusetheMLGmpIDL
.idl
files.
1.1Requirements
•
GMPlibrary(testedwithversion4.0andup)
MPFRlibrary(optional,testedwithversion2.2.x)
FINDLIB/ocamlfind
OCaml3.0orup(testedwith3.09and3.10)
Camlidl(testedwith1.05)
3

CHAPTER1.Module
Introduction
1.2Installation
•
SetthefileMakefile.configusingtheMakefile.configmodeltoy
ourownsetting.Youmightalso
havetomodifytheMakefileforexecutables
Ifyoudownloadfromthesubversionrepository,type’maker
ebuild’,whichbuilds
.ml
,
.mli
,and
_caml.c
filesfrom
.idl
files.
type’make’,possibly’makedebug’,andthen’makeinstall’
TheOCamlpartofthelibraryisnamed
gmp.cma
,(
.cmxa
,
.a
).TheCpartofthelibraryisnamed
libgmp_caml.a
libgmp_caml.so/dllgmp_caml.so
.
’makeinstall’installsnotonly
.mli
.cmi
,butalso
.idl
files.
Beawarehoweverthatimportingthose
filesfromother
fileswillprobablyrequestthe
applicationofSEDeditorwiththescripts
sedscript_caml
and
sedscript_c
(lookattheMakefile).
•
Interpreterandtoplevel
Withdynamiclinking,youcanuseordinaryruntimeocamlrun
andtoplevel.
Youcanplaywith
session.ml
,andcompileitwith’makesession.byte’,’makesession.op
t’.
•
Documentation
Thedocumentationisgeneratedwithocamldoc.
’makemlapronidl.dvi’
’makehtml’(puttheHTMLfilesinthehtmlsubdirectoy)
Miscellaneous
’makeclean’and’makedistclean’havetheusualbehaviour.
’makemostlyclean’,inadditionto’makeclean’,removesth
e
.ml
,
.mli
and
_caml.c
filesgenerated
from.
idl
files.
4

Chapter2
Module
Mpz
:GMPmulti-precision
integers
type
'
att
GMPmulti-precisionintegers
typem
Mutabletag
typef
Functional(immutable)tag
typet=mtt
Mutablemulti-precisioninteger
Thefollowingoperationsaremappedasmuchaspossibletoth
eirCcounterpart.Incaseofimperative
functions(like
set
,
add
...
)thefirstparameteroftype
t
isanout-parameterandholdstheresultwhen
thefunctionreturns.Forinstance,
addxyz
addsthevaluesof
y
and
z
andstorestheresultin
x
.
ThesefunctionsareasefficientastheirCcounterpart:theyd
onotimplyadditionalmemoryallocation,
unlikethecorrespondingfunctionsinthemodule
Mpzf
[7].
2.1Prettyprinting
valprint:Format.formatter->
'
att->unit
2.2InitializationFunctions
Cdocumentation[
http://gmplib.org/manual/Initializing-Integers.html
#Initializing-Integers
]
valinit:unit->
'
att
valinit2:int->
valrealloc2:t->int->unit
2.3AssignementFunctions
Cdocumentation[
http://gmplib.org/manual/Assigning-Integers.html#As
signing-Integers
]
Thefirstparameterholdstheresult.
5

CHAPTER2.Module
Mpz
:GMPmulti-precisionintegers
valset:t->
'
att->unit
valset_si:t->int->unit
valset_d:t->float->unit
For
set_q:t->Mpq.t->unit
,see
Mpq.get_z
[3.4]
val_set_str:t->string->int->unit
valset_str:t->string->base:int->unit
valswap:t->t->unit
2.4CombinedInitializationandAssignmentFunctions
Cdocumentation[
http://gmplib.org/manual/Simultaneous-Integer-Init-
_0026-Assign.html#Simultaneous-Int
valinit_set:
'
att->
btt
valinit_set_si:int->
att
valinit_set_d:float->
val_init_set_str:string->int->
valinit_set_str:string->base:int->t
2.5ConversionFunctions
Cdocumentation[
http://gmplib.org/manual/Converting-Integers.html#C
onverting-Integers
]
valget_si:
'
att->nativeint
valget_int:
att->int
valget_d:
att->float
valget_d_2exp:
att->float*int
val_get_str:int->
att->string
valget_str:base:int->
2.6UserConversions
Thesefunctionsareadditionstoorrenamingoffunctionsoff
eredbytheClibrary.
valto_string:
'
att->string
valto_float:
att->float
valof_string:string->
att
valof_float:float->
valof_int:int->
2.7ArithmeticFunctions
Cdocumentation[
http://gmplib.org/manual/Integer-Arithmetic.html#In
teger-Arithmetic
]
Thefirstparameterholdstheresult.
valadd:t->
'
att->
btt->unit
valadd_ui:t->
att->int->unit
valsub:t->
att->
btt->unit
valsub_ui:t->
att->int->unit
valui_sub:t->int->
att->unit
6

CHAPTER2.Module
Mpz
:GMPmulti-precisionintegers
valmul:t->
'
att->
btt->unit
valmul_si:t->
att->int->unit
valaddmul:t->
att->
btt->unit
valaddmul_ui:t->
att->int->unit
valsubmul:t->
att->
btt->unit
valsubmul_ui:t->
att->int->unit
valmul_2exp:t->
valneg:t->
att->unit
valabs:t->
2.8DivisionFunctions
Cdocumentation[
http://gmplib.org/manual/Integer-Division.html#Inte
ger-Division
]
c
standsforceiling,
f
forfloor,and
t
fortruncate(roundstoward0).
2.8.1Ceilingdivision
valcdiv_q:t->
'
att->
btt->unit
Thefirstparameterholdsthequotient.
valcdiv_r:t->
att->
btt->unit
Thefirstparameterholdstheremainder.
valcdiv_qr:t->t->
att->
btt->unit
Thetwofirstparametersholdresp.thequotientandtheremai
nder).
valcdiv_q_ui:t->
att->int->int
Thefirstparameterholdsthequotient.
valcdiv_r_ui:t->
Thefirstparameterholdstheremainder.
valcdiv_qr_ui:t->t->
Thetwofirstparametersholdresp.thequotientandtheremai
nder).
valcdiv_ui:
valcdiv_q_2exp:t->
att->int->unit
Thefirstparameterholdsthequotient.
valcdiv_r_2exp:t->
Thefirstparameterholdstheremainder.
2.8.2Floordivision
valfdiv_q:t->
att->
btt->unit
valfdiv_r:t->
valfdiv_qr:t->t->
valfdiv_q_ui:t->
att->int->int
valfdiv_r_ui:t->
7

CHAPTER2.Module
Mpz
:GMPmulti-precisionintegers
valfdiv_qr_ui:t->t->
'
att->int->int
valfdiv_ui:
valfdiv_q_2exp:t->
att->int->unit
valfdiv_r_2exp:t->
2.8.3Truncatedivision
valtdiv_q:t->
att->
btt->unit
valtdiv_r:t->
valtdiv_qr:t->t->
valtdiv_q_ui:t->
att->int->int
valtdiv_r_ui:t->
valtdiv_qr_ui:t->t->
valtdiv_ui:
valtdiv_q_2exp:t->
att->int->unit
valtdiv_r_2exp:t->
2.8.4Otherdivision-relatedfunctions
valgmod:t->
att->
btt->unit
valgmod_ui:t->
att->int->int
valdivexact:t->
att->
btt->unit
valdivexact_ui:t->
att->int->unit
valdivisible_p:
att->
btt->bool
valdivisible_ui_p:
att->int->bool
valdivisible_2exp_p:
valcongruent_p:
att->
btt->
ctt->bool
valcongruent_ui_p:
att->int->int->bool
valcongruent_2exp_p:
att->
btt->int->bool
2.9ExponentiationFunctions
Cdocumentation[
http://gmplib.org/manual/Integer-Exponentiation.htm
l#Integer-Exponentiation
]
val_powm:t->
'
att->
btt->
ctt->unit
val_powm_ui:t->
att->int->
btt->unit
valpowm:t->
att->
btt->modulo:
ctt->unit
valpowm_ui:t->
att->int->modulo:
btt->unit
valpow_ui:t->
att->int->unit
valui_pow_ui:t->int->int->unit
2.10RootExtractionFunctions
Cdocumentation[
http://gmplib.org/manual/Integer-Roots.html#Integer
-Roots
]
valroot:t->
'
att->int->bool
valsqrt:t->
att->unit
val_sqrtrem:t->t->
8

CHAPTER2.Module
Mpz
:GMPmulti-precisionintegers
valsqrtrem:t->remainder:t->
'
att->unit
valperfect_power_p:
att->bool
valperfect_square_p:
2.11NumberTheoreticFunctions
Cdocumentation[
http://gmplib.org/manual/Number-Theoretic-Functions
.html#Number-Theoretic-Functions
]
valprobab_prime_p:
'
att->int->int
valnextprime:t->
att->unit
valgcd:t->
att->
btt->unit
valgcd_ui:toption->
att->int->int
val_gcdext:t->t->t->
att->
btt->unit
valgcdext:gcd:t->alpha:t->beta:t->
vallcm:t->
vallcm_ui:t->
att->int->unit
valinvert:t->
att->
btt->bool
valjacobi:
btt->int
vallegendre:
valkronecker:
valkronecker_si:
att->int->int
valsi_kronecker:int->
att->int
valremove:t->
att->
btt->int
valfac_ui:t->int->unit
valbin_ui:t->
att->int->unit
valbin_uiui:t->int->int->unit
valfib_ui:t->int->unit
valfib2_ui:t->t->int->unit
vallucnum_ui:t->int->unit
vallucnum2_ui:t->t->int->unit
2.12ComparisonFunctions
Cdocumentation[
http://gmplib.org/manual/Integer-Comparisons.html#I
nteger-Comparisons
]
valcmp:
'
att->
btt->int
valcmp_d:
att->float->int
valcmp_si:
att->int->int
valcmpabs:
att->
btt->int
valcmpabs_d:
att->float->int
valcmpabs_ui:
att->int->int
valsgn:
att->int
2.13LogicalandBitManipulationFunctions
Cdocumentation[
http://gmplib.org/manual/Integer-Logic-and-Bit-Fidd
ling.html#Integer-Logic-and-Bit-Fi
valgand:t->
'
att->
btt->unit
9

CHAPTER2.Module
Mpz
:GMPmulti-precisionintegers
valior:t->
'
att->
btt->unit
valxor:t->
valcom:t->
att->unit
valpopcount:
att->int
valhamdist:
att->
btt->int
valscan0:
att->int->int
valscan1:
valsetbit:t->int->unit
valclrbit:t->int->unit
valtstbit:
att->int->bool
2.14InputandOutputFunctions:notinterfaced
2.15RandomNumberFunctions:see
Gmp_random
[6]module
2.16IntegerImportandExportFunctions
Cdocumentation[
ttp://gmplib.org/manual/Integer-Import-and-Export.h
tml#Integer-Import-and-Export
]
val_import:
t->
(int,Bigarray.int32_elt,Bigarray.c_layout)Bigarray.
Array1.t->
int->int->unit
val_export:
'
att->
int->int->(int,Bigarray.int32_elt,Bigarray.c_layout
)Bigarray.Array1.t
valimport:
dest:t->
(int,Bigarray.int32_elt,Bigarray.c_layout)Bigarray.
Array1.t->
order:int->endian:int->unit
valexport:
'
att->
order:int->
endian:int->(int,Bigarray.int32_elt,Bigarray.c_layo
ut)Bigarray.Array1.t
2.17MiscellaneousFunctions
Cdocumentation[
http://gmplib.org/manual/Miscellaneous-Integer-Func
tions.html#Miscellaneous-Integer-Fu
valfits_int_p:
'
att->bool
valodd_p:
valeven_p:
valsize:
att->int
valsizeinbase:
att->int->int
valfits_ulong_p:
att->bool
valfits_slong_p:
valfits_uint_p:
valfits_sint_p:
valfits_ushort_p:
valfits_sshort_p:
10

Chapter3
Module
Mpq
:GMPmulti-precision
rationals
type
'
att
GMPmulti-precisionrationals
typem
Mutabletag
typef
Functional(immutable)tag
typet=mtt
Mutablemulti-precisionrationals
Thefollowingoperationsaremappedasmuchaspossibletoth
eirCcounterpart.Incaseofimperative
functions(like
set
,
add
...
)thefirstparameteroftype
t
isanout-parameterandholdstheresultwhen
thefunctionreturns.Forinstance,
addxyz
addsthevaluesof
y
and
z
andstorestheresultin
x
.
ThesefunctionsareasefficientastheirCcounterpart:theyd
onotimplyadditionalmemoryallocation,
unlikethecorrespondingfunctionsinthemodule
Mpqf
[8].
valcanonicalize:
'
att->unit
3.1Prettyprinting
valprint:Format.formatter->
3.2InitializationandAssignmentFunctions
Cdocumentation[
http://gmplib.org/manual/Initializing-Rationals.htm
l#Initializing-Rationals
]
valinit:unit->
'
att
valset:t->
att->unit
valset_z:t->
aMpz.tt->unit
valset_si:t->int->int->unit
val_set_str:t->string->int->unit
valset_str:t->string->base:int->unit
valswap:t->t->unit
11

CHAPTER3.Module
Mpq
:GMPmulti-precisionrationals
3.3AdditionalInitializationandAssignementsfunctions
Thesefunctionsareadditionstoorrenamingoffunctionsoff
eredbytheClibrary.
valinit_set:
'
att->
btt
valinit_set_z:
aMpz.tt->
valinit_set_si:int->int->
att
valinit_set_str:string->base:int->
valinit_set_d:float->
3.4ConversionFunctions
Cdocumentation[
http://gmplib.org/manual/Rational-Conversions.html#
Rational-Conversions
]
valget_d:
'
att->float
valset_d:t->float->unit
valget_z:Mpz.t->
att->unit
val_get_str:int->
att->string
valget_str:base:int->t->string
3.5UserConversions
Thesefunctionssareadditionstoorrenamingoffunctionso
ffeeredbytheClibrary.
valto_string:
'
att->string
valto_float:
att->float
valof_string:string->
att
valof_float:float->
valof_int:int->
valof_frac:int->int->
valof_mpz:
aMpz.tt->
btt
valof_mpz2:
bMpz.tt->
ctt
3.6ArithmeticFunctions
Cdocumentation[
http://gmplib.org/manual/Rational-Arithmetic.html#R
ational-Arithmetic
]
valadd:t->
'
att->
btt->unit
valsub:t->
valmul:t->
valmul_2exp:t->
att->int->unit
valdiv:t->
att->
btt->unit
valdiv_2exp:t->
att->int->unit
valneg:t->
att->unit
valabs:t->
valinv:t->
12

CHAPTER3.Module
Mpq
:GMPmulti-precisionrationals
3.7ComparisonFunctions
Cdocumentation[
http://gmplib.org/manual/Comparing-Rationals.html#C
omparing-Rationals
]
valcmp:
'
att->
btt->int
valcmp_si:
att->int->int->int
valsgn:
att->int
valequal:
att->
btt->bool
3.8ApplyingIntegerFunctionstoRationals
Cdocumentation[
http://gmplib.org/manual/Applying-Integer-Functions
.html#Applying-Integer-Functions
]
valget_num:Mpz.t->
'
att->unit
valget_den:Mpz.t->
valset_num:t->
aMpz.tt->unit
valset_den:t->
3.9InputandOutputFunctions:notinterfaced
13

Chapter4
Module
Mpf
:GMPmulti-precision
floating-pointnumbers
type
'
att
GMPmulti-precisionfloating-pointnumbers
typem
Mutabletag
typef
Functional(immutable)tag
typet=mtt
Mutablemulti-precisionfloating-pointnumbers
Thefollowingoperationsaremappedasmuchaspossibletoth
eirCcounterpart.Incaseofimperative
functions(like
set
,
add
...
)thefirstparameteroftype
t
isanout-parameterandholdstheresultwhen
thefunctionreturns.Forinstance,
addxyz
addsthevaluesof
y
and
z
andstorestheresultin
x
.
ThesefunctionsareasefficientastheirCcounterpart:theyd
onotimplyadditionalmemoryallocation.
4.1Prettyprinting
valprint:Format.formatter->
'
att->unit
4.2InitializationFunctions
Cdocumentation[
http://gmplib.org/manual/Initializing-Floats.html#I
nitializing-Floats
]
valset_default_prec:int->unit
valget_default_prec:unit->int
valinit:unit->
'
att
valinit2:int->
valget_prec:
att->int
valset_prec:t->int->unit
valset_prec_raw:t->int->unit
14

CHAPTER4.Module
Mpf
:GMPmulti-precisionfloating-pointnumbers
4.3AssignementFunctions
Cdocumentation[
http://gmplib.org/manual/Assigning-Floats.html#Assi
gning-Floats
]
valset:t->
'
att->unit
valset_si:t->int->unit
valset_d:t->float->unit
valset_z:t->
aMpz.tt->unit
valset_q:t->
aMpq.tt->unit
val_set_str:t->string->int->unit
valset_str:t->string->base:int->unit
valswap:t->t->unit
4.4CombinedInitializationandAssignementFunctions
Cdocumentation[
http://gmplib.org/manual/Simultaneous-Float-Init-_0
026-Assign.html#Simultaneous-Float
valinit_set:
'
att->
btt
valinit_set_si:int->
att
valinit_set_d:float->
val_init_set_str:string->int->
valinit_set_str:string->base:int->
4.5ConversionFunctions
Cdocumentation[
http://gmplib.org/manual/Converting-Floats.html#Con
verting-Floats
]
valget_d:
'
att->float
valget_d_2exp:
att->float*int
valget_si:
att->nativeint
valget_int:
att->int
valget_z:Mpz.t->
att->unit
valget_q:Mpq.t->
val_get_str:int->int->
att->string*int
valget_str:base:int->digits:int->
4.6UserConversions
Thesefunctionssareadditionstoorrenamingoffunctionso
fferedbytheClibrary.
valto_string:
'
att->string
valto_float:
att->float
valof_string:string->
att
valof_float:float->
valof_int:int->
valof_mpz:
aMpz.tt->
btt
valof_mpq:
aMpq.tt->
valis_integer:
att->bool
15

CHAPTER4.Module
Mpf
:GMPmulti-precisionfloating-pointnumbers
4.7ArithmeticFunctions
Cdocumentation[
http://gmplib.org/manual/Float-Arithmetic.html#Floa
t-Arithmetic
]
valadd:t->
'
att->
btt->unit
valadd_ui:t->
att->int->unit
valsub:t->
att->
btt->unit
valui_sub:t->int->
att->unit
valsub_ui:t->
att->int->unit
valmul:t->
att->
btt->unit
valmul_ui:t->
att->int->unit
valmul_2exp:t->
valdiv:t->
att->
btt->unit
valui_div:t->int->
att->unit
valdiv_ui:t->
att->int->unit
valdiv_2exp:t->
valsqrt:t->
att->unit
valpow_ui:t->
att->int->unit
valneg:t->
att->unit
valabs:t->
4.8ComparisonFunctions
Cdocumentation[
http://gmplib.org/manual/Float-Comparison.html#Floa
t-Comparison
]
valcmp:
'
att->
btt->int
valcmp_d:
att->float->int
valcmp_si:
att->int->int
valsgn:
att->int
val_equal:
att->
btt->int->bool
valequal:
att->bits:int->bool
valreldiff:t->
btt->unit
4.9InputandOutputFunctions:notinterfaced
4.10RandomNumberFunctions:see
Gmp_random
[6]module
4.11MiscellaneousFloatFunctions
Cdocumentation[
http://gmplib.org/manual/Miscellaneous-Float-Functi
ons.html#Miscellaneous-Float-Functi
valceil:t->
'
att->unit
valfloor:t->
valtrunc:t->
valinteger_p:
att->bool
valfits_int_p:
valfits_ulong_p:
valfits_slong_p:
valfits_uint_p:
16

CHAPTER4.Module
Mpf
:GMPmulti-precisionfloating-pointnumbers
valfits_sint_p:
'
att->bool
valfits_ushort_p:
valfits_sshort_p:
17

Chapter5
Module
Mpfr
:MPFR
multi-precisionfloating-point
numbers
type
'
att
typeround=
|Near
|Zero
|Up
|Down
|Away
|Faith
|NearAway
MPFRmulti-precisionfloating-pointnumbers
typem
Mutabletag
typef
Functional(immutable)tag
typet=mtt
Mutablemulti-precisionfloating-pointnumbers
Thefollowingoperationsaremappedasmuchaspossibletoth
eirCcounterpart.Incaseofimperative
functions(like
set
,
add
...
)thefirstparameteroftype
t
isanout-parameterandholdstheresultwhen
thefunctionreturns.Forinstance,
addxyz
addsthevaluesof
y
and
z
andstorestheresultin
x
.
ThesefunctionsareasefficientastheirCcounterpart:theyd
onotimplyadditionalmemoryallocation.
5.1Prettyprinting
valprint:Format.formatter->
'
att->unit
valprint_round:Format.formatter->round->unit
valstring_of_round:round->string
18

CHAPTER5.Module
Mpfr
:MPFRmulti-precisionfloating-pointnumbers
5.2RoundingModes
Cdocumentation[
http://www.mpfr.org/mpfr-current/mpfr.html#Rounding
-Related-Functions
]
valset_default_rounding_mode:round->unit
valget_default_rounding_mode:unit->round
valround_prec:t->round->int->int
5.3Exceptions
Cdocumentation[
http://www.mpfr.org/mpfr-current/mpfr.html#Exceptio
n-Related-Functions
]
valget_emin:unit->int
valget_emax:unit->int
valset_emin:int->unit
valset_emax:int->unit
valcheck_range:t->int->round->int
valclear_underflow:unit->unit
valclear_overflow:unit->unit
valclear_nanflag:unit->unit
valclear_inexflag:unit->unit
valclear_flags:unit->unit
valunderflow_p:unit->bool
valoverflow_p:unit->bool
valnanflag_p:unit->bool
valinexflag_p:unit->bool
5.4InitializationFunctions
Cdocumentation[
http://www.mpfr.org/mpfr-current/mpfr.html#Initiali
zation-Functions
]
valset_default_prec:int->unit
valget_default_prec:unit->int
valinit:unit->
'
att
valinit2:int->
valget_prec:
att->int
valset_prec:t->int->unit
valset_prec_raw:t->int->unit
5.5AssignmentFunctions
Cdocumentation[
http://www.mpfr.org/mpfr-current/mpfr.html#Assignme
nt-Functions
]
valset:t->
'
att->round->int
valset_si:t->int->round->int
valset_d:t->float->round->int
valset_z:t->
aMpz.tt->round->int
valset_q:t->
aMpq.tt->round->int
val_set_str:t->string->int->round->unit
valset_str:t->string->base:int->round->unit
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:MPFRmulti-precisionfloating-pointnumbers
val_strtofr:t->string->int->round->int*int
valstrtofr:t->string->base:int->round->int*int
AsMPFR’sstrtofr,butreturnsapair
(r,i)
where
r
istheusualternaryresult,and
i
istheindexin
thestringofthefirstnot-readcharacter.Thus,
i=0
whennonumbercouldbereadatall,andisequal
tothelengthofthestringifeverythingwasread.
valset_f:t->
'
aMpf.tt->round->int
valset_si_2exp:t->int->int->round->int
valset_inf:t->int->unit
valset_nan:t->unit
valswap:t->t->unit
5.6CombinedInitializationandAssignmentFunctions
Cdocumentation[
http://www.mpfr.org/mpfr-current/mpfr.html#Combined
-Initialization-and-Assignment-Fun
valinit_set:
'
att->round->int*
btt
valinit_set_si:int->round->int*
att
valinit_set_d:float->round->int*
valinit_set_f:
aMpf.tt->round->int*
btt
valinit_set_z:
aMpz.tt->round->int*
valinit_set_q:
aMpq.tt->round->int*
val_init_set_str:string->int->round->
att
valinit_set_str:string->base:int->round->
5.7ConversionFunctions
Cdocumentation[
http://www.mpfr.org/mpfr-current/mpfr.html#Conversi
on-Functions
]
valget_d:
'
att->round->float
valget_d1:
att->float
valget_z_exp:Mpz.t->
att->int
valget_z:Mpz.t->
att->round->unit
val_get_str:int->int->
att->round->string*int
valget_str:base:int->digits:int->t->round->string*i
nt
5.8UserConversions
Thesefunctionssareadditionstoorrenamingoffunctionso
fferedbytheClibrary.
valto_string:
'
att->string
valto_float:?round:round->
att->float
valto_mpq:
att->
bMpq.tt
valof_string:string->round->
att
valof_float:float->round->
valof_int:int->round->
valof_frac:int->int->round->
valof_mpz:
aMpz.tt->round->
btt
valof_mpz2:
aMpz.tt->
bMpz.tt->round->
ctt
valof_mpq:
aMpq.tt->round->
btt
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:MPFRmulti-precisionfloating-pointnumbers
5.9BasicArithmeticFunctions
Cdocumentation[
http://www.mpfr.org/mpfr-current/mpfr.html#Basic-Ar
ithmetic-Functions
]
valadd:t->
'
att->
btt->round->int
valadd_ui:t->
att->int->round->int
valadd_z:t->
att->
aMpz.tt->round->int
valadd_q:t->
aMpq.tt->round->int
valsub:t->
btt->round->int
valui_sub:t->int->
att->round->int
valsub_ui:t->
att->int->round->int
valsub_z:t->
att->
aMpz.tt->round->int
valsub_q:t->
aMpq.tt->round->int
valmul:t->
btt->round->int
valmul_ui:t->
att->int->round->int
valmul_z:t->
att->
aMpz.tt->round->int
valmul_q:t->
aMpq.tt->round->int
valmul_2ui:t->
att->int->round->int
valmul_2si:t->
valmul_2exp:t->
valdiv:t->
att->
btt->round->int
valui_div:t->int->
att->round->int
valdiv_ui:t->
att->int->round->int
valdiv_z:t->
att->
aMpz.tt->round->int
valdiv_q:t->
aMpq.tt->round->int
valdiv_2ui:t->
att->int->round->int
valdiv_2si:t->
valdiv_2exp:t->t->int->round->int
valsqrt:t->
att->round->bool
valsqrt_ui:t->int->round->bool
valpow_ui:t->
att->int->round->bool
valpow_si:t->
valui_pow_ui:t->int->int->round->bool
valui_pow:t->int->
att->round->bool
valpow:t->
att->
btt->round->bool
valneg:t->
att->round->int
valabs:t->
5.10ComparisonFunctions
Cdocumentation[
http://www.mpfr.org/mpfr-current/mpfr.html#Comparis
on-Functions
]
valcmp:
'
att->
btt->int
valcmp_si:
att->int->int
valcmp_si_2exp:
att->int->int->int
valsgn:
att->int
val_equal:
att->
btt->int->bool
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CHAPTER5.Module Mpfr :MPFRmulti-precisionfloating-pointnumbers valequal: 'att-> btt->bits:int->bool valnan_p: att->bool valinf_p: valnumber_p: valreldiff:t-> att-> btt->round->unit 5.11SpecialFunctions Cdocumentation[http://www.mpfr.org/mpfr-current/mpfr.html#Special- Functions]vallog:t-> 'att->round->int vallog2:t-> vallog10:t-> valexp:t-> valexp2:t-> valexp10:t-> valcos: att-> btt->round->int valsin: valtan: valsec: valcsc: valcot: valsin_cos: btt-> ctt->round->bool valacos:t-> att->round->int valasin:t-> valatan:t-> valatan2:t-> att-> btt->round->int valcosh: valsinh: valtanh: valsech: valcsch: valcoth: valacosh:t-> att->round->int valasinh:t-> valatanh:t-> valfac_ui:t->int->round->int vallog1p:t-> valexpm1:t-> valeint:t-> valgamma:t-> vallngamma:t-> valzeta:t-> valerf:t-> valerfc:t-> valj0:t-> 22

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:MPFRmulti-precisionfloating-pointnumbers
valj1:t->
'
att->round->int
valjn:t->int->
valy0:t->
valy1:t->
valyn:t->int->
valfma:t->
att->
btt->
ctt->round->int
valfms:t->
att->
btt->
ctt->round->int
valagm:t->
att->
btt->round->int
valhypot:t->
valconst_log2:t->round->int
valconst_pi:t->round->int
valconst_euler:t->round->int
valconst_catalan:t->round->int
5.12InputandOutputFunctions:notinterfaced
5.13MiscellaneousFloatFunctions
Cdocumentation[
http://www.mpfr.org/mpfr-current/mpfr.html#Rounding
-Related-Functions
]
valrint:t->
'
att->round->int
valceil:t->
att->int
valfloor:t->
valround:t->
valtrunc:t->
valfrac:t->
att->round->int
valmodf:t->t->
valfmod:t->
att->
btt->round->int
valremainder:t->
valinteger_p:
att->bool
valnexttoward:t->
att->unit
valnextabove:t->unit
valnextbelow:t->unit
valmin:t->
att->
btt->round->int
valmax:t->
valget_exp:
att->int
valset_exp:t->int->int
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Gmp_random
:GMPrandom
generationfunctions
typestate
GMPrandomgenerationfunctions
6.1RandomStateInitialization
Cdocumentation[
http://gmplib.org/manual/Random-State-Initializatio
n.html#Random-State-Initialization
]
valinit_default:unit->state
valinit_lc_2exp:
'
aMpz.tt->int->int->state
valinit_lc_2exp_size:int->state
6.2RandomStateSeeding
Cdocumentation[
http://gmplib.org/manual/Random-State-Seeding.html#
Random-State-Seeding
]
valseed:state->
'
aMpz.tt->unit
valseed_ui:state->int->unit
6.3RandomNumberFunctions
6.3.1Integers(
Mpz
[2])
Cdocumentation[
http://gmplib.org/manual/Integer-Random-Numbers.htm
l#Integer-Random-Numbers
]
moduleMpz:
sig
valurandomb:Mpz.t->Gmp_random.state->int->unit
valurandomm:Mpz.t->Gmp_random.state->
'
aMpz.tt->unit
valrrandomb:Mpz.t->Gmp_random.state->int->unit
end
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CHAPTER6.Module
Gmp_random
:GMPrandomgenerationfunctions
6.3.2Floating-point(
Mpf
[4])
Cdocumentation[
http://gmplib.org/manual/Miscellaneous-Float-Functi
ons.html#Miscellaneous-Float-Functi
moduleMpf:
sig
valurandomb:Mpf.t->Gmp_random.state->int->unit
end
6.3.3Floating-point(
Mpfr
[5])
Cdocumentation[
http://www.mpfr.org/mpfr-current/mpfr.html#Miscella
neous-Functions
]
moduleMpfr:
sig
valurandomb:Mpfr.t->Gmp_random.state->unit
valurandom:
'
aMpfr.tt->Gmp_random.state->Mpfr.round->unit
end
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Chapter7
Module
Mpzf
:GMPmulti-precision
integers,functionalversion
Functionsinthismodulehasafunctionalsemantics,unlike
thecorrespondingfunctionsin
Mpz
[2].These
functionsarelessefficients,duetotheadditionalmemoryal
locationneededfortheresult.
Thismodulecouldbeextendedtooffermorefunctionswithafu
nctionalsemantics,ifaskedfor.
type
'
att=
aMpz.tt
typet=Mpz.ftt
multi-precisioninteger
val_mpz:t->Mpz.t
val_mpzf:Mpz.t->t
valto_mpz:t->
'
aMpz.tt
valof_mpz:
aMpz.tt->t
SafeconversionfromandtoMpz.t.
Thereisnosharingbetweentheargumentandtheresult.
7.1Pretty-printing
valprint:Format.formatter->
'
att->unit
7.2Constructors
valof_string:string->t
valof_float:float->t
valof_int:int->t
7.3Conversions
valto_string:
'
att->string
valto_float:
att->float
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CHAPTER7.Module Mpzf :GMPmulti-precisionintegers,functionalversion 7.4ArithmeticFunctions valadd: 'att-> btt->t valadd_int: att->int->t valsub: att-> btt->t valsub_int: att->int->t valmul: att-> btt->t valmul_int: att->int->t valcdiv_q: att-> btt->t valcdiv_r: valcdiv_qr: btt->t*t valfdiv_q: btt->t valfdiv_r: valfdiv_qr: btt->t*t valtdiv_q: btt->t valtdiv_r: valtdiv_qr: btt->t*t valdivexact: btt->t valgmod: valgcd: vallcm: valneg: att->t valabs: 7.5ComparisonFunctions valcmp: att-> btt->int valcmp_int: att->int->int valsgn: att->int 27

Chapter8
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Mpqf
:GMPmulti-precision
rationals,functionalversion
Functionsinthismodulehasafunctionalsemantics,unlike
thecorrespondingfunctionsin
Mpq
[3].These
functionsarelessefficients,duetotheadditionalmemoryal
locationnededfortheresult.
type
'
att=
aMpq.tt
typet=Mpq.ftt
multi-precisionrationals
valto_mpq:t->
valof_mpq:
aMpq.tt->t
SafeconversionfromandtoMpq.t.
Thereisnosharingbetweentheargumentandtheresult.
val_mpq:t->Mpq.t
val_mpqf:Mpq.t->t
UnsafeconversionfromandtoMpq.t.
Sharingbetweentheargumentandtheresult.
8.1Pretty-printing
valprint:Format.formatter->
'
att->unit
8.2Constructors
valof_string:string->t
valof_float:float->t
valof_int:int->t
valof_frac:int->int->t
valof_mpz:
'
aMpz.tt->t
valof_mpz2:
aMpz.tt->
bMpz.tt->t
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CHAPTER8.Module
Mpqf
:GMPmulti-precisionrationals,functionalversion
8.3Conversions
valto_string:
'
att->string
valto_float:
att->float
valto_mpzf2:
att->Mpzf.t*Mpzf.t
8.4ArithmeticFunctions
valadd:
att->
btt->t
valsub:
valmul:
valdiv:
valneg:
att->t
valabs:
valinv:
valequal:
att->
btt->bool
8.5ComparisonFunctions
valcmp:
att->
btt->int
valcmp_int:
att->int->int
valcmp_frac:
att->int->int->int
valsgn:
att->int
8.6ExtractionFunctions
valget_num:t->Mpzf.t
valget_den:t->Mpzf.t
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Chapter9
Module
Mpfrf
:MPFR
multi-precisionfloating-point
version,functionalversion
Functionsinthismodulehasafunctionalsemantics,unlike
thecorrespondingfunctionsin
Mpfr
[5].These
functionsdonotreturntheroundinginformationandareles
sefficients,duetotheadditionalmemory
allocationnededfortheresult.
type
'
att=
aMpfr.tt
typet=Mpfr.ftt
multi-precisionfloating-pointnumbers
valto_mpfr:t->
valof_mpfr:
aMpfr.tt->t
SafeconversionfromandtoMpfr.t.
Thereisnosharingbetweentheargumentandtheresult.
val_mpfr:t->Mpfr.t
val_mpfrf:Mpfr.t->t
UnsafeconversionfromandtoMpfr.t.
Theargumentandtheresultactuallysharethesamenumber:b
ecautious!
ConversionfromandtoMpz.t,Mpq.tandMpfr.tThereisnosha
ringbetweentheargumentandthe
result.
9.1Pretty-printing
valprint:Format.formatter->t->unit
9.2Constructors
valof_string:string->Mpfr.round->t
valof_float:float->Mpfr.round->t
valof_int:int->Mpfr.round->t
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CHAPTER9.Module
Mpfrf
:MPFRmulti-precisionfloating-pointversion,functional
version
valof_frac:int->int->Mpfr.round->t
valof_mpz:
'
aMpz.tt->Mpfr.round->t
valof_mpz2:
aMpz.tt->
bMpz.tt->Mpfr.round->t
valof_mpq:
aMpq.tt->Mpfr.round->t
9.3Conversions
valto_string:t->string
valto_float:?round:Mpfr.round->t->float
valto_mpqf:t->Mpqf.t
9.4ArithmeticFunctions
valadd:
'
att->
btt->Mpfr.round->t
valadd_int:
att->int->Mpfr.round->t
valsub:
att->
btt->Mpfr.round->t
valsub_int:
att->int->Mpfr.round->t
valmul:
att->
btt->Mpfr.round->t
valmul_ui:
att->int->Mpfr.round->t
valui_div:int->
btt->Mpfr.round->t
valdiv:
att->
valdiv_ui:
att->int->Mpfr.round->t
valsqrt:
att->Mpfr.round->t
valui_pow:int->
btt->Mpfr.round->t
valpow:
att->
valpow_int:
att->int->Mpfr.round->t
valneg:
att->Mpfr.round->t
valabs:
9.5ComparisonFunctions
valequal:
att->
btt->bits:int->bool
valcmp:
btt->int
valcmp_int:
att->int->int
valsgn:
att->int
valnan_p:
att->bool
valinf_p:
valnumber_p:
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