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### ***Rocky Enterprise Linux 9.2 Manual Pages on command 'BN\_exp.3ossl'***

***\$ man BN\_exp.3ossl***

BN\_ADD(3ossl)                    OpenSSL                    BN\_ADD(3ossl)

#### 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` (" $r=(a*b) \bmod m$ "). `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  $x^2 = a \pmod{p}$ . The modulus  $p$  must be a prime, otherwise an error or an incorrect "result" will be returned. The result is stored into `r` 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)`.

ERR\_get\_error(3), BN\_CTX\_new(3), BN\_add\_word(3), BN\_set\_bit(3)

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