$$\frac{\mathrm{d}}{\mathrm{d}t}\frac{\partial \mathscr{L}}{\partial \dot{q}} = \frac{\partial \mathscr{L}}{\partial q}$$

Google Hash Code 2018

How to (almost) win the Extended Round

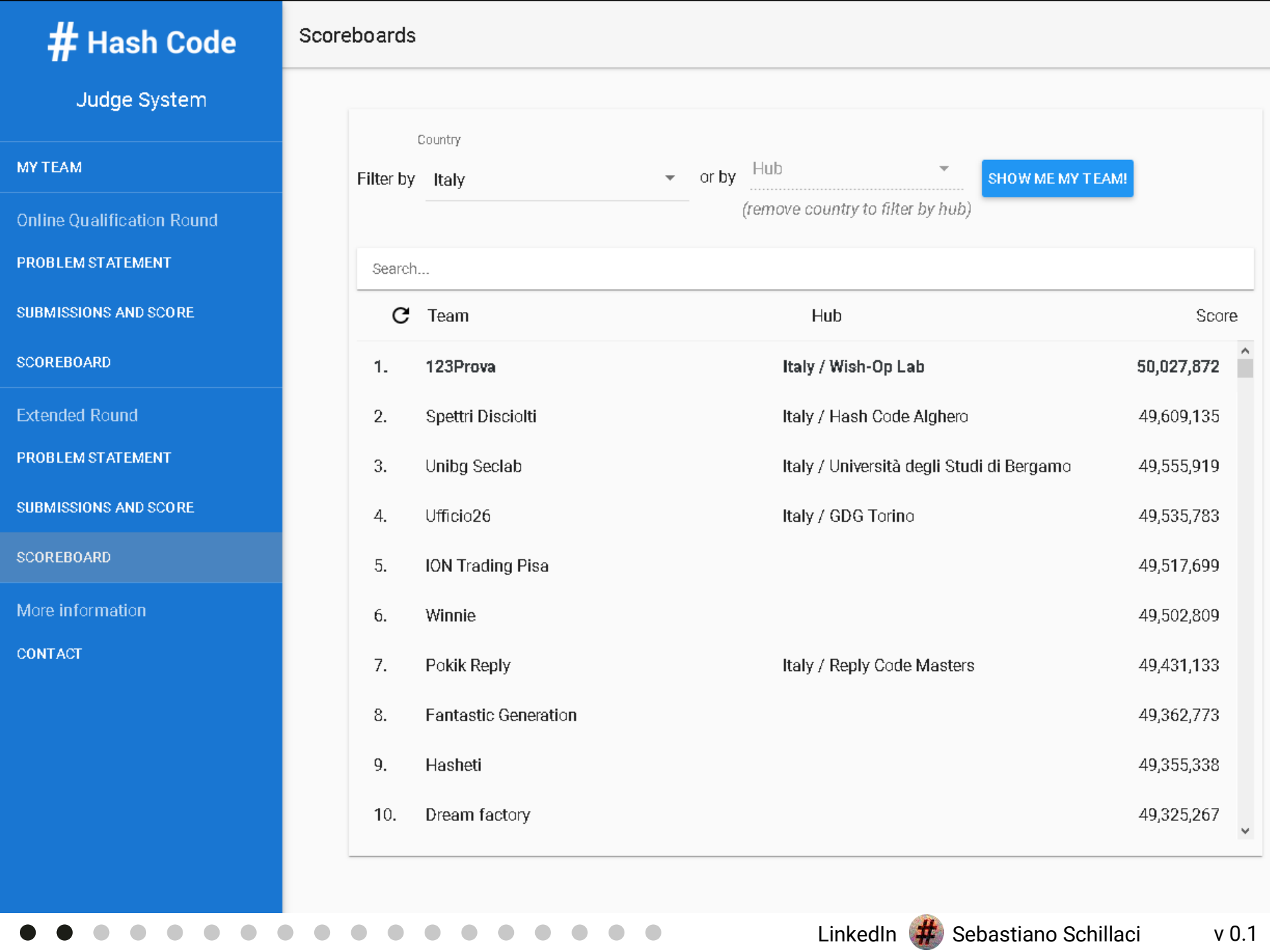
LinkedIn  Sebastiano Schillaci

Hash Code

A team programming competition

You pick your team and programming language,
Google picks an engineering problem for you to solve.

Qualification Round	3h 45m
Final Round	12h
Extended Round	10 days
Extended Final Round	10 days


Hash Code
Judge System
MY TEAM
Online Qualification Round
PROBLEM STATEMENT
SUBMISSIONS AND SCORE
SCOREBOARD
Extended Round
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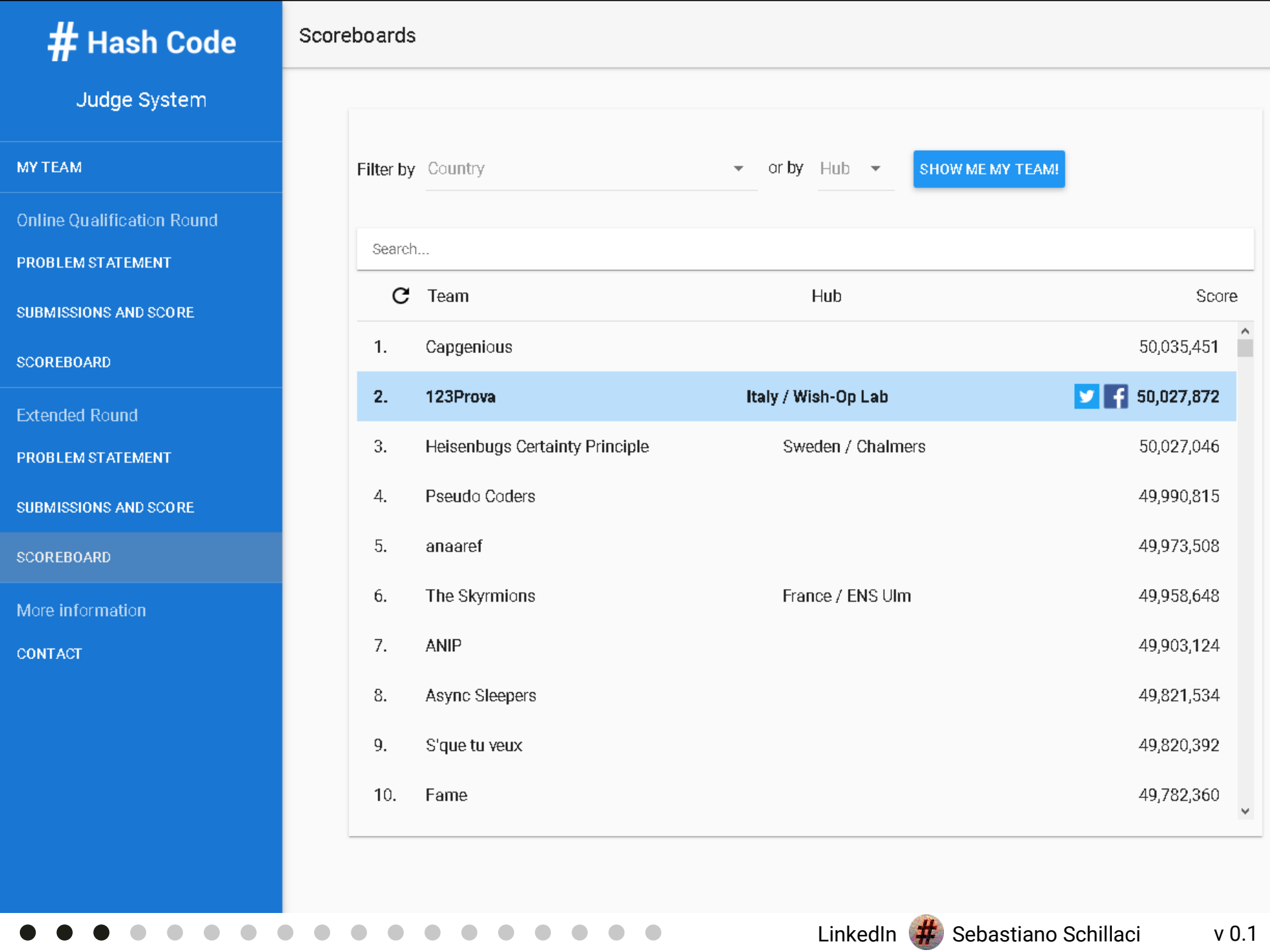
SUBMISSIONS AND SCORE
SCOREBOARD
More information
CONTACT
Scoreboards
Country
Filter by Italy
or by Hub
SHOW ME MY TEAM!
(remove country to filter by hub)
Search...
Team
Hub
Score
1. 123Prova Italy / Wish-Op Lab 50,027,872
2. Spettri Disciolti Italy / Hash Code Alghero 49,609,135
3. Unibg Seclab Italy / Università degli Studi di Bergamo 49,555,919
4. Ufficio26 Italy / GDG Torino 49,535,783
5. ION Trading Pisa 49,517,699
6. Winnie 49,502,809
7. Pokik Reply Italy / Reply Code Masters 49,431,133
8. Fantastic Generation 49,362,773
9. Hasheti 49,355,338
10. Dream factory 49,325,267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1. Capgenious 50,035,451
2. 123Prova Italy / Wish-Op Lab 50,027,872
3. Heisenbugs Certainty Principle Sweden / Chalmers 50,027,046
4. Pseudo Coders 49,990,815
5. anaaref 49,973,508
6. The Skyrmions France / ENS Ulm 49,958,648
7. ANIP 49,903,124
8. Async Sleepers 49,821,534
9. S'que tu veux 49,820,392
10. Fame 49,782,360
LinkedIn
Sebastiano Schillaci
v 0.1

Other teams

- //TODO: select team name (Kazakhstan)
- A team has no name. (Italy)
- The team's name should not be empty! (Poland)
- All the witty names were taken (Sweden)
- Please disable AdBlock to see this teams name (Switzerland)
- 404 Error: Name Not Found (Portugal)

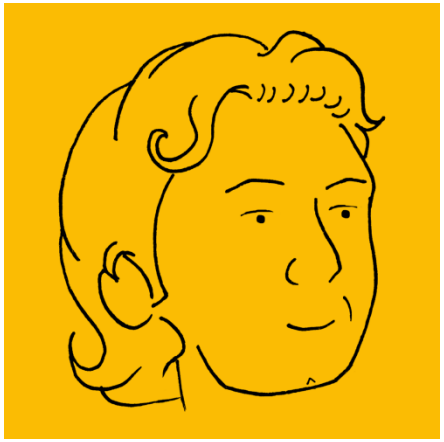
- Unsigned Long Long (Netherlands)
- NPcompete (Poland)
- 10^100 (Italy)
- Have you tried turning it off and on again? (Netherlands)
- Game of Threads (Ireland)
- .titanic{float: none;} (France)
- Rage against the virtual machine (France)
- Make Hash Code Great Again (South Africa)

Other teams

- sudo make sandwich (Belgium)
- import solution (Poland)
- //TODO : WIN (Turkey)
- Ok Google, let us win (Austria)
- Hire Us Google 🤓 (United Kingdom)
- can we have canadian citizenship pls (Turkey)

- #define true false (Germany)
- alias ls='rm -rf /' (Germany)
- Hey Siri say "OK Google" (Austria)
- "; DROP TABLE TEAMS;-- (Slovakia)
- conDITional'); DROP TABLE OPPONENTS; /* (Ireland)
- ; DROP GOOGLE; -- (Italy)

Team 123Prova



David Barbato

Padova

Maurizio Barbato

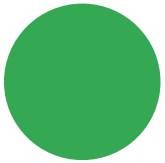
Benevento

Sebastiano Schillaci

Pisa

Getting ready...

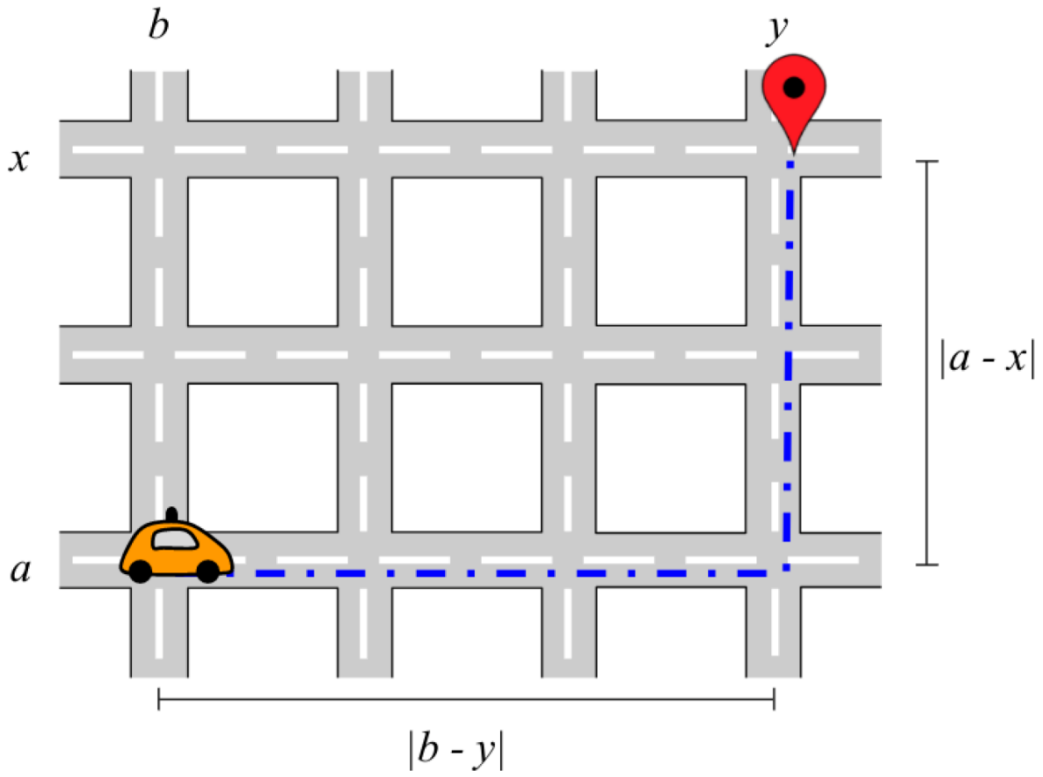
Operating system



Programming language

Compiler

Self-driving rides



Task

Given a list of pre-booked rides in a city and a fleet of self-driving vehicles, assign the rides to vehicles, so that riders get to their destinations on time.
For every ride that *finishes* on time (or early), you will earn points proportional to the distance of that ride; plus an additional bonus if the ride also *started* precisely on time.

Input file format

First line

R – rows of the grid
C – columns of the grid
F – vehicles in the fleet
N – rides
B – per-ride bonus for starting the ride on time
T – steps in the simulation

Subsequent lines (a line per ride)

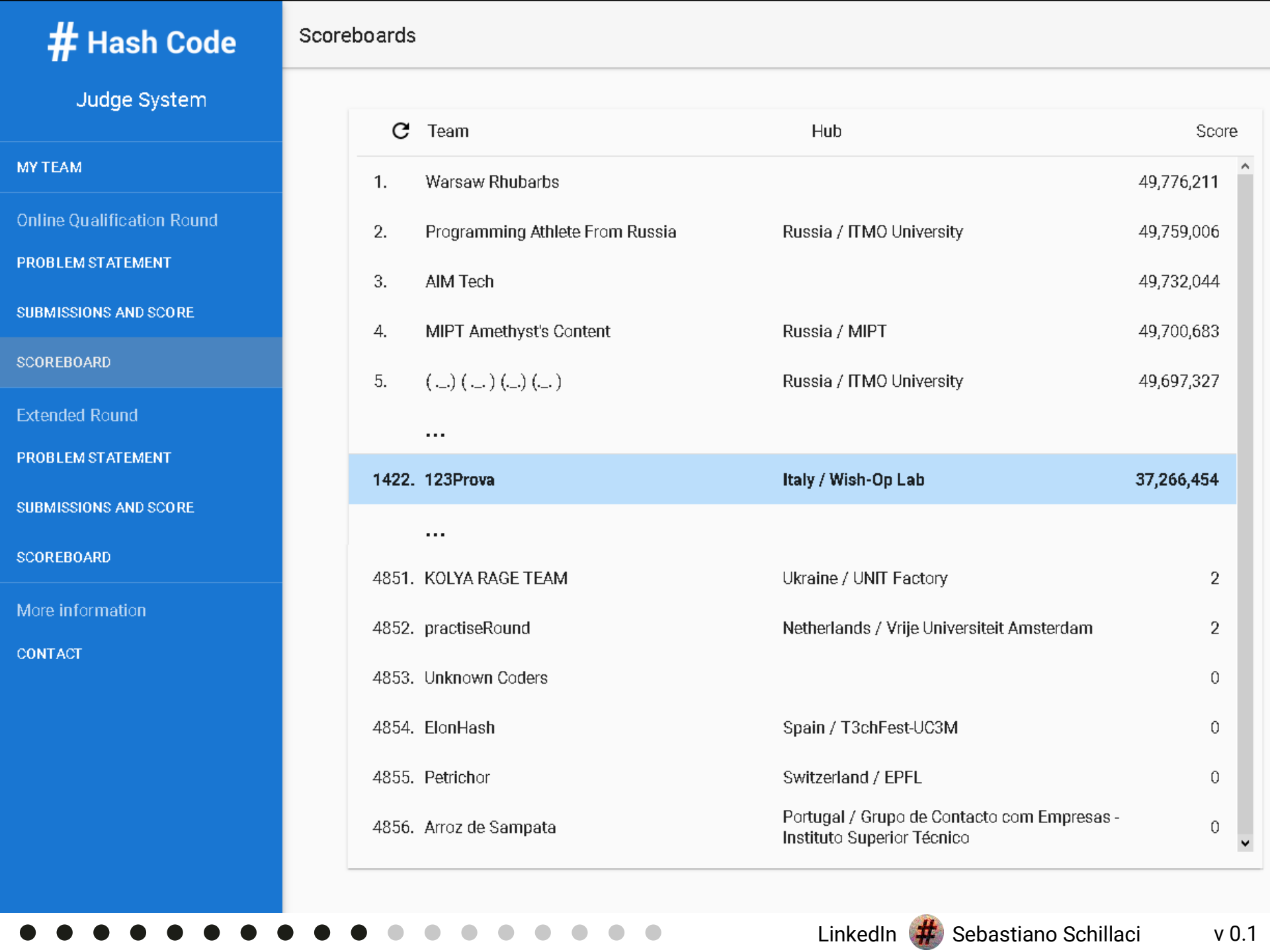
(a,b) – start coordinates
(x,y) – finish coordinates
s – earliest start
f – latest finish

Constraints

$$0 \leq s < s + |a - x| + |b - y| \leq f \leq T$$

Datasets

Input file	R	C	F	N	B	T
A – example	3	4	2	3	2	10
B – should be easy	800	1,000	100	300	25	25,000
C – no hurry	3,000	2,000	81	10,000	1	200,000
D – metropolis	10,000	10,000	400	10,000	2	50,000
E – high bonus	1,500	2,000	350	10,000	1,000	150,000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Score
1. Warsaw Rhubarbs 49,776,211
2. Programming Athlete From Russia Russia / ITMO University 49,759,006
3. AIM Tech 49,732,044
4. MIPT Amethyst's Content Russia / MIPT 49,700,683
5. (._.) (._.) (._.) (._.) Russia / ITMO University 49,697,327
...
1422. 123Prova Italy / Wish-Op Lab 37,266,454
...
4851. KOLYA RAGE TEAM Ukraine / UNIT Factory 2
4852. practiseRound Netherlands / Vrije Universiteit Amsterdam 2
4853. Unknown Coders 0
4854. ElonHash Spain / T3chFest-UC3M 0
4855. Petrichor Switzerland / EPFL 0
4856. Arroz de Sampata Portugal / Grupo de Contacto com Empresas - Instituto Superior Técnico 0
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Qualification Round

Ci servivano altri 5 minuti...

S

D

Ti avevo detto di ripassare
come si usa fscanf!

Deterministic Algorithm

```c
#include<stdio.h>
#include<math.h>

#define DIE(a) {fprintf(stderr,a"\n",*v);return 1;}
#define DIST(a,b,x,y) (abs((a)-(x))+abs((b)-(y)))
#define MAX(a,b) ((a)>(b)?(a):(b))

FILE*fp;
int R,C,F,N,B,T,
    a[10000],b[10000],x[10000],y[10000],s[10000],f[10000],
    D[10000], //rides' length
    L[400]={0},X[400]={0},Y[400]={0}, //local time and position of vehicles
    P[400]={0}, //number of rides assigned to each vehicle
    O[400][512], //O[j][k]: 'k'-th ride assigned to vehicle 'j'
    S=0, //score
    i,j,k,t,m,M;

int main(int u,char**v){

    if(u!=3)
        DIE("Assign rides to vehicles (to be used with A, B, and E data sets)\n"
            "  Usage: %s InputFile OutputFile")

    //read data
    if(!(fp=fopen(*++v,"r")))
        DIE("File \"%s\" not found!")
    fscanf(fp,"%d%d%d%d%d%d\n",&R,&C,&F,&N,&B,&T);
    printf("R=%d\nC=%d\nF=%d\nN=%d\nB=%d\nT=%d\n\n",R,C,F,N,B,T);
    for(i=0;i<N;i++){
        fscanf(fp,"%d%d%d%d%d%d\n",&a[i],&b[i],&x[i],&y[i],&s[i],&f[i]);
        D[i]=DIST(a[i],b[i],x[i],y[i]);} //ride's length
    fclose(fp);

```

```
34      //repeat until local time of all vehicles is 'T'
35      for(;;){
36          //find the vehicle 'j' with minimum local time
37          t=T;
38          for(i=0;i<F;i++)
39              if(t>L[i]){t=L[i];j=i;}
40          if(t>=T)break;
41          //find the ride 'k' that vehicle 'j' can start first
42          m=T;
43          for(i=0;i<N;i++)
44              if(f[i]>=t+DIST(X[j],Y[j],a[i],b[i])+D[i]){
45                  M=MAX(t+DIST(X[j],Y[j],a[i],b[i]),s[i]); //time at which vehicle 'j' would start ride 'i'
46                  if(m>M){m=M;k=i;}}
47          if(m==T){L[j]=T;continue;}
48          //assign ride 'k' to vehicle 'j' and then update local variables and score
49          f[k]=0;
50          O[j][P[j]++]=k;
51          X[j]=x[k];
52          Y[j]=y[k];
53          L[j]=D[k]+m;
54          S+=D[k]+B*(m==s[k]);}
55
56      printf("Score=%d\n",S);
57
58      //save rides' schedule
59      if(!(fp=fopen(*++v,"wb")))
60          DIE("Cannot write to file \"%s\"!")
61      for(j=0;j<F;j++){
62          fprintf(fp,"%d",P[j]);
63          for(k=0;k<P[j];k++)
64              fprintf(fp," %d",O[j][k]);
65          fprintf(fp,"\n");}
66      fclose(fp);}
```

Different strategies

Algorithm	A	B	C	D	E	Total	Rank
One ride per taxi	8	55,731	128,142	530,280	766,476	1,480,637	3,930
One ride per taxi, longest rides first	8	91,147	330,581	3,622,865	1,244,918	5,289,519	3,720
Minimize wasted time	10	176,877	15,790,161	11,739,569	21,465,945	49,172,562	144
Minimize wasted time, maximize bonus	10	176,877	15,790,161	11,750,762	21,465,945	49,183,755	135
Maximum score	10	176,877	15,914,164 - 16,200,000	12,593,305 - 14,186,166	21,465,945	50,150,301 - 52,028,998	–

Upper bound estimate

$U = \{ \textit{rides that can be finished in time} \}$

$V = \{ \textit{rides that can be started at the earliest time} \} \subseteq U$

$$\textit{Bound} = \min \left\{ F \cdot T, \sum_{U} \textit{rides' length} \right\} + B \cdot |V|$$

Extended Round

M Quasi 48 milioni

M 68esimi nel mondo ora!

Extended Round

Extended Round

D: Ho fatto un nuovo programma con una nuova filosofia: prende l'ultima soluzione e la migliora

M: Errore di segmentazione

S: Per velocizzare prova a compilare con g++ -Ofast -m64

M: Hanno superato i 50 milioni

S: Te l'avevo detto che si potevano superare!

Extended Round

Comunque se avessimo fatto questo punteggio in gara saremmo stati i primi in Italia — S

M — Almeno è caduta Bergamo :D

D — Mitico, ma salva! Incredibile che continui a migliorare

Quarti! 47esimi nel mondo — S

D — A questo punto devi lasciarlo tutta la notte. Dai, che se va bene domattina siamo primi

Extended Round

S: Ho tolto i printf dovrebbe essere più veloce ora

M: Non ditelo che l'ho messo a girare sul server aziendale...

D: Ho appena trovato un errore grave

D: Prima praticamente sceglieva a caso e ogni tanto trovava qualcosa di utile

Extended Round

D Provo a mettere giù un metodo al secondo ordine

Siamo decimi S

D Quando lo vede Maurizio gli prende un colpo

Ho l'impressione che convenga cambiare più spesso il valore del parametro S

Extended Round

D: Ho provato a implementare il metodo al secondo ordine ma ho dovuto interrompere. Stasera riprovo

S: Io sto provando a fare una versione multithreaded del programma per windows

M: Io non ho problemi a far girare sotto winzoz

D: Domani alle 18 scade il tempo

Extended Round

D Siamo a 46mila punti dal secondo e a 115mila dal primo

I secondi hanno superato i primi! S

Ho l'impressione che alternare l'algoritmo nuovo con l'algoritmo vecchio funzioni meglio S

D Siamo pure noi sopra i 50 milioni, due giorni fa mi sarebbe sembrato un obiettivo impossibile

Extended Round

S Versione multithread dell'ultima versione del programma!

D Ho cambiato un parametro e sembra andare meglio

D È incredibile, abbiamo avuto 10 giorni e ci siamo ridotti all'ultima mezz'ora

S Secondi!!!

D Ci serviva un'altra mezz'ora...

Submissions and score

Time is up! The round has ended.
It is no longer possible to create new submissions for this round.

Score

A - example	10
B - should be easy	176877
C - no hurry	15868630
D - metropolis	12516410
E - high bonus	21465945
Total score	**50,027,872**

Submissions

✓ 5:59 PM	D - metropolis	**12516410** points	DETAILS	VISUALIZE
✓ 5:57 PM	D - metropolis	**12516410** points	DETAILS	VISUALIZE
✓ 5:56 PM	D - metropolis	**12513977** points	DETAILS	VISUALIZE
✓ 5:55 PM	D - metropolis	**12514195** points	DETAILS	VISUALIZE
✓ 5:55 PM	D - metropolis	**12513799** points	DETAILS	VISUALIZE
✓ 5:52 PM	C - no hurry	**15868630** points	DETAILS	VISUALIZE
✓ 5:44 PM	C - no hurry	**15868593** points	DETAILS	VISUALIZE

Stochastic Optimization Algorithm

- Improves on previous results
- First and second order methods
- More algorithms together

Parallelize!

- Distributed computing
- Multithreading
- GPGPU

Thank you!

Get latest version at http://sxs.altervista.org/hashcode/