okmercury

(Blatantly plagiarizing the okcupid matching algorithm to help people discover who to meet at a tradeshow.)

WHO ARE WE

Cedric Hurst & Gary Turovsky

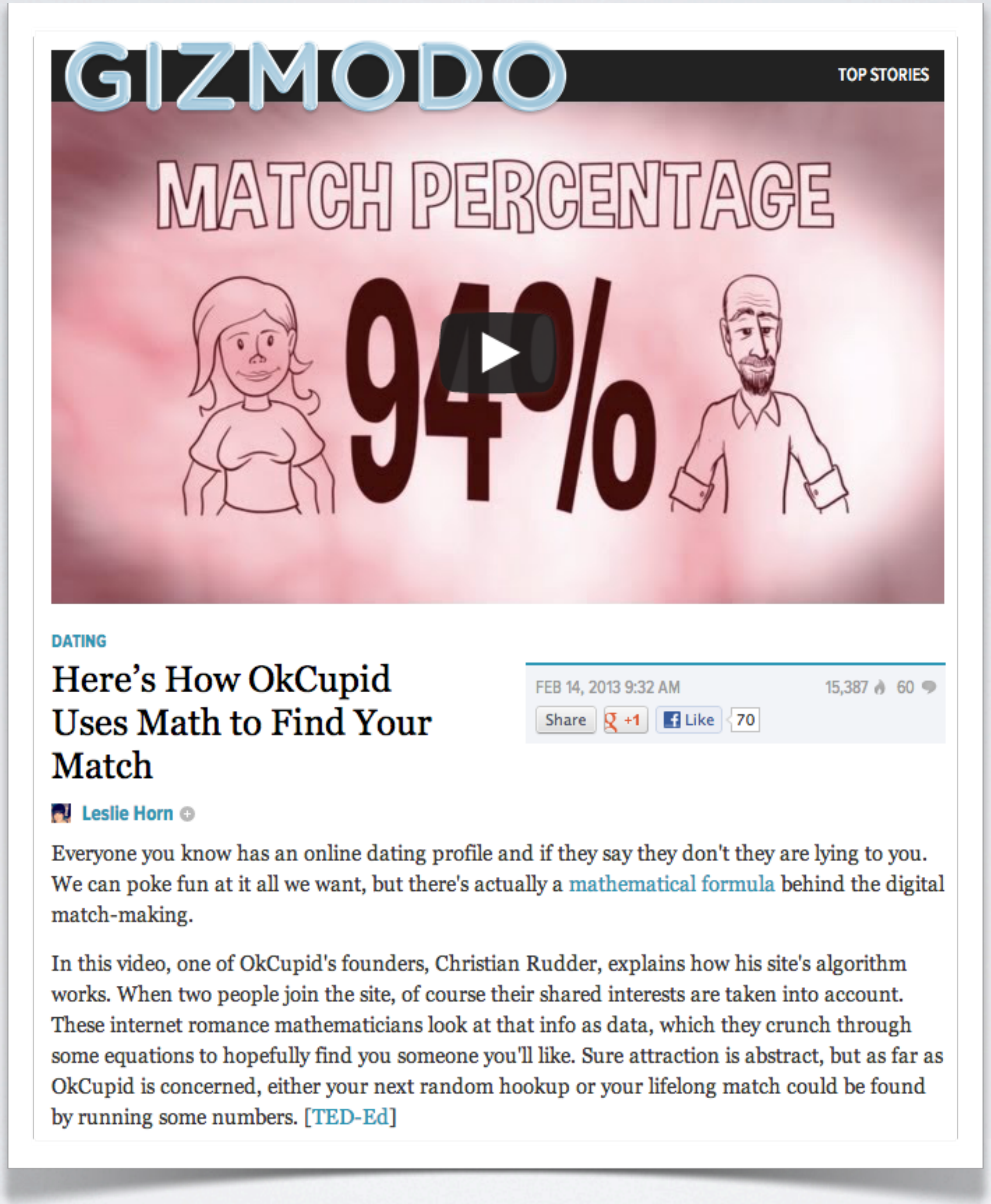
50% of Spantree Technology Group, LLC

Groovy, Grails, Java, Solr, Elasticsearch, Drools, Backbone, Coffeescript, Hadoop

Planning Systems, Search Engine Design, Algorithms

Work across several industries with companies of many sizes, focused exclusively on open source

WHAT'S OUR IDEA?



DATING

Here's How OkCupid Uses Math to Find Your Match

FEB 14, 2013 9:32 AM 15,387 60

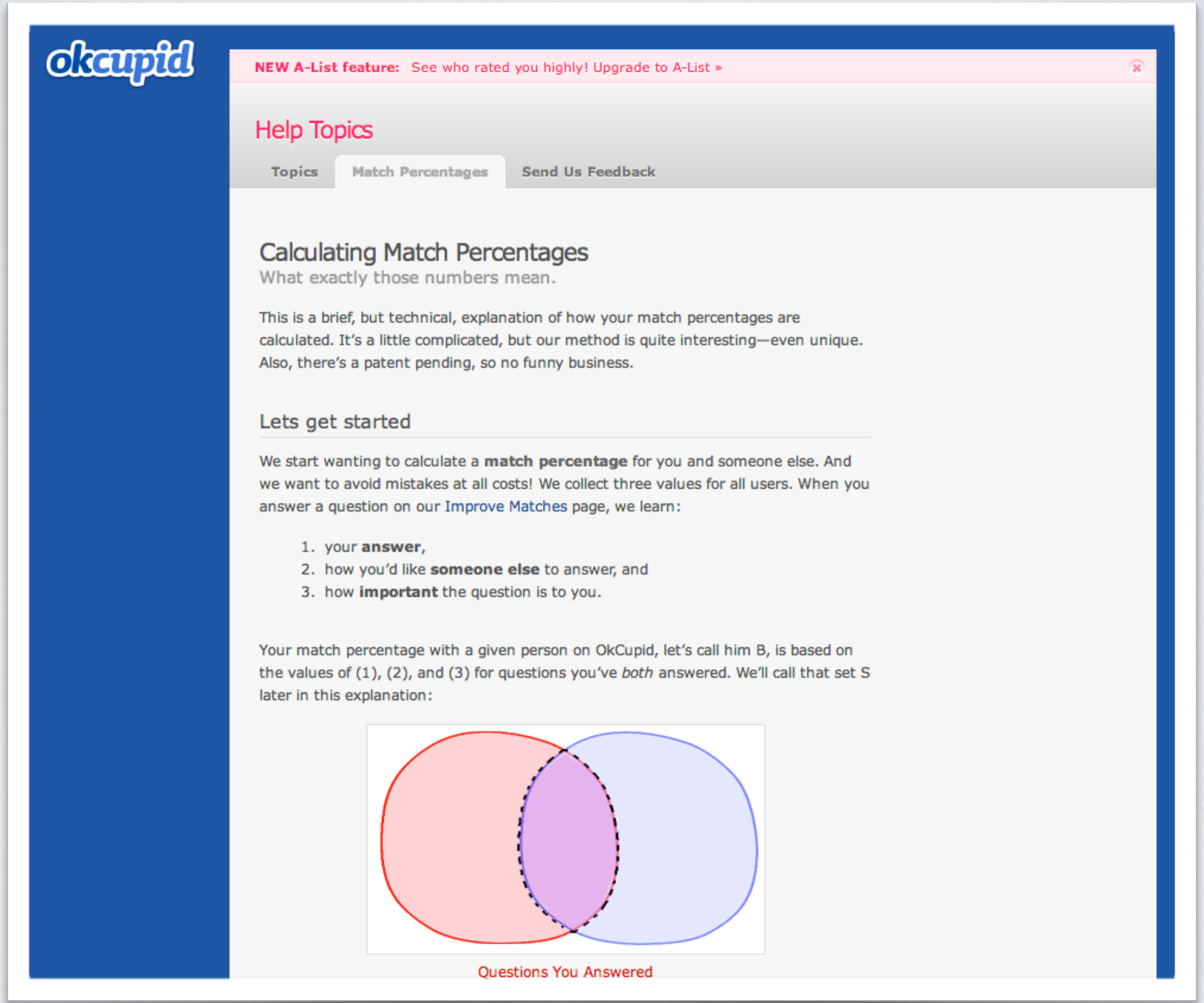
Share +1 Like 70

Leslie Horn

Everyone you know has an online dating profile and if they say they don't they are lying to you. We can poke fun at it all we want, but there's actually a mathematical formula behind the digital match-making.

In this video, one of OkCupid's founders, Christian Rudder, explains how his site's algorithm works. When two people join the site, of course their shared interests are taken into account. These internet romance mathematicians look at that info as data, which they crunch through some equations to hopefully find you someone you'll like. Sure attraction is abstract, but as far as OkCupid is concerned, either your next random hookup or your lifelong match could be found by running some numbers. [TED-Ed]

WHAT'S OUR IDEA?



NEW A-List feature: See who rated you highly! Upgrade to A-List »

Help Topics

Topics | Match Percentages | Send Us Feedback

Calculating Match Percentages

What exactly those numbers mean.

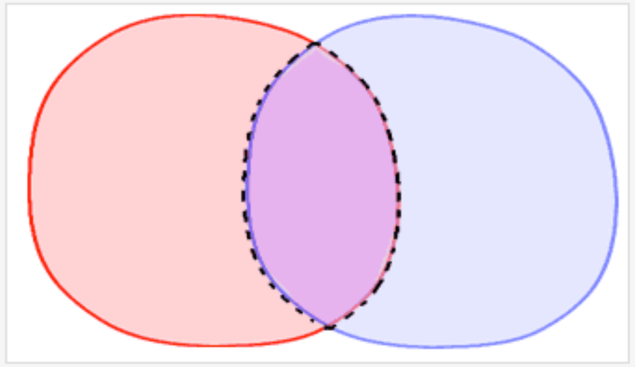
This is a brief, but technical, explanation of how your match percentages are calculated. It's a little complicated, but our method is quite interesting—even unique. Also, there's a patent pending, so no funny business.

Lets get started

We start wanting to calculate a **match percentage** for you and someone else. And we want to avoid mistakes at all costs! We collect three values for all users. When you answer a question on our Improve Matches page, we learn:

1. your **answer**,
2. how you'd like **someone else** to answer, and
3. how **important** the question is to you.

Your match percentage with a given person on OkCupid, let's call him B, is based on the values of (1), (2), and (3) for questions you've *both* answered. We'll call that set S later in this explanation:



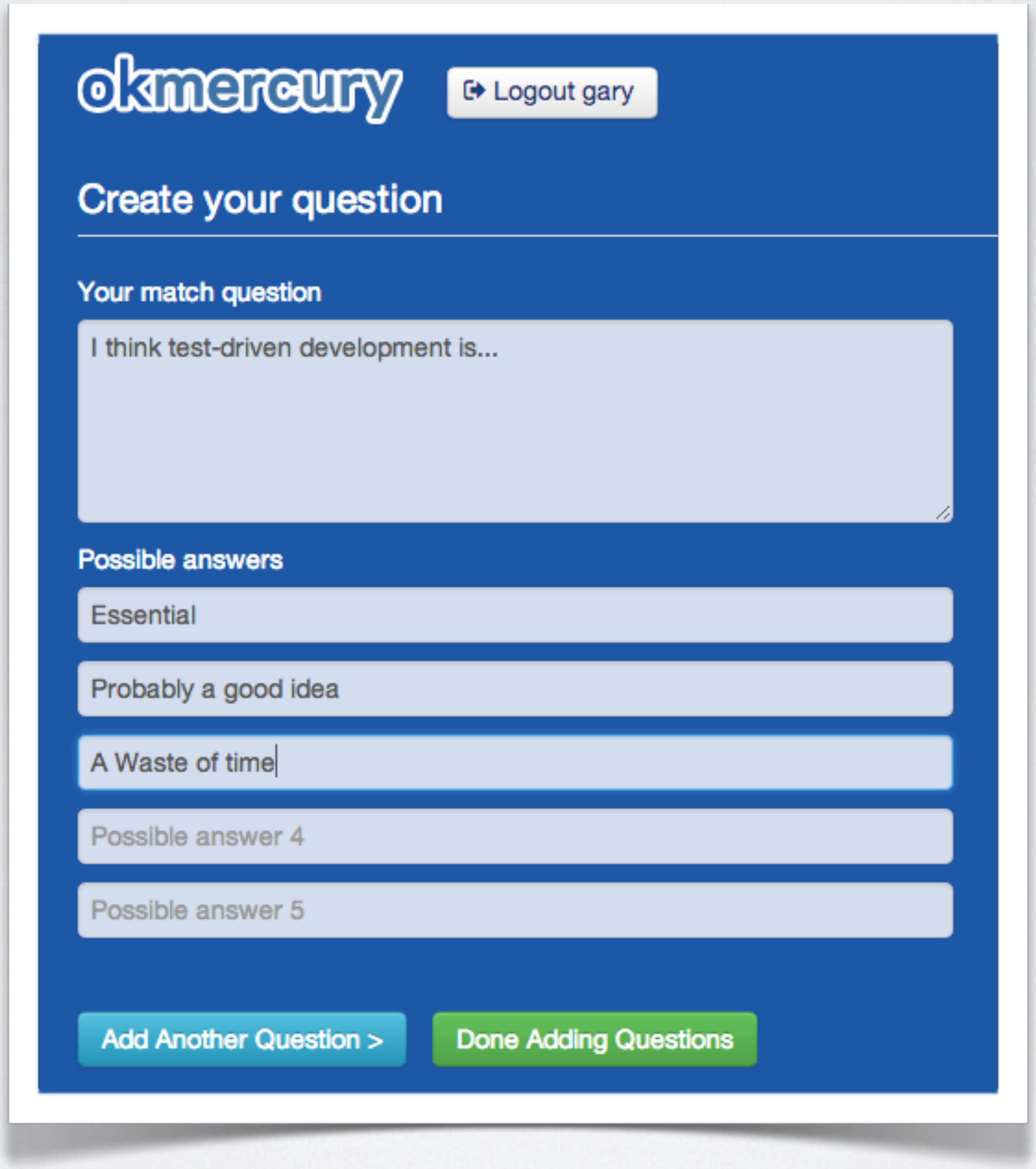
Questions You Answered

MYTHOLOGY LESSON

Mercury was the patron god of financial gain, commerce, eloquence, messages/communication, travelers, boundaries and luck.

HOW IT WORKS

Users submit questions they'd like answered by other attendees



Create your question

Your match question

I think test-driven development is...

Possible answers

Essential

Probably a good idea

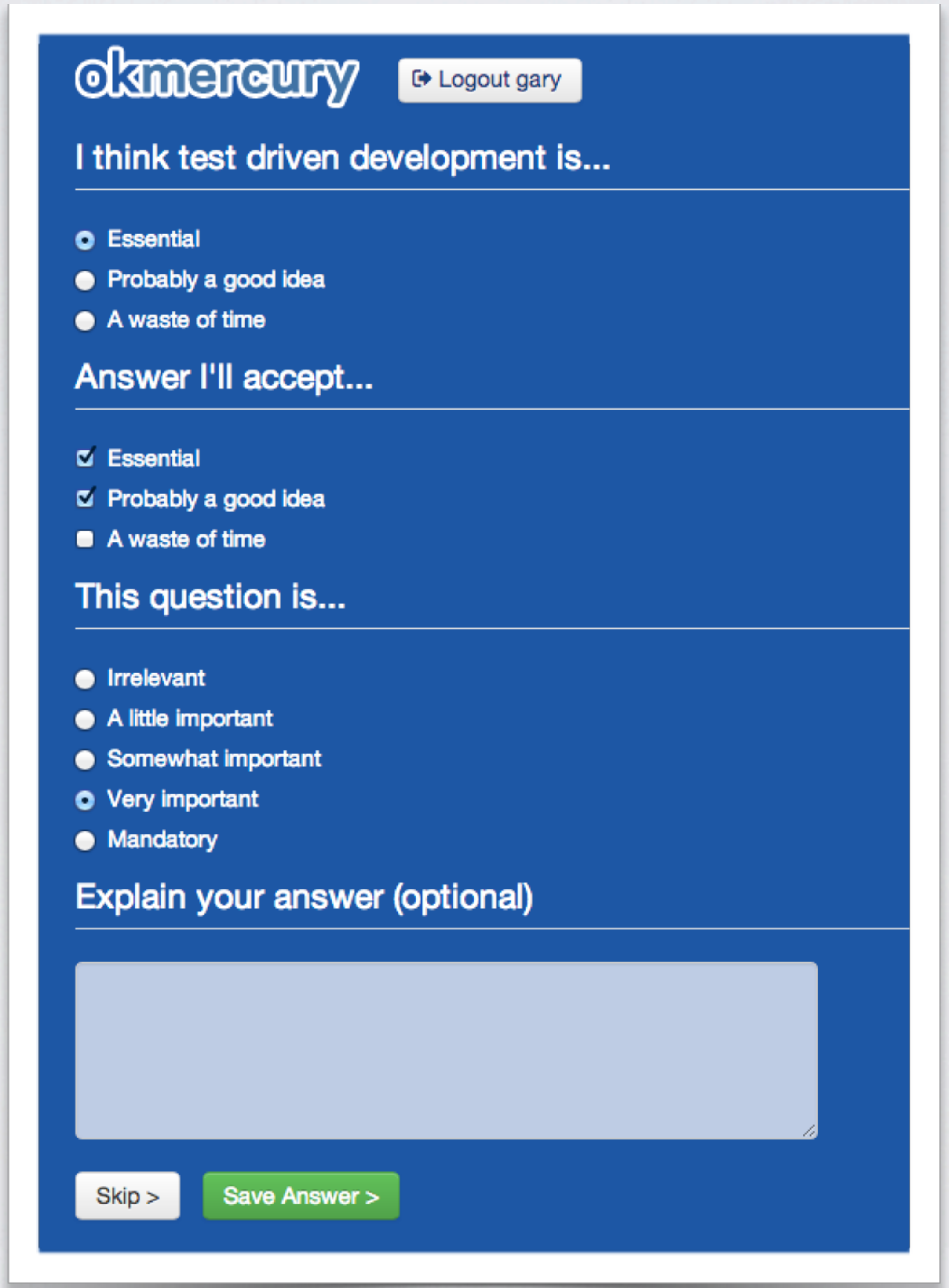
A Waste of time

Possible answer 4

Possible answer 5

HOW IT WORKS

Other attendees answer the question for themselves and specify possible answers for the people they'd like to meet



okmercury [Logout gary]

I think test driven development is...

[✓ Essential]
Probably a good idea
A waste of time

Answer I'll accept...

[✓ Essential]
[✓ Probably a good idea]
A waste of time

This question is...

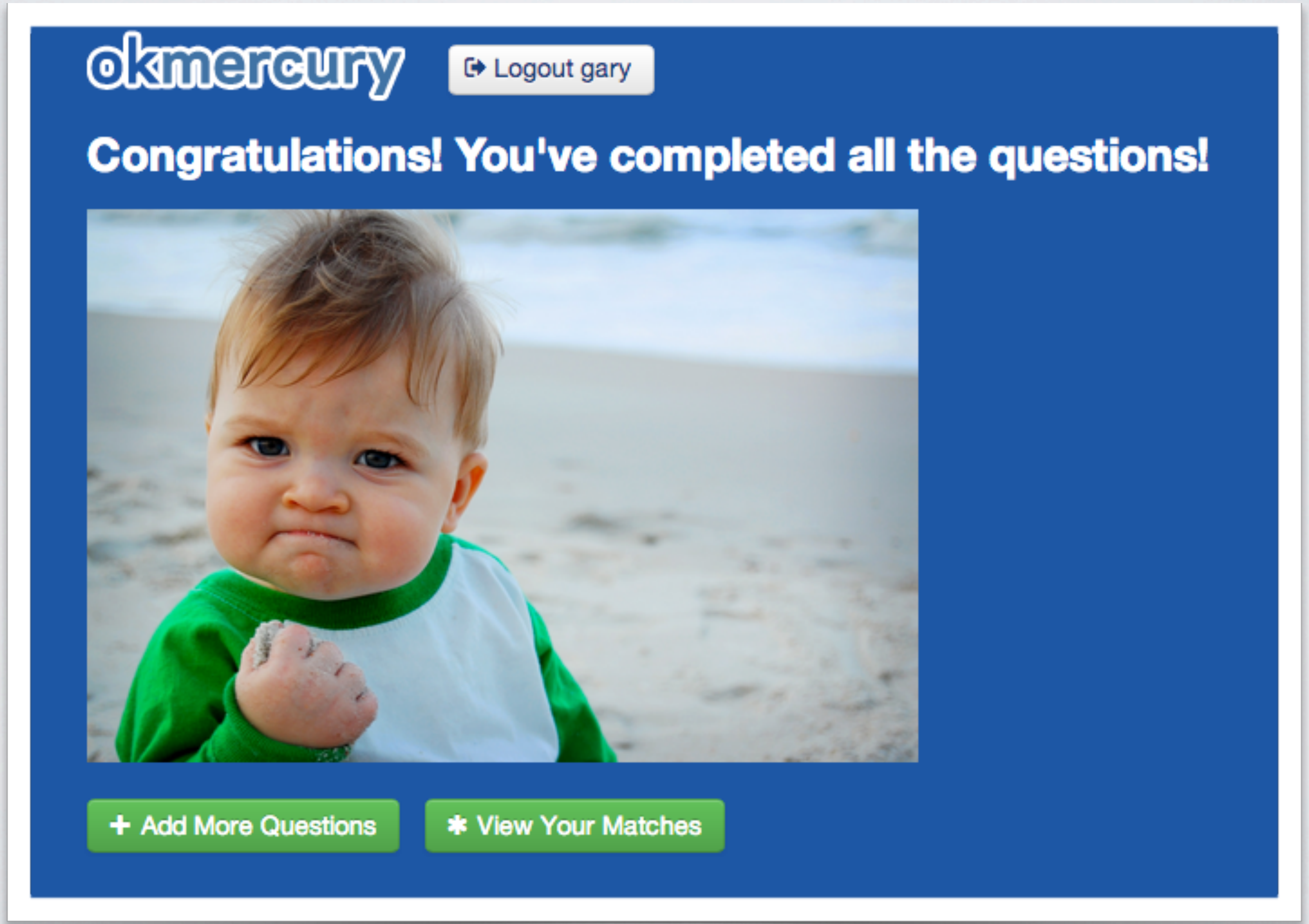
Irrelevant
A little important
Somewhat important
[✓ Very important]
Mandatory

Explain your answer (optional)

[Skip >] [Save Answer >]

HOW IT WORKS

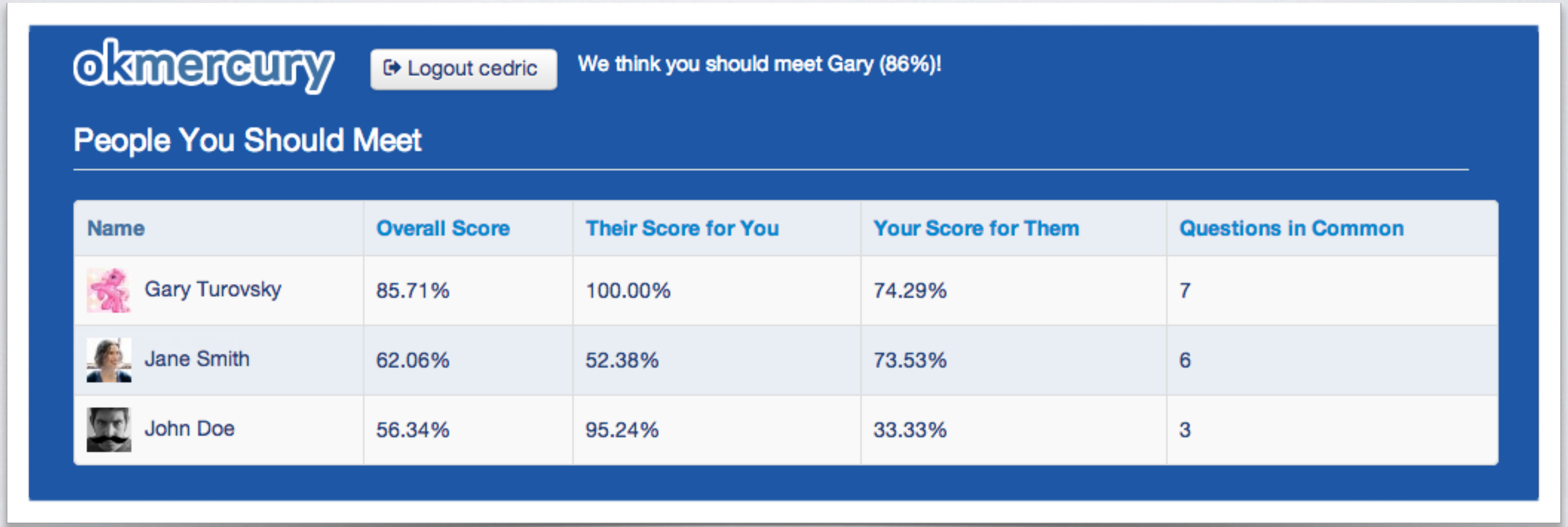
Once an attendee is finished answering questions, they can add more or view their matches



Congratulations! You've completed all the questions!

HOW IT WORKS

We do do a bunch of math and recommend other attendees to meet at the event

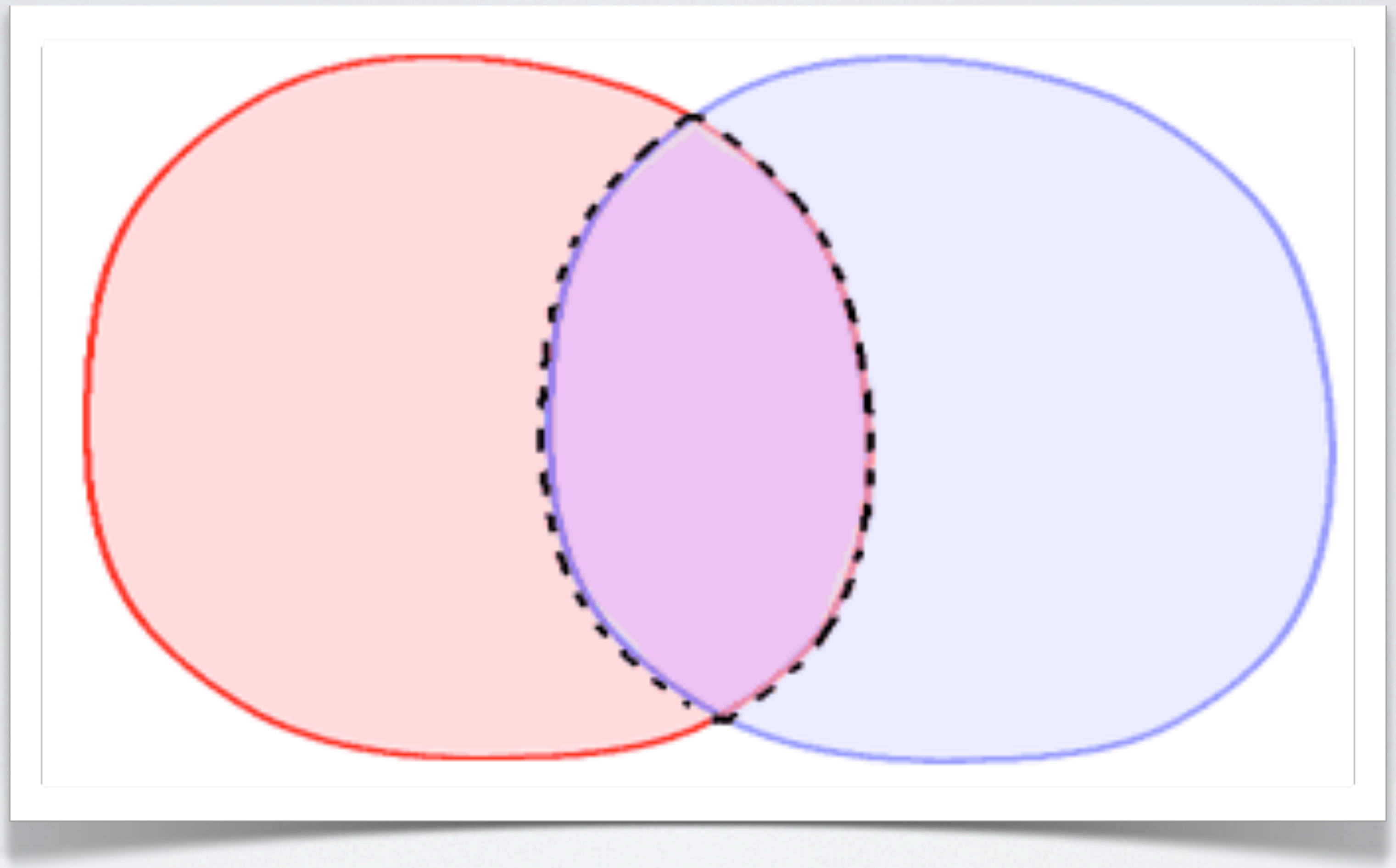


We think you should meet Gary (86%)!

People You Should Meet

Name	Overall Score	Their Score for You	Your Score for Them	Questions in Common
Gary Turovsky	85.71%	100.00%	74.29%	7
Jane Smith	62.06%	52.38%	73.53%	6
John Doe	56.34%	95.24%	33.33%	3

THE MATH



Questions You Answered

Questions You Both Answered (S)

Questions B Answered

THE MATH

Important data...

(A) Your answer

(B) How you'd like someone else to answer

(C) How important the question is to you

IMPORTANCE

Weighted based on how much you care

Irrelevant	0
A little important	1
Somewhat important	10
Very important	50
Mandatory	250

THE MATH

How much did John's answer make you happy?

If John's answer is in your list of acceptable answers:
The importance score of how much you care

If John's answer is not in your list of acceptable answers:
No points for John!

THE MATH

How much did your answer make John happy?

If your answer is in John's list of acceptable answers:
The importance score of how much they care

If your answer is not in John's list of acceptable answers:
No points for you!

THE MATH

Should you want to meet John?

$$\frac{\text{Questions John got right (weighted by your importance)}}{\text{Total possible points for common questions (also weighted by your importance)}}$$

THE MATH

Should John want to meet you?

$$\frac{\text{Questions you got right (weighted by John's importance)}}{\text{Total possible points for common questions (also weighted by John's importance)}}$$

THE MATH

Margin of Error

$$\frac{1}{\text{Number of Questions You Both Answered}}$$

THE MATH

Should you and John meet?

Square Root of (Your Score x John’s Score) - Margin of Error

THE STACK

Groovy

GRAILS

mongoDB

CoffeeScript

VAGRANT

jQuery
write less, do more.

puppet labs®

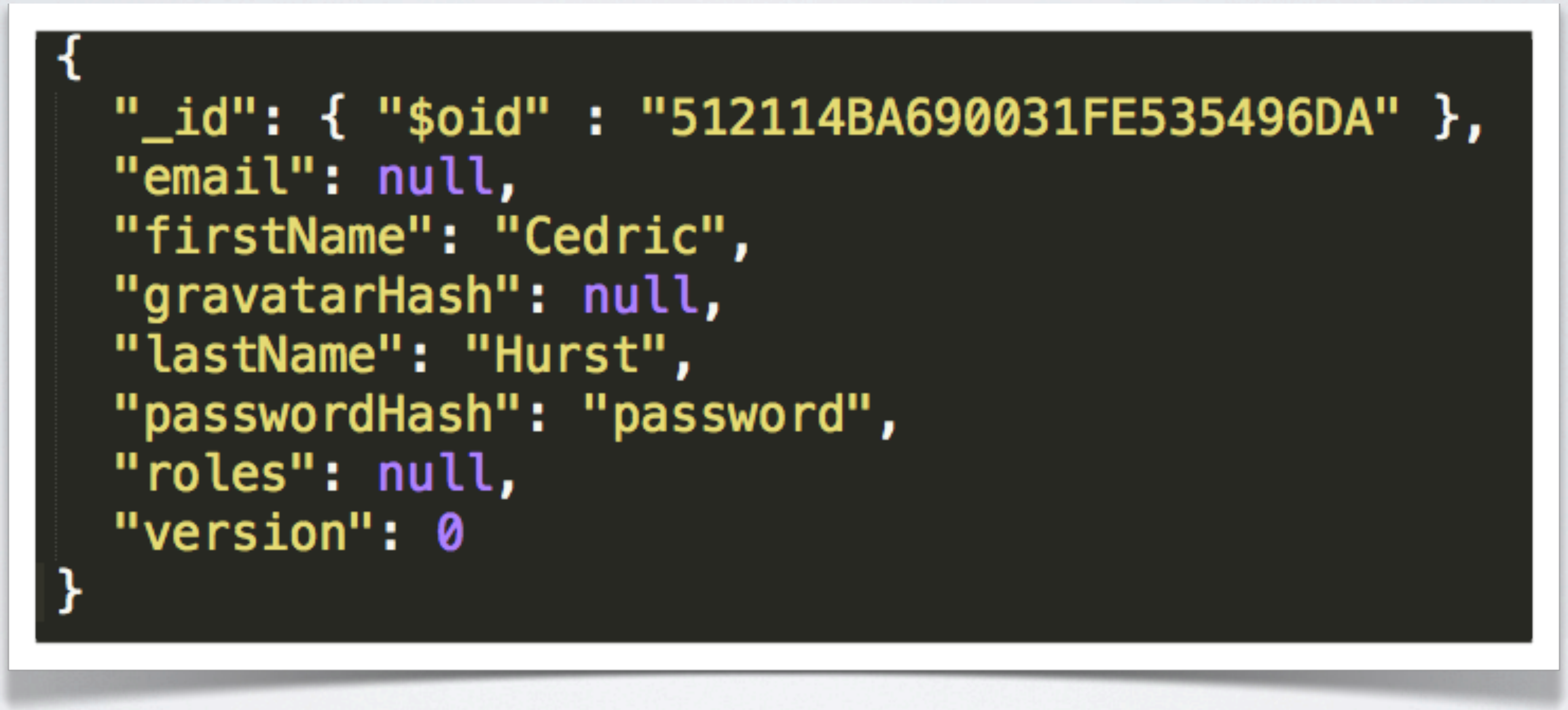
{less}

amazon web services™

github SOCIAL CODING

THE DATA

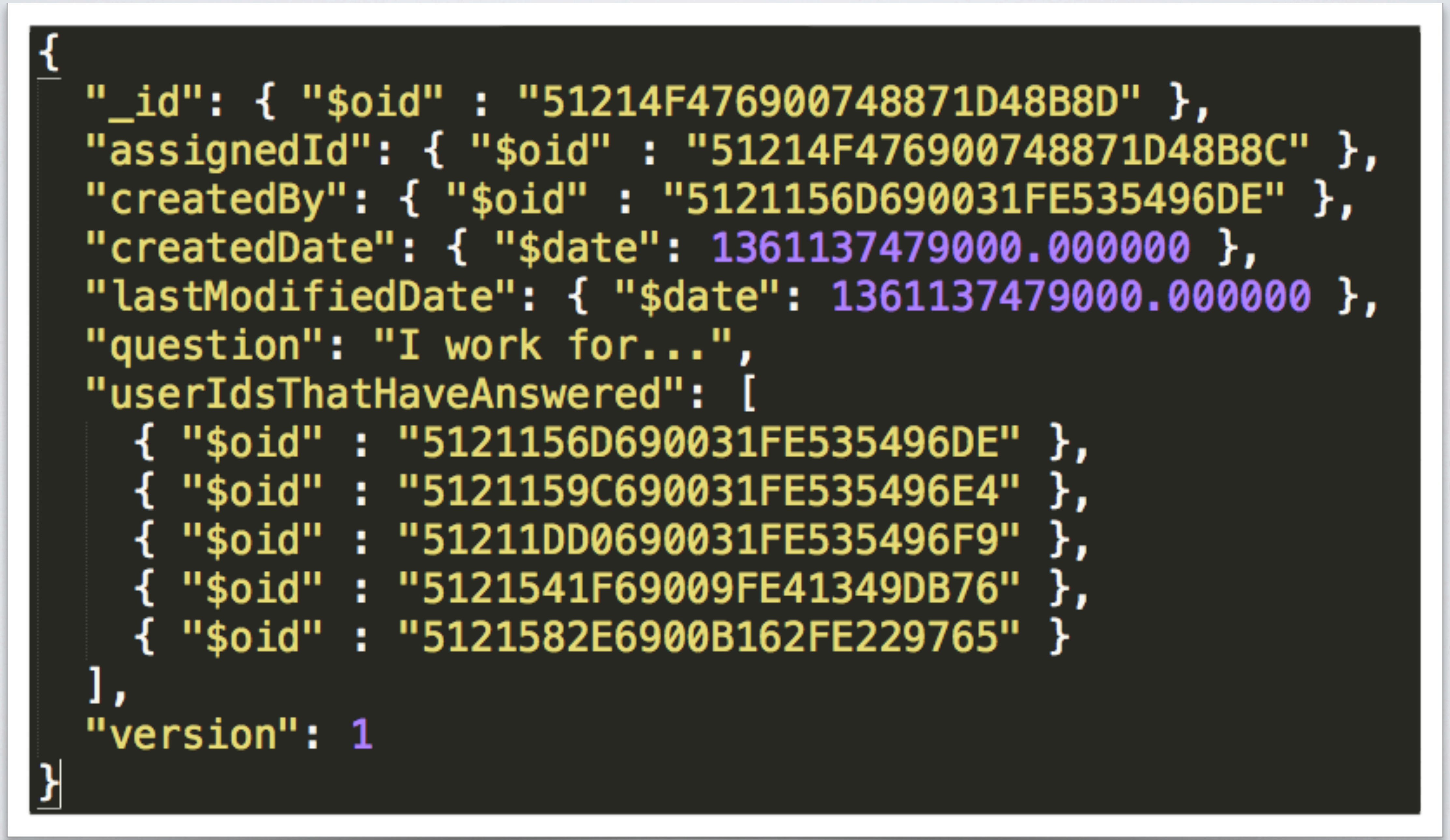
Users



```
{
  "_id": { "$oid" : "512114BA690031FE535496DA" },
  "email": null,
  "firstName": "Cedric",
  "gravatarHash": null,
  "lastName": "Hurst",
  "passwordHash": "password",
  "roles": null,
  "version": 0
}
```

THE DATA

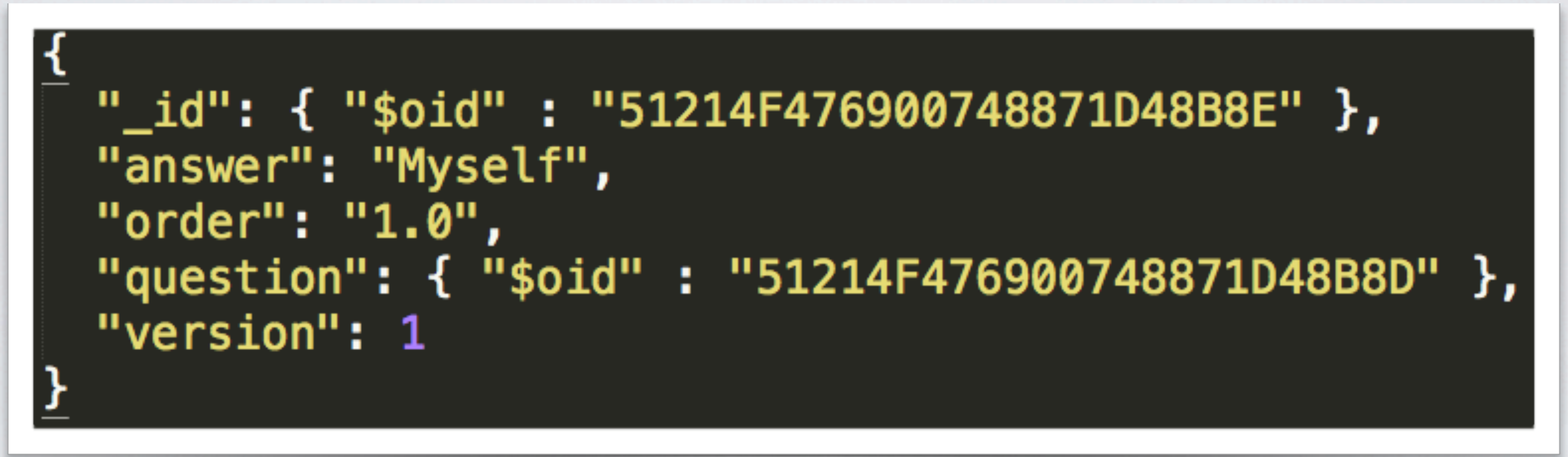
Questions



```
{
  "_id": { "$oid" : "51214F476900748871D48B8D" },
  "assignedId": { "$oid" : "51214F476900748871D48B8C" },
  "createdBy": { "$oid" : "5121156D690031FE535496DE" },
  "createdDate": { "$date": 1361137479000.000000 },
  "lastModifiedDate": { "$date": 1361137479000.000000 },
  "question": "I work for...",
  "userIdsThatHaveAnswered": [
    { "$oid" : "5121156D690031FE535496DE" },
    { "$oid" : "5121159C690031FE535496E4" },
    { "$oid" : "51211DD0690031FE535496F9" },
    { "$oid" : "5121541F69009FE41349DB76" },
    { "$oid" : "5121582E6900B162FE229765" }
  ],
  "version": 1
}
```

THE DATA

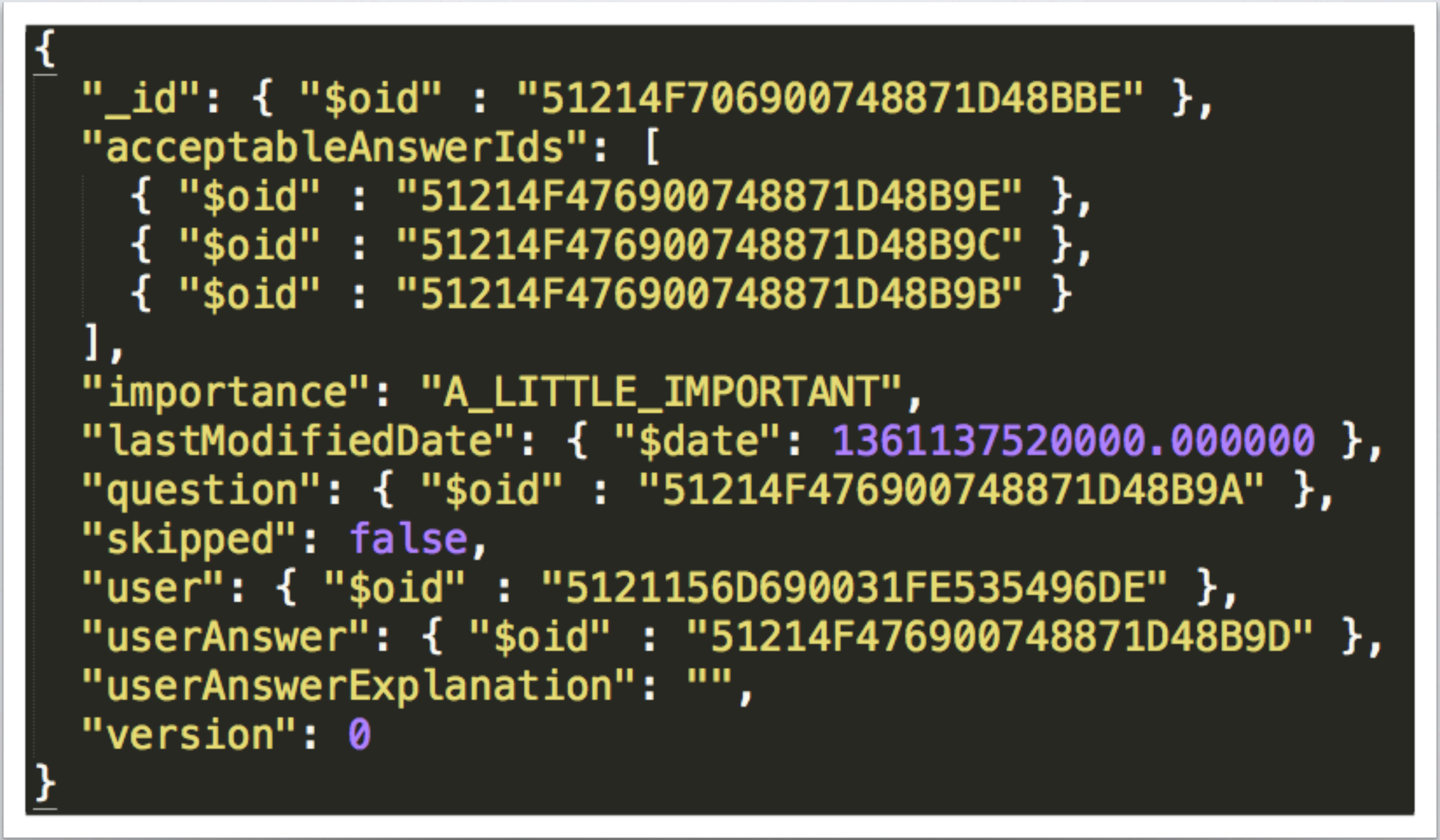
QuestionOptions



```
{
  "_id": { "$oid" : "51214F476900748871D48B8E" },
  "answer": "Myself",
  "order": "1.0",
  "question": { "$oid" : "51214F476900748871D48B8D" },
  "version": 1
}
```

THE DATA

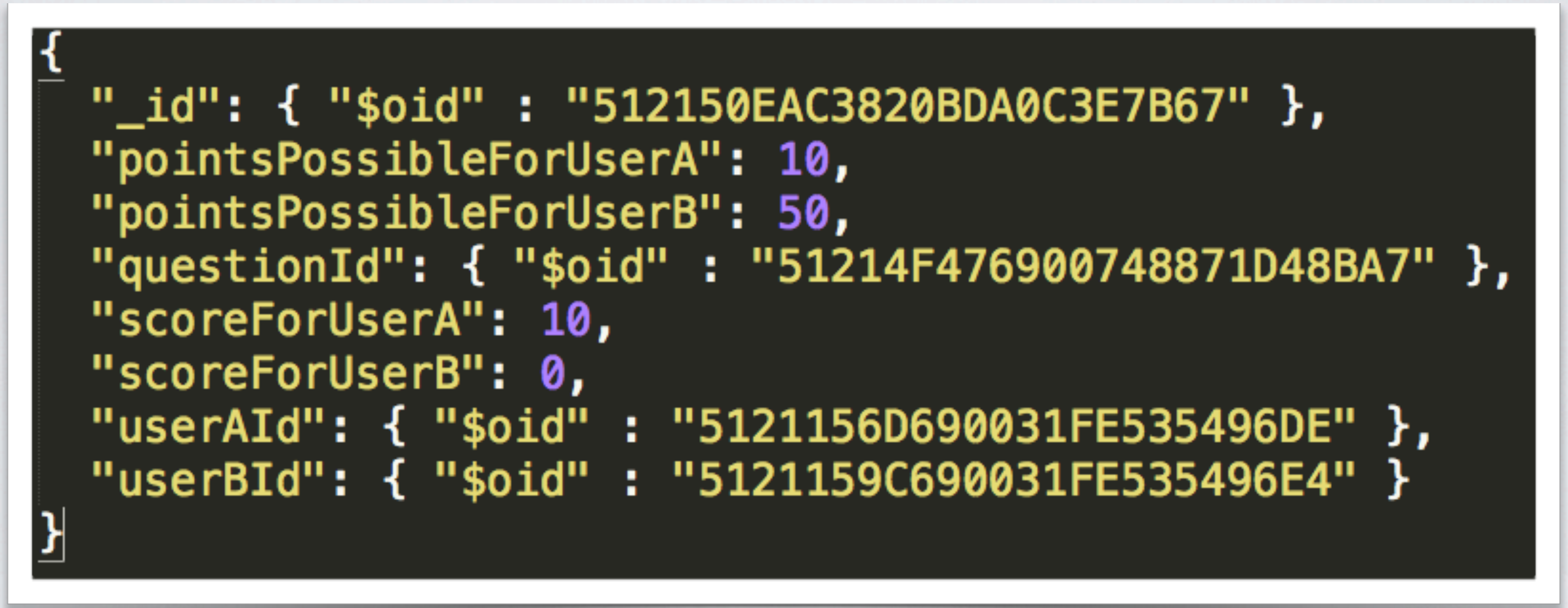
Answers



```
{
  "_id": { "$oid" : "51214F706900748871D48BBE" },
  "acceptableAnswerIds": [
    { "$oid" : "51214F476900748871D48B9E" },
    { "$oid" : "51214F476900748871D48B9C" },
    { "$oid" : "51214F476900748871D48B9B" }
  ],
  "importance": "A_LITTLE_IMPORTANT",
  "lastModifiedDate": { "$date": 1361137520000.000000 },
  "question": { "$oid" : "51214F476900748871D48B9A" },
  "skipped": false,
  "user": { "$oid" : "5121156D690031FE535496DE" },
  "userAnswer": { "$oid" : "51214F476900748871D48B9D" },
  "userAnswerExplanation": "",
  "version": 0
}
```

THE DATA

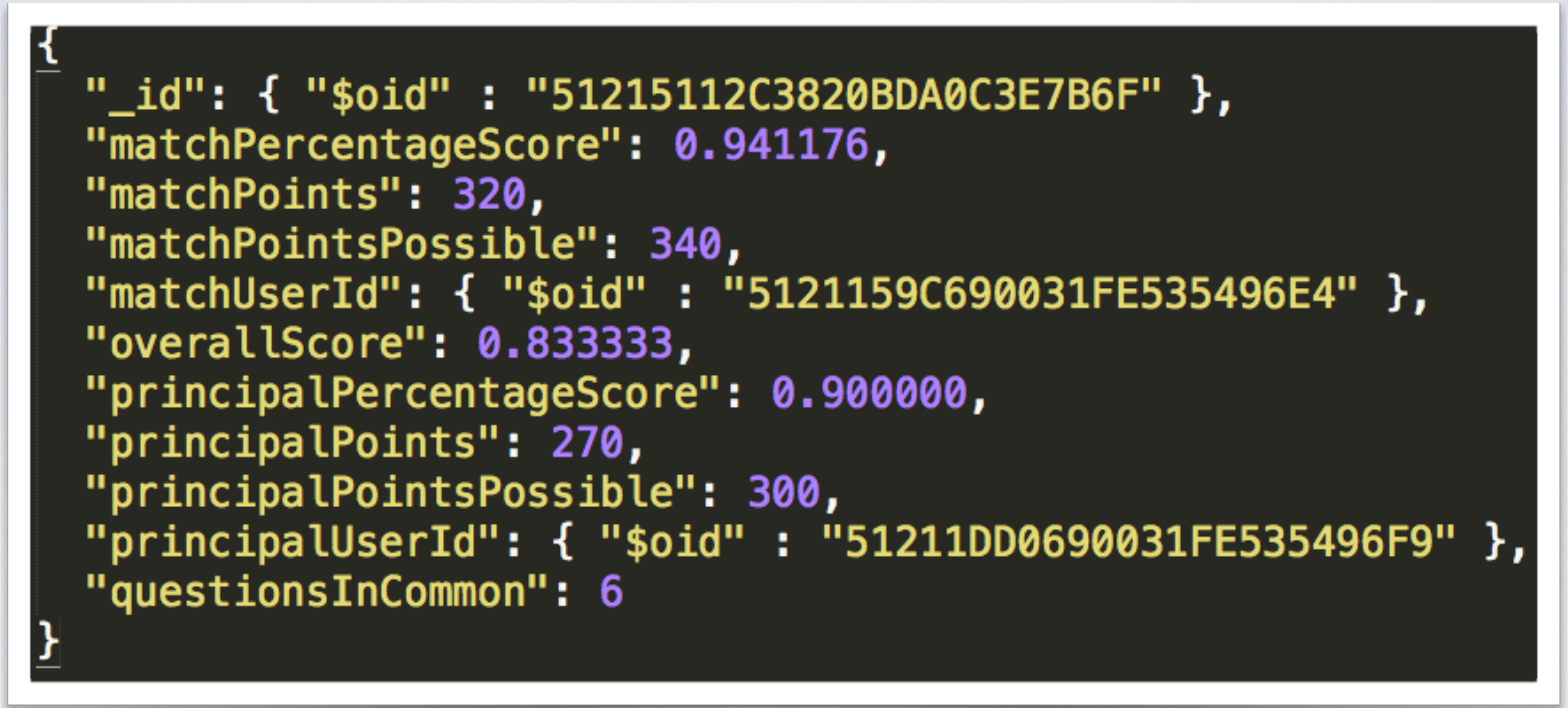
QuestionMatches



```
{
  "_id": { "$oid" : "512150EAC3820BDA0C3E7B67" },
  "pointsPossibleForUserA": 10,
  "pointsPossibleForUserB": 50,
  "questionId": { "$oid" : "51214F476900748871D48BA7" },
  "scoreForUserA": 10,
  "scoreForUserB": 0,
  "userAId": { "$oid" : "5121156D690031FE535496DE" },
  "userBId": { "$oid" : "5121159C690031FE535496E4" }
}
```

THE DATA

UserMatches

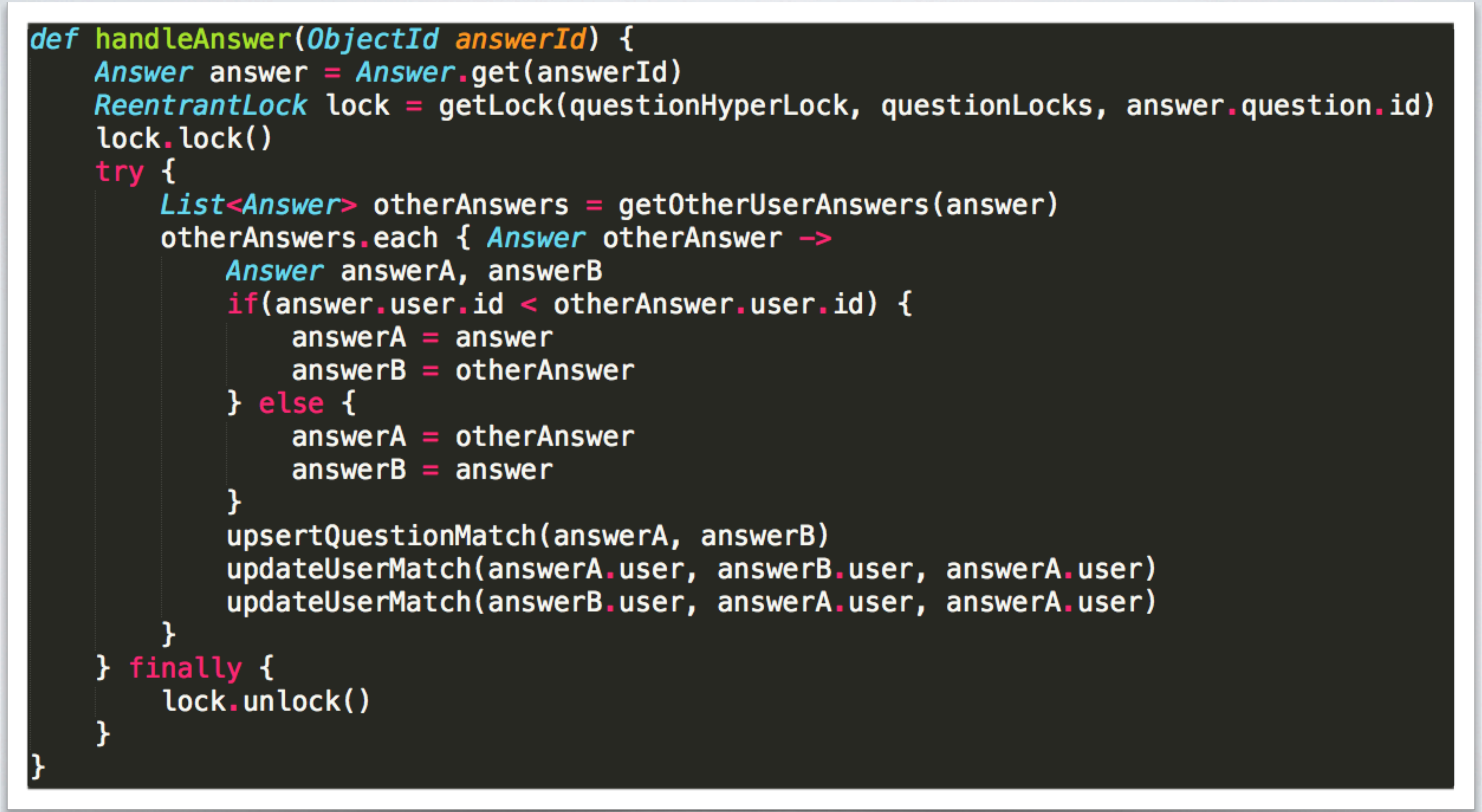


```
{
  "_id": { "$oid" : "51215112C3820BDA0C3E7B6F" },
  "matchPercentageScore": 0.941176,
  "matchPoints": 320,
  "matchPointsPossible": 340,
  "matchUserId": { "$oid" : "5121159C690031FE535496E4" },
  "overallScore": 0.833333,
  "principalPercentageScore": 0.900000,
  "principalPoints": 270,
  "principalPointsPossible": 300,
  "principalUserId": { "$oid" : "51211DD0690031FE535496F9" },
  "questionsInCommon": 6
}
```

PUTTING IT ALL TOGETHER

As users answer questions, we find other user's answers to those questions and calculate the score from both sides and "upsert" the QuestionMatch into MongoDB.

PUTTING IT ALL TOGETHER

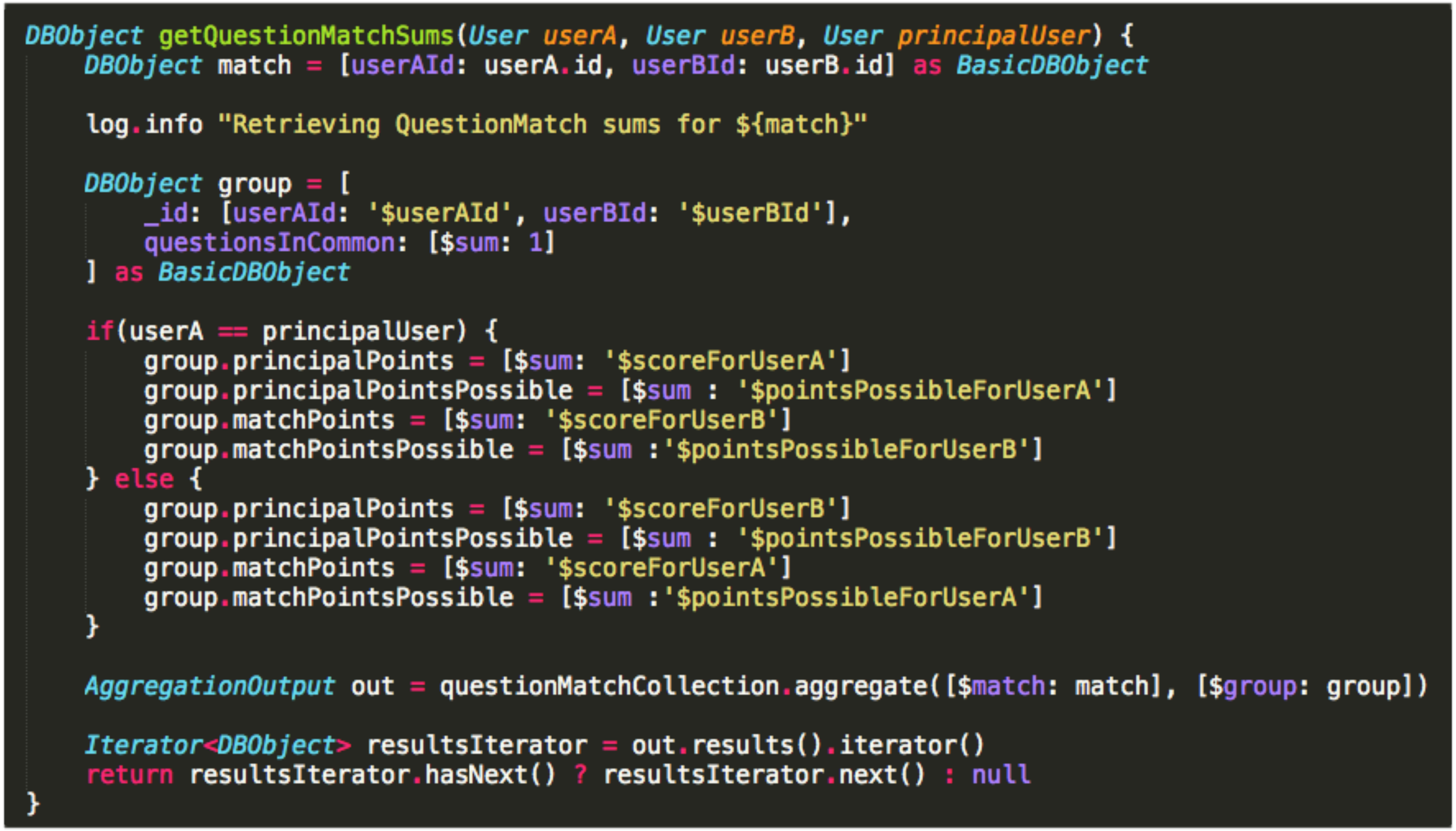


```
def handleAnswer(ObjectId answerId) {
    Answer answer = Answer.get(answerId)
    ReentrantLock lock = getLock(questionHyperLock, questionLocks, answer.question.id)
    lock.lock()
    try {
        List<Answer> otherAnswers = getOtherUserAnswers(answer)
        otherAnswers.each { Answer otherAnswer ->
            Answer answerA, answerB
            if(answer.user.id < otherAnswer.user.id) {
                answerA = answer
                answerB = otherAnswer
            } else {
                answerA = otherAnswer
                answerB = answer
            }
            upsertQuestionMatch(answerA, answerB)
            updateUserMatch(answerA.user, answerB.user, answerA.user)
            updateUserMatch(answerB.user, answerA.user, answerA.user)
        }
    } finally {
        lock.unlock()
    }
}
```

PUTTING IT ALL TOGETHER

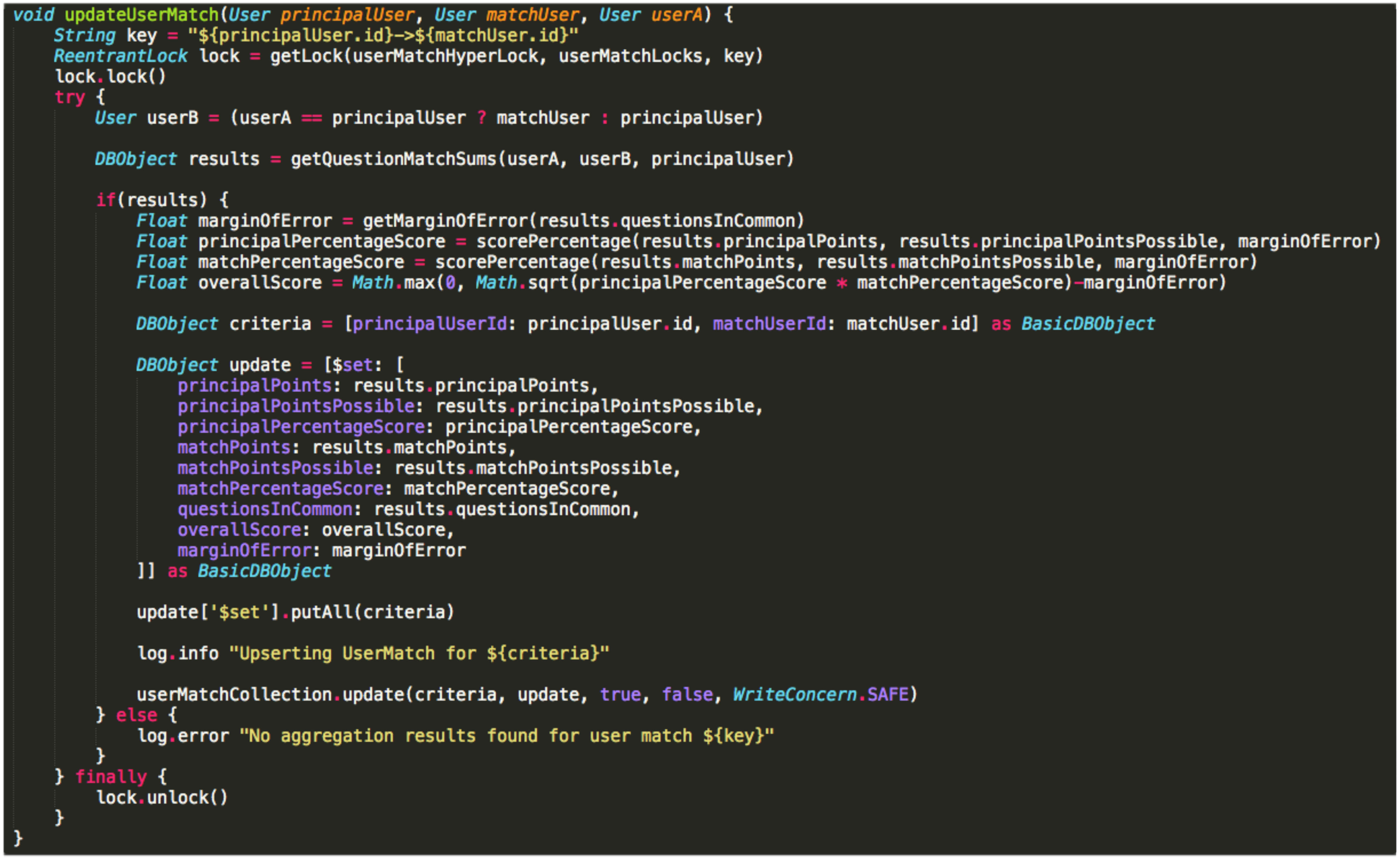
After we calculate the QuestionMatch, we (re)calculate the user match using the MongoDB Aggregation Framework and "upsert" a UserMatch.

PUTTING IT ALL TOGETHER



```groovy
DBObject getQuestionMatchSums(User userA, User userB, User principalUser) {
    DBObject match = [userAId: userA.id, userBId: userB.id] as BasicDBObject

    log.info "Retrieving QuestionMatch sums for ${match}"

    DBObject group = [
        _id: [userAId: '$userAId', userBId: '$userBId'],
        questionsInCommon: [$sum: 1]
    ] as BasicDBObject

    if(userA == principalUser) {
        group.principalPoints = [$sum: '$scoreForUserA']
        group.principalPointsPossible = [$sum : '$pointsPossibleForUserA']
        group.matchPoints = [$sum: '$scoreForUserB']
        group.matchPointsPossible = [$sum :'$pointsPossibleForUserB']
    } else {
        group.principalPoints = [$sum: '$scoreForUserB']
        group.principalPointsPossible = [$sum : '$pointsPossibleForUserB']
        group.matchPoints = [$sum: '$scoreForUserA']
        group.matchPointsPossible = [$sum :'$pointsPossibleForUserA']
    }

    AggregationOutput out = questionMatchCollection.aggregate([$match: match], [$group: group])

    Iterator<DBObject> resultsIterator = out.results().iterator()
    return resultsIterator.hasNext() ? resultsIterator.next() : null
}
```

PUTTING IT ALL TOGETHER

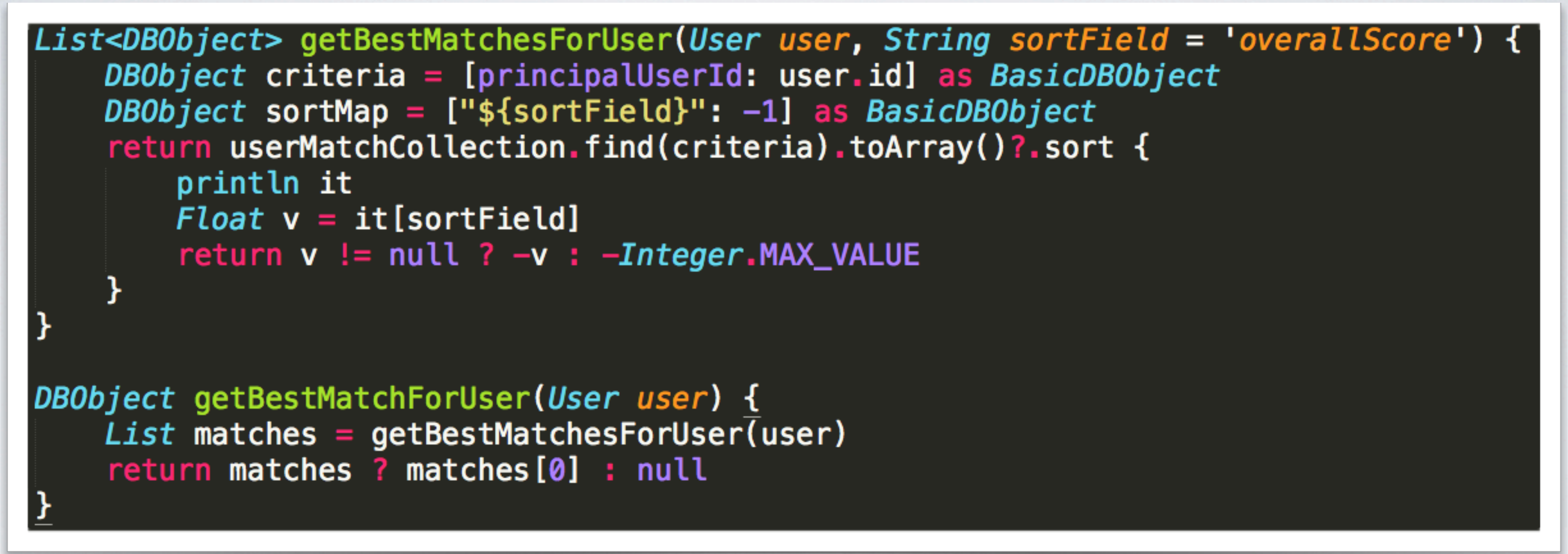


```
void updateUserMatch(User principalUser, User matchUser, User userA) {
    String key = "${principalUser.id}->${matchUser.id}"
    ReentrantLock lock = getLock(userMatchHyperLock, userMatchLocks, key)
    lock.lock()
    try {
        User userB = (userA == principalUser ? matchUser : principalUser)

        DBObject results = getQuestionMatchSums(userA, userB, principalUser)

        if(results) {
            Float marginOfError = getMarginOfError(results.questionsInCommon)
            Float principalPercentageScore = scorePercentage(results.principalPoints, results.principalPointsPossible, marginOfError)
            Float matchPercentageScore = scorePercentage(results.matchPoints, results.matchPointsPossible, marginOfError)
            Float overallScore = Math.max(0, Math.sqrt(principalPercentageScore * matchPercentageScore)-marginOfError)

            DBObject criteria = [principalUserId: principalUser.id, matchUserId: matchUser.id] as BasicDBObject

            DBObject update = [$set: [
                principalPoints: results.principalPoints,
                principalPointsPossible: results.principalPointsPossible,
                principalPercentageScore: principalPercentageScore,
                matchPoints: results.matchPoints,
                matchPointsPossible: results.matchPointsPossible,
                matchPercentageScore: matchPercentageScore,
                questionsInCommon: results.questionsInCommon,
                overallScore: overallScore,
                marginOfError: marginOfError
            ]] as BasicDBObject

            update['$set'].putAll(criteria)

            log.info "Upserting UserMatch for ${criteria}"

            userMatchCollection.update(criteria, update, true, false, WriteConcern.SAFE)
        } else {
            log.error "No aggregation results found for user match ${key}"
        }
    } finally {
        lock.unlock()
    }
}
```

PUTTING IT ALL TOGETHER

When an attendee wants to see their matches, we simply query the UserMatch collection sorting by `` `overallMatch` `` score.

PUTTING IT ALL TOGETHER



```
List<DBObject> getBestMatchesForUser(User user, String sortField = 'overallScore') {
    DBObject criteria = [principalUserId: user.id] as BasicDBObject
    DBObject sortMap = ["${sortField}": -1] as BasicDBObject
    return userMatchCollection.find(criteria).toArray()?.sort {
        println it
        Float v = it[sortField]
        return v != null ? -v : -Integer.MAX_VALUE
    }
}

DBObject getBestMatchForUser(User user) {
    List matches = getBestMatchesForUser(user)
    return matches ? matches[0] : null
}
```

COOL (GEEKY) STUFF WE DID

You can use it right now

http://okmercury.co

Completely RESTful API

Our frontend consumes it

100% Open-Source (Apache 2.0)

http://github.com/Spantree/okmercury

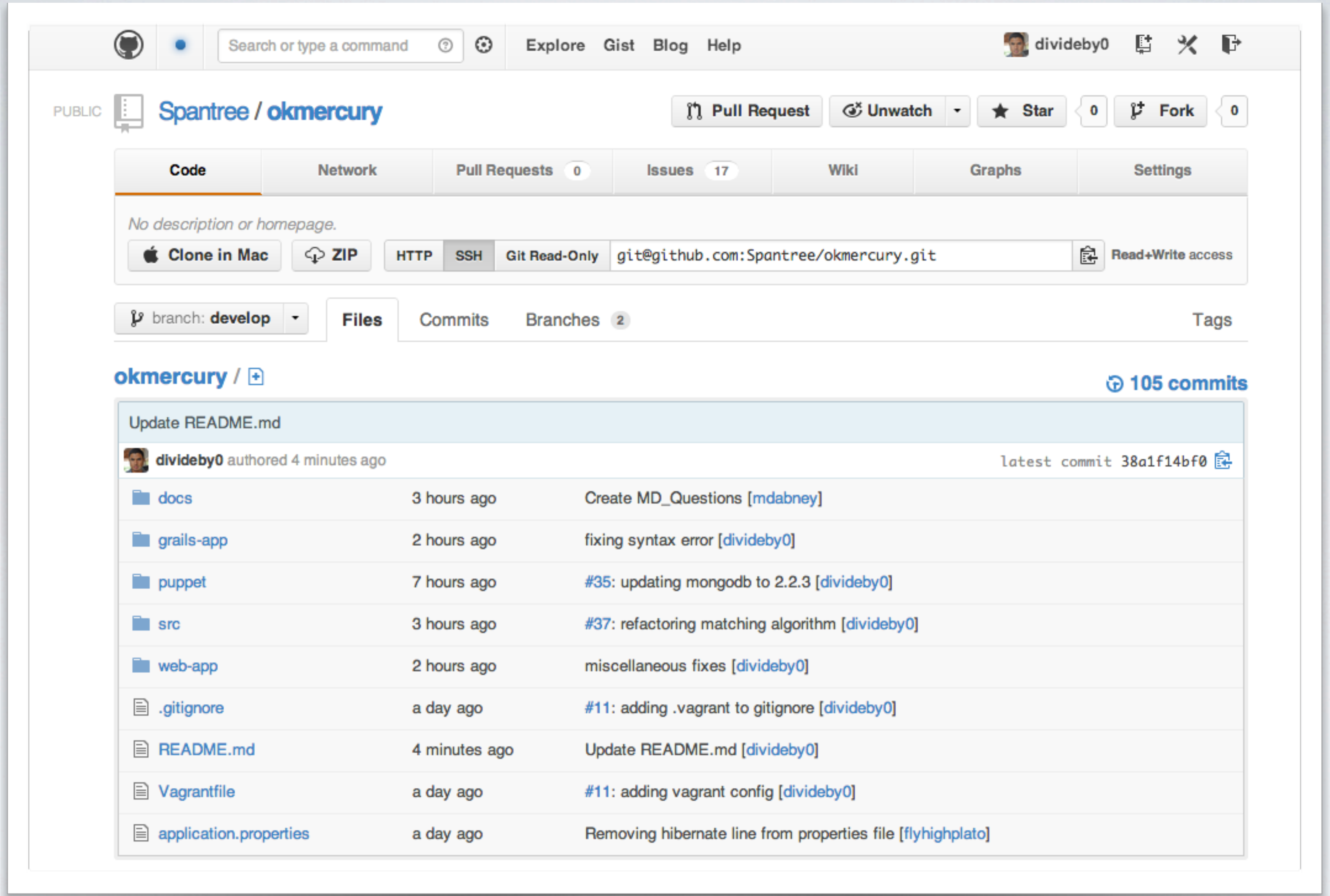
STUFF WE DIDN'T HAVE TIME FOR

Add multi-tenancy support

Use backbone.js for rich(er) front-end

Do the number crunching with map-reduce

CHECK IT OUT



No description or homepage.

```
git@github.com:Spantree/okmercury.git
```

Update README.md

divideby0 authored 4 minutes ago — latest commit 38a1f14bf0

docs	3 hours ago	Create MD_Questions [mdabney]
grails-app	2 hours ago	fixing syntax error [divideby0]
puppet	7 hours ago	#35: updating mongodb to 2.2.3 [divideby0]
src	3 hours ago	#37: refactoring matching algorithm [divideby0]
web-app	2 hours ago	miscellaneous fixes [divideby0]
.gitignore	a day ago	#11: adding .vagrant to gitignore [divideby0]
README.md	4 minutes ago	Update README.md [divideby0]
Vagrantfile	a day ago	#11: adding vagrant config [divideby0]
application.properties	a day ago	Removing hibernate line from properties file [flyhighplato]

http://github.com/Spantree/okmercury

SAY HELLO

Web: http://www.spantree.net

Twitter: @spantreellc @divideby0 @flyhighplato

Github: http://www.github.com/Spantree

LinkedIn: http://www.linkedin.com/company/spantree-technology-group-llc

Email: info@spantree.net