

Code Hunt Contest Analytics

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and team



Working for fun

Enjoyment adds to long term retention on a task

Discovery is a powerful driver, contrasting with direct instructions

Gaming joins these two, and is hugely popular

Can we add these elements to coding?



Write a program to determine all the sets of effectively identical rooms in a maze. (A page of background, sample input and output given)

Pex



for fun

[My Duels▼](#) | [Settings▼](#) | [Sign In](#)

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[Learn](#)

[APCS](#)

[New](#)

1,584,635 clicked 'Ask Pex!'

[C#](#)

[Visual Basic](#)

[F#](#)

The code is a puzzle. Do you understand what the code does? Click **Ask Pex!** to find out.

```
using System.Diagnostics;

public class Program
{
    public static void Puzzle(int index, int count)
    {
        if (index >= 0 && count >= 0)
        {
            // Can any value of index and count fail this assertion?
            // Ask Pex to find out!
            Debug.Assert(index + count >= 0);
        }
    }
}
```

Ask Pex!

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Pex4
Fun

Pex

Z3

Audiences

Coders and Students: proceed through a sequence on puzzles to learn and practice.

Educators: exercise different parts of a curriculum, and track students' progress

Recruiters: use contests to inspire communities and results to guide hiring

Researchers: mine extensive data in Azure to evaluate how people code and learn

Code Hunt Usage

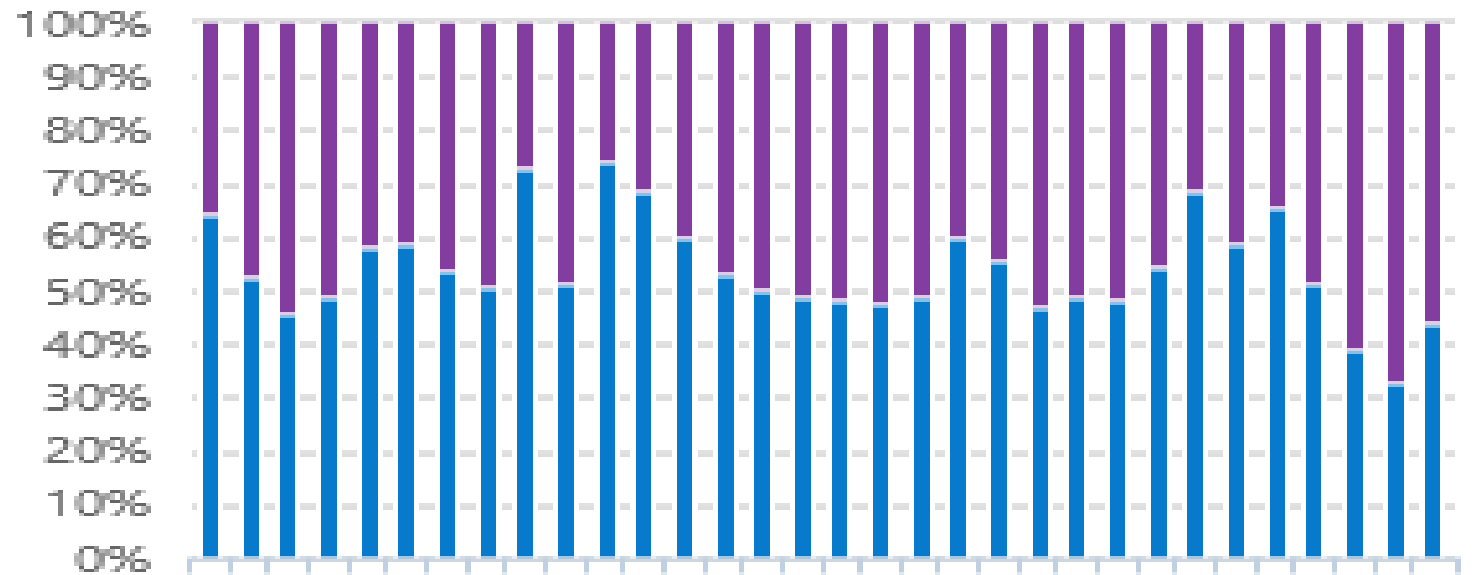
Code Hunt has had several **hundred thousands** of users since launch in March 2014

Stats from Visual Studio Analytics over the period 9/19/14 and 10/20/14 indicate 1,150 users a day

Stickiness (loyalty) is very high

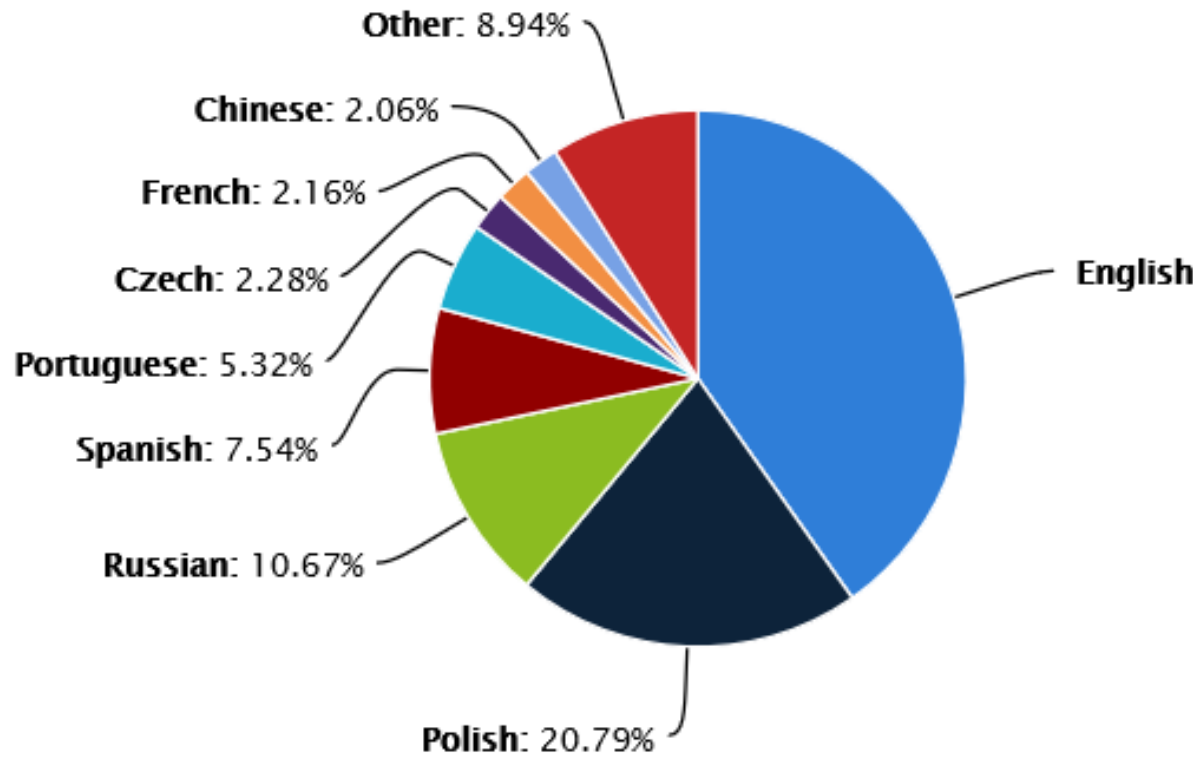
% Returning
< 14 days

99.79%



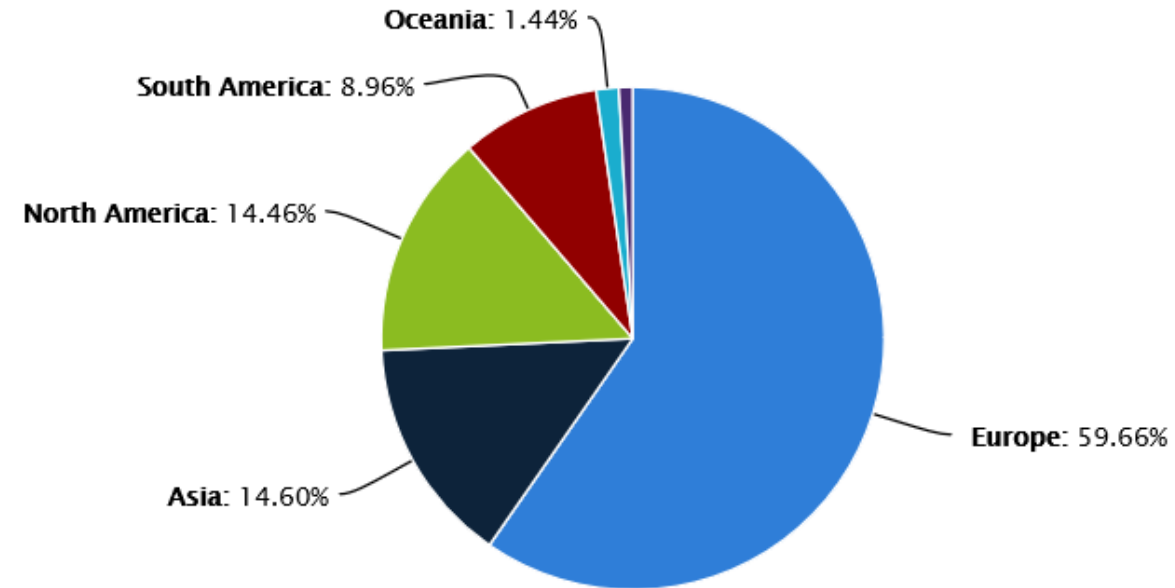
Period 3-10 October, 2014

Languages



Sessions: **8,769** Activities: **1,647,761**

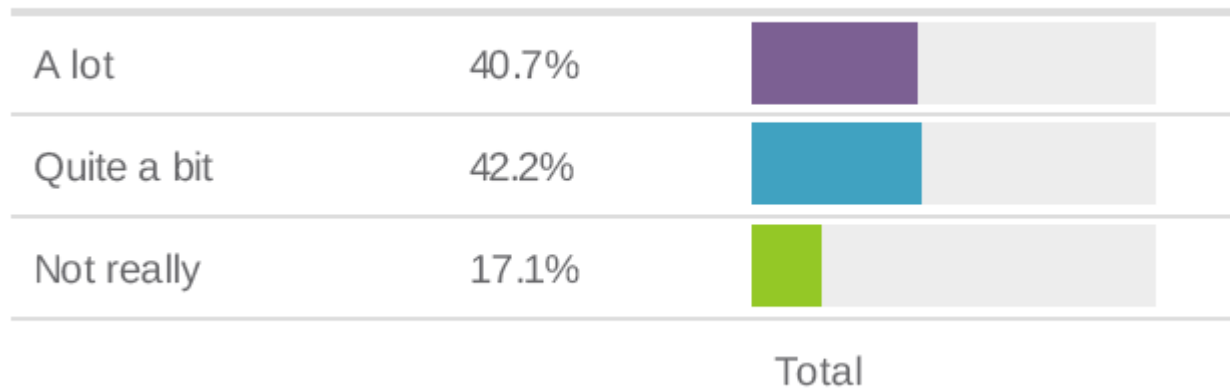
Global



Sessions: **6,909** Activities: **1,444,846**

Survey results (735 respondents)

How much did the puzzle aspect of Code Hunt keep you interested in reaching a solution?



In your opinion, were your final solutions well-structured code?



We have many other statistics, but not so relevant to contests

Contest Goals

identify top coders

make online competitions more fun



2,353 players	41.0 average tries per level
350 top players	7.6 average tries per level

Contests completed

15 with usually 400 contestants, but can be 12 to 13,000

Planned

Regional contests

Beauty of Programming

3 more Imagine Cup



P067

Arrays

Remove
duplicates from
an array

NH

2

Creating new contests

1. Creating new puzzles
2. Requires curation of a puzzle bank (250 now)
3. Original data about each puzzle
 1. Group – numbers, arrays, strings, bools, binary
 2. Description
 3. Source – who wrote the puzzle
 4. Difficulty – between 1 and 5
4. Each contest has a sequence of sectors in increasing difficulty
5. Avoid “Bad” puzzles early on – those that fool users

SELECT ZONE

ENTER CODE

 49/134 CODE HUNT	 00/24 IMAGINECUPDEC2014	 00/12 POLSKA 2014	 00/24 LASERELBA2014
 00/24 IMAGINECUPSEPT2014	 03/09 IFIP SA	 00/24 IMAGINECUPNOV2014	 01/15 BOOTCAMP2014
 00/24 LASER2014	 00/24 IMAGINECUPDEC2014	 01/03 SIMPLE EXAMPLE	 00/55 PEX4FUN
 00/06 TESTZONE2014	 00/00 TESTZONE2014	 00/00 TESTZONE2014	 00/01 LASERELBAEXTRA
 00/00 UNDEFINED	 00/17 BOP 2014 QUALIFICATION	 00/18 TEALS 2014	

Leaderboard and Dashboard

Visible only to the organizer

TOP CODE HUNTERS



ZONE DASHBOARD

users	rank	score	Windows01	Windows02	Windows03	Windows04	Windows05	Office01	Office02	Office03	Office04	Office05	Cloud01	Cloud02	Cloud03	Cloud04	Cloud05
	31	avg	2.6	13.6	6.7	5.9	4.4	2.6	13.4	4.7	23.3	22.5	16.6	3.2	15.3	7.4	17.0
		dev	2.6	8.3	7.2	5.6	3.0	1.5	21.9	5.2	18.1	15.9	13.7	2.3	13.9	8.3	18.5
CakeMan	001	225	3	14	15	4	4	2	108	2	6	38	29	2	15	6	59
CCCPFTW	002	225	2	9	2	2	3	2	7	2	22	29	12	3	13	4	42
Complexity	003	206	2	9	2	3	2	2	52	2	18	16	6	2	4	5	3
alextan	004	202	2	13	5	3	3	2	9	2	18	21	28	2	13	4	9
Abhijit	005	194	2	18	3	5	8	2	20	10	32	28	8	5	28	10	33
imapersonman	006	170	2	16	2	4	4	2	4	2	4	39	37	2	50	25	43
Sudharsan	007	161	2	17	4	2	5	2	1	3	12	25	10	5	8	8	21
Logan	008	137	2	16	8	3	3	5	36	3	44	29	23	3	25	30	26
erickson	009	131	2	5	2	3	5	2	2	3	22	23	6	5	9	5	7
Lukas	010	126	3	13	7	23	12	2	4	4	77	14	35	3	37	6	2
Kyle	011	125	2	9	2	4	5	2	1	3	20	10	8	3	12	2	1
Amrutha	012	125	3	7	7	8	4	6	2	2	25	4	1	11	1	1	1
Kenny	013	122	2	11	7	5	3	2	9	3	62	70	15	2	26	3	2
Abhi	014	116	17	15	8	5	4	8	40	4	31	8	48	1	1		
Kerstin	015	103	2	6	6	12	9	4	12	9	6	31	14	1			
Gabby	016	97	2	5	2	2	3	2	2	5	12	13	2	1	1	1	3
Teal	017	96	2	40	4	10	2	3	8	8	10	7					
Landon	018	94	2	5	2	2	1	2	1	4	29	21	1	3	2	1	3
Gryffindore	019	90	2	5	2	4	4	2	7	2	19	36					
Bailey	020	87	2	14	11	13	2	2	8	1	7	11					
Katie	021	84	3	16	7	3	9	2	20	28	42	43					

rating: 0 1 2 3

Publically visible, updated during the contest

Updating the puzzle bank statistics

- Updating the **used** field
- Modifying the **difficulty** rating based on user experience. Options:
 - **Score** – but the score is 1-3 and we know from the survey that 77% of users improve their code to get a 3
 - **Tries** – a fairly objective reflection of how long it took to find the pattern and program a correct solution
- **Tries** does depend on
 - Mix of students who enter
 - The internet speed
 - Whether students use an IDE in addition

Perceived Difficulty

$$D = a + \text{tries} * b + \text{tries} * c * \text{distance}$$

where a , b and c are constants with values

$$a = 1 \qquad b = 0.02 \qquad c = 0.05$$

tries is the average attempts for all players who solved the puzzle

distance is the number of levels solved so far.

The $b * \text{tries}$ term causes the difficulty of a puzzle to be rated progressively higher as more attempts are needed to solve it.

The $\text{tries} * c * \text{distance}$ term is an attempt to account for two effects:

- players are improving their solving skills as they progress through the puzzles,
- the set of players attempting each puzzle is decreasing in size and containing ever stronger players as weaker players get stuck and do not advance to the next sector.

The observed result is that fewer tries are needed to solve a puzzle used late in the contest as compared to one used earlier.

Adding this extra term boosts the Calculated Difficulty to a number that better reflects its true difficulty level, after removing the learning effect and the player selection effect.

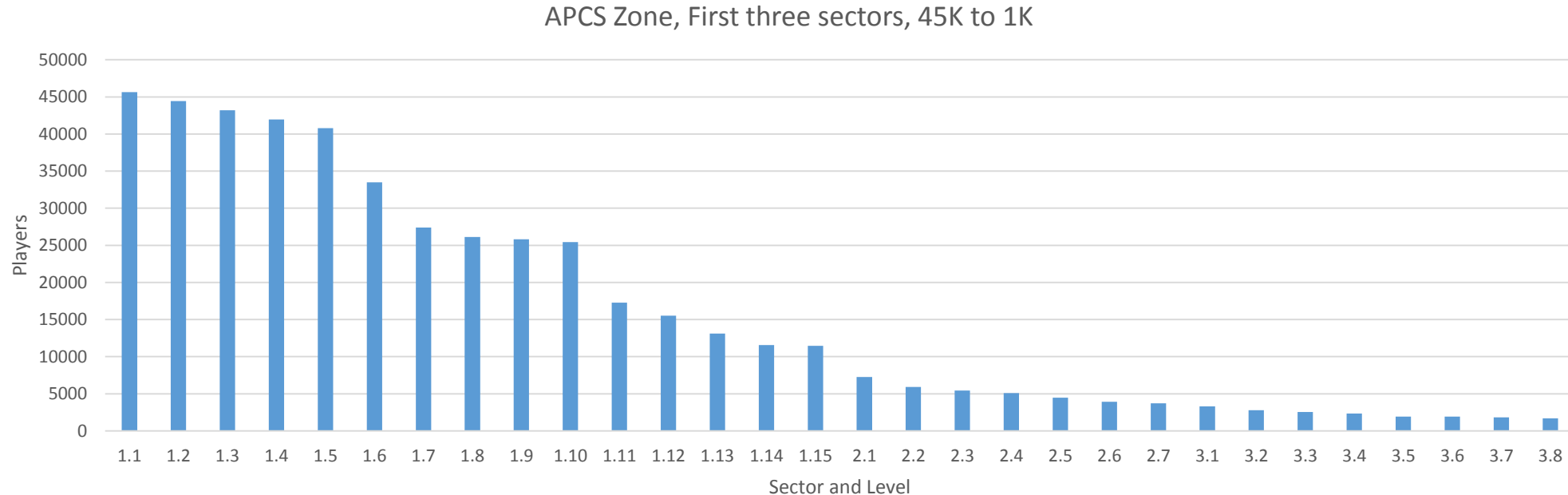
How players perceive difficulty

Same Community, Different Contests	Subjective difficulty	Perceived difficulty	Players who started
Qualification	1.59	2.72	13773
Preliminary A	2.17	1.84	1017
Preliminary B	2.50	1.84	141
Semi-Final	2.60	2.22	1164

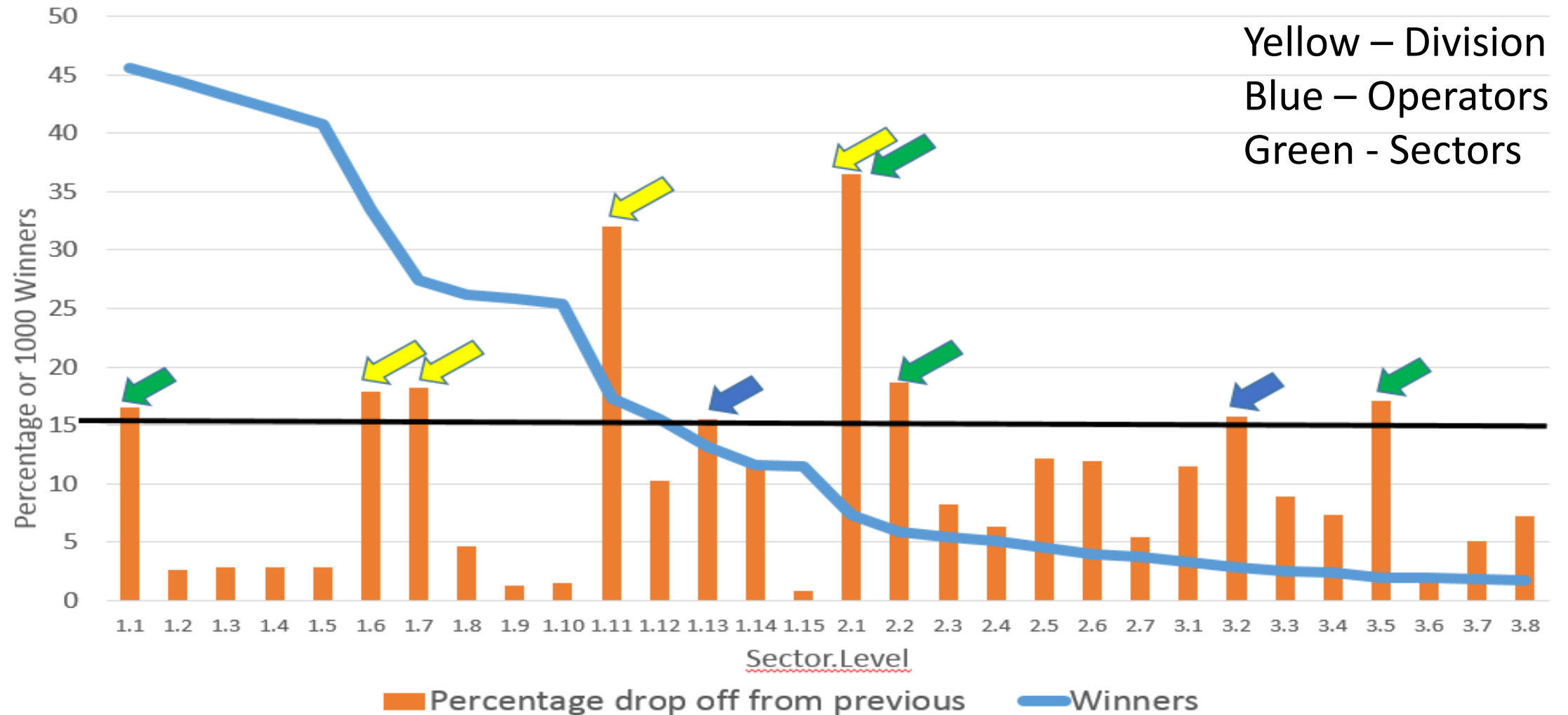
Different Communities, Same Contest	Subjective difficulty)	Perceived difficulty	Players who started
Students	1.96	5.22	61
Teachers	1.96	4.38	14

Code Hunt - the APCS (default) Zone

- Opened in March 2014
- 129 problems covering the Advanced Placement Computer Science course
- So far, over 45,000 users started.



Effect of difficulty on drop off in sectors 1-3



Results and rewards

Detailed results are presented

- Ranking is always based on score, not on time or attempts
- Score is based on
 - how many puzzles solved,
 - how well solved, and
 - when solved
- Rewards for contests should be multiple



Imagine Cup Code Hunt Contest September 2014									
Nickname	Id	Score	Puzzles solved	Earth01 attempts	Earth01 rating	Earth01 score	Earth02 attempts	Earth02 rating	Earth02 score
Participated				299	290	290	299	297	297
Players solved it				250	250	259	257	257	259
Top players solved it				12	12	12	12	12	12
Super top players solved it				2	2	2	2	2	2
Average attempts if Won		14.59		3.98	2.91	5.61	2.18	2.98	8.88
Average attempts Top 12 if won		16.56	22	3.17	3.50	7.00	2.42	3.50	10.50
Average Attempts Top 2 if won		17.34	24	4.00	1.50	3.00	2.00	1.50	4.50
	a3f5670a-514f-4f56-adcc-922c2	432	24	4	3	6	2	3	9
	99e57fa9-f478-47e8-b87c-0ce2	428	24	4	3	6	2	3	9
	2044d575-4592-40b2-a0ed-658	408	23	3	3	6	2	3	9
	f1d9b6d6-8696-43d9-830e-198	408	23	2	3	6	2	3	9
	65f6dc83-4293-4328-9acc-de07	408	23	2	3	6	2	3	9
	88e0d73d-1173-4ba1-860a-5f44	391	23	2	3	6	2	3	9
	4d0a57cf-8b37-4b7e-a82a-62fc	387	23	2	3	6	2	3	9
	78b29d3b-d7a5-43bf-8781-f3a0	357	21	2	3	6	2	3	9
	98506b49-7cb7-4054-9b08-2c61	352	23	2	3	6	2	3	9
	ec37d730-c922-4a7e-a011-f22b	339	20	2	3	6	2	3	9
	a1f0ffd8-291f-4dd7-a546-6c332	336	19	3	3	6	3	3	9
	60ab15c3-a908-45bc-a33a-53c7	331	20	3	3	6	2	3	9
	d6e3bdeb-b8df-4dd2-abac-a92	283	19	4	3	6	2	3	9
	c80af9d7-8d50-49da-b9b2-b80	271	18	3	3	6	2	3	9
	cfdcbb11d-ba92-4cb6-9f89-333a	271	21	2	3	6	2	3	9
	5a53b467-9ef6-4601-be62-e0b	270	18	2	3	6	2	3	9
	05ba1bc8-69d4-47b0-ae2e-701	248	18	2	3	6	2	3	9
	0100fe70-d8c9-4e57-ba8f-de48	234	18	3	3	6	2	3	9
	379573c5-4507-4316-89d9-42c3	229	16	2	3	6	2	3	9
	dbfc4454-3c56-4844-b673-8b41	218	16	2	3	6	2	3	9

Laser, Sept 2014	Original Difficulty	Average Calculated Difficulty s	Total Try Count	Average Try Count	Max Try Count	Total Solved Users
24	2.21	4.60				
1.1	2	1.79	106	8.83	27	12
1.2	2	1.42	56	4.67	13	12
1.3	3	2.42	158	15.80	45	10
1.4	2	2.43	130	13.00	31	10
1.5	2	4.05	211	23.44	73	9
1.6	1	3.29	122	15.25	52	8
2.1	3	4.29	116	19.33	43	6
2.2	3	1.87	23	4.60	7	5
2.3	2	1.84	20	4.00	8	5
2.4	2	9.05	70	35.00	68	2
2.5	1	3.10	42	8.40	27	5
2.6	2	18.10	190	63.33	138	3

The size of the data

APCS	725,199
ICSE	627
BoPQuali	13,778
BopA 1,017 BopB	1,103
BopSemi	1,164
CSTA	61
TEALS	14
BootCamp	30
Laser Sept	12
Polska Oct	344
ImCupJan	542
ImCupDec	222
ImCupNov	379
ImCupOct	831
ImCupSept	257

Total Try Count	Average Try Count	Max Try Count	Total Solved Users
13374	363	1306	1581

For ImCupSept

257 users x 24 puzzles x approx. 10 tries =
about **13,000 programs**

Gender and Code Hunt

	Female	Male
Respondents	98 or 12%	682 or 80%
Played as practice for a course in C#	11%	18%
Played as practice for a course in Java	40%	23%
Played for own enjoyment	47%	57%

Table V Survey results by gender

Towards a Course Experience



Office Mix Customer Preview

Gallery My Mixes Getting Started Vote Sign In

CODE HUNT

Try to capture the code!

CAPTURE CODE

Java

```
1 using System;
2 public class Program {
3     public static char Puzzle(string s, int x) {
4         return 'a';
5     }
6 }
7
```

	5	X	YOUR RESULT	EXPECTED RESULT	DESCRIPTION
✗	null	0	'a'	null	Mismatch
✗	"\0"	0	'a'	'\0'	Mismatch
✓	"a"	0	'a'	'a'	

Microsoft Research

ABOUT | TERMS OF USE | PRIVACY & COOKIES

01:33 / 02:14 1.0x

Summary:

Code Hunt: A Game for Coding



- Powerful and versatile platform for coding as a game
- Unique in working from unit tests not specifications
- Large contest numbers enable testing of hypotheses and making conclusions about how players are mastering coding, and what holds them up
- Work on course experience progressing

Next Contest:

Imagine Cup for \$1,000

Starts February 21 midnight UTC

Alert your students