WELCOME

Beyond the Basics
Next level database development

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Three key things I wish all developers knew about

- How to work with arrays
- Database Expressions
- Schema Validation

Working with arrays

Arrays 101

A query will match **any** element in an array

```
query = {"booked_weeks.bookingId": "B75421" }
db.villas.find(query)
```

We are using 'Week Number' instead of date in these example to make it easier to read! It would be Date() types normally.

```
{
    _id: "P1234",
    name: "Apple Villa",
    sleeps: 5,
    booked_weeks: [
        {
            from: 2,
            to: 3,
            bookingId: "B66462"
        }
        , {
            from: 3,
            to: 4,
            bookingId: "B76251"
        },
        {
            from: 7,
            to: 8,
            bookingId: "B75421"
        }
    ]
}
```

Arrays 101

You can use a dollar **($) in a projection** to return just that element from the array

```
query = {"booked_weeks.bookingId": "B75421" };
projection = {"booked_weeks.$": 1};

db.villas.find(query, projection);
```

```
{
   _id: "P1234",
   booked_weeks: [
     {
          from: 7,
          to: 8,
          bookingId: "B75421"
     }
   ]
}
```

Arrays 101

You can also use **$ in an update** to modify the matched element

```
query = { "booked_weeks.bookingId": "B75421" };
update = { $set: { "booked_weeks.$.to": 10}};

db.villas.updateOne(query, update);
```

```
{
   _id: "P1234",
   name: "Apple Villa",
   sleeps: 5,
   booked_weeks: [
       {
           from: 2,
           to: 3,
           bookingId: "B66462"
       },
       {
           from: 3,
           to: 4,
           bookingId: "B76251"
       },
       {
           from: 7,
           to: 10, <- Was 8
           bookingId: "B75421"
       }
   ]
}
```


Test time!

Test time!

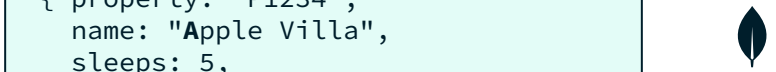
How many properties are booked before week 2?

```
query = {"booked_weeks.from": { $lt: 2} }
```

```
{ property: "P1234",
  name: "Apple Villa",
  sleeps: 5,
  booked_weeks: [
    { from: 1, to: 3 },
    { from: 3, to: 4 },
    { from: 7, to: 9 }
  ]
}
```

```
{ property: "P1234",
  name: "Berry Villa",
  sleeps: 5,
  booked_weeks: [
    { from: 2, to: 6 },
    { from: 8, to: 9 },
    { from: 9, to: 10 }
  ]
}
```

```
{ property: "P1234",
  name: "Cherry Villa",
  sleeps: 5,
  booked_weeks: [
    { from: 1, to: 3 },
    { from: 5, to: 6 },
    { from: 8, to: 9 }
  ]
}
```



Test time!

How many properties are booked before week 2?

```
query = {"booked_weeks.from": { $lt: 2} }
```

```
{ property: "P1234",
  name: "Apple Villa",
  sleeps: 5,
  booked_weeks: [
    { from: 1, to: 3 },
    { from: 3, to: 4 },
    { from: 7, to: 9 }
  ]
}
```

```
{ property: "P1234",
  name: "Berry Villa",
  sleeps: 5,
  booked_weeks: [
    { from: 2, to: 6 },
    { from: 8, to: 9 },
    { from: 9, to: 10 }
  ]
}
```

```
{ property: "P1234",
  name: "Cherry Villa",
  sleeps: 5,
  booked_weeks: [
    { from: 1, to: 3 },
    { from: 5, to: 6 },
    { from: 8, to: 9 }
  ]
}
```

Test time!

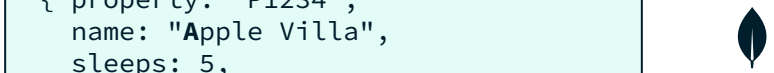
How many properties are booked after week 7?

```
query = { "booked_weeks.to": { $gt: 7} }
```

```
{ property: "P1234",
  name: "Apple Villa",
  sleeps: 5,
  booked_weeks: [
    { from: 1, to: 3 },
    { from: 3, to: 4 },
    { from: 7, to: 9 }
  ]
}
```

```
{ property: "P1234",
  name: "Berry Villa",
  sleeps: 5,
  booked_weeks: [
    { from: 2, to: 6 },
    { from: 8, to: 9 },
    { from: 9, to: 10 }
  ]
}
```

```
{ property: "P1234",
  name: "Cherry Villa",
  sleeps: 5,
  booked_weeks: [
    { from: 1, to: 3 },
    { from: 5, to: 6 },
    { from: 8, to: 9 }
  ]
}
```



Test time!

How many properties are booked after week 7?

```
query = { "booked_weeks.to": { $gt: 7} }
```

```
{ property: "P1234",
  name: "Apple Villa",
  sleeps: 5,
  booked_weeks: [
    { from: 1, to: 3 },
    { from: 3, to: 4 },
    { from: 7, to: 9 }
  ]
}
```

```
{ property: "P1234",
  name: "Berry Villa",
  sleeps: 5,
  booked_weeks: [
    { from: 2, to: 6 },
    { from: 8, to: 9 },
    { from: 9, to: 10 }
  ]
}
```

```
{ property: "P1234",
  name: "Cherry Villa",
  sleeps: 5,
  booked_weeks: [
    { from: 1, to: 3 },
    { from: 5, to: 6 },
    { from: 8, to: 9 }
  ]
}
```

Test time!

How many properties are booked in week 6?

```
query = { "booked_weeks.from": 6 }
```

```
{ property: "P1234",
  name: "Apple Villa",
  sleeps: 5,
  booked_weeks: [
    { from: 1, to: 3 },
    { from: 3, to: 4 },
    { from: 7, to: 9 }
  ]
}
```

```
{ property: "P1234",
  name: "Berry Villa",
  sleeps: 5,
  booked_weeks: [
    { from: 2, to: 6 },
    { from: 8, to: 9 },
    { from: 9, to: 10 }
  ]
}
```

```
{ property: "P1234",
  name: "Cherry Villa",
  sleeps: 5,
  booked_weeks: [
    { from: 1, to: 3 },
    { from: 5, to: 7 },
    { from: 8, to: 9 }
  ]
}
```

Test time!

How many properties are booked in week 6?

```
query = {
  "booked_weeks.from": { $lte: 6 },
  "booked_weeks.to":   { $gt: 6 }
}
```

```
{ property: "P1234",
  name: "Apple Villa",
  sleeps: 5,
  booked_weeks: [
    { from: 1, to: 3 },
    { from: 3, to: 4 },
    { from: 7, to: 9 }
  ]
}
```

```
{ property: "P1234",
  name: "Berry Villa",
  sleeps: 5,
  booked_weeks: [
    { from: 2, to: 6 },
    { from: 8, to: 9 },
    { from: 9, to: 10 }
  ]
}
```

```
{ property: "P1234",
  name: "Cherry Villa",
  sleeps: 5,
  booked_weeks: [
    { from: 1, to: 3 },
    { from: 5, to: 7 },
    { from: 8, to: 9 }
  ]
}
```

Test time!

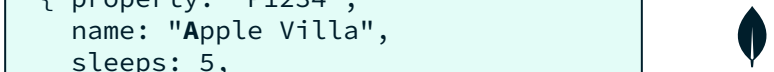
How many properties are booked in week 6?

```
query = {
  "booked_weeks.from": { $lte: 6 },
  "booked_weeks.to":   { $gt: 6 }
}
```

```
{ property: "P1234",
  name: "Apple Villa",
  sleeps: 5,
  booked_weeks: [
    { from: 1, to: 3 },
    { from: 3, to: 4 },
    { from: 7, to: 9 }
  ]
}
```

```
{ property: "P1234",
  name: "Berry Villa",
  sleeps: 5,
  booked_weeks: [
    { from: 2, to: 6 },
    { from: 8, to: 9 },
    { from: 9, to: 10 }
  ]
}
```

```
{ property: "P1234",
  name: "Cherry Villa",
  sleeps: 5,
  booked_weeks: [
    { from: 1, to: 3 },
    { from: 5, to: 7 },
    { from: 8, to: 9 }
  ]
}
```



$elemMatch

How many properties are booked in week 6?

```
elQuery = {
     from: { $lte: 6 },
     to: { $gt: 6 }
}

query = {
  booked_weeks: { $elemMatch:
                          elQuery }
}
```

```
{ property: "P1234",
  name: "Apple Villa",
  sleeps: 5,
  booked_weeks: [
    { from: 1, to: 3 },
    { from: 3, to: 4 },
    { from: 7, to: 9 }
  ]
}
```

```
{ property: "P1234",
  name: "Berry Villa",
  sleeps: 5,
  booked_weeks: [
    { from: 2, to: 6 },
    { from: 8, to: 9 },
    { from: 9, to: 10 }
  ]
}
```

```
{ property: "P1234",
  name: "Cherry Villa",
  sleeps: 5,
  booked_weeks: [
    { from: 1, to: 3 },
    { from: 5, to: 7 },
    { from: 8, to: 9 }
  ]
}
```

Adding to arrays

$push

Use **$push to add something to an array** without reading and writing the whole array

```
query = { property: "P1234" }

newbooking = { from: 5, to: 6 }

update = { $push: { booked_weeks:
                          newbooking}}

properties.updateOne(query, update)
```

```
{ property: "P1234",
  name: "Apple Villa",
  sleeps: 5,
  booked_weeks: [
    { from: 1, to: 3 },
    { from: 3, to: 4 },
    { from: 7, to: 9 }
  ]
}
```

```
{ property: "P1234",
  name: "Apple Villa",
  sleeps: 5,
  booked_weeks: [
    { from: 1, to: 3 },
    { from: 3, to: 4 },
    { from: 7, to: 9 },
    { from: 5, to: 6 }
  ]
}
```

$each (reviews)

Use **$push with $each, $position, $slice** for a subset or topN pattern

```
query = { property: "P1234" }
review = { score: 5,
           comment: "Very quiet" }

update = { $push: {
           latest_reviews: {
               $each: [review],
               $position: 0,
               $slice: 3
        } } }

properties.updateOne(query, update)
```

```
{ property: "P1234",
  name: "Apple Villa",
  sleeps: 5,
  latest_reviews: [
    {score: 2,comment: "Too dirty"},
    {score: 4,comment: "Nice view"},
    {score: 5,comment: "Cheap"}
  ]
}
```

```
{ property: "P1234",
  name: "Apple Villa",
  sleeps: 5,
  latest_reviews: [
    {score: 5,comment: "Very quiet"}
    {score: 2,comment: "Too dirty"},
    {score: 4,comment: "Nice view"},
    {score: 5,comment: "Cheap"}
  ]
}
```

Database expressions

$abs
$accumulator
$acos
$acosh
$add
$addToSet
$allElementsTrue
$and
$anyElementTrue
$arrayElemAt
$arrayToObject
$asin
$asinh
$atan
$atan2
$atanh
$avg
$binarySize
$bitAnd
$bitNot
$bitOr
$bitXor
$bottom
$bottomN
$bsonSize
$ceil
$cmp
$concat
$concatArrays
$cond
$convert
$cos
$cosh
$count
$covariancePop
$covarianceSamp
$dateAdd
$dateDiff
$dateFromParts
$dateFromString
$dateSubtract
$dateToParts
$dateToString
$dateTrunc
$dayOfMonth
$dayOfWeek
$dayOfYear
$degreesToRadians
$denseRank
$derivative
$divide
$documentNumber
$eq
$exp
$expMovingAvg
$filter
$first
$firstN
$floor
$function
$getField
$gt
$gte
$hour
$ifNull
$in
$indexOfArray
$indexOfBytes
$indexOfCP
$integral
$isArray
$isNumber
$isoDayOfWeek
$isoWeek
$isoWeekYear
$last
$lastN
$let
$linearFill
$literal
$ln
$locf
$log
$log10
< Many Removed >
$trim
$trunc
$type
$unsetField
$week
$year
$zip

Simple query

How can I find all bookings in "London"

```
// SELECT * from bookings
// WHERE location = "London"

query = { location: "London" }
bookings.find(query)
```

```
{
  bookingId: "B65143",
  property: "P1234",
  name: "Apple Villa",
  location: "London",
  from: 2,
  to: 3
}
```

```
{
  bookingId: "B66462",
  property: "P1234",
  name: "Apple Villa",
  location: "London",
  from: 3,
  to: 8
}
```

```
 {
   bookingId: "B76251",
   property: "P1234",
   name: "Cherry Villa",
   location: "London",
   from: 4,
   to: 6
 }
```

Expressive query

How can I find all bookings in London longer than 3 weeks when **there is no duration field** to query?

```
// SELECT * from bookings
// WHERE to-from > 3 AND
// location = "London"

duration = { $subtract: ["$to", "$from"]}

query = {
         location: "London",
         $expr: { $gt: [duration, 3] }
 }
```

```
{
  bookingId: "B65143",
  property: "P1234",
  name: "Apple Villa",
  location: "London",
  from: 2,
  to: 3
}
```

```
{
  bookingId: "B66462",
  property: "P1234",
  name: "Apple Villa",
  location: "London",
  from: 3,
  to: 8
}
```

```
{
  bookingId: "B76251",
  property: "P1234",
  name: "Cherry Villa",
  location: "London",
  from: 4,
  to: 6
}
```

Expressive projection

How can we return the computed values?

```
// SELECT *, to-from AS duration
// from bookings WHERE duration > 3 AND
// location = "London"

duration = { $subtract: ["$to", "$from"]}

query = { location: "London",
          $expr: { $gt: [duration, 3]}}

projection = { bookingId: 1, from: 1,
               to: 1, property: 1,
               name: 1,
               duration: duration }
bookings.find(query, projection)
```

```
{
   bookingId: "B66462",
   property: "P1234",
   name: "Apple Villa",
   from: 3,
   to: 8,
   duration: 5
 }
```

Test: What performance issue will we have if we are querying on duration frequently?

Expressive update

Update all the documents to add the computed field

```
// UPDATE bookings
// SET duration = to-from

newDuration = {$subtract:["$to", "$from"]}

query = {} // Match everything

update= [{$set:{ duration: newDuration }}]

bookings.updateMany(query, update)
```

Before

```
{
    bookingId: "B66462",
    property: "P1234",
    name: "Apple Villa",
    from: 3,
    to: 8
}
```

After

```
{
    bookingId: "B66462",
    property: "P1234",
    name: "Apple Villa",
    from: 3,
    to: 8,
    duration: 5
}
```

Expressive Update

When updating **to** or **from,** recompute the field based on the new value and the one in the DB

```
// UPDATE bookings
// SET to=10, duration=10-from
// WHERE bookingId = "B66462"

query = { bookingId: "B66462" }

newToDate = 10;

newDuration = {$subtract: [newToDate, "$from"]}

update = [{ $set: {to: newToDate,
                   duration: newDuration }} ]

bookings.updateOne(query, update)
```

Before

```
{
    bookingId: "B66462",
    property: "P1234",
    name: "Apple Villa",
    from: 3,
    to: 8,
    duration: 5
}
```

After

```
{
    bookingId: "B66462",
    property: "P1234",
    name: "Apple Villa",
    from: 3,
    to: 10,
    duration: 7
}
```

And how could that possibly go wrong?

Schema validation

CREATE/ALTER TABLE in MongoDB

You can Create and Alter the schema for a collection in MongoDB - you can also use it to fetch the schema

```
CREATE TABLE BOOKINGS (
   bookingId STRING NOT NULL,
   propertyId STRING NOT NULL,
   name STRING not NULL,
   from Int32 NOT NULL,
   to Int32 NOT NULL,
   CHECK ( bookingId LIKE "B%" ),
   CHECK ( propertyId LIKE "P%"),
   CHECK ( from >=1 AND from <=52),
   CHECK ( to >=1 AND to <=52)
}
```

```
{
   bookingId: "B66462",
   property: null,
   name: "Apple Villa",
   from: 3,
   to: 5
 }
```

$jsonSchema validation

You can enforce many simple rules by applying a $jsonSchema validation

```
schema = {}
schema.$jsonSchema = {
 bsonType: "object",
 required: ["bookingId", "property", "name", "from",
            "to"],
 properties: {
   bookingId: {bsonType: "string", "pattern": "^B" },
   propertyId: {bsonType: "string", "pattern": "^P" },
   name: {bsonType: "string"},
   from: {bsonType: "int", minimum: 1, maximum: 52},
   To: {bsonType: "int", minimum: 1, maximum: 52}
  }
}


db.createCollection("bookings", {validator: schema})
```

```
{
   bookingId: "B66462",
   property: "P12345",
   name: "Apple Villa",
   from: 3
 }
```

```
Exception: Document failed validation
Additional information: {
  details: {
    operatorName: '$jsonSchema',
    schemaRulesNotSatisfied: [{
        operatorName: 'required',
        specifiedAs: {
          required: [ "bookingId",
"property", "name", "from", "to" ]},
        missingProperties: [ "to" ]
}
```

CREATE TABLE

```
CREATE TABLE BOOKINGS (
   bookingId STRING NOT NULL,
   propertyId STRING NOT NULL,
   name STRING not null,
   from Int32 NOT NULL,
   to Int32 NOT NULL,
   duration Int32 NOT NULL,
   CHECK ( bookingId LIKE "B%" ),
   CHECK ( propertyId LIKE "P%"),
   CHECK ( from >=1 AND from <=52),
   CHECK ( to >=1 AND to <= 52),
   CHECK (duration >=1 AND duration=to - from);
```

```
{
   bookingId: "B66462",
   property: null,
   name: "Apple Villa",
   from: 3,
   to: 5,
   duration: 2
 }
```

Expressive validation

You can also enforce any calculated fields

```
schema = { $jsonSchema: {
 bsonType: "object",
 required: ["bookingId", "property", "name", "from",
            "to", "duration"],
 properties: {
   bookingId: {bsonType: "string","pattern": "^B" },
   propertyId: {bsonType: "string","pattern": "^P" },
   name: {bsonType: "string"},
   from: {bsonType: "int", minimum: 1, maximum: 52},
   to:{bsonType: "int", minimum: 1, maximum: 52},
   duration: {bsonType: "int", minimum: 1, maximum: 52},
  }
}}

schema.$expr = { $eq: ["$duration",
                       {$subtract: ["$to", "$from"]}]}

db.createCollection("bookings", {validator: schema})
```

```
{
   bookingId: "B66462",
   property: "P12345",
   name: "Apple Villa",
   from: 3,
   to: 4,
   duration: 3
 }
```

```
MongoServerError: Document failed
validation
Additional information: {
  details: {
    operatorName: '$expr',
    specifiedAs: {
      $expr: { $eq: ["$duration", {
$subtract: [ "$to","$from" ] }]}},
    reason: 'expression did not
match',
    expressionResult: false
  }
}
```

Conclusion

It pays to know more than most

Learn how to interact with arrays in query and update

Master expressions - they are key to pushing work to the database and avoiding latency

Validate your schemas