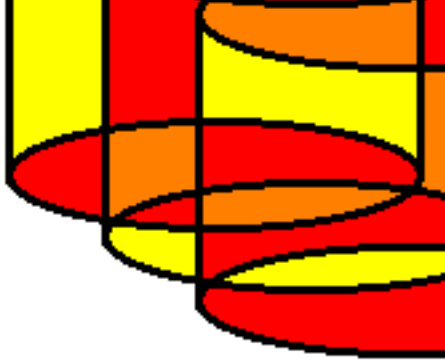
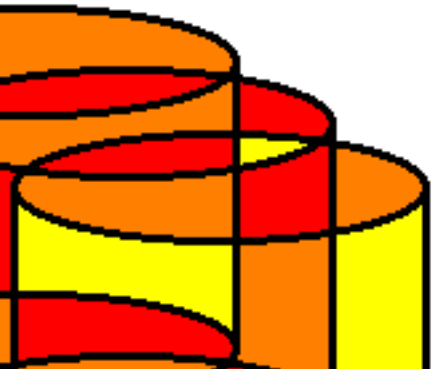
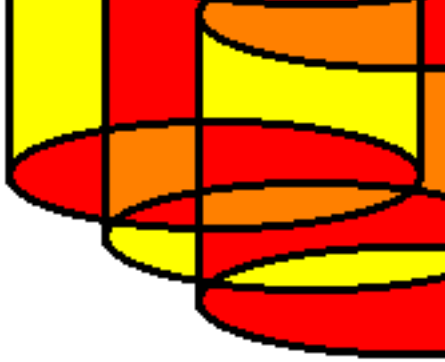
Polustrukturirane JSON baze podataka



- Uz pojam NoSQL (engl. Not only SQL) često se veže podatkovni format JSON (engl. JavaScript Object Notation)
- Postoje mnoge baze podataka koje pohranjuju ovaj format (ili njegov binarni ekvivalent BSON), a podržavaju ga gotovo svi programski jezici u široj upotrebi
- Jedan od najpoznatijih sustava za upravljanje tzv. dokument-baziranim bazama podataka je MongoDB



Priprema



- U slučaju da nije instaliran potrebno je instalirati mongodb

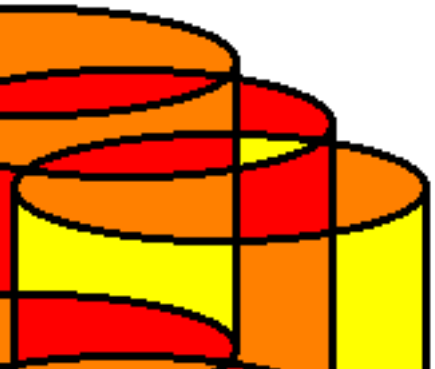
  `sudo apt install mongodb`

- I pokrenuti servis

  `sudo service mongodb start`

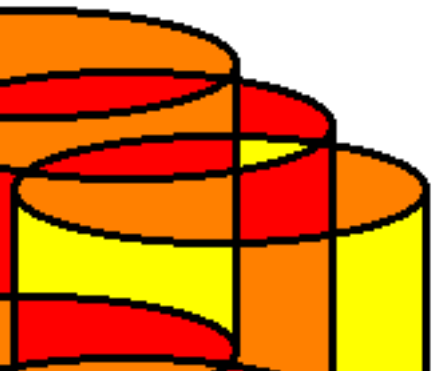
- Primjere u nastavku prikazat ćemo u MongoDB konzoli koju pokrećemo s naredbom:

  `mongo`



Upute

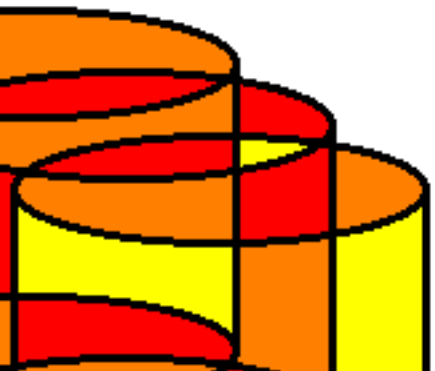
- Rezultate isprobavanja (kopiju konzole) pospremite u datoteku ime_prezime.txt



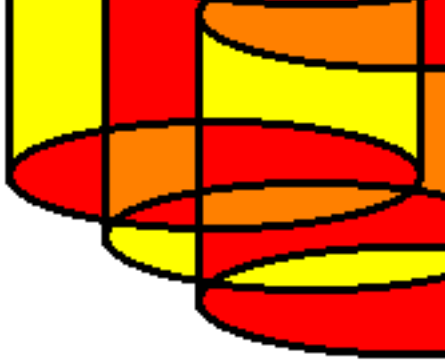
Uvod

- Isprobajte sljedeće naredbe te opišite čemu služe:

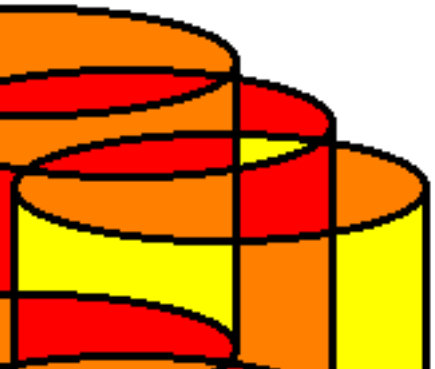
```
db.help()
db.stats()
```



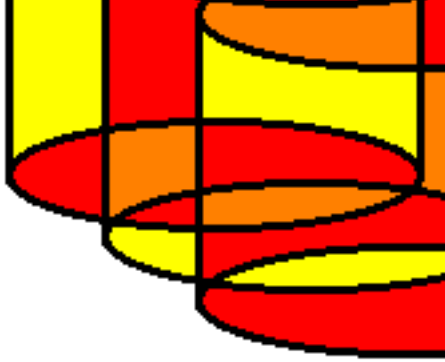
Uvod



- Na MongoDB sustavu može biti više baza podataka, svaka baza podataka može imati više kolekcija, a svaka kolekcija više dokumenata od kojih je svaki JSON dokument
- Shema podataka je proizvoljna i promjenjiva, tj. za razliku od relacijskih baza podataka nije potrebno unaprijed odrediti shemu

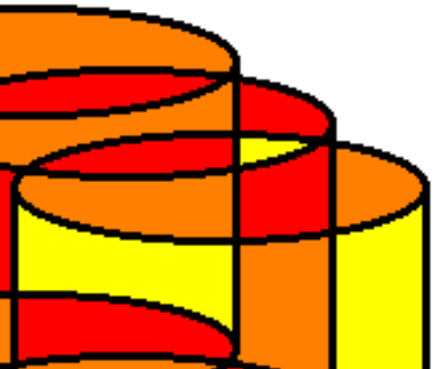


Uvod

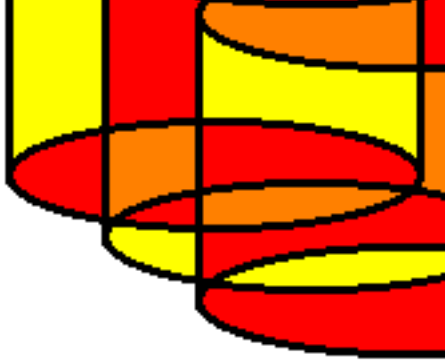


- MongoDB ljuska uvije ima jednu trenutnu bazu podataka s kojom se radi i pohranjena je u varijabli **db**
- Da bi se promijenila trenutna baza podataka koristi se naredba **use**, npr.:

```
use mojabp
```

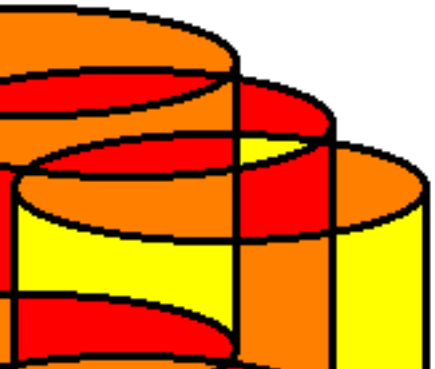


Primjer

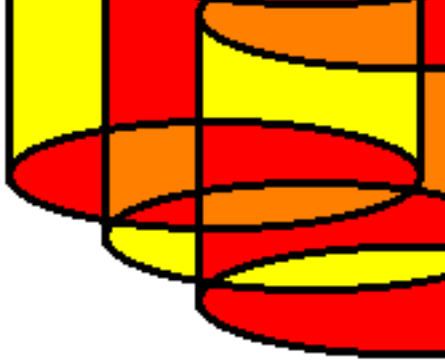


- Isprobajte sljedeće naredbe:

```
use mojabp
db
show dbs
```

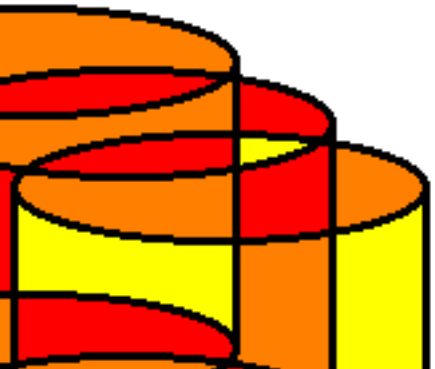


Kreiranje baze podataka

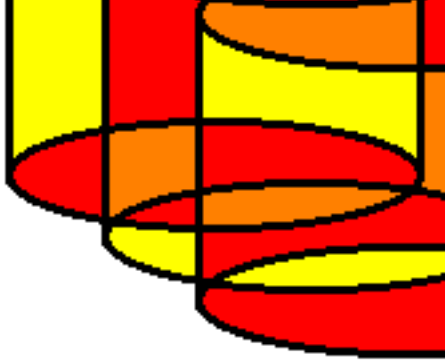


- Kako bismo kreirali našu bazu podataka moramo dodati barem jedan dokument, npr.

```
db.proba.insert( { "ključ":"vrijednost" } )
show dbs
```



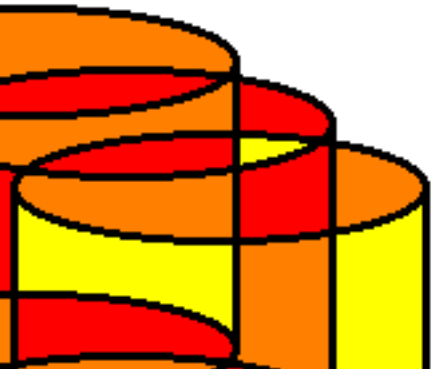
Brisanje baze podataka



- Za brisanje trenutne baze podataka koristimo metodu dropDatabase()

```
db.dropDatabase()
```

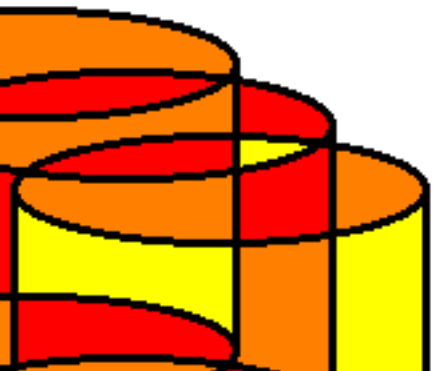
```
show dbs
```



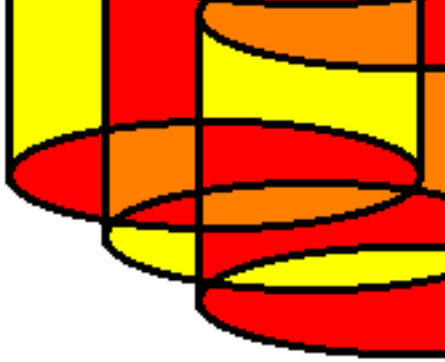
Kreiranje kolekcija

- Za kreiranje kolekcija koristi se metoda createCollection()

```
db.createCollection( "kolekcija" )
show collections
```



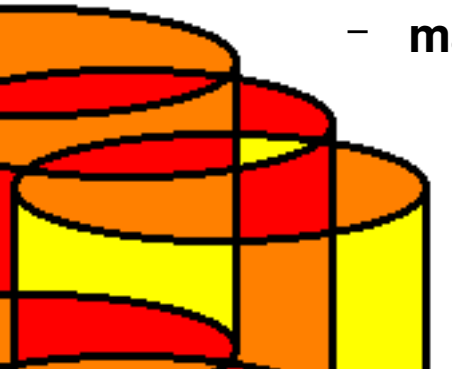
Opcije kreiranja



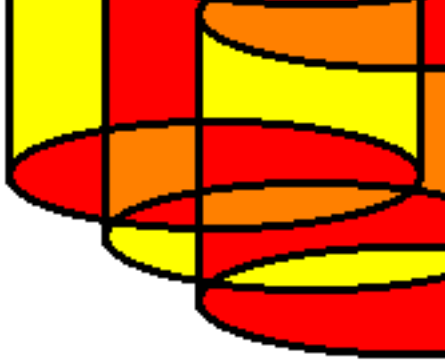
- Opcionalno se mogu podesiti opcije kreiranja kolekcije, npr.:

```
db.createCollection( "druga", { capped : true,
size : 6142800, max : 10000 } )
```

- Opcije imaju sljedeće značenje:
  - **capped** (bool) - kolekcija ima fiksiranu maksimalnu veličinu, ako se popuni, automatski se počinju brisati najstariji zapisi. Ako je true obavezno treba navesti size
  - **size** (int) - maksimalna veličina u bajtovima
  - **max** (int) - maksimalan broj dokumenata u kolekciji (također ide uz capped, ali opcionalno)

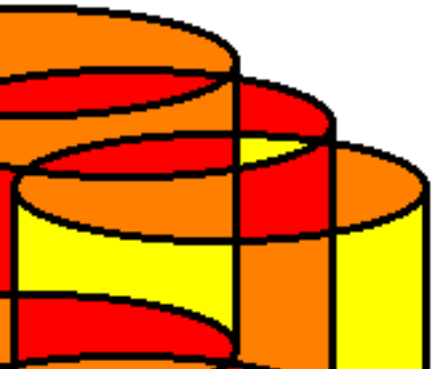


Brisanje kolekcija

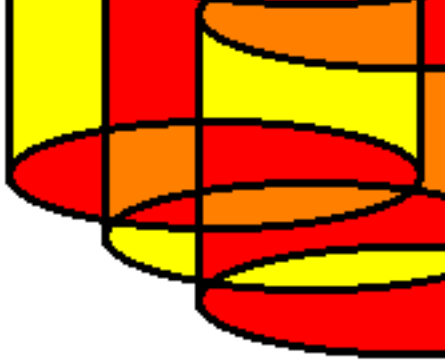


- Za brisanje trenutne kolekcije koristi se njezina metoda drop()

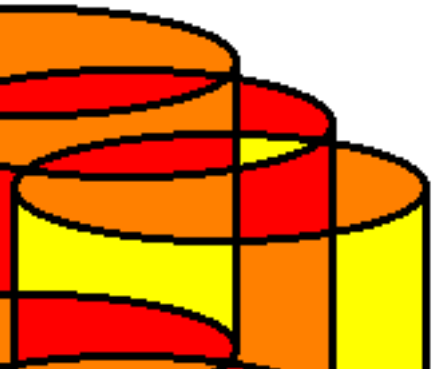
```
db.druga.drop()
```



Tipovi podataka



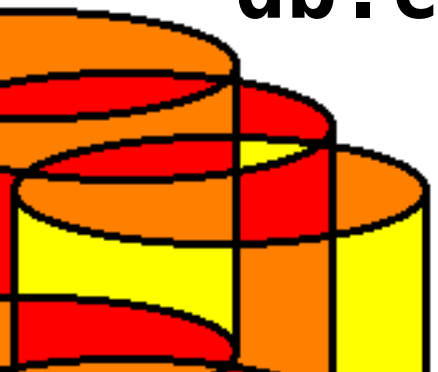
- Podržani su sljedeći tipovi podataka:
  - **String** – znakovni nizovi (UTF-8)
  - **Integer** – cijeli brojevi
  - **Boolean** – istinitosne vrijednosti
  - **Double** – decimalni brojevi
  - **Min / Max keys** – tip podataka koji se koristi za uporedbu s najmanjim / najvećim BSON elementom.
  - **Arrays** – polja
  - **Timestamp / ctimestamp** - temporalni podaci (trenutak u vremenu)
  - **Object** – ugnjiježđeni dokumenti
  - **Null** – striktno nije tip već null vrijednosti
  - **Symbol** – u načelu isto kao i String, koristi se za jezike koji koriste specifični simbolički tip
  - **Date** – temporalni podaci (datum)
  - **Object ID** – identiteti objekata
  - **Binary data** – binarni podaci
  - **Code** – pohrana JavaScript programskog koda
  - **Regular expression** – pohrana pravilnih izraza



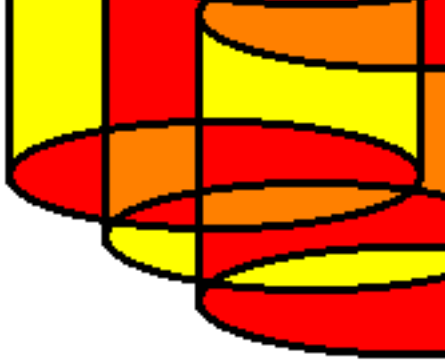
Primjer

- Za primjer ćemo kreirati bazu podataka za Weblog, koja će imati dvije kolekcije, korisnici i zapisi:

```
db.dropDatabase()
use blog
db.createCollection( "korisnici" )
db.createCollection( "zapisi" )
```

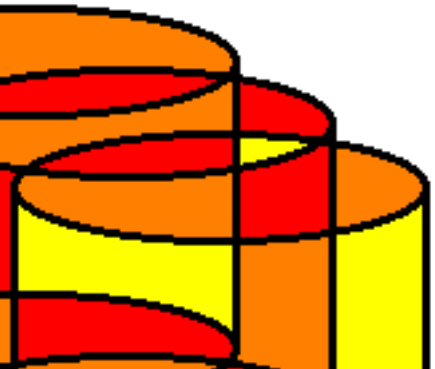


Unos podataka

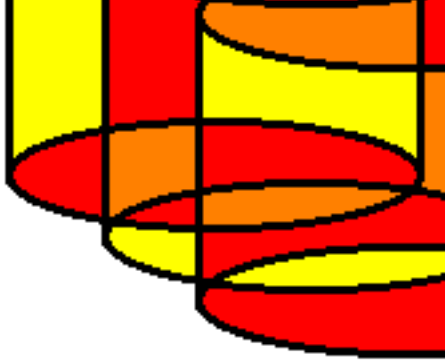


- Unos podataka obavlja se metodom insert() kolekcije u koju se želi unesti jedan ili više dokumenata
- Ako želimo unesti više dokumenata unosimo ih u listi koja se prosljeđuje kao argument metodi insert()
- Naredbe za unos u našu bazu podataka nalaze se na adresi:

https://tinyurl.com/mongodb-unos

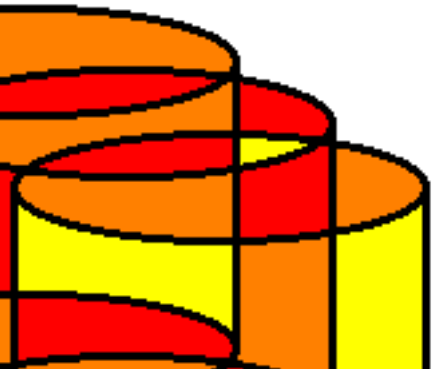


Pretraživanje baze podataka

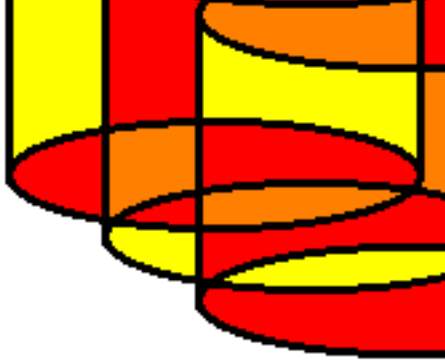


- Koristi se metoda **find()**. Isprobajte sljedeće naredbe:

```
db.korisnici.find()
db.korisnici.find().pretty()
db.zapisi.find().pretty()
```

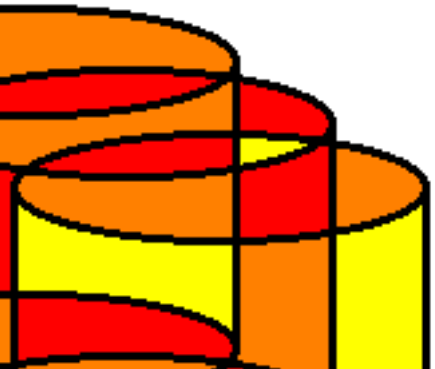


Filtriranje

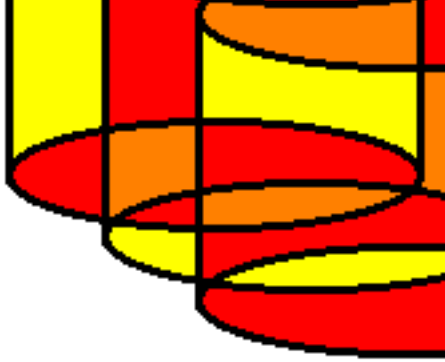


- Za provjeru jednakosti koriste se JSON dokumenti, npr. upit koji vraća sve korisnike iz Hrvatske:

```
db.korisnici.find( { "država":"Hrvatska" } ).pretty()
```

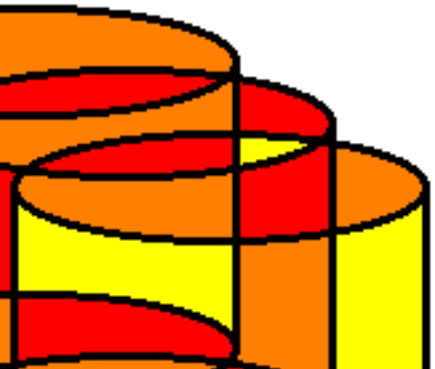


Filtriranje



- Kako bismo provjerili je li postoji ili ne postoji neki atribut koristimo ključnu riječ $exists:

```
db.korisnici.find( { "spol":{ $exists:true } } ).pretty()
db.korisnici.find( { "spol":{ $exists:false } } ).pretty()
```

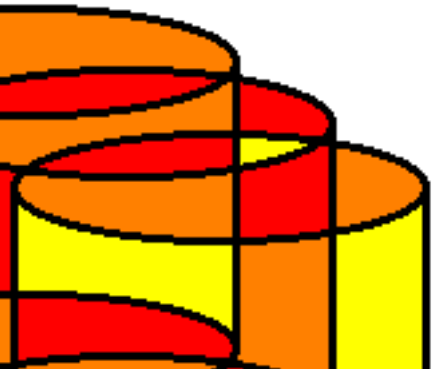


Filtriranje

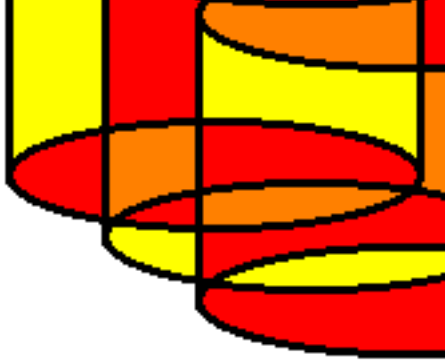
- Za binarne usporedbe koristimo sljedeće ključne riječi:

```
<  $lt
>  $gt
<= $lte
>= $gte
!= $ne
```

```
db.zapisi.find( { "lajkova":{ $gt:1000 } } ).pretty()
```



Logički veznici



- Primjer za logičko “i”:

```
db.korisnici.find( {
   $and:[
      { "spol":{ $exists:false } },
      { "država":"Hrvatska" }
   ]
} ).pretty()
```

Logički veznici

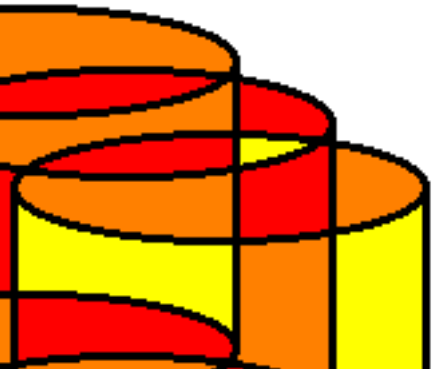
- Primjer za logičko “ili”:

```
db.korisnici.find( {
   $or:[
      { "spol":{ $exists:false } },
      { "država":"Hrvatska" }
   ]
} ).pretty()
```

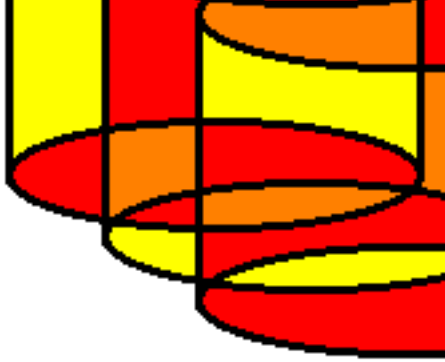
Logički veznici

- Kombinaciji “i” i “ili”

```
db.zapisi.find( {
  "komentari":{ $exists:true },
  $or:[
    { "lajkova":{ $gt:1000 } },
    { "naslov":"Odojak na lički punjen vrganjima" }
  ]
} ).pretty()
```



Projekcija

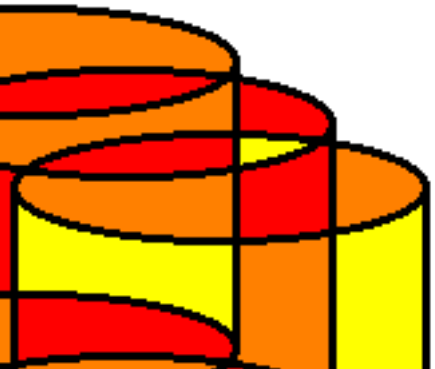


- Kako bismo prikazali samo neke atribute koristimo drugi argument metode find():

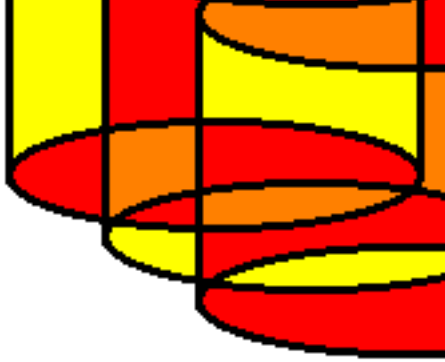
```
db.zapisi.find( { "oznake" : "gluten free" }, { "naslov":true,
"vrijeme":true, "_id":false } ).pretty()
```

- ili kraće

```
db.zapisi.find( { "oznake" : "gluten free" }, { "naslov":1,
"vrijeme":1, "_id":0 } ).pretty()
```

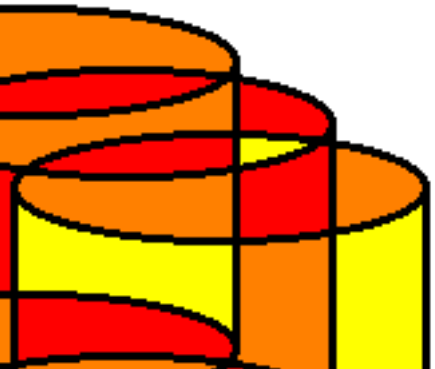


Ograničavanje izlaza

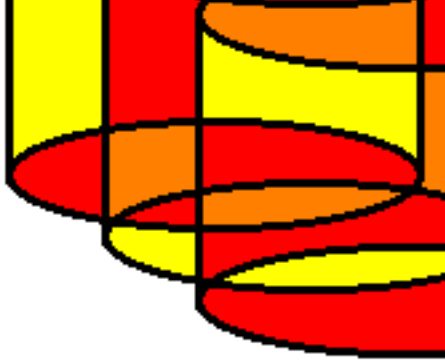


- Za ograničavanje izlaza koristimo metode limit() i skip():

```
db.korisnici.find().limit( 2 ).pretty()
db.korisnici.find().limit( 2 ).skip( 1 ).pretty()
```

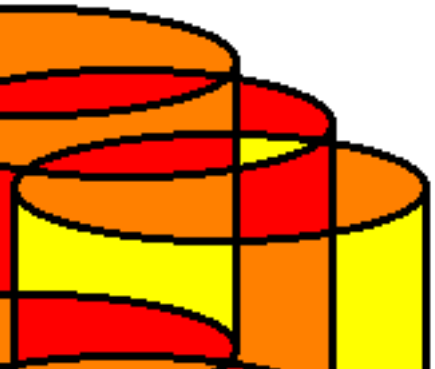


Sortiranje izlaza

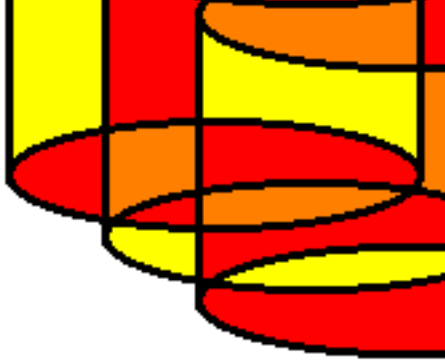


- Kako bismo sortirali izlaz koristimo metodu sort() navodeći atribute po kojima želimo sortirati pri čemu je vrijednost 1 za silazno, a vrijednost -1 za uzlazno sortiranje:

```
db.zapisi.find( {}, { "naslov":1, "lajkova":1, "_id":0 } ).sort( { "lajkova":-1 } )
```

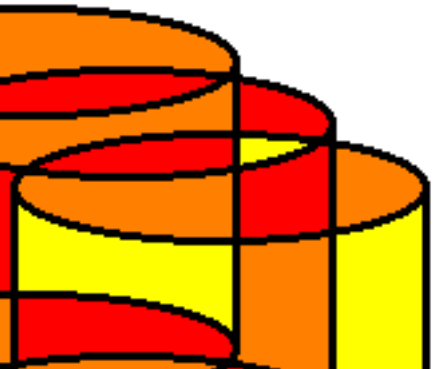


Pravilni izrazi (RegEx)



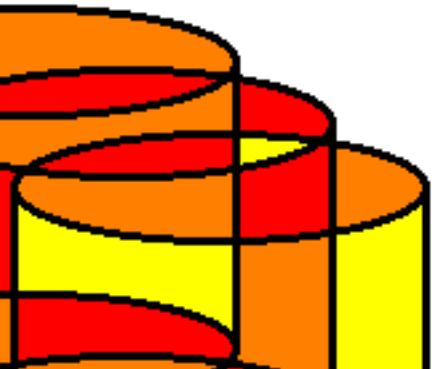
- Moguće je pretraživati i putem pravilnih izraza (engl. regular expressions) na sljedeći način:

```
db.zapisi.find( { "naslov":{ "$regex":/Odojak/ } } ).pretty()
```

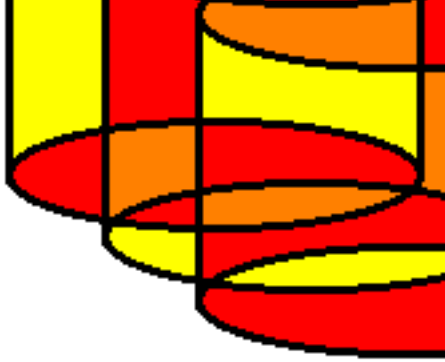


Zadatak

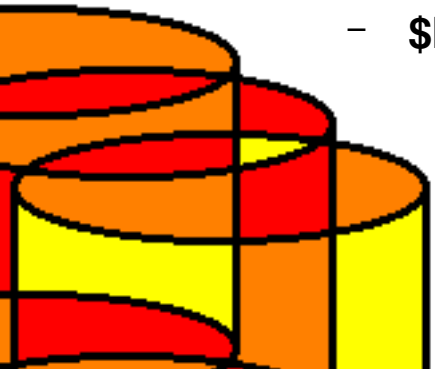
- Kreirajte novu bazu podataka na proizvoljnu temu te pri tome:
  - Kreirajte barem dvije kolekcije
  - U svaku kolekciju unesite barem 10 dokumenata
  - U svaki dokument unesite barem 5 atributa
  - Kreirajte barem 2 upita s filtriranjem
  - Kreirajte barem 2 upita s logičkim veznicima
  - Kreirajte barem 2 upita s projekcijom (ukupno minimalno 6 upita)
- Sve korištene naredbe pohranite u datoteku ime_prezime.js

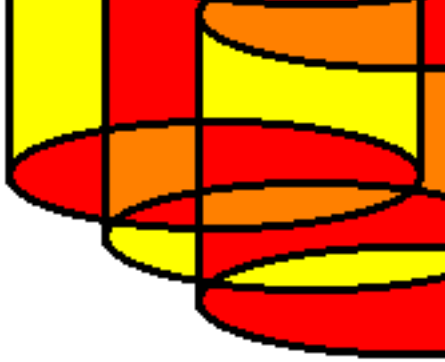


Agregacije



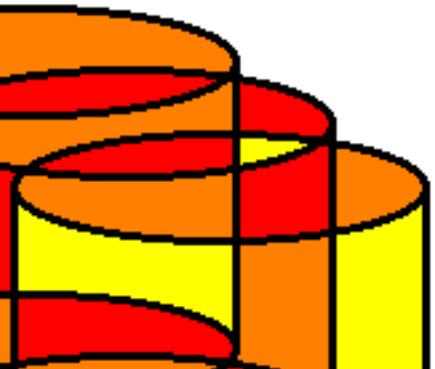
- Koristi se metoda **aggregate()**. Podržane su sljedeće zbirne funkcije:
  - **$sum** - zbraja grupu vrijednosti (može se koristiti i kao ekvivalent count() funkciji za prebrojavanje)
  - **$avg** - računa prosjek grupe vrijednosti
  - **$min** - pronalazi minimalnu vrijednost
  - **$max** - pronalazi maksimalnu vrijednosti
  - **$push** - "gura" vrijednosti u polje koje će biti izlaz iz agregacije
  - **$addToSet** - ubazuje vrijednosti u polje ali eliminira duplikate
  - **$first** - pronalazi prvi element u grupi (u pravilu se koristi s nekom vrstom sortiranja)
  - **$last** - pronalazi zadnji element u grupi (isto kao i prethodni)





Upute

- Rezultate isprobavanja (kopiju konzole) pospremite u datoteku ime_prezime.txt

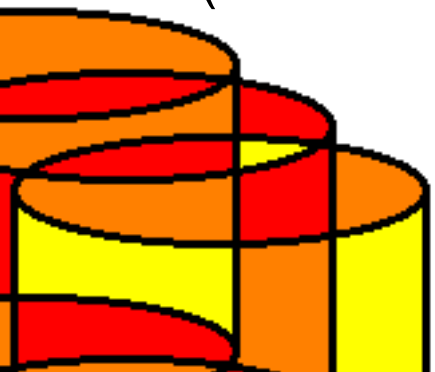


Primjeri

- Upit koji vraća broj zapisa po autoru:

```
db.zapisi.aggregate( [ {
   $group : {
      _id : "$autor",
     "broj_zapisa" :
       { $sum:1 }
   }
} ] )
```

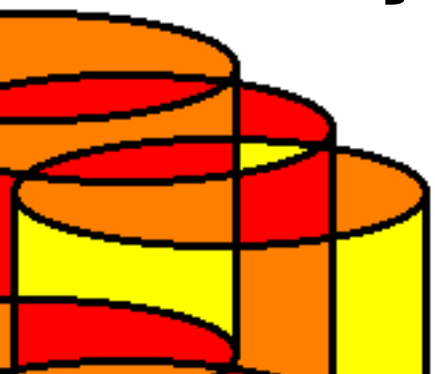
- Grupira se po autoru, a za svaku stavku u grupi sumira se broj 1 (konstanta) zbog čega se $sum ponaša kao count().



Primjeri

- Upit koji vraća broj lajkova po autoru:

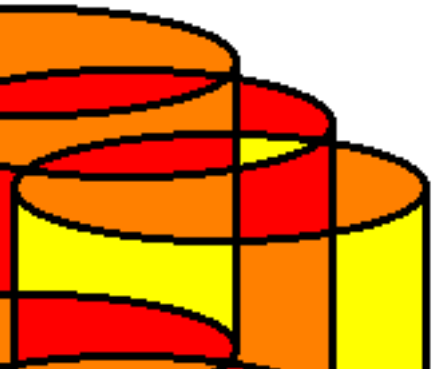
```
db.zapisi.aggregate( [ {
   $group : {
      _id : "$autor",
      "broj_lajkova" : {
        $sum:"$lajkova"
      }
   }
} ] )
```



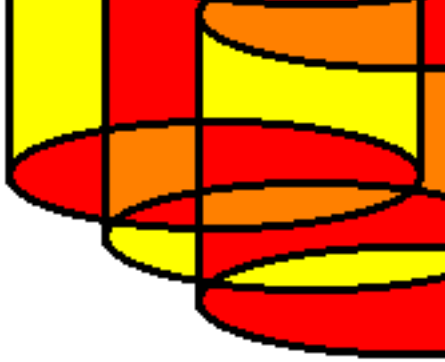
Primjeri

- Upit koji vraća listu (polje) naslova po autoru:

```
db.zapisi.aggregate( [ {
    $group : {
        _id : "$autor",
        "naslovi" :
            { $push:"$naslov" }
    }
} ] )
```



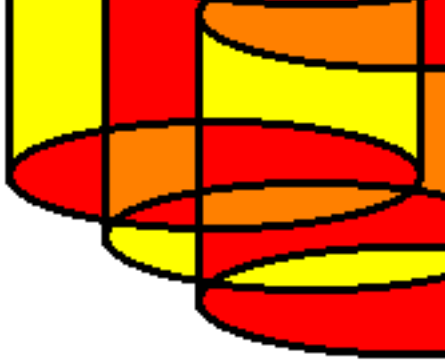
Cjevovod (engl. pipline)



- Slično kao UNIX shell (npr. operatorom |) MongoDB dopušta da rezultat jedne agregirajuće operacije bude ulaz u sljedeću.
- Primjer - korištene oznake prema autoru

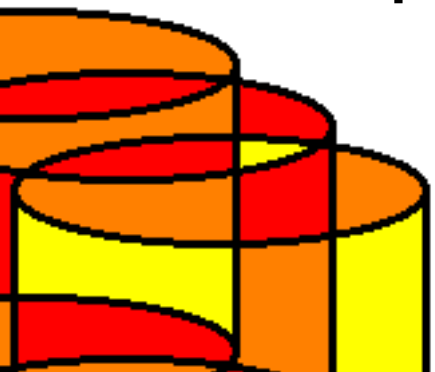
```
db.zapisi.aggregate( [
  { $unwind : "$oznake" },
  { $group : {
    _id : "$autor",
    "broj_lajkova" : { $addToSet:"$oznake" }
  } }
] ).pretty()
```

Cjevovod (engl. pipline)



Moguće su sljedeće operacije:

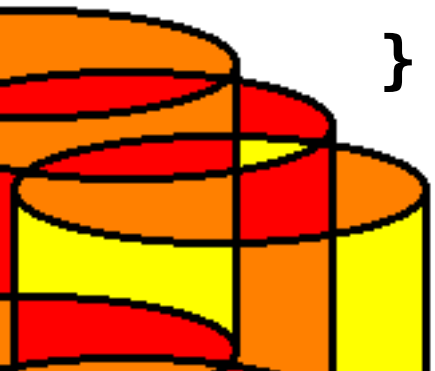
- **$project** – projekcija na samo određene vrijednosti u dokumentu
- **$match** – filtriranje
- **$group** – agregacija uz neku od funkcija (kao što je dano u prethodnim primjerima)
- **$sort** – sortiranje
- **$skip** – preskakanje određenog broja zapisa
- **$limit** – ograničavanje na određeni broj zapisa
- **$unwind** – pretvaranje polja u pojedinačne elemente
- **$lookup** – spajanje s drugim kolekcijama (slično JOIN u SQL-u)



Primjer za $lookup

- Upit koji uz zapise spaja korisnike

```
db.zapisi.aggregate( [ {
  $lookup:{
    from:"korisnici",
    localField:"autor",
    foreignField:"_id",
    as:"autor_obj"
  }
} ] ).pretty()
```



MapReduce

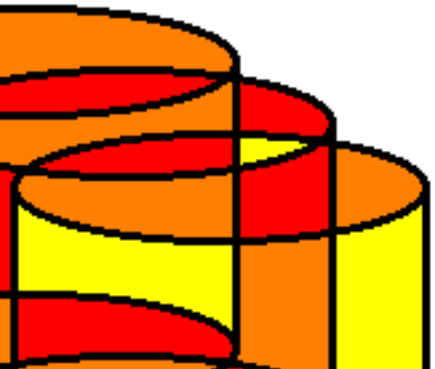
- Postupak mapiranja i reduciranja u MongoDB-u implementira se pomoću funkcija u JavaScript-u.
- Sintaksa je sljedeća:

```
db.[kolekcija].mapReduce(
   function() { // funkcija mapiranja
      emit( kljuc, vrijednost ) ;
   },
   function( kljuc, vrijednosti ) { // funkcija reduciranja
      return [reduceFunkcija]
   },
   {
      out: [kolekcija], // izlazna kolekcija
      query: [dokument], // filter kao u find() (opcionalno)
      sort: [dokument], // sortiranje kao u sort() (opcionalno)
      limit: [broj] // ograničenje izlaza  (opcionalno)
   }
)
```

Primjeri

- Ukupan broj lajkova za svakog korisnika

```
db.zapisi.mapReduce(
    function(){
       emit( this.autor, this.lajkova );
    },
    function( kljuc, vrijednost ){
       return Array.sum( vrijednost )
    },
    { out: "lajkovi ukupno" }
).find().pretty()
```



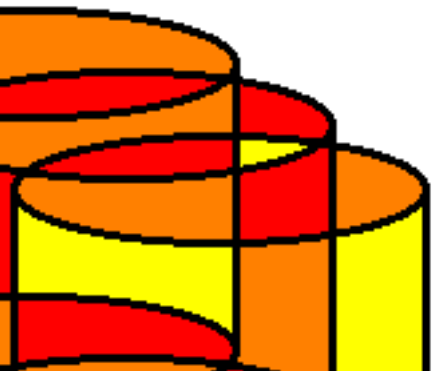
Primjeri

- Ukupan broj lajkova komentara za svakog korisnika:

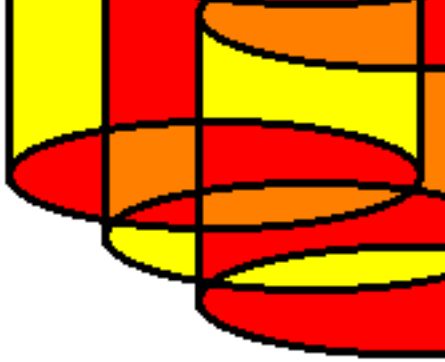
```
var mapiraj =  function(){
    for( var i in this.komentari )
    {
        emit( this.autor, this.komentari[ i ].lajkova );
    }
}

var reduciraj = function( kljuc, vrijednosti ){
    return Array.sum( vrijednosti )
}

db.zapisi.mapReduce( mapiraj, reduciraj, { "out":"lajkovi komentara" }
).find().pretty()
```

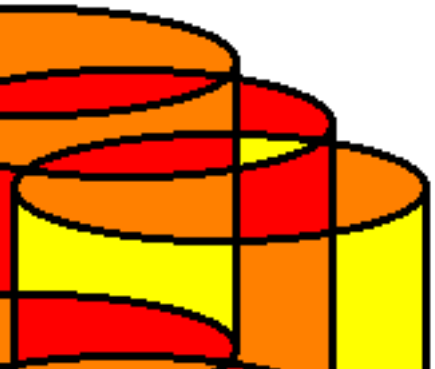


Ažuriranje baze podataka

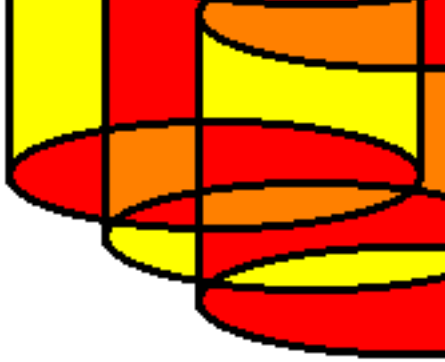


- Dokumente možemo ažurirati metodom update():

```
db.zapisi.update(
   { "naslov":"In vino veritas" },
   { $set:{ "lajkova":3293 } }
)
```

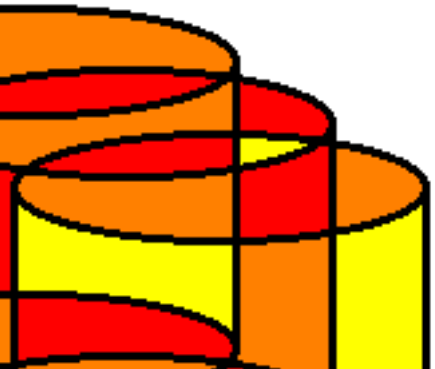


Ažuriranje baze podataka



- U pravilu metoda update() mijenja samo prvi dokument na koji naiđe. Ako želimo mijenjati sve dokumente na koje se odnosi kriterij moramo podesiti parametar multi:

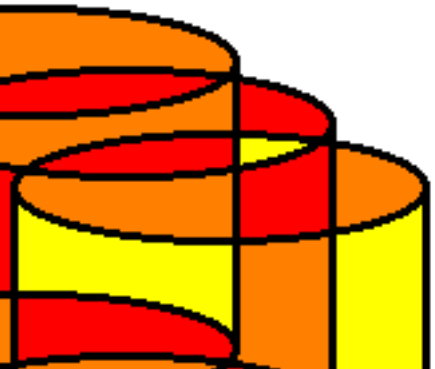
```
db.korisnici.update(
   { "država":"Hrvatska" },
   { $set:{ "na vezi":true } },
   { multi:true }
)
```



Metoda save()

- Prepisuje objekt s određenim identitetom objekta

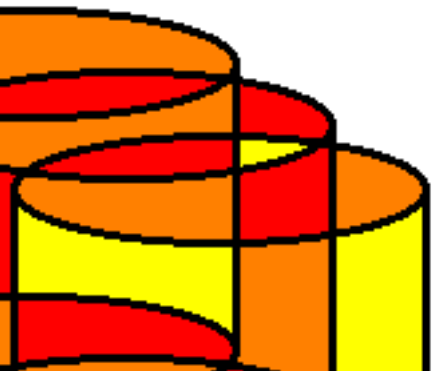
```
db.korisnici.save(
    {
        "_id":ObjectId("5de0232f41459750677cd9f1"),
        "e-mail":"stefa@tmobile.de",
        "ime":"Štefanija Jambrešćak-Prekratki",
        "godina rođenja":1998,
        "grad":"Berlin",
        "država":"Njemačka"
    }
)
```



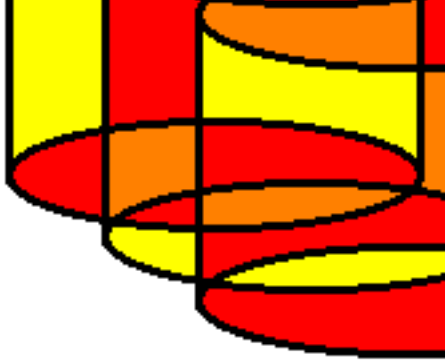
Brisanje dokumenata

- Za brisanje dokumenata koristimo metodu remove():

```
db.zapisi.remove( { "naslov":"Parkour po Dravi" } )
```

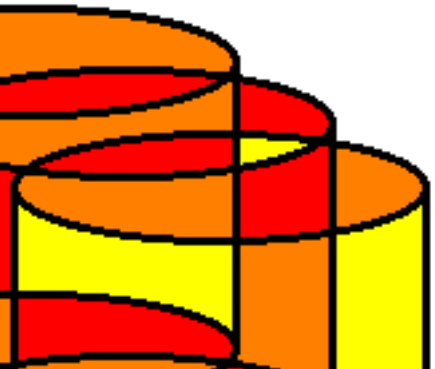


Indeksiranje



- Kako bi se povećala efikasnost pretraživanja prema nekom atributu mogu se koristiti indeksi, npr.

```
db.zapisi.ensureIndex( { "naslov":1 } )
```



Zadatak

- U bazu podataka iz prethodnog zadatka pridodajte:
  - Barem 3 upita s agregacijom
  - Barem 3 upita s MapReduce-om
  - Barem 3 ažuriranja
- Sve korištene naredbe dodajte u datoteku ime_prezime.js iz prethodnog zadatka