okmercury

(Blatantly plagiarizing the okcupid matching algorithm and letting it run wild to help people know who to meet at a tradeshow)

WHO ARE WE

Cedric Hurst & Gary Turovsky

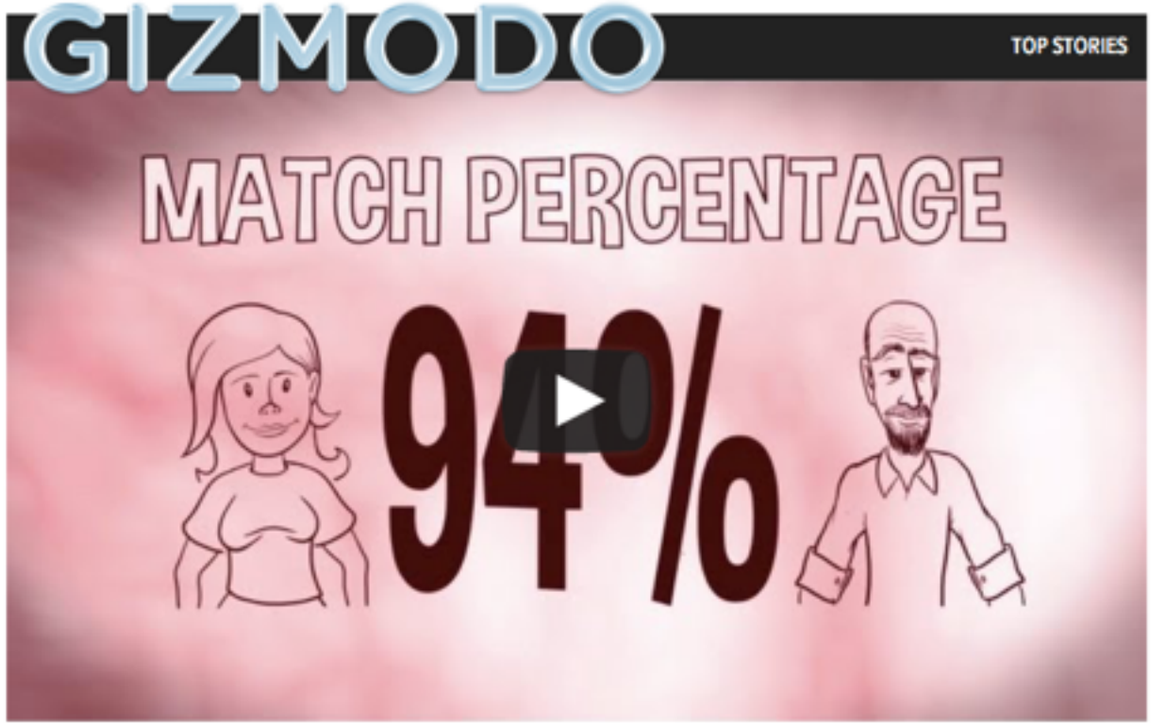
50% of Spantree Technology Group, LLC

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

Planning Systems, Search Engine Design, Algorithms

Work across several industries, 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

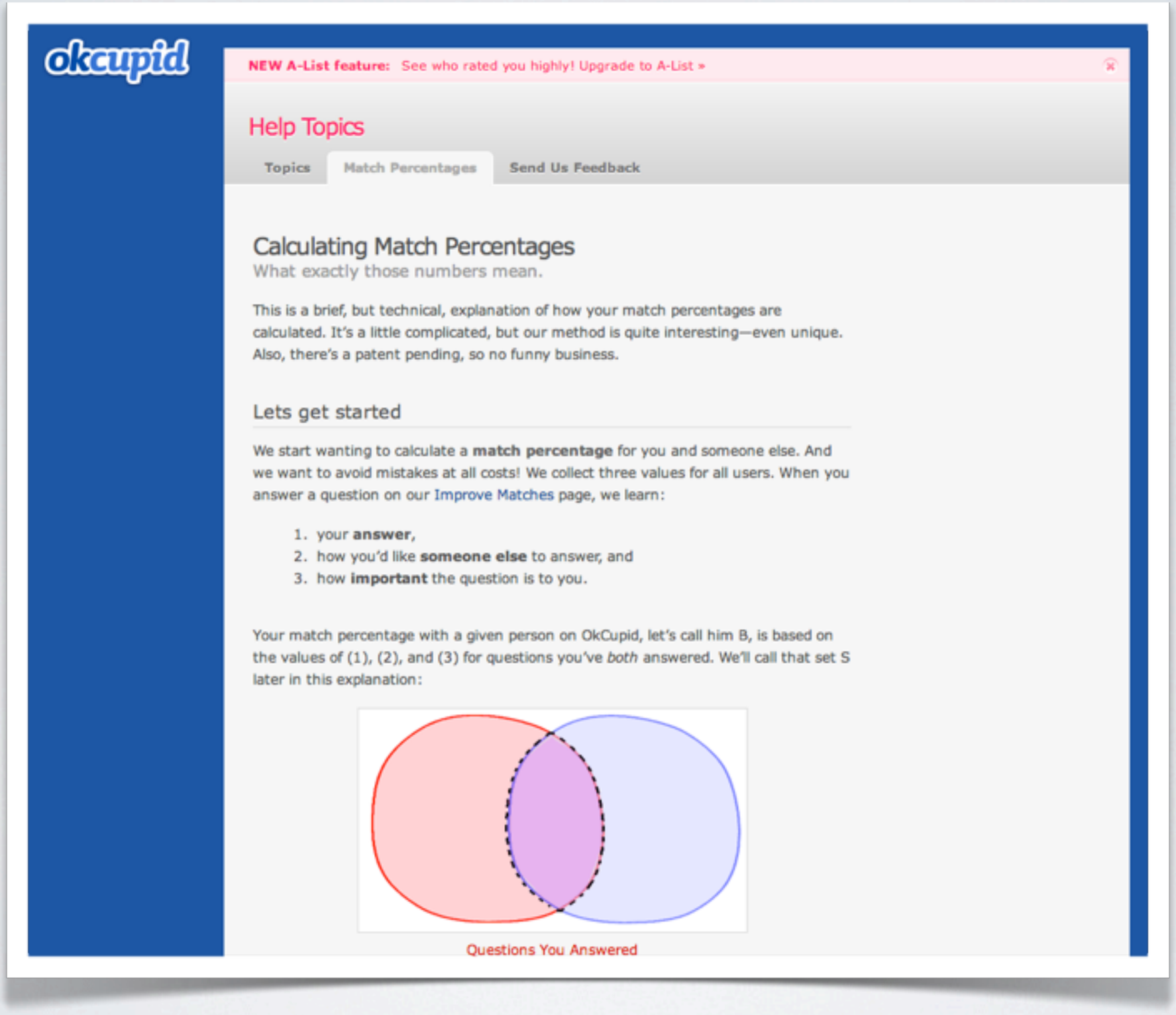
Share +1 Like 70

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?

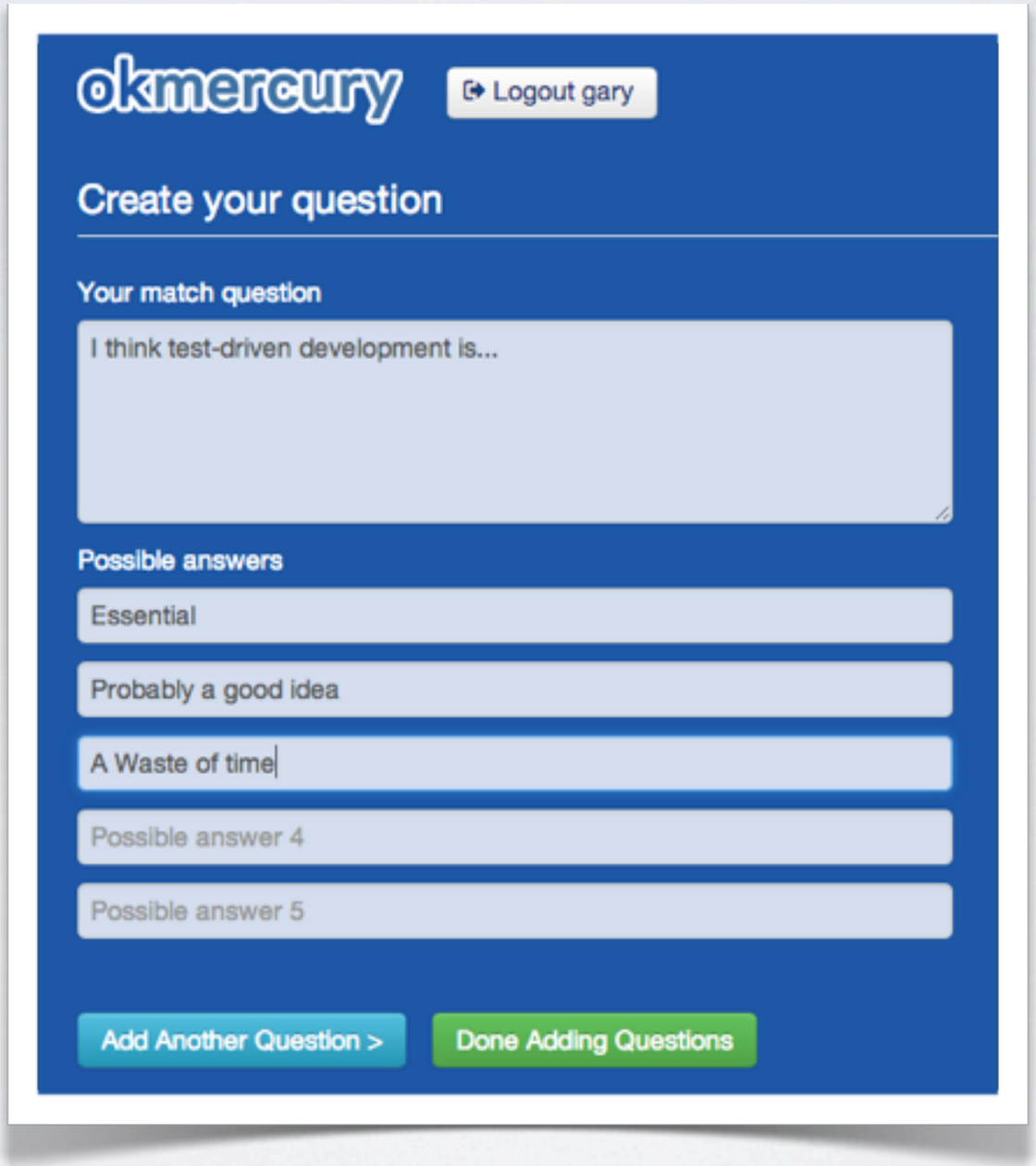


MYTHOLOGY LESSON

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

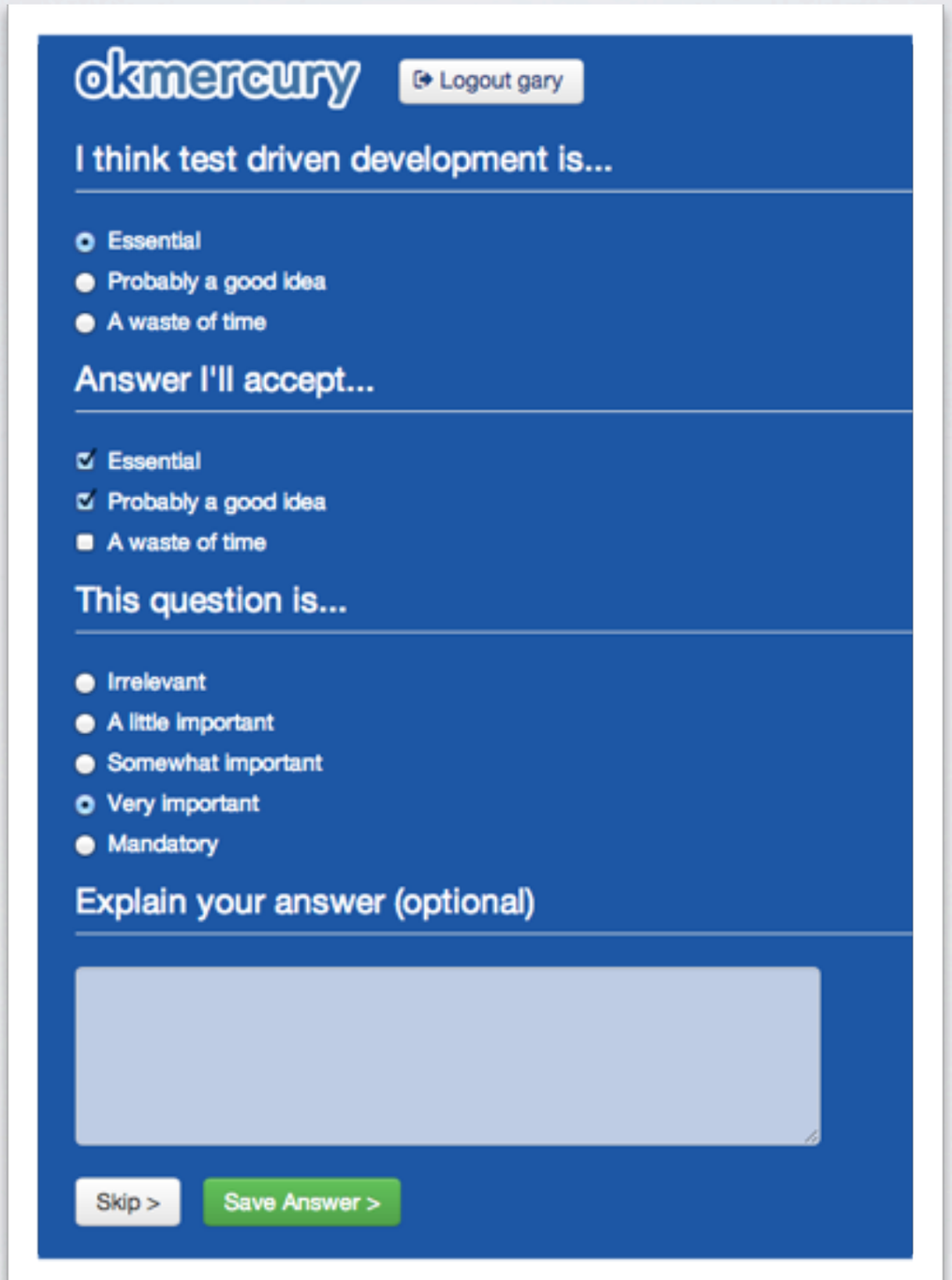
HOW IT WORKS

Users submit questions they'd like answered by other attendees



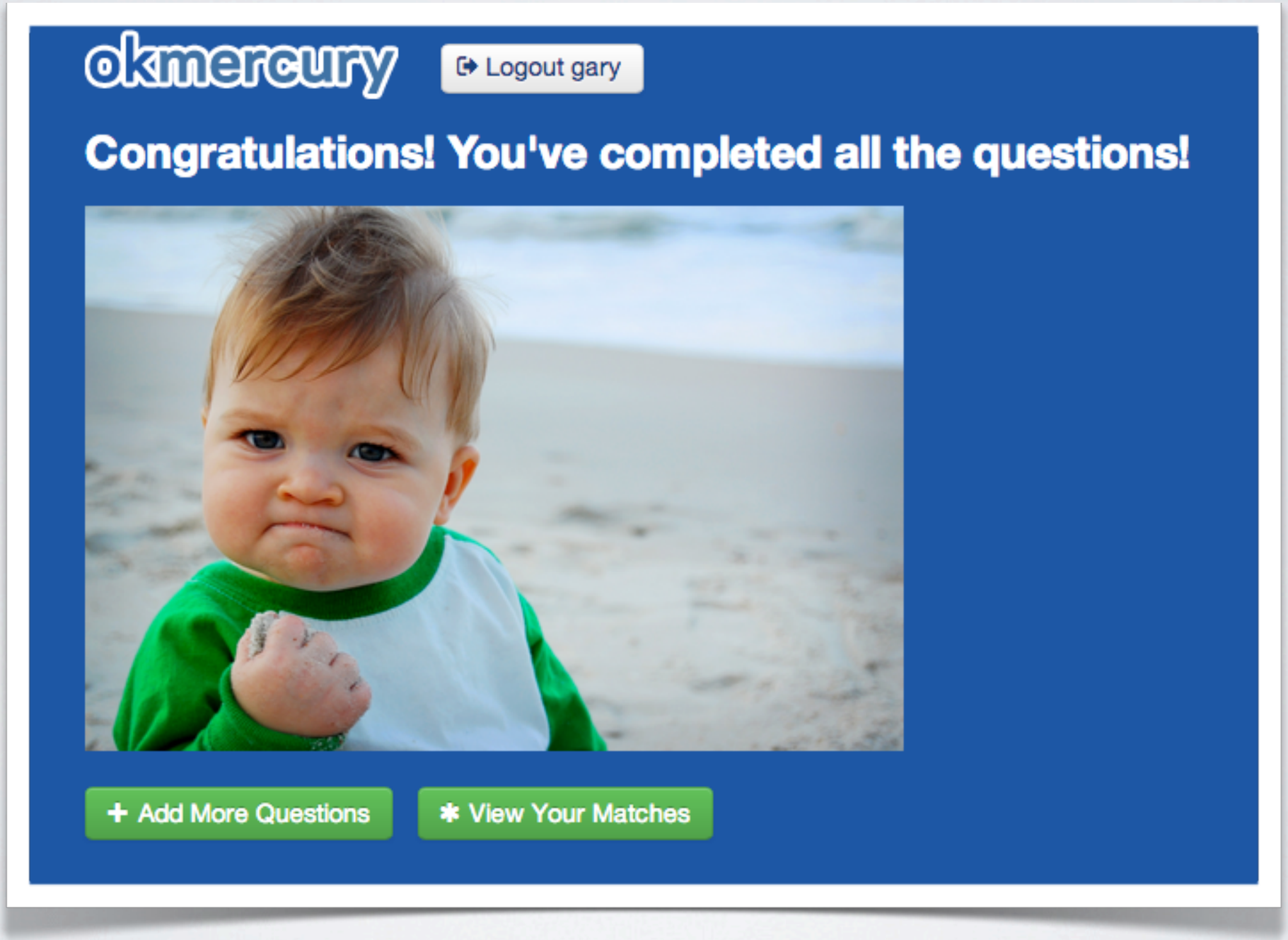
HOW IT WORKS

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



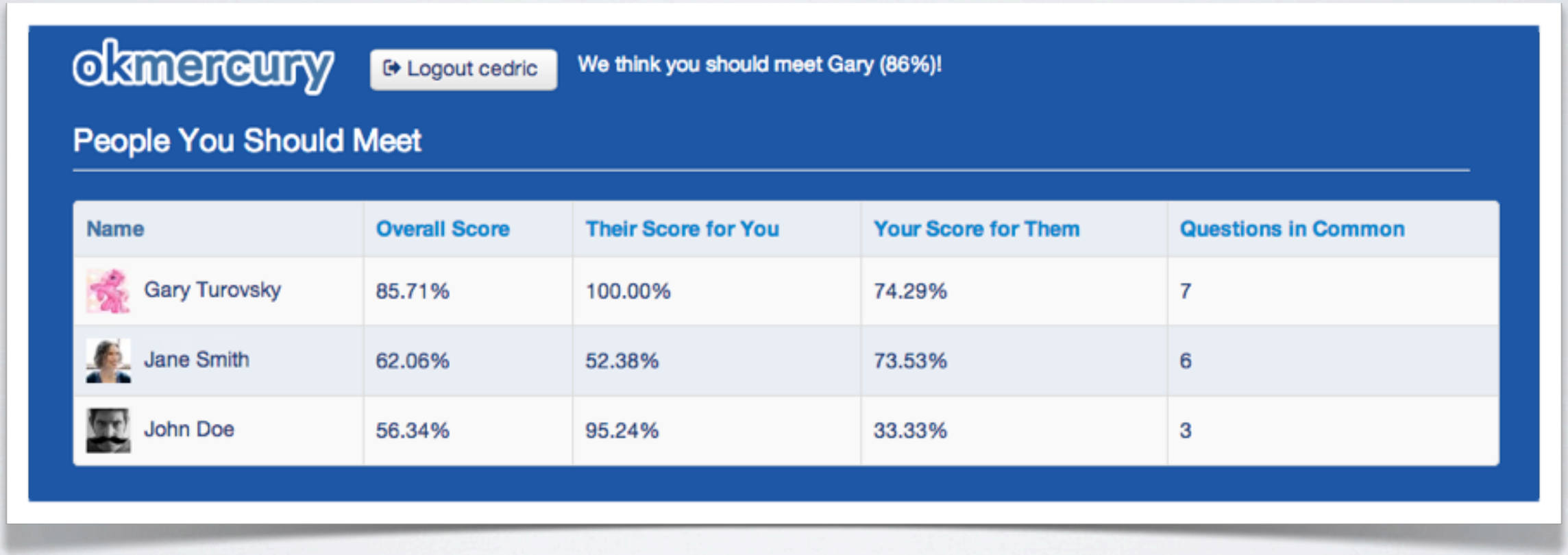
HOW IT WORKS

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

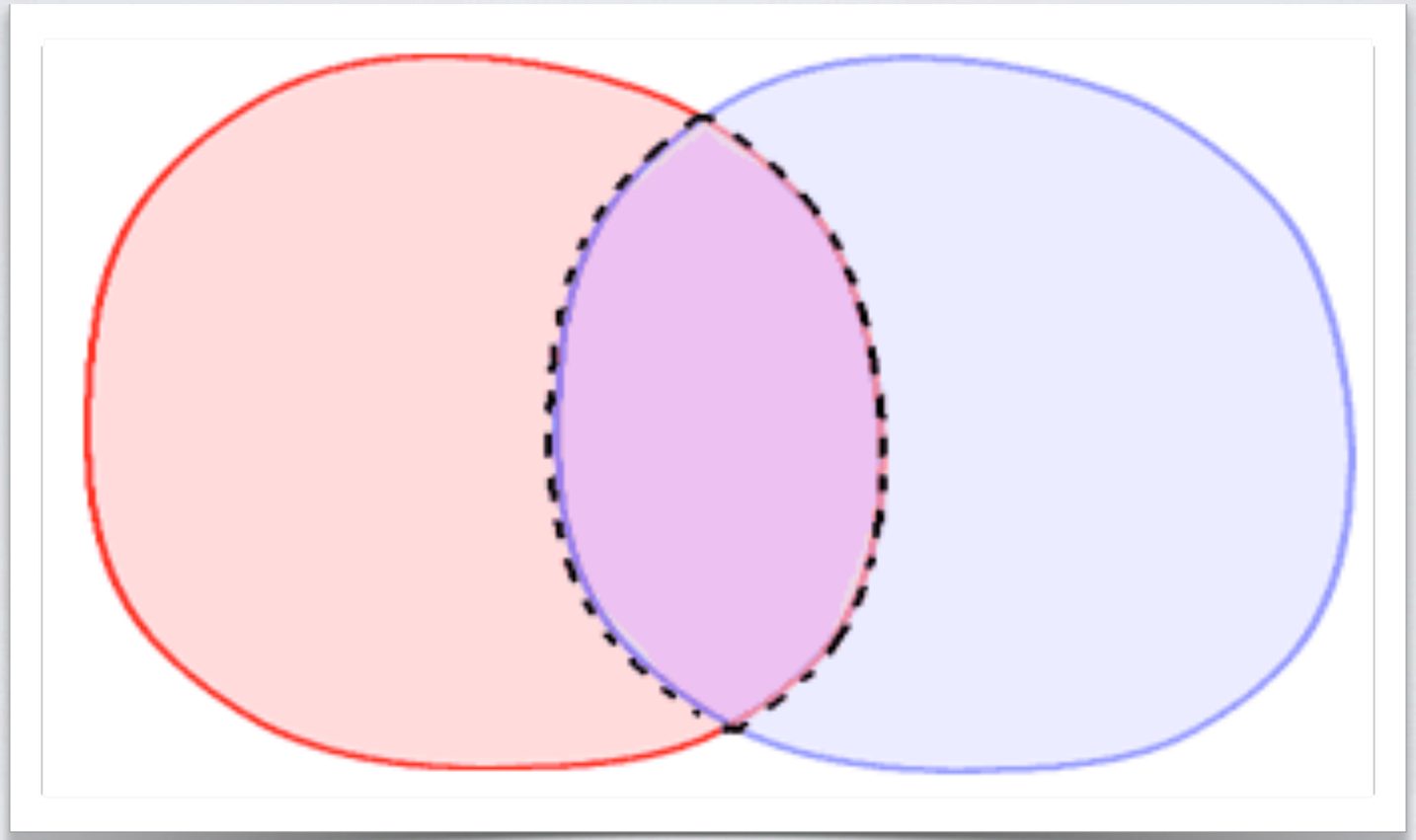


HOW IT WORKS

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



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 their answer is in your list of acceptable answers:
The importance score of how much you care

If their answer is not in your list of acceptable answers:
Not at all!

THE MATH

How much did your answer make John happy?

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

If your answer is not in their list of acceptable answers:
Not at all!

THE MATH

Should you want to meet John?

Questions John got right
(weighted by your importance)

Total possible points for common questions
(also weighted by your importance)

THE MATH

Should John want to meet you?

Questions you got right
(weighted by John's importance)

Total possible points for common questions
(also weighted by John's importance)

THE MATH

Should you and John meet?

Square Root of (Your Score x John's Score)

THE STACK

Groovy

GRAILS

mongoDB

CoffeeScript

VAGRANT

{less}

puppet labs®

jQuery
write less, do more.

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
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 match = [userAId: userA.id, userBId: userB.id] as BasicDBObject

        log.info "Match: ${match}"

        DBObject group = [
            _id: [userAId: '$userAId', userBId: '$userBId'],
            principalPoints: [$sum: '$scoreForUserA'],
            principalPointsPossible: [$sum : '$pointsPossibleForUserA'],
            matchPoints: [$sum: '$scoreForUserB'],
            matchPointsPossible: [$sum :'$pointsPossibleForUserB'],
            questionsInCommon: [$sum: 1]
        ] as BasicDBObject

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

        Iterator<DBObject> resultsIterator = out.results().iterator()

        if(resultsIterator.hasNext()) {
            DBObject results = resultsIterator.next()

            Float marginOfError = getMarginOfError(results.questionsInCommon)
            Float principalPercentageScore = scorePercentage(results.principalPoints, results.principalPointsPossible)
            Float matchPercentageScore = scorePercentage(results.matchPoints, results.matchPointsPossible)
            Float overallScore = Math.min((1F-marginOfError), Math.sqrt(principalPercentageScore * matchPercentageScore))

            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
            ]] as BasicDBObject

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

            log.info "criteria: ${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

http://github.com/Spantree/okmercury

STUFF WE DIDN'T GET TIME FOR

Support user registration and OAuth

Allow attendees to edit previous questions

Add multi-tenant support

Create an attendee profile page

Do the number crunching with map-reduce

SAY HELLO

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Twitter: **@divideby0** (Cedric) and **@flyhighplato** (Gary)

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

Email: **info@spantree.net**