

NAME

BN_add, BN_sub, BN_mul, BN_sqr, BN_div, BN_mod, BN_nnmod, BN_mod_add, BN_mod_sub, BN_mod_mul, BN_mod_sqr, BN_mod_sqrt, BN_exp, BN_mod_exp, BN_gcd - arithmetic operations on BIGNUMs

SYNOPSIS

```
#include <openssl/bn.h>
```

```
int BN_add(BIGNUM *r, const BIGNUM *a, const BIGNUM *b);
```

```
int BN_sub(BIGNUM *r, const BIGNUM *a, const BIGNUM *b);
```

```
int BN_mul(BIGNUM *r, BIGNUM *a, BIGNUM *b, BN_CTX *ctx);
```

```
int BN_sqr(BIGNUM *r, BIGNUM *a, BN_CTX *ctx);
```

```
int BN_div(BIGNUM *dv, BIGNUM *rem, const BIGNUM *a, const BIGNUM *d,  
          BN_CTX *ctx);
```

```
int BN_mod(BIGNUM *rem, const BIGNUM *a, const BIGNUM *m, BN_CTX *ctx);
```

```
int BN_nnmod(BIGNUM *r, const BIGNUM *a, const BIGNUM *m, BN_CTX *ctx);
```

```
int BN_mod_add(BIGNUM *r, BIGNUM *a, BIGNUM *b, const BIGNUM *m,  
              BN_CTX *ctx);
```

```
int BN_mod_sub(BIGNUM *r, BIGNUM *a, BIGNUM *b, const BIGNUM *m,  
              BN_CTX *ctx);
```

```
int BN_mod_mul(BIGNUM *r, BIGNUM *a, BIGNUM *b, const BIGNUM *m,  
              BN_CTX *ctx);
```

```
int BN_mod_sqr(BIGNUM *r, BIGNUM *a, const BIGNUM *m, BN_CTX *ctx);
```

```
BIGNUM *BN_mod_sqrt(BIGNUM *in, BIGNUM *a, const BIGNUM *p, BN_CTX *ctx);
```

```
int BN_exp(BIGNUM *r, BIGNUM *a, BIGNUM *p, BN_CTX *ctx);
```

```
int BN_mod_exp(BIGNUM *r, BIGNUM *a, const BIGNUM *p,  
              const BIGNUM *m, BN_CTX *ctx);
```

```
int BN_gcd(BIGNUM *r, BIGNUM *a, BIGNUM *b, BN_CTX *ctx);
```

DESCRIPTION

BN_add() adds a and b and places the result in r ("r=a+b"). r may be the same **BIGNUM** as a or b .

BN_sub() subtracts b from a and places the result in r ("r=a-b"). r may be the same **BIGNUM** as a or b .

BN_mul() multiplies a and b and places the result in r ("r=a*b"). r may be the same **BIGNUM** as a or b . For multiplication by powers of 2, use **BN_lshift(3)**.

BN_sqr() takes the square of a and places the result in r ("r=a^2"). r and a may be the same **BIGNUM**. This function is faster than **BN_mul(r,a,a)**.

BN_div() divides a by d and places the result in dv and the remainder in rem ("dv=a/d, rem=a%d"). Either of dv and rem may be **NULL**, in which case the respective value is not returned. The result is rounded towards zero; thus if a is negative, the remainder will be zero or negative. For division by powers of 2, use **BN_rshift(3)**.

BN_mod() corresponds to **BN_div()** with dv set to **NULL**.

BN_nnmod() reduces a modulo m and places the nonnegative remainder in r .

BN_mod_add() adds a to b modulo m and places the nonnegative result in r .

BN_mod_sub() subtracts b from a modulo m and places the nonnegative result in r .

BN_mod_mul() multiplies a by b and finds the nonnegative remainder respective to modulus m ("r=(a*b) mod m"). r may be the same **BIGNUM** as a or b . For more efficient algorithms for repeated computations using the same modulus, see **BN_mod_mul_montgomery(3)** and **BN_mod_mul_reciprocal(3)**.

BN_mod_sqr() takes the square of a modulo m and places the result in r .

BN_mod_sqrt() returns the modular square root of a such that " $in^2 = a \pmod{p}$ ". The modulus p must be a prime, otherwise an error or an incorrect "result" will be returned. The result is stored into in which can be **NULL**. The result will be newly allocated in that case.

BN_exp() raises a to the p -th power and places the result in r ("r=a^p"). This function is faster than repeated applications of **BN_mul()**.

BN_mod_exp() computes a to the p -th power modulo m ("r=a^p % m"). This function uses less time and space than **BN_exp()**. Do not call this function when m is even and any of the parameters have the **BN_FLG_CONSTTIME** flag set.

BN_gcd() computes the greatest common divisor of a and b and places the result in r . r may be the same **BIGNUM** as a or b .

For all functions, ctx is a previously allocated **BN_CTX** used for temporary variables; see **BN_CTX_new(3)**.

Unless noted otherwise, the result **BIGNUM** must be different from the arguments.

RETURN VALUES

The **BN_mod_sqrt()** returns the result (possibly incorrect if p is not a prime), or NULL.

For all remaining functions, 1 is returned for success, 0 on error. The return value should always be checked (e.g., "if (!BN_add(r,a,b)) goto err;"). The error codes can be obtained by **ERR_get_error(3)**.

SEE ALSO

ERR_get_error(3), **BN_CTX_new(3)**, **BN_add_word(3)**, **BN_set_bit(3)**

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