

# Collections Nesting

## Traditional approach for unique prefixes

Hardcoded prefixes in the constructor using a short one letter prefix that was converted to a vector of bytes. When using nested collection, the prefix must be constructed manually.

```
use  
  
near_sdk :: borsh :: { self ,  
  
BorshDeserialize ,  
  
BorshSerialize } ; use  
  
near_sdk :: collections :: { UnorderedMap ,  
  
UnorderedSet } ; use  
  
near_sdk :: { near_bindgen ,  
  
AccountId } ;
```

## [near\_bindgen]

## [derive(BorshDeserialize, BorshSerialize)]

```
pub  
  
struct  
  
Contract  
  
{ pub accounts :  
  
UnorderedMap < AccountId ,  
  
UnorderedSet < String  
  
        , }  
  
impl  
  
Default  
  
for  
  
Contract  
  
{ fn  
  
default ( )  
  
->  
  
Self  
  
{ Self  
  
{ accounts :  
  
UnorderedMap :: new ( b"t" ) , } } }
```

## [near\_bindgen]

```
impl
```

```

Contract

{ pub

fn

get_tokens ( & self , account_id :

& AccountId )

->

Vec < String

{ let tokens =

self . accounts . get ( account_id ) . unwrap_or_else ( ||

{ // Constructing a unique prefix for a nested UnorderedSet from a concatenation // of a prefix and a hash of the account id.
let prefix :

Vec < u8

=

[ b"s" . as_slice ( ) , & near_sdk :: env :: sha256_array ( account_id . as_bytes ( ) ) , ] . concat ( ) ; UnorderedSet :: new (
prefix ) } ) ; tokens . to_vec ( ) } }

```

## Generating unique prefixes for persistent collections

Read more about persistent collections [from this documentation](#) or from [the Rust docs](#) .

Every instance of a persistent collection requires a unique storage prefix. The prefix is used to generate internal keys to store data in persistent storage. These internal keys need to be unique to avoid collisions (including collisions with `keySTATE` ).

When a contract gets complicated, there may be multiple different collections that are not all part of the main structure, but instead part of a sub-structure or nested collections. They all need to have unique prefixes.

We can introduce an enum for tracking storage prefixes and keys. And then use borsh serialization to construct a unique prefix for every collection. It's as efficient as manually constructing them, because with Borsh serialization, an enum only takes one byte.

```

use

near_sdk :: borsh :: { self ,

BorshDeserialize ,

BorshSerialize } ; use

near_sdk :: collections :: { UnorderedMap ,

UnorderedSet } ; use

near_sdk :: { env , near_bindgen ,

AccountId ,

BorshStorageKey ,

CryptoHash } ;

```

**[near\_bindgen]**

**[derive(BorshDeserialize, BorshSerialize)]**

```

pub

struct

```

```

Contract

{ pub accounts :
  UnorderedMap < AccountId ,
  UnorderedSet < String
    , }

impl
  Default
  for
    Contract
  { fn
    default ( )
    ->
      Self
    { Self
      { accounts :
        UnorderedMap :: new ( StorageKeys :: Accounts ) , } } }

```

## [derive(BorshStorageKey, BorshSerialize)]

```

pub
enum
  StorageKeys
  { Accounts , SubAccount
  { account_hash :
    CryptoHash
  } , }

```

## [near\_bindgen]

```

impl
  Contract
  { pub
    fn
      get_tokens ( & self , account_id :
        & AccountId )
      ->
        Vec < String
      { let tokens =
        self . accounts . get ( account_id ) . unwrap_or_else ( ||
        { UnorderedSet :: new ( StorageKeys :: SubAccount

```

```
{ account_hash :
env :: sha256_array ( account_id . as_bytes ( ) ) , } } } ; tokens . to_vec ( ) } }
```

## Error prone patterns

By extension of the error-prone patterns to avoid mentioned in the [collections section](#) , it is important to keep in mind how these bugs can easily be introduced into a contract when using nested collections.

Some issues for more context:

- <https://github.com/near/near-sdk-rs/issues/560>
- <https://github.com/near/near-sdk-rs/issues/703>

The following cases are the most commonly encountered bugs that cannot be restricted at the type level:

```
use
near_sdk :: borsh :: { self ,
BorshSerialize } ; use
near_sdk :: collections :: { LookupMap ,
UnorderedSet } ; use
near_sdk :: BorshStorageKey ;
```

## [derive(BorshStorageKey, BorshSerialize)]

```
pub
enum
StorageKey
{ Root , Nested ( u8 ) , }

// Bug 1: Nested collection is removed without clearing it's own state. let
mut root :
LookupMap < u8 ,
UnorderedSet < String
=
LookupMap :: new ( StorageKey :: Root ) ; let
mut nested =
UnorderedSet :: new ( StorageKey :: Nested ( 1 ) ) ; nested . insert ( & "test" . to_string ( ) ) ; root . insert ( & 1 ,
& nested ) ;

// Remove inserted collection without clearing it's sub-state. let
mut _removed = root . remove ( & 1 ) . unwrap ( ) ;

// This line would fix the bug: // _removed.clear();

// This collection will now be in an inconsistent state if an empty UnorderedSet is put // in the same entry of root. root . insert (
& 1 ,
& UnorderedSet :: new ( StorageKey :: Nested ( 1 ) ) ) ; let n = root . get ( & 1 ) . unwrap ( ) ; assert! ( n . is_empty ( ) ) ;
assert! ( n . contains ( & "test" . to_string ( ) ) ) ;

// Bug 2 (only relevant for near_sdk::collections, not near_sdk::store): Nested // collection is modified without updating the collection
itself in the outer collection. // // This is fixed at the type level in near_sdk::store because the values are modified // in-place and
guarded by regular Rust borrow-checker rules. root . insert ( & 2 ,
```

```
& UnorderedSet :: new ( StorageKey :: Nested ( 2 ) ) ) ;
```

```
let
```

```
mut nested = root . get ( & 2 ) . unwrap ( ) ; nested . insert ( & "some value" . to_string ( ) ) ;
```

```
// This line would fix the bug: // root.insert(&2, &nested);
```

```
let n = root . get ( & 2 ) . unwrap ( ) ; assert! ( n . is_empty ( ) ) ; assert! ( n . contains ( & "some value" . to_string ( ) ) )
```

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